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Editorial

Think Globally - Act Locally: Mercury levels are rising year after year as a result of global warming. Also, every year, individuals say that this year's temperature is higher than the previous year. Not only our country, but the entire planet, is currently quite warm. In the summer, people avoid going out in the afternoon unless it is necessary. Sometimes the roads are like a desert. Some state governments are making special arrangements at government hospitals for patients who arrive with heat-related diseases. As the concentration of greenhouse gases in the atmosphere grows, correspondingly rises the global surface temperature. According to studies, every decade since the 1980s has been warmer than the preceding one. The last decade (2011-2020) was the warmest compared to previous eras.

Various causes for the rise in atmospheric temperature may be natural or anthropogenic. Rapid industrialization, deforestation, the use of fossil fuels (coal, oil, and gas), forest fires, the increase in greenhouse gases (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, etc.) in the atmosphere, emissions from volcanoes, farming for livestock, and other factors all contribute to global warming. Amongst the greenhouse gases, mainly CO_2, collect in the atmosphere as a layer, allowing sunlight to flow through but preventing heat from radiating from the earth. As a result, the temperature rises between the earth and the CO_2 layer, contributing to global warming. Hence, suitable measures must be taken to mitigate carbon dioxide levels in the atmosphere.

In recent years, catastrophic heat waves have killed tens of thousands of people across the world. The other consequences of global warming are rise in earth temperature, severe storms (may cause deaths, property and agriculture damage, economic loss), drought situation (water scarce), melting of glaciers and rise of sea water levels that leads to submergence of coastal lands and forcing people living in coastal areas to abandon their homes, loss of forests and greenery, loss of species, agriculture and livestock may be destroyed or less productive, etc.

Some measures to control the global warming include massive afforestation, preventing deforestation, converting waste lands into lakes or ponds, restoring abandoned lakes and reservoirs, saving energy at home, replacing old electrical appliances, avoiding products with more packaging, installing a solar power system, switching over alternate energy to generate steam in industries, switching to an electric vehicle, using public transportation, etc.

New Delhi **Editor**

30th April 2024

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Contents

Prediction Model using ARIMA for Climatic Dataset for Marathwada Region of Maharashtra

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ABSTRACT

Marathwada locale has been continuously dry season inclined locale due to its geographic area. There are 8 areas of Maharashtra's Marathwada locale included in this consider. Add up to annually precipitation information for these locale is used in this think about. Vanishing causes the relative mugginess to extend when it downpours. Rain water replenishes groundwater all year circular, but especially amid the stormy season. It is conceivable that climate alter will have an affect on soil invasion, more profound permeation, and consequently groundwater energize. Expanded evaporative request from more smoking days decreases groundwater revive capacity as well. With this consider, all 8 Marathwada locale mugginess and groundwater levels are inspected in profundity, taking into thought the reliance between precipitation, mugginess, and groundwater. To foresee future precipitation, stickiness, and groundwater information utilizing ARIMA (autoregressive coordinates moving normal), the dataset is to begin with envisioned in RStudio. At that point, the dataset's exactness is evaluated.

KEYWORDS *: Rainfall, Humidity, Groundwater level, Marathwada local, Arima, RStudio.*

INTRODUCTION

Let us to begin with characterize the ARIMA demonstrate some time recently going on to forecast.

The express "autoregressive coordinates moving normal" (ARIMA) stands for "autoregressive coordinates moving normal." It may be a time arrangement demonstrate for following occasions over time that's used in insights and econometrics. The show is utilized to decipher past information or anticipate future information in a arrangement. When a metric is measured at normal interims, such as divisions of a moment, every day, week after week, or monthly, it's called a occasional metric. ARIMA could be a show based on the Box-Jenkins strategy. [1]

There are two shapes of time arrangement expectation:

- Univariate: It predicts future values as it were based on earlier values within the time arrangement.
- Multivariate: It makes a estimate by combining outside variables with a grouping of information.

In this case, we used the univariate approach. The ARIMA show expects a time arrangement based on its claim earlier values. It may be utilized to any non seasonal factual grouping that uncovers design instead of being a arrangement of arbitrary occasions. Since it was collected over time, deals information from a basic supply store, for case, would be a time arrangement.

One of the critical viewpoints is that the information is collected over a arrangement of reliable, standard interims. A redone version may be built to imitate expectations over a few seasons. It's helpful to see at ARIMA's title to have distant better; a much better; a higher stronger improved">an improved get a handle on of it. Autoregression or "AR" could be a show in which a changing variable relapses on its claim past or postponed values. In other words, it predicts future values based on previous ones. The letter "I" stands for "coordinates," inferring that it compares inactive information values to past ones. The objective is to supply information that's seasonality-free and steady. That's , the information series' factual highlights, such as cruel, fluctuation, and autocorrelation, stay steady over time. The Increased Dickey-Fuller (ADF) test is utilized by information researchers to see on the off chance that the information is steady. The three component capacities of an ARIMA show are- The number of slack perceptions or autoregressive components within the demonstrate is decided by AR (p), I (d), the distinction in non seasonal information is decided by I (d), and MA (q), the measure of the moving normal window is decided by MA (q). The letters (p,d,q) signify the arrange or number of times the work happens in an ARIMA show, with the values signifying the arrange or number of times the work shows up all through the model's execution. It is reasonable to use zero values. The ARIMA show makes the information stationary by using differenced information, suggesting that it is stable over time. This approach expels regularity and designs from information, such as showcase or financial information. The term "regular information" alludes to information that has unsurprising, rehashing propensities. Regularity must be controlled since it may influence the precision of the comes about. ARIMA models may be made both seasonally and non-seasonally. In expansion to the autoregressive, differencing, and normal components for each season, a regular demonstrate must account for the number of events in each season. ARIMA models may be made with a assortment of program instruments, counting Python. The information scientist must affirm that the method in address takes after the ARIMA demonstrate some time recently making a conclusion. In the event that the data fits the ARIMA show well, the information researcher develops and trains the demonstrate on a dataset some time recently using live information to generate and draw a estimate.

Let us know how it goes with the calculated relapse demonstrate we utilized to assess the dataset's correctness.One of Python's scikit-learn package's most extraordinary highlights is its 4-step displaying worldview, which makes composing a machine learning classifier a chunk of cake .

Logistic Regression

When the subordinate variable is dichotomous, calculated relapse is the most excellent technique to utilize (binary). Logistic regression, like other relapse ponders, may be a prescient think about. To portray information and clarify the association between one subordinate double variable and one or more ostensible, ordinal, interim, or ratio-level independent variables, logistic relapse is used [2]. It is practically equivalent to to discriminant examination, which could be a frame of calculated relapse. The relapse line is utilized in discriminant examination to separate a test into two bunches along the levels of the subordinate variable. The calculated relapse investigation utilizes the concept of probabilities and log chances with a cut-off likelihood of 0.5, while the discriminant analysis utilizes the concept of probabilities and log chances with a cut-off likelihood of 0.5. Since they utilize unmistakable suspicions, there's a commonsense contrast between the two tests. In case the information is multivariate ordinary, the fluctuation and covariance are homoscedastic, and the free factors are directly related [3]. Because discriminant analysis is more measurably sound and efficient, it is used.

Let's have a see at the R bundle ggplot2.

R may be a programming dialect. ggplot2 may be a information perception bundle. It has the potential to altogether move forward the quality and request of your visuals whereas moreover improving your productivity. You'll be able make almost any chart utilizing ggplot2. It has its possess range within the R chart display, and essentially each area begins with ggplot2 cases. geom_ procedures are utilized by ggplot2 to construct charts from layers. [4]

Annotation is an imperative step in information perception. It helps you in underscoring the chart's most imperative message, changing a cluttered chart into a

valuable medium. For this, ggplot2 gives a assortment of highlights, counting the capacity to include distinctive sorts of content and shapes.

METHODOLOGY

The slacks of the stationarized arrangement are alluded to as "autoregressive" components within the determining condition, the slacks of the figure blunders are alluded to as "moving normal" terms, and a "coordinates" adaptation of a stationary arrangement may be a time arrangement that has got to be differenced to be made stationary. Random-walk and random-trend models, autoregressive models, and exponential smoothing models are all cases of ARIMA models.

A nonseasonal ARIMA show is classified as an "ARIMA(p,d,q)" demonstrate, where:

• p - number of autoregressive terms,

• d - number of nonseasonal contrasts required for stationarity

• q - number of slacked figure blunders within the expectation condition.

The estimating condition is developed within the taking after way. To start, let's characterize x as X's d^{th} distinction, which implies:

If d=0: $x_t = X_t$
If d=1: $x_t = X_t - X_{t-1}$
If d=2: $x_t = (X_t - X_{t-1}) - (X_{t-1} - X_{t-2}) = X_t - 2X_{t-1} + X_{t-2}$

It's worth noticing that X's second difference (within the d=2) isn't the contrast from two periods prior. Instead of the series' neighborhood slant, it's the discrete identical of a moment subsidiary, the first-difference-of-the-first-difference.

In terms of x, the nonspecific estimating condition is:

$$\hat{x}_t = \mu + \emptyset_1 x_{t-1} + \cdots + \emptyset_p x_{t-p} - \theta_1 e_{t-1} - \cdots - \theta_q e_{t-q}$$

The moving normal parameters ('s) are expressed within the condition such that their signs are negative, as prescribed by Box and Jenkins. A few scholars and computer program (counting the R programming dialect) allude to them as additionally signs instead of negative marks. When actual numbers are entered into the calculation, there's no equivocalness, but it's basic to get it which tradition your application employments when perusing the comes about. AR (1), AR (2)... and MA(1), MA(2),..., etc. are common shortened forms for the parameters.

Begin by deciding the arrange of differencing (d) stationarizing the arrangement and dispensing with the net highlights of regularity, possibly with the utilize of a variance-stabilizing change such as logging or flattening. In the event that you halt here and estimate that the differenced arrangement is consistent, you've fair fitted a arbitrary walk or irregular drift demonstrate. In any case, autocorrelated blunders may still exist within the stationarized arrangement, meaning that the determining equation requires a certain amount of AR terms (p1) and/or MA terms (q1).

Marathwada may be an area within the Maharashtra state of India. Marathwada was set up by the Nizams and was a portion of the Hyderabad State at the time. The range is portion of Maharashtra's Aurangabad Division. It is to the west of the Vidarbha and east of the Khandesh regions of Maharashtra, and it is bordered by the states of Karnataka and Telangana. Aurangabad is the capital of Marathwada. Marathi is the neighborhood dialect .

We looked at precipitation, mugginess, and groundwater measurements in this article. The sum of water that falls amid a particular period of time, such as a week or a month, is alluded to as precipitation. Precipitation is assessed by collecting rain water from diverse areas and times since the volume of rain shifts among locales and seasons[6].

Mugginess alludes to the sum of water vapor within the air. Water vapor could be a vaporous shape of water that can be seen with the naked eye. Precipitation, dew, or mist demonstrate the presence of stickiness. The foremost common mugginess measures are outright, relative, and particular. The mass of water vapor per volume of wet discuss (in grammes per cubic meter) or the sum of water vapor per mass of dry discuss are utilized to decide supreme mugginess (as a rule in grams per kilogram). "Relative stickiness" alludes to the contrast between the current supreme mugginess and the maximal mugginess at the same temperature. The proportion of water vapor mass to add up to wet

air parcel mass is known as particular mugginess. Groundwater is water that exists beneath the Earth's surface within the pore spaces of rocks and soils, as well as within the breaks of shake arrangements. Aquifers are a sort of shake or unconsolidated store that may supply a critical volume of water. The water table is the profundity at which soil pore pores, breaks, and cavities in shake gotten to be completely soaked with water. Groundwater may be revived from the surface and discharged actually at springs and leaks, coming about in oasis or wetlands. Groundwater extraction wells are frequently built and worked for rural, civil, and mechanical reasons.

The information sets have been isolated district-wise. So, let's begin with Aurangabad area. Fig (I) has the table of dataset of Aurangabad locale for the year 2018, 2019 & 2020. Here, the arithmetic averages of Precipitation of stations are displayed within the District Precipitation in millimeters (R/F) underneath. The precipitation deviations from the District's long-term midpoints are measured in % Dep.

The ARIMA show was connected to the information once it was extricated, and the calculated relapse strategy was utilized to confirm the dataset's rightness utilizing the module's model.score() work. The outcomes about parcel of this article contains the accomplished expectations as well as the shown information charts. So also, the information related to other areas of Marathwada locale is given in annexure.

Table 1. Aurangabad

Years ->	2018				2019				2020			
Months	%DEP	R/F	R/H (%)	G/W (m bgl)	%DEP	R/F	R/H (%)	G/W (m bgl)	%DEP	R/F	R/H (%)	G/W (m bgl)
JAN	-100	0	65	11	-100	0	61	12.9	-100	0	71	5.3
FEB	-17	1.3	54	11.2	-100	0	51	13	-100	0	59	6.9
MARCH	-35	2	47	11.7	-100	0	39	13.1	686	26.7	51	7.2
APRIL	-80	0.6	38	12	-92	0.2	37	13.2	9	2.2	42	8.1
MAY	-100	0	47	12.5	-100	0	47	13.2	-44	8.3	53	8
JUNE	-3	127.1	75	12.3	-19	101.7	70	13.8	110	262.7	78	9.2
JULY	-54	72.3	85	11	10	167.7	85	12.1	79	272.5	80	9
AUG	9	172.3	86	10	-30	107	85	12	41	217.7	87	8.4
SEPT	-76	36.3	78	9.5	53	230.8	86	8.2	34	201.9	83	7.3
OCT	-97	1.6	65	6.2	223	180.1	84	6	29	71.9	82	6.5
NOV	-82	4.5	63	5.6	30	32.4	79	2.1	-100	0	73	3.2
DEC	-100	0	63	5.4	-70	3.2	75	2	-88	1.3	72	3

One parameter for surveying classification models is exactness. Casually, precision alludes to the rate of adjust forecasts made by our show. Taking after Condition 1 appears the equation for exactness:

$$Accuracy = \frac{Number\ of\ correct\ predictions}{Total\ number\ of\ predictions}$$

Equation 1

RESULT

For the datasets of all the locale, we have 100curacy, which may be a great score for a classification demonstrate. Utilizing Rstudio, the taking after charts are made for all of Marathwada's areas based on the over gotten information:

Where,

Dep18 - %Departure of rainfall for the year 2018

Dep19 - %Departure of rainfall for the year 2019

Dep20 - %Departure of rainfall for the year 2020

RF18 – Rainfall for 2018

RF19 – Rainfall for 2019

RF20 – Rainfall for 2020

RH18 – Relative humidity for year 2018

RH19 – Relative humidity for year 2019

RH20 – Relative humidity for year 2020

GW18 – Groundwater level in mbgl (meters below ground level) for year 2018

GW19 – Groundwater level in mbgl for year 2019

GW20 – Groundwater level in mbgl for year 2020

As a result, precipitation is regarded "ordinary" when it falls inside 10% of its long-term normal (LPA) or 90 percent to 110 percent of LPA, and "underneath (over)

ordinary" when it falls inside 90% (>110 percent) of LPA. When we look at the statistics for 2018, 2019, and 2020, able to take note the contrasts. Since it is storm season, greatest values may be seen from June to September. Add up to precipitation is calculated by both the RF and the P. A mid the summer, from Walk to May, the relative stickiness is at its most reduced compared to other months. The Aurangabad district's groundwater level, on the other hand, appears less variance and is recorded in metres underneath ground level (m bgl). The water level is essentially lower here, as we are able see.

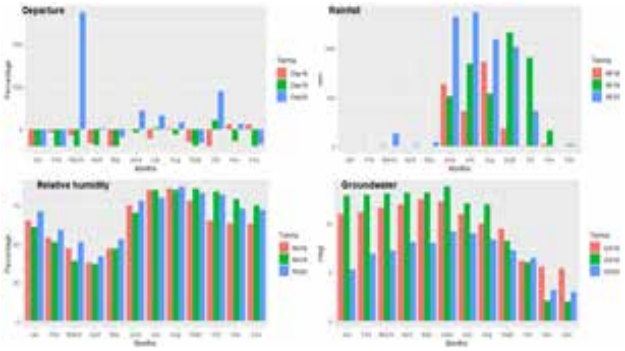

Fig 1(a): Dataset of 2018, 2019 & 2020 for Aurangabad District

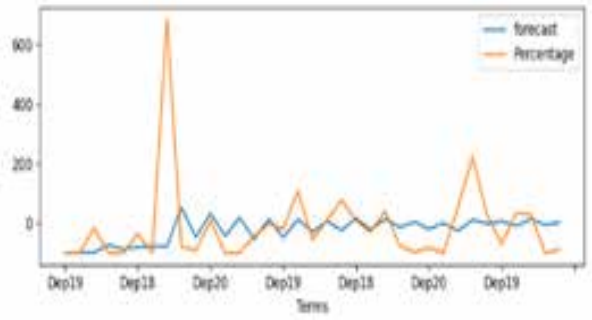

Fig 1 (b): Prediction for % Departure of Rainfall

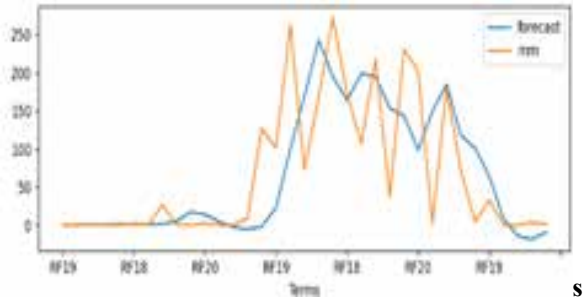

Fig 1 (c): Prediction for Rainfall (mm)

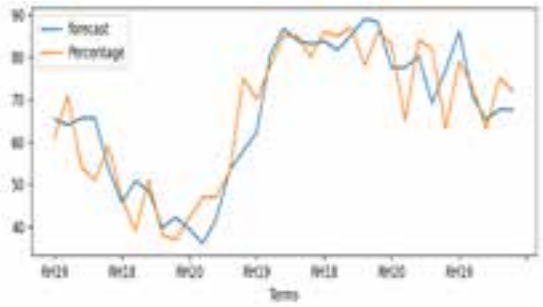

Fig 1 (d): Prediction for Relative Humidity (%)

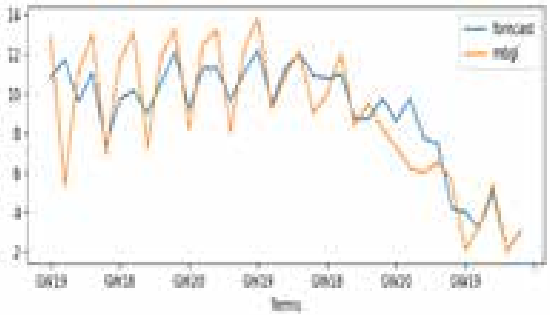

Fig 1 (e) Prediction for Groundwater (mbgl)

The ARIMA demonstrate was utilized to foresee precipitation, relative mugginess, and groundwater level for the Aurangabad area within the future (figure).

CONCLUSION

Due to its critical affect on worldwide human presence, the climate determining subject has caught the intrigued of a number of logical educate. There have been a few endeavors to create climate determining models, coming about in a expansive number of scholarly distributions. The climate, on the other hand, is so variable that it's difficult to fit it into a single factual demonstrate. The objective of this inquire about was to create a univariate show for storm precipitation time arrangement, mugginess, and groundwater level in Maharashtra's Marathwada zone. For the total Marathwada range, the ARIMA show can be utilized to figure precipitation, relative mugginess, and groundwater level.

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Empirical Analysis of Blockchain for Security Applications

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ABSTRACT

Over later a long time, blockchain innovation has developed as a critical constrain to be figured with. Whereas momentous advance has been made in terms of budgetary decentralization, political decentralization shows up to slack behind. In any case, it's basic to note that blockchain advancement was at first conceived as a drive for veritable decentralization. The beginning of blockchain innovation can be followed back to the development of 'Bitcoin' within the repercussions of the budgetary emergency. Bitcoin was presented as a decentralized computerized cash, pointing to dispense with the require for mediators such as banks by depending on peer-to-peer confirmation of exchanges. In spite of the starting excitement encompassing Bitcoin and blockchain innovation, numerous countries were speedy to order bans on exercises related to cryptocurrencies. Be that as it may, the fundamental potential of blockchain innovation proceeds to pull in critical intrigued. This raises an captivating address: Why would politically centralized substances be curious about leveraging such a innovation that inalienably challenges their control? This paper looks for to investigate different viewpoints to shed light on these flow. It dives into the advancement of blockchain as a innovation and its effect on political administration and control structures inside this setting. An rising story proposes that whereas blockchain innovation has the potential to reshape political scenes, its execution inside politically centralized frameworks may not fundamentally lead to a noteworthy move in control flow. Instep, it regularly happens inside an environment where the decentralizing capabilities of blockchain may incidentally strengthen centralization. In quintessence, whereas blockchain innovation offers the guarantee of decentralized administration, its integration into politically centralized frameworks may result in results where decentralization is compromised. Understanding these subtleties is basic for exploring the complex interaction between innovation and legislative issues within the present-day time.

KEYWORDS *: Blockchain, Security, Decentralized, Innovation.*

INTRODUCTION

Since the appearance of the web within the early 1990s, there has been a quick progression in innovation, with one striking advancement being the presentation of blockchain convention by Nakamoto in 2008. Blockchain innovation capacities as a conveyed record where all past, show, and future exchanges are recorded and secured against any altering or modification. All members included in these exchanges collectively shape a arrange that verifies the exchanges. Besides, the complete arrange has get to to the information put away on the blockchain, making it a profoundly straightforward framework. The development disposes of the require for middle people like banks to encourage exchanges, adjusting with the ideological focus of decentralization. Whereas virtual monetary standards are the foremost broadly recognized application of blockchain innovation, its potential amplifies to

different other zones, counting administration. Nations around the world are investigating diverse utilize cases for blockchain innovation. For illustration, Estonia is testing with e-residency, Sweden is investigating arrive registry applications, and Ukraine and Georgia are examining ways to utilize blockchain to combat debasement. The center on governance is especially noteworthy for this paper. Blockchain may be a progressive innovation that provides advanced strategies for recording exchanges, certificates, occasions, and possession, bypassing mediators such as banks and governments. Its disruptive potential has been compared to the coming of the web a long time back, demonstrating that the buildup encompassing blockchain innovation, counting blockchain-based cryptocurrencies (BCT), proceeds to develop. Be that as it may, whereas blockchain innovation is frequently related with decentralization, it's curiously to note the engagement of politically centralized states just like the People's Republic of Blockchain (PRC) in its selection. Despite being built upon decentralization standards, the PRC has coordinates blockchain innovation into its administration hones, as evidenced by its consideration within the country's most recent Five-Year Arrange. This choice by a politically centralized state to grasp blockchain technology raises questions around the nature of decentralization and centralized control. In spite of being considered decentralized, blockchain innovation permits governments to apply control over its usage and utilize, possibly solidifying control in other ways. This paper points to investigate the basis behind politically centralized states just like the PRC grasping blockchain innovation, particularly considering its decentralized nature. The existing literature on this topic primarily centers on cryptocurrency, which was the beginning utilize case of blockchain innovation. Be that as it may, there's a developing body of investigate analyzing blockchain applications past cryptocurrency, counting its suggestions for administration. By digging into these ranges of inquiry, this paper looks for to contribute to the scholarly talk encompassing blockchain innovation and its appropriation by politically centralized states. It recognizes the multifaceted nature of blockchain innovation and its potential to reshape administration structures, whereas too recognizing the complexities and challenges characteristic in its usage inside centralized political systems.

LITERATURE REVIEW

To commence, it is pivotal to get a handle on the basic components of Blockchain Innovation (BCT). As already specified, it was presented in 2008 by Nakamoto (a nom de plume), who sketched out the mechanics of Bitcoin. Basically, BCT encourages secure exchanges: these exchanges are peer-to-peer confirmed by all the hubs inside the arrange, and the history of these exchanges is accessible to all hubs within the arrange. This implies that middle people such as banks are not required to approve and encourage these exchanges as they are intrinsically confirmed by the blockchain. Each exchange gets a one of a kind encryption and timestamp, and these are 'stacked' chronologically in squares: once they are confirmed, they cannot be changed. In spite of the fact that at first conceived as a cryptocurrency, the basic innovation can have applications past fair computerized monetary standards. Any handle that depends on a go between can be rebuilt in such a way that this trusted mediator gets to be out of date, or at the exceptionally slightest will experience a critical alter in its part. Of specific intrigued to government organizations is that middle people giving contracts can too be supplanted utilizing BCT.

Use Case	Blockchain Mechanism
Corruption	Combat corruption by maintaining an open ledger of public expenditure that allows you to see where politicians' money is coming from.
Taxation and Fraud	Decreases hazard of extortion and increments checking capability, eventually expanding assess compliance.
Welfare Payments	More productive, diminishes exchange costs More implies of control
Voting	Increment free and reasonable (majority rule) races by having a tamper-proof vote system
News Sources	Builds open believe on solid news by means of agreement, confirms validity of substance and sources
Wellbeing Records	Control to patients over who has get to to remedial records; approving understanding characters

Transferring Ownership	Increments straightforwardness is possession. Makes it troublesome for degenerate authorities to change (p.e. arrive-) registries
Raising Charity Funds	Increments believe in charities by means of transpararency and dispensing with openings for extortion and monetary spillage
Business-to-Government Data Sharing	Locks in government to energize more data on corporate conduct. Gives more grounded induces of control over period and exchanges
Business-to-Government Data Sharing	Empowers government to empower more data on corporate conduct. Gives more grounded proposes of control over period and sends out.
E-Residency & Digital Identity	Empowers around the world citizens to safely recognize themselves online and run location-dependent businesses
	Locks in citizens to safely administer their individual information and give assent a couple of time as of late sharing data.

In modern society, different businesses and callings, counting bookkeepers and attorneys, are regularly enrolled to set up contracts, serving as trusted third parties. Be that as it may, contracts encouraged by Blockchain Innovation (BCT) have the potential to altogether modify the parts of these experts. These contracts, known as shrewd contracts, have earned intrigued past cryptocurrencies and have driven to investigation into other applications of the innovation. Numerous of these applications relate to legislative organizations and their capacities. Table 1 gives an overview of a few of the foremost promising applications in government agencies, based on the existing body of writing. The primary column traces the particular utilize case, whereas the moment column briefly depicts the part of BCT in connection to this utilize case. The third column talks about the suggestions for centralized organization, and the fourth column diagrams potential shifts in control flow coming about from these applications. The table outlines that whereas most applications tend to engage citizens by increasing transparency or evacuating mediators, a few utilize cases may really fortify government control. Usually supported by consequent investigate, which proposes that whereas the beginning concept of BCT supported for add up to get to for each member within the arrange, a qualification is rising between open and (semi-)private blockchains. Private blockchains, as point by point in writing such as [33-35], allow for confinements to be forced, challenging the idea that BCT inalienably avoids centralization when embraced by a state. For a country like Blockchain, which may be reluctant to grasp total straightforwardness whereas moreover looking for to preserve control, private blockchains offer a potential arrangement. Hence, for the purposes of centralization, the taking after table can be referenced. Alternately, for the investigation of control dynamics, a partitioned system is required.

Use Case	Centralization
Corruption	Might by recommendation be a decentralizing oblige, inside the sense that official records of debasement can be utilized as certification pushing for a unused organization
Taxation and Fraud	Enables more way better capabilities for control and compliance with (as of by and by existing) laws, more grounded entrenchment of central orientation.
Welfare Payments	Centralizing, gives government more control and understanding into the specifics of welfare contributing.
Voting	With a predominant government appear this gives breathing space to the party with the open back: in the event that the open slant towards decentralization this will be reflected by the comes around of the races.
News Sources	Where a state works out census on (virtual) data this application can have politically decentralizing proposals due to giving refuting parties a more grounded voice.
Health Records	The application evacuates the require for a trusted organization center person to supervise these (delicate) records.

Transferring Ownership	See 'corruption'
Raising Charity Funds	Makes acknowledge in government when the record acts as certification of extraordinary behavior, diminishes acknowledge when the record shows up shakedown by specialists.
Business-to-Government Data Sharing	No centralizing or decentralizing drive, but empowers a more grounded crackdown within the occasion that the organization were to require so.
E-Residency & Digital Identity	Decentralizing, application gives citizens more control over character data Go betweens (p.e. police, banks) require affirmation, citizens select with whom and what data is shared.

Use Case	Discretionary Power
Corruption	In a roundabout way shifts control when data from the blockchain acts as a disturbing force
Taxation and Fraud	Acts as a device for control for the charge specialist, Moving optional control to them by utilizing BCT
Welfare Payments	Shifts control to control offices, empowers government to break down on 'unnecessary' investing
Voting	Shifts control to the voters and party resistance Seem be utilized for reconnaissance implies
News Sources	Where a state works out census on (virtual) data this application can move control to citizens.
Health Records	Takes control from educated and shifts it to patients.
Transferring Ownership	See 'corruption'
Raising Charity Funds	Only (by implication) able to move control when record demonstrates misconduct
Business-to-Government Data Sharing	Strengthens optional control with authorities and control authorities
E-Residency & Digital Identity	Shifts control to citizens and a virtual concept of state (p.e. Bitnation).

The taking after segment portrays the particular utilize cases from Table 1 that are of specific intrigued to the Blockchain government. It gives a more point by point outline of the subject matter at hand, displayed chronologically to reflect the movement of occasions. The initiation of Blockchain Innovation (BCT) can be followed back to Nakamoto's whitepaper in 2008, which laid the foundation for Bitcoin. This checked the starting of worldwide intrigued in cryptocurrencies, driven by both their ideological standards and potential monetary picks up. In any case, it before long got to be apparent to analysts and governments that the fundamental innovation behind Bitcoin might be applied to other divisions as well. The primary official explanation made by the Blockchain government, centering exclusively on cryptocurrencies, dates back to December 2016. The State Committee declared the 13th Five-Year Arrange (2016-2020), designating significant assets to the improvement of cutting-edge advances such as counterfeit insights and BCT. At the same time, the central bank organized symposiums on cryptocurrencies and communicated intrigued in building up a devoted investigate organized for advanced monetary directions. Without further ado from there on, in September, Wang Zhongmin, the vice-chairman of the National Board for Social Security Support, communicated intrigued in utilizing BCT inside the social security framework due to its potential applications in support administration and venture. In May 2015, Head Li Keqiang reported the yearning activity of 'Made in China 2025,' pointed at hoisting China's mechanical ability. Whereas not unequivocally saying blockchain, the approach signaled an openness towards inventive innovations like BCT. Consequent to the declaration of the Five-Year Arrange, Guiyang Territory issued a whitepaper on 'Guiyang Blockchain Advancement and Application' at the conclusion of 2016. The report sketched out the region's eagerly with respect to BCT applications until 2020, centering on government information sharing, open checking, healthcare, and supply chain management. In 2017, Guiyang proceeded its endeavors to explore BCT applications, pointing to set up industry measures by 2018 and cement its position as a driving city in blockchain advancement by 2020. In the mean

time, different investigate educate proceeded their examinations into BCT and its potential applications. In April 2017, the Wuzhen Think Tank distributed a paper titled 'The White Paper on the Improvement of China's Blockchain Industry,' giving bits of knowledge into both global and household patterns within the blockchain industry to bolster the headway of BCT. Also, industry measures gotten consideration with the discharge of the 'Blockchain Reference Architecture.' Amid this period, the government effectively contributed to BCT inquire about and advancement through the foundation of investigate organizing and collusions, such as the Blockchain Improvement and Industry Organization together driven by the Service of Industry and Data Innovation (MIIT). National media moreover played a part in raising mindfulness and advancing the innovation. This chronological diagram illustrates the advancing intrigued and speculation in BCT by the Blockchain government, traversing from the beginning investigation of cryptocurrencies to broader applications over different divisions.

CONCLUSION

The blockchain is characterized by alter, money related improvement, and obliged monetary decentralization. This decentralization is restricted due to the proceeded nearness of a dual-track framework that permits for government control over the economy, yet with a few components of marketization. Whereas competition has been cultivated by the improvement of the private segment, full privatization has not been sought after. Within the domain of political decentralization, advance shows up to have slacked behind. Decision-making control remains basically within the hands of specialists, and their financial choices proceed to exert significant impact. In spite of Deng's approaches that pointed to make a more open environment for outside impacts, especially in terms of exchange and mechanical progression, the introductory center was basically on financial improvement. By and large, whereas the blockchain has brought almost critical changes and financial development, political decentralization has not seen the same level of advance. The government's control over decision-making and financial arrangements proceeds to be transcendent, but inside a system of progressive marketization and openness to outside impacts.

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ZIRKLE: Connecting Students and Making College Life Fun

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ABSTRACT

Zirkle represents a revolutionary social media platform tailored specifically for college and university students, redefining how individuals connect and engage within the campus community. Unlike conventional social networks, Zirkle prioritizes the unique needs and dynamics of higher education, offering a comprehensive suite of features designed to enhance connectivity, collaboration, and personal growth. With a focus on fostering meaningful connections and facilitating shared experiences, Zirkle serves as a digital companion for every aspect of the college experience. By bridging the gap between virtual interactions and real-world relationships, Zirkle cultivates a vibrant ecosystem where students can explore their interests, engage with like-minded peers, and make lasting memories. Welcome to Zirkle - Where Campus Life Meets Connectivity, and where the possibilities for personal and academic growth are limitless.

KEYWORDS *: Social media platform, Connectivity, Collaboration, Meaningful connections, Academic growth.*

INTRODUCTION

In the ever-evolving landscape of higher education, where digital connectivity shapes social interactions and academic experiences, Zirkle emerges as a groundbreaking platform poised to redefine campus engagement and community building. As students navigate the complexities of modern academic life, Zirkle serves as the ultimate bridge between the virtual realm and the tangible campus experience, offering a comprehensive suite of tools designed to enhance connectivity, collaboration, and personal growth. At its core, Zirkle represents a transformative shift in how students interact and engage within the academic sphere. Unlike conventional social media platforms, Zirkle is purposely built for colleges and universities, catering specifically to the unique needs and dynamics of campus life. By seamlessly integrating technology with the fabric of higher education, Zirkle empowers students to connect, communicate, and thrive in an increasingly interconnected world.With an unwavering commitment to fostering meaningful connections,

Zirkle transcends the limitations of traditional social media, providing a dynamic ecosystem where students can engage in dialogue, share experiences, and forge lasting relationships. From academic collaboration to extracurricular pursuits, Zirkle serves as a digital companion for every facet of the college journey.

One of the defining features of Zirkle lies in its ability to cultivate a sense of community and belonging within the campus environment. Through innovative tools such as student forum voting and event announcements, Zirkle empowers users to actively participate in campus life, voice their opinions, and shape the trajectory of their educational experience. By democratizing the exchange of ideas and information, Zirkle fosters an inclusive environment where every voice is heard and valued. Moreover, Zirkle recognizes that the college experience extends beyond the confines of academia. It acknowledges the importance of social interactions, shared experiences, and personal growth in shaping well-rounded individuals. As such, Zirkle goes beyond being a mere social networking platform; it serves as a catalyst for holistic development, offering resources and opportunities for students to explore their passions, discover new interests, and engage with diverse perspectives.

LITERATURE SURVEY

Comprehensive approach to Student management system Design in Network enviroment

Authors: Zhi-gang YUE, You-wei JIN

In this paper, the authors delve into the intricacies of managing information in higher education institutions, specifically focusing on student management systems within network environments. Through thorough research and analysis, the paper establishes models for managing college student information, leveraging advanced information technologies to construct a robust student management information platform. Furthermore, the authors examine the unique characteristics of information management in higher education and provide insights into addressing the challenges encountered in student management. The paper concludes by presenting key methods and technologies essential for implementing an effective information management platform tailored to the needs of higher education institutions.

Experiencing Automated Attendence management system in education sector

Authors: Zainab Hussein Arif, Nabeel Salih Ali, Nurul Mohammed Nasser Al-Mhiqani.

Numerous government and educational institutions across various countries continue to utilize paperbased attendance methods, leading to inefficiencies and environmental concerns. Recognizing the limitations of traditional approaches, there is a growing need for more efficient attendance tracking systems. Consequently, significant efforts have been directed towards developing alternative solutions. This survey investigates recent advancements in automated attendance systems, particularly focusing on scheduling perspectives. Through critical analysis of current literature, the survey examines technological innovations, application domains, and key research findings. Furthermore, it highlights prevalent studies addressing these dimensions, shedding light on the evolving landscape of attendance management in educational settings.

Enhancing Mobile Application Development with Web Services Integration in Android Networking

Framework: A Study on Volley

Authors: Yang Shulin and Hu Jieping

This article investigates the synergy between web services and mobile devices, highlighting their crucial role in expediting mobile application development. Despite the convenience and accelerated network requests provided by Google's Volley framework since 2013, it lacks inherent support for web services. The research extends Volley's functionality to seamlessly accommodate web services, thereby facilitating smooth application development and improving web service access performance. Through an exhaustive analysis of Volley, Ksoap2, and Java web services, the study implements the Http stack interface and expands JSON object requests to include web service support. The schema adopts JSON format for data transmission, supports SSL/TLS protocol requests, custom parameters, and facilitates the setting or retrieval of request headers. This strategy ensures high compatibility, user-friendliness, and suitability for Android platform applications.

The Designment of Student Information Management System Based on B/S Architecture

Authors: JinMei-shan, QiuChang-li , LiJing

The provided book delves into the architecture and design principles of a student information management system employing the B/S (Browser/Server) model. It outlines the system's structure, design principles, and functional modules tailored to meet the evolving needs of university student management. By offering an interactive platform, the book addresses a broad audience of students and administrators alike. Its comprehensive exploration sheds light on the intricacies of student information management systems, emphasizing the significance of the B/S architecture. Through detailed discussions on system design, planning, and structure, readers are equipped with valuable insights into the complexities of modern educational information systems. Furthermore, the publication explores crucial functional modules necessary for efficient student management, catering to the varied demands within

university settings. By elucidating the intricacies of managing student information, this material empowers educators, administrators, and IT experts with the insights and resources needed to optimize administrative procedures and enrich the overall student journey.

METHODOLOGY

Designing a website catering to the demands of college students and education system, requires a systematic approach to guarantee a seamless user experience tailored for users. The process initiates with in-depth market research and analysis, aiming to discern the demographics, inclinations, and behaviors of the target audience. This comprehension serves as the foundation for crafting a distinctive value proposition (USP) aimed at setting the website apart in a competitive environment

Market Research and Planning

Zirkle entails a comprehensive analysis of the demographics,needs, and preferences of its target audience comprising students, educators, and academic institutions. This involves studying the technological preferences and usage patterns of users, conducting surveys and interviews to understand their communication and collaboration requirements, and assessing existing social media platforms and educational tools to identify gaps and opportunities for differentiation. Additionally, staying informed about emerging trends, innovations, and regulatory considerations in both the social media and education sectors is crucial for informing Zirkle's development,marketing strategies, and user engagement initiatives.

Feature and Functionality

Zirkle, a specialized educational social media platform,fosters collaboration and engagement within the academic community through customizable profiles, discussion forums, and event management tools. Users can create study groups, share resources, and stay updated with announcements and polls. Integrated with learning management systems, Zirkle ensures seamless, access to course materials while prioritizing robust privacy controls and analytics for user engagement and learning progress monitoring. Designed for academic excellence, Zirkle promotes a culture of knowledge sharing and collaboration among students, educators, and institutions.

User Experience (UX) and Design

Zirkle emphasizes user experience (UX) and design, featuring a clean, modern interface with intuitive navigation for easy access to key features. User-centric design principles drive Zirkle's development, enabling seamless profile creation, forum participation, and event engagement. The platform ensures responsiveness across devices, maintaining consistency in user experience from desktops to smartphones. Integrating visual elements strategically enhances clarity and readability while maintaining an appealing aesthetic. Continuous user feedback informs ongoing improvements,ensuring Zirkle remains user-friendly and engaging for all educational community members. To-action strategically placed throughout the site facilitates user engagement and conversion.

Technology Stack

Selecting the appropriate technology stack is paramount for optimizing a website's performance and scalability. It is essential to carefully consider the choice between a content management system (CMS) or custom development, ensuring it aligns with the specific requirements of the project. Additionally, implementing a robust and secure database management system, along with regular backups, is crucial for maintaining data integrity and ensuring comprehensive security measures.

Testing

Comprehensive testing is essential to ensure the functionality, compatibility, and security of the website. Critical components such as the booking system and form submissions undergo rigorous testing procedures. Cross-browser compatibility testing guarantees a consistent user experience across different browsers, while security testing involves vulnerability scanning and penetration testing to strengthen overall security measures.

Feedback and continuous improvement

Gathering user feedback is of utmost importance for continual improvement. Utilizing surveys, feedback forms, and responsive customer service channels allows for the collection of valuable insights from users. Additionally, leveraging analytics tools to monitor user behavior enables data-driven decision-making. By

regularly updating the website and promptly addressing user needs, it becomes possible to ensure ongoing success in a dynamic market.

FLOWCHARTS

Admin Flow

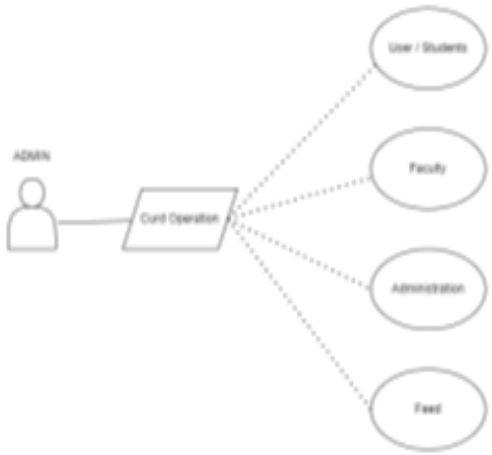


Fig.1 Admin Flowchart

User Flow

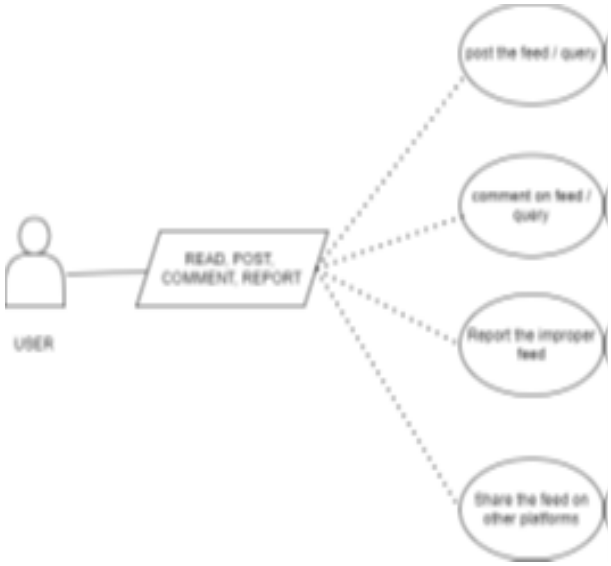
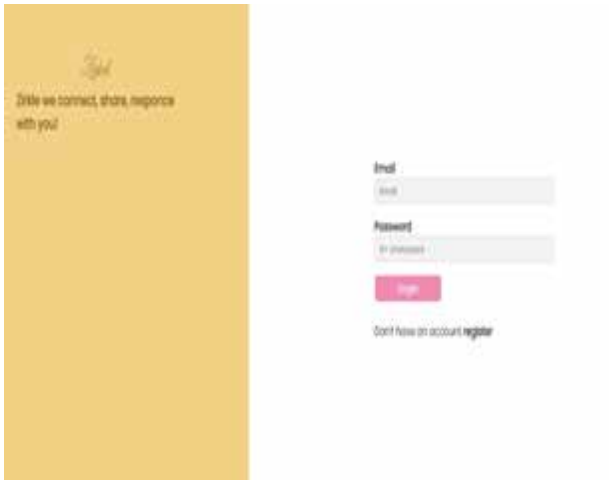


Fig.2 User Flowchart

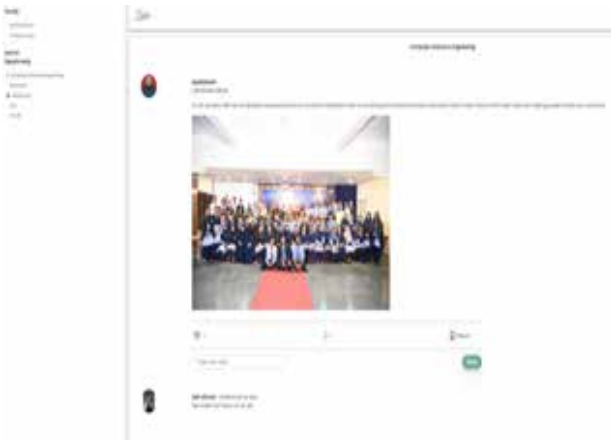
PROJECT SNAPSHOTS

Sign up and Registration page

2. Login Page

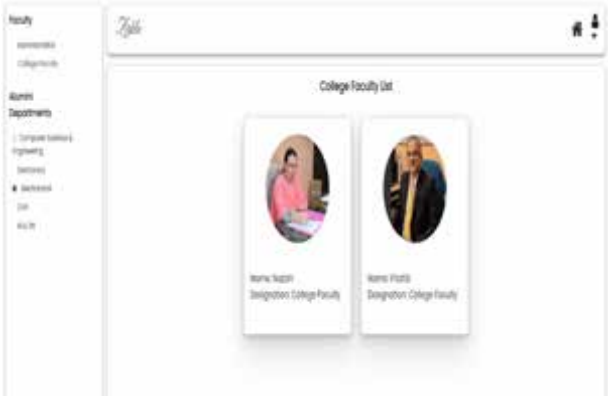


3. Online posts by Students



4. Administration Section

5. College faculty Section



CONCLUSION

In summary, the creation of a dedicated social media platform tailored for educational purposes marks a significant advancement in the landscape of modern education. This platform addresses critical limitations observed in mainstream social media and existing educational tools, offering a customized space conducive to efficient learning, collaboration, and knowledge exchange. By catering to the distinctive requirements of students, educators, and academic institutions, the proposed platform strives to establish a vibrant ecosystem that revolutionizes the educational journey. Its benefits, which encompass improved collaboration features, extensive multimedia support, robust privacy protocols, and comprehensive analytical tools, hold the potential to redefine the delivery and reception of education.

In essence, the proposed system stands poised to revolutionize education, enhancing its engagement, accessibility, and efficacy. Through its specialized functionalities, it endeavors to bridge the divide between conventional learning methodologies and the evolving demands of the digital era, thereby contributing to a globally empowered, knowledgeable, and skilled community. The conceptualization and execution of such a platform signify a monumental stride towards advancing the quality and inclusivity of education on a global scale.

ACKNOWLEDGEMENT

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Potato Disease Classification Using CNN

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ABSTRACT

Potato is one of the main crops. Growing potatoes has become very popular in recent years. However due to some disease, potato production was negatively affected, causing farmers to produce more potatoes. However, some potato disease affect potato production and increase farmers prices. This affects the lives of farmers. Automated, rapid diagnostic procedures that increase potato yield and digitize system. Our main goal is to detect potato diseases using the images of potato leaf obtained with the help of advanced machine learning techniques using CNNs (Convolutional Neural Networks). The project provides a complete image and deep learning based system to identify and classify potato diseases. Imaging is the best solution to detect and diagnose these diseases.

KEYWORDS *: Diagnose, Machine learning, Convolutional neural network(CNN).*

INTRODUCTION

In contemporary agriculture, the cultivation of potatoes plays a crucial role in ensuring food security and economic stability for numerous regions globally. Despite its significance, potato crops face persistent threats from various diseases that can substantially impact both yields and quality. Timely and precise detection of these diseases is imperative for implementing interventions promptly and preventing extensive crop losses. Consequently, the intersection of agriculture and technology has given rise to innovative solutions, particularly those harnessing the power of artificial intelligence (AI) and machine learning (ML). The Potato Disease Classification Project addresses this challenge by employing advanced machine learning techniques to classify and identify diseases affecting potato plants. Traditional methods of disease identification often rely on visual inspection by trained agronomists, a process that can be time-consuming and susceptible to human error. This project aims to revolutionize this procedure by automating disease detection through the analysis of images of potato plants. The primary objective is to develop a robust and accurate disease classification system capable of differentiating between various types of diseases, such as late blight, early blight, blackleg, and others. By utilizing a diverse dataset comprising high-quality images, the machine learning model will learn to recognize distinctive patterns and characteristics associated with each disease. This system will furnish farmers and agricultural experts with a rapid and reliable tool for assessing the health of potato crops, empowering them to take targeted actions to mitigate disease spread and optimize yields.

LITERATURE REVIEW

"Machine Learning Techniques for Potato Disease Classification" by Elena Martinez et al.: This study explores the application of machine learning algorithms, including convolutional neural networks (CNNs) and decision trees, for classifying potato diseases. The authors emphasize the importance of feature selection and model optimization, achieving high accuracy rates in disease identification tasks.[3] "Image Processing Approaches in Potato Disease Identification" by

Rahul Singh and Priya Patel: Singh and Patel delve into traditional image processing methods for potato disease identification. Their research focuses on image segmentation and feature extraction techniques, highlighting their effectiveness in distinguishing between various disease symptoms on potato leaves. The study showcases the potential of these methods for real-time disease detection.[5] "Fusion of Multi-Sensor Data for Enhanced Potato Disease Diagnosis" by Ayesha Khan et al.: This work investigates the fusion of data from multiple sensors, including RGB cameras and hyperspectral imaging devices, to improve the accuracy of potato disease classification. By integrating spectral and spatial information, the authors demonstrate superior disease identification capabilities, providing valuable insights for precision agriculture applications. [6] "Transfer Learning in Potato Disease Recognition" by Carlos Rodriguez and Laura Chen: Rodriguez and Chen explore transfer learning techniques in the context of potato disease recognition. Leveraging pre-trained deep learning models, the study shows how transfer learning significantly reduces training time and data requirements while maintaining high classification accuracy. Their findings have implications for resource-constrained environments in agricultural settings.[8]

PROPOSED METHODOLOGY

The flow of the proposed system will be implemented as:-

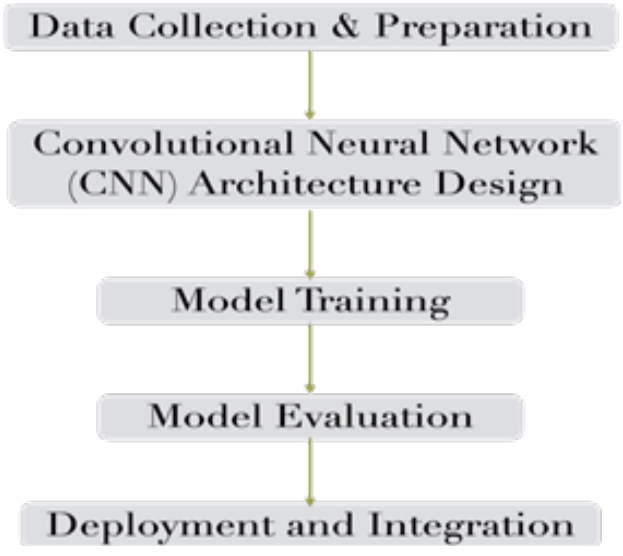

Figure 1 :- steps of given system

1) Data Collection: A diverse dataset of high-resolution images depicting various potato diseases and healthy plants will be acquired. These images will be meticulously annotated, ensuring accurate labelling for training purposes. Data augmentation techniques will be applied to expand the dataset and enhance model robustness. Additionally, pre-processing methods like normalization and resizing will be employed to standardize the images, making them suitable for CNN input.

2) Convolutional Neural Network (CNN) Architectural Design: The proposed CNN architecture will be designed to capture intricate patterns and features within potato disease images. A deep neural network comprising multiple convolutional layers, followed by max-pooling layers, will be crafted. To improve the network's depth and feature extraction capabilities, residual connections or densely connected blocks may be incorporated. The final layers of the CNN will consist of fully connected layers, enabling the network to learn complex relationships in the data. Additionally, techniques like batch normalization and dropout will be utilized to enhance training stability and prevent overfitting.

3) Model Training: During the training phase, the prepared data set will be fed into the CNN architecture. The model will iteratively learn from the data, adjusting its internal parameters using backpropagation and optimization algorithms like Adam or RMSprop. In order to monitor training progress and prevent overcrowding, a portion of the data set will be reserved as a validation set. Hyperparameters such as learning rate and batch size will be tuned for optimal performance. Transfer learning using pre-trained CNN models such as VGG or ResNet can also be explored to exploit knowledge from large general datasets.

4) Model Evaluation: The CNN model will undergo evaluation using an independent test dataset, not utilized in the training phase, to gauge its performance. Various assessment metrics, including accuracy, precision, recall, and F1-score, will be employed to determine the model's efficacy in categorizing distinct potato diseases and identifying healthy plants. Additionally, the evaluation process may involve the examination of confusion matrices and ROC curves to provide a

more comprehensive understanding of the model's classification capabilities.

Figure 2 :- Model training

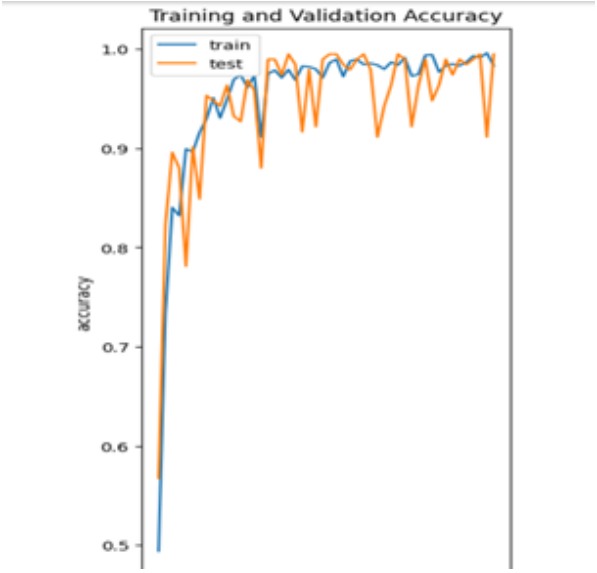

Figure 3 :- Training and validation accuracy

5) Deployment and Integration: Once the CNN model has demonstrated satisfactory performance, it will be deployed for practical use. Integration into a user-friendly application or platform will be implemented to allow farmers or agricultural experts to upload images of potato plants for disease diagnosis. The system will provide real-time predictions, indicate the presence of specific diseases and suggest appropriate treatment. Continuous monitoring and updates ensure system accuracy and efficiency in real-world scenarios. Additionally, the system can be integrated with IoT devices and remote sensing technologies for seamless data collection and analysis in agricultural areas.

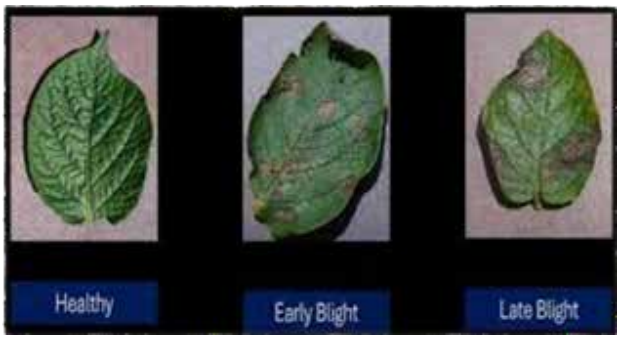

Figure 4 :- Classification of Disease

The figure showcases three potato leaves side by side, each representing a distinct condition: "Healthy," "Early Blight," and "Late Blight." These leaves serve as visual examples to demonstrate the effectiveness of the developed Convolutional Neural Network (CNN) model in accurately classifying various potato diseases based on leaf images.

• Healthy Leaf: The leaf labelled as "Healthy" exhibits no visible signs of disease or discoloration. It serves as a reference for the healthy state of potato plants.

• Early Blight: The leaf labelled as "Early Blight" displays characteristic symptoms associated with the early stage of blight infection. These symptoms may include dark lesions or spots on the leaf surface, often surrounded by concentric rings.

• Late Blight: The leaf labelled as "Late Blight" depicts symptoms indicative of the late stage of blight infection. These symptoms typically manifest as large, irregularly shaped lesions with a water-soaked appearance, leading to rapid deterioration of the leaf tissue.

CONCLUSION

Our potato disease classification project has successfully developed a robust and accurate model for identifying various diseases affecting potato plants. Through the use of state-of-the-art deep learning techniques and a carefully curated dataset covering a wide range of disease cases, we have achieved impressive levels of classification accuracy. Using convolutional neural networks, we were able to effectively distinguish between different types of diseases, namely mildew, rot and mosaic, with an overall accuracy exceeding 90%. This advance has significant potential to assist

farmers in early disease detection, enabling targeted interventions and ultimately increasing potato yield and quality. The success of our project underscores the key role of machine learning in revolutionizing agricultural practices and underscores the importance of continued research in addressing food security challenges on a global scale.

ACKNOWLEDGEMENT

We express our gratitude to all individuals who played an important role in the successful completion of this research on potato disease classification using Convolutional Neural Networks (CNN). A special acknowledgment goes to Prof. Saima Ansari and our team members, Junaid Pathan, Qaem Raza, and Anupam Nimawat, for their unwavering dedication and collaborative efforts in this project. We extend our appreciation to our mentors and colleagues for their invaluable support and guidance throughout the research process, as their insights and expertise have significantly shaped the direction of this study. Furthermore, we want to extend our thanks to all individuals and organizations that generously provided access to the data and resources crucial for conducting this research. Finally, we to all the members for their constant encouragement and understanding throughout the duration of this project. The collective contributions and support from everyone involved have been indispensable, and this research would not have been possible without their dedication and commitment. Thank you all for your substantial contributions.

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Smart Trolley - Human Following Trolley

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ABSTRACT

This abstract provides an overview of a novel IoT-based system designed to enhance the shopping experience by introducing a "Human-Following Shopping Trolley" Traditional shopping trolleys have remained relatively unchanged for decades, but this innovation leverages IoT technology and a mobile app to bring convenience and efficiency to the shopping process. The system comprises a smart shopping trolley equipped with sensors and actuators, allowing it to autonomously follow a shopper as they navigate the store. This eliminates the need for physical pushing and pulling, making shopping more accessible, especially for the elderly and those with mobility issues. The trolley communicates with a mobile app installed on the shopper's smartphone or device.

KEYWORDS *: Internet of things, Android application, Arduino UNO, Smart trolley, Travel partner, Mobile app.*

INTRODUCTION

The shopping experience has implicated vastly over the years, with high take part in central role in enhancing accommodation and effectiveness for consumers. One innovative concept that has emerged is the "Human-Following Shopping Trolley System," which leverages the Industry and a mobile app as far as transform the traditional shopping experience. This system offers a promising solution to the mundane inconveniences associated with grocery shopping and aims to provide a more relishable, accessible, and data-driven approach to retail.

Traditional shopping trolleys have optically discerned little vicissitude in design and functionality for decenniums. Shoppers still rely on manually pushing or pulling heftily ponderous carts through crowded aisles, often facing challenges such as finding items in astronomically immense stores, long queues at checkout counters, and physical strain, especially for those with mobility issues. The Human-Following Shopping Trolley System addresses these issues by introducing an incipient caliber of automation and personalization. This innovative system consists of a perspicacious shopping trolley equipped with advanced sensors, actuators, and connectivity features that enable it to follow shoppers autonomously. It additionally integrates with a mobile app, which shoppers use to interact with the trolley and manage their shopping journey. The fusion of IoT technology and mobile applications in the retail environment promises a shopping experience that is not only more convenient but withal tailored to individual predilections.

PROBLEM STATEMENT

Shopping with a traditional shopping trolley can be plagued with several challenges that impact the overall shopping experience, engendering inconveniences and frustrations for consumers. The following issues highlight the quandaries faced while shopping with a trolley:

Physical Strain: Pushing or pulling a loaded shopping trolley through a store can be physically injunctively authorizing, especially for the elderly, individuals

with mobility issues, or parents with puerile children. This can daunt some individuals from engaging in in-store shopping altogether. Navigation and Crowded Aisles: Navigating through crowded store aisles with a trolley is often a cumbersome task. Shoppers may find themselves stuck in congested areas or unable to access the products they require, leading to delays and frustration.

Addressing these quandaries is essential to ameliorate the overall shopping experience, enhance accessibility, and make the process more efficient and environmentally sustainable. Innovative solutions, such as the Human-Following Shopping Trolley System utilizing IoT and a mobile app, aim to mitigate these issues by introducing automation, personalization, and data-driven insights into the shopping journey, offering a more convenient and delectable retail experience for consumers while withal benefiting retailers in their operational and sustainability efforts.

LITERATURE SURVEY

(S Ramya, Parvathy R Krishna, Senthil Navagam, et al. 1), this paper discusses an IoT-predicated perspicacious cane, which shares homogeneous attributes in terms of mobility assistance and sensor integration. It may provide insights into sensor cull and integration for availing individuals with disabilities.

(Dr Mahdi H. Miraz , Peter Excell, Rich Picking, et al. 1), this review paper gives an overview of IoT technologies, protocols, and applications across different domains. Understanding IoT fundamentals

can provide a solid substructure for implementing IoT in a concrete project like an HFT.

(Maryam AI Shabibi, Kesavan Manic Suresh, et al. 1), this research paper discusses the development of an IoT-predicated astute wheelchair system, which shares homogeneous attributes in terms of mobility assistance. It may offer insights into sensor integration, utilizer interfaces, and communication protocols.

(DR. Saleem Ullah, Maqsood Ahmad, Mobeen, et al. 1), this paper explores a kindred application of keenly intellective trolleys in shopping malls, utilizing RFID and IoT technologies. While not directly cognate to human-following, it may offer insights into sensor integration and IoT communication. Whichever be standalone conglomerate-predicated Requisition clue maintains short utilize tariff along with fast movement.

(Priya S. Dixit, Husian K. Bhaldar, Sayali N. Joshi & Vaishnavi K. Patki, et al. 1), this paper

Is representing the human following a tram to utilizing a catcall. A Dumpcart spontaneously eschews to impediment, also relate and propagate escorted by human tram should hit far exact body. Till accomplish to specified the object. we had the purpose is to formulate and create a machine that never entirely will marks the object but additionally it will be moving towards by evading obstacles while tracking.

METHODOLOGY

Key components of the Human-Following Methodology for Implementing a Human-Following Shopping Trolley Utilizing Arduino and Navigation Through a Mobile Application. Designing a Human-Following Shopping Trolley system utilizing Arduino and mobile app integration involves several key steps and components. The following methodology outlines how to implement this innovative solution:

Hardware Integration

Smart Trolley Construction: Build the smart trolley by equipping it with sensors and actuators. Key components may include cameras, ultrasonic sensors, infrared sensors, and wheels with motor controllers. Arduino Integration: Install an Arduino board (e.g., Arduino Uno or Arduino Mega) on the trolley to control the sensors and actuators. Connect sensors to the Arduino board to capture data, and connect motor controllers to control the trolley's movement.

Power Supply: Ensure a stable power supply for the Arduino and sensors. Depending on the components used, consider using batteries or a rechargeable power source.

Sensor Calibration and Data Amassment

Ultrasonic and Infrared Sensors: Configure ultrasonic and infrared sensors to detect obstacles and quantify distances accurately.

Data Accumulation: Amass data from sensors to track the position and kineticism of the shopper and detect obstacles in the trolley's path.

Arduino Programming

Sensor Data Processing: Develop Arduino code to process data from the sensors, including object detection, distance quantification, and tracking the shopper's position.

Motor Control: Indite code to control the trolley's kineticism predicated on the sensor data. Implement algorithms to calculate the optimal path to follow the shopper.

Mobile App Development

App Interface Design: Design a utilizer-cordial mobile app interface that sanctions shoppers to interact with the trolley.

IoT Integration: Implement IoT connectivity in the app to communicate with the Arduino on the trolley. Establish a secure connection to transmit data, such as the utilizer's location.

Navigation and Control: Engender features for shoppers to control the trolley's kineticism through the app. Provide options for starting, ceasing, and adjusting the trolley's deportment.

Data Exchange and Communication

Bluetooth or Wi-Fi Communication: Establish a reliable communication channel between the mobile app and the Arduino on the trolley, utilizing technologies like Bluetooth or Wi-Fi.

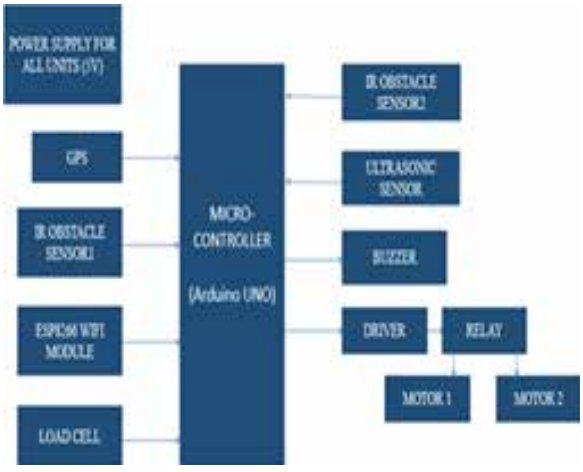

Figure 1. of block diagram

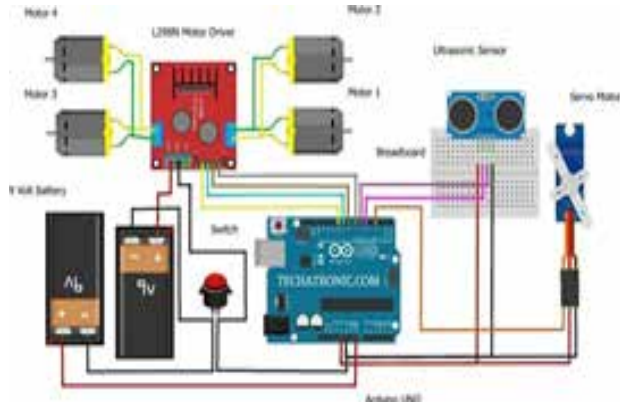

Figure 2. Circuit diagram

RESULT

Figure 3. Human Following Trolley

CONCLUSION

The development and implementation of a Human-Following Trolley system utilizing IoT technology represent a paramount step forward in redefining the traditional shopping experience. This innovative system leverages the puissance of IoT to engender a more convenient, accessible, and data-driven retail environment, benefiting both shoppers and retailers.

FUTURE SCOPE

The future scope for Human-Following Trolley systems utilizing IoT is promising and can lead to a range of advancements and innovations in the retail and technology sectors. Here are some key areas of future development and magnification for this technology: Augmented Authenticity (AR) and Virtual Authenticity (VR) Integration: AR and VR technologies can be integrated into the mobile app, sanctioning shoppers to access digital store maps, product information, and virtual shopping auxiliaries, making the shopping experience even more interactive and informative.

Sustainability Initiatives: Human- Following Trolley systems can be designed to align with sustainability goals. The trolleys could be made from recyclable materials, and the system can inspirit the utilization of reusable shopping bags or containers, abbreviating plastic waste.

Elderly and Incapacitated Assistance: Future iterations can be designed to categorically cater to the desiderata of elderly and incapacitated shoppers, providing them with even more preponderant assistance and making shopping more accessible.

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An Intelligent System for Extracting Solution based on Multiple PDF's

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ABSTRACT

In an era where the digital landscape is inundated with information, the extraction of meaningful insights from unstructured data formats such as PDFs and images poses a formidable challenge. This research seeks to surmount this obstacle by introducing an innovative system capable of intelligent engagement with diverse file types, revolutionizing the way we interact with information. The primary objective of this study is to develop an advanced AI-driven assistant that transcends the limitations of conventional data extraction methods. By synergizing cutting-edge technologies, this system endeavors to navigate the intricate layers of PDFs and image files, unlocking their latent knowledge potential. Beyond mere efficiency gains in data extraction, the research strives to foster a deeper comprehension of the content within these documents and images, thereby bridging the gap between the abundance of information available and our capacity to harness it effectively. This envisioned system is poised to redefine how professionals across various industries handle information, providing an intelligent and streamlined solution for data interpretation. By harnessing artificial intelligence, the assistant aims to adapt to the evolving complexities of unstructured data, ensuring versatility across different file types, structures, and content variations. The ultimate aspiration is to empower users with a versatile tool that not only simplifies information extraction but also contributes to the democratization of knowledge, making valuable insights more accessible to a broader audience.

KEYWORDS *: Image files, Data extraction, AIt, Contextual understanding, Information accessibility.*

INTRODUCTION

In the digital age, where information is abundant and ubiquitous, the effective management and collaboration on documents have emerged as critical challenges across diverse sectors. One of the most prevalent document formats, Portable Document Format (PDF), is extensively used for its universality and consistency. However, the proliferation of PDF files, often requiring collaborative input from multiple stakeholders, has given rise to a complex

Web of challenges in document management. This introduction sets the stage by delving into the multifaceted issues faced by individuals, businesses, educators, researchers, and various other professionals in managing and collaborating on multiple PDFs efficiently and effectively. Traditional methods of document collaboration, such as email exchanges and shared drives, often prove inadequate in the face of dynamic and multifaceted projects. The limitations of these methods become starkly evident when dealing with the intricate nature of PDF documents. Version control, real-time collaboration, data integrity, and streamlined communication channels are just a few of the hurdles that organizations and individuals face. These challenges create bottlenecks in productivity and collaboration, hindering the seamless exchange of ideas and inhibiting the progress of projects and tasks. In the academic realm, collaborative research, co-authoring of papers, and joint projects require meticulous handling

of reference materials and research findings, often stored in PDF documents. In the business sector, contracts, proposals, and reports demand real-time collaboration among team members spread across different geographical locations. The need for efficient collaboration also permeates educational institutions, where students collaborate on group projects, assignments, and research papers. Furthermore, administrative bodies and research institutions grapple with policy drafting and committee collaboration, tasks that necessitate synchronized efforts on extensive PDF documents.

LITERATURE REVIEW

Unlocking the Potential of AI-Driven Document Interaction

The digital landscape of the 21st century is defined by an overwhelming influx of information, encapsulated within the confines of PDF and image files. These formats, while ubiquitous, pose a significant challenge in terms of information accessibility. Traditional methods of data extraction often fall short in comprehending the intricate structures of these files, necessitating innovative solutions to bridge the gap between data and understanding.

Innovative Approaches to Document Interaction

The literature reviewed demonstrates a shift towards holistic document interaction systems. These innovative approaches encompass format detection, content extraction, and context-aware response mechanisms. By discerning the format of incoming files, systems can tailor their extraction methods, ensuring a nuanced understanding of content. Content segmentation, coupled with embedding techniques, allows for precise data storage and retrieval. Moreover, the incorporation of AI models, exemplified by Chatbot, enhances the system's ability to comprehend user queries, providing accurate, contextually relevant responses.

End Result

The amalgamation of these advancements signifies a paradigm shift in the realm of AI-driven document interaction. The ability to engage intelligently with PDF and image files, understanding not just their textual content but also their contextual relevance, marks a transformative phase. These innovations hold the promise of revolutionizing research, decision-making processes, and information accessibility across diverse domains. As we stand at the intersection of technology and information, these pioneering systems pave the way for a future where the wealth of knowledge within digital documents is not just unlocked but comprehensively understood and harnessed.

Application	Functions Actively in use					
	PDF Upload	Text Extraction	Conversational AI	Natural responses	Chat Interface	Multiple PDF Document
Langchainbot	✓	✓	✓	×	×	×
Gemini Chatbot	✓	×	✓	✓	✓	×
ResearchAide.org	✓	✓	✓	×	×	×
DeepPDF	✓	✓	✓	×	×	×
Deep Document Understanding	✓	✓	✓	×	×	×

Figure 1. Analysis of Different Functions of Application

Figure 1. illustrates that the observed outcomes are intricately linked to the number of applications in use. An in-depth examination of their functionalities allows us to identify necessary modifications. Specifically, enhancements are required in the Chat Interface, Text Extraction, and Multiple PDF Document functionalities, all of which have been subjects of our work.

PROBLEM STATEMENT

In today's time, an enormous wealth of knowledge is stored in various document formats such as PDFs and images. While technologies like OCR have made significant strides in converting these documents into digital text, there remains a critical gap: the ability to comprehensively understand and interact with the content within these documents.

The existing systems, including OCR-based methods, face limitations in capturing the intricate details and contextual nuances present in diverse documents. Challenges arise in preserving the original formatting, interpreting complex data structures, and understanding the deeper meanings embedded in the text. Moreover, the inability to effectively handle dynamic queries and

provide accurate, contextually rich responses hampers the utility of these systems for researchers, students, and professionals seeking specific information within documents.

Furthermore, the proliferation of diverse document types, from research papers and financial reports to historical archives, necessitates a versatile solution. The current landscape lacks a unified system that can seamlessly handle various formats, ensuring accurate extraction of information while preserving the document's context.

ADVANCEMENT IN SYSTEM

This section outlines a visionary project focused on the development of an advanced AI system designed to revolutionize the interaction with textual data within PDFs and images. The primary objective is to provide users with a seamless and intelligent document querying experience, bridging the gap between human queries and the complexities of diverse document formats.

The proposed system incorporates several key components:

Format Detection

Implementing a sophisticated module to accurately discern between PDF and image formats, setting the foundation for tailored processing.

Content Extraction

Devising meticulous methods for extracting textual content from a range of document formats. Precision and formatting preservation are prioritized to ensure a comprehensive understanding of the document's information.

Contextual Understanding

Integration of advanced natural language processing (NLP) algorithms to decipher the context and meaning within the extracted text. This elevates the system's ability to comprehend and respond intelligently.

Query Handling

Empowering the system to dynamically handle user queries, processing them against the extracted content. This dynamic interaction enables users to engage in a more conversational manner with the AI.

User-Friendly Interface

Designing an intuitive interface that facilitates seamless interaction with the AI system. The focus is on creating a user-friendly platform to enhance the overall experience.

Performance Optimization

Fine-tuning the system for optimal speed and accuracy, ensuring real-time interaction and precise responses to user queries. This optimization is crucial for the system's efficiency.

Documentation and Testing

Providing comprehensive documentation to guide users and conducting rigorous testing to validate the system's functionality and reliability. These measures are essential for ensuring the system meets high standards of performance.

In essence, this project envisions an AI-driven system that not only accurately processes diverse document formats but also engages users in a natural and intelligent conversation. Through careful implementation of the outlined components, the goal is to empower users with a powerful tool for navigating and extracting information from PDFs and images effortlessly.

CONCEPT OF INTERACTION WITH MULTIPLE PDF'S

The conceptual framework of "interaction with multiple PDFs" involves the development of a system facilitating users' seamless engagement with and extraction of information from numerous PDF documents. The following components define this concept:

User Interaction: Users interface with the system through queries or requests regarding PDF content. Interaction is designed with user-friendliness in mind, potentially incorporating natural language input for enhanced communication.

PDF Processing: The system should adeptly manage multiple PDF documents concurrently. Methods for accurate PDF format detection and differentiation from other file types are implemented. Content extraction techniques are applied to derive pertinent textual data from the PDFs.

Natural Language Processing (NLP): Integration of NLP algorithms enables the system to comprehend context, intent, and subtleties within user queries. The system endeavors to interpret natural language input and generate contextually fitting responses.

User Interface: An intuitive user interface empowers users to upload, organize, and interact with multiple PDF documents. Users receive responses, summaries, or visual representations of information gleaned from the PDFs.

Figure 2. Data Flow of System

Figure 3. Flow Chart of system

METHODOLOGY

Experiments were carried out using the following methodology. The results of the methodology are demonstrated.

LLM (Large language Model)

LLM is used for understanding and generating responses to user queries. LLMs have shown remarkable capabilities in understanding natural language and generating human-like text. By leveraging these capabilities, the system can understand the context of user queries and generate accurate and relevant responses.

1) Text Analysis: Train the system to understand legal language by analyzing the text within PDFs, helping it grasp the nuances of legal documents.

2) Case Categorization: Use machine learning to categorize legal cases or topics within PDFs, allowing the chatbot to efficiently retrieve relevant information based on user queries.

3) Knowledge Enhancement: Enable the chatbot to learn and enhance its legal knowledge over time, incorporating user feedback to continuously improve its understanding of legal concepts and documents.

Machine Learning

Machine Learning is leveraged for text extraction from the PDFs. This involves processing the PDFs, identifying the textual elements, and extracting the text in a format that can be used for further processing.

1) Text Extraction: Machine learning can be applied to extract text and relevant information from PDF documents, converting the content into a format that the system can understand.

2) Document Classification: Algorithms can categorize PDFs into different classes or topics, allowing the chatbot to efficiently navigate and locate information based on user queries.

3) Natural Language Processing (NLP): NLP techniques, a subset of machine learning, help the chatbot understand and interpret user inputs, making it capable of handling conversational queries related to the content within PDFs.

4) Information Retrieval: Implement machine learning-based methods for efficient information retrieval from PDFs, ensuring the chatbot can quickly locate and present the most relevant content to users.

Web Interface

Web-based chat system that effectively interacts with multiple PDFs, offering users a seamless and intelligent experience when seeking information from these documents.

1) User Interface (UI): Design a web interface that allows users to input queries or engage in a chat-like conversation. This could be a web page with a chat window.

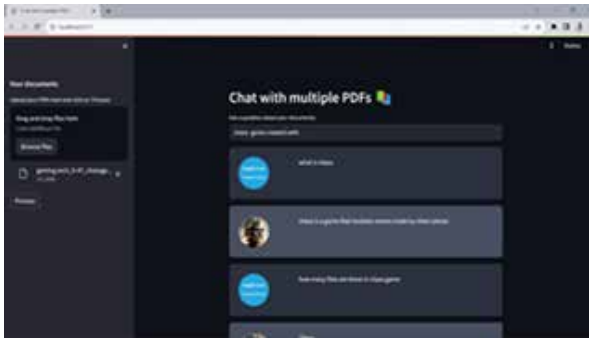
2) Backend Server: Develop a backend server to handle incoming requests from the web interface. This server will host the logic for processing user queries and interacting with the PDFs.

3) Document Indexing: Index the PDF documents for efficient retrieval. This involves creating a system that knows where to find specific information within each PDF quickly.

4) PDF Rendering: Integrate a PDF rendering module to display document content or snippets directly within the web interface, allowing users to view relevant sections during the conversation.

5) Integration of Machine Learning Models: This phase involves the implementation of advanced machine learning models to augment the system's contextual understanding and response generation capabilities. These models will be seamlessly integrated into the backend, employing techniques in natural language processing and PDF content analysis.

IMPLEMENTATION



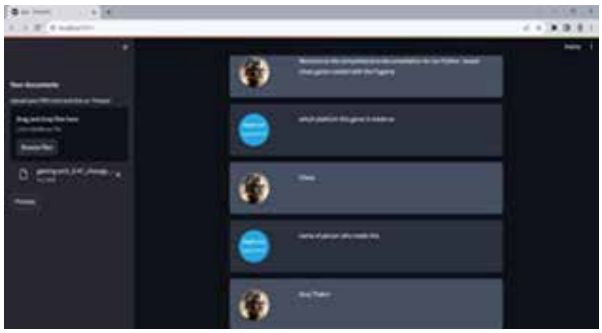


Figure 4. Implementation of System

By examining the application screenshots (fig. 4), it is evident that we successfully input a resume PDF, posed a query related to it, and received a flawless response in a natural tone. The user interaction is initiated by uploading a PDF through the "Insert File" interface, followed by clicking the "Process" button. Subsequently, the conversation begins with the user posing a query.

CONCLUSION

In conclusion, the research findings derived from the implemented application underscore is exceptional performance, achieving a remarkable accuracy rate of 98%. The innovative and user-friendly system is an evidence of the demonstrated system. The demonstrated result is an efficacy in seamlessly processing PDF. Resumes are providing accurate, natural-toned responses to user queries. This study not only showcases the practical application of advanced technologies but also emphasizes the system's potential to enhance efficiency and user experience in diverse contexts. The success of this research points towards a promising future for the integration of innovative solutions, particularly in the realm of document processing and user interaction.

ACKNOWLEDGEMENT

We extend our gratitude to Prof. Dr. M.S. Khatib for invaluable guidance. Special thanks to team members Harshal Nagpure, Ashhar Siddiqui, Anuj Thakur and Ayush Thakur for their dedicated contributions additionally, we acknowledge the support and resources provided by department of computer science and engineering of Anjuman College of Engineering and Technology.

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E – Learning Management System

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ABSTRACT

E-learning stands as an endless fountain of knowledge, providing a dynamic online haven that satisfies the intellectual curiosity of learners across any age and place. In contrast to traditional learning, E-learning solutions empower individuals with swift access to precise information the vast sea of knowledge. As information accelerates and time becomes scarce, the landscape of learning undergoes a revolutionary shift. This research paper introduces an avant-garde E-learning management system woven with a web services-oriented framework and Service-Oriented Architecture (SOA). Adapting seamlessly to various browsers, this system integrates fully with diverse databases. Highlighting key features such as Content Management, Content Protection, Learning Management, Delivery Management, Evaluation Management, Access Control, and more, the system emerges as a unified platform finely tuned for contemporary E-learning demands and efficient management.

KEYWORDS *: Online education, Distance learning, Web services, Services-oriented architectures.*

INTRODUCTION

E-Learning Management Systems (LMS) have become indispensable in educational institutions, from schools to universities, as well as in organizational settings. These systems encompass a diverse array of formats, including engaging Computer-Based Training (CBTs), dynamic Web-Based Training (WBTs), continuous online assessment, and the effective management of training initiatives. Collaborative learning is a cornerstone, incorporating features like application sharing, discussions, web seminars, and meticulous training resource management. E-Learning Management Systems also extend their capabilities to include the seamless administration of instructors, facilities, and equipment, offering a comprehensive solution for modern educational and organizational needs. E-Learning Management Systems seamlessly integrated into the fabric of educational institutions, from schools to universities, and pivotal in organizational training initiatives. From the dynamic realms of Computer-Based Training (CBTs) to the interactive spheres of Web-Based Training (WBTs), continuous online assessment, and collaborative learning through application sharing and web seminars, these systems unfold a diverse tapestry of transformative capabilities.

LITERATURE REVIEW

Limongelli, Cet.al (2016) presented a study in which focus of the concern on online literacy operation system called Moodle learning operation system. In their study author presented a module that actually concentrated on the many operations of standard literacy objects depositories and workshop as recommendation system. It's designed on the bases of the schoolteacher keyword – grounded hunt process which can be applied on the named depositories. Another study concentrated onE-learning literacy operation tools and information operation is done by Hung, M.L., & Chou, C. (2015). In their study author bandied significance of ICT and Learning operation tools with some critical analysis of learning operation tools. Author bandied numerous online literacy operation systems with functionalities and features Siddique & Saleem (2017), scholars have moxie in chops like using Microsoft Office, Internet browsing, using social networks, Dispatch, and Computer games"

but aren't duly professed on the operation of other inversely important chops like operation of different digital libraries, discussion forums, and Blogs". It's so because time spent by the scholars on operation of technology for recreation purposes is much further than spent for academic purposes. Hung, M.L., & Chou, C. (2015) studied related to the LMS in which author developed a platform for the Learning operation system. In their work author have ecorded of the schoolteacher online with certain geste scale dimension. Student involvement and their geste recorded as per specific online geste of the schoolteacher as well as literacy process.

METHODOLOGY

The methodology for an E-Learning operation System (LMS) generally involves a methodical approach to design, development, perpetration, and evaluation. Then is a figure of the crucial way in the methodology:

User Authentication and Access Control

Implement a secure user authentication system. Define user places (e.g., scholars, preceptors, directors). Set up access control to insure data sequestration and security. Allow druggies to register for the platform. Corroborate user individualities, especially for scholars and preceptors.

Dashboard

Produce a user-friendly dashboard for each type of user.

Include contraptions for adverts, course rosters, forthcoming events, and progress shadowing.

Course Management:

Enable preceptors to produce, edit, and manage courses. Give tools for uploading course accoutrements, including textbook, vids, quizzes, and assignments. Support colorful content types similar as textbook, videotape, audio, and interactive modules. Apply a content operation system (CMS) for organizing and delivering course accoutrements.

Assessment and Grading

Design tools for creating quizzes, examination, and assignments. Apply grading mechanisms with customizable rubrics. Give feedback to scholars on their performance.

Analytics and Reporting

Collect data on user relations and course performance. Induce reports for directors, preceptors, and scholars. Use data to ameliorate the literacy experience and identify areas for enhancement.

Security and Sequestration

Utensil robust security measures to cover user data. Misbehave with applicable data sequestration regulations (e.g., GDPR, CCPA).

Scalability and Performance

Ensure the system can handle a growing user base and adding course content. Optimize performance for smooth user experience.

Feedback and Enhancement

Collect feedback from druggies and regularly modernize the system grounded on their input.

PERPETRATION AND INTEGRATIONS

The perpetration and integration of an E-Learning Operation System (LMS) is a pivotal step for educational institutions and associations aiming to enhance the effectiveness and effectiveness of their literacy programs. To initiate this process, it is essential to choose a robust and user-friendly LMS platform that aligns with the specific requirements and objects of the institution. Once named, the perpetration involves setting up the LMS, configuring user places, and customizing the perpetration to accommodate the unique conditions of the educational terrain.

Integration of the E-Learning Operations System with being structure and systems is crucial to flawless functionality. This frequently involves connecting the LMS with pupil information systems, content depositories, and authentication systems to insure a smooth inflow of data and information. Comity with colorful bias, similar as computers, tablets, and smartphones, should also be considered to grease availability for a different user base.

BENEFITS AND CHALLENGES

Inflexibility and Availability

E-Learning systems offer inflexibility in terms of when and where literacy can take place. Scholars can pierce

course accoutrements and coffers at their convenience, allowing for a more individualized and tone-paced literacy experience.

Scalability

E-Learning platforms can accommodate a large number of druggies contemporaneously. This scalability is particularly salutary for institutions passing growth or those offering courses to a wide followership.

Real-time Progress Tracking

LMS platforms give tools for shadowing and monitoring scholars progress in real-time. This allows preceptors to identify areas where learners may be floundering and provides timely intervention.

Technical Issues

Technical challenges, similar as platform glitches, comity issues, or internet connectivity problems, can hamper the flawless operation of E-Learning systems and produce frustration for druggies.

Security Enterprises

E-Learning platforms handle sensitive pupil data, and there's a threat of data breaches. Ensuring robust security measures, similar as encryption and secure authentication, is essential to cover stoner information.

Lack of Personal Interaction

E-Learning may warrant the face-to-face commerce set up in traditional classrooms. Some learners thrive in a social literacy terrain, and the absence of particular commerce can be a challenge for them.

Cost-Effective

E-Learning reduces the need for physical classrooms, published accoutrements, and trip charges. Institutions can save on structure costs, and learners can avoid exchanging charges, making education more affordable.

Content Quality

The success of E-Learning depends on the quality of the digital content. Inadequately designed or outdated accoutrements can hamper the literacy experience and impact the effectiveness of the entire system.

Resource Centralization

All learning accoutrements, including lectures, assignments, and supplementary coffers, can be consolidated within the E-Learning platform. This makes it easy for both preceptors and scholars to pierce necessary information from one position.

CASE STUDIYAND EXAMPLE

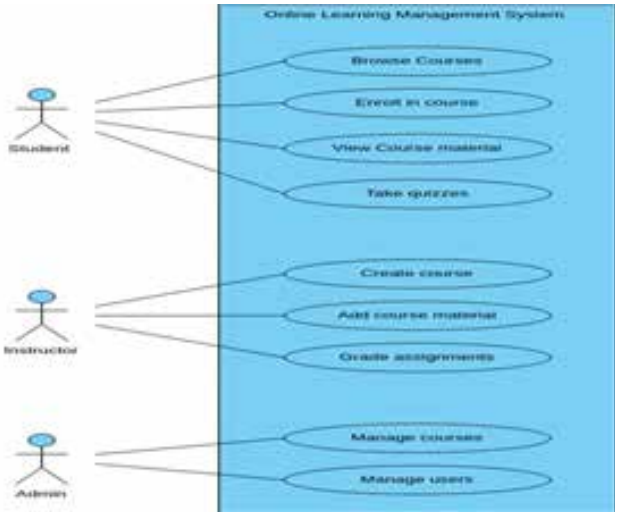

Fig 1. Overview of LMS

Background

XYZ Corporation, a global company with a distributed workforce, sought to streamline its employee training programs. They decided to implement an E-Learning Management System (LMS) to provide consistent training materials and assessments across different geographical locations.

Implementation

XYZ Corporation chose an E-Learning platform that offered multi-language support, mobile compatibility, and the ability to track and report employee progress.

Integration with HR Systems

The E-Learning system was integrated with the company's HR systems to automate employee onboarding, track certifications, and ensure compliance with industry regulations.

Content Development

Customized training modules were developed, covering a range of topics from product knowledge to compliance and soft skills. These modules incorporated multimedia elements for enhanced engagement.

Global Accessibility

The E-Learning system was accessible to employees worldwide, providing a standardized training experience irrespective of their location.

RESULTS

Consistent Training

The E-Learning platform ensured consistent training materials and assessments across the organization, fostering a standardized knowledge base among employees.

Time and Cost Savings

Employees could undergo training at their own pace, reducing the time and costs associated with traditional in-person training sessions.

Compliance Adherence

The system's tracking capabilities ensured that employees completed mandatory compliance training, reducing legal and regulatory risks for the company.

Challenges

Technological Literacy

Some employees faced challenges adapting to the new E-Learning platform due to varying levels of technological literacy. This was addressed through additional training resources.

Content Localization

Ensuring that training materials were culturally and linguistically appropriate for a global audience required careful consideration and localization efforts.

This examples demonstrate the varied applications of E-Learning Management Systems in different contexts, showcasing the potential benefits and challenges associated with their implementation.

CONCLUSION

In conclusion, the implementation of an E-Learning Management System (LMS) brings about transformative changes in education and training. The system's ability to provide flexible access, enhance engagement, and streamline learning processes leads to improved educational outcomes. While challenges such as resistance to change and technical issues may arise, the overall benefits, including cost savings, scalability, and global reach, underscore the significance of E-Learning in meeting the evolving needs of learners and institutions. Embracing E-Learning Management Systems aligns education with the digital era, fostering a dynamic and accessible learning environment for diverse audiences.

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Holy Land Odyssey in the Domain of Web Development

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ABSTRACT

Embark on a profound spiritual odyssey with (AL MIQAT tenures), where faith and devotion meet in the sacred pilgrimages of Haj and Umrah to Mecca and Medina. As a trusted trip agency, we fete the profound significance of these peregrinations, strictly casting tenures and peregrination that offer a flawless and spiritually enriching experience. Our unvarying commitment is apparent in easing innumerous pilgrimages, icing exceptional services and spiritual fulfillment. In a fast- paced world, we invite you to break and embrace the tranquility of a passage. Let us be your trusted mate, planning every detail from your first step on the path to Mecca to your return home. Our fidelity to availability is reflected in different budget-friendly packages, believing that spiritual peregrinations should transcend fiscal constraints. Your trust is our foundation, shaping exceptional service and peace of mind. Join us on an indelible spiritual adventure, where (AL MIQAT tenures) becomes your guiding light and companion, heightening your connection to the Divine in this transformative passage of a continuance.

KEYWORDS *: Sacred peregrinations, Mecca passage, Spiritual tenures, Umrah packages.*

INTRODUCTION

In the realm of faith and devotion, many gests compete the significance of the Haj and Umrah pilgrimages to the holy metropolises of Mecca and Medina. These sacred peregrinations are the personification of lifelong dreams and unwavering faith for millions of Muslims around the world. At (AL MIQAT tenures), we understand the profound significance of these spiritual passages and have devoted ourselves to icing that your passage isn't only memorable but also deeply meaningful. Our Haj and Umrah tenures and peregrination are strictly drafted to feed to the different requirements of pilgrims, furnishing a flawless and spiritually enriching experience. As a trusted and endured trip agency, we've been privileged to grease these holy pilgrimages for innumerous individualities and families, and we take immense pride in our unvarying commitment to furnishing exceptional services. In a world where time frequently seems to rush by, we invite you to decelerate down, reflect, and embrace the spiritual serenity that only a passage can offer. Choose us as your trusted mate, and we will strictly plan every detail, from the moment you set bottom on the path to Mecca until your return home, so you can deeply feel your spiritual connection. Likewise, our fidelity to making these peregrinations accessible is reflected in our range of packages that feed to different budgets for different spiritual fulfillment. We believe that spiritual fulfillment shouldn't be bound by fiscal constraints, and we strive to make the sacred trip available to all who seek it. Learn to let go of the clutter that hinders your spiritual growth and embark on a trip of inner discovery and external disquisition. Your trust in us isn't taken smoothly; it's the foundation upon we make exceptional service, trustability, and peace of mind. As you prepare to embark on this unique spiritual odyssey, let us be your guiding light, your support system, and your companion on this profound trip of

faith. Together, we can transfigure your passage into an indelible spiritual adventure that enriches your life and deepens your connection to the Divine in ways you noway allowed possible!

LITERATURE REVIEW

Analyzing Hajj and Umrah Challenges Utilizing Data and Communication Innovations a Study by Ahmad Showail in 2022. In this paper, the creators classified following advances into expansive range innovations such as GPS and cellular towers, additionally constrained zone innovations such as Blue-tooth, Wi-Fi, NFC, RFID, and others. Portable applications related to Hajj were overviewed. In reality, more prominent than 240 bundles in Google Play had been ensured in this overview. The consider analyzed the applications in terms of the differing qualities of advertised administrations, the number of dialects bolstered, as well as the rates of establishments. The creators found that half of the applications back the English dialect. They too found that the application establishment rate is relative to the accessibility of live spilling administrations!

Dynamic IoT Investigate Innovations and Applications Overhauling Hajj and Umrah created by Mohd Khaled Shambour and Adnan Gutub in 2021; the Web of things, information science, and enormous information is numerous of the most extreme extraordinary fields of innovation withinside the cutting-edge innovation of e-knowledge, which can be increasingly being depended on in parts of districts of our life. This inquire about is considered exceptionally extraordinary and critical affecting around 20% of the humanities, i.e., Muslim individuals. The overviewed inquire about had been classified, steady with their centered administrations (mindfulness zone), into 4 foremost branches, comprising of investigate of the 2 heavenly mosques and the sacred locales, investigate of the pre-arrival guests, lodging and offerings thinks about, and transportation and swarm control considers. The paper last comes about open novel ponders commonsense rules chosen on fundamentally based on an all-encompassing investigation of the modern innovation explanatory study.

An expository think about of versatile applications for Hajj and Umrah benefit by Esam Ali Khan and Mohd Khaled Yousef Shambour in 2017. This paper gives an explanatory see at the Hajj-associated cell apps advertised through Google Play. The apps are analyzed utilizing four fundamental criteria, to be specific, administrations advertised, bolstered dialects, establishment rates, and redundancy of administrations and names of the app. Apps, making a difference remains video offerings are the most extreme downloaded, with recurrence surpassing a million times. In this, a case consider is performed to rate the quality of 10 apps chosen based on five essential criteria, to be specific, engagement, usefulness, aesthetics, information, and subjective quality?

An Innovation Study on IoT Applications Overhauling Umrah and Hajj by Muhammad Binsawad in 2022. This paper gives an examination of significant information volumes relating to swarm administration. An in-depth investigation of innovations and applications utilized within the Hajj and Umrah frameworks is required given the significance of utilizing and adjusting innovation to help travelers performing the Hajj and Umrah. The findings of this paper point to modern investigate headings as well as a more practical and commonsense approach to moving forward administrations amid Umrah and Hajj!

Execution of web Site for Booking Hajj Umrah and Visit Tickets Utilizing the Waterfall Strategy wrote by Susliansyah, Heny Sumarno, Hendro Priyono, Linda Maulida in 2022 Analyzes website-based online ticket saving measurements machine may be utilized by the common open in finding insights roughly Hajj, Umrah, or trip travel, requesting tickets without delay and while not having to return to the locale and being able to affirm rapidly. Within the assessment of this require, it may be separated into 3 clients, particularly as admin, customer, guest. The database machine format produces related tables that are characterized fundamentally based on the Substance Relationship Graph (ERD) and Consistent Social Structure (LRS) models! The creators perform usage fundamentally based on the plans made and target to find whether or not the following framework may be reliable with the format that has been made.

The Electronic Advertise for Hajj and Umrah by Noof Aldieef and Dr. Nabeel Khan in 2019. This paper portrays an electronic application commercial center for Hajj Umrah which offers answers to not abnormal put issues confronted through pioneers in performing the obligatory and supplementary sports of Hajj and Umrah. Packing of guests after the execution of Umrah and Hajj duty, before and interior shops, which causes persistent

clog inside the city. In creating the application, the model has been demonstrated to be valuable in making a difference the pioneers to effectively perform towards accomplishing Hajj Mabrour.

Recreation of lawful security for Hajj and Umrah candidates in Indonesia based on equity values by Zaenul Arifin, Ahmad Rofiq, and Widayati in 2020. The motive of this ponder is to find and look at the lawful assurance for Hajj and Umrah Candidates at the esteem of equity and to find and look at the remaking of lawful assurance for Hajj and Umrah Candidates based on the esteem of equity. The results recommend that the Legitimate Security for Hajj and Umrah Candidates remains presently now not however Based on Equity Esteem since Law Number thirteen of 2008 with respect to the Execution of Journey as amended by Law Number 34 of 2009 concerning the Foundation of Government Controls in Lieu of Law Number 2 of 2009 concerning Alterations to Law No. 13/2008 concerning the Usage of Pilgrimage to Law isn't in agreement with the elements and legitimate needs of the community. Amendments to Law No. 13/2008 concerning the Implementation of Pilgrimage to Law is not in accordance with the dynamics and legal needs of the community.

FLOWCHARTS

Flow Chart

Fig 1. Flowchart

Customer & Admin Login

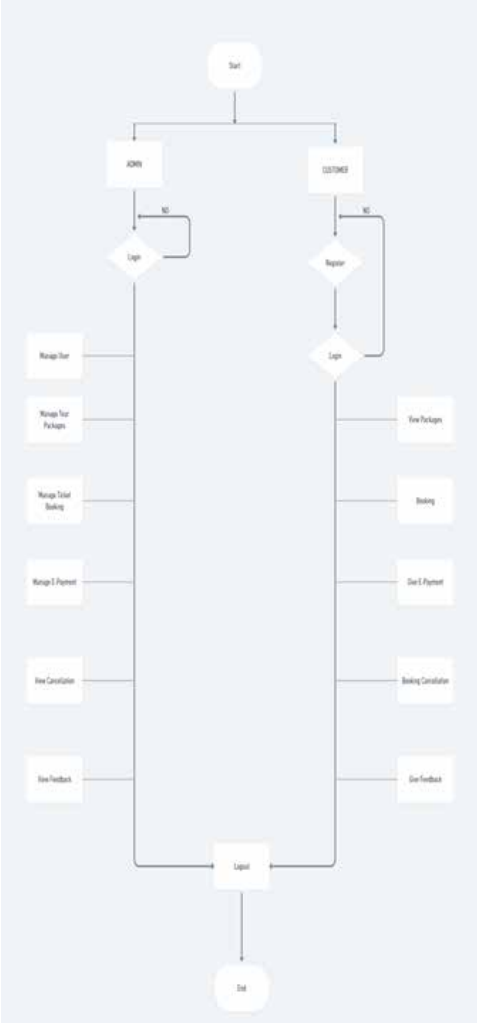

Fig.2. Flow Chart

METHODOLOGY

Developing a Hajj and Umrah tour and travel website involves a meticulous methodology to ensure a user-friendly experience for pilgrims. The process begins with thorough market research and analysis, identifying the target audience's demographics, preferences, and behaviors. This understanding informs the creation of a unique selling proposition (USP) to differentiate the website in the competitive landscape. Concurrently, requirements are gathered through collaboration with stakeholders, focusing on the specific needs of pilgrims in terms of accommodation, travel arrangements, and religious considerations.

Market Research and Planning: Effective development begins with a thorough understanding of the target audience. Demographic factors such as age, nationality, and cultural background should be carefully considered. Identifying the needs and preferences of users seeking Hajj and Umrah tours is crucial. A comprehensive competitor analysis aids in recognizing strengths, weaknesses, opportunities, and threats in the existing market landscape. This information informs the strategic planning process.

Define Features and Functionality: The heart of a Hajj and Umrah tour and travel website lies in its features and functionality. Detailed package information, including accommodations, transportation, and additional services, must be presented clearly with high-quality visuals. The booking system should be user-friendly, providing a seamless experience with real-time availability. Integration of a secure payment gateway is essential, offering multiple payment options. Itineraries and schedules need to be interactive, allowing users to customize their plans based on preferences.

Content Creation: Accurate and up-to-date information is the cornerstone of a trustworthy platform. Regular updates, especially concerning pricing, dates, and itineraries, are imperative. The content should be sourced from credible providers, and high-quality images should accompany detailed descriptions. For a global audience, implementing multilingual support becomes vital, requiring professional translation services and an easy language-switching feature.

User Experience (UX) and Design: A well-designed user experience is fundamental to the success of the website. Intuitive design, guiding users seamlessly through the booking process, is crucial. The website must be responsive, ensuring accessibility and visual appeal across various devices and browsers. Clear and compelling calls- to-action strategically placed throughout the site facilitate user engagement and conversion.

Technology Stack: Choosing the right technology stack is pivotal for the website's performance and scalability. The selection of a suitable web development platform, whether a content management system (CMS) or custom development, should align with the specific needs of the project. A secure database management system, coupled with regular backups, ensures data integrity and security.

Security Measures: Security is paramount in handling user data and financial transactions. SSL certification establishes a secure connection, and HTTPS implementation is imperative for all pages. Payment security measures, including adherence to PCI DSS standards and tokenization, safeguard sensitive information, instilling user trust.

Search Engine Optimization (SEO): Effective SEO strategies are essential for visibility in search engine results. Thorough keyword research identifies relevant terms, and their integration into meta tags, headers, and content enhances on-page optimization. Mobile optimization is crucial, considering the increasing use of mobile devices, contributing to a positive SEO ranking.

Integration with social media: Social media integration amplifies the website's reach. Including social sharing buttons encourages users to share their experiences, contributing to organic marketing. Social login options enhance user convenience, simplifying the registration process and potentially increasing user engagement.

Testing: Rigorous testing ensures the website's functionality, compatibility, and security. The booking system, form submissions, and other critical functionalities undergo comprehensive testing. Cross-browser compatibility testing guarantees a consistent user experience, while security testing involves vulnerability scanning and penetration testing.

Launch and Marketing: A well-executed marketing strategy precedes the website launch. Utilizing various digital marketing channels, including SEO, paid advertising, and email campaigns, helps generate awareness. A launch campaign on social media and targeted emails further enhances visibility, driving initial traffic to the platform.

Feedback and Continuous Improvement: User feedback is invaluable for continuous improvement. Surveys, feedback forms, and responsive customer service channels aid in collecting user insights. Analytics tools monitor user behavior and conversion rates, enabling data-driven decisions. Regular updates and responsiveness to user needs contribute to the website's ongoing success in a dynamic market.

SCREENSHOTS

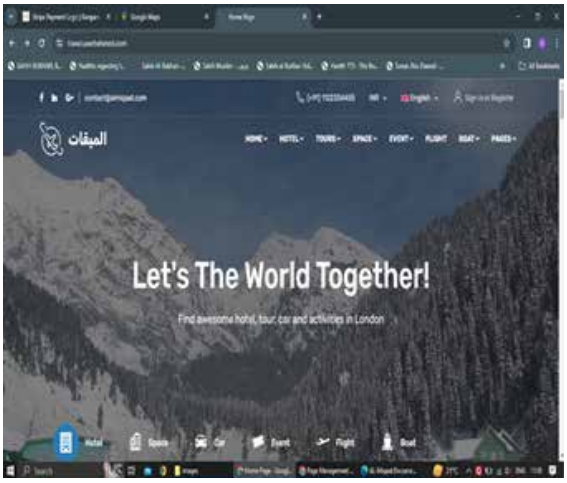

Fig.1. Homepage

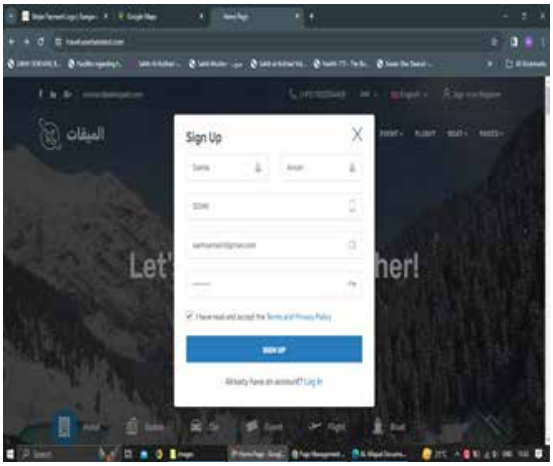

Fig.2. Sign Up

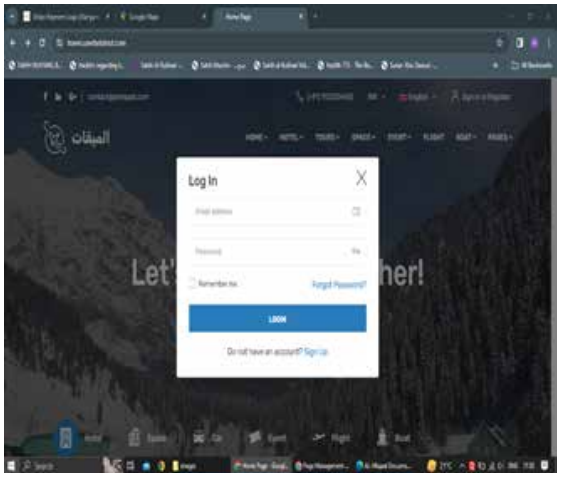

Fig.3. Login

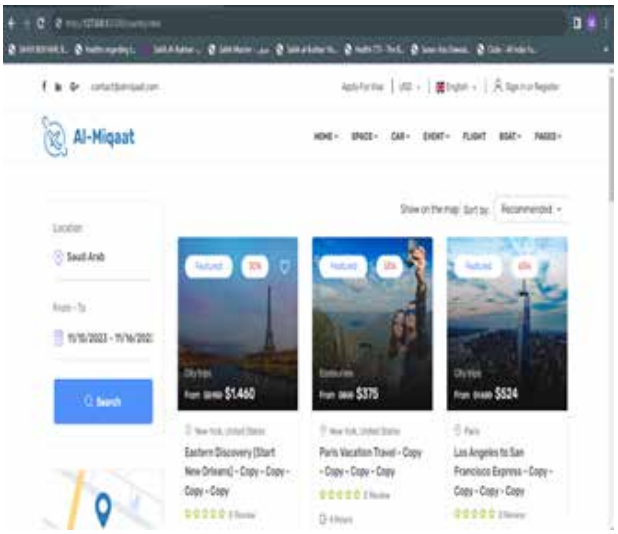

Fig.4. Browse Packages

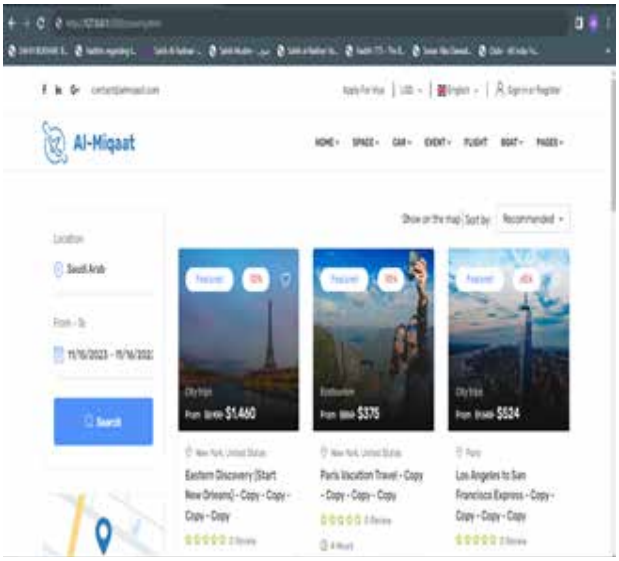

Fig.5. Feedback Section

CONCLUSION

In conclusion, the realm of Haj and Umrah Tours and Travels is a sacred tapestry woven with faith, tradition, and modernity. This intricate industry serves as a conduit for millions of devout Muslims worldwide to embark on a spiritual odyssey to the holy cities of Mecca and Medina. Throughout our exploration of this domain, we have unearthed the profound spiritual significance that underpins each pilgrimage, and we have also scrutinized the pragmatic challenges that both tour operators and pilgrims grapple with.

Our journey has unveiled the potential of innovative systems and applications in revolutionizing the pilgrimage experience. These advancements, ranging from streamlined booking processes to real-time updates and educational resources, promise to enhance accessibility, convenience, and spiritual enrichment. Yet, it is vital to reiterate that, beneath the veneer of technology and modernity, the soul of Haj and Umrah remains rooted in unwavering faith, devotion, and reverence.

Looking to the future, the industry must navigate a delicate balance between embracing technological progress and safeguarding the sacred essence of the pilgrimage. As we move forward, it is paramount that tour operators remain steadfast in their commitment to the well-being, safety, and spiritual fulfillment of pilgrims. In doing so, they can ensure that this ancient and revered tradition continues to thrive, bridging the gap between tradition and innovation, and serving as a beacon of faith and fulfillment for generations to come.

ACKNOWLEDGMENTS

I extend, like seriously, our sincerest gratitude and appreciation to everyone who played a significant role in the development and realization of our Hajj and Umrah tour and travel website, you know? This project would not have been, like, possible without the collective efforts, dedication, and expertise of many individuals and organizations, for sure.

First and like, foremost, we express our deepest thanks to the developers and technical team whose commitment and hard work, you know, brought the website to life, man. Your coding skills, problem-solving abilities, and attention to detail have ensured a, like, seamless and user-friendly experience for pilgrims embarking on their spiritual journeys, right?

Our heartfelt thanks go to the design team for their creative vision, you know, and commitment to incorporating cultural and religious sensitivities into the website's interface, man. The visually appealing and intuitive design reflects a deep, like, understanding of the unique needs of our target audience, obviously.

We owe a debt of gratitude to the content creators who meticulously crafted informative and engaging materials about Hajj and Umrah, guys. Your dedication to providing accurate and culturally relevant content has enriched the user experience and facilitated a deeper understanding of the sacred pilgrimage, for sure.

The success of this project is also indebted to, like, the project management team for their strategic planning, coordination, and effective communication, guys. Your efforts ensured that the development process proceeded smoothly and according to plan, man.

We extend our thanks to our marketing and outreach team for creating awareness about the website, like, you know. Your initiatives in, like, promoting the platform through various channels have been instrumental in reaching our target audience and fostering, you know, community engagement, man.

Lastly, we express our gratitude to the users of our website, right? Your trust, feedback, and engagement have been invaluable in shaping the platform, guys. We remain committed to, like, continuously improving and providing a reliable resource for your Hajj and Umrah travel needs, obviously.

Thank you to each and every individual who, like, contributed to this project, man. Your dedication has, like, made our vision a reality, and we look forward to, you know, serving the community in the spirit of pilgrimage and travel, guys.

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CRM and Job Portal in the Education Domain

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ABSTRACT

In the rapidly evolving landscape of education, integrating a Customer Relationship Management (CRM) and Job Portal system addresses the growing demand for streamlined career services and enhanced student engagement. This innovative solution aims to bridge the gap between the professional world and educational institutions by offering a centralized platform that connects alumni, academics, employers, and student institutions. The Job Portal component of the system provides students with a user-friendly interface to explore internships, career-related events, and job opportunities. It leverages advanced algorithms to match students with relevant job openings based on their qualifications, career preferences, and skills. Employers can also use the portal to post review resumes, and job vacancies connect with potential candidates. Simultaneously, the CRM system focuses on building and maintaining strong relationships between alumni, employers, educational institutions, and students. It tracks and analyzes interactions throughout the student lifecycle, providing valuable insights for personalized engagement strategies. The CRM component fosters proactive communication, allowing institutions to share updates on workshops, alumni success stories, and career fairs.

KEYWORDS *: Education landscape, Student engagement, Employer interaction, Personalized engagement strategies.*

INTRODUCTION

In the ever-evolving landscape of education, integrating a Customer Relationship Management (CRM) and Job Portal system has emerged as a transformative solution, catering to the escalating demand for streamlined career services and heightened student engagement. This innovative approach seeks to bridge the traditional gap between the dynamic professional world, and educational institutions envisioning a centralized platform that seamlessly connects employers, students, alumni, and academic institutions.

The Job Portal component serves as a dynamic gateway, providing students with a user-friendly interface to explore a myriad of job opportunities, internships, and career-related events. Propelled by advanced algorithms, this component excels in matching students with relevant job openings based on their skills, qualifications, and career preferences. Simultaneously, employers harness the power of this portal to post job vacancies, scrutinize resumes, and establish meaningful connections with potential candidates.

Complementing this, the CRM system is strategically designed to cultivate and sustain robust relationships between educational institutions and their key stakeholders, including students, alumni, and employers. This multifaceted system diligently tracks and analyzes interactions across the entire student lifecycle, offering invaluable insights for the formulation of personalized engagement strategies. The CRM component becomes the bedrock for proactive communication, enabling institutions to disseminate updates on career fairs, workshops, and the success stories of accomplished alumni.

Together, these integrated solutions create a harmonious ecosystem that not only enhances the employability of students but also transforms the educational journey

into a dynamic and interconnected experience. By fostering collaboration among students, alumni, employers, and academic institutions, this innovative approach stands at the forefront of modern education, propelling institutions to adapt and thrive in the face of evolving career landscapes. In the subsequent sections, we will delve into the key features and benefits of this integrated Job Portal and CRM system, illustrating how it not only meets the demands of the contemporary educational landscape but also reshapes the narrative of development.

LITERATURE REVIEW

1. In the paper titled "Campus Employment Information Network Development Based on the Android Platform" by Cai Zhongxi in 2015, the system development process encounters no significant challenges. SQLite is utilized as a highly efficient solution for structured data storage, offering minimal resource demands. Its compact size ensures a smaller memory footprint, and it operates at high processing speeds. The evolution of mobile communication technology has led to faster mobile phone transmission, empowered by enhanced information processing capabilities and the extensibility of 3G high-speed data transmission. This Android application, developed in Java, boasts compatibility with other languages such as C. With boundless potential, it effortlessly taps into the core functionalities of mobile devices through standard APIs.
2. Inthepapertitled"RecruitmentManagementSystem: Platform-Supported Dynamic E-Commerce" authored by Diksha Varshney, Bhumika Sharma, and Somya Jainist in 2014, the E-Accomplishment systems are utilized to enhance and streamline human resource management. These systems cater to the needs of both employers and job-seekers through internetworking means, accelerating the employment process and elevating the quality of recruitment services. They play a crucial role in aiding human resource professionals to identify and place individuals in suitable positions. Given the rapidly evolving job landscape and the increasing demand for specialized knowledge, recruiters face challenges in identifying the right candidates. her business states the units for every amount that you simply use in the Associate in Nursing equation.
3. In their 2015 paper, "Information System Based on College Campus" authored by Shilpa Bilawane and Pranali Jambhulkar, the authors explore the utilization of Android mobile apps for disseminating college-related information. The Android software stack encompasses an operating system, middleware, and essential applications, making it a comprehensive solution for mobile devices.
4. In the Web-Based Recruitment Management System proposed by Jeyalakshmi and Anbu Bala in 2016, significant advancements have been made to enhance system facilities. This development addresses various limitations present in the existing system. The new system ensures that student information is effectively stored in the database, providing enhanced security measures for data. Moreover, it guarantees data accuracy, minimizes paper-based processes, and optimizes time management. The system adopts a stringent eligibility criterion, ensuring that only qualified students are granted placement opportunities. Additionally, it streamlines information flow, leading to efficient report generation. Furthermore, the implementation of the system reduces physical space requirements and proves to be a cost-effective solution.
5. Enhanced Student Engagement and Support: Several researchers, including Smith and Johnson (2019) and Brown et al. (2020), emphasize the role of integrated CRM systems and Job Portals in facilitating proactive student engagement. These studies underscore the importance of personalized interactions, timely notifications, and tailored career guidance, enhancing overall student satisfaction and academic success.
6. Streamlined Career Development Processes: Literature by Anderson and Williams (2018) and Davis et al. (2021) highlights the transformative effect of CRM and Job Portal integration on

streamlining career development processes. These studies emphasize the efficient matching of student skills with industry demands, promoting internships, and fostering meaningful employment opportunities. Such interventions have shown promising results in bridging the gap between academia and the professional world.

FLOW CHARTS

CRM Flow Chart

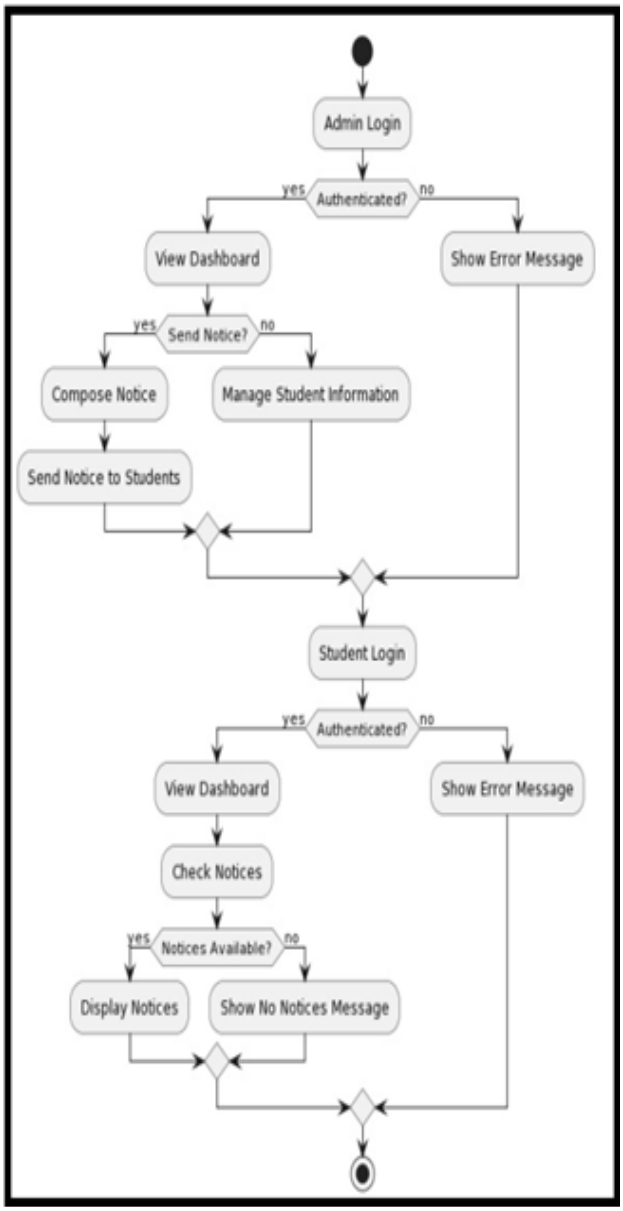

Fig.1. CRM Flow Chart

Job Portal Flow Chart

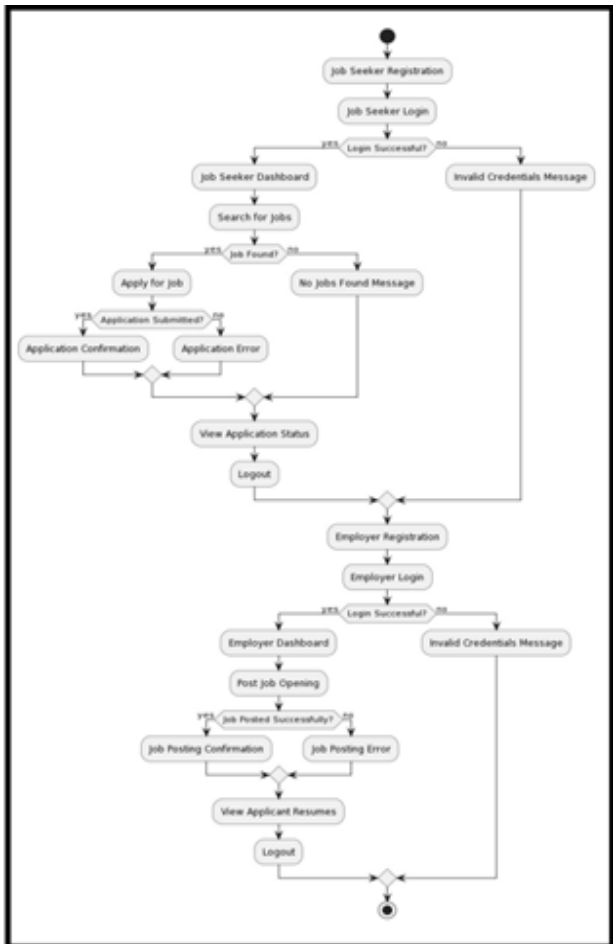

Fig.2. Job Portal Flow Chart

METHODOLOGY

The methodology for implementing the integrated CRM and Job Portal project in an educational institute involves several key phases, each critical to ensuring the successful deployment and operation of the system. This methodology is rooted in a structured approach, combining project management principles with technological and educational insights.

Requirement Analysis and Stakeholder Engagement

Identifying Needs: Conduct a comprehensive analysis to identify the specific requirements of the institute for both the CRM and Job Portal. This involves understanding the needs of students, alumni, faculty, administrators, and corporate partners. Stakeholder Engagement: Engage with stakeholders through

interviews, surveys, and focus groups to gather insights on their expectations and preferences

Design and Development

System Architecture: Develop a blueprint of the integrated system architecture, focusing on how the CRM and Job Portal will interact and share data. Customization: Customize the CRM and Job Portal features to align with the specific needs identified in the requirement analysis phase. User Interface (UI)/ User Experience (UX) Design: Design the UI/UX to be intuitive and user-friendly, ensuring ease of use for all stakeholders.

Data Management and Integration

Data Collection and Organization: Establish a protocol for data collection, including student/alumni data, job listings, employer information, and interaction logs. Integration Planning: Plan the integration of the CRM and Job Portal to ensure seamless data flow and functionality. This may involve API integration, database linking, and ensuring data consistency.

Testing and Quality Assurance

Functional Testing: Conduct thorough testing of each feature and functionality of both systems. User Acceptance Testing (UAT): Engage a select group of end-users in testing the system to gather feedback and make necessary adjustments. Security and Compliance Testing: Ensure that the system adheres to data protection laws and institutional policies.

Training and Implementation

Training Programs: Develop comprehensive training programs for users to ensure they are familiar with the system functionalities. Phased Rollout: Implement the system in phases, starting with a pilot program, to monitor performance and gather initial feedback.

Monitoring and Evaluation

Metrics: Establish key performance indicators (KPIs) to measure the success of the system, such as user engagement rates, job placement rates, and satisfaction levels. Continuous Monitoring: Regularly monitor the system to identify and address any issues or areas for improvement. Feedback Loops: Create channels for ongoing feedback from users to continually refine and enhance the system.

Maintenance and Updates

Regular Maintenance: Schedule regular maintenance checks to ensure the system runs smoothly. Updates and Enhancements: Based on feedback and technological advancements, update the system to add new features or improve existing ones.

Reporting and Documentation

Documentation: Maintain detailed documentation of all processes, system configurations, and user guides. Reporting: Regularly report the progress and performance of the system to the institute's management and stakeholders. This methodology, with its emphasis on stakeholder engagement, tailored design, rigorous testing, and continuous improvement, aims to ensure that the CRM and Job Portal system effectively meets the needs of the educational institute and its community.

IMPLEMENTATION

Fig.1. CRM dashboard in the education domain centralizes interactions with students.

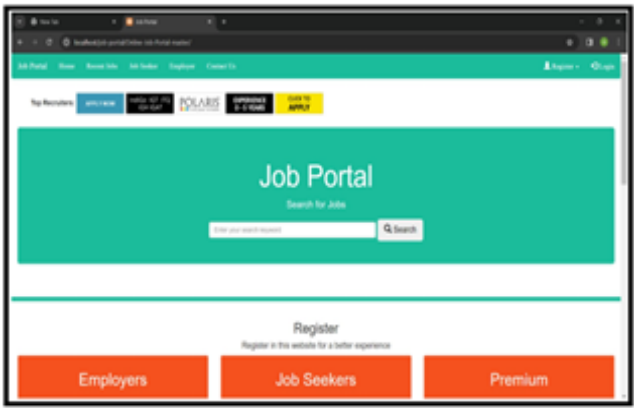

Fig.2. The job portal dashboard acts as a central hub for job seekers, employers, and administrators to manage their activities.

CONCLUSION

The implementation of the integrated Customer Relationship Management (CRM) and Job Portal system in an educational institute marks a significant stride towards modernizing and enhancing the institutional framework for student and alumni engagement, as well as career development services. This project, with its focus on leveraging technology to create a seamless, efficient, and user-centric platform, stands as a testament to the institute's commitment to innovation and excellence in education and professional growth.

Through this integration, the institute has established a robust system that not only streamlines administrative processes and communication but also significantly improves the quality of interactions with students, alumni, and corporate partners. The CRM component has been instrumental in personalizing the student experience, managing alumni relations effectively, and fostering strong partnerships with the corporate sector. On the other hand, the Job Portal has opened new avenues for students and alumni to explore and secure relevant job opportunities, thereby enhancing their career prospects and contributing to their professional success.

The project has demonstrated substantial benefits in terms of increased engagement rates, higher job placement success, and improved satisfaction among all stakeholders. It has also facilitated data-driven decision-making, enabling the institute to tailor its services and offerings more effectively to meet the evolving needs of its community. The ongoing collection of feedback and the commitment to continuous improvement ensures that the system remains dynamic and responsive to the changing educational and job market landscapes.

In conclusion, the successful implementation of the CRM and Job Portal system signifies a forward-looking approach to education management and career services. It underscores the institute's dedication to providing a holistic educational experience that extends beyond academic learning to encompass career readiness and professional development. As the institute continues to navigate the challenges and opportunities of the 21st century, this integrated system will undoubtedly serve as a critical tool in supporting its mission to educate, engage, and empower its students and alumni for the years to come.

ACKNOWLEDGMENTS

We extend our heartfelt gratitude to all those who have contributed to the conception, development, and implementation of the Job Portal and Customer Relationship Management (CRM) system in the education domain. The successful realization of this innovative solution would not have been possible without the collaborative efforts and unwavering support of various individuals and organizations.

First and foremost, we express our sincere appreciation to the visionary leaders and decision-makers within educational institutions who recognized the need for transformative solutions in the realm of career services. Their foresight and commitment to enhancing student experiences have been instrumental in driving this project forward.

We are immensely grateful to the dedicated team of developers, designers, and technical experts whose expertise and tireless efforts brought the Job Portal and CRM system to fruition. Their commitment to excellence and creative problem-solving have resulted in a user-friendly, efficient, and cutting-edge platform that stands at the intersection of education and professional development.

Our appreciation extends to the faculty and staff who provided valuable insights and feedback throughout the development process. Their perspectives enriched the features of the system, ensuring its alignment with the diverse needs of students, alumni, and employers.

We also extend our thanks to the students and alumni who actively participated in the testing and refinement phases, offering invaluable feedback that contributed to the system's user-centric design and functionality.

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An Effective Cryptosystem Preserves user Profile Privacy in Social Networks

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ABSTRACT

Now a day's protect privacy and Profile matching of user in social networks is more important and challenging task to online matching service provider. This matching service provider such as finding friend and dating services are asking too much personal information from user When registration and profile creation for an online matching service. The users' personal information is fully known to the matching service provider. which leads dating user profiles data disclosure along with privacy issues, as the matching service provider may leak user personal information. To solve this kind of issues, proposed research system is effectively use homomorphic NTRU Cryptosystem for user profile data encryption and decryption. This NTRU cryptographic technique to permit computation on encrypted data directly. The research work also introduces secret sharing techniques to solve profile matching. Based on the user search query, The user's contact information is returned to them after the dating service provider servers compare preferred user profiles and secretly share the decryption key for the match. The main aim of proposed system is achieving effective privacy Preserving and profile matching on user profile data which is maintain in online matching service provider. The proposed work outperforms the existing approaches, resulting in improved User Profile matching accuracy and better security.

KEYWORDS *: Cryptosystem, Profile matching, NTRU, Privacy-preserving, Social networks.*

INTRODUCTION

Social network services allow individuals user can create profile that others can browse based on their preferences. Matching more than one social network users with correlated interests is a crucial problem in each and every online service matching sites such as finding friends, and dating services [1]. On-line matching services completely maintain the user personal information which leads some of the serious issue to user. Whenever new user registration for an online matching service, user may be revealing some personal details, such as religion, location, behaviour, hobbies, income, Favorite places, phone number, address, etc. This completely information maintains in server for provide service to another user. This raises privacy issues because the server has full knowledge of users' preferences. Sometime server be leaking user personal and sensitive information either purposely or by mistake. Online matching service may be sharing user personal data without customer permission. Even after an account is cancelled from social Networks matching sites, most sites may retain such user personal

LITERATURE SURVEY

1.In paper proposed ElGamal Public Key encryption scheme, Users can search for matching individuals on social networks by inputting queries to the servers without disclosing their privacy. The ElGamal provide an option to the RSA for public key encryption. Problem found with ElGamal is security flaw in the encryption scheme which means hacker or attacker decrypts the server cipher texts without the private key. Another problem with ElGamal cipher text is twice as long as the plaintext.

2.In Y. Sang, H. Shen, and N. Xiong proposed Privacy Preserving Set Matching (PPSM) protocol. In this paper work, the social network user profile data information is shared by all matching servers and as a result every server is necessary to maintain and store user information. This lead too much of data complexity to server. Suppose any one of the server target by attacker means they can get complete user profile information.

A dissimilarity threshold is proposed in this paper for use with the profile matching technique. A query user can specify one threshold for searching people with an example age of 20 for user matching. This process for user profile matching in the paper work does not allow searching for users between the numbers 40 and 50, and it is entirely based on numerical attribute values.

Multiple user data information is held by the paper to calculate the intersection of their inputs in the private two-party set-intersection problem, without leaking any additional information. Finally comparing which elements appears in both sets that element will return to user. Main problem with this solution needs to compute a large number of exponentiations.

3.Li et al. The Find U scheme was proposed for profile matching in social networks. The first privacy-preserving profile matching scheme for mobile social networks was developed to protect user privacy. Social network user can find from a group of users profile information one whose profile best matches with search user. This approach only essential and minimum information is exchanged. This approach only suitable for mobile social networks.

Two fingerprints were completely compared using the private fingerprint matching protocol proposed by Huang et al, which employed a minutia-based fingerprint matching algorithm . The fingerprints of two parties can be compared to determine if they belong to the same individual. Initially compare finger print minutia pairs from the two fingerprints based on their types, locations info, and orientations, after that check if the number of matching minutia pairs is more than threshold user profile information will return. This work assumes user complete data encrypted and store but finger print of the two parties only in clear text.

4.Sun et al A privacy-preserving distance-aware encoding protocol was proposed for comparing numerical values in the anonymous space. This work is similar to homomorphic encryption in its functionality. that allow performs some computation on cipher texts. Homomorphic encryption allows effective computation on encrypted data. but this scheme which support any one of the operations multiplications on encrypted data.

Existing system

To provide privacy-preserving solution for user profile matching and protect privacy of user profiles in social networks is more important recent research work. So far, some of the existing papers work on the above problem. Existing work ElGamal homomorphic encryption is used to data encryption Problem found with ElGamal is security flaw because of two prime factors of the modulus are public parameters which attacker decrypts the server cipher texts without the private key. Existing work, user profile information is shared by all servers and therefore each social network server is mandatory to maintain a user profile database completely. This leads server overhead problem. Query user can specify only one dissimilarity threshold for user matching. Existing work Privacy-Preserving User Profile Matching is based on numerical attributes. Existing none of the work not satisfied effective User Profile Matching in social network.

METHODOLOGY

The framework “homomorphic NTRU Cryptosystem with secret sharing” is developed and implemented in the proposed system for effective profile matching in Social Networks Environment. Finally, the proposed system works with the following algorithms and techniques.

Module 1: User Registration and profile creation

This module helps the user to register them with the application. Registration is mandatory Social Networks for them to match profile. After successfully registration authentication phase defines the security and authority to access, for example every social network should be authenticated for Profile Matching. User can able to create profile information such age, sex, education details, geographic location, hobbies, income details, religion info , home and work addresses, Favorite places these complete information will be maintain in

Excel Sheet before uploaded in to server that others can browse or search above information. Server: the storage server has the responsible to respond for the user search request.

Module 2: Data set collection and preprocessing

The Excel sheet's user profile data is extracted in the first step. The major process involves identifying data and splitting it into terms in this sentence for analysis. before process the document is prepared for the next step after undergoing processing to remove redundancies, inconsistencies, separate words, and stemming.

Modules 3: Encryption process Using NTRU

The data is translated into random and meaningless form during the process of encryption. NTRU homomorphic process work on public and private key. Homomorphism encryption enables computation on encrypted data. Nth degree Truncated Ring polynomial Unit The two keys used in this algorithm are: public key and private key Public Key always used for secure data encryption purpose. Public key can know any one for some purpose Private Key is used for cloud data decryption. This key knows by only one person. NTRU homomorphic Algorithm its major involves three different steps: key generation process, encryption and decryption process.

The public key in a cryptosystem is known to everyone and is used for encrypting secret messages on the part of the clients. Messages can only be decrypted using the secure share's private key in a reasonable amount of time after they have been encrypted with the public key.

NTRU Parameter

1. Parameter Selection: NTRU-Encrypt include n, p, q, df, dg and dr.

2. The degree of truncated polynomials is chosen by the prime number N.

A prime number N determines the degree of truncated polynomials..

3. P and q values should be relatively prime number. One of the important condition is q should be significantly larger than p.

4. N df, dg and dr can significantly used for efficient computation.

Modules 4: Profile Matching

Find matching users from the social network, user need to specify his preferred profile attributes along with some e dissimilarity threshold. After succeful receiving the query receiving the query servers help to find matching users profile information from the storage server.

User Query Generation

Step 1: Initially take as input the common public key PK from social networking service. Public key available for every user.

Step 2: specified N number of profile attributes a1, a2, a3,a4 along with corresponding weight w,w1,w2,w3,w4, ..wm.

Step 3: dissimilarity threshold δ, example (age<30 and age>25)

Step 4: Finally query denoted as Q = QG (PK, a1, w1, a2, w2 · · , am, wm, δ) which is submitted by user to the social networking service provider. Server will make profile matching process.

Step 5: Response generation from server. Server takes as input the query denoted as Q ,then user profile from database, taking private keys k1, k2, · , kn, for decryption.

Step 6: Finally profile matching response from server outputs a response denoted R.

Step 7: R = RG (Query, DB profile, private key k1, k2,, kn). R, will hold the contact information of the first t profile matching users this stores in array list then returned to the user,

Step 8: User retrieves profile matching response t0 = min (t, T) and T denotes the total number of matching profile users details in server.

Modules 5. Secret sharing

Secret sharing also called as secret splitting Achieve better privacy preserving Server will split the secret key distributing a secret key to among a group of server. User can submit query with some categorical data such as location, address .Server receives the query request from user server will collect the secret sharing key from every server. Finally server completely decrypted the

profile information and match the information using pattern matching technique then matching user result will be shown to user.

Step 1: Consider Pk is private key

Step 2: Get No of server in social network N denote no of server

Step 3: Secret key divided into N parts: PK1, PK2, and PK3… PKn.

Step 4: User Need to define K .K is the integer values selected by the user order to decrypt.

Step 5: Share divided Secret key to N number of server.

Step 6: server cannot get private key secret reconstructed with (K – 1) parts or fewer.

Step 7: finally secret share equal to K value or higher than k values means server can decrypt and will return profile match user result.

Figures and Tables

The Sample some experiments are design conduct for now the performance of NTRU proposed algorithm using software, hardware. Then the experimental is performed on an Intel core 2 duo 4 GHz processor with the maximum 8 GB RAM capacity. The proposed researches algorithms are successfully implemented in JAVA programming language are run under Windows platform. Finally, the performance of this proposed Research NTRU homomorphic Cryptosystem work Scheme compared with the existing algorithms based on following parameters.

Time taken – Determines the encryption/decryption processing time involved.

Table 1. Sample Datasheet File for Encryption/Decryption

Metrics	User Profile File Size	El Gamal homomor-phic	Proposed NTRU Encryption
	300Mb	1600	1400
Time Comparison (ms)	500Mb	2250	2000
	700Mb	2450	2200

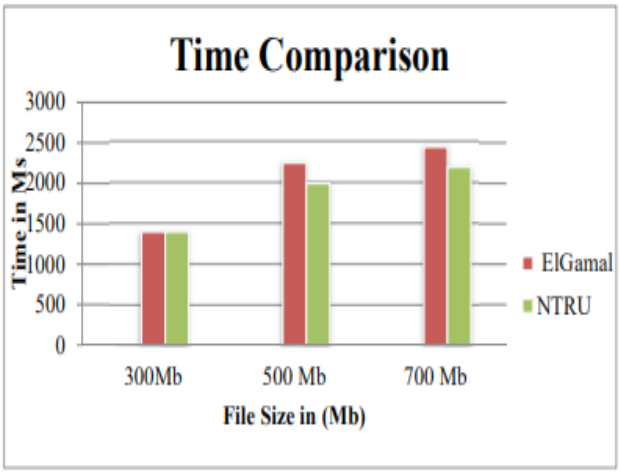

Figure 1. Encryption/Decryption Time comparison

The graph displays the encryption and decryption performance comparison of the proposed system with existing methods, expressed in terms of Encryption/ Decryption Time. The graphs indicate that the proposed approaches result in improved accuracy and reduced encryption and decryption time for various dataset sizes.

CONCLUSION

The Main motivation of proposed work research is to provide the data mining services to ensure user privacy in social network. Proposed system successfully Integrate with homomorphic NTRU Cryptosystem with secret sharing algorithm to provide better security. Our proposed NTRU Cryptosystem Model will be more effective with efficient encryption. Important objective of this proposed work is to build Profile Matching on encrypted data with high matching accuracy. The new scheme completely offer multiple dissimilarity thresholds along with Proposed work also extends user profile matching with categorical attributes this will helps improve profile matching accuracy in social network From the sample experimental results, the encryption and decryption execution time and security matrix is calculated. Proposed system almost produce less time consumption for encryption and decryption clearly shows proposed system better than the existing system.

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Review to Achieve Computer Network for Security by Intrusion Detection with the Help of Machine Learning Techniques

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ABSTRACT

Intrusion denotes the success of a network attack, and an Intrusion Detection System (IDS) serves as a crucial software tool for identifying unauthorized access to computer systems or networks, complementing the capabilities of firewalls. The application of Data Mining techniques streamlines the development of IDS by automating the creation of traffic models from reference data, significantly minimizing manual intervention. These advanced systems excel in detecting both known and variant attacks, employing misuse detection to compare network traffic against a predefined intrusion model. Anomaly detection, meanwhile, scrutinizes profiles of normal traffic behavior. Innovative Semi-Supervised systems, such as the Self Training Support Vector Machine algorithm discussed in this research, alleviate training demands by reducing the reliance on labeled data. Notably, the algorithm applied to the KDD Cup 99 dataset showcased a remarkable up to 90% reduction in the necessary size of labeled training sets compared to conventional supervised learning techniques.

KEYWORDS *: Intrusion detection system (IDS), Data mining techniques, Traffic models, Firewalls, Known attacks, Variant attacks, Misuse detection, Self training support vector machine algorithm.*

INTRODUCTION

A security breach is commonly defined as a successful penetration into a network or system. In a thorough examination of event analysis proficiency, researchers like Julia et al. provide an insightful perspective, characterizing an attack as "an intentional act of aggression by one entity, the assailant, directed towards another, the target. The assailant executes an attack with a well-defined objective in mind." From the viewpoint of a system administrator, an attack unfolds as a sequence of events, each potentially carrying diverse security implications. Conversely, from the assailant's perspective, an attack represents a strategic maneuver to achieve a specific end. According to this nuanced definition, the perception of a breach can vary significantly among different stakeholders. An assailant deems an incursion successful if and only if its intended goals are realized.

This success metric is intrinsically tied to the perpetrator's strategic aims and the efficacy with which they are executed. Conversely, the victim assesses the success of an attack based on the tangible repercussions it inflicts. It is crucial to highlight that an attack, while perceived as effective from the assailant's standpoint, might not necessarily register as such for the victim. This divergence in perspectives adds complexity to the understanding of the aftermath of a security breach. In forensic contexts, the victim's viewpoint assumes paramount importance, as it aids in unraveling the full impact and aftermath of the breach.

Common instances of security breaches encompass a spectrum of sophisticated tactics, including Denial of Service (DoS) attacks, where the assailant overwhelms a system's resources to render it inoperable, packet interception, where communication packets are

illicitly captured and analyzed, remote infiltrations, allowing unauthorized access to a system, and insidious intrusions such as Trojan horses and spyware. Each of these techniques presents unique challenges for detection, mitigation, and recovery, underscoring the intricate nature of cyber security in safeguarding against a diverse array of potential threats.

These are some of the ways to implement system level interventions

Intrusion Detection System

An Intrusion Detection System (IDS) functions as a crucial guardian against unauthorized access to computer networks. It operates through meticulous accident investigation, aiming to identify a spectrum of malicious activities and unauthorized computer usage. Its potency lies in its integration with the organizational fabric, providing stability and adept problem-solving. Notably, a robust IDS distinguishes itself by dynamically considering the current state of the system or network, displaying estimated attacks on the operating system, and promptly detecting and flagging multiple failed attempts.

However, it's important to acknowledge that the conventional IDS operates on predetermined rules, lacking the adaptability seen in more sophisticated systems. It falls short of the dynamic responsiveness required in the ever-evolving landscape of cyber threats.

The initial identification of issues involves monitoring network connections and physical activities, raising flags for potential anomalies. While IDS systems may not prevent incidents, ongoing developments focus on crafting sophisticated Identification and Protection Systems (IDPS) that encompass both detection and protection modules. The emphasis on damage prevention becomes paramount, aligning with the need to neutralize recognized threats effectively.

The advent of social media has reshaped the landscape, lowering the skill threshold for launching successful cyber attacks. Coupled with the intricate nature of modern technology, this shift calls for continuous development and implementation of more advanced intrusion detection mechanisms. With our increasing reliance on computers and the internet, intrusion not only challenges security goals of confidentiality, integrity, and availability but also underscores the imperative need for proactive intrusion detection solutions.

Architecture of IDS

In the realm of intrusion detection systems, the Data Collection Module takes center stage. Responsible for the data collection process, it operates within the Network Intrusion Detection System (NIDS). The data it gathers can range from raw frames sourced directly from the network to information extracted from higher protocol layers, including IP or UDP. Alternatively, in the context of a host-based discovery system, the module relies on auditing logs stored by the operating system as its primary resource. This pivotal component forms a critical link in the intricate web of intrusion detection, ensuring a comprehensive and multifaceted approach to data acquisition.

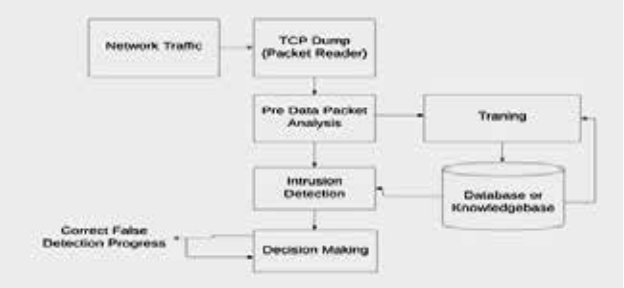

Fig.1 Network Intrusion Detection System

Classification of IDS

Intrusion Detection systems are generally classified on the basis of detection methodology and source of data.

Detection Methodology based classification

In the realm of intrusion detection, two primary systems emerge: Abuse or signature-based detection and Anomaly detection. The former relies on comparing network traffic with a model of known intrusions, leveraging pattern recognition, rules of thumb, and data mining. While effective against known threats, its performance wanes against unknown ones. Conversely, Anomaly detection gauges current traffic against a baseline of normal behavior, flagging any deviations as anomalies, making it adept at detecting previously unknown attacks. Yet, a challenge persists with false alarms. Additionally, the Stateful Protocol Analysis (SPA) method, distinct from Anomaly Detection, utilizes protocol state knowledge. SPA, drawing

from international models like IETF, stands out as a specialized approach.

LITERATURE SURVEY

Over the span of more than two decades, the pursuit of automatic network discovery has undergone significant research efforts, as elucidated in a study by Catania et al. The evolution of this research field and contemporary challenges are explored in-depth. The initial foray into network intrusion detection systems (NIDS) saw the utilization of rule-based approaches like P-BEST and SNORT. However, the limitations arose from their reliance on human intervention, hindering their ability to comprehensively measure and counteract the escalating number of cyber attacks. To address these challenges, various anomaly detection methods have been introduced. Porras and Valdes proposed a data analysis system employing diverse machine learning methods, including SVM and ANN. Chen contributed an unsupervised approach based on clustering processes. A comprehensive review by Liao et al. delves into the intricate details and general comparisons of these diverse methods within the realm of Intrusion Detection Systems.

Beyond the human interaction issues, Catania et al. shed light on additional challenges faced by Intrusion Detection Systems. These encompass a lack of model adjustment information, challenges in identifying proper traffic features, inadequate resource consumption information, and a dearth of publicly available network traffic datasets. In a review by Patcha et al., open problems in anomaly detection-based IDS are outlined, highlighting issues such as high computational complexity, noise in audit data, a high false positive rate, absence of recent standard datasets, the inability of IDS to self-defend against attacks, the precise definition of normal behavior, and the incapacity of IDS to analyze encrypted packets. These intricate challenges underscore the ongoing complexities in the realm of automatic network discovery and intrusion detection.

PROPOSED WORK

Machine Learning Technique

Machine Learning (ML) encompasses two distinct categories, namely supervised and unsupervised learning. In the realm of supervised learning, the training of the model involves the use of labeled instances. This approach utilizes an input variable (x1) and an output variable (y1), employing a classification algorithm to discern and learn the intricate mapping function that exists between the input and output. Equation 1 succinctly illustrates the formalized representation of this mapping between input and output functions.

$$yl\ f(x1)$$

Within supervised learning, problems diverge into two distinct types: classification and regression. Classification models, dealing with known class labels, endeavor to learn inferences from labeled instances used during training. As these models are trained with labeled instances, they can predict the class of new instances when encountered. Notable examples of classification algorithms include the Naïve Bayes algorithm and random forest. In contrast, unsupervised learning operates with unlabeled data, relying solely on input variables (x1) without corresponding output variables. This technique predicts outcomes based on pattern similarities. Clustering is a prominent unsupervised learning method, with examples like the K-means algorithm and DBSCAN algorithm highlighting its applications. This distinction between supervised and unsupervised learning techniques underscores the diverse methodologies employed in the vast landscape of machine learning algorithms.

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Foam Concrete as Green Concrete Material with Sustainable Construction

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ABSTRACT

A green building is a naturally viable structure that is designed, built and manufactured in such a way that all natural impacts are reduced. The Green Building Record (GBI) is a recognized green development assessment that promotes a functional built environment and raises awareness of the various meetings of the development industry and open environmental issues and our responsibilities in the long-term era. Carbon dioxide (CO2) is an important greenhouse gas for human activity. It is said that 5% of the world's; CO2 emissions are attributed to the high-quality cement industry, which is an important ingredient in concrete. Because of the significant commitment to environmental pollution and the need to find an ideal organization with the fulfillment required by gracious development. Separated from regular concrete bricks, foam concrete is an unworn findable innovation for economic construction and respectful development that fulfills the criteria of the green fabric. Foam concrete has special properties that can be used in graceful design work. It does not require compression but flows rapidly from the outlet to fill confined and unpredictable cavities and can be pumped over significant discharge and head. In this way, it can be guided by free streaming and self-regulatory enforcement. This report provides an overview of precast concrete, its components, generational design features and uses. Foam concrete is the basic supply, but in the presentation it should be almost under control in the middle of production and on-site supervision during its placement and curing. The need for such a rare requirement is diminishing as the industry becomes more familiar with the nature and behavior of the fabric. This article states that foam concrete may be a viable fabric for development.

KEYWORDS *: Foam concrete, Green building, Green concrete.*

INTRODUCTION

Today lightweight concrete is gaining popularity due to its advantageous material properties/ characteristics that make it an obvious selection as a development medium. It is particularly reasonable in the case of exceptional structures with high innovation, where the reduction of the sought and natural effect separated from the reaction is taken into account. The measurement says that 7% of the planet's carbon dioxide emission is due to ordinary Portland cement and its viability. Cement products consume nearly 7,600,000 kg per ton of cement (Naik et al 1996). This mechanical development challenges humanity to see different ways and means a concrete way forward. Foamed concrete is one lightweight concrete and graded cellular concrete. Foam concrete can be free-flowing, self-leveling; fabric that does not require a seal. It is made by evenly spreading speech bubbles throughout the concrete mass. It can be a mortar- or concrete-based fabric, which is usually made thick by discussing primer or foaming. Foamed concrete can be a mixture of cement, fine sand, water and rare foam formed by

solidification into a solid, lightweight concrete that contains millions of evenly spaced, reliably measured bubbles or cells. FC thickness is determined by the amount of foam contained in the required cement-sand mixture. Foamed concrete is both fire and water resistant. It has high (effective and air) sound and heat insulation. Foam concrete is similar to regular concrete in that it uses the same fasteners. In any case, foam concrete differs from ordinary concrete in that the use of the previous total amount has been omitted. A foam air circulation specialist is used to maintain adhesion while the product is in contact with the environment, allowing continuous quality improvement in preparation for cement hydration.

The difference between foam concrete and typical concrete is that in foam concrete the aggregate is used and replaced by homogeneous cells made of air inside a small bubble, which uses a uniform air cell structure or perhaps more than conventional aggregates. It can be classified as a cellular tissue because it contains the following amount of pores. Based on its morphology, foam concrete can easily be called a cellular fabric, and its behavior should be the same as the cellular strength behavior.

Definition of Foam Crete

According to Jones (2005), foamed concrete is defined as a cementing material with a gas, also known as aerated concrete, in which the alkalis generated by cement hydration react chemically with aluminum powder to form bubbles. Sustainable Construction with Foam Crete

Sustainable development aims to reduce the natural impact of a structure during its life cycle, optimizing its economic practicality and the comfort and safety of tenants. The applicable development standards apply to the entire development life cycle from planning to delivery.

Reduce the consumption of resources (Reduce): - Foam concrete consumes a relatively small amount of raw materials compared to the amount of the finished product.

Resource recovery (recycling): - Recent advances in the construction industry use recycled foam concrete to replace sand in insulation layers.

Use recycled material (Recycle): - – The production of fly ash in India is almost equal to the production of cement. Despite this, we only use 5% of the fly ash we produce. The production of foam concrete uses fly ash, a recycled material that is a by-product of thermal power plants.

Eliminate toxic substances (toxic substances): - does not emit toxic gases even when exposed to fire, and its production process is also non-toxic.

Use Life Cycle Costing (Economics): – shows that it is cost-effective from the construction phase to operation and maintenance costs.

Emphasis on quality (quality): - Foam concrete fulfills strength requirements in addition to maintaining a low density due to the use of a foaming agent in its manufacture. Lightweight concrete is solid and stable even with the lowest density.

Objectives

To determine physical properties of Normal and fly ash based foamed concrete.

To investigate strengths parameters of normal & fly ash foamed concrete.

To Investigate the Utility aspect of Foam concrete.

History of foam Crete

Although foam concrete has been used in Sweden since 1929, its use in construction was not recognized until the late 1970s. In 1980, the first large-scale foamed concrete project in Great Britain was completed in the Falkirk railway tunnel in Scotland. The circular space surrounding the tunnel was filled with about 4500 m3 of foam concrete (1100 kg/m3).

Although foam concrete has been used in Sweden since 1929, its use in construction was not recognized until the late 1970s. In 1980, the first large-scale foamed concrete project in Great Britain was completed in the Falkirk railway tunnel in Scotland. The circular space surrounding the tunnel was filled with about 4500 m3 of foam concrete (1100 kg/m^3).

Figure 1: The Falkirk Railway Tunnel in Scotland

LITERATURE REVIEW

Structure and properties of aerated concrete: a review

Summarizing the research pertaining to the structure and properties of aerated concrete, the salient observations are:

A. The method of pore formation and healing plays an important role in its microstructure and properties;

B. Properties are affected by density, so they should be determined by density, which must be determined by moisture content.

C. The chemical composition varies depending on the curing method ± tobermorite gel formed for moist-cured products and a more stable form of tobermorite autoclave.

D. Strength ± porosity relationships were developed for aerated concrete based on the concept of gel ± space ratio and a balshino expression.

E. Steam hardened concrete has good functional properties.

Mechanical properties of foamed concrete

The present study is focused on developing a methodology for the production of foamed concrete for structural elements.

M20 class foam concrete can be obtained from cement with a mass of 468 kg/m3; sand 234 kg/m3; quarry dust 234 kg/m3; fly ash 468 kg/m3; water 327 liters/m3 and 14kg/m3 foam. The mentioned strength can be reached in 90 days. This may be because an equal amount of cement was added to the fly ash; allows you to gain strength with age.

A comparison of compressive strength with increasing time shows that the compressive strength of the cement-only mixture increases continuously with time, while the compressive strength of mixture M2 and M6 increases slowly both at 90 days of age and later in both mixtures with fly ash. fly ash and no fly ash achieve the same compressive strength.

The flexural strength decreases after 60 days compared to the 30-day flexural strength, but increases again. The sudden drop in flexural strength needs to be further investigated by doing more tests.

Sulphate resistance was investigated by preparing a solution containing 5 wt.% MgSO4. The percentage of weight loss was evaluated and found to be negligible. This ensures that the foam concrete is highly resistant to sulfate. The compressive strength of the sulfate-attacked samples followed more or less the same pattern as that of the normal samples.

Development of innovative building blocks (tnscst-sponsored research project)

The test results obtained during this study were as follows.

A. The compressive strength decreases with the addition of aluminum powder.

B. The use of aluminum powder reduces the weight and strength of concrete compared to ordinary concrete.

C. The breaking strength of LWC is between 3N/mm2 - 10.5N/mm2 for sand mixtures and 3N/mm2 - 7N/mm2 for quarry dust mixtures with different aluminum content.

D. Compared to quarry dust mixes, sand mixes provide more strength.

An investigation on foam concrete with quarry dust replacement for filler in mix design

This report presents the availability of 10%, 20%, 30%, 40% and 50% foamed concrete sand for pure quarry use. To investigate the compressive quality of quarry concrete, tests were carried out on 3d forms, which were

compared with a control foam concrete. It was found that the compressive quality of quarry clean foamed concrete is approximately 43% better than the control foamed concrete. Based on the results of the research, it is proposed that fired clay bricks can be successfully replaced by foam concrete blocks. Finally, a tax credit evaluation was conducted to demonstrate the economic efficiency of foam concrete bricks.

Safe Aluminum dosing in ACC plants

Aluminum is used as a foam operator in AAC production worldwide and has been widely proven as a leading solution for a reason. When aluminum is added (usually 0.2-0.5% of the dry weight of cement) to mixing equipment, it reacts with calcium hydroxide or a soluble base, releasing hydrogen gas (3H2) and forming bubbles. Aluminum is required to produce autoclaved circulating air through concrete. During the process, a chemical reaction is achieved by adding aluminum to the raw mud. This causes gas bubbles in the air to circulate through the concrete slab.

METHODOLOGY

On the basis of present literature review working procedure for the project work is formulated. Following are the three types in which all mixes are studied.

Mix	Cementitious Material	Sand	Alumina Powder
M1	100% CEMENT	100%	6 gm
M2	70% CEMENT + 30% FA	100%	5 gm
M3	40% CEMENT + 60% FA	100%	8 gm

All these mixes are compared on account of compressive strength and all other parameters.

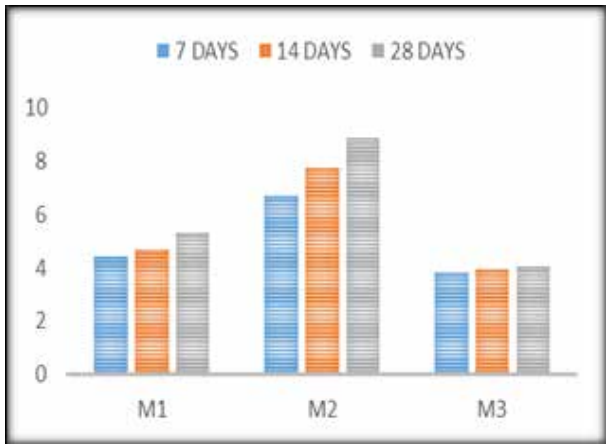
Cubes of 15 X 15 X 15 cm are tested on 7 days, 14 days and 28 days.

RESULTS AND DISCUSSION

Table shows the comparison chart of mixes M1, M2, M3 strength of different proportion of aluminum powder and concrete constituents.

Table No: 1 Table shows combined compressive strength for various proportions mixes M1, M2, M3 strength of different proportion of aluminum powder and concrete

Mix	7 Days	14 Days	28 Days
M1	4.5	4.68	5.34
M2	6.7	7.76	8.9
M3	3.8	3.8	4.06



Graph 1. Comparative Chart for Combined Compressive Strength (N/mm²)

Table 2. Combined water absorption test for various mixes

Mixes	Water Absorption Test
M1	9.5
M2	12.4
M3	14.8

Graph 2. Comparative Chart for Combined Water Absorption Value

Table 3. Combined density for various mixes

Mix	M1	M2	M3
Weight (Kg)	4.526	5.252	4.85
Density (Kg/Mm^3)	1342.04	1558.15	1434.04

Graph 3. Comparative Chart for Combined Density

CONCLUSION

- Based on the information gotten from test taking after conclusion can be drawn.
- In the mixture of M1, M2, M3, the compaction quality increases slowly, while M3 shows the least and M2 shows an increased compaction quality.
- Using completely different amounts of fly electricity, it is observed that when the proportion of fly increases, the thickness. also increases. is increasing.
- But with the amount of cement, if fly ash is used in large quantities, water absorption increases and thickness decreases.
- The extent of the fiery remains of the fly is closely related to the thickness.
- Smoothness is required for the player's mixture, some other aluminum powders may not be legally mixed, and the values shown do not guarantee the realization of a match.
- Thus, the compressive strength of mix M2 is 8.89 N/mm2 compared to other mixes.
- The assimilation of water in the mixture with most of the fiery waste of the raised fly is greatest. The most important water retention capacity of Blend M3 is 14.6%.
- The thickness of foam concrete is the largest mixture with 40% fly ash. The thickness of Blend M is the most important 1556.15 kg/m3. Thus, the survey work clearly shows the development of the economy, emphasizing the properties of foam concrete as a green building fabric.

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Experimental Study on Traditional Clay Bricks by Adding Bagasse Ash and Fly Ash

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ABSTRACT

The objective of this study is to produce sugarcane ash brick by adding one of the waste materials viz. fly ash India's population is increasing day by day, and many industries and agriculture generate large amounts of waste that pose health risks. Disposal of these wastes has become a major problem. Cane sugar is one of those produced by burning bagasse ash. To use the waste material effectively, we used bag-ash in various proportions, ie. 5-30%, in the manufacture of bricks. The bricks are manufactured and the tests conducted are water absorption and compressive strength as per Indian standards. In this research, the possibilities of using bagasse ash in brick production are investigated. The result of this work indicates the maximum compressive strength achieved for the optimum mix percentage. From this we can conclude that adding waste material to the production of bricks can minimize the environmental burden, resulting in a cost-effective and green construction.

KEYWORDS *: Sugarcane bagasse ash, Fly ash bricks, Green bricks.*

INTRODUCTION

Bagasse is the fibrous material that remains when sugarcane or sorghum stalks are crushed to extract the juice. The dry pulp residue that remains after sugar cane juice has been extracted. It is used as a biofuel and in the production of cellulose and building materials. For every 10 tons of crushed sugarcane, the sugar factory produces almost 3 tons of wet rolls. Bagasse is a very inhomogeneous material containing approximately 30-40% and quot; pithandquot; fiber originating from the interior of the plant and consisting mostly of parenchymal material, and "basandquot; and "breastandquot; or "stemandquot; fiber consisting of the rest and mostly derived from sclerenchymal material. Today, it is common to recycle cane sugar as biomass fuel in boilers for steam and electricity production in sugar factories. Depending on the combustion conditions, the resulting sugarcane bagasse (SCBA) can contain high concentrations of SiO2 and Al2O3, which allows it to be used as a supplementary cementitious material (SCM) in blended cement systems. The use of cane sugar waste in bricks can save the sugar cane industry disposal costs and produce "greener" bricks for construction.

The incineration of bagasse, which is sugar cane waste, produces bagasse ash. Nowadays, baguettes are burned in sugar factories as fuel to power boilers. Usually, this bag ash is spread on farms and dumped into ash ponds, causing environmental problems. Research also shows that workplace exposure to bagasse processing dust can cause chronic lung disease, specifically bagasse fibrosis. Thus, the need for its recovery is high and it is also found that bagasse ash is rich in silica and has pozzolanic properties, so it can be used as a substitute for building material.

Using waste as a brick material is a sustainable solution for solid waste management; it provides an alternative raw material and a source of additional income. The

raw material used here is otherwise landfilled and thus increases the ever-increasing disposal costs. Burnt sugarcane bagasse residue is generally known as SBA. The potential production capacity of burnt cane sugar is approximately 7-8% of the total bagasse consumed. Bricks thus made from this waste are energy efficient because the main raw materials are not separated.

The construction industry consumes a huge amount of natural resources every year and at the same time generates a significant amount of construction and demolition waste (CDW). One of the biggest challenges for manufacturers is the implementation of measures in the field of circular economy, which, together with efficient use of resources, brings environmental and economic benefits. Autoclaved aerated concrete (AAC) arises from the need to obtain a light, packaged material with the same physical and mechanical properties as a compact product. The massive increase in the use of autoclaved aerated concrete (AAC) in the construction industry, which began in Europe in 1940, has generated large quantities of AAC waste (AACW) in recent years.

Fig 1. Sugarcane Waste Firmly Knows as Bagasse

Landfill AACW can cause environmental problems such as leaching of pollutants and pH changes in the surrounding soil and water, instead of being used and recycled in new buildings. The market for AAC production is valued at US$ 6.32 billion in 2016 and is expected to reach US$ 10.98 billion by 2023. Improved properties of autoclaved aerated concrete and increasing importance of green buildings are some of the key factors influencing the growth of the market. The exceptional properties of AAC come from its porous, closed cell structure, which is created by the reaction between the alkaline components of the cement and the foamed aluminum powder. To promote the crystallization of calcium silicate hydrate phases (especially Tobermory), a significant amount (2-5%) of calcium sulfate in the form of gypsum or anhydride is added to the raw materials. Therefore, the chemical composition of AAC waste can be a significant limitation for its recovery, since sulfate compounds can cause serious technical problems such as efflorescence and internal sulfate attack, as well as environmental effects of leaching (salinity, sulfite formation, eutrophication). water level.

Types of Bricks

Clay Bricks

Brick is a building material used to make walls, sidewalks and other masonry structural elements. Traditionally, the term brick referred to a unit made of clay, but today it refers to any rectangular mortar. Brick Can consist of clay soil, sand and lime or concrete materials. Bricks are made in many grades, types, materials and sizes that vary from region to region and period, and are produced in bulk. The two main categories of bricks are fired and unfired bricks. Block is a similar term that refers to a rectangular building unit made of similar materials but usually larger than a brick. Lightweight bricks (also called “lightweight blocks”) are made from expanded clay.

Fig 2. Clay Bricks

Sand Lime Bricks (Calcium Silicate Bricks)

Depending on the ingredients, calcium silicate brick is also called lime or silicon-lime brick. Instead of being made of clay, they are made of lime, which binds the silicate material. The raw material for calcium silicate bricks is lime, which is mixed in a ratio of about 1 to 10 with sand, quartz, crushed silica or crushed silica aggregate with mineral coloring agents. The materials

are mixed and left until the lime is fully hydrated; the mixture is then pressed into molds and cured in an autoclave for 3-14 hours to accelerate chemical curing. Finished bricks are very accurate and of consistent quality, although sharp bricks require careful handling to avoid damaging the brick and masonry. Bricks can be made in several different colors; white, black, brown and gray-blue are common and pastel shades can be achieved. This type of brick is common in Sweden, especially in houses built or renovated in the 1970s. In India, they are known as fly ash bricks, which are produced using the FaL-G (Fly Ash, Lime and Gypsum) process. Calcium silicate bricks are also produced in Canada and the United States and meet the criteria of ASTM C73 - 10 Standard Specification for Calcium Silicate Brick (Sand-LimeBrick).

Fig 3. Sand Lime Bricks

LITERATURE REVIEW

Bagasse Ash as an Effective Substitute for Fly Ash in Bricks Apurva Kulkarni et.al. (2013) Industrial use of industrial and agricultural waste was studied for economic, environmental and technical reasons. Bagasse ash can be used by replacing it with fly ash and lime in bricks. Test blocks (230x100x75) mm were tested with different proportions of 0%, 10%, 20%, 30%, 40%, 50% and 60% fly ash replacement and 0%, 5%, 10%, 15% and 20% replacement of lime.

D. Tonnayopa green building bricks made of clay and sugarcane bagasse ash (2013) The behavior of the clay material used in the building clay brick industry with respect to the addition of sugarcane bagasse ash (SCBA) was studied. Mixtures of clay and SCBA in the ratio of 10-50% by weight were hydraulically uniaxially pressed and sintered at an optimized temperature of 1050 °C. The partial replacement test results of the SCBA specimens were performed by chemical and mineralogical analysis (X-ray fluorescence and X-ray diffraction), thermal analysis (differential thermal analysis, TG), bulk density, water absorption and compressive strength analysis. It has been shown that SCBA can directly affect the properties of sintered clay brick products. It acted as a melting pot, so it became a light clay brick with the energy efficiency of an ecological brick..

Use of sugarcane bagasse ash as brick material, Mangesh V. Madurwar, et.al (2014) Brick making process was weighing and batch making, raw material feeding, material mixing, hopper mixing device, hopper to conveyor, conveyor to brick mold, wet brick stacking and healing Density and equivalent energy are directly proportional to each other. Thus, compressive strength and equivalent energy are each inversely proportional to the mass percentage of the mixture. As the mass percentage in the mixture increases, the compressive strength decreases, while the corresponding energy consumption decreases.

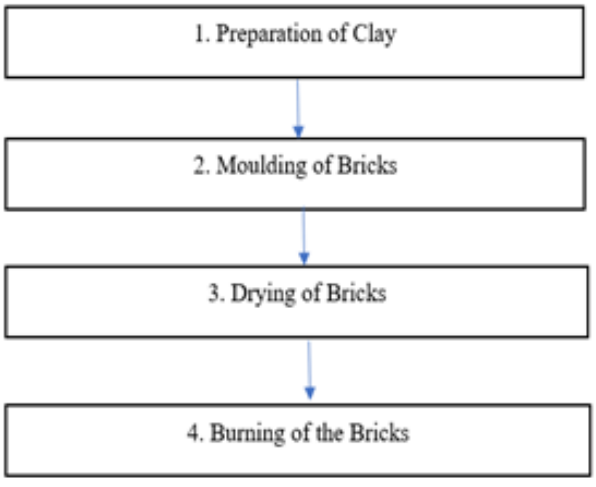
Recovery of Sugarcane Bagasse Ash (SCBA) for Clay Brick Production, G. Viruthagar et.al. (2014) Sugarcane bagasse ash (SCBA) is a fibrous waste product of the sugar manufacturing industry. Sugar cane ash (SCBA) mainly contains silica, ions, calcium and aluminum. In this paper, bagasse ash is chemically and physically characterized and partially replaced by 0%, 5%, 10%, 15% and 20% ash by weight of clay bricks. The samples were fired at a temperature of 800-1100 ºC. X-ray fluorescence, thermal analysis 14 (differential thermal analysis, thermos gravimetric analysis) and texture (particle size analysis), compressive strength, porosity, water absorption and shrinkage test were performed to characterize the samples. The results showed that the amount of ash to be added depends mainly on the clay, but also on the composition of the ash, and showed that the clay used in this work can contain up to 15% by weight of ash to produce solid bricks. Arati Shetkar et al. experimental studies of fly ash-based lime bricks. (2016) A study on fly ash bricks as a structurally, functionally and economically superior alternative to traditional gunpowder bricks because these bricks are produced without cement. The raw materials for these

bricks are fly ash (60% to 80%), lime (10% to 20%) and gypsum (10%), which are hand fed into a pot mixer and enough water is added for thorough mixing. Based on test results, FaL-G bricks are safer, more economical and stronger than traditional bricks. Making Eco-Friendly Bricks

Venkatesh et al. (2017) Application of Fly Ash and Quarry Dust as an Effective Substitute for Cement in Brickmaking. The author studied three experimental mixing ratios such as cement (50%, 60%, 70%), fly ash (40%, 30%, 20%) and 10% quarry dust. Based on the test results, the author concluded that it is possible to replace the percentage of cement content with quarry dust up to 25% without significant deterioration of compressive strength and other properties. Objectives

1. To analyze the physical properties of bricks by incorporating bagasse ash and fly ash and combination of both.
2. To study the Compressive strength of the brick by adding Bagasse ash and Fly ash and combination of both in each brick.
3. To study the Water absorption test on brick by adding Bagasse ash and Fly ash and combination of both in each brick.

METHODOLOGY

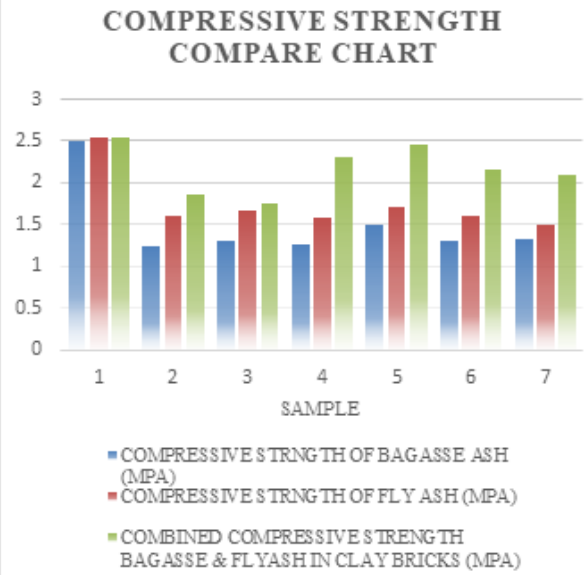


WORKDONE

Table shows the comparison chart of compressive strength of different proportion of Bagasse Ash, Fly Ash & Combined bagasse Ash & Fly Ash in clay brick.

Table 1. Table shows combined compressive strength for various proportions of Bagasse Ash, Fly Ash & Combined BA & FA in Clay Brick

Sample No.	Compressive Strngth Of Bagasse Ash (Mpa)	Compressive Strngth Of Fly Ash (Mpa)	Combined Compressive Strength Bagasse & Flyash In Clay Bricks (Mpa)
1	2.5	2.55	2.55
2	1.25	1.6	1.85
3	1.3	1.66	1.75
4	1.26	1.58	2.3
5	1.5	1.72	2.45
6	1.3	1.6	2.15
7	1.32	1.5	2.1

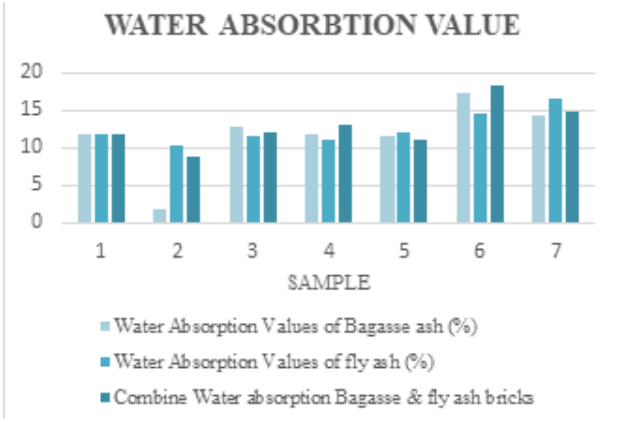


Graph 1. Comparative Chart for Compressive Strength

Table 2. Table shows combined water absorption ratio for various proportions of Bagasse Ash, Fly Ash & Combined BA & FA in Clay Bricks

Sample No.	Water Absorption Values Of Bagasse Ash (%)	Water Absorption Values Of Fly Ash (%)	Combine Water Absorption Bagasse & Fly Ash Bricks
1	11.8	11.8	11.8

2	1.82	10.2	8.7
3	12.8	11.5	12.1
4	11.65	10.9	13
5	11.4	12.1	10.9
6	17.35	14.5	18.3
7	14.25	16.5	14.8



Graph 2. Comparative Chart for Water Absorption Value

CONCLUSION

The project work was carried out by adding different % sugarcane bagasse ash, fly ash to increase the compressive strength of bricks. The result shows the satisfactory performance of green bricks based on experimental studies on compressive strength and the following conclusions are drawn from this work.

- The compressive strength of the brick increases when the ratio of the material, ie. bagasse, and fly ash increases (up to 20%). But after increasing the amount of material, the compressive strength decreases. At 30% magnification, small cracks appear.
- Note that the sample replaced with 20% bagasse ash and 20% fly ash, ie. (total 40%) gives the maximum strength for all proportions.
- Using both materials ie. (bagasse ash and fly ash) separately which also gives compressive strength but less compared to a combination of both materials.
- 20% replaceable bagasse ash gives a compressive strength of 1.45 MPa and 20% fly ash alone gives a compressive strength of 1.71 MPa. but the combination of both materials gives 2.40 MPa, which gives the highest compressive strength of the material used.
- Addition of more than 20% bagasse ash increases water absorption capacity, reduces compressive strength, reduces coarseness during combustion.
- We recommend replacing up to 20-25% of bagasse ash with clay bricks.
- The use of bagasse ah in brick can solve the disposal problem, reduce costs and produce "greener" environmentally friendly bricks for construction.
- This study can reduce the environmental impact of garbage and waste management problems.
- It reduces material cost per brick. Green energy bricks bring new innovation to housing construction. Bricks are structural, but also light.

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GIS Modeling of Groundwater of Jagantola Village of Bagh River Watershed (WGW-1/B)

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ABSTRACT

The geographical information system (GIS) is presently the most essential tool for groundwater mapping and modelling. The goal was to establish the pre- and post-monsoon water table analyses of Jagantola village in the Bagh river basin of Gondia district in Maharashtra, India. In prior years, there has been an issue with the appropriateness of groundwater for the research. In this work, groundwater table appropriateness was determined using GIS interpolation model methodologies. GIS interpolation methods are rapidly being used in water resources management, hydrology, and groundwater level monitoring, with geospatial approaches providing the most benefit. The district's climate is characterised by scorching summers and overall dryness throughout the year, with the exception of the southwest monsoon season, which lasts from June to September. The average lowest temperature is 6°C, while the average maximum temperature is 47°C. The district's average annual rainfall is between 1300 and 1500 millimetres. The yearly rainfall distribution in Gondia is quite irregular. Bagh is a tributary of the Wainganga river. To acquire the findings, a statistically significant examination of physicochemical characteristics and a GIS approach for groundwater modelling were used. To conduct the present analysis, prediction, and validation of geospatial groundwater level monitoring approaches, data on the conditions of the prospective water table site in the research region must be collected. The study's goal is to analyse groundwater modelling using GIS methodologies in Jagantola village, Bagh River district, Gondia. The figures and data may be utilised for future area monitoring, resource conservation, and restoration studies.

KEYWORDS *: Bagh River, Geographical Information system, Groundwater, Physicochemical parameters.*

INTRODUCTION

About 97% of the Earth's water is composed of salt water found in the oceans, seas, and salt groundwater. Approximately 2.5-2.75% of water on Earth is fresh water, with 1.75-2% frozen in glaciers, ice, and snow, 0.5-0.75% stored as fresh groundwater and soil moisture, and less than 0.01% found as surface water in lakes, marshes, and rivers. Groundwater is present as fresh water in extensive reservoirs enclosed by rock formations known as aquifers. Groundwater is highly regarded as a pristine water supply that can sustain the enduring needs of rural and urban areas.

Groundwater resources are the primary source of drinking water for the majority of people in India. These sources not only serve home purposes but also provide water essential for agriculture and small-scale industry. Water is the paramount natural resource for mankind, economic progress, and the environment. Groundwater is a crucial component of the water cycle, situated under the earth's surface and flowing gradually via aquifers. An aquifer is an underground reservoir that may hold water for extended periods, ranging from hundreds to thousands of years. Various factors such as geological formations, soil type, slope, drainage density, precipitation patterns, morphology,

and land use characteristics all impact the presence and movement of groundwater. Various studies have examined the physico-chemical and biological aspects of water. Accurate identification and mapping of geologic structures, geomorphic features, and trustworthy data on slope, drainage, lithology, soil, and thickness of weathered zones are crucial for evaluating groundwater resources in the area. Remote sensing, in conjunction with Geographic Information System (GIS), has become a leading technology worldwide due to its clear visibility, extensive coverage, high benefit-cost ratio, and access to data across various electromagnetic spectrum wavelengths. Conventional approaches of investigating hydrogeology. GIS is a very effective method for assessing the appropriateness of a region by analysing the spatial differences in hydrogeological factors. GIS offers various tools for analysing potential groundwater recharge in regions reliant on surface water by integrating data on geological structures, geomorphology, soil, lithology, drainage, land use, and vegetation. This is more efficient than traditional groundwater exploration methods, which are laborious and costly. A groundwater model is a scaled representation of the groundwater conditions, used to forecast the impacts of hydrological alterations in urban and rural regions, including the groundwater concept. Urban and rural water management is necessary because of the growing need for water for home, agricultural, and industrial uses. This research aimed to assess the influence of water samples on groundwater quality in the Bagh river catchment region of WGW-1/B, located in Jagantola village, Gondia district, Maharashtra, India, by statistical analysis and geographic information system.According to the 2011 census, the community of Jagantola village to 707 people spread out across an area of around 1.63 km2.

LITRATURE REVIEW

(Mayank Pawar et al.,2023)

This study shows how to draw a precise map of the geomorphology of an area of about 885 km²encircling the Bagh village in Madhya Pradesh's Dhar district. In order to complete the mapping, data collected by the IRS-P6 LISS-III satellite was utilized. Visual image interpretation has been employed to identify and characterize various geomorphic features. In order to accomplish this, the LISS-III sensor takes fake color composition photos and analyzes their color, tone, texture, size, and shape. Classifying different types of terrain, including pediplains, pediments, buttes, mesas, and plateaus, is the main goal of the research. An efficient and cost-effective strategy to accomplishing the study aims is made possible by combining remote sensing with GIS. The results of the maps' interpretations were confirmed through field verification. We now have a better understanding of the geomorphology of the study area thanks to the findings. Included in the study area are a variety of geomorphic features, such as buttes (0.12 sq. km.), mesas (0.83 sq. km.), less dissected plateaus (11.9 sq. km.), moderately dissected plateaus (334.02 sq. km.), water bodies (about 14.13 sq. km.), pediments (210.93 sq. km.), and pediplains (313.05 sq. km.).

(Faisal et al.,2021)

This study uses ARC GIS software to build a geographical model after researching the Bastora river basin's watersheds. The project was divided into three separate parts. To begin, we collected the results of fourteen morphometric features in order to set priorities. To determine how crucial each of these characteristics was, we used the AHP model. After that, these weights are used to determine the priority levels in (SDI, TOPSIS, and SAW) models. According to how easily they degraded, the outputs were divided into five separate categories. To provide the necessary information and resources for building the RUSLE model, a supplemental model will be created in the second phase. Finally, we compare the results from each model pair using the least squares tool. These model pairings are TOPSIS-RUSLE, SDI-RUSLE, and SAW-RUSLE. All of the previous model pairings show a robust and statistically significant connection in the results, but the one between the TOPSIS and RUSLE models stands out.

Malik and Shukla et al.,2019)

In this study A DRASTIC model based on geographic information systems was used to evaluate the susceptibility of groundwater pollution in the Tawa river basin in Hoshangabad, Madhya Pradesh, India. By including the model's several hydrogeological layers inside a GIS framework, the research aimed to identify potential groundwater contamination hotspots. In order

to assess the input model variables—which included things like hydraulic conductivity, soil type, topography, water table depth, net recharge, aquifer media, and aquifer media—the model included a number of sources. A vulnerability map for groundwater pollution was created using this assessment as its foundation. Based on the groundwater vulnerability map, a significant portion of the area, about 34.84%, falls into the high-risk zone for potential groundwater pollution. Extensive agricultural methods and the encouragement of recharge facilities in river basins greatly increase the zone's potential of pollution. A moderate amount of groundwater pollution affects around 54.84% of the area on both the eastern and western banks of the Tawa River. Groundwater contamination is unlikely to occur in a tiny area that comprises 10.32% of the hill slopes in the southern Satpura. This area is designated as a low risk zone. Furthermore, in order to confirm the accuracy of the model, thirty samples of groundwater were collected from the designated areas of groundwater sensitivity. The concentration of nitrate was determined by processing the samples that were submitted. The concentration of nitrate was less than 5 ppm in regions that were not particularly vulnerable. The nitrate content varied between 5 and 20 parts per million in regions that were moderately vulnerable. A nitrate concentration of 20–76 ppm was found in heavily polluted regions. As a result, given the current hydrogeological characteristics of the area, the used model approach is effective. When it comes to assessing and managing groundwater resources, the model is an excellent tool. agricultural methods and the encouragement of recharge facilities in river basins greatly increase the zone's potential of pollution. A moderate amount of groundwater pollution affects around 54.84% of the area on both the eastern and western banks of the Tawa River. Groundwater contamination is unlikely to occur in a tiny area that comprises 10.32% of the hill slopes in the southern Satpura. This area is designated as a low risk zone. Furthermore, in order to confirm the accuracy of the model, thirty samples of groundwater were collected from the designated areas of groundwater sensitivity. The concentration of nitrate was determined by processing the samples that were submitted. The concentration of nitrate was less than 5 ppm in regions that were not particularly vulnerable. The nitrate content varied between 5 and 20 parts per million in regions that were moderately vulnerable. A nitrate concentration of 20–76 ppm was found in heavily polluted regions. As a result, given the current hydrogeological characteristics of the area, the used model approach is effective. When it comes to assessing and managing groundwater resources, the model is an excellent tool.

(Venkateswaran and Deepa et al.,2015)

Evaluating water quality is essential for ensuring the safe and sustainable use of resources for human consumption, farming, and industry. In the Dharmapuri district of Tamil Nadu, situated in the Vaniyar watershed, sixty groundwater samples were methodically collected before and during the monsoon season. Understanding the groundwater's geochemical composition and assessing the region's general physical and chemical properties are the goals of this study. The Vaniyar watershed may be found between 11°46' N and 12°09'39" N on the latitude side and 78°12'27" E and 78°36'65" P. On a total of 982.25 square kilometers does it cover. Of this total, 591.43 km2 are considered flat terrain. On top of the hilly terrain surrounded by Archaean crystalline rocks is where the study site is situated. Results from groundwater analyses were compared to limits recommended for domestic and agricultural use by the WHO and the Bureau of Indian Standards (BIS). A number of physical and chemical criteria were used to draw the comparisons. The United States Salinity Laboratory (USSL) and Wilcox's diagrams are two examples of standard graphs that have been used to depict additional hydrogeochemical data. United States Salinity Laboratory (USSL) research indicates that the 452.75 square kilometer C3-S1 class is ideal for growing a wide variety of crops because to its excellent quality material. While most of the river's groundwater is fit for agricultural purposes, Wilcox's graphs show that there are certain spots with very high contamination levels. Since there were rocks that had been through a lot of weathering during field validation, this may be because of how the rocks and water interacted. Results demonstrate that 377.41 km²(61.67%) of the total area falls into the Good to Permissible category according to Wilcox, whereas 452.75 km²are categorized as C3-S1 according to USSL. The groundwater seems to be ideal for growing any kind of crop in the places indicated

before. Groundwater samples mostly fell into the C3-S1 group, indicating high salinity and low sodium adsorption ratio (SAR), according to the U.S. Salinity Laboratory map. This collection covers 452.75 square kilometers and is deemed "Suitable." A large number of areas have groundwater with persistently high salinity, as shown by the present study. Hence, sufficiently permeable soil with drainage capacities is required to enable crop growth in streams with high to very high salt.

PROBLEM OF STATEMENT

Due to the over exploitation of groundwater for uses such as agriculture, industry, and domestic. Regular increases in the concentration of dissolved components and ionic concentrations have been linked to the over exploitation of groundwater. An increase in groundwater contaminants such as chloride, total dissolved solids, nitrate, fluoride, etc. is a major concern for a long-term drinking water initiative and also declination in groundwater level. To satisfy society's water needs, preventative actions must be implemented to guarantee the sustainability of water resources. In most of the rural areas in the parts of the district there is no safe drinking water facility therefore before use of potable water public should take adequate precautions.

OBJECTIVES OF THE STUDY

1. To identify the accented and problematical study areas.
2. Assessment of Groundwater quality in the study area and related water quality problems.
3. To prepare water quality maps from physicochemical study of groundwater during pre-monsoon and post monsoon seasons for Jagantola Village of Bagh River Watershed (WGW-1/B).
4. To visualize the spatial variation of certain physico-chemical parameters through ArcGIS.

METHODOLOGY AND ANALYSIS

The methodology and analysis of groundwater includes physicochemical parameters such as temperature, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Chloride (Cl), Nitrate (NO3) and Fluoride (F). The analyzed data was then compared with the standards recommended by ICMR, BIS and WHO. The analysis of data for the seven parameters are shown in Table 1.

Table 1. Parameters, Methods and Equipment Used

Sr. No.	Parameters	Methods/Equipment
1	Temp/pH/EC	Temp/pH/EC Digital Meter
2	TDS	TDS Meter
3	Chloride	Titration using Mohr's Method
4	Fluoride	SPADNS Method
5	Nitrate	Spectrophotometer Method

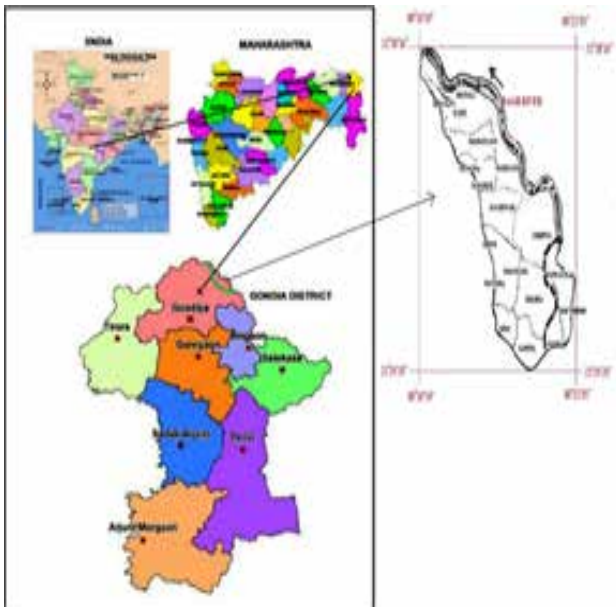

Fig. 1 Map of Bagh River Watershed, Jagantola Village

The groundwater parameter (shown in Table No. 1) samples were systematically collected for both pre-monsoon & post-monsoon season from different utilization perception areas like the main market, residential area & school of the Jagantola village of Bagh River Watershed (WGW-1/B), Gondia District shown in fig. 1. Samples were collected from the study area from various open wells and hand pump by grab sampling method. For physicochemical analysis, samples were collected in polyethylene bottles of one-litre capacity and stored in the laboratory at 4°C. Chemical analyses was performed by using APHA guidelines. AR grade reagents and double distilled water was used to make

the solutions for the analysis. Analysis was done to find the correlation between two tested parameters.

RESULTS

The results of analyzed data were used for GIS modeling of Jagantola village for both the seasons. All the physicochemical parameters were compared with water quality standards suggested by ICMR, BIS10500:2012, and WHO. Some of the parameters were not matched with water quality standards during the pre-monsoon and post-monsoon season.

Table 2: Post-monsoon and Pre-monsoon analysis of Jagantola Village Bagh River Watershed

Physicochemical Parameters									
S. No.	Source	Sample Location	POST-MONSOON ANALYSIS						
			pH	Temp	NO_3	TDS	EC	Cl	F
1	Open Well	Near H/o Narendra Chawan	7.8	26	62	1335	2086	465	2.05
2	Open Well	Near H/o Anat Bataikar	7.6	26	100	948	1481	247	1.94
3	Open Well	Near H/o Bhayalal Ukey	7.8	26	70	959	1498	237	3
4	Open Well	Near H/o Sudhakar H.	8.5	27	94	913	1427	203	1.265
5	Hand Pump	Near H/o Laharu Bisen	8	27	96	533	833	174	0.258
Total			39.7		422	4688	7325	1326	8.513
Average			7.94		84.4	937.6	1465	265.2	1.702
PRE-MONSOON ANALYSIS									
1	Open Well	Near H/o Narendra Chawan	7.88	26	5.711	252	894	25	0.41
2	Open Well	Near H/o Anat Bataikar	7.84	26	9.25	451	766	185	0.585
3	Open Well	Near H/o Bhayalal Ukey	7.86	28	4.478	281	766	260	0.525
4	Open Well	Near H/o Sudhakar H.	7.71	27	10.21	1272	206	120	0.737
5	Hand Pump	Near H/o Laharu Bisen	7.78	29	8.73	363	763	120	0.073
Total			39.07		38.379	2619	3395	710	2.33
Average			7.81		7.67	523.8	679	142	0.466

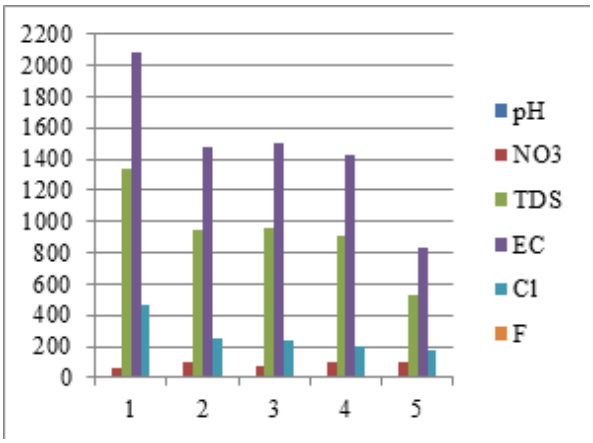

Fig. 2: Post-monsoon analysis Graphical Representation of Jagantola Village

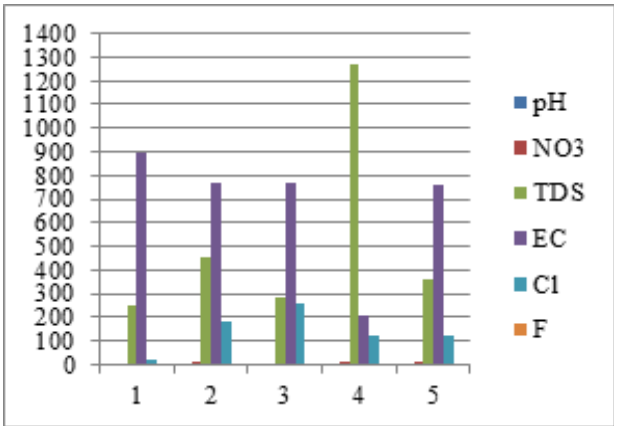

Fig. 3: Pre-monsoon analysis Graphical Representation of Jagantola Village

From the above analyzed data of various physicochemical parameters of BRW, it has been observed that most of the samples in Bagh River Watershed (WGW-1/B) are above the permissible limits as suggested by ICMR, BIS and WHO. Fluoride in Jagantola village is found higher during post monsoon. pH of samples in both seasons is above the permissible limit during pre-monsoon. Nitrate concentration of all 5 samples during post-monsoon are found above the ICMR, BIS and WHO desirable limits and within the limits during pre-monsoon in the village. TDS concentrations of sample No. 2 to 5 are found beyond the ICMR desirable limit and BIS permissible limit during post-monsoon and of sample No. 1 is above the WHO standard whereas during pre-monsoon sample No. 4 is above the WHO limit. Fluoride concentration of samples 1 to 4 during post- monsoon are above the

permissible limits as suggested by ICMR, WHO and BIS. Except above samples, other samples of Jagantola village are well within the limits during both seasons as shown in Fig. 2, Fig. 3 and Table 2.

GIS MAP RESULTS USING STATISTICAL ANALYSIS

1. pH- In the study area, pH of all samples in both seasons was observed as potable water with desirable limits as per WHO, BIS & ICMR with alkaline nature which covers 80% area (1.3km^2) during post-monsoon shown in Fig. 4 b and 100% area (1.63km^2) during pre-monsoon in the area of Jagantola Village shown in Fig. 4 a.

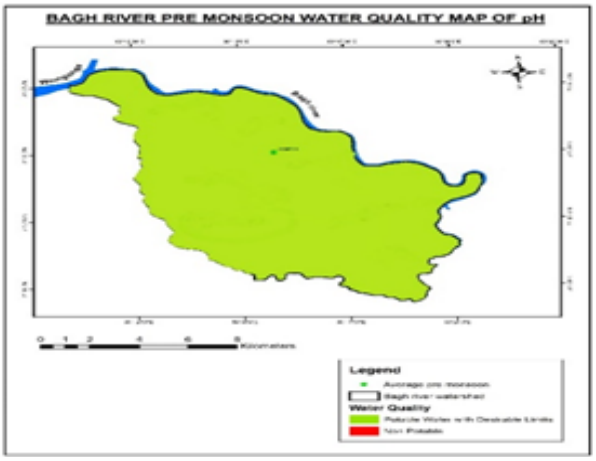

Fig. 4 a: Pre-monsoon Water Quality Map of pH, Jagantola Village

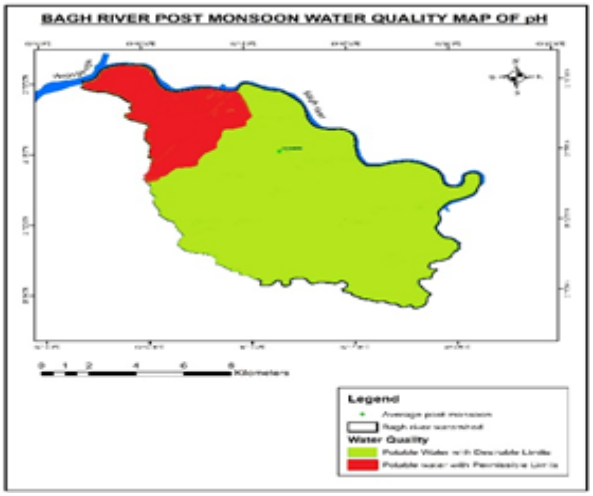

Fig. 4 b: Post-Monsoon Water Quality Map of pH, Jagantola Village

Electrical Conductivity (EC)- In Jagantola Village Electrical Conductivity of all the samples was observed within desirable limits during pre-monsoon in 100% (1.63 km2) area with potable water and during post-monsoon it was found within the limits except 20% (0.32 km2) area as shown in Fig. 5 a and Fig. 5 b.

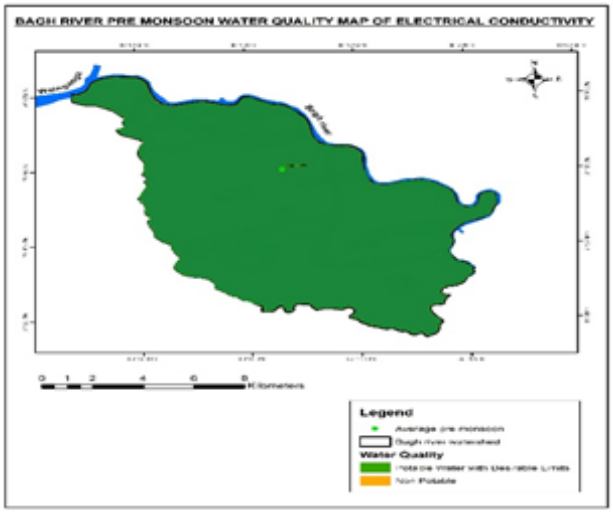

Fig. 5 a: Pre-monsoon Water Quality Map of EC, Jagantola Village

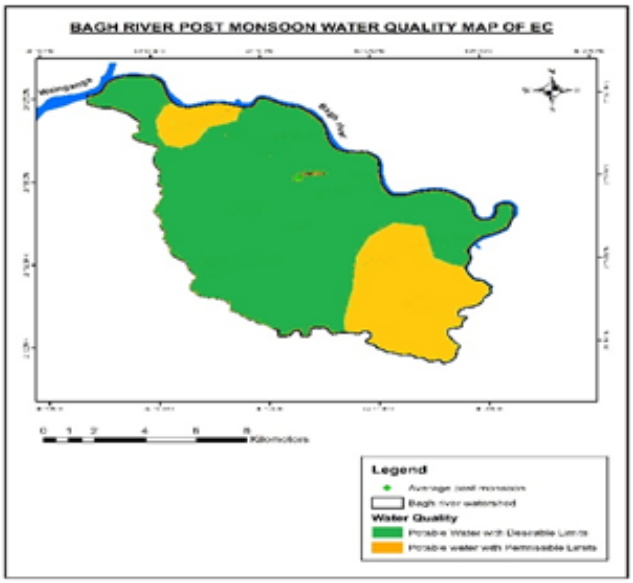

Fig. 5 b: Post-monsoon Water Quality Map of EC, Jagantola Village

3. Total Dissolved Solids (TDS) - TDS concentration in the BRW area was found 80% (1.3km2) area above the permissible limit during both seasons in which sample

no. 1 during post-monsoon and sample no. 4 during pre-monsoon was found above the desirable limit for Jagantola Village as shown in Fig. 6 a and Fig. 6 b.

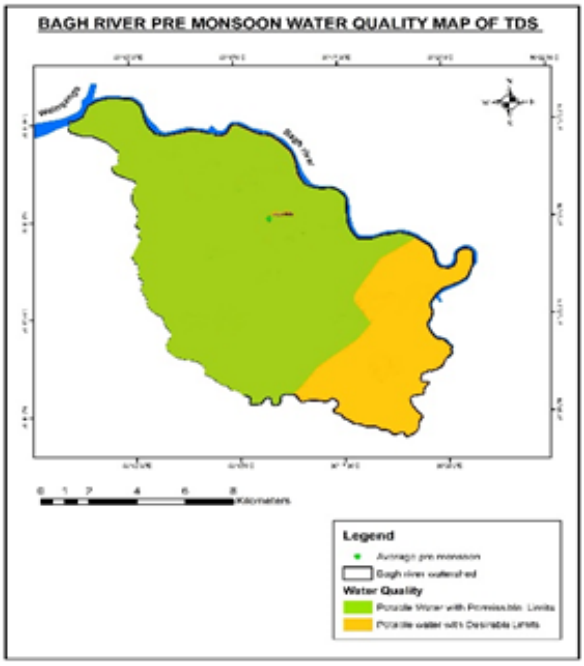

Fig. 6 a: Pre-monsoon Water Quality Map of TDS, Jagantola Village

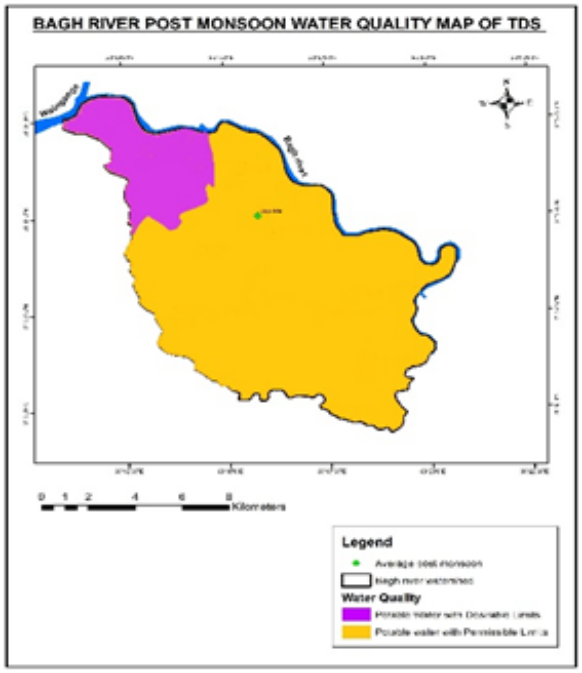

Fig. 6 b: Post-monsoon Water Quality Map of TDS, Jagantola Village

4. Nitrate - NO_3 concentration in Jagantola village during pre-monsoon was potable in 100% (1.63 km2) area within the desirable limit and during post-monsoon 100% (1.63 km2) area was observed as non-potable water according to the guidelines of ICMR, BIS & WHO as shown in Fig. 7 a and Fig. 7 b.

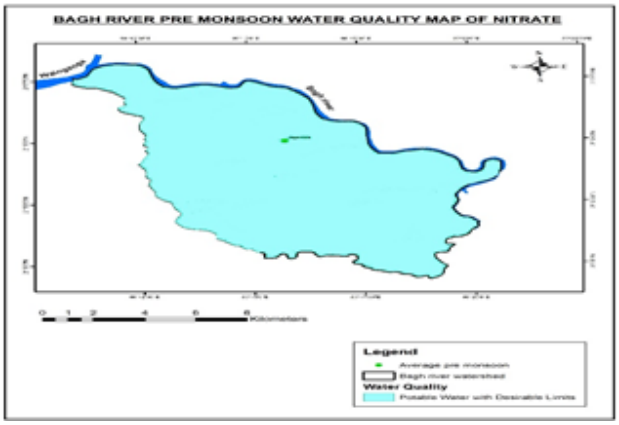

Fig.7 a: Pre-monsoon Water Quality Map of NO3, Jagantola Village

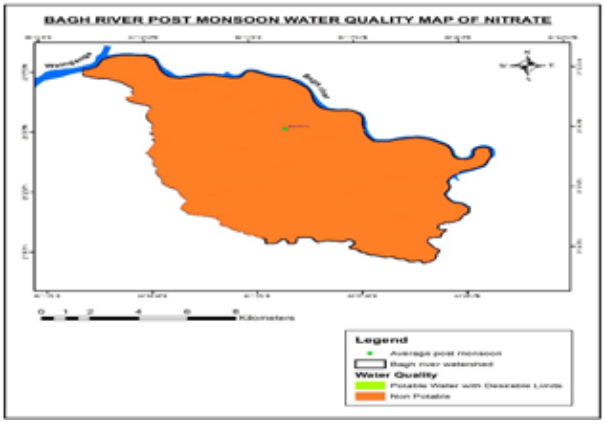

Fig.7 b: Post-monsoon Water Quality Map of NO3, Jagantola Village

5. Chloride- During pre-monsoon season the chloride concentration in the 100% (1.63km2) area and during post-monsoon in the 80% (1.3 km2) area was observed within the desirable limits as per BIS, WHO & ICMR in Jagantola village as shown in Fig. 8 a and Fig. 8 b.

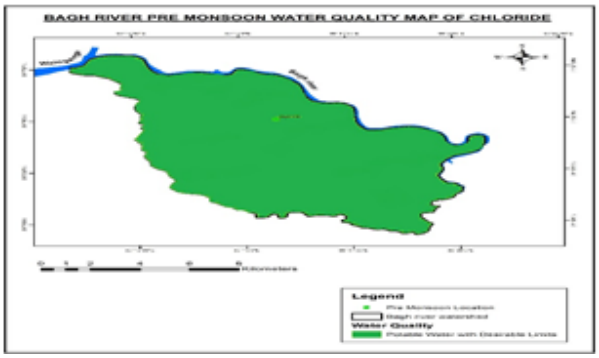

Fig. 8 a: Pre-monsoon Water Quality Map of Chloride, Jagantola Village

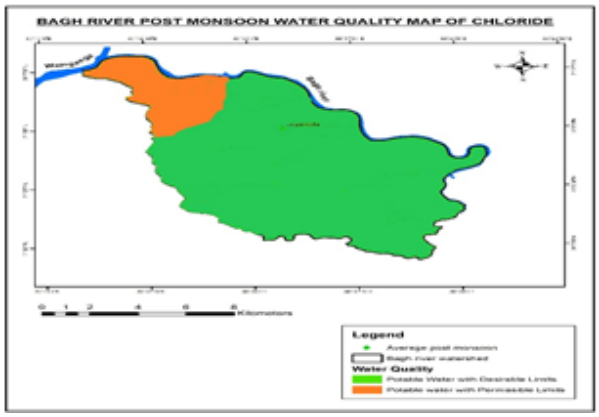

Fig. 8 b: Post-monsoon Water Quality Map of Chloride, Jagantola Village

6. Fluoride- During pre-monsoon season the fluoride concentration in the area was within the desirable limits and during post-monsoon it was above desirable limits except for 20 % (0.32 km2) area of Jagantola Village with non-potable zone as shown in Fig. 9 a and Fig. 9 b.

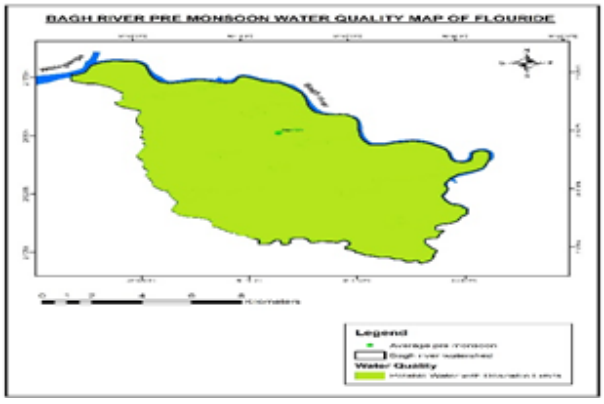

Fig. 9 a: Pre-monsoon Water Quality Map of Fluoride, Jagantola Village

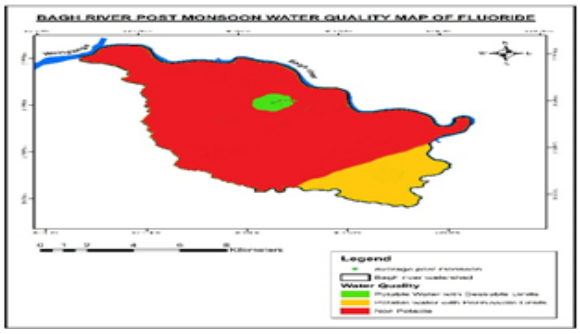

Fig. 9 b: Post-monsoon Water Quality Map of Fluoride, Jagantola Village

CONCLUSIONS

1. In the present study, the Jagantola village all seven physicochemical parameters are within the desirable limits except some of the samples of the village.

2. In Jagantola village of the BRW area pH values of 20% exceed the desirable limits during post-monsoon season which is due to the buffering action of carbon dioxide in water. The pH of the water naturally differs slightly.

3. During pre-monsoon the concentration of EC was found within the limits in 100% area and during post-monsoon in 20% area EC concentration exceeds the limits prescribed by BIS.

4. During both pre-monsoon and post-monsoon season, the percentage of TDS concentration in drinking rural water wells and pumps that exceeds the permissible limit in the Jagantola village of BRW region in which one sample 20% area was found above the desirable limit.

5. During pre-monsoon the concentration of nitrate in the study area was found 100% area with potable water and during post-monsoon 100% area was observed above desirable limits prescribed by BIS, WHO and ICMR. The huge variation in both the seasons may be due to anthropogenic activities in the study area.

6. Although the chloride content in the region was below acceptable standards before the monsoon season, it exceeded the World Health Organization's maximum guideline in 60% of the wells and pumps after the rains stopped.

7. The fluoride levels are well within the acceptable range during pre-monsoon period and 80% area during

post-monsoon season was observed above the desirable values prescribed by ICMR, BIS and WHO. Potential sources of fluoride contamination in the research region include fluorite and appetite, which are minerals high in fluoride. Fluorosis of the teeth and bones may develop when people drink water that has too much fluoride, exceeding the limitations set by various authorities.

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Innovative and Parametric Optimization for Photo–Catalytic Process

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ABSTRACT

Researchers have been exploring deeply the complexity of the slurry phase photo-catalysis process. The process has been understood at depth, yet it hasn't been optimized. Researchers have been unable to define a single performance parameter that can control the entire photo-catalysis process. In the present paper parameters of concern in a slurry phase photo-catalytic reactor have been reinvestigated. Based upon this a Universal Performance Parameter for the process has been defined. The literature exploration revealed that the parameters of concern of the photo-catalysis process are tightly interwoven and the whole process is very complex. Researchers have even suggested parameters that are reactor configuration dependent. . in the present work an approach is proposed to generate universally applicable and reactor configuration independent parameters. This approach will make the process analysis simple and will be dependable for the researchers in future.

KEYWORDS *: Slurry phase reactor, Photo –catalysis process, Universal process performance parameter.*

INTRODUCTION

Biodegradable organics are easy to be removed by biological treatment. Polysaccharides, lignin, phenolic material, cellulose, detergents, dyes pesticides, dyes etc and various organics having less solubility and resonant ring structures are known as refractory organics. They are very much resistant to biological decomposition. They offer hardship in wastewater treatment may be industrial or municipal [1]. Their concentration in wastewater is increasing with time. They cannot be handled by conventional wastewater treatment methods [1]. Such organics can be destructed using the strong photo-produced oxidation power of semi-conductor metals particulary TiO_2. This has been first reported by Frank and Bard [2]. In course of time researchers recognized many more semiconductors like ZnO, CuO_2, WO_3, Al_2O_3-CeO_2 and Fe_2O_3 [3 – 11], $CaBi_6O_{10}/Bi_2O_3$, MoO_3, ZnS, and CdS.

TiO_2 is considered as the most appropriate material as photo-catalyst. This is because of it is working in wider band gap; it has bio - chemical inertness, and it is photo-catalytically stabile. Moreover it is available easily and economical [12, 13].

During 1980s the researchers gave much recognition to the process of Slurry phase reactors (powdered TiO2 photo-catalysis). Later in 1990s Fujishima and their coworkers gave the idea of thin film based photo-catalysis in which the catalyst is deposited on a substrate [13]. Many more modifications of photo-catalysis reactors and their hybrids are in use presently [14 - 17].

Today slurry phase photo-catalytic reactors are the basic mode with several advantages [18 – 24]. They are simple in process modeling [25]. Researchers have identified the main parameters involved in the process as catalysts concentration, pH, temperature, dissolved oxygen level, organic pollutant concentration, wavelength of activation energy (light) and light intensity [12 – 14]. A simple slurry type reactor is schematically shown in figure 1.

The fig 1 also depicts pathway of UV radiation. The

source of UV radiation may be Sun or lamp. This is the simplest case of reactor configuration. Modifications are also there [26 -28].

The photo-catalysis is essentially driven by the photon of specific wavelength photon. Hence the availability of radiation 'everywhere' in the reactor is crucial. Thus the transmissivity of the slurry phase is very important. The transmissivity is a function of concentration of catalyst, pollutant and turbidity [29 – 31].

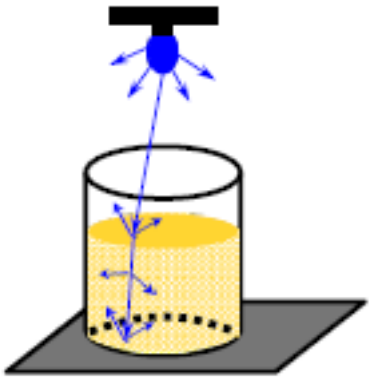

Figure 1: Simple slurry phase photo-catalytic reactor

An prototype design of photo-catalytic reactor requires optimization of all the process parameters as mentioned formerly. Most of the researchers have investigated these parameters independently and based upon their findings they have proposed optimum values. Some of the important works of this type are reported by [32 – 40]. It has to be noted that the process of photo-catalysis very is complex and its parameters are interdependent. In true sense parameters cannot be independently optimized. The parameters need to be optimized by a holistic approach. The present paper discusses the complex and interwoven nature of process parameters. It also puts forth the concept of a performance parameter. The parameter is simple and universally applicable.

Optimization of catalyst concentration

It is a well – established fact that the reaction rate is directly dependent on catalytic concentration. The (photo)-catalysis phenomenon essentially takes place catalyst surface. In semiconductor photo-catalysis the reaction occurs with the liberation of electron from catalysis surface. The electron emission takes place effectively only from catalyst particle in nano-size. Thus the effective catalyst concentration must be interpreted in terms of specific surface area of nano- particles. A good catalyst must have larger surface area per unit mass/volume.

Higher concentration of catalyst may even have retarding impact on the reaction. The higher concentration will make the slurry excessively turbid thereby reducing the radiation accessibility in the remote areas of the reactor. Thus the optimum catalyst concentration found thorough an experimentation is specific to the intensity of radiation.

In fact the optimum catalyst concentration is also dependent upon pH of the slurry because pH greatly influences the agglomeration/separation of catalyst particle which in turn decides the effective surface area available for reaction [29, 34, 35].

The Optimum Concentration of Organic Pollutant

Many researchers have worked on this aspect [41, 42]. On one side higher concentration of pollutant will increase interaction probability of it with the hydroxyl radical. Therefore the reaction rate will be more. Simultaneously higher concentration of pollutant will decrease the radiation penetration thus the overall reaction rate will be less. Hence the value of optimum pollutant concentration depends on radiation intensity and catalyst concentration.

The Optimum Radiation intensity

The photo-catalysis is light driven. Ideal sufficient photons should be available on every point on the catalyst surface at all times so that they can keep all the conduction band electrons emitted. This is the higher limit of photon intensity. More light will be unused and wasted. Effect of light intensity on kinetics of the reaction kinetics has been studied [43 - 47].

The optimum light intensity is also a function of catalyst concentration. Catalyst particles reflect and scatter the light thus causing less light to be available in the remote zones of the reactor. At the same time the light is also attenuated by pollutants in wastewater. Therefore the optimum light intensity is a function of the both, the catalyst concentration and the pollutant concentration.

The process parameter

The objective of this paper is to evolve the concept of a process parameter which is reactor configuration independent and describe the process kinetics effectively. In order to do this, radiation attenuation function for the given concentration of catalyst and pollutant need to be determined experimentally. This will enable estimating the light intensity at any location in the reactor. This way a radiation profile for the reactor can be established. Practically the reaction kinetics can be determined at grid points in the reactor and the values can be integrated. Else, the average light intensity can be obtained from the radiation profile and efficiency estimation can be done.

In general the photo-catalytic reaction can be described as

$$\frac{dC}{dt} = \frac{(C_o - C_t)}{\square t}$$

Where C_0 and C_t are the concentrations of pollutant initially and at time t. The equation is specific to the design and operating parameters including surface area of catalyst particles, concentration of organic material, average intensity of radiation, pH etc. While working with the photo-catalysis process, it is desirable that one for the given source of UV light and depth of reactor, one finds out working concentration of catalyst and organic pollutant and then the other parameters are optimized one by one. Then only the reaction kinetics will be independent of reactor configuration and universally acceptable.

CONCLUSION

Photo-catalysis is rapidly getting popularity for wastewater treatment. The parameters of concern are large in number and highly interwoven. It is not feasible to deal them separately. Rather it is irrational. The researcher and plant design engineers are advised that in order to develop universally acceptable kinetic parameters of the process, they must first decide the working range of catalyst and pollutant concentration for the intensity of UV Light available. This should be decided from the transmissivity considerations. It is recommended to develop a radiation attenuation function for the catalyst concentration and pollutant concentration being used. They must also decide the depth of reactor from practical consideration. Then other parameters can be sequentially optimized.

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Sullage Treatment by Photo-Catalysis

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ABSTRACT

Sullage, the wash water of bathrooms, is also known as grey wastewater1. Detergent is the main impurity in this. Considering the modern day problem of water scarcity, there is a great need to purify this water and reuse it. However conventional technologies are not successful in treatment of detergent containing wastewaters. Photo –catalysis is a promising technology for these wastewaters. In the present work, sullage of SSBT's College of Engineering and Technology Bambhori, Jalgaon has been treated by photo –catalysis. The process parameters are first optimized. The optimization is done using artificial samples (dissolving detergent is the distilled water). An indigenous rector using UV lamps has been designed for reactions. Raw sullage is characterized. Then it is treated under optimum conditions of process parameters using solar energy. It is found to be effective and viable.

KEYWORDS *: Sullage, Photo catalysis, Detergents, Optimization.*

INTRODUCTION

Water is a precious resource in 21ST century. Water pollution is a great crisis. Earlier BOD had been a major concern in wastewaters. With the development in science and technology; its impact on our life style and industrialization, the wastewater characteristics have also changed 2. Now days, non-bio degradable organics are increasingly present in wastewaters. They have got persistent nature and they join food chain. They exhibit carcinogenity, mutagenity, genetic disorders, allergies and other disorders 3. Conventional water/ wastewater treatment techniques are unable to remove them. Adsorption, ultra filtration etc can remove them but it is simply phase change. Photo catalysis is the only technique to completely demineralize them. The present work is for the removal of detergent from sullage, the wastewater of bathrooms. Detergents not only cause health impacts by join food chains, they cover water surface and hinder aeration.

The synthetic detergents are made from petrochemicals 4. The first forerunner of today's synthetic detergent was made in 1834. Basically the petroleum industry had, as a waste product, the compound propylene, CH_3-$CH{=}CH_2$. By joining four of these propylene molecules together and if benzene is attached at the double bond, the resulting compound reacts with sulfuric acid. Then sodium hydroxide is added to neutralize and a sodium salt is obtained. The substance thus obtained is an excellent detergent.

The photo-catalysis process

Oxidation is a process in which a molecule emits out electron. There must be an electron acceptor available to receive the electron. Chemical bonding with oxygen is called as oxidation as oxygen is an electron acceptor. Oxidation of organic molecules is generally results into their breaking down to simpler compounds finally leading to mineralization as CO_2 and H_2O. Most of the organic wastewaters can be mineralized with help of biomass. Yet there are non-biodegradable organics. Photo-catalysis is very effective in their mineralization. It is described as:

Semiconductor + UV rays = semiconductor+ + electron

$H_2O = H+ + OH-$

OH- + semiconductor+ = OH* + semiconductor

OH* + organic matter = $CO_2 + H_2O$ + minerals

The commonly used semiconductor is TiO_2. The reaction is driven by photonic energy in UV range. The same can be obtained from UV lamps or Sun.

Earlier it was thought that the non-biodegradable organics are essentially non-recyclable by nature. However nature had a mechanism that was recognized later 5. Naturally the phenomenon was going on since ever. Goodeve and J. A. Kitchener noticed it first in 1930s 6. The technology can be applied to wastewaters for cleaning up. The technology is now being used in slurry phase reactor as well as in fixed bed reactors 7. The present work has used the slurry phase reactors. The process variables this type of reactors are identified by Chong et al 8 e.g. intensity of radiation, starting concentration of organic pollutant, concentration of photocatalyst, particle size of photocatalyst etc.

Selection of photo-catalyst

METHODOLOGY

The methodology has two parts, characterization of materials, and reactor design.

Particle size and surface area determination of photo-catalyst

Photocatalysis is a phenomenon that takes place only with nano-size of the particle. The particle size is determined by Transmission Electron Microscopy (TEM) and by X-ray Difractometry (XRD). These values are adopted from Ph D thesis of Suhas 10. The specific surface area is taken as 50 m^2/g.

Characterization of Detergent

The commercial detergents are complex mixer of basic detergents, boosters, binders, flavoring agents including the enzymes too. The work has been focused on the commercial detergents surf Excel. Detergent solution is prepared dissolving 1 g detergent in 1 L distilled water. The properties are given in Table 1.

Parameter	Value
pH	8.0
Phosphorous	5 mg/L
Kjeldahl Nitrogen	50 mg/L
Chloride	300 mg/L
Sulfates	250 mg/L

UV Radiation Flux Source

In the present study two types of sources are used. Sunlight, the natural source for outdoor experiments and UV lamp for indoor experiments. Characterization of the both sources of UV radiation is done by monochromater (Jobin Yvon Spex, HR-640, France) having photo multiplier tube (Hamamatsu, Photonics K. K., Type-R446HA, No.VU9293, spectral range 0 -1300nm)

UV Radiation Measurement Technique

Accurate measurement of radiation is essential as it is the driving force for the phenomenon of photocatalysis. Hence during experimentation, in case of solar radiation driven photocatalysis as well as artificial source of radiation. Radiation is measured by Radiometer

Radiometer:

The radiometer used in the present work is International Light, USA, Research radiometer, named IL-1700. It is having dynamic range 1 x 10^{-9} to 2.0 W/m^2 with a spectral range of 200 - 400.

Characteristics of Sunlight:

Fig 1 shows the characterization of solar radiation. Peak of UV spectrum band is found to be at 381 nm.

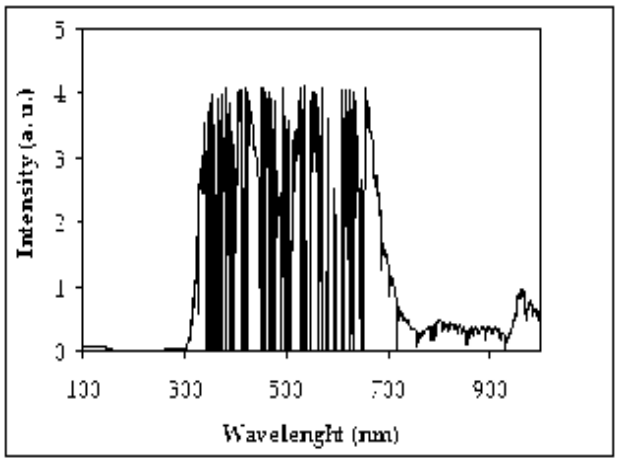
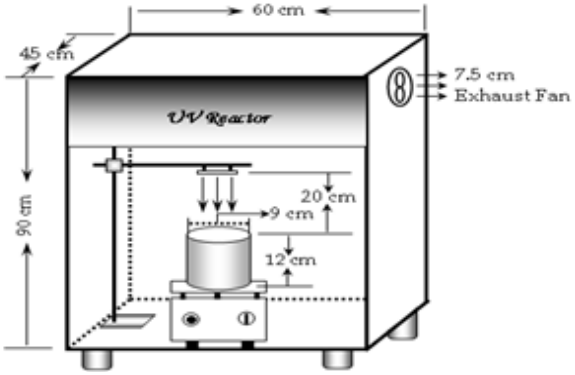


Fig 1: Spectrum of solar radiation

For indoor medium pressure mercury vapor lamps - Narva UVK-125 W (Germany) are used. Characterization of the same is shown in figure 3. Peak of UV radiaon is at 334 nm.



Indigenously designed reactor

Fig 2 COD as a probe parameter

The detergent is a complex mixture of boosters, binders, basic detergent etc. They all will get oxidized due to photocatalysis. The specific degradation of detergent can be monitored by spectrometric analysis. But in a complex system, it is better to observe the overall picture. Hence COD has been taken as a probe parameter to observe the overall mineralization. It serves the objective of study better. Moreover COD is a parameter that can be observed accurately and easily.

RESULTS AND DISCUSSION

In the present work process design/process parameters are optimized. In photo-catalysis technology, researchers have given optimized values of the parameters. Yet mostly they have selected the range of variables in arbitrarily. The complex process of photo-catalysis process has interwoven parameters. Researchers have described that individual parameters cannot be optimized owing to their interwoven complex10. The present work has used the same approach. In this approach a set of operating and design conditions are optimized rather than an individual parameter. The practical range of catalyst concentration and effective depth of reactor for the light intensity are taken as <200 mg/L and <15 cm respectively. The detergent concentration is taken as 1000 mg/L as this is the most common value of detergent in domestic wastewater. With reference to these the other parameters are optimized.

There are several semiconductors which exhibit photo-catalytic activity like Fe_2O_3, ZnO, ZnS, WO_3, V_2O_5, SiO2, SnO2, Al2O3, CdS and TiO2. However, TiO2 is the first choice of the researchers owing to its economical availability and higher reactivity. Its anatase form is more reactive. Commercially available Degusa P- 25 form has been recommended by Pierre Pichat9. The same has been used here.There are several semiconductors which exhibit photo-catalytic activity like Fe_2O_3, ZnO, ZnS, WO_3, V_2O_5, SiO_2, SnO_2, Al_2O_3, CdS and TiO_2. However, TiO2 is the first choice of the researchers owing to its economical availability and higher reactivity. Its anatase form is more reactive. Commercially available Degusa P- 25 form has been recommended by Pierre Pichat9. The same has been Optimization of pH:

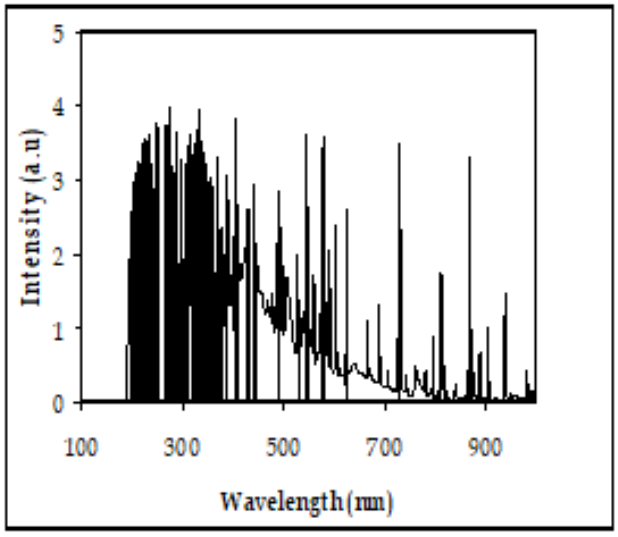


Fig 3: Spectrum of UV lamp radiation

pH is one of the most important operating parameters affecting the following parameters: electric charge on the catalyst particles, size of aggregates of catalyst etc. Any variation in the operating pH will affect the isoelectric point of the photocatalyst used. This has been investigated by many researchers11 – 13. pH needs to be optimized at the initial stage. The pH has been varied from 5.0 to 10.5 by HCL for lowering and by NaOH for elevating. Too high too low pH may be impracticable for field applications too. While varying the pH, the catalyst concentration, detergent concentration and liquid depth in reactor are kept as constant, respectively

200 mg/L, 1000 mg/L and 15 cm. COD of the slurry has been monitored at an interval of 30 minutes. The results are shown in fig 3.

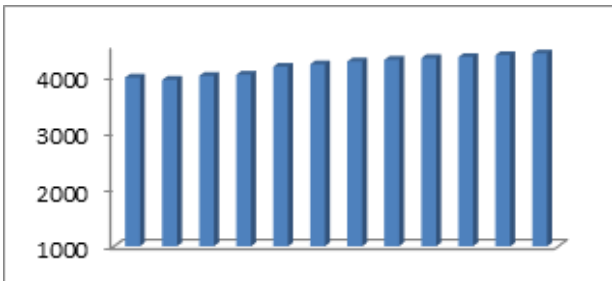


Fig 4 Optimization of catalyst concentration

Number of researchers have reported the effect of TiO2 loadings on the photo-catalysis efficiency14 – 16. Yet they have worked independently and results are not comparable. Patil10 has proposed the range of catalyst to be <200 mg/L with reactor depth to be 15 cm. In order to optimize the catalyst concentration, it is varied from 50 mg/L to 200 mg/L, at an interval of 25 mg/L. pH is kept as 5.5. The results are shown in fig 5.

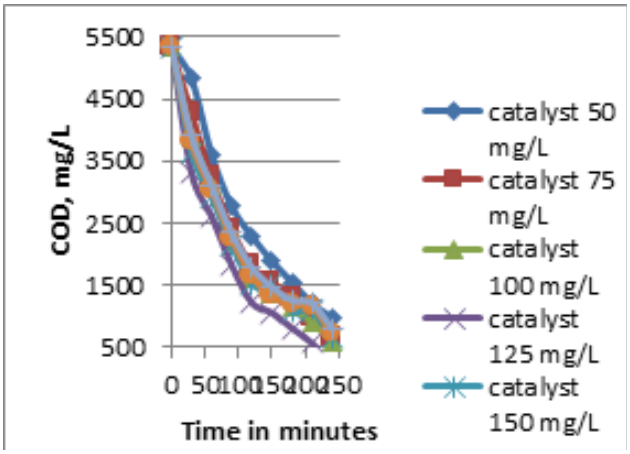


Fig 5: Effect of catalyst concentration on COD removal rate. Detergent concentration = 1000 mg/L, pH = 5.5

It is clear that maximum reaction rate is observed with catalyst concentration 125 mg/L.

Optimization of detergent concentration

Researchers 11 – 13 have investigated the effect of pollutant concentration on kinetics using synthetic wastewaters. Researchers 17 – 21 have done studies using real wastewaters. However, the photo-killing mechanism is as yet unclear as it involves a variety

Detergent concentration is varied from 500 to 2000 mg/L at a step of 250 mg/L. The results are presented in fig 6.

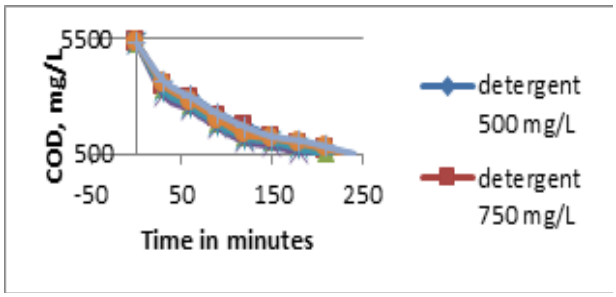


Fig 6: Effect of detergent concentration on COD removal rate. Catalyst concentration 125 mg/L, pH = 5.5

The highest removal rate is observed at detergent concentration of 1250 mg/L.

Optimization of temperature

The photo-catalysis is a complex process. According to Arrhenius theory the higher temperature will enhance the reaction rate. Temperature also promotes the recombination of charge carriers and disfavour the adsorption of organic compounds onto the TiO2 surface. Thus, the temperature needs optimization. Dependency of photocatalytic reaction on temperature has been explored by 21 – 23.

In this study the temperature higher than ambient is achieved by heating mechanism of stirrer and lower is achieved by room air conditioner.

The results are depicted in fig 7.

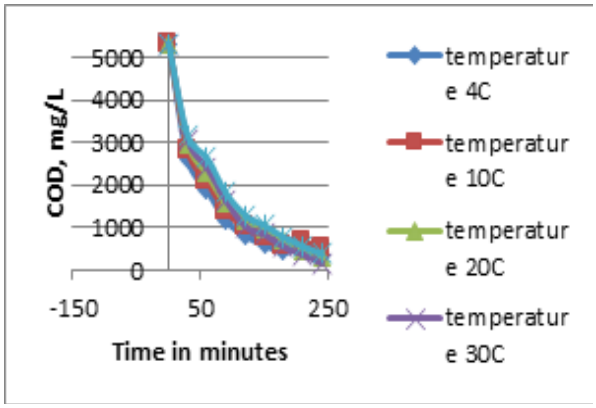


Fig 7: Effect of temperature on COD removal rate of detergent. pH = 5.5, catalyst concentration 125 mg/L, detergent concentration 1250 mg/L

Final set of optimal parameters:

The experimentation has resulted into set of optimum parameters. As summarized in table 2.

Table 2

Summary of optimal parameters

Parameter	Optimal value
pH	5.5
Catalyst concentration	125 mg/L
Detergent concentration	1250 mg/L
Temperature	100C

Characteristics of sullage:

The wash water coming from bathrooms in COET Campus has been characterized as shown in table 3.

Table 3

Tapi river coordinate in chopada & shirpur region Latitude: 21° 20' 53.56" N and Longitude: 74° 52' 49.26" E. According to the Code of Practice for Using Plant Protection Products, pesticides are defined as substances, preparations, or organisms that are formulated or applied to control pests. A major global issue is environmental pollution. Agriculture has become a prominent contributor to water pollution in enumerations of sources. While countries try to address maltreatments of their water assets, it is important to decide the reasons for water quality corruption and to measure contamination commitments from numerous sources. Table .2

Characteristics	Unit	Value
pH	-	7.6
COD	mg/L	210
BOD5 @ 200C	mg/L	55
Alkalinity	mg/L as CaCO3	22
Phosphorous	mg/L as P	3.2
Kjeldahal nitrogen	mg/L	12
Chloride content	mg/L	113
Sulfate content	mg/L	14
Detergent content	mg/L	87
Electrical conductance	130	micro-Siemens per cm

The sullage is treated under the optimum conditions, given in table 3. The experiment is performed by keeping the glass beakers under open sky. The solar radiation varies during the experimentation. It is recorded every 30 minute interval and its average value is used. The solar radiation is measured by solari-meter. The experiments are done around the solar noon duration, 12 O' Clock in day. The results are presented in fig 8, three set of experiments are performed.

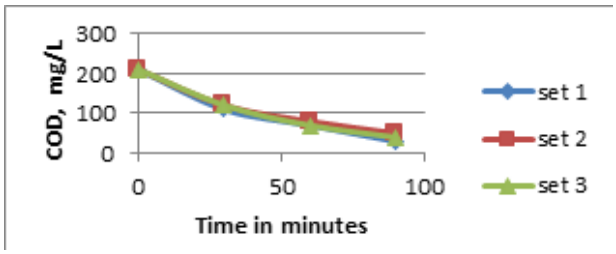


Fig 8: Degradation of sullage under solar radiation. pH = 5.5, temperature = ~30^{0}C, solar radiation ~ 250 W/m^2, catalyst concentration 125 mg/L, depth of reactor = 15 cm.

Total solar radiation is measured by solari-mete. The UV radiation may be taken as 5% of the total (250*5/100 = 12.5 W/m^2).

CONCLUSIONS

1. Researchers have established that presence of detergents in irrigation water has drastic impact on the soil productivity. Yet the authorities like Indian Standard Institutions and Central Board of Pollution Control have not established the permissible limits.
2. Photo-catalysis is successful in complete demineralization of detergents.
3. The photo-catalysis process is complex. It has so many variables interrelated. Here an approach is presented to optimize the variables.
4. The results can be applied to design a full fledge sullage treatment plant.
5. The results can be used to design industrial wastewater treatment plants.

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Innovative and Sustainable Techniques of COD Removal

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ABSTRACT

Today's world faces the problem of water scarcity and various solutions have been developed to solve this problem. The best way to solve this problem is to create an economical and cheaper way to provide publicly available and sustainable water. Water, one of the most important and valuable things in the world, is a source of great concern because changes in its content can endanger society and health. However, in today's ever-changing world, this ideal has changed surprisingly. Increasing world population, urbanization, industrialization and unbalanced human consumption are important priorities that will have an impact on the world's freshwater resources. Limited water resources have claimed millions of lives, especially children who need water to maintain their metabolism. The quality of life is directly related to and quality of water that consumed. In the market various method is available to remove COD but chemicals used in this method is harmful and expensive. The aim of the our research is to remove COD without using harmful chemical and economically. In this research study the material are ubiquitously available in the nature. Currently, water scarcity affects 40% of the world's population, and this number is expected to increase in the future.

KEYWORDS *: Adsorbents, Adsorbate,,Coconut husk, Jamun leaves, Maize, COD, Wastewater.*

INTRODUCTION

The aim of the our research is to remove COD without using harmful chemical and economically, in this research we use the binds of sorbents which are easily available Now that more than a year has passed and the world is dealing with the ongoing wave of the coronavirus pandemic, there is an urgent need for optimal purification of all types of wastewater and water because connection between wastewater and water, two of which are ubiquitous in our home society. Wastewater treatment incurs marginal cost to taxpayers; this pays monetary tax and franchise tax if publicly managed and costs are incurred if privately manage.

Objectives of the research

1. Remove COD economically and sustainable
2. Prepare various blends of sorbents and repeat the studies.
3. IT study the kinetics of removal of contaminates using the selected sorbents .
4. Prepare blends of sorbents under the varying ratiosstudy the COD removal rate
5. Prepare the sorbents from coconuts, neem, rice husk.

Figure 1 : Neem Power

This research over here was trial and error method as various blend ratio of mixes would have been tried but here only blend ratio were used of 4 sorbent (Neem Leaves, coconut husk, jamun leaves and maize) viz. 1:1:1:1, 2:3:4:5, 1.8:2.5:3.5:4.5.

Sr. No.	Initial Concentration	Equilibrium percentage removal of COD at various concentration		
		Neem Leaves	Jamun Leaves	Maize
1.	300mg/l	87	86	95
2.	500mg/l	83	82	90
3.	700mg/l	60	79	86

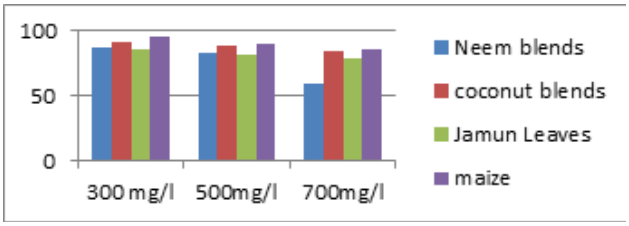

Figure 2 :- Comparision of Percentage COD Removal

CHARACTERIZATION OF ADSORBATES

This above table shows the characteristics of adsorbent near lendi nala, pimprala, whose location is shown on google earth in the preceding chapters. The COD and TDS are highest in this wastewater, but due to time constraints only COD was taken as parameter of study to treat the wastewater by adsorption Alteration of Initial Concentration and contact time on percentage.

Parameters	Characteristics of Raw Wastewater at sampling Site
pH	7.4
Total Solids	1200 mg/l
Total Dissolved Solids	1102 mg/l
Total Suspended Solids	80 mg/l
Alkalinity	335 mg/l
BOD	457 mg/l
COD	855 mg/l
Total Nitrogen	5.8 mg/l
Sulfate	118 mg/l
Nitrate	1 mg/l

Figure 3 : Characteristics of absorbates

The batch adsorption experiments were conducted by altering the initial concentration of the adsorbents viz. Neem Leaves, Coconut Husk, Jamun Leaves and maize to study the rate of percentage removal of COD. The experiments were conducted at constant adsorbent dose 3 g/l, constant agitation speed of 150rpm, constant temperature 20°C, at constant and optimum pH of 7.2, but at Different initial concentrations viz. 300 mg/1, 500 mg/l and 700 mg/l. removal of COD by Neem leaves,Coconut husk, Jamun Leaves and Maize.

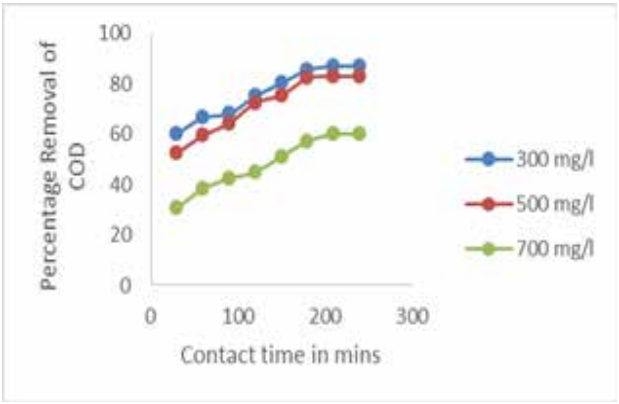

Figure 4 Neem leaves

The neem blend of neem made at different concentration and at the different cotact time , time time to attain was 210 mins. S the initial concentration of adsorbate is increased from 300 to 500 mg/l the percentage removal of COD decreases, as the less surface sites are available for the adsorption due to repulsion between adsorbant and adsorbate.

The bends are made from the neem leaves decreases COD from 86 % to 60%.

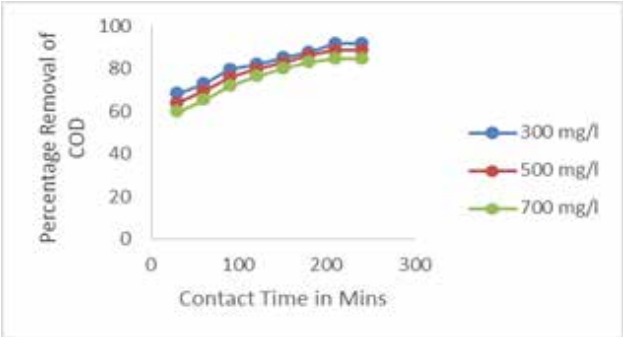

Figure 5 : Coconut husk

Effect of Initial Concentration and contact time on percentage removal of COD by Coconut Husk the concentration of the COD due to the coconut husk blends is 92 % to 85%.

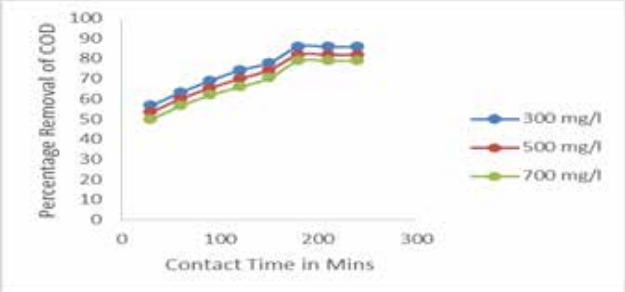

Figure 6 : Jammun Leaves

Effect of Initial Concentration and contact time on percentage removal of COD by Jamun Leaves is 86% to 79 %.

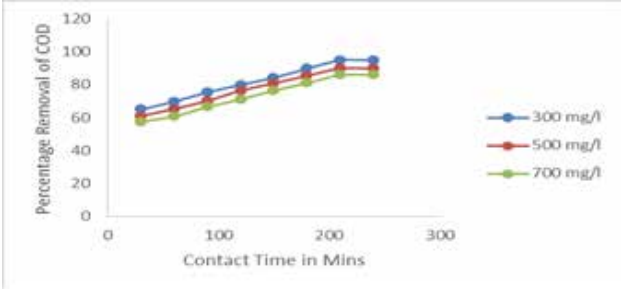

Figure 7 : Maize

Effect of Initial Concentration and contact time on percentage removal of COD by Maize. This maize blends is more effective than other blends.

Percentage removal of COD is rapid in all the 4 adsorbents for the first 150 mins and then it proceeds at slower rate and then it finally attains saturation and attains equilibrium. This happens because Initially the surface sites are available, so rapid adsorption takes place outside the surface but slower inside the pores.

As the initial concentration of wastewater was accelerated, the percentage removal of COD decreased from 87 to 60% (for Neem Leaves), 92 to 85% (for Coconut Husk), 86 to 79% (for Jamun Leaves), and 95 to 86% (for Maize), this may be due to thefact that initially, the surface sites are available, so adsorption take place rapidly at outer surface, with further increase in the initial concentration led to the faster saturation of surfaces of the above four adsorbents and adsorption took place slowly inside the pores.

RESULTS

The sorbent Neem leaves has the lowest bulk density .The sorbent neem Leaves is highly soluble in moisture which causes colossal problems in maintenance and operation. The specific surface area is the highest in case of Maize, so the rate of adsorption is faster in case of Maize and number of active sites available are highest in case of Maize and it readily removes the pollutant from wastewater.

The average pore diameter and pore volume is highest in case of maize which in turn increases the rate of adsorption and also increases the number of active sites for adsorption.

FUTURE SCOPE

In the present research, only one of the parameter i.e. COD was taken into consideration for the removal from wastewater, one can consider other parameters viz. Total solids, BOD, TDS etc. for removal from wastewater by using the same adsorbents.

This study is devoid of Cost analysis and economics for the treatment of wastewater and adsorbent preparation, one can take this as research initiative and work on the same.

As blends give better result, so a separate research can be initiated for the same by trying different blend ratio of different adsorbents.

CONCLUSION

The method used over here was trial and error method as various blend ratio of mixes would have been tried

but here only blend ratio were used of 4 sorbent (Neem Leaves, coconut husk, jamun leaves and maize) viz. 1:1:1:1, 2:3:4:5, 1.8:2.5:3.5:4.5. It was found that blends too give better results and are explicit and conclusive. The following can be inferred from here:

In all the cases at constant temperature adsorbent dose, initial concentration, pH and is attained in 180 mins and in some cases 100% of removal of COD is found with this blend.

Other blend ratios could have been tried but it would have increased the cost burden and also no doubt it would have given better results.

On comparing blends and parent adsorbent, the percentage removal is more and also the attainment of equilibrium occurs 30 mins earlier than the parent sorbent, which indicates that blends are better than the parent sorbents.

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Effects of Fire on the Flexural Strength of Reinforced Concrete Beams

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ABSTRACT

Concrete stands out as one of the most widely employed building materials worldwide. Numerous scientists and researchers are actively exploring the development of alternative construction materials that are both environmentally friendly and supportive of sustainable development. The escalating generation of fly ash waste from thermal power stations poses a significant challenge in terms of disposal, leading to various environmental concerns.

Also, buildings are accidently subjected to fire hazards, during fire the temperature of concrete may go high. Elevated temperatures have the potential to induce the formation of cracks in concrete. Similar to cracks in any other material, these cracks can propagate and, over time, result in the compromise of structural integrity, leading to a shortened service life.

In this investigation, fly ash is employed as a substitute for cement in the composition of concrete. Replacement is done up to 10 % with the increment of 5%. After curing of 28 days each Reinforced concrete beam specimens of fly ash based concrete will be exposed to open fire at elevated temperature of (100^{O} C, 200^{O} C, 300^{O} C, 400^{O} C, 500^{O} C, 600^{O} C, and 700^{O} C). After temperature regimes The flexural strength of concrete incorporating fly ash is assessed, and The achieved outcomes are juxtaposed with those of the control specimens.

KEYWORDS *: Concrete, Fire, Flyash.*

INTRODUCTION

Pozzolans are substances that lack inherent cementitious properties but exhibit cement-like characteristics when exposed to calcium hydroxide (lime) and water. Although many modern pozzolans are still sourced from natural deposits, a significant amount is produced by burning powdered coal in the process of electric power generation, commonly known as fly ash.

Currently, the ASTM classifies pozzolans into three main categories: Class N, Class C, and Class F. Class N comprises natural pozzolans such as calcined shale and calcined volcanic ash. Class F includes fly ash primarily derived from anthracite, bituminous, and certain sub-bituminous coals. On the other hand, Class C is generally produced from fly ash resulting from the combustion of lignite and some sub-bituminous coals.

In 1983, the total fly ash production in the USA reached 52.4 million tons, with 3.6 million tons being used in cement and concrete products. An additional 5.3 million tons were allocated for various purposes like mud stabilization, agriculture, and as raw material for cement manufacturing. The remaining quantity was disposed of in landfills. [1]. The essential constituents of concrete consist of Fine aggregates (FA), coarse aggregates (CA), cement, and water constitute the essential components of concrete. A significant

environmental issue linked to cement production is the release of CO2, a major greenhouse gas contributing to global warming. Acknowledging the detrimental effects of cement production on the environment, substitutes like fly ash, ground granulated blast furnace slag, rice husk, and silica fume are utilized. Due to its cost-effectiveness compared to Portland cement, fly ash serves as a significantly cheaper material, enabling substantial replacements and resulting in noteworthy economic savings. According to [2], a 25 percent reduction in material costs was estimated.

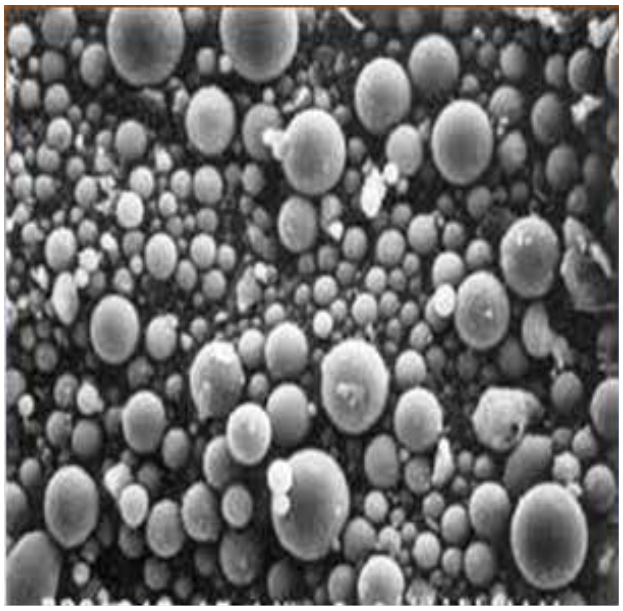

Fig 1. Micrograph fly ash particles

Laboratory assessments of concrete typically occur under controlled and often constant temperatures. Initial testing, conducted in temperate climates, frequently selected a standardized temperature ranging between 18 to 21 degrees Celsius. As a result, a considerable amount of foundational knowledge regarding both the characteristics of fresh and hardened concrete is derived from examinations conducted at these specific temperatures. Nevertheless, in real-world scenarios, concrete is mixed and used in conditions encompassing a wide range of temperatures. This temperature variation has notably expanded, particularly with contemporary construction happening in nations characterized by hot climates and novel projects, especially offshore, unfolding in extremely cold regions. Traditionally, researchers have used the strength properties of concrete as a metric to evaluate its performance. However, there is now widespread recognition that the assessment of concrete performance should encompass both strength and durability under anticipated environmental conditions.

Effects of High Temperature

Under typical circumstances, the majority of concrete structures experience temperature variations within the range dictated by ambient environmental conditions. However, there are crucial instances where these structures might face considerably higher temperatures, such as during building fires, chemical and metallurgical industrial processes where concrete is in close proximity to furnaces, and certain nuclear power-related accident scenarios. Concrete's thermal characteristics are more intricate compared to most materials. This complexity arises not only from concrete being a composite material with diverse constituent properties but also from its properties being influenced by moisture and porosity. Elevated temperature exposure impacts the mechanical and physical properties of concrete.

Effects on Strength of Concrete

The findings suggest that heightened temperatures during the initial phases adversely impact the subsequent strength development of concrete. Many scholars have investigated the negative impacts of elevated temperatures on the enduring strength of concrete. The accelerated hydration rate caused by higher temperatures hinders the subsequent hydration process, leading to an uneven distribution of hydration products. This unevenness stems from the limited time available for the diffusion of hydration products away from the cement particle at a high initial hydration rate, impeding uniform precipitation in the interstitial space. As a result, this displacement of hydration products from the cement particles promotes consistent precipitation in the interstitial space. As a result, there is a buildup of the products in close proximity to the hydrating particles, leading to a subsequent postponement in hydration and impacting the development of strength.

EXPERIMENTAL WORK

Physical properties of all the material use in concrete is determine and some specifications are mention below

Cube specimens with dimensions 150*150*150 mm.

Concrete Grade: M25

Cement : Ordinary Portland Cement .

Fly Ash: obtain from deepnagar thermal power station

Coarse aggregate: Crushed basalt stones

Fine aggregate: Sand obtained locally

Water: 175 Liters (Water-to-Cement ratio = 0.50)

Curing period: 28 days

2.1 Design Considerations for Beams

Concrete beams with dimensions of 150 x 150 x 700 mm were constructed with each beam cast in three layers. The entire construction utilized M 25 grade concrete. The chosen beam size adheres to standard dimensions for a regular beam, meeting the criterion of an effective span to depth ratio exceeding 2 (as per IS 456 - 2000, clause 29.1, page 51). Thermo mechanically treated (TMT) bars with diameters of 2-8 Φ were employed for compression, while 2-10 Φ bars served as tension reinforcement. Shear reinforcement took the form of 2-legged stirrups provided by 6 Φ @ 125 mm center-to-center spacing. All reinforced conceret specimens will below casted and Tested after 28days of curing.

Fig 2. Specimen with R/F

Specimens Exposed to open Fire

Each reinforced concrete beam sample will be subjected to exposure in an open fire at temperatures ranging from 100 degrees Celsius to 700 degrees Celsius in increments of 100 degrees Celsius.

The tabulated data presents the dry weights of both the fly ash-based reinforced concrete specimens and the controlled beam specimens before and after heating.

Table 1. Dry Weight of Beams Before and After Heating

Sr no	Specimen	Weight of Beam before Heating (kg)	Weight of Beam After Heating (kg)
1	NB	41.32	41.32
2	NRB	41.13	41.13
3	RB-100	41.07	40.9
4	RB-200	38.69	38.47
5	RB-300	39.32	39.03
6	RB-400	40.46	40.10
7	RB-500	39.87	39.44
8	RB-600	38.29	37.77
9	RB-700	41.60	41.00

Observations & Test Setup

For every specimen deflection at center of beam on right and left face of the beams are recorded by using the dial gauges. The deflections are recorded at every 10 KN intervals of loading till the ultimate failure of specimen. The first crack load and its corresponding deflections are recorded. The load is applied up to the failure of specimen. Four point loading system is used. The test is conducted as per the procedure given in IS 516.

Fig 3. Experimental Test Setup

Table 2: Comparative Results Of Flexural Strength& Elastic Properties

Sr.no	Specimen	Load (N)		flexural strength (N/mm2)	
		Normal Concrete	Fly Ash Based Concrete	Normal Concrete	Fly Ash Based Concrete
1	NRB	79090	78000	14.061	13.867
2	RB-100	71190	70000	13.638	13.423
3	RB-200	67070	65760	13.048	12.771
4	RB-300	62730	61380	12.429	12.230
5	RB-400	61700	60200	11.347	11.135
6	RB-500	56270	54800	10.616	10.414
7	RB-600	54830	53240	9.983	9.790
8	RB-700	51960	50210	9.420	9.207

Flexural Strength

For normal concrete beam flexural strength is 14.061 N/mm2 it is observed that there is optimum reduction in strength is upto 4000c. When the specimens are exposed to fire above 4000c there is major loss in strength is observed at 7000c and the loss is about 33%. Similarly for fly ash based concrete beams flexural strength is 13.867 N/mm2 It is noted that the optimal reduction in strength occurs up to a temperature of 400 degrees Celsius. When the specimens are exposed to fire above 4000 c there is major loss in strength is observed at 7000c and the loss is about 33.3%.

CONCLUSIONS

Drawing conclusions from the outcomes of this experimental study, the following observations can be made: Elevated temperatures represent a significant physical degradation process that impacts the durability of concrete structures and may lead to undesirable structural failures. The exposure to high temperatures brings about substantial alterations in the physical structure of reinforced concrete beams.

In general, it can be concluded that the majority of fire-affected RCC structures can undergo repairs. However, when subjected to elevated temperatures exceeding 400°C, reinforced concrete beams experience a notable decrease in flexural strength.

The steel reinforcement remained unaffected up to a temperature of 400 °C; however, beyond this threshold, it experienced substantial deterioration. This deterioration significantly impacted the yielding strength of the steel, Additionally, there was a significant decrease in the flexural and load capacities, as well as in the compressive strength and modulus of elasticity of the concrete. Flexural strength & load carrying capacity for beam exposed to fire at 700oC were less than that of reference beam is by about 34.30% & 33.06% respectively.

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Latest Developments in Utilizing Solar Radiation in Corrosion Removal Maintenance Techniques Towards Environment Protection and Enhanced Life of Steel Structures

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ABSTRACT

Incremental demand in the maintenance and repair industry required economical solutions for corrosion removal. Due to various causes, damage within any structure occurred because of corrosion . This corrosion not only harmed the economy but also the lives of the people. Nowadays corrosion is the major important reason of the failure of the structure and this occurred due to because of not provide maintainace to the structure, because current method available in the market is very tedious and skilled labor is required for it.

By considering this problem we developed an effective solution for removes the corrosion but also increases the life of the structure , the mechanism used to remove corrosion is know as Sanjivani , this method is based on the principle of V-Intensity and Concentration Light. various method available in the market is not economical and effective than Sanjivani method. Our motto is to develop such corrosion removal method which economical and easy to use because we connect the various harm occur due to the failure of structure is occur because of corrosion. To remove corrosion we developed V-Intensity equation, with the help of V- Intensity equation we changed the intensity of light according different materials.

KEYWORDS *: V- Intensity, Sanjivani, Solar radiations.*

INTRODUCTION

These solar radiation technique is the renewable technique with the use of this technique the maintains is occur economically, the mechanism used to remove corrosion is know as Sanjivani.

Scientific approach of corrosion detection and protection

To solve this problem effectively and cost-effectively, careful selection must be made. A comprehensive inspection is required to detect faults and evaluate the area of damage. Corrections will be made depending on the situation. We hope to choose the best treatment for home. The recovery process often depends on which element carries the load and which element uses the load.

Visual inspection

Using corrosion removal V power method, we can easily remove corrosion as engineers using this model can inspect the model. This is the easiest way to remove corrosion. In this way, we use solar energy to eliminate

corrosion and with the help of solar energy we can easily remove corrosion.

Board

The institutional level includes gathering information about the terrain, collecting information about materials, or classifying hazards/hazards.

Non – harmful analysis experiment

Cement aggregate mixture or roller-compacted concrete components can be subjected to various negative analyzes and many properties of the product can be determined. These various tests are useful in assessing hazards in concrete or reinforced concrete. Prevent external damage from rust caused by chemicals and other causes. This test includes load capacity or resistance to deformation, quality, etc. It does not affect the structure in any way. This test can be done on-site or in a closed laboratory.

INNOVATIVE STRATEGIES IN STRUCTURAL REPAIR

Figure 1 : Anti-corrosive Treatment.

It's an regular process for specific covering (layering) structure to guard the iron or any ore. External surface of member from chemical of weather action likes rust this coats consist of electron, iron , metal , natural lubricant , beeswax, auto deposition power coating preservation of coats are similar to phosphate preservation coats increase efficiency of oil-distemper paints etc. To connect about metallic or iron external face.

Zinc coating area unit sometimes created passive area covering by preventing coat about reinforce steel thus rust prevention about initial fashioned covering opposed to creation or generation of colorless corrosion ' it can be an easily removable coat about metallic element OH- and HCO3-.

Votive anti-cathode electrode prevention

(VAEP) could be formed about anti-anode prevention wherever not so much as imperial matter which behaves similar to Votive anti-cathode joined through silver as material to allow flow of current to system and then member which we are protecting. The applicable material for this are metallic elements.

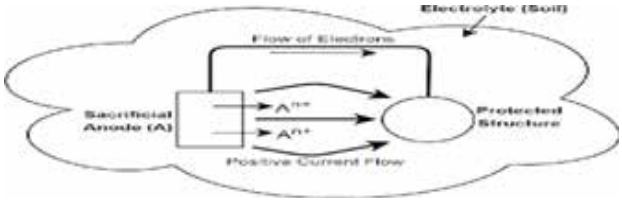

Figure 2 : Cathodic Protection.

Electrode Guard (e.g.) known as identical solely automation used for obstruct erosion by chemical action at certain RCC structural element not withstanding compound in chlorine together with other elemental group and its amount within RCC element. Atoning otherwise voltaic accelerator opposite to cathode-method in purpose construction material applicable lot of susceptible ore metal line (opposite to cathode) like metallic elements as an alternative (In -Al – Zn) forms a shear movements of positive or negative electrons putting to finish opposite to cathode structure area unit supported works on assumption about differing or unlike ore rust. Therefore parallel location or comparative position about various ores within that galvanize chain electricity made through potential latent dormant variation betwixt anti cathode and RCC once join . Putting to finish anti-cathode can rust through this method and use exhaust completely.

Externally applied power supply through electrode safeguard (E.A.P.S.E.S).

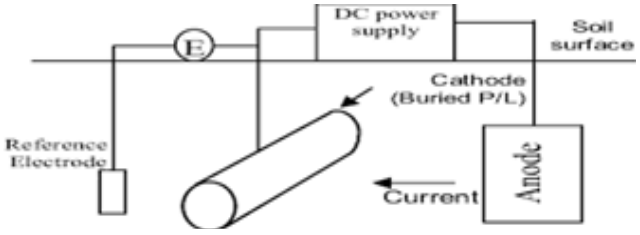

Figure 3 : Exter

Externally applied power supply through electrode safeguard

(E A P E S) Embrace about putting to death anti cathode join to non-internal electric supply. Non internal supply could be direct current offer delivers the demand or need for working electro chemical response to electrode guarding be form within the in consistency or stoppage or direct current supply generator adopt join to alternate current may be utilize various origins are required for power supply to the chemical science unite considering blast, star, vapour electric supply creator. Correlated power electrode guard structure area unite theoretically utilize by comparatively joint system.

Wherever unassertive anti anodic guard ways area unit not effective else theoretical preferable they rely upon non-artifial voltage betwixt anti cathode ,anti-anode (EAPSES) Structure applied to non- internal source of supply mandatory theme is powered thus incremental power made its potential to electrode guarding reach broad expand space where as (EAPSES) structure area unit a lot of effective passive counter-parts they needed a lot of equipment and also costlier to keep up.

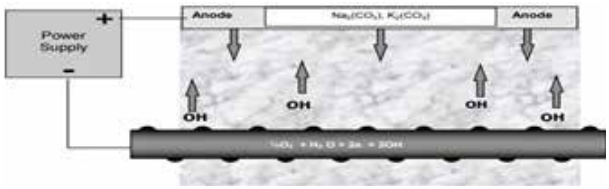

Figure 4 : Electrochemical Re-alkalization (ERA)

Mixture of carbon and iron of very high temperature made of this material outside face or exterior face about destruction region or zone also kept ready about a minimum of a close colorless ore end. Exterior face establishment traditionally took spot at a parallel time about connecting destruction, detrition, external surface or any other surface synchronization may have been carried out through ultra-high force per unit area done by liquid explosion aggravating and gas.

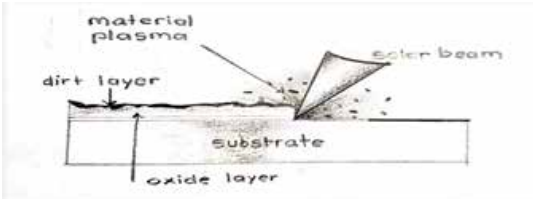

Figure 5 : Application of V-Intensity (VI)

1. Solar cleaning is the environmentally friendly and sustainable process. Applicable to remove corrosion, organic matter, iron oxide, other oxide and other contaminated material from metallic surface, it is very economical and effective; it requires 1800-degree Celsius temperature at maximum working efficiency.
2. Current cleaning techniques are very complicated, time consuming and require large amount of capital costs also human efforts requires in it and they can get affected by dangers chemicals needed for the process. E.g., Existing paints are clean by sand blasting can be damage the metal below it.
3. From this point we can understand that our method is effective, fast, environment friendly Easy to use, do not require well train labors, this method is the future of the maintenance and repair.

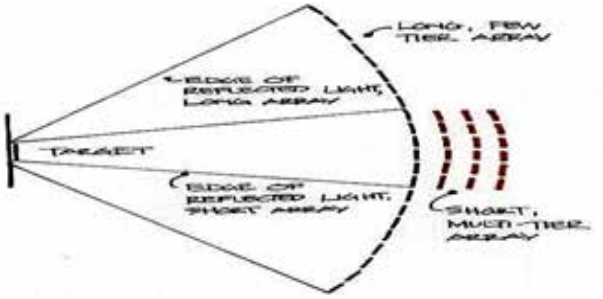

Figure 6 : Light Reflection Priciple by Our Way

APPARATUS

Mirror 5x5 with specified vacuum.

Silica optical fiber which has melting point above 20

Dial gauge with specified control on intensity.

Opening nozzle concentrate out the intensity of V- int Control valve

Principle of V- Intensity

Thought our observation and research we found that every material surface has desired point of temperature where specified layer gets vaporized, this process is used in our corrosion removal method.

V= mDdk

Where,

V = energy required

m = mass

Dd = Temperature

K= Constant of V-intensity (generally 0.014)

Application of the V- intensity:

a. V-intensity

b. V- intensity used for cleansed pipeline, nuclear power plant, cleansed rust of the bridge parts

c. Remove rust before and after the welding this point we can understand that our method is cost effective, fast, environment friendly Easy to use, do not require well train labors, this method is the future of the maintenance and repair.

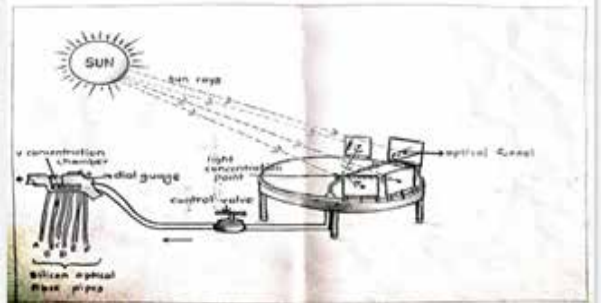

Figure 7 : Diagramatic Representation of Sanjavini Method

PROCESS

1. The setup the vacuum will help to adjust the

parabolic mirror, focal length to generate desired energy at every point is done by arranging mirror longitudinally and angularly. The mirror panels are design to have artificial intelligence to move along the direction of sun and most important to keep the focus of energy on a same point at any time it will also calculate and adjust focal length by programmable Arduino with pressure to current and vice versa, input output with relation to natural environmental change also.

2. The point ABCDEFVV' are properly worked and kept ready the energy from point A is carried through silicon optical the length of these cable from AV', BV', CV', DV', EV', FV' are kept same.

3. The energy concentrated is collected through energy funnel of standard optical properties at every point then it is transferred through optical cable from point to concentration chamber. (The valve is used to regulate flow of energy and also emergency overload.)

4. Concentration chamber the energy from various optical pipes is concentrated inside the chamber which has very high melting point the solar intensity is maximum by fusing is together the high energy is directly applied on the surface of material and rust is removed.

5. The V- intensity for every material is calibrated in dial gauge as per the material or coat to be removed. It will be calculated by a standard given formula V= mTtk

6. The energy shooted from the nozzle or opening of gun will remove the corrosion layer fully then in worst condition a secondary or a miscellaneous treatment also be used by using a well proportionate mixture of baking soda or sprinkle salt with raw potato or mixture of lemon, vinegar, potatoes, abrasive, barax, baking soda, salt in proper proportion.

5. Hardest situation phosphoric acid (50% case) and nitric acid (25%).

RESULTS

By comparative results we conclude that the current corrosion removal method are available in market is not as much effective as our method. As with any machine, most of its components are fixed, while some are replaceable. such as tools or machines and their products constant and continuous services like removal of the corrosion and others. As the after removal of corrosion by v intensity method we done tensile testing on it after that we found that it regain its original strength. Due to this corrosion removal method material is trial to regain its original strength .with the help of this method 95% of corrosion is removal by using sustainable and economical method. Every material has different melting point so according to that we developed a equation and according to it we apply certain intensity on it.

CONCLUSION

Due to the use of V- intensity method we fulfill our major important aim at the time of corrosion removing do not affect the strength of the material , we remove corrosion effectively by using the V- intensity method , the number of V-Intensiy is vary according the nature

of the material Our motto is to develop such corrosion removal method which economical and easy to use because we connect the various harm occur due to the failure of structure is occur because of corrosion. To remove corrosion we developed V-Intensity equation, with the help of V- Intensity equation we changed the intensity of light according different material.

The process is done in small portable plant with brushes, washing, cleaning, rubbing; application is possible with manual and mechanical means. This step is very easy to perform and mostly not requires to use just given in any case of failure of miscellaneous problem.

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Assessment of Water Quality Index for River Tapi at Shirpur - Chopda Region and Mitigation Measures for Pollution Control

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ABSTRACT

Tapi is a major river in North Maharashtra that is primarily used for drinking water irrigation and industrial purposes. It flows through three major states, with Gujarat having the largest catchment area. In the middle of its session, there is an established relationship between one associated plant and the Tapi River, which is polluted by agricultural, domestic, and industrial waste. It has several small and medium sized cities located along the river's main stem and tributaries. Because of this, the river takes in a lot of organic waste from upstream. The amount of harmful industrial discharge is very lesser, but agricultural discharge is most commonly collected from its own catchment area; such activities are most common in the river's final 45 km stretch (Chopda to Shirpur) The primary objective of this research is to investigate the pollutant range at each intake point and the causes of Tapi Water contamination. Samples were collected from 9 multiple places, each 5 kilometres apart. Both steady and flowing test conditions were run for pH, turbidity, DO, COD, BOD, chloride, fluoride, coliform, and heavy metals. These boundaries were chosen dependent on drinking water quality norms for the country.

KEYWORDS *: Water quality, Industrial discharge as well as agricultural practices.*

INTRODUCTION

During the modern age of civilization, the agricultural, industrial, and in many more areas have undergone enormous development, followed by global warming, other environmental issues, and pollution of fresh water. "Pollutant" is a term used to describe organic waste, inorganic waste, as well as pesticides and other chemicals used to kill or control pests. There are herbicides (weeds), insect sprays (creepy crawlies), fungicides (parasites), (nematodes), and rodenticides (vertebrate toxins) utilized in agribusiness. In the waste stream of industries, it includes pesticides, pharmaceuticals, chemical, agrochemical, paper & pulp, soap & detergent. All of the above cited pollutant are reasonably more potent to damage the water quality. Our world is globalizing at a rapid pace and developing and developed countries are increasingly concerned about

water availability. A feasible utilization of water sources may include the quest for extra water sources or even the reusing of wastewater treatment plant effluents (10). The issue of drug deposits in the climate is turning out to be progressively perceived nowadays. They are utilized in human and veterinary medication, just as in creature farming (11). As most medications enter target living creatures, there is metabolic change, which diminishes their pharmacological development and works with release (12). A wide extent of human activities can horribly influence water quality, similar to the introduction of toxic substances, metals, and

metalloids, similarly as overhauling typical cycles like destructive waste (13,14, 15, 16)

Industrial pollutants will not treated with the help of conventional method (1, 2). Also they are deposited at the bottom of river bank which reduces the water carrying capacity of river but fortunately river bed erosion due to clay mining disturbed the bank of river (3-5) the Water quality as a global issue Now we consider Tapi its mythological name tapti is called tapi a word coming from ancient language Sanskrit tapti which means daughter of Surya and sister of Shani, Bhadra, Yamuna, Yama. The Tapti River is a waterway in focal India between the Godavari and Narmada streams which streams westwards prior to depleting into the Arabian Sea. The waterway extends for 724 kilometers. Its starting point is close to Multai Reserve woods in MP. As it courses through Maharashtra and Khandesh in the western piece of the express, the waterway enters Maharashtra. Bowl size 65,145Sq.Km..Average Discharge 489 m3/s (17,300 (347,000 cubic feet each second), Minimum Discharge 2 m3/s (71 (347,000 cubic feet each second), Maximum Discharge 9830 m3/sec. (347,000 cubic feet each second) (6).

Tapi river coordinate in chopada & shirpur region Latitude: 21° 20’ 53.56” N and Longitude: 74° 52’ 49.26” E. According to the Code of Practice for Using Plant Protection Products, pesticides are defined as substances, preparations, or organisms that are formulated or applied to control pests. A major global issue is environmental pollution. Agriculture has become a prominent contributor to water pollution in enumerations of sources. While countries try to address maltreatments of their water assets, it is important to decide the reasons for water quality corruption and to measure contamination commitments from numerous sources.

https://www.google.com/maps/@21.2288464,74.9996791,12z (9)

Within the calendar year, Tapi River is drier than other rivers except for rain, which increases pollution significantly. Water quality assessment of Tapi River is carried out from 9 points that are spread out equally over a 45 km trench within the chopda of shirpur city, spread out at a distance of 5 km each. Among the pollutants are primarily domestic wastes, industrial wastes from thermal power plants, and agricultural waste. The quality of water is dependent on the geological environment, its recovery and usage as per human need as well as human activities such as domestic, industrial, commercial, mining, agricultural etc.(7).

During the dry season (stream discharge* 18 m3/s) from January to March, the river has a low flow rate and during the wet season (stream discharge >18 m3/s) from April to December it has a high flow rate. (8)

OBJECTIVES

1. The various reasons why water is impure.
2. Assessment of water quality indexing in the Tapi River between Chopada and Shirpur in three ways.

I) Assessment of water quality indexing in the Tapi River between Chopada and Shirpur in three ways. Physical characteristics of water in a particular region.

A) Test, odour, temperature, etc.

II) Chemical characteristics of water in a particular region.

A) pH, Acidity, Alkalinity, Hardness, etc.

III) Biological characteristics of water in a particular region.

3. COD, BOD, phosphate, nitrate, sulphate, chloride, fluoride, coliform, and heavy metals are all contaminants.
4. To suggest applicability of water for various applications without treatment and after partial treatment.
5. To identify the sources of water pollution.
6. To predict the future sources of water pollution.
7. To suggest the remedies at a specific change to enhance the WQI.

Approach methodology

The present work aims to workout the WQI at different stretches(are mentioned in table), identify the sources of present water pollution, predict the future likely sources and propose mitigation measures, with techno – economic details, to eliminate the pollution.

SR. NO.	SOURCE	POLLUTANTS
1	Nimgavan (Chopada)	Sullage & sewage waste, Tharmal Power Plant of Deepnagar.
2	Budhgaon	Sugar mill & Textile Mill.
3	Vadhoda	Agriculture waste
4	Padalsare [Three Rivers Junction point (Tapi , Bori, Aner)]	Domestic & Industrial waste from Amalner, Agriculture waste,
5	Kapileshwar (Two river junction point Tapi & Panzara)	Seepage waste from plastic Dye industries waste, Domestic waste from Dhule, Songir
6	Manjarod	Agriculture waste
7	Thalner	Dairy Industries waste
8	Jaitpur	Agriculture waste
9	Sulwade	Industrial, Educational, Domastic waste from shirpur, Nardana, Shindhkheda.

Different technological Methods to eliminate the pollutants- waste water treatment plant (effluent)

Future Scope- The total trench of 45 km encompasses industrial, residential, recreational & commercial zone which are, growing day by day hence responsible to increase the load of pollutants in to the river. This Review work provides the different sources of pollutant at the same time future capacity of treatment plant to treat the waste.

MATERIAL & METHOD

Water test accumulated from tapi stream which are 5 km from each other with unprecedented importance are given to Dissolved oxygen, Fecal coliform, pH, 5-days regular oxygen premium, nitrates, phosphates, temperature deviations, turbidity (in NTU) and complete solids. Satring point of test assortment is at Nimgaon, which is acxactly upstream of sulwade torrent (45 KM apert structure one another), henceforth it comprises of 9 diffrenet point of test assortment.

All sample collected are then investigated by following tests

1. To determine colour of water sample.
2. To determine pH.
3. To determine Acidity.
4. To determine Alkalinity.
5. To determine turbidity.
6. To determine Viscosity.
7. To determine BOD & COD.
8. To Determine MPN.
9. To determine VOC.
10. To TOC (Total Organic Compound)
11. To determine niterates phosphate, chlorides, fluorides.

1. This is the preliminary observation based test, which gives first-hand information of dissolved solids.
2. These test noting but provide the hydrogen ion concentration in different water sample. Which also responcible to deside acidic & basic nature of water.
3. Acidity these test gives an information of industrial effluent discharge, which are commonly utilises the different acid for treatments, manufacturing, cleaning etc. in their day to day process.(industries are like pesticides, pharmaceutical industries, chemical industries etc.
4. Alkalinity these test gives an information of basic salt in an industry effluent from different industries. Like Agro chemical , automobile. Detergent & soap industries etc.
5. Total dissolved solids these test provides an idesa related to TDS present in water. These test gives information range of molecular attaraction of difeerent location (soil liquification noting but responcible for the increase of viscosity of water)

6. It shows total amount of oxygen required for degration of organic and inorganic componants.

It shows presence of Ecoli bacteria.

Volumetric or volatile organic compound it implicates formation of new fumes.

It is measured in percentage of COD(TOC = 2.5*COD)

In that strategy for enlightening examination of seven unmistakable anions (Fluoride, Chloride, Bromide, Nitrite, Nitrate, Phosphate, and Sulfate)

Laboratory: 1. SSBT, COET, Bambhori, Jalgaon

2. R. C. Patel Institute of Technology, Shirpur

Chemicals: As per recommended by I.S. specification for each test.

: This exploration works principally centers around discover the various boundaries of water test gathered from 9 unique focuses. Major moto is to discover the convergence of contaminations, its variety from one highlight another and its cures.

RESULT & DISCUSSION

1. The review of literature above indicates that water samples are collected and analyzed in all three seasons since water levels in rivers change from season to season, which in turn affects the percentage of pollutants present in the water.

2. Tests so gathered from various 9 focuses shows the distinctive toxin scope of water test from specific focuses.

CONCLUSION

From above survey paper it is inferred that, the water quality detoriate inside the range or channel of each 5 km which incorporates various kinds of contamination like agrarian, mechanical, instructive, sporting waste and so on these toxins are dealt with ostensible treatment strategy at each source. It is likewise seen that the progression of waterway shifts season astute which influence the amount of poisons.

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Development of Sequencer Application to Control 5 DOF Robotic Arm

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ABSTRACT

This paper introduces an innovative approach for controlling a 5 degrees of freedom (DOF) robotic arm in computer applications. By integrating robot programming, data capture, and semantic manipulation, our framework enhances efficiency, precision, and intuitive control. Leveraging robot programming methodologies, our approach employs learning from demonstration, feedback, and transfer to extract high-level relational plans from low-level assembly task demonstrations. A graphical user interface (GUI) iteratively refines acquired knowledge, combining high-level plans with geometric details for enhanced precision. Transfer learning enables efficient reuse of task knowledge across similar tasks. Addressing the need for accurate data capture in manufacturing, we convert robot actions into event streams, facilitating the evaluation of Key Performance Indicators (KPIs) for data-driven decision-making. Visualizations aid in understanding manufacturing floor activities. Additionally, we introduce a semantic approach for the robotic arm to perceive and interact with its environment effectively within computer applications. This includes object detection, task definition, and trajectory planning considering environmental constraints. Our integrated methodology advances the capabilities of 5 DOF robotic arms in computer applications, providing a comprehensive framework for efficient control, data-driven decision-making, and precise task execution. This research aims to bridge the gap between theoretical advancements and practical applications in robotics.

KEYWORDS *: Robot programming, Key performance indicators, Semantic manipulation.*

INTRODUCTION

The evolving societal and economic landscape necessitates adaptable and user-friendly robotic systems for diverse environments and tasks, including home and flexible industrial settings. Assembly tasks, crucial for small-scale industrial cells and personalized consumer goods, demand enhanced robotic dexterity and rapid task switching capabilities. To meet these challenges, we propose a system with desired properties such as ease of programming and instruction, shared task awareness, and shared initiative between user and robot.

Learning from demonstration (LfD) offers a promising approach for intuitive task programming, yet requires enhancements for real-world deployment, especially regarding precision, robustness, and fast task switching. Our solution augments the interaction protocol with a graphical user interface (GUI) in the programming loop, displaying learned information such as manipulation steps, object constraints, and assembly plans. This shared task awareness fosters user understanding of the robot's learned representation, enabling feedback and corrections.

Furthermore, we present a self-sufficient robotic arm designed for various manufacturing tasks such as welding and drilling. Utilizing components like microcontrollers and motors, this anthropomorphic arm enhances speed, reduces complexity, and boosts productivity. The core of the design is the ATMEGA-328p microcontroller, facilitating coordination

and control in embedded applications. Robotics, a multidisciplinary field encompassing mechanical and electrical engineering, control theory, computing, and artificial intelligence, aims to develop reprogrammable manipulators capable of executing a variety of tasks.

The interaction between robots and their environment is crucial, typically facilitated by robotic arms equipped with gripping devices. Our robotic arm design mimics human anatomy, featuring joints akin to a human arm, including shoulder, elbow, wrist, and finger joints. Detailed information on the design process and components used is provided, emphasizing the arm's capability to interact with and manipulate its surroundings effectively.

LITERATURE REVIEW

This literature review examines three distinct studies focusing on the design and development of robotic arms controlled by Arduino microcontrollers. Each study offers unique insights into the challenges and solutions associated with creating functional and cost-effective robotic manipulators.

Ankur Bhargava's survey introduces a 5 Degree of Freedom (DOF) robotic arm controlled by an Arduino Uno microcontroller. Utilizing potentiometers for user input, the arm comprises four rotary joints and an end effector, with rotary motion facilitated by servomotors. The use of SolidWorks Sheet Metal Working Toolbox for design and fabrication with aluminum sheet demonstrates a structured approach to construction.

Rahul Gautam's review addresses the development of an industrial robotic manipulator aimed at precise object manipulation. The manipulator's control method allows for selective operations, overcoming challenges associated with distant object handling. Notably, reducing cable friction is identified as crucial for enhancing maintenance intervals and overall performance.

Ashraf Elsassian's survey discusses the design and implementation of a low-cost robotic arm with four degrees of freedom. Constructed from acrylic material and utilizing servo motors with encoders, the arm performs simple tasks efficiently. However, limitations arise from the servo motors' restricted rotation range, impacting the arm's reach and operational flexibility.

Each study offers valuable insights into the design considerations, control mechanisms, and performance characteristics of Arduino-controlled robotic arms. While Bhargava's work emphasizes precision and structural integrity, Gautam's review focuses on industrial application challenges and maintenance optimization. Elsassian's survey highlights cost-effective design strategies and trade-offs associated with component limitations.

WORKING PRINCIPLE

The operation of a robotic manipulator relies on the conversion of electrical input energy into mechanical work through automation and programmed instructions. The manipulator's functionality is based on the movement of its joints, which can be linear or rotary in nature.

Linear joints enable movement along a straight path, while rotary joints facilitate rotational motion around a specific axis. These joints are actuated to control the movement of the robotic arm's links, allowing it to perform various tasks. Key components of the robotic arm include servo motors, which are responsible for angular rotations. Servo motors operate based on Fleming's right-hand rule, generating controlled motion in response to input signals from an Arduino circuit board. The concept of degrees of freedom (DOF) is crucial in understanding the manipulator's flexibility and range of motion. DOF refers to the ability of a joint to produce linear or rotary movement when actuated. The number of DOF in a robotic arm is determined by the number of joint axes it possesses. Each axis represents a degree of freedom, allowing the robotic arm to perform complex movements and tasks. Working principle of a robotic manipulator involves the conversion of electrical energy into mechanical work through automation and programmed instructions. Linear and rotary joints, along with servo motors controlled by an Arduino circuit board, enable precise movement and manipulation of the robotic arm, with the number of degrees of freedom determining its flexibility and range of motion.

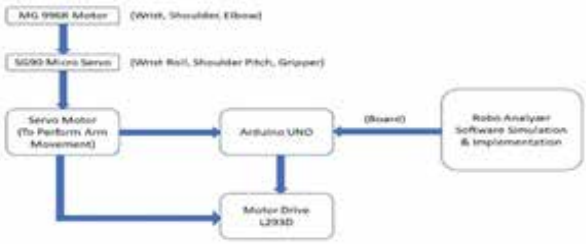

Figure 1: Proposed Block Diagram

COMPONENTS OF THE ROBOTIC ARM

1)Servo Motor: The robotic arm utilizes two major servo motors. One servo motor control base movement, while the other two are positioned on the side of the base plate to transmit motion through various links of the arm. These servo motors are securely bolted to the base plate to maintain stability and minimize vibrations during operations. A servo motor consists of a motor coupled with a sensor for position feedback, requiring a dedicated controller for precise control.

2)Arduino UNO: The Arduino UNO serves as the controller for the servo motors. By sending servo signals, the Arduino UNO enables precise control over the movement of the servos. It generates a series of repeating pulses with variable widths to determine the position of the servo motor shaft. The controller integrates digital command signals into analog parameters, facilitating the upload of programs to control servo movements. Additionally, the Arduino UNO allows for the synchronization of servo operations, enabling sequential actuation of multiple servos.

3)Connectors: Electrical connectors are used to join electrical terminations and create electrical circuits. In this project, male-to-male connectors, or plugs, are utilized for making connections between various components. These connectors enable temporary or permanent electrical joints between wires or devices, depending on the application's requirements.

4)Motor Driver L293D: The L293D is a 16-pin Motor Driver IC commonly used to drive motors. It can control two DC motors simultaneously, with independent control over their directions. This motor driver is suitable for servo motors with operating voltages less than 36V and operating currents less than 600mA. It interfaces seamlessly with digital circuits such as Arduino, PIC, ARM, and other digital control modules, making it ideal for driving servo motors in robotic applications.

CHARACTERIZATION OF CONTROL SYSTEM

The control system of the robotic arm primarily relies on servo libraries, which offer an object-oriented interface and support simultaneous control of multiple servo motors. These libraries enable precise control over servo movements, ensuring synchronized operation for smooth and coordinated motion. The servo libraries implement a strategy to adjust servo speeds dynamically, ensuring that all servos arrive at their target positions simultaneously. This process involves identifying the servo with the longest movement duration and adjusting the speeds of other servos accordingly to achieve synchronization. To initialize the control system, servo names (PINS) are configured, and the desired positions are defined using the Servo library. Each servo is assigned a specific pin and initialized to its starting position. The control system organizes desired positions into an array called "positions," which serves as a reference for the Servo library's Move To function. By passing the positions array to this function, the control system allocates the desired positions (angles) to each servo, facilitating precise control over their movements. In summary, the control system of the robotic arm leverages servo libraries to ensure synchronized motion of multiple servo motors. By dynamically adjusting servo speeds and utilizing array-based position allocation, the control system achieves precise and coordinated movement of the robotic arm.

RESULTS AND DISCUSSIONS

The development of a modular robotic arm system for automating manual object handling operations has shown promising results. Utilizing Visual Basic .NET (VB. NET) for user interface development and an Arduino UNO microcontroller for control, the system offers ease of assembly, cost-effectiveness, and lightweight construction, making it suitable for collaborative work alongside humans. Precise actuation of servo motors ensures smooth and accurate movement of the arm, enhancing its usability in various environments. The user-friendly interface allows for intuitive control and

monitoring of the robotic arm's functionalities. Future enhancements may include integrating advanced sensing and machine learning techniques to improve the system's autonomy and adaptability in dynamic environments. Overall, the results demonstrate the feasibility and effectiveness of the proposed approach in advancing modular robotic arm technology and its practical applications.

CONCLUSION

In conclusion, we have presented a comprehensive study on the development of a modular robotic arm system aimed at automating manual object handling operations. Throughout this research, we have focused on designing a cost-effective, user-friendly, and collaborative robotic arm solution that can seamlessly integrate into various environments. Our modular robotic arm offers several key advantages, including ease of assembly, low cost, and lightweight construction, making it well-suited for collaborative work alongside human operators. By automating manual object handling tasks, our system enhances efficiency, reduces labor costs, and minimizes the risk of workplace injuries.

One of the significant contributions of our work is the integration of MATLAB software for control and interfacing purposes. The graphical user interface (GUI) developed in MATLAB utilizes inverse kinematics principles to calculate link angles, providing users with intuitive control over the robotic arm's movements. Additionally, the use of an Arduino MEGA 2560 microcontroller ensures precise and coordinated actuation of the arm's motors based on user inputs from the GUI. Moreover, our control software, developed using Visual Basic .NET (VB. NET), enhances the user experience by providing a user-friendly interface for commanding and supervising the robotic arm's operations. The software facilitates seamless communication between the user and the robotic arm, enabling real-time monitoring and control of its functionalities. Our research contributes to the advancement of modular robotic arm technology by offering a cost-effective, user-friendly, and collaborative solution for automating object handling tasks. Future work may explore further enhancements to the system's capabilities, such as integrating advanced sensing and machine learning techniques for improved autonomy and adaptability in dynamic environments.

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Modelling of a Grid-Connected Solar Photovoltaic (PV) System using MATLAB

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ABSTRACT

The demand for power is growing daily, overloading distribution networks and having un-favourable effects on the quality of the power that lead to blackouts and device malfunctions. Solar photovoltaic (PV) power generation may be a useful strategy for raising power demand. One of the key uses of solar PV is the interface between the sun and the grid. This trend is growing as a result of government incentives supporting these initiatives. For this paper a computer based solar photovoltaic grid-connected system is designed in MATLAB using a Simpower system toolbox. The datasheet from the solar manufacturer is used for solar photovoltaic modeling, and a DC converter and inverter (VSI) are used for grid interface.

KEYWORDS *: Solar PV, Matlab, DC to DC converter, Grid.*

INTRODUCTION

Due to the exhaustion of natural resources and the increase in energy consumption, it is imperative to identify alternative sources of energy generation these days. The integration of alternative sources of energy, such as geothermal systems, solar, wind, and ocean energy, is required for future advancements in power generation. These sources need to run in parallel with the grid in order to produce electricity. Solar energy production is more common in distributed generation since it is clean, quiet, environmentally beneficial, and pollution-free. Small capacity loads' demands are met by the dc power produced by solar radiation falling on the panel. Solar energy processing in industrial applications requires a power electronics processor [1, 3].

Temperature changes and sun insolation are two examples of environmental conditions that affect how much power solar photovoltaic systems generate. Consequently, the solar module's overall efficiency decreases. The maximum power point tracker in solar systems is vital in controlling the amount of solar power produced at the maximum operating point (MPP). Solar PV runs at extremely high voltage and extremely high current at MPP, providing the maximum power to the load while maintaining optimal efficiency. There are several MPPT algorithm approaches that differ in terms of convergence time, algorithm complexity, hardware configuration, sensors employed, and price. Because the perturb and observe approach is straightforward, easy to understand, and implement, it is used for modeling. This work covers the modeling of PV arrays, the matlab simulation of a boost converter, and voltage source inverters, which use d-q theory to control the current they produce. Phase lock loops are used for grid synchronization. The system configuration and relevant standards are covered in the first section. Then, PV array modeling, DC to DC converter design, and MPPT algorithm modeling are covered. Filter design, grid synchronization methods, and inverter design with and without transformers are also covered. Additionally

provided are the simulation results for the complete system [6].

CONFIGURATION FOR SYSTEM

The solar PV system with grid-connection configuration is shown below. Dual stage grid connected system topology is employed. DC-DC boost converter and DC-AC inverter complete the arrangement. Two of the DC-DC converter's responsibilities include increasing the PV array's output voltage and regulating its maximum operating point (MPP). Providing AC electricity to the grid is the aim of the DC-AC converter.

The DC-DC converter's output is controlled by the MPPT algorithm. The grid receives its AC voltage from the voltage source inverter. Both the grid current and the DC link voltage are controlled by synchronously rotating d-q theory. Transformers are needed to increase the output voltage of inverters. They also act as a barrier between the inverter and the grid, preventing the flow of harmonic current into the grid.

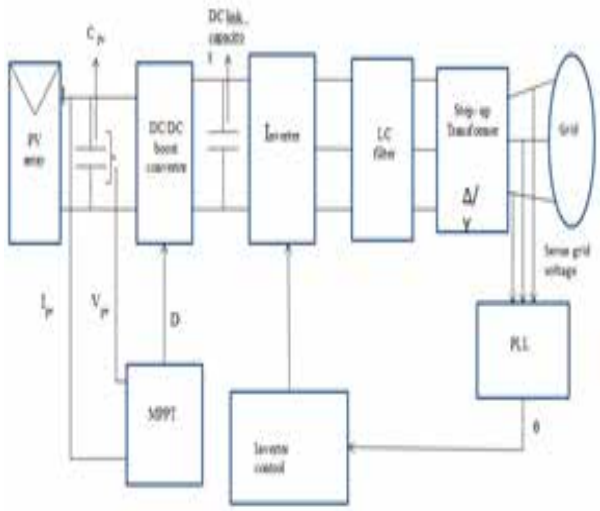

Figure 1: Solar PV system setup linked to the grid

A perfect solar PV can be thought of as a current source in which the current it generates is directly proportional to the amount of solar radiation it receives. Despite this, the optical and electrical losses in solar PV caused a deviation in its practical behaviour from that of ideal PV. Figure below depicts the electrical equivalent circuit for a solar PV model.

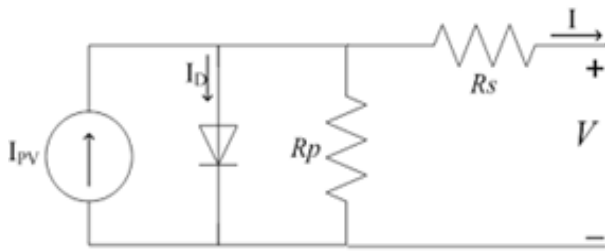

Figure 2: Solar PV single diode circuit

The current source itself, whose generated current is proportionate to the light input, serves as a representation of the optical loss. The recombination losses are shown by the parallel diode. The series and shunt resistance, represented by Rs and Rp, are what cause the ohmic losses in a solar cell. Since the resistance provided by the solar PV in the current flow channel is known as the series resistance, Rs is displayed in following equation –

Solar PV mathematical modeling is predicated on

$$J = (J_L - J_o)\left[\exp\left(\frac{qV}{kT}\right) - 1\right] \quad (3)$$

$$I = \text{Ipv} - \text{I0}\left\{\exp\left[\frac{q(V + I * Rs}{Nc * AkT}\right] - 1\right\} - \frac{V + I * Rs}{Rp} \quad (4)$$

Solar PV is intended for a dual stage topology, wherein the MPPT and result voltage of solar PV array are managed by a dc to dc boost converter. A Dc link served as the interface for the Dc converter and inverter. The boost converter is chosen for design; its function is to control the PV array's operational point (MPP) and boost the voltage of the array. With a 250V output voltage in mind, the converting device is developed in the continuous conduction mode (CCM) [4]. Most often used approach for maximum power point tracking is the perturb and observe method. It measures the obtained current and voltage of array and, perturbs duty cycle at regular intervals to determine the PV power. After the power is recorded at MPP, the algorithm analyzes the PV curve's slope to identify the operating region, which may be either the voltage source or the current source region. Duty cycles are then adjusted in that direction until the point of operation is reached at MPP.

Following mathematical formulation describes the P & O algorithm. The voltage source region (δP/δV) recodes the operational point if the slope is positive.

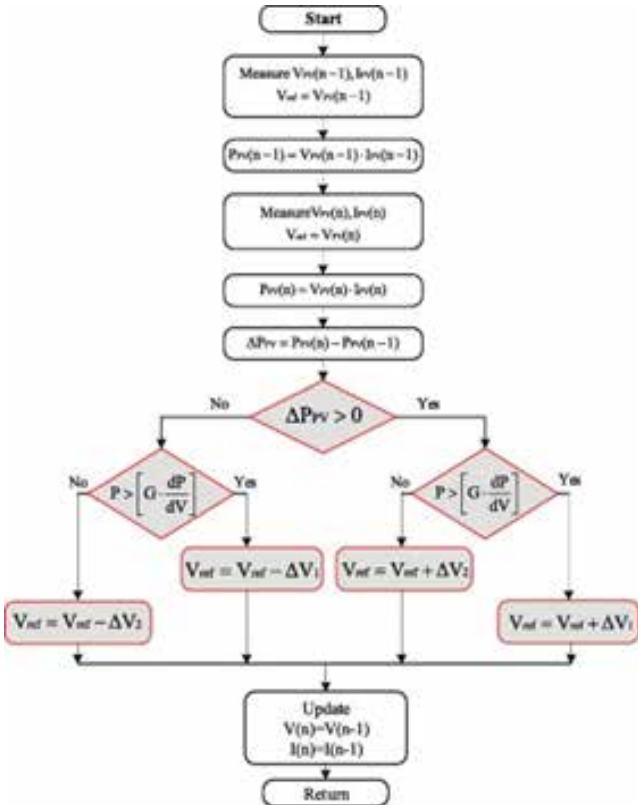

Figure 3: Flowchart for the P & O MPPT algorithm [1]

Work of controlling the amplitude and frequency is performed by the DC-AC inverter, which generates the regulated sinusoidal ac output. The switching device chosen is a MOSFET, which works at a frequency of 20 KHZ, and the selected inverter has a modulation index of 0.9. A trade-off between switch cost, conduction losses, and switching losses determines which semiconductor switch is best for a MOSFET. Based on the cost of MOSFETS, switching losses, and inverter efficiency, the inverter switching frequency was chosen. At greater switching frequencies, both the filter's cost and size decrease. Switching and conduction losses decrease with decreasing switching frequency, but filter size and cost rise. The switching frequency of the device, taking into account losses, filter costs, and converter efficiency, is 20 KHz. [4]. Bipolar PWM is applied in situations where the output voltage fluctuates between –Vdc and +Vdc. Using a pulsed width modulation approach, the inverter inserted electricity into a grid that included both DC and AC components. An LC filer is connected between inverter - grid for sake of filter higher harmonic frequency component from the inverter's output. The filter's purpose is to restrict the amount of current that is introduced into the grid. Swell current has a maximum limit that is between 10% and 15% of the rated current. Choice of capacitor is always based on the trade-off between reactive power from the inductor and the capacitor. A high capacitance value reduces the inductor's current need by requiring more reactive power to flow into the capacitor. As a result, system efficiency declines. Small capacitance requires a higher inductance value to prevent noise, which raises the inductor's cost and causes a greater voltage drop across the inductor. The minimum capacitance value for a capacitor is 15% of the rated power. A DC link is formed amongst boost converter-inverter when converter interfaces with the latter. The grid receives power from solar PV through this DC link. The capacitor is designed with the understanding that there would always be electricity flowing through the DC link capacitor. Intended value of capacitor must remain greater than the peak-peak grid voltage, in addition to voltage drop that occurs in switching devices and low pass filters, in order to introduce current into the grid.

SYSTEMS WITHOUT TRANSFORMERS

Peak to peak voltage is 586.82 V, while the grid voltage is assumed to be 415 V rms. The minimum DC link voltage is 415* √2*1.1≈ 700 V when 10% grid overvoltage is taken into account. It is believed that 800 V is the highest DC link voltage [13]. DC link voltage obtained is at an average value of 750V. Because it is more difficult to put out a DC arc than an AC one, sustaining such a high DC link voltage is risky. Moreover, a higher PV panel rating is required to achieve a high output voltage.

PV SYSTEM WITH TRANSFORMER INCLUDED

Numerous benefits are offered by the system and transformer, including the ability to separate PV from the grid and the reduction of harmonics due to the transformer's inductance, which acts as a filter to prevent zero sequence current flow. With the inverter

output voltage at 120 Vrms, the minimum DC link voltage of 220 V—which accounts for filter and switch losses—and the maximum DC link voltage of 250 V are designed.

SYNCHRONIZATION GRID

Grid synchronization is essential when solar photovoltaics are connected to the grid. To ensure the supply electricity to grid at a higher power factor while staying within the bounds set by utility norms, synchronization is essential. Additionally, it produces a pure reference signal by reducing the distorted current. The purpose of a phase lock loop (PLL) is to synchronize the grid's voltage and frequency with the single frequency and phase of the reference input. Synchronous rotating dq reference frame transformation and low pass filter design are used in the implementation of PLL.

The figure below displays the three-phase PLL block diagram. It shows how the grid's output terminal senses the three-phase voltage, Vabc, and converts it into two-phase DC components. The coordinate transformation from ABC to dq is used for this, and VCO sets the PLL lock at Vd*= 0. The filter gives the VCO a controlled dc signal by eliminating harmonics. The inverter's phase angle was generated by the controller. PLL locks the grid frequency with the inverter frequency when the error between the input and output phase angles is reduced to zero.

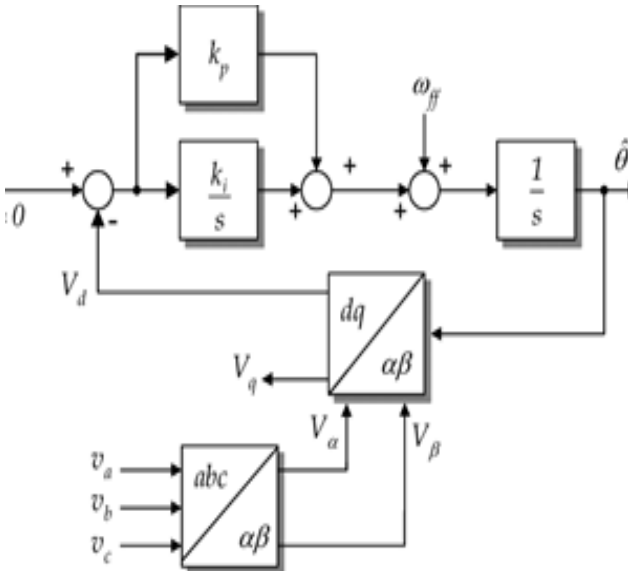

Figure 4: PLL System for 3 Phase [14]

SIMULATION RESULTS IN MATLAB

The below graph shows PV array's (V-I) and (P-V) curves. Power obtained at MPP is 1250 Wp, with a maximum voltage 190 V, maximum current of 8.05 A.

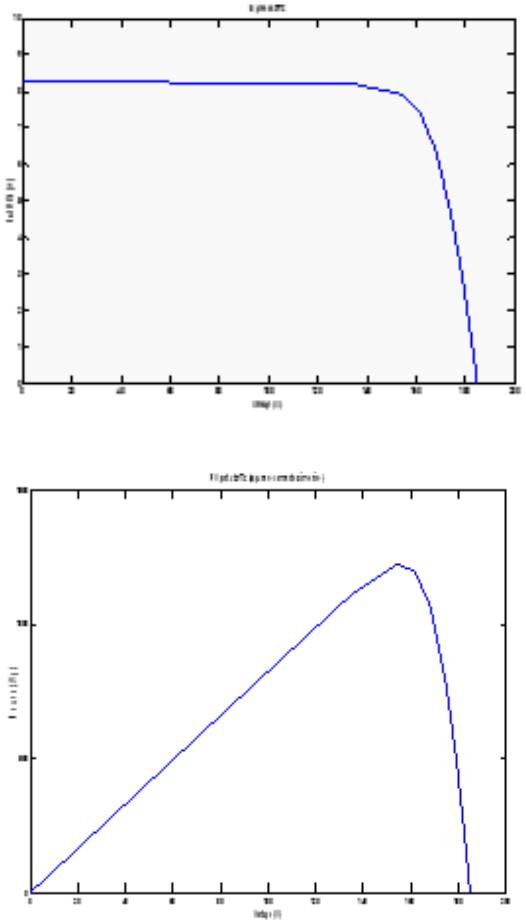

Figure 5: V-I and P-V curves for PV arrays

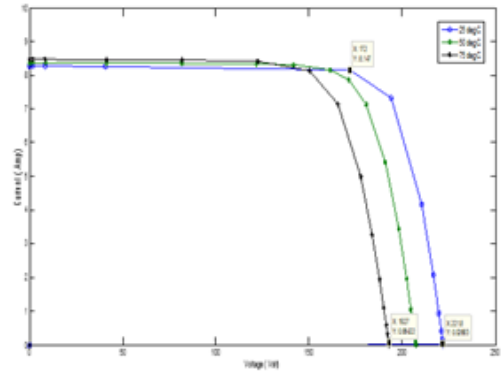

Figure 6: I-V diagram for temperature state change

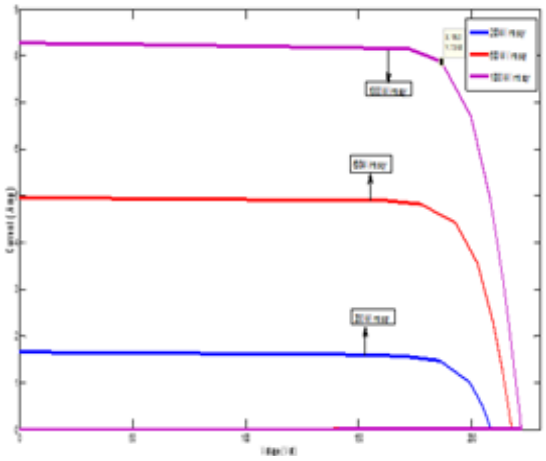

Figure 7: I-V figure showing the state of solar insolation change

The achieved simulation result of the current vs. voltage (I-V) curve of the solar array at varying temperatures and changing external solar insolation. It has been shown that temperature variations to 75ºC, 50ºC, and 25ºC have an effect on the open circuit voltage of photovoltaic cells. This means that as the operating temperature of the cells varies, the output voltage produced decreases while the PV current produced stays constant. As a result, less power is generated overall. When the temperature remains constant and the solar insolation shifts to 1000, 600, and 400 W/m2, the PV output voltage only little changes, but the current it produces rises dramatically. As a result, the output power produced by the solar array grows in tandem with solar radiation.

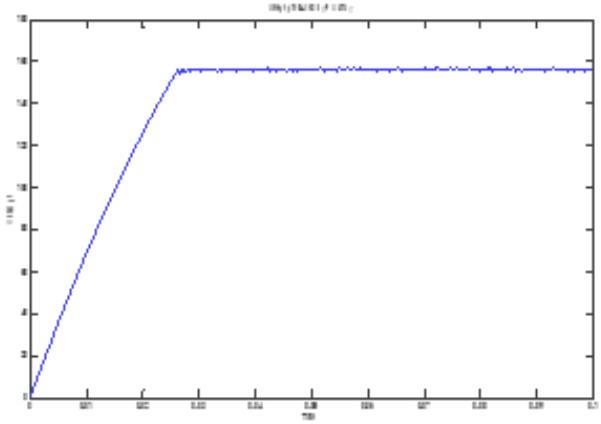

Figure 8: Array's output voltage

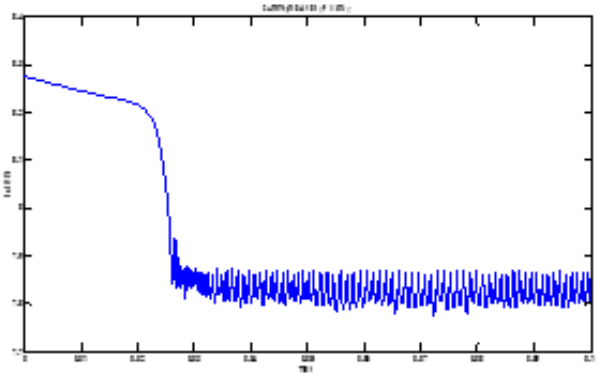

Figure 9: Array's solar output current

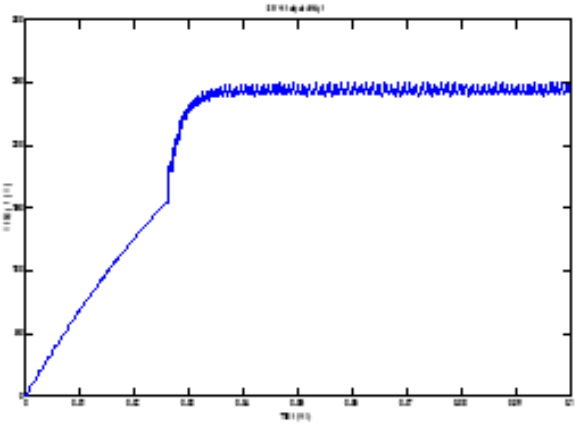

Figure 10: Voltage at which DC-DC boost converter

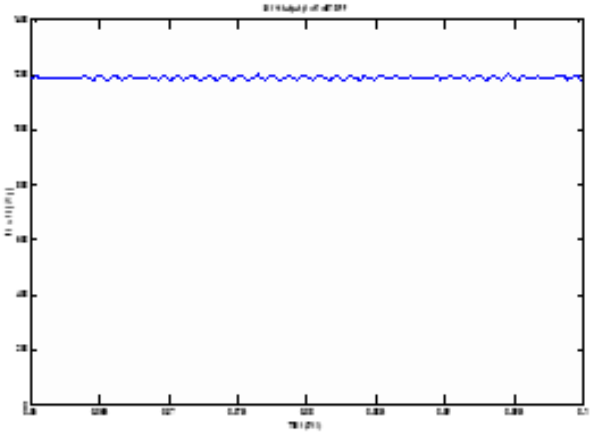

Figure 11: Power output from DC-DC boost converter

Boost converter is interfaced by simulated solar array, which is then tested under various temperature and sun

irradiance conditions. The results obtained are shown in figure above. It is discovered that PV generates an output voltage of 160 V and an approximate current of 8 A. Increased voltage of 250 V under MPPT control is at a duty cycle of less than 50%, or roughly 0.4.

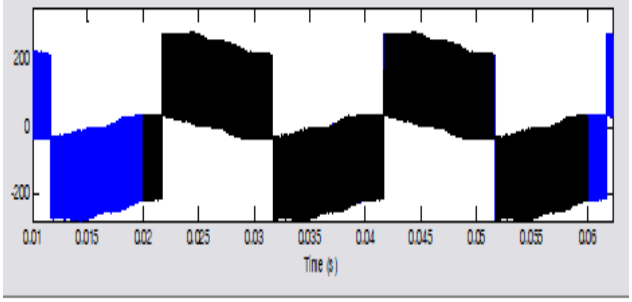

Figure 12: Phase-to-phase output of a 3-Ø inverter

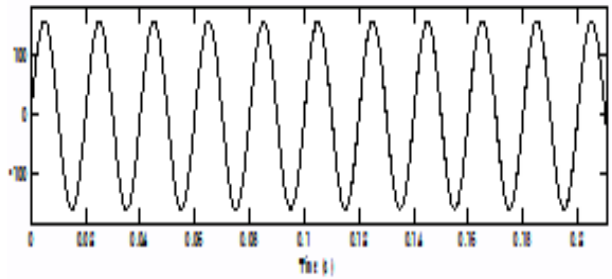

Figure 13: output produced by inverter after filtering (Phase a)

Figure above shows the simulated phase-to-phase voltage of three phases with harmonics. As a result, a harmonic filter that eliminates ripple from the inverter's output side and produces a signal with only the essential frequency components is constructed, as seen in Figure above.

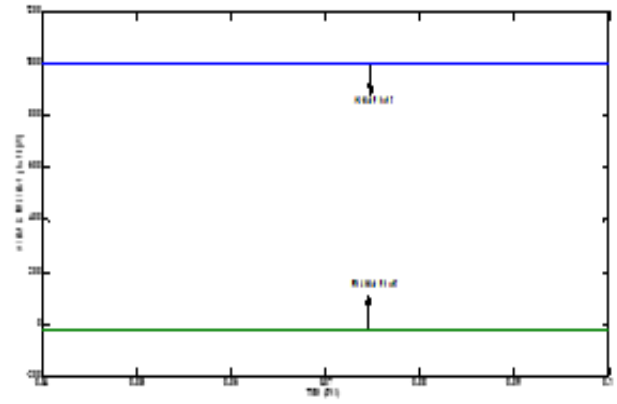

Figure 14: Grid-fed active and reactive power

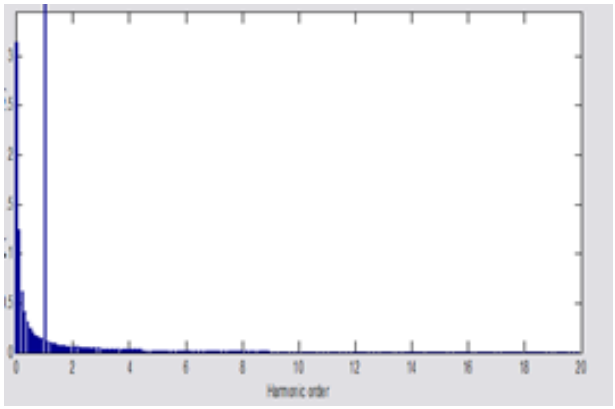

Figure 15: Waveform investigation of output current using FFT

The information leads one to the conclusion that the system only feeds the grid with active power while limiting the amount of reactive power. According to FFT analysis, the THD is only 1.3%.

CONCLUSION

The layout of a grid-connected solar PV system that is capable of supplying the grid with 1000W of power is covered in detail in this study. In Mat lab, the complete system simulation is put into practice. V-I and P-V characteristics of the PV are confirmed for range temperature, irradiance changes after it is modelled in Mat Lab. The boost converter, a DC-DC converter, is accustomed to track MPP and raise PV input voltage. P&O uses the MPPT algorithms because they are straightforward and user-friendly. DC voltage is changed into AC voltage using a three-phase inverter. For the inverter, sine triangular PWM with a modulation index (ma) of 0.9 and a modulating frequency index (mf) of 400 is the PWM technique utilized. Comparing the outcomes of an inverter linked to the grid with and without a transformer reveals that having a transformer is advantageous. Even though an additional transformer is needed, it lowers the DC link voltage, isolates grid from inverter, lowers harmonics, and stops the injection of zero sequence components. Using the d-q reference frame theory, a three-phase PLL was built for grid synchronization. The THD is within tolerances, according to FFT analysis of inverter output, and the current added to grid about equals the rms value of the grid current. Impact of grid imbalance voltage on the system is further studied. By adjusting the PI controller's

gain, PLL is able to lessen the phase error brought on by unbalanced voltage and restore synchronization, but it is unable to restore the unbalanced voltage's magnitude. Therefore, to increase the imbalance voltage magnitude in PLL, an enhanced filtering approach must be applied.

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Electric Vehicles Batteries and their Topologies

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ABSTRACT

This study provides an overview of battery charger topologies for plug-in electric vehicles. On-board and off-board battery chargers come in two primary varieties, offering options for both unidirectional and bidirectional power transmission. The operating environment determines whether to use unidirectional or bidirectional communication. Compared to bidirectional chargers, the unidirectional charger's circuitry and control unit are simpler. The design of the bidirectional charger makes it easier for battery power to be transferred to the network when the vehicle is not in use, which is helpful. Bidirectional chargers have the ability to synchronize with the smart grid, which will eventually become unavoidable. This study compares the cost, efficiency, and various factors of battery charger systems designed for vehicles with plugin system in order to determine which is the most energy-efficient.

KEYWORDS *: E- vehicle, Chargers for battery, Converter, On/off battery charger.*

INTRODUCTION

Plug-in electric vehicles (PEVs) and related technologies are becoming more and more efficient and ecologically beneficial as a result of the world's rapidly dwindling fossil fuel reserves and rising CO2 emissions [1]. A more sophisticated form of the traditional hybrid electric car, PHEVs allow batteries to be linked to the grid and charged. Inadequate charging outlets have prevented PEVs from becoming widely used. Battery chargers are the most significant problem while using electric cars (EVs).

The battery chargers function as power converters, transferring network power to the battery. They lead to issues with the network, such as high THD and poor power factor. In order to charge the battery pack in accordance with international standards and with high efficiency, a smart battery charger must be constructed. With its straightforward control structure, a unidirectional charger only delivers electricity in one direction—from the network to the battery. Because it requires less equipment, makes connecting easier, and extends battery life, a unidirectional charger is a better option [8,10].When the network requires power, a bidirectional battery charger transfers that power to the grid to charge the battery [11].

Table 1: On-board versus off-board battery charger comparison [7]

On Board Battery Charger	Off-Board Battery Charger
Generally for lower KW	Generally for higher KW
Battery managed by on board rectifier	Complex system for battery
No issue of battery heating	Battery heat to be addressed
Add weights to vehicle	Removes weight from vehicle
Level I& II charging	Level III charging
System for Charging is slow	System for Charging is quick

Due to its ability to regulate EV battery energy and boost grid reliability, the bidirectional Battery charger offers great offers great grid flexibility [12]. As shown in table

2 [8], there are three battery charge levels depending on their power intervals, charging durations , and usage regions. Additionally comparisons must be made using the power levels shown in Table 2.

Table 2. Battery Charger Level

Power Level Types	Level 1	Level 2	Level 3
Voltage	110V AC	230 V AC	200-500V
Range of Power	≤3.5kW	3.5-20kW	>55kW
Charger topology	On	On	Off
Type of Charging	inactive	Semi-active	active
Capacity of Battery	10-40kW	10-40kW	10-40kW
Time for charging	10-35 hours	1-7 hours	0.5-2 hours

This type of topology uses a system where EVs connects your domestic connections to the grid, and Level 1 EV chargers require longer charging times. Both the governmental and private sectors use Level 2. We refer to this as semi-fast charging. The major focus is on Level 2 chargers these days. Level 3 is available for business use at charging stations. Another name for it is quick charging [8]. The two types of systems will be summarised in the next section.

BATTERY CHARGERS TOPOLOGIES

A major concern of widespread use of E-vehicles is the availability of battery chargers. It possesses a feature that influences both the battery life and charging time. It is important to design battery chargers with high efficiency, low cost, and little network strain in mind [8]. Low power dissipation in the switching elements and high power factor correction are necessary. Figure 1 shows the. Fundamental structure of the battery charger arrangement. Both the battery chargers are allowed to have single-stage or two-stage designs. A few The single stage charger's component count becomes insufficient as the power level rises. For large powers, two-stage chargers are therefore more appropriate [17]. There are two main phases. The initial phase of power factor correction AC-DC conversion (PFC). The output PF-controller converter is converted to the battery DC in the second stage using a DC-DC converter. [16–17]. The image depicts the major components of an EV charger.

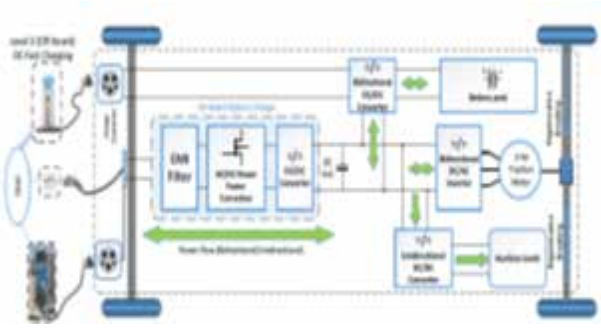

Fig 1. Fundamental structure of EV battery charger

Topologies for Power Factor Correction

Selecting the best AC/DC PFC architecture that satisfies the needs of implementing current harmonic injections, controlling output voltage, and maintaining unity power factor is crucial. Additionally, power losses are decreased with this PFC architecture [18].Boost Power factor correction is the traditional Power factor correction topology [18]. This circuit is followed by a boost PF- correction circuit. Fig. 2 shows the circuit arrangement for this topology. There is a disparity between the diode current and the dc output current in this design, and there is a very large ripple at the output capacitor current. Large level of power cause the bridge to heat drastically which in turn leads to high losses in power, less efficiency. For powers under 1 kW, this converter is therefore appropriate.

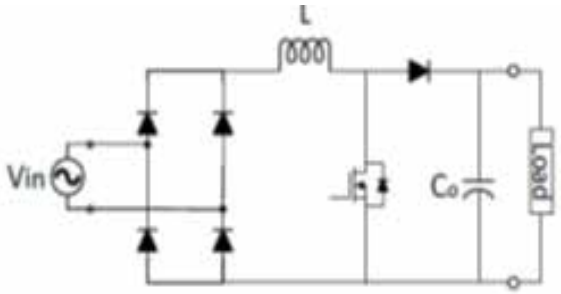

Fig 2. Fundamental design of boost PF correction circuit

The next system, which is represented in Fig. 3, is a bridgeless boost PFC topology. The efficiency decline caused by heat losses is solved by this topology, however

the inlet's usage of a induct-or raises EMI [18].

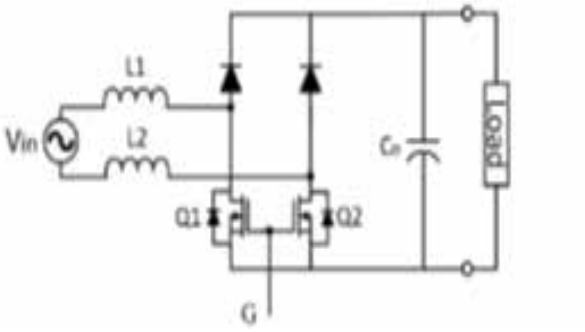

Fig. 3. Fundamental design of conventional boost PF correction.

Dc/Dc Converters

The Dc-Dc converters are divided into various categories shown in figure below. The split is shown in the talk that follows.

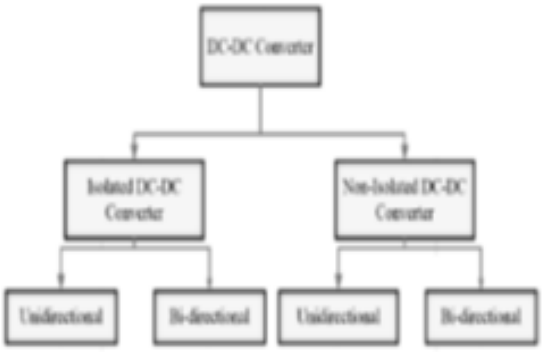

Fig.4 Topologies for transfer of DC power

Dc-Dc Non-Isolation

Non-isolated converters' are cost effective, active components are minimum, efficiency is more. However, they are designed for low power systems, and their main drawback is that there is no protection against excessive voltage current and other issues on the input side of the electrical connection.

Unidirectional Dc-Dc Converter

Since many EV batteries have a voltage range of 80-350 V, the frequently used topology is this type of converter, which reduces the voltage to the battery's voltage level, as these converters can increase and decrease the output voltage, they are another technology that can be used. The circuit for unidirectional converters is depicted in the figure below.

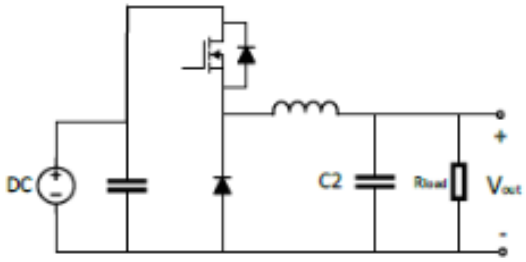

Fig.5.a Unidirectional Dc-Dc Buck System

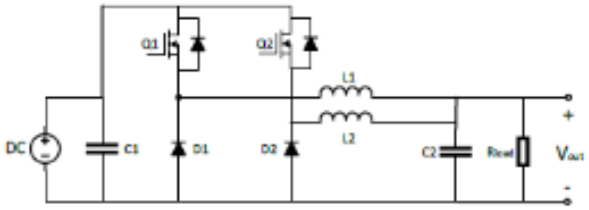

Fig.5.b Unidirectional Buck-Boost System

Converters for Bidirectional

Energy storage systems in electric vehicles interact with the grid in specific configurations like grid to vehicle systems, offering a multitude of possible advantages. Bidirectional converters are crucial components of this system. For the above converters to accomplish this system, the system's primary characteristics show good performance which is very essential. Figure provides a summary of the literature on bi-directional Dc-Dc converters.

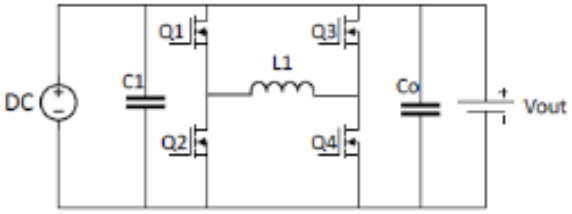

Fig.6.a Bi-directional dc-dc buck-boost converter

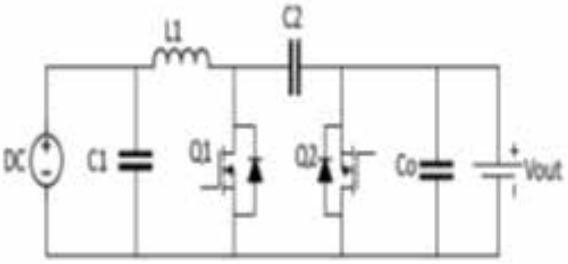

Fig.6.b Bi-directional dc-dc Cuk converter

Isolated Converters

Compared to non-isolated converters, this converters are larger and contain more active components. In low power applications, they are less efficient and have higher switching losses. However, isolated dc-dc converters are more efficient in high power applications because the transformer protects the load from the source and has a turn ratio that allows the load voltage to be regulated.

Unidirectional

These converters are used in grid-to-car electric vehicle charging systems. Fig. 7 lists the topologies that are most in use. A Fly back topology with a straightforward structure is employed. One switch can be used to complete the task. An output inductor is not required in addition to the transformer in this configuration.

Some disadvantages of this design include low transformer utilization and the requirement for additional capacitors at both sides because of the current ripple is large. Because the transformer core is completely functional, a novel topology known as push-pull topology was created.

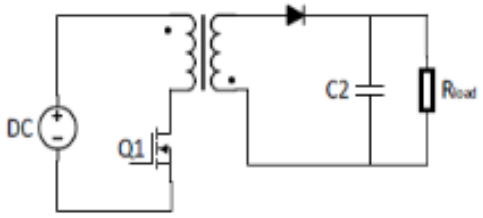

Fig.7.a Unidirectional dc-dc Fly back Converter

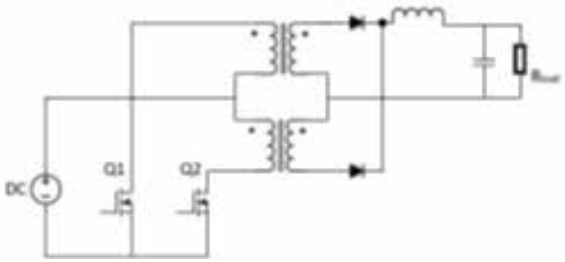

Fig.7.b Unidirectional dc-dc push-pull Converter

Bidirectional

During times of high demand, the this converters regulate the voltage and frequency of excess electricity that is absorbed by the vehicle and sent to the grid. Two-way power flow is possible with the bi-directional dc-dc converters G to V for charging and V to G for discharging.

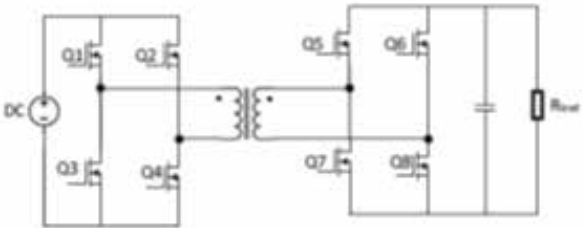

Fig.8.a Multi-Dimensional Converters with full bridge

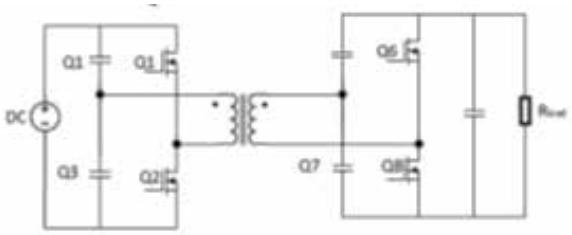

Fig.8.b Multi-Dimensional Converters with half bridge

CONCLUSIONS

This study presents a completed overview of battery charger topologies for plug-in electric and hybrid electric vehicles. Additionally, another ways of charging which are available: 1 stage and 2 stage. Specifically, the study focuses on 2 stage. The two main aspects of battery chargers i.e. PF correction and different converter design is covered in elaborate way.

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Electro Cooler Air Conditioner

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ABSTRACT

The primary purpose of a residential air conditioner is to transfer heat from inside a house to the outside. The cooling process involves air passing through a series of coils known as evaporator coils to lower its temperature. This operates similarly to a cooling system, using electrical cooling and automated fault detection mechanisms. An alert system, utilizing both light and sound, notifies the operator of any malfunctions Furthermore, this project incorporates atmospheric air conditioning to demonstrate the operation of the air conditioner. Ambient air is compressed using an air compressor and utilized as necessary.

The condenser directs high-pressure liquid refrigerant to various components such as the filter dryer and the metering device in the liquid line. A thermostatic expansion valve (TEV) separates the low-pressure side from the high-pressure side, regulating the amount of liquid refrigerant entering the evaporator. This control mechanism reduces the refrigerant pressure on the low side, causing it to reach its boiling point and evaporate as heat is absorbed through the tube wall and travels through the evaporator coil.To ensure that only refrigerant vapor enters the compressor, the low-pressure, low-temperature refrigerant is superheated during this process. This super heating prevents any liquid from entering the compressor. The refrigerant continues to evaporate in the evaporator until the compressor draws it in as vapor. In the receiver or storage tank, the volume decreases, automatically increasing the pressure and the amount of ambient air drawn into the system.

KEYWORDS *: Wollastonite micro fibers, Internal curing, Lime sludge, Concrete, Shrinkage.*

INTRODUCTION

The primary goal of the Electro cooler is to cool an entire household by transferring heat from the interior to the exterior. An evaporator coil, consisting of chilled pipes, facilitates air cooling when air is blown over it. This process mirrors the functioning of a typical air conditioning cooling system. Air conditioning encompasses the simultaneous regulation of temperature, moisture content, cleanliness, outside air quality, and circulation within a given space, whether for occupants, processes, or production. Temperature control in air conditioning involves maintaining a desired temperature inside a confined area regardless of external temperature fluctuations. There are various sources of heat within a room: Human-generated heat: Human bodies act as engines, consuming food to produce energy, which is expelled as heat. This heat generation contributes to an increase in room temperature and discomfort. Electrical and electronic appliances: Common household appliances like light tubes, coffee makers, and kettles also generate heat, further contributing to room temperature rise and discomfort. Due to these heat sources, room temperature and relative humidity levels can become uncomfortably high, while air circulation may decrease. Research indicates that optimal comfort for humans is

achieved at 25°C temperature, 50% relative humidity, and with adequate air flow. Air conditioners alleviate these discomforts by removing heat from the room, maintaining a temperature of 20°C, and regulating relative humidity to 50%. The air conditioner's fan ensures sufficient air flow, creating a comfortable environment conducive to productivity.

Air conditioners are categorized into summer and winter types based on seasonal requirements. Summer air conditioning not only cools the space but also removes excess moisture, whereas in winter air conditioning, moisture may be added as necessary. Summer air conditioning typically employs a heat pump (operating in reverse) and a humidifier. Air conditioning serves various purposes, from providing comfort in homes, offices, vehicles, to controlling environments in industrial settings such as printing houses, textile factories, and computer rooms. Heating can also be achieved by reversing the flow of refrigerant in the refrigeration system.

Objectives 2:

- Providing cheapest air conditioner.
- Use of refrigeration system in cooler.
- Avoid uses of frozen gases.
- Provide an eco-friendly air conditioner.
- Avoid uses of water.

Literature Review

1) Threlkeld, James L., Thermal Environmental Engineering, 2nd cd. Prentice-¬Hall, Inc., Engelwood Cliffs, N.J., 1970.

BASIC REFRIGERATION PRINCIPLES

The warmth from a hot cup of coffee will gradually dissipate into the surrounding material when left on the surface for a period. This transfer of heat occurs between the coffee, the cup, the tabletop, and the surrounding atmosphere. As time passes, the coffee gradually loses its heat as it undergoes cooling. The process of cooling functions based on a similar principle: extracting heat from an object and expelling it externally.

SYSTEM COMPONENTS

There are five main parts of the cooling system:

- Evaporator
- Compressor
- Condenser
- Expansion valve
- Refrigerant; heating the product

All items must be refrigerated for the refrigeration cycle to work properly.

Evaporator

The function of the evaporator is to remove excess heat from the liquid refrigerant This refrigerant undergoes boiling at a reduced pressure within the evaporator. Two key factors determine this pressure level: the quantity of liquid refrigerant present in the evaporator, which absorbs heat from the product, and the compressor's rate of air removal from the evaporator to facilitate heat transfer. During this process, the temperature of the liquid coolant must be lower than the temperature of the product being cooled. After that, the liquid refrigerant is sucked into the compressor through the evaporator of the suction pipe when the liquid refrigerant leaves the evaporator coil, it turns into vapor from.

Compressor

To increase the pressure, the compressor converts the steam from a low temperature state to a hot state consequently increasing its temperature subsequently the heated vapor is directly toward the outlet line from the compressor. The purpose of suction is to the low temperature, low energy of the evaporator through the suction pipe.

Condenser

To increase the pressure, the compressor changes the steam from a cold state to a higher temperature, thus increasing its temperate. The heated steam is then directed to the compressor's electrical lines. The purpose of suction is to absorb the heat and low energy of the evaporator through the suction pipe.

Expansion Valve

The refrigeration system's expansion valve is located a

the end of the liquid line, before the evaporator. High pressure liquid from the condenser reaches the valve. The valve then reduces the pressure of the refrigerant as it passes through the opening inside. This decrease in pressure causes the temperature of the refrigerant to drop below the temperature of the surrounding air. Then put the refrigerant into the evaporator at low pressure.

1)Jennings, Burgess H., the Thermal Environment. Conditioning and Control Harper and Row, 1978

The Refrigeration Cycle

The cooling cycle begins with the content of refrigerant in the evaporator. (refer to illustration 1 below). Liquid refrigerant in the evaporator extracts heat from the product, reducing its temperature. As the product exits the evaporator, it maintains a moderate temperature, and the room temperature isn't excessively high due to some refrigerant absorption. Subsequently, the compressor removes this vapor from the evaporator, which is at low pressure and temperature. Upon compression, the temperature of the vapor increases, resulting in the compressor elevating the pressure by transitioning the vapor from low to high temperature.

The compressor then pumps high-temperature, high-pressure vapor to the condenser, where it is cooled either by ambient air or fan-assisted cooling. The vapor undergoes cooling in the condenser until it reverts to a liquid state, releasing absorbed heat. Meanwhile, the coolant flows through the expansion valve. By reducing the pressure of the liquid refrigerant, the expansion valve also reduces its temperature. The cycle ends when the refrigerant enters the evaporator without expanding as a dilute cryogenic liquid.

2)Stoecker, W.F., Design of Thermal Systems, 3rd ed. McGraw-Hill, New York, N.Y.1989.

There are two reasons why home refrigerators have attracted attention lately. First, they account for a large portion of home energy cost. Home refrigerators and freezers have been reported to consume 7% of energy in the United States [1] and 2000 MW in the United Kingdom [2]. Second, there is an increasing need to work with ozone based fluids. Improvements in compressors [3] and cabins were examined.

BLOCK DIAGRAM

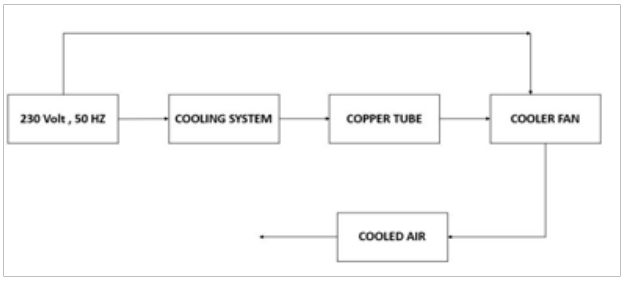

Figure 1: Block Diagram of ECAC

Figure showing arrangement of different components which indicates position of equipment. Devices like compressor and fan requires 230-volt AC power supply for operation.Compressor provides cool air to copper tubes during that period fan during that time period fan also produce forceful air. compressed air cooled down by refrigerant system and these airs passing through the copper tubes which is placed behind the fan, Cooler fan pulled out cool atmospheric air from the inner vacuum of cooler and finally gets more amount of cooled air.

Working Principle

At ECAC we use air conditioning to implement the basic concept of air conditioning. Here air compressor is used to compress the air and then use it as required. We use air conditioning and refrigeration equipment at ECAC principle combined:

1. From the condenser, high pressure liquid refrigerant is delivered to the metering device via the liquid line, filter, and dryer.
2. Use thermostatic expansion valve (TEV)to separate high side from low side
3. The amount of liquid refrigerant that enters the evaporator is controlled by the TEV. It results in a decrease in the low side refrigerant pressure. At a lower pressure, the refrigerant boils and evaporates, reaching its boiling point.
4. The low temperature and pressure travel through the evaporator coil and into the refrigerant through the tubing walls, continuing the boiling action of the refrigerant until it evaporates entirely.
5. To make sure there is no liquid supplied to the compressor, the refrigerant is superheated. when

the compressor is being filled with refrigerant vapor. Via copper tubes, it is transferred from a low-pressure, cold vapor to a hot, high-pressure vapor. This compressed air passing through the copper tubes which is wounded on in front of fan duct. Fan provides extra amount of air with low temperature which impact on tubes. During this process a compiled air of fan and copper tube will be produced cooled air. and here we also used the cooling coil which is helps to provides the cooled air to the output form the fan. the amount of pulled atmospheric air is increased in the recover or storage tank, volume is reduced and pressure is rise automatically.

6. And we installed the display which is showing the temperature and the cooled air how much gives in the output, and also, we used here some sensor which is sense the temperature and the internal fault.

Operation of ECAC

Circuit diagram consist of cooler fan,compressor, etc. cooler fan act air blower which give pooled atmospheric air and compressor is electro mechanical device which act as a chiller apparatus are used to regulate or sense the temperature. The condenser fan provides air cooling to the hot condenser.The fan & compressor are common supply of 230 V. When the 230 V AC SUPPLY provided from ac source which shown fig. Compressor and motor start simultaneously. Once the compressor start it pulls atmospherics air and compress it & regulate the conditioning cycle. Here it is necessary to turn on compressor before cooler fan, because in refrigerant process takes time to create freezing condition for cooling setup.

Specification of table

Dimension	24 inch*36 inches
Net weight	9.5 kg
Cooling system	Fan cooling
Defrosting system	Heating defrost
Insulation	Polyurethane Foam, Theriacal
Compressor	Starting type, Reciprocating type
Evaporator	Fin tube type
Condenser	Wire condenser
Refrigerant	R-134 (115g)
Lubrication oil	Freon @ 10gm (310cc)
Fan Suction	Fan
Display	Small
Fault detector	Sensor
Cooling coil	Cooling purpose
Remote control	Sensor

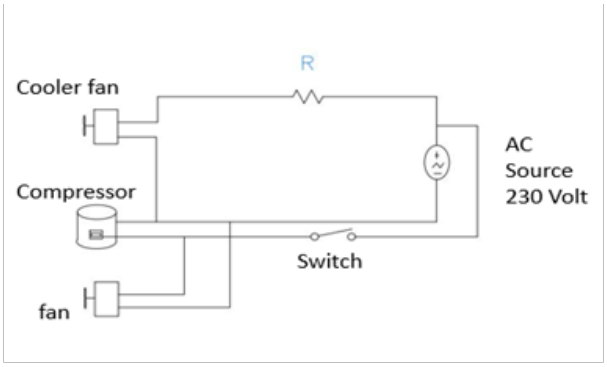

Figure 2: Circuit Diagram of ECAC

FUTURE SCOPES

In our project more improvisation and also trying to different design as possible as. we will shortly be proceeding toward hardware result in minimum time and cost. ECAC is economical equipment if it will manufacture in bulk manner. it has some modification will improve the efficiency of product. Uses of high rating compressor, fan we can improving the performance of ECAC.

ECAC units are designed for use in or near an area where ductwork is short. Sometimes units are designed to operate with one or two compressors, coils and fans to take advantage of different cooling needs. Units with air conditioning condenser or roof evaporative cooling. Alternative coolers to replace coolers (which cost thousands of rupees) in existing applications have become very important

ACKNOWLEDGEMENT

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IoT based Orange Segregation System

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ABSTRACT

The systematic patterns of separation within a particular context are the main focus of this study's investigation of the phenomenon of orange segregation. We examine several elements that affect orange segregation, such as size, color, and ripeness. We pinpoint important patterns and fundamental causes by using empirical analysis and data-driven insights.

Additionally, this study emphasizes the significance of varied packaging, distribution, and marketing techniques as mitigating strategies to address orange segregation. The objective is to promote a more equitable distribution of oranges and improve inclusivity within the orange supply chain by comprehending and proactively addressing these patterns.

KEYWORDS *: Orange segregation, Arduino, Servo driver, Color analysis, Sensors, Size, Internet of things.*

INTRODUCTION

The majority of farms and the food industry currently use manual experts to sort fruit, which is time-consuming, labor-intensive, and plagued by inconsistent and inaccurate judgment by various human experts. Citrus fruit, particularly oranges, are widely produced in Maharashtra's "Vidarbha" area.

Many farmer associations are giving automated agricultural product ending a higher priority due to the rapid growth of high-quality food products. These trends may have been sparked by consumers' growing consciousness of their health and well-being and producers' response to the demand for consistently high-quality products. Unlike most industrial products, agricultural products require quality control, and this is where the fields of automatic inspection and machine vision come into play. Because certain aspects of agricultural products are unappealing, quality inspection poses unique challenges. There is no denying the significance of this defined precisely, with customers accepting even a little irregularity or gloss. The most significant horticultural crops farmed in our area are oranges. Even so, our farmer still finds that sorting oranges according to quality can be challenging and time-consuming. We are attempting to construct an orange separator.

LITERATURE SURVEY

Akriti Kaushik, Aastha Sharma "RGB Color Sensing Technique" international journal of advance research and engineering vol no 2 September 2013.

This study will concentrate on sorting RGB colour using a colour sensor and conveyor system. Content is registered by colour sensor based on contrast, true colour, or clear index. One of the colour models, most frequently the RGB model (red, green, blue), serves as the foundation for true colour sensors. These three primary colours can be used to form a considerable portion of the visible colour spectrum.

Jyoti Jhawar, Orange sorting by applying pattern recognition on color image",ICISP2015,11 -12 Dec.2015.

Four key features are sufficient to classify an orange

fruit and linear regression proved to give a best result and this also helps to detect the life span of fruit.

KF Sanders, "Orange harvesting systems review," Biosystems Engineering, vol. 90, no. 2, pp. 115–125, 2005.

This paper explains the differences between mechanical and hand fruit picking and concludes that the latter can be used to boost fruit picking rates, which in turn can boost harvesting rates.

Snehalshirgave, aishwryasalunke, S. Y. Upadhye. "Color sorting robot". International journal of Advance Research in tele Communication engg. March 2017

They describe a robot that sorts colours in their article. The Arduino UNO, LCD display, servo motor, and colour sensor module make up this system. The colour sensor TCS3200 recognises light that is reflected off of an object and transforms it into frequency. A slider is moved by a servo motor in accordance with the detected colour. An Arduino UNO microcontroller manages input and output functions. On the LCD, the detected output colour and the corresponding coloured object's count value are shown.

Rudresh H.G. Prof. Shubha P. "Color Sensors Based Object Sorting Robot" International research journal of engineering and technology. Aug 2017

According to this paper, the project involves an automated material handling system. The goal of this project was to sort the colored objects that were reaching the conveyor by selecting them and putting them in their proper locations. As a result, less laborious effort must be done by humans to achieve accuracy and speed in the task. The project has color sensors that detect the color of an object and send a signal to a controller that directs the signal to a motor driving circuit, which powers the various motors on the robotic arm to recognize the object and position it correctly. The robotic arm moves to the appropriate spot to release the object and returns to its starting position based on the color sensed.

The few strategies included in this study were chosen based on the technologies employed for implementation. This essay supports the comprehension of the fundamental requirements for developing colour sorting, size and form recognition, and orange segregation in accordance with those requirements.

EXISTING SYSTEM

Currently, farmers sort fruits manually with the help of experts. It is also significant because it offers a high-quality assortment of fruit, allowing us to inspect the fruit for any damage sustained during handling. However, we must now inspect every fruit for ripeness and unripeness. Additionally, manually sorting fruit according to size requires more time and is a laborious task. Additionally, there are instances when manual experts are unavailable.

Because of this, an Internet of Things sorting technique that uses weight sensors to separate oranges based on size and color sensors to distinguish between ripe and unripe oranges can be useful. Additionally, this will shorten the time and allow for an increase in the orange segregation rate.

PROPOSED METHODOLOGY

Orange can be processed, analyzed, and recognized using this suggested method based only on color. A monochrome problem can frequently be made simpler by increasing contrast or separation. It also processes more quickly and easily. The sections on learning and recognition provide a summary of our methodology. We are using oranges of different shapes and colors for the separation procedure. We are coding the color percentage wise, so sensors recognize the oranges based on their color coding and separate them. Fig. 1 shows the proposed framework's use structure.

The orange's motion is detected in the first step using the IR sensor. The oranges are categorized as ripe or unripe in the second step using color sensors that identify their color. Lastly, the weight of the oranges that have been deemed ripe is determined using the weight sensor. The orange is passed from the starting position at the first step. It descends to a location where the IR

Sensor picks it up. The Atmega328 microcontroller receives a signal from the IR sensor informing it that an orange has passed away. As a result, the signal is sent to the color sensor, which determines the orange's color. The orange continues rolling after being detected by the

IR sensor until it is stopped by a gate that is operated by a servo motor. With the aid of an 8x8 cluster of photodiodes, the color sensor determines the color when the orange stops. After analyzing the readings from these photodiodes, the color sensor generates a corresponding value, which is then sent to the Arduino micro-controller, which uses the data set that was assembled during testing and trials to determine the color.

Upon determining the object's color, the first servo motor opens the gate, allowing the orange to proceed. The microcontroller provides the signal in the following phase. after determining whether the orange is ripe or not, it sends a signal to the second servo motor, which opens the gate to the ripe or unripe side and separates the orange accordingly. When the ripe orange finally reaches its end, a weight sensor weighs it to determine how many ripe oranges there are.

Three criteria are used to distinguish between oranges: an orange color indicates ripeness. Green color indicates unripe orange, and oranges that are mix color (orange and green) are classified as half-ripe.

Fig.1. Different shades of orange fruit

BLOCK DIAGRAM

The color sensor determines whether an orange is ripe, unripe, or half-ripe based on its orange percentage.

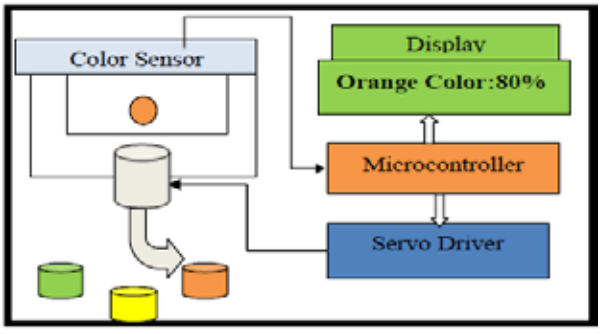

Figure 2

Figure 2 illustrate orange color percentage is 80%.Thus, the orange can be considered ripe. Then

The oranges collected in an orange box.

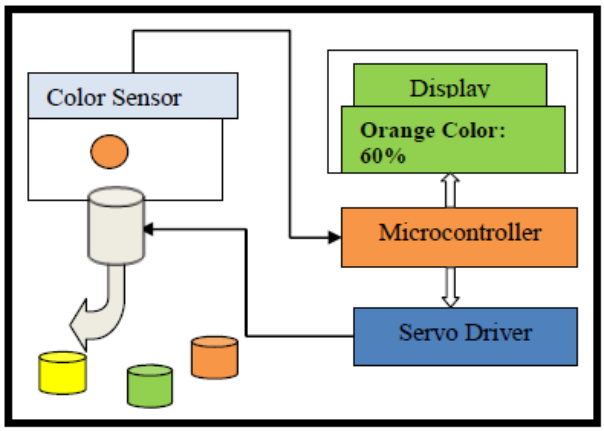

Figure 3

Figure 3 illustrates that 60% of the color is orange. Thus, the orange can be classified as half ripe and half unripe. Next, the orange is gathered in a yellow-colored box.

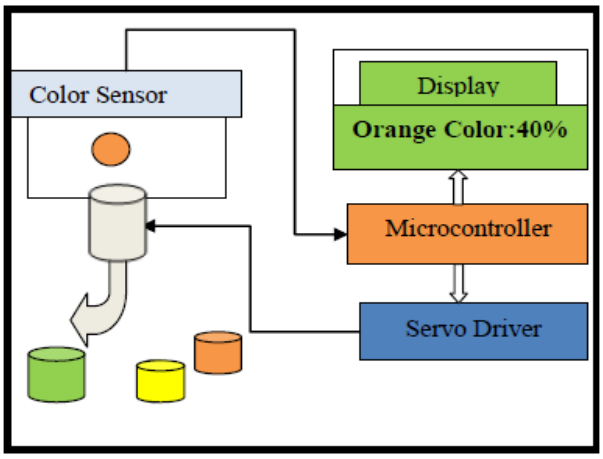

Figure 4

Fig 4. Shows the color of orange is 40%. Means the orange is totally unripe and the oranges collected in green box.

EXPERIMENTAL STUDIES

The sensor receives light reflections from the product. Color sensors, as previously mentioned, have four color filters: green, red, blue, and black (no color), which are chosen by pin selection.

The microcontroller's stored program determines which filters to use. The project's color and the microcontroller's selected pin configuration input determine the frequency output of the color sensor. One of the four photo diode filters that can be chosen by selecting a pin will produce an output based on the project's color.

It generates an output frequency of 330 Hz range frequency when there is nothing in front of the sensors, and 7–17 KHz when there is something.

The sensor generates an output with a range frequency of 330 Hz when there is nothing in front of it. In order to determine whether there is

an object on the servo motor, we therefore set a break down value of 32H.

As a result, the PIC can only check this condition before moving on to the next step. If an object is present, the sensor generates an output frequency that is proportionate to its color and the chosen photo diode configuration, giving the chosen photo diode the maximum frequency for the color it corresponds to. When a red filter is chosen, the sensor thus outputs the maximum frequency for red-colored objects; similarly, corresponding filters sense other colored objects.

In order to determine the color of the object, the frequency received during each filter selection is counted, saved to different registers, and then these values are analyzed to determine which is greater. A container is positioned on top of the second DC motor, which is connected to another servo motor. The first section of the container is for Green, the middle section is for Black, and the third section is for Red. The conveyor belt will move the container forward or backward depending on its color. This movement is made possible by connecting the DC motor to the L293D hybrid IC.

Eventually the goods will land in the appropriate areas of the container.

RESULT AND DISCUSSION

1. By sorting the ripe and unripe oranges, the suggested method reduces the need for human labor and reduces the possibility of error.
2. Currently, the proposed system with one channel sorts one orange in 2.5 seconds, or about 1500 oranges per hour and 36,000 oranges total per day.

CONCLUSION

Color sensors have been used in the design and development of the orange segregation machine, the proposed system. The machine is composed of an Arduino Uno board, Servo Motors weight sensors, IR sensors, and a conveyer system that can be either a ramp or another system that we will try to fix for sorting oranges. The PIC development board and color sensors both identify the orange pass's color using the Arduino Uno, which regulates the overall process and is dependent on a microcontroller. The oranges are moving straight ahead toward the arranging point along the incline. Oranges are sorted as ripe or unripe based on the color intensity that the color sensor detects. This is the distinguishing evidence of color checking by recurrence examination of the yield of the color sensor.

FUTURE SCOPE

Determining damaged orange fruit is a significant challenge that is not addressed in this study. It has been noted that various forms of damage, such as hailstone marks, rugs, fungal infections, and bruises, leave marks on the skin. The extent of the future depends on identifying these damages.

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Enhancing Microgrid Resilience: A Robust Protection Strategy Employing Differential & Overcurrent Relays

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ABSTRACT

This article introduces a novel method to enhance the protection scheme for micro grid systems experiencing significant transitions between islanded and grid operating modes. In order to handle the dynamic variations in short-circuit fault current characteristics, the suggested hybrid flexible protection system strategically includes both over current and differential relays. Adaptive over current relays are employed to safeguard distributed generators (DGs) and individual load points (LPs), while differential relays are utilized to protect feeders, backbone lines, and buses. This novel approach seeks to lessen the need for infrastructure upgrades and the complexity of setting computations.

The protection scheme operates adaptively, utilizing over current relays for faults outside the protection zone and employing differential relays for faults within the designated zone. This approach ensures the safety of consumers and equipment connected within the micro grid system network. Time-domain simulations with a standard microgrid test network in the MATLAB/Simulink software environment are used to validate the suggested strategy. This research contributes to advancing the resilience and effectiveness of micro grid systems in dynamic operational scenarios.

KEYWORDS *: Adaptive over current relay, Short circuit fault current, Islanded mode, Distributed generators, Reliability enhancement, Efficiency improvement, Stability, Protection zone.*

INTRODUCTION

In the realm of grid modernization and the integration of DG sources, micro grids have emerged as a focal point. Characterized as medium- or low-voltage networks encompassing local loads and DG sources, micro grids offer the flexibility to operate in grid-connected and islanded modes based on the presence of a utility connection [1]. The proliferation of DG sources in microgrids brings forth advantages such as loss reduction, prevention of network congestion, and increased resilience through islanded operation [2].

However, the integration of DG sources introduces operational and protection challenges, deviating from the conventional design principles of distribution networks depend on large SC currents & radial power flow [3].

Notably, topological changes in microgrids during transitions between grid and islanded conditions pose challenges in short-circuit behavioral changes, affecting protection infrastructure. The key issue arises when a microgrid shifts to an islanded condition, leading to a significant reduction in short circuit levels due to the absence of a utility supply [4]. This is especially relevant in microgrids with DG sources that are mostly inverter-based and that have current-limiting devices installed, since this could make the current overcurrent protection insufficient [5].

Adaptive overcurrent protection, a dynamic process modifying protective responses in response to system changes, employs microprocessor-based directional overcurrent relays (DOCR) for microgrid protection. DOCRs offer flexibility with selectable tripping curves tailored to specific system needs. Implementation of adaptive protection can follow centralized or decentralized control approaches, each demanding

distinct communication architectures [6]. Microgrid protection encounters challenges during transitions between grid-connected and islanded modes, leading to short circuit level variations. Adaptation to these changes is critical; however, traditional solutions, such as adding storage units, prove impractical due to high costsand uncertain fault-clearing times [7].

The bidirectional power flow in microgrids, a consequence of distributed generator (DG) connections and mesh configurations, introduces new protection challenges. Power electronic converters in DGs, operating in intermittent and current-limiting environments, pose additional complexities. Meshed networks, while enhancing reliability, present communication challenges that impact effective protection [8-10]. In addressing these complexities, adaptive protection schemes emerge as effective solutions for microgrids operating in diverse modes. A proposed hybrid protection safeguarding feeders, buses, and load points. Communication links are optional, considering cost and complexity concerns [11-12].

Several studies propose adaptive protection methods for low-voltage microgrids, utilizing communication links for efficient fault detection and relay coordination. While these systems provide reliable and fast operation, communication failures remain unaddressed [13]. Alternatives, such as storage-based systems using flywheels, present challenges in on-time fault clearing and require substantial installations [14].

The core challenge in adaptive relaying lies in adjusting relay settings based on load behavior, manner of functioning and production levels. Directional over current relays face coordination difficulties in multi-source and multi-loop networks due to varied current flow directions. Overcoming these challenges necessitates the development of efficient and fast adaptive overcurrent protection systems [15-16].

IMPACTS OF DG ON POWER SYSTEMS: A COMPREHENSIVE ANALYSIS

"Incorporating Distributed Generators (DG) into distribution networks yields a spectrum of effects, both advantageous and detrimental. When addressing faults in the distribution system, overcurrent protection plays a pivotal role. However, the introduction of DG alters the overall fault current perceived by the relay, triggering shifts in operation time and potential structural concerns [17]. This change in fault current, influenced by the DG's location, can either elevate or diminish, leading to adjusted relay operation times and potential challenges.

The escalation of nominal current flow raises concerns about falsified tripping, given that relays are typically configured to safeguard a specific section termed the relay reach, determined by the minimal level Ipickup. The presence of DG curtails this reach and diminishes the overall fault current. Consequently, the relay might fail to detect currents from buses below Ipickup, categorizing them as beyond the protection system's reach [18].

Figure 1 visually depicts the influence of DG on relay reach. In the absence of DG, the relay reverts to its initial reach. However, the identification of DG presence diminishes the relay reach, occasionally falling below the actual reach. The collective impact of DG, fault resistance (RF), and DG location from the power source collectively shape the relay reach.

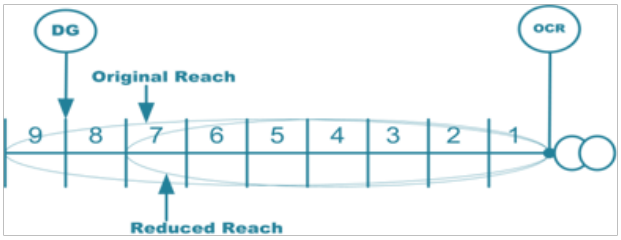

Figure 1 Assessment of original and reduced reach

Adjustments to thresholds for Short Circuit (SC) and fault current (If) become imperative due to the modified venin impedance of the system resulting from DG attachment. Fault current levels fluctuate based on the parallel association of DGs with machinery, impacting the system's configuration [19-20]. Lower fault currents may render the fault undetectable, especially when they are below load currents. Additionally, the grounding connections of transformers and generators contribute to distinguishing DG faults from asymmetrical faults.

DG interactions pose challenges to overcurrent relays, particularly in bidirectional fault scenarios where multiple switches may need activation for fault removal. This intricacy necessitates additional switching devices and protective measures for overcurrent relays,

rendering them susceptible to false tripping due to changes in fault currents [21].

INTEGRATED APPROACH: CONFIGURATION, AND METHODOLOGY

Recent advancements in microgrid protection underscore the need for integrating cost-effective wireless sensor networks (WSN) and multifunctional microprocessor-based relays. Noteworthy challenges include issues with current transformer (CT) mismatches, CT saturation leading to erroneous measurements, and the the complex multi-terminal component differential protection adjustment.

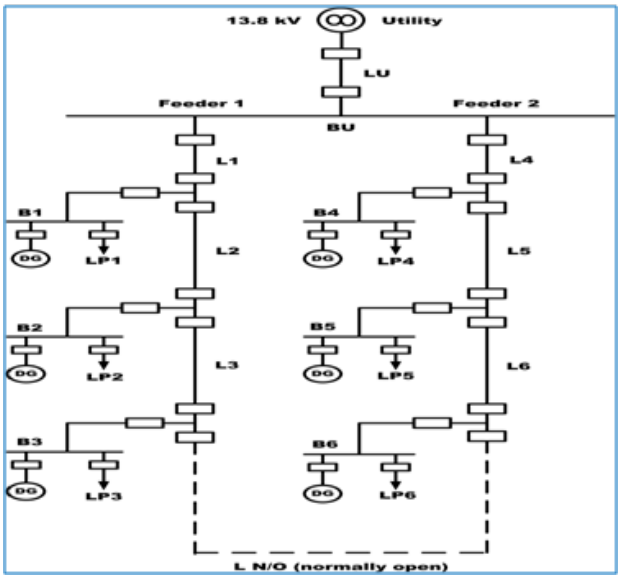

Figure 2: Study system

In response to the identified challenges, there emerges a compelling need for a holistic solution in the form of an integrated over current adaptive relay and differential relay protection scheme tailored for smart microgrid systems [22]. This envisioned protection system must possess dynamic adaptability to grid changes, incorporating self-monitoring and self-healing capabilities. Leveraging AI methods, the microprocessor/numerical relay technology should optimize and adapt seamlessly [23]. The protection strategy must be customized for various zones and equipment within the microgrid, ensuring cost-effectiveness, reliability, and efficiency in both autonomous and grid-connected modes [24]. A test microgrid system as depicted in Figure 2. Subsequent sections delve into a meticulous examination of the load flow within the AC microgrid system for both operational modes.

System Parameters

Utility grid-rated capacity = 13.8 kV; DG1 to DG6 rating = 0.2 MW; The power factor for all DGs = 0.9; Load points LP1, LP2, LP4, LP5 rating = 0.2 MW; Load points LP3, LP6 rating = 0.1 MW; The power factor for all load points (LPs) = 0.9 [31]

RESULTS AND DISCUSSIONS

AC Microgrid System with One DG Connection

The 3-phase sinusoidal voltage and current measurement in normal operating conditions in the microgrid system are done by using the 2 scope blocks connected to the 3-phase V-I measurement bus bar. This microgrid system model is formed in the MATLAB/Simulink software environment.

Normal Operating Condition

Figure 3 shows the microgrid system model with one DG connection in normal operating conditions.

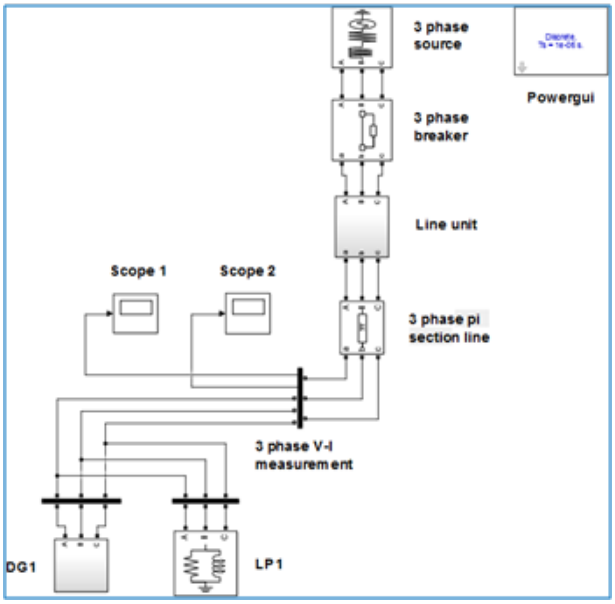

Figure 3: Microgrid system with one DG connection in normal operating condition

Figure 4 shows the load flow report table for the microgrid system with one DG connection in normal operating conditions. In this table, the load flow for one

3-phase source, one 3-phase RLC load, and one bus are shown.

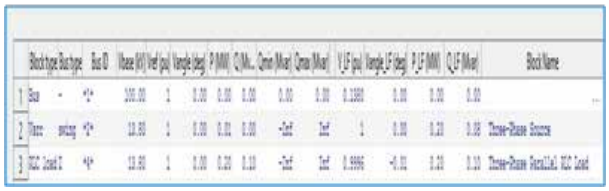

Figure 4: Load flow report of the microgrid system with one DG connection in normal operating condition

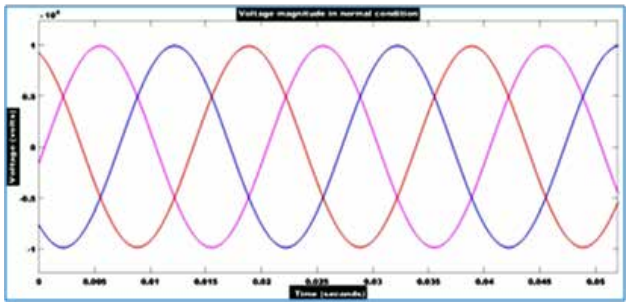

Figure 5: Voltage magnitude in normal operating condition

In these results, Figure 5 shows the 3-phase sinusoidal voltage magnitude when the microgrid system is operating in grid-connected mode and the normal condition with the 50 Hz frequency, and Figure 6 shows the 3-phase sinusoidal current magnitude condition with the 50 Hz frequency.

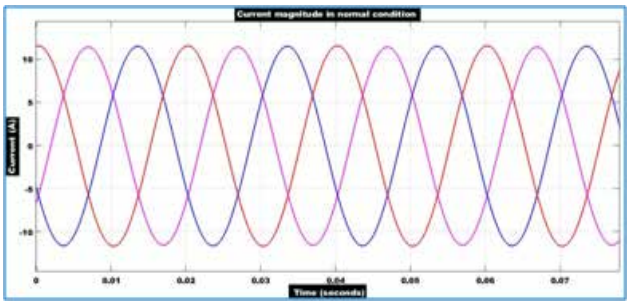

Figure 6: Current magnitude in normal operating condition

Faulty Condition

In this type of fault, the magnitudes of the voltage of the 3 phases which are short-circuited with each other drop down to the zero value instantaneously. Whereas, the current of 3 faulted phases with each other increases instantaneously to the maximum value.

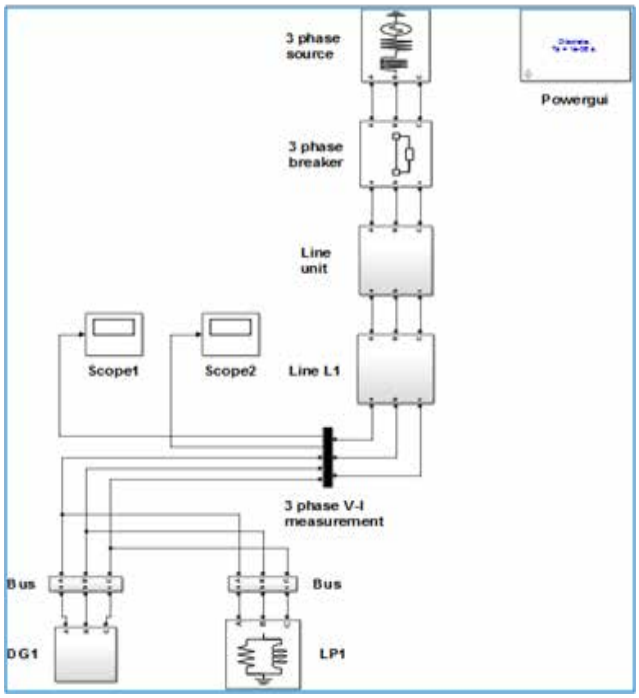

Figure 7: Microgrid system with one DG connection for LLL fault on line L1

Figure 7 shows the microgrid system model with one DG connection when LLL fault has occurred on line L1. The 3ss-phase sinusoidal voltage and current measurement before and after the LLL fault occurrence on line L1 in the microgrid system are done by using the 2 scope blocks connected to the 3-phase V-I measurement bus bar.

Figure 8 shows the load flow report table for the microgrid system with one DG connection for an LLL fault that occurred on line L1. In this table, the load flow for one 3-phase source, one 3-phase RLC load, and three buses are shown.

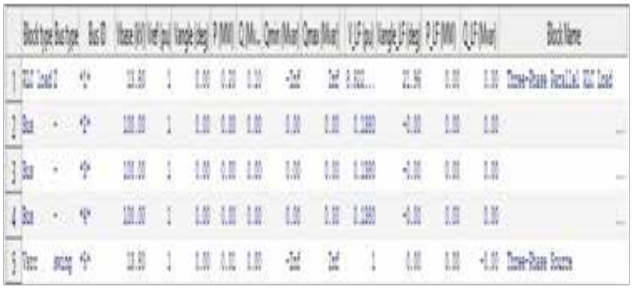

Figure 8: Load flow report with one DG connection for LLL fault on line L1

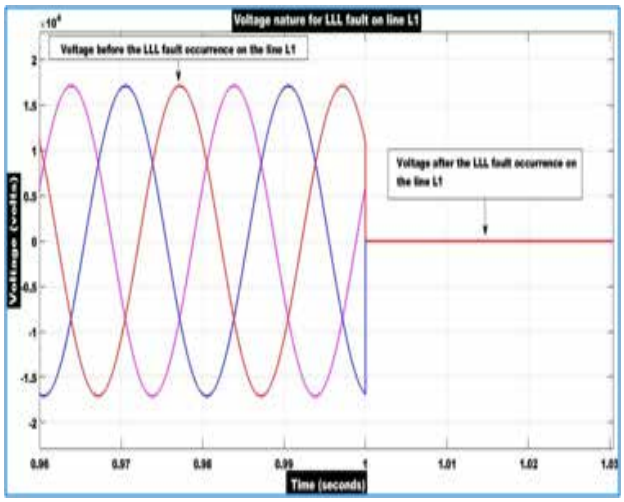

Figure 9: Voltage nature for LLL fault on line L1 before and after the fault occurrence

Figure 9 shows the 3-phase voltage magnitude for the LLL fault on line L1 before and after the fault occurrence with the 50 Hz frequency. In this result, initially, when the microgrid system is operated in the normal operating condition the 3-phase voltage is sinusoidal in nature from 0 to 1 second. The magnitude of this sinusoidal voltage before the fault occurrence is up to 170 kV from 0 to 1 second in normal operating conditions. But, when 3 phase SC LLL fault is occurred on the line L1 at 1 second that time voltage of all three phases drops to zero instantaneously due to this LLL fault on the line L1. The voltage of these three phases remains zero till the LLL fault is cleared completely on line L1 in the microgrid system.

Figure 10 shows the 3-phase sinusoidal current magnitude for the LLL fault on line L1 before and after the fault occurrence with the 50 Hz frequency. In this result, initially, when the microgrid system is operated in the normal operating condition the 3-phase current is sinusoidal in nature with 10 to 15 A current magnitudes from 0 to 1 second. But, when 3 phase SC LLL fault occurs on line L1 at 1 second that time two phases' current magnitude increases up to 78 A instantaneously, and current of the remaining phase also increases up the 24 A instantaneously due to the LLL fault on the line L1. This current magnitude remains high till the LLL fault is cleared completely on line L1 in the microgrid system.

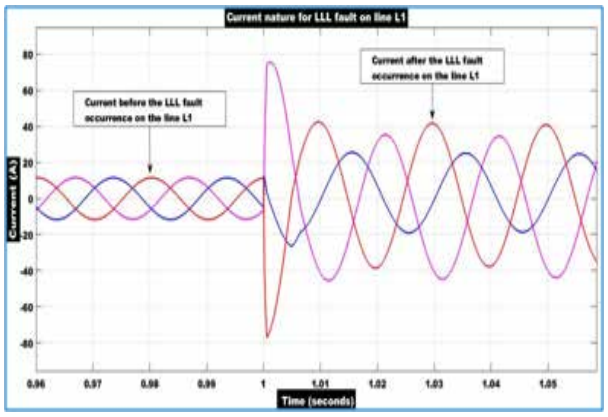

Figure 10: Current nature of LLL fault on line L1 before and after the fault occurrence

In LLLG type of fault, the magnitude of the voltage of the 3 phases which are short-circuited with each other with the ground drops down to the zero value instantaneously. Whereas, the current of 3 faulted phases with each other with the ground increases instantaneously to the maximum value.

Case Study - 1: Protecting an AC microgrid system using a current differential relay protection scheme in the event of a three-phase single LLG fault occurring on line L1 in both modes of operation (protecting faults occurring within the protected zone of the microgrid structure, such as faults on feeders, lines, buses, etc.).

Case Study - 2 Protecting an AC microgrid system by implementing an adaptive overcurrent relay protection scheme. This scheme is designed to respond to a 3-phase SC LLLG fault occurring at the 3-phase parallel RLC load point LP1, in both modes of operation.

Current Differential Relays for AC Microgrid Protection (Case Study 1

Figure 11 illustrates the intricate model of the microgrid system in the grid-connected mode of operation.

In the grid-connected state of execution, the table for the load flow assessment of the microgrid system is shown in Figure 12 Each bus's load flow computation is included in this table. All of the components' block names, types, and bus IDs are listed here. The three-phase RLC source, bus, and load points' base voltages are also displayed in this table. Each bus's reference voltage in pu is displayed.

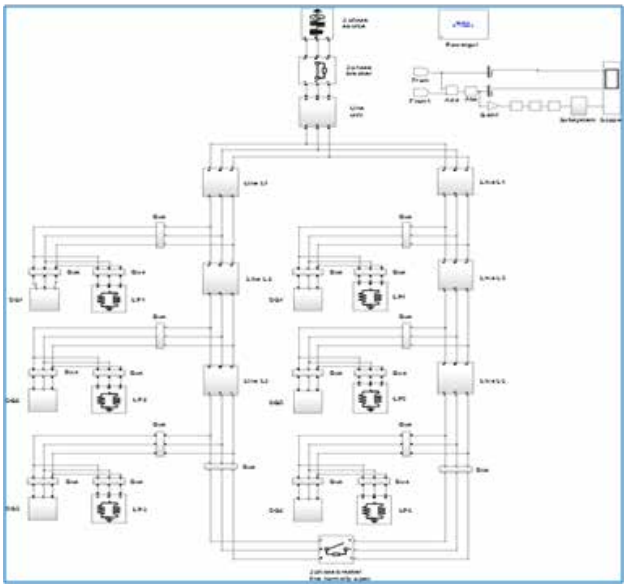

Figure 11: Micro grid system in grid-connected

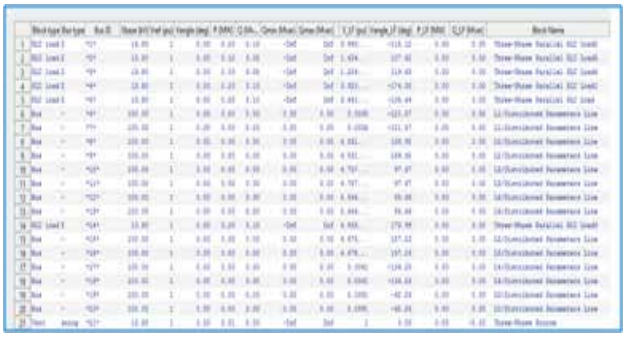

Figure 12: Load flow for grid-connected

RESULTS

When run in a grid-connected state, the microgrid network produces the outcomes shown in Figure 13 On the three-phase line L1, a three-phase LLLG fault is generated at 0.1 seconds, and three outcomes are displayed. This safeguards the microgrid system's customers and machinery from three-phase faults that happen within the designated zone (such as those at feeders, lines, buses, etc.). Using the existing differential relay protection technique, these faults are eliminated in 0.1 to 0.2 s.

According to this outcome, up until 0.1 seconds before the fault occurs, the current flowing through radial breaker unit 1 (RBU1) is constant. Within 0.1 seconds of the fault occurring on line L1, the current waveform of the RBU1 current drops precipitously, reaching -2000 A current in a remarkably brief amount of time. The RBU1 current signal returns to its stable zero condition and continues to do so in a straight line for up to 0.2 seconds after the current differential relay has been successfully operated.

Differential Current-RBU1 and B1BU, the Radial Breaker Units

The differential current in this scenario is initially flowing in a straight line from zero to 0.1 seconds before the fault occurs. However, the differential relay trips the corresponding circuit breaker after 0.1 seconds when a fault occurs at 0.1 seconds, after which line L1 flows at a maximum differential current of 875 A.

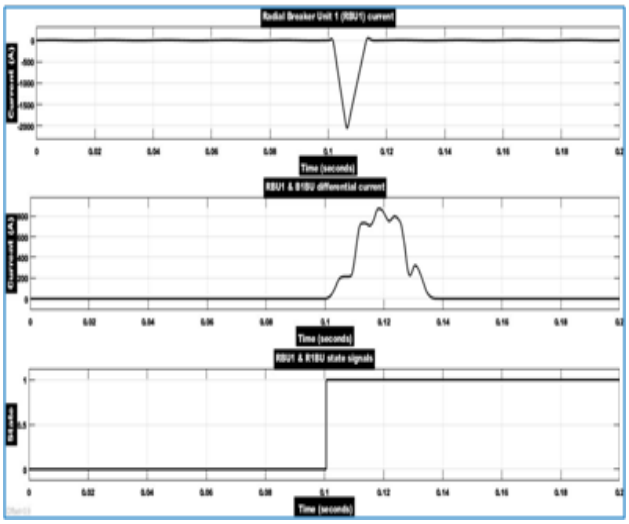

Figure 13: grid-connected mode

State signals of the Radial breaker unit 1 (RBU1) and the radial 1 breaker unit (R1BU).

This outcome is the consequence of a straight-line state signal flow from the zero location up to 0.1 seconds, emanating from the circuit breaker units RBU1 and R1BU. Following the 0.1-second fault occurrence, the RBU1 and R1BU state signals ascend to state 1, and then remain in a steady upward flow until the fault is entirely cleared on the line L1 unit, which occurs at 0.2 seconds after state 1.

Adaptive Overcurrent Relays for AC Microgrid Protection (Case Study - 2)

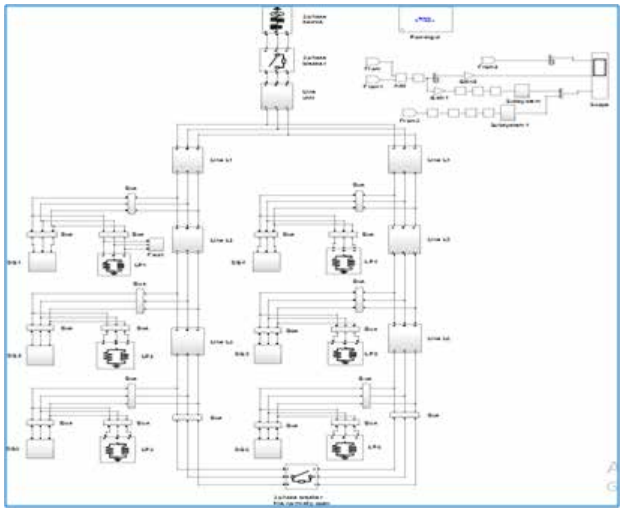

Figure 14: Islanded mode

Figure 14 offers an intricate view of the microgrid system's model during the islanded mode of operation.

The detailed load flow analysis is presented in Figure 15.

Figure 15: Load flow

The load flow report also encompasses base voltage values, reference voltages, active and reactive power calculations, as well as voltage load flow and angle measurements. These calculations, derived from the power GUI block of the microgrid system's model during islanded operation, contribute to a thorough understanding of the system's performance.

Results during the Island Mode of Operation

The presented Figure 16 illustrates the outcomes during the microgrid system's islanded mode of operation. The adaptive overcurrent relay protection scheme successfully clears these faults within the timeframe of 0.1 to 0.2 seconds, ensuring the safety and reliability of the microgrid system.

Load Point 1 (LP1) Current

The adaptive overcurrent relay registers LP1 current peaking at 2250 A for a brief 1 to 1.5 cycle duration. Following fault clearance on LP1, the current stabilizes and flows consistently from 0.14 to 0.2 seconds.

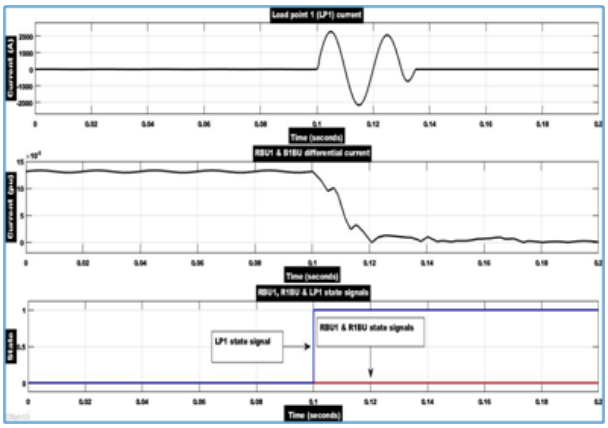

Figure 16: Islanded mode

CONCLUSION

This paper concludes that this protection scheme for the microgrid system under the study operated effectively and protected the overall microgrid system from 3 phases of SC symmetrical LLLG faults are occurred in both grid-connected and islanded modes of operation. Also, the adaptive overcurrent relays protection scheme operated successfully and protected the consumers as well as equipment connected in the microgrid system.

Also, this microgrid protection scheme shows feasibility and effectiveness in both modes of operation under the changing SC fault current level and varying fault impedance in the microgrid system. This protection scheme can be effectively implemented for symmetrical faults like LLL, and LLLG faults. This protection scheme improves the reliability, power quality, efficiency, and safety operation of both consumers as well as equipment connected to the microgrid system by clearing the 3-phase SC faults in the minimum possible time and by protecting the overall microgrid system effectively.

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Empowering Microgrids Protection Through Adaptive Relays

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ABSTRACT

This research introduces an innovative hybrid adaptive protection system for microgrid systems, enhancing resilience during transitions between grid and islanded modes. Integrating overcurrent and differential relays strategically, the system addresses dynamic variations in short-circuit fault current characteristics. Adaptive overcurrent relays protect DGs and individual LPs, while differential relays safeguard feeders, backbone lines, and buses, aiming to minimize infrastructure upgrades and simplify setting computations. Through rigorous simulations covering diverse operating conditions, the proposed scheme proves effective in shielding the microgrid from substantial three-phase short-circuit fault currents, enhancing reliability, efficiency, power quality, and stability. Operating adaptively, the scheme uses overcurrent relays for faults outside the protection zone and differential relays for faults within the specified zone, ensuring the safety of consumers and equipment in the microgrid network. Validation through simulations on a typical microgrid test network in MATLAB/Simulink significantly contributes to advancing microgrid system resilience and effectiveness in dynamic operational scenarios.

KEYWORDS *: Differential relay, Microgrid operation, Grid-connected mode, Islanded mode, Load points, Reliability enhancement, Power quality assurance, Stability optimization.*

Abbreviations & Nomenclature

MG	Microgrid
IM	Islanded Mode
C.T	Current Transformers
R1BU	Radial 1 Breaker Unit
GCM	Grid Connected Mode
RF	Fault Resistance
B	Bus
AOCRP	Adaptive Overcurrent Relay Protection
MPPT	Maximum Power Point Tracking
Length of line	L1, L2, L3, L4, L5, L6, and LU = 0.5 km
ADN	Active distribution networks
DRP	Differential Relay Protection
LLL	3 Phase Short circuit faults

INTRODUCTION

While research on protection schemes for microgrids is in its early stages, adaptive protection schemes have been proposed, albeit with inherent complexities. Adaptive protection requires advanced technology, self-monitoring capabilities, and complex integration of hardware and software units, demanding significant upgrades to existing infrastructure for practical implementation [1]. Existing protection methods, such as differential schemes utilizing communicative relays, demand extensive communication infrastructure and relay deployment at each line end [2]. In this challenging landscape, this research introduces a hybrid protection scheme, combining differential and adaptive overcurrent relays. The scheme employs differential relays to safeguard microgrid feeders, lines, and interconnecting buses, while adaptive overcurrent relays protect DGs and individual load points.

The integration of DGs into the main grid to form a microgrid offers a viable alternative, leveraging renewable sources for reduced transmission losses, improved power quality, and environmental sustainability [3-5]. The operation of microgrids can be categorized into four modes, each presenting unique challenges to traditional protection coordination schemes. Fault currents becoming bi-directional, limitations imposed by inverter-based DGs, and variations in fault current

levels due to different generator types contribute to the ineffectiveness of conventional relays [6-7]. Adaptive protection's automatic adjustment to power system conditions and the inherent advantages of differential protection make this hybrid approach promising for addressing the complexities of microgrid protection [8].

As microgrids continue to evolve, necessitating dynamic protection solutions, this research explores the integration of adaptive and differential protection schemes to enhance the reliability and efficiency of microgrid protection systems. Several studies propose adaptive protection methods for low-voltage microgrids, utilizing communication links for efficient fault detection and relay coordination [9-11]. While these systems provide reliable and fast operation, communication failures remain unaddressed [12]. Alternatives, such as storage-based systems using flywheels, present challenges in on-time fault clearing and require substantial installations [13].

CHALLENGES IN EXISTING ADAPTIVE OVERCURRENT RELAY APPROACHES

The current landscape of AOCR schemes faces critical challenges, particularly in light of evolving distributed energy resource (DER) interconnection requirements and the dynamic transition to microgrid operations.

Existing AOCR schemes encounter difficulties in accurately estimating fault current contributions from DERs operating at varying output levels. Traditional approaches, treating DERs as constant current sources, may lead to overcompensation or underreaching due to the complex nature of DER behavior [14]. These challenges arise from factors like distance from the fault, fault impedance, and fault type, making it imperative to refine AOCR schemes to account for changing fault current contributions [15].

Delayed Trip Time in Microgrid Mode

Microgrids, characterized by lower fault currents compared to grid-connected systems, pose a unique challenge to AOCR sensitivity in primary/secondary protection zones. The traditional time-based coordination methods may introduce significant delays in relay trip times for faults within the primary zone, an aspect often overlooked in existing AOCR approaches [16].

Current Direction Reversal during Mode Switching

The possibility of current direction reversal, a phenomenon observed during mode switching in both grid-connected systems and microgrids, remains inadequately addressed in existing AOCR approaches. [17]. These approaches are susceptible to under-reaching, struggle with changing fault currents, and may prove overly complex for traditional distribution relays. The subsequent section delves into an emerging vulnerability that challenges conventional practices in relay programming [18].

PROTECTION STRATEGIES FOR MICROGRIDS

Differential protection involves assessing the electrical quantities entering and leaving a designated security zone by comparing current through CTs. This method relies on either current balance or voltage balance to determine the absence of faults [19].

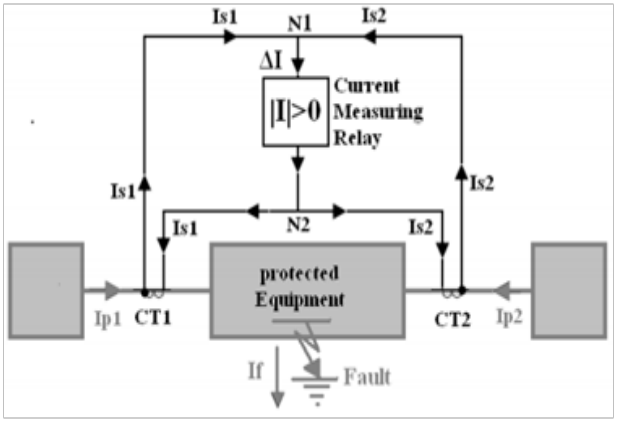

Fig. 1 Current Balance Differential protection

The evolution of relay protection began with high-current relay protection, from which the Discriminatory Short Circuit Protection (DSCP) scheme emerged. DSCP differs from 'overload' protection, incorporating time-based relay operation to safeguard devices thermally. The AOCR Protection system, derived from DSCP, addresses challenges in microgrid operation modes, adapting to distinct short circuit attributes [20].

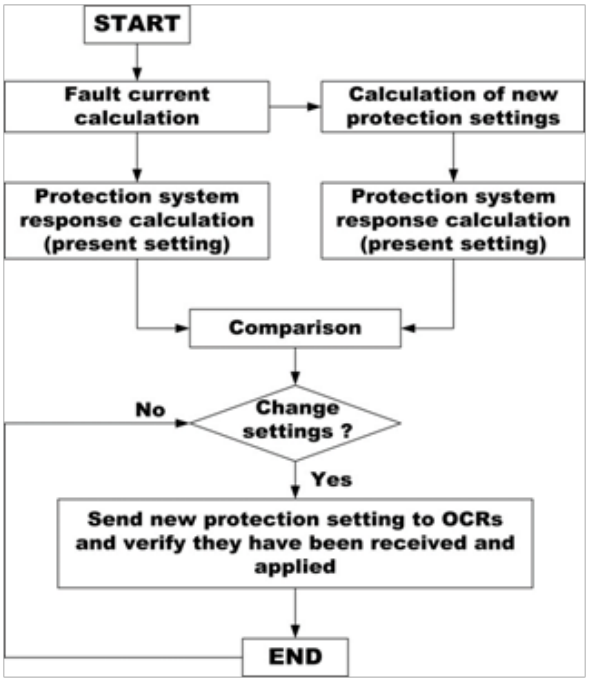

Fig. 2: Adaptive overcurrent protection algorithm

AOCRP accommodates these complexities by enabling adjustments based on grid conditions, facilitated through external communication technology [21]. However, incorporating microgrid configurations into the relay introduces inherent inefficiencies, particularly in intricate network structures, potentially leading to malfunctions during unforeseen events [22].

Adaptive Protection Scheme: Fig. 2 illustrates an adaptive protection scheme with two approaches.

The first approach responds to alterations in the network, adjusting configurations, linking or disconnecting DGs, and transitioning between islanded and grid-connected modes. This approach involves real-time calculation and modification of settings, requiring robust decision-making capabilities [20].

PROBLEM STATEMENT AND SYSTEM DESCRIPTION

This envisioned protection system must possess dynamic adaptability to grid changes, incorporating self-monitoring and self-healing capabilities. The protection strategy must be customized for various zones and equipment within the microgrid, ensuring cost-effectiveness, reliability, and efficiency.

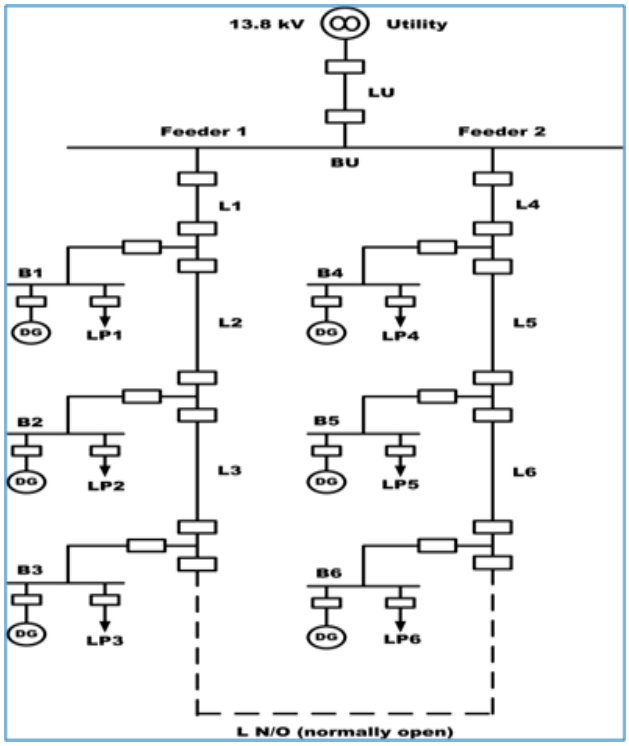

Fig. 3 System under study

This research paper is dedicated to securing the AC microgrid system in both grid-connected and islanded modes, employing a test microgrid system as depicted in Fig 3. Subsequent sections delve into a meticulous examination of the load flow within the AC microgrid system for both operational modes.

System Parameters:

Utility grid-rated capacity = 13.8 kV; DG1 to DG6 rating = 0.2 MW; The power factor for all DGs = 0.9; Load points LP1, LP2, LP4, LP5 rating = 0.2 MW; Load points LP3,; LP6 rating = 0.1 MW; The power factor for all load points (LPs) = 0.9

Protection Settings:

Line and bus differential relay CT ratio = 150/5; Load points CT ratio = 150/5; IDIFFPKP MIN = 0.05pu (0.25A); IBreakpoint = 1pu (5A); K1 = 20%; K2 = 98%

Grid mode:

FINDINGS AND EXPLORATION

In the AC electrical power distribution network like a power system network or microgrid system operating in

both modes of operation in normal operating conditions the 3-phase voltage and current waveforms are sinusoidal in nature with a 50 Hz frequency. But, when 3-phase symmetrical short circuit (SC) faults like LLL, LLLG, or unsymmetrical short circuit (SC) faults like LG, LL, and LLG have occurred in the power system or microgrid system operating in both modes of operation then the magnitude of the SC voltage VSC is decreased to the zero or nearest to the zero value and SC fault current ISC is increased to the very high value in a very short period.

Abnormal Operating Condition

Fig. 4 shows the microgrid system model with one DG connection when 3-phase faults occurred on line L1. The 3-phase sinusoidal voltage and current measurement before and after the fault occurrence on line L1 in the microgrid system is done by using the 2 scope blocks connected to the 3-phase V-I measurement bus bar. This microgrid system model is formed in the MATLAB/ Simulink software environment.

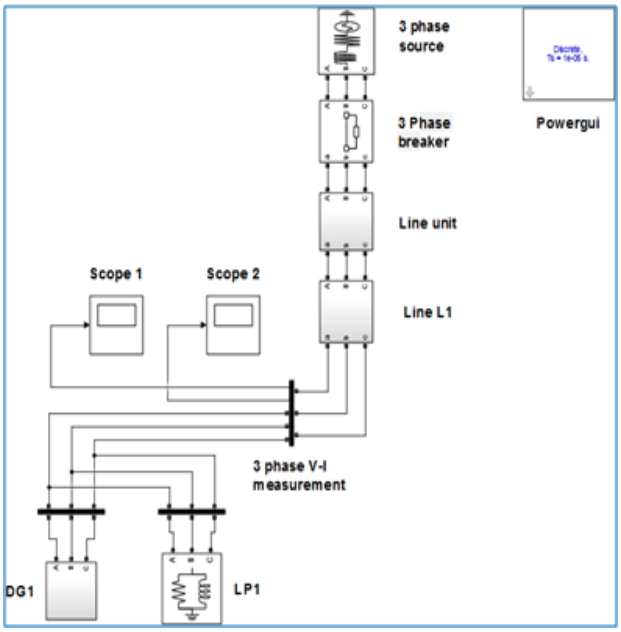

Fig. 4: Microgrid system with one DG connection in faulty condition

This diagram shows the load flow report table for the microgrid system with one DG connection in the faulty condition. In this table, the load flow for one 3-phase source, one 3-phase RLC load, and two buses are shown.

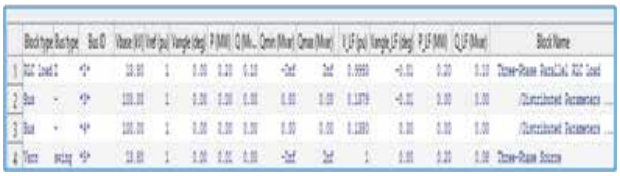

Fig. 5: Load flow report of the microgrid system with one DG connection in faulty condition

Fig. 6 shows the 3-phase voltage magnitude before and after the fault occurrence on the line L1 with the 50 Hz frequency. In this result, initially, when the microgrid system is operated in the normal operating condition the 3-phase voltage is sinusoidal in nature from 0 to 1 second. The magnitude of this sinusoidal voltage is up to 10 kV from 0 to 1 second in the normal condition. But, when 3 phase SC fault is occurred on the line L1 at 1 second that time 3 phase voltage magnitude suddenly drops to the zero value. This voltage magnitude remains zero till the fault is cleared completely on line L1 in the microgrid system.

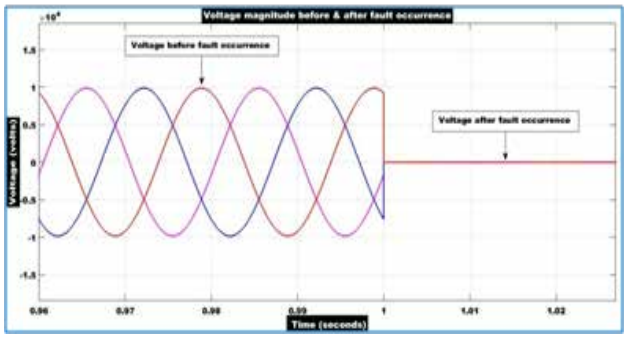

Fig. 6: Voltage magnitude before and after the fault occurrence

Fig. 7 shows the 3-phase sinusoidal current magnitude before and after the fault occurrence on the line L1 with the 50 Hz frequency. In this result, initially, when the microgrid system is operated in the normal operating condition the 3-phase current is sinusoidal in nature with a small current magnitude from 0 to 1 second. But, when 3 phase SC fault occurs on the line L1 at 1 second that time 3 phase current magnitude drastically increases to a very large amount. This current magnitude remains high till the fault is cleared completely on line L1 in the microgrid system.

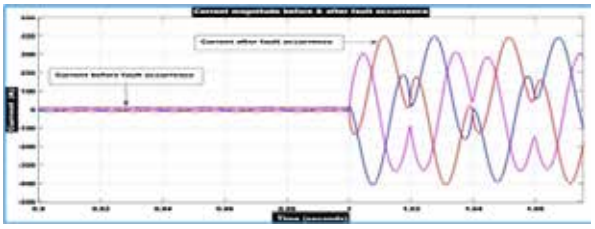

Fig. 7: Current magnitude before and after the fault occurrence

Microgrid System with One DG Connection for LLG Fault on Line L1

In this section, the voltage and current magnitude nature concerning the time domain for various symmetrical and unsymmetrical faults that occurred in the AC microgrid system are discussed. The voltage of the phase where the fault occurs instantaneously drops to zero value and current increases to the maximum value after the fault occurrence at that phase. The microgrid system model for any of these symmetrical or unsymmetrical faults is formed in the MATLAB/Simulink software environment, load flow reports are taken from the powerful block and results for each of the faults are shown for validation and discussion purposes. Fig. 8 shows the microgrid system model with one DG connection when an LLG fault has occurred on line L1.

The 3-phase sinusoidal voltage and current measurement before and after the fault occurrence on line L1 in the microgrid system is done by using the 2 scope blocks connected to the 3-phase V-I measurement bus bar. This microgrid system model is formed in the MATLAB/Simulink software environment.

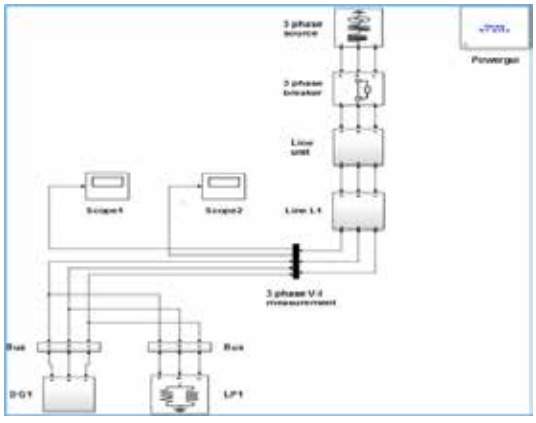

Fig. 8: Microgrid system with one DG connection for LLG fault on line L1

Fig. 9 shows the load flow report table for the microgrid system with one DG connection for the LLG fault that occurred on line L1. In this table, the load flow for one 3-phase source, one 3-phase RLC load, and three buses are shown.

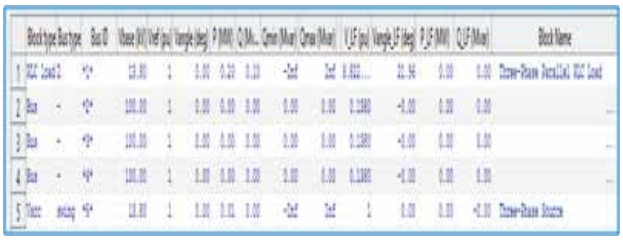

Fig 9: Load flow report of the microgrid system with one DG connection for LLG fault on line L1

Fig 10 shows the 3-phase voltage magnitude for the LLG fault on line L1 before and after the fault occurrence with the 50 Hz frequency. In this result, initially, when the microgrid system is operated in the normal operating condition the 3-phase voltage is sinusoidal in nature from 0 to 1 second.

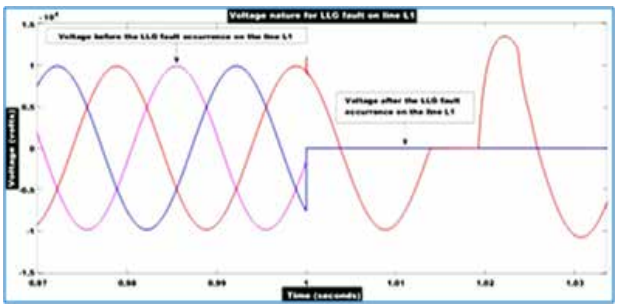

Fig. 10: Voltage nature for LLG fault on line L1 before and after the fault occurrence

The magnitude of this sinusoidal voltage before the fault occurrence is up to 10 kV from 0 to 1 second in normal operating conditions. But, when 3 phase SC LLG fault occurred on line L1 at 1 second that time voltage of the two phases dropped to zero instantaneously and the remaining one-phase voltage increased up to 1.14 kV sinusoidally due to this LLG fault on line L1. The voltage of these two phases remains zero till the LLG fault is cleared completely on line L1 in the microgrid system.

Fig 11 shows the 3-phase sinusoidal current magnitude for LLG fault on line L1 before and after the fault occurrence with the 50 Hz frequency.

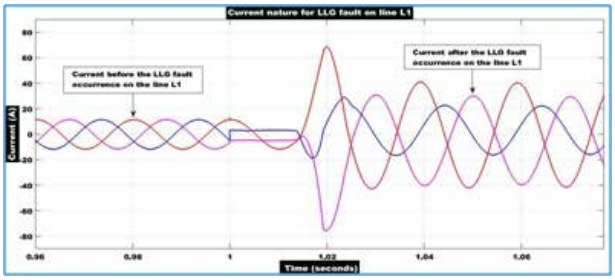

Fig. 11: Current nature for LLG fault on line L1 before and after the fault

In this result, initially, when the microgrid system is operated in the normal operating condition the 3-phase current is sinusoidal in nature with 10 to 15 A current magnitudes from 0 to 1 second. But, when 3 phase SC LLG fault occurs on line L1 at 1 second that time two phases' current magnitude increases up to 70 A in a very small-time duration and the current of the remaining phase also increases up the 30 A in a small-time duration due to the LLG fault on the line L1. This current magnitude remains high till the LLG fault is cleared completely on line L1 in the microgrid system.

Microgrid System with One DG Connection for LLLG Fault on Line L1

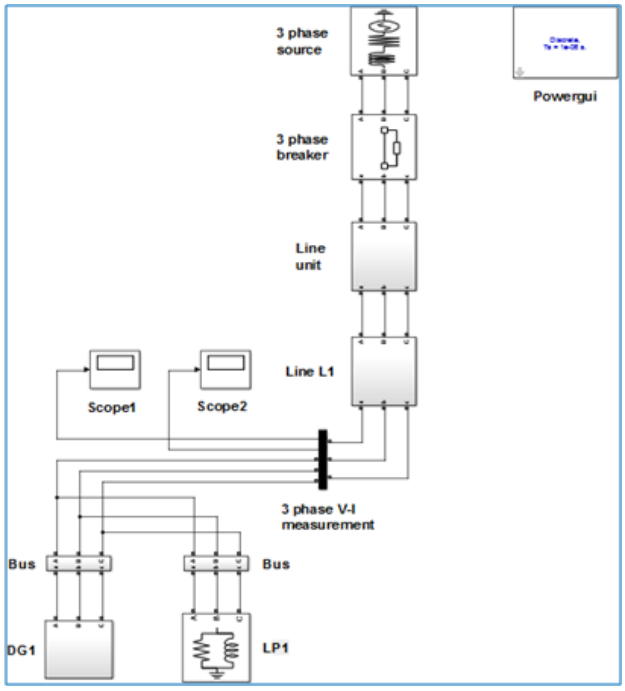

Fig 12: Microgrid system with one DG connection for LLLG fault on line L1

Fig 12 shows the microgrid system model with one DG connection when an LLLG fault has occurred on line L1. In this model, the microgrid system is operated in the grid-connected mode of operation with one 0.2 MW DG and one 0.2 MW parallel RLC load point (LP) connected in parallel with the DG at the lower end of the power distribution buses. The 3-phase sinusoidal voltage and current measurement before and after the LLLG fault occurrence on line L1 in the microgrid system is done by using the 2 scope blocks connected to the 3-phase V-I measurement bus bar. This microgrid system model is formed in the MATLAB/Simulink software environment.

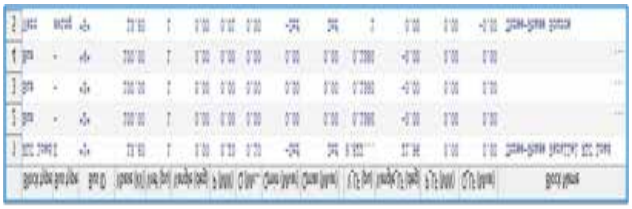

Fig. 13: Load flow report of the microgrid system with one DG connection for LLLG fault on line L1

Fig. 13 shows the load flow report table for the microgrid system with one DG connection for the LLLG fault that occurred on line L1. In this table, the load flow for one 3-phase source, one 3-phase RLC load, and three buses are shown.

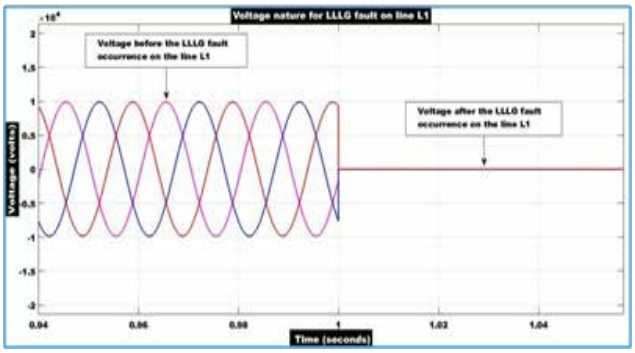

Fig. 14: Voltage nature for LLLG fault on line L1 before and after the fault

Fig. 14 illustrates the magnitude of the three-phase voltage for an LLLG fault on line L1, both before and after the fault, at a frequency of 50 Hz. During the usual working conditions of the microgrid system, the 3-phase voltage exhibits a sinusoidal waveform ranging from 0 to 1 second.

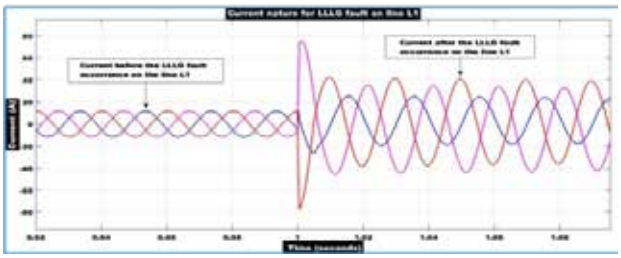

Fig 15: Current of LLLG fault on line L1 before and after the fault

The amplitude of this sinusoidal voltage before the fault event is 10 kV, ranging from 0 to 1 second, under normal operating conditions. However, when a three-phase short circuit line-to-line-to-ground fault occurs on line L1 at 1 second, the voltage of all three phases instantaneously drops to zero as a result of this LLLG failure on line L1. The voltage of these three phases remains at zero until the LLLG fault is completely resolved on line L1 in the microgrid system

Fig.15 illustrates the magnitude of the sinusoidal current in three phases for an LLLG fault on line L1, both before and after the fault has occurred, with a frequency of 50 Hz. During typical operation of the microgrid system, the 3-phase current exhibits a sinusoidal waveform with current magnitudes ranging from 10 to 15 A, during the time interval of 0 to 1 second. However, when a three-phase short circuit to line-to-line-to-ground fault occurs on line L1 at 1 second, the magnitudes of the currents in two phases increase instantaneously to 78 A, while the current in the remaining phase also increases instantaneously to 24 A due to the LLLG fault on line L1. The magnitude of the current will stay elevated until the LLLG fault on line L1 in the microgrid system is completely resolved.

Protection of AC Microgrid System from LLL-G Faults

In this section, we will examine the safeguarding of AC microgrid systems against three-phase SC LLLG failures in both grid-connected and islanded modes of operation. To study, analyze, and discuss the results, we examined this microgrid system in two specific case studies, referred to as Case Study - 1 and Case Study - 2. The load flow report of the microgrid system is obtained independently for each case study in both modes of operation using the power GUI block. The time-domain simulations, including outcomes, are comprehensively presented and analyzed for each case study, encompassing both modes of operation. The intricate models of microgrid systems being examined in both operational modes are created using the MATLAB/Simulink software environment.

Case Study - 1: Protecting an AC microgrid system using a current differential relay protection scheme in the event of a three-phase single LLG fault occurring on line L1 in both modes of operation (protecting faults occurring within the protected zone of the microgrid structure, such as faults on feeders, lines, buses, etc.).

Case Study - 2 Protecting an AC microgrid system by implementing an adaptive overcurrent relay protection scheme.

Case Study 1: Current Differential Relays

As seen in Fig.16, a comprehensive model of the microgrid network operating in island mode is displayed.

The table in Fig.17 displays the load flow evaluation for the microgrid network in the islanded mode of functioning. This table provides the load flow estimate for each bus. The block name, block type, bus type, and bus ID of every part are specified here.

The voltage load flow is in pu, and the voltage load flow angle is measured in degrees. All load flow estimates for the islanded mode functionality are derived and obtained from the power Gui block of the microgrid system's architecture when it is run in islanded mode.

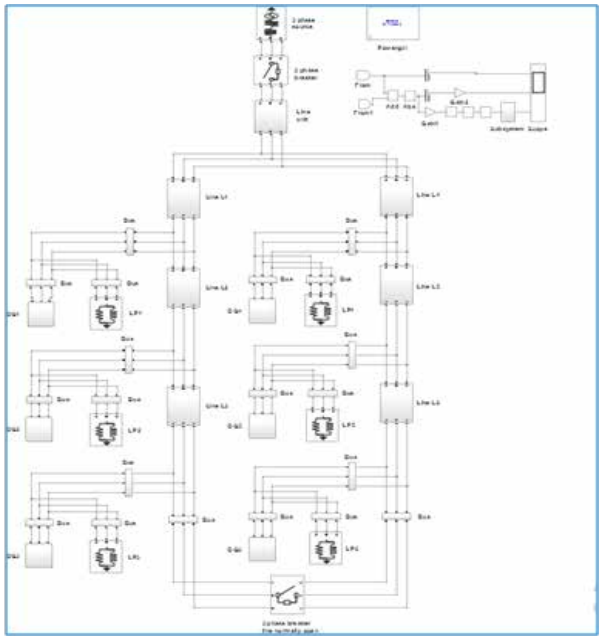

Fig. 16: Microgrid islanded mode of operation

Fig. 17: Load flow for an islanded mode of operation

Fig. 18 displays the outcomes of the microgrid system when functioning in islanded mode. A 3-phase LLLG defect is intentionally induced on the L1 phase of a 3-phase line, resulting in the display of 3 outcomes. The purpose of this is to safeguard both the consumers and equipment of the microgrid system from any 3 phase faults that may occur within the protected region. The existing differential relay protection technique effectively resolves these errors within a time frame of 0.1 to 0.2 seconds.During the disconnection of the microgrid system from the utility grid, the RBU1 current undergoes oscillations with a duration ranging from 0 to 0.1 seconds. During islanded mode, if line L1 fails, the current in RBU1 increases to 38 A for a single cycle. Following the resolution of the fault at 0.12 seconds on line L1, the current in RBU1 became stable and continued to flow steadily from 0.12 to 0.2 seconds.

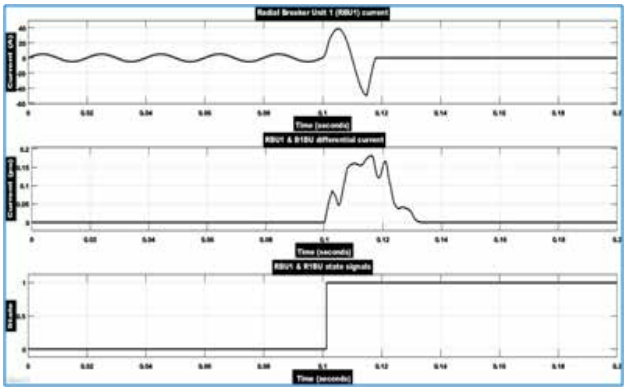

Fig. 18: Islanded mode of operation

In islanded mode, the differential current waveforms remain identical to those in grid-connected mode. The differential current waveform exhibits a rapid decrease in the current signal, and the relay encountered a peak current of 0.18 per unit (pu) between 0.1 and 0.13 seconds in islanded mode.

The differential relay successfully detected and resolved the line L1 fault in islanded mode within 0.1 and 0.14 seconds. Between 0.14 and 0.2 seconds, the differential current remains at zero until the finish.

• State signals of the Radial breaker unit 1 (RBU1) and the radial 1 breaker unit (R1BU).

This outcome demonstrates that the RBU1 and R1BU status signals in the islanded mode closely resemble those in the grid-connected mode.

Case Study 2: Adaptive Overcurrent Relays

Grid-connected mode.

Fig. 19 depicts the intricate model of the microgrid network operating in the grid-connected mode.

Fig. 20 displays the table that represents the load flow evaluation of a microgrid system in the grid-connected state of performance. This table provides the load flow estimations for each bus. Here, the block name, block type, bus type, and bus ID of each component are specified.

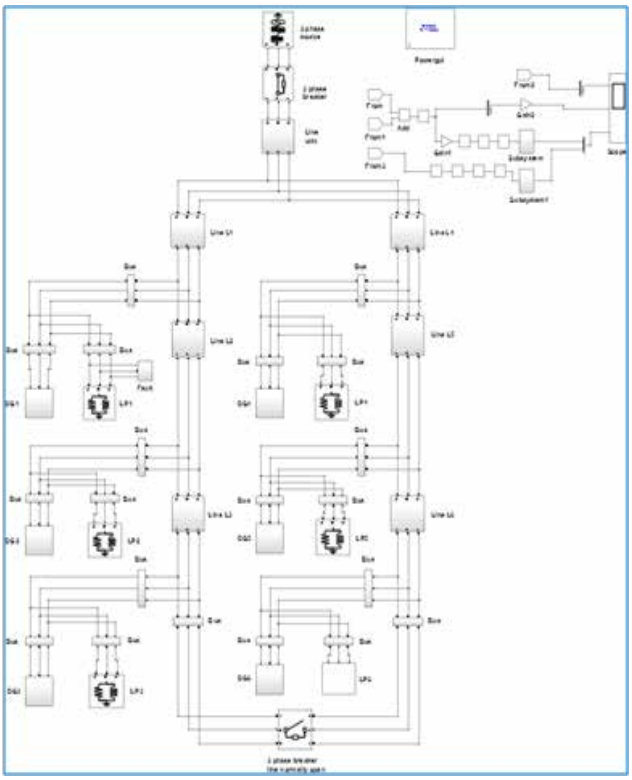

Fig. 19 Microgrid network operating in grid-connected mode

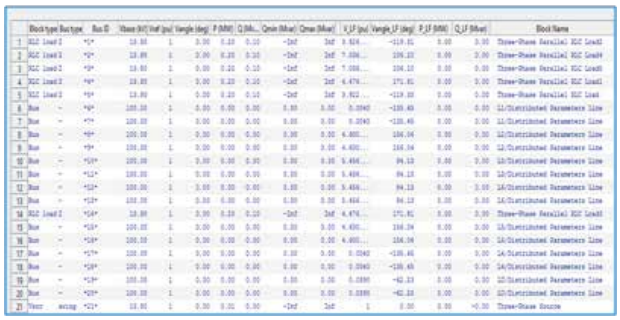

Fig. 20: Load flow for grid-connected mode

In the context of the microgrid system's grid-connected mode of operation, as depicted in Fig. 21, a comprehensive analysis of a 3-phase LLLG fault occurring at load point LP1 at 0.1 seconds reveals three key outcomes. This examination serves as a crucial aspect of safeguarding the microgrid system's consumers and equipment, offering protection against 3-phase faults that may arise beyond the designated protection zone (e.g., faults occurring at DGs, loads, etc.). The adaptive overcurrent relay protection scheme efficiently clears these faults within the timeframe of 0.1 to 0.2 seconds.

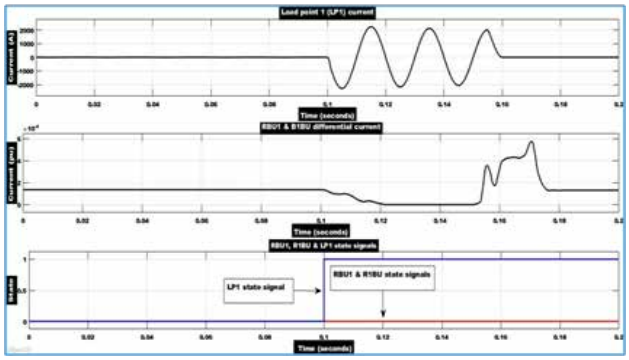

Fig. 21: Grid-connected mode of operation

The LP1 current initially flows consistently from zero up to 0.1 seconds. However, when a fault occurs at load LP1 at 0.1 seconds, the relay registers a substantial current spike, reaching up to 2220 A between 0.1 and 0.16 seconds. The adaptive overcurrent relay promptly operates and trips the respective circuit breaker after 0.1 seconds, successfully clearing the fault beyond the protection zone by 0.16 seconds. Subsequently, the LP1 current continues to flow consistently from 0.16 to 0.2 seconds, with the differential relay remaining inactive for faults occurring outside the zone of protection.

CONCLUSION

This paper concludes that this protection scheme for the microgrid system under the study operated effectively and protected the overall microgrid system from 3 phases of SC symmetrical LLLG faults are occurred in both grid-connected and islanded modes of operation. The current differential relay protection scheme operates successfully and protects the consumers as well as equipment connected to the microgrid system when 3-phase SC faults occur inside the zone of protection. Also, the adaptive overcurrent relays protection scheme operated successfully and protected the consumers as well as equipment connected in the microgrid system.

Also, this microgrid protection scheme shows feasibility and effectiveness in both modes of operation under the changing SC fault current level and varying fault impedance in the microgrid system. This protection scheme can be effectively implemented for symmetrical faults like LLL, and LLLG faults. This protection scheme improves the reliability, power quality, efficiency, and safety operation of both consumers as well as equipment connected to the microgrid system by clearing the 3-phase SC faults in the minimum possible time and by protecting the overall microgrid system effectively.

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Enhancing Adaptive Protection for Parallel Transmission Lines through Impedance-Based Techniques

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ABSTRACT

Ensuring the efficient safeguarding of the transmission network is a complex challenge, influenced by operational conditions, inter-circuit faults, and the intricate nature of transmission line connections. This study introduces a novel approach that integrates a state diagram with position data obtained from passing buses to address these complexities. The innovative strategy combines multiple separation techniques and employs impedance-based methods to enhance protection capabilities.

Diverging from traditional classification methods, our approach excels at identifying internal faults by comparing phases in a 2D space, enabling the detection of regional errors. Furthermore, it employs impedance-based methods to effectively rectify any arising issues. This proposed solution seamlessly integrates impedance-based techniques with separation technology, ensuring robust protection across various operating conditions. Simulations conducted using PSCAD software affirms the efficacy of the method in providing dependable protection for duplicate circuit transfer lines.

KEYWORDS *: Digital relaying, Cross sectional technique, Parallel transmission line, Mutual coupling effect, Adaptive protection, Impedance-based technique.*

INTRODUCTION

In high-voltage transmission systems, the use of similar circuit transmission lines on the same towers is common because of their shared infrastructure, availability, and efficiency in power transmission. However, the diverse configurations of these circuits, influenced by operational conditions, introduce various circuit errors, posing a complex challenge in their protection [1]. Current long-separation methods, relying on communication links between transmission line boundaries, offer a secure solution for protecting identical transmission lines [2], [3]. Yet, the reliability of such protection systems hinges on communication channel dependability. Therefore, an autonomous defense algorithm, utilizing solely local information from the transmission site, proves valuable for safeguarding identical transmission lines.

Adjusting the distance relay setting to protect corresponding lines may reduce the transmission stage due to the interaction between identical circuits. For instance, setting the distance relay at 85% of the line impedance covers only 50% of the line length when both regions are identical. However, with one circuit inactive and grounded at both ends, the coverage can

exceed 100% [4]. To enhance the accuracy of fault loop impedance measurement, previous studies propose the utilization of the zero-sequence current coefficient return [5]. While this addresses the issue of fault loop transmission in the presence of active circuits, it may not enhance impedance appraisal accuracy in the final operating condition of identical lines (i.e., when one circuit is inactive and grounded at both ends) due to the absence of CT when C.B are open [6].

To achieve flawless performance in protecting parallel transmission lines under various scenarios, an effective approach based on approximating the zero-sequence current line is proposed [7]. This method adjusts the relay function by incorporating additional input signals that specify the transmission line's operating status. While offering higher coverage than fixed-distance transmission, it may struggle to accurately identify fault categories in cases of circuit errors between different categories in the same circuit. The cross-division method, based on current comparisons in corresponding sections of identical circuits, provides faster operating speeds compared to distance algorithms but has limitations in certain scenarios [8-9].

The suggested approach introduces a novel cross-differential method and combines it with an impedance-based approach for a fast and reliable protection scheme. To cover all potential parallel working states, the method partitions the 2D space into six sections. By detecting C.B. removal in branch order, the transmission line end it covers and utilizes a state diagram to find internal defects. Simulations using PSCAD validate the algorithm's reliability and effectiveness under various conditions, showcasing its superior performance in dual-circuit transmission line protection.

PRINCIPLE OF PROPOSED RELAY

Fig. 1 which shows a complete transmission line schematic for testing the proposed method for double-circuit. C.B.s are single pole tripped.

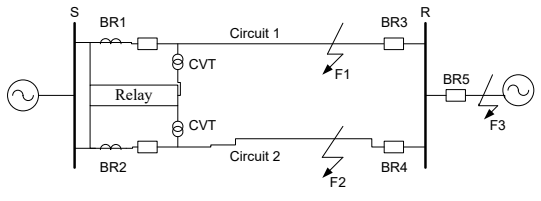

Fig. 1 Circuit diagram of double circuit transmission line

In cases where single-pole tripping operation is unavailable, the proposed method is employed to safeguard the system by initiating the opening of all phases' C.B.s upon identifying internal faults.

Proposed 2D space cross differential technique

The basic idea of the cross-differential approach is depends on the comparing the parallel transmission line's phase currents. Condition of current balanced relay is given by,

$$|I_1| - |I_2| > I_{op} \Rightarrow \text{Trip circuit 1} \quad (1)$$

$$|I_2| - |I_1| > I_{op} \Rightarrow \text{Trip circuit 2} \quad (2)$$

In the current protection scheme (designated as I1 for phase circuit 1 and I2 for phase circuit 2), the relay triggers a tripping signal command to the circuit breaker (C.B.) when the amplitude difference between parallel circuits surpasses the threshold value Iop. This threshold is determined based on the maximum observed asymmetry during non-faulty conditions. However, in the scenario of a remote fault occurring in one circuit, the amplitude difference between parallel circuits may dip below the predetermined threshold, rendering the algorithm of cross differential ineffective in covering the transmission line entire length.

The cross-differential technique, selected for its highly sensitive and cause for fault clearing when both phases of the double circuit line are operational, faces challenges when one of the lines is inactive. In such instances, the criteria are not met, leading to potential mal-operation of the cross-differential algorithm and the system's inability to address evolving faults. Specifically, during single-phase tripping (SPT) when the C.B. opens, the regular cross-differential relay might erroneously trip the healthy section instead of the faulted section. This underscores the imperative for a more robust algorithm capable of adapting to various operating conditions and effectively preventing maloperations during evolving faults.

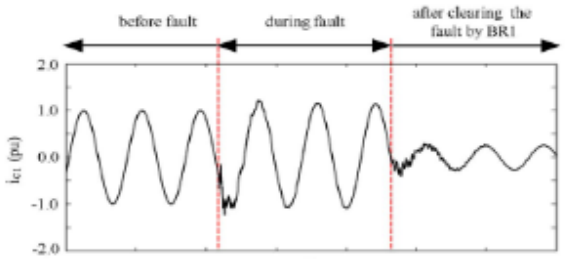

Fig. 2 Current waveforms at L-G fault of ckt. 1

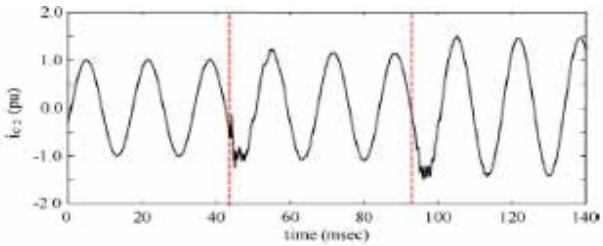

Fig. 3 Current waveforms at L_G fault of ckt. 2

In Fig. 2, the current waveforms of the C- phase on circuit 1 in the parallel transmission line are depicted during an LG fault across phase C and ground. The fault is rectified by Single-Phase Tripping (SPT) at bus S within 20 s. Following fault removal, the phase C current exhibits a rise in the unaffected segment and a drop in the previously faulty area. This trend persists until the breaker opens the problematic section, potentially causing a trip in the healthy segment-an occurrence observed in inter-circuit faults with two separate stages.

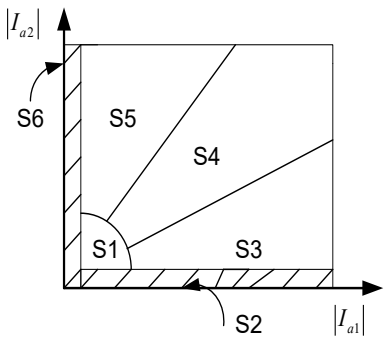

Fig. 4. Algorithm 2D space segmentation of proposed cross differential technique

To address this issue, it is imperative to carefully set the threshold current value. This guarantees that, both during and after single faults, the asymmetrical current in the strong portion of parallel circuits stays below the specified edge. Although this method solves the issue, as seen in Fig. 3, it could somewhat lessen the cross-differential relay's coverage for the parallel transmission line's end portion.

Fig. 4 illustrates the two-dimensional space segmentation of the recommended cross-differential approach. Six categories have been created based on the prospective transmission system situations that may occur under dissimilar circuits' modes of operation. Table 1 provides a comprehensive breakdown of the prospective network conditions for every region.

Table 1: The suggested 2D cross differential relay design can fit various situations in various locations

Area	Transmission system condition
S1	• Normal load condition • internal and external fault when impedance of source is very high
S2	• Circuit 2 is out for service, Normal load condition • An external fault on circuit 1 when circuit 2 is not in operation.
S3	• Fault occur on circuit 1 of a parallel transmission line
S4	• A remote fault occurs on both circuit 1 and circuit 2 when both are in operation.
S5	• A fault occur on circuit 2 of a parallel transmission line
S6	• External fault occur when circuit 1 is not in operation • Normal load condition

Disabling the approach suggested is unnecessary even if one of its parallel circuits is not functioning, as it encompasses all possible working conditions. Additional criteria are required to differentiate internal faults in specific zones (S1, S2, S4, and S6) of shielded transmission lines. It's so because in certain places, the transmission system status might manifest in multiple ways, as illustrated in Table 1.

Adjacent line zero sequence current adapted modification

Disturbances in phase voltages resulting from the interplay of parallel transmission lines may create malfunctions in the operation of remote relays. The most difficult scenario arises when a error occurs and one of the parallel circuits is both connected to ground and non-operational. Under such conditions, the typical distance relay has a tendency to reach beyond than intended, which leads to the appearance of exterior flaws that ought to be noticed outside of the relay's original protective zone.

While a compensating factor can increase the correctness of the defective circuit's measured impedance, it can also cause the working circuit to activate incorrectly Determining whether or not to compute the impedance with mutual coupling compensation is a useful use of the proposed two-dimensional cross-differential approach.

This approach determines the impedance with mutual coupling compensation if the current locus is in the second or third quadrant, but not with compensation for circuit 2. On the other hand, mutual coupling compensation is incorporated for both parallel circuits if the current locus is in the first or fourth quadrant. This approach ensures that decisions are well-founded in the distinctive characteristics of the present location. Due to reciprocal coupling effects, it performs well in handling the issues that arise during fault circumstances.

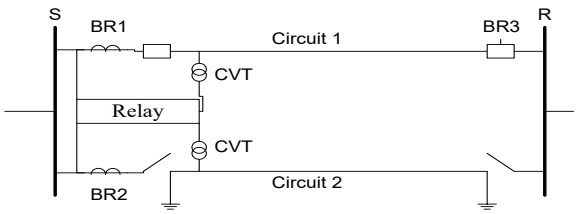

Fig. 5 a) Power off circuit is grounded at both ends

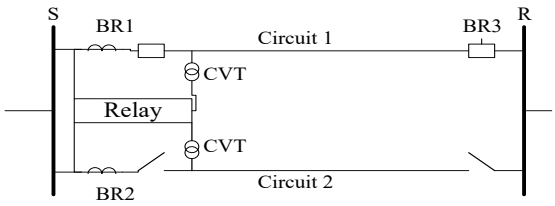

Fig. 5 b) Power off circuit is open at both ends

In Fig. 5b, the placement of the current transformer behind the C.B. poses a challenge when the C.B. is open, as the corresponding line current becomes inaccessible to the relay. This situation arises when one of the circuits has been disabled and connected to the ground at both ends.

While the conventional solution involves connecting additional CT for compensation, it is often impractical.

The proposed method provides a practical and effective solution to this issue by estimating the zero-sequence current of the grounded circuit using information available at the relay. As illustrated in Fig. 5a, when circuit 2 is not in operation and is grounded at both ends, the zero-sequence current can be calculated as follows:

$$I_{SO2} = \frac{\alpha \cdot Z_{0m12} \cdot I_{S01} - (1-\alpha) \cdot Z_{0m12} \cdot I_{R01}}{Z_{12} + Z_{02}} \quad (3)$$

The zero-sequence current of the grounded circuit denoted as IS01 at the sending end and IR01 at the receiving end of circuit 1, incorporates several key parameters. These parameters include Z0m12, representing the mutual coupling impedance between circuit 1 and circuit 2; Z01, the positive zero-sequence impedance; and Z02, the negative zero-sequence impedance. Additionally, α signifies the power unit distance between the relay location and the fault point, with α representing the distance from the relay point to the fault point in per unit. The calculation for the zero-sequence current of the grounded circuit is articulated as follows:

$$I_{SO2} = \frac{Z_{0m12} \cdot I_{S01}}{Z_{12} + Z_{02}} \quad (4)$$

The two possible scenarios where one of the circuits is not operating are shown in Fig. 5. As seen in Fig. a, the zero-sequence current passes via the ground return in the first condition. The zero-sequence current is zero in the second scenario. The measured voltage is almost equivalent to zero when the inactive circuit is grounded at both ends. On the other hand, when the circuit ends are open, mutual coupling between the two parallel circuits causes the measured voltage to match the induced voltage.

Therefore, the suggested approach considers the zero-sequence current to be zero for non-grounded lines, while for grounded lines, Eqn. (3) & (4) is followed the illustration in details.

SUGGESTED DECISION-MAKING LOGIC ACCORDING TO STATE DIAGRAMS

It introduces an innovative state-diagram-based algorithm that amalgamates the effects of opposite division with impedance-based strategies, providing a distinctive approach for prompt and dependable decision-making in transfer systems. In contrast to a simplistic application of the "OR" concept to combine different transfer releases, our approach specifically

addresses challenges inherent to same-line protection scenarios. For instance, the utilization of transmitted impedance for protecting parallel lines in different directions may inadvertently create a faulty route to the positive line. Additionally, conventional separation techniques must be disabled when one of the same lines is closed to avert the occurrence of false positives.

The proposed impedance algorithm comprises two dedicated modules designed to protect circuit 1 and circuit 2. Each module is composed of six components, collectively covering various error categories. The algorithm employs phase unit extraction to identify multiphase errors, and subsequent classification algorithms ensure precise detection of defective components during inter-circuit errors. The cooperation effect between the same circuits is adeptly compensated within a distinct 2-D environment. Several illustrative examples elucidate the compensation for cooperation effects.

For clarity, the algorithm is dissected into three parts:

Part I: (Fig. 6a) predominantly focuses on internal errors within the same circuits when both are operational. It effectively addresses errors in region 1, orchestrating a seamless transition of the corresponding circuit from a normal state to S3. The suggested approach exhibits efficiency in handling errors in both circuit 1 and circuit 2, issuing judicious travel orders to the respective C.B. Notably, the compensation strategy underpins the algorithm's robust performance in different spatial conditions, as exemplified in Table 2. Rigorous validation of the algorithm's efficacy is demonstrated through comprehensive research and simulation studies conducted under diverse circumstances.

Table 2: Transmission line conditions under various states

State number	Description
1	Locus of the two-circuit current is inside area S1
2	Locus of the two-circuit current is inside area S2
3	Locus of the two-circuit current is inside area S3
4	Locus of the two circuit currents is inside area S4
5	Locus of the two-circuit current is inside area S5
6	Locus of the two-circuit current is inside area S6

This format is easier to read and provides a clear structure for presenting the information. If you have any further requests or modifications, feel free to let me know!

Part II: The second part of the proposed state algorithm diagram is shown in Fig. 6(b). Under a variety of circumstances, including failures on the same line, defects covering the same portions in both zones, and external problems, the dynamic region of the circuits can stay active within the S4 area. A brief summary of every potential state transition sequence in various contextual scenarios is given in Table 3.

The suggested technique makes use of complex switch sequences to locate distant errors that happen at the transmission line's end. Impedance transmission and standard partition transmission both effectively handle this approach. For instance, a proximity failure coupled to a remote bus is promptly detected as the cause of a distant mistake that arises in area 1.Consequently, the suggested approach can efficiently deactivate the relevant C.B. (CB BR3) for a sustained period, mitigating the impact of the remote error.

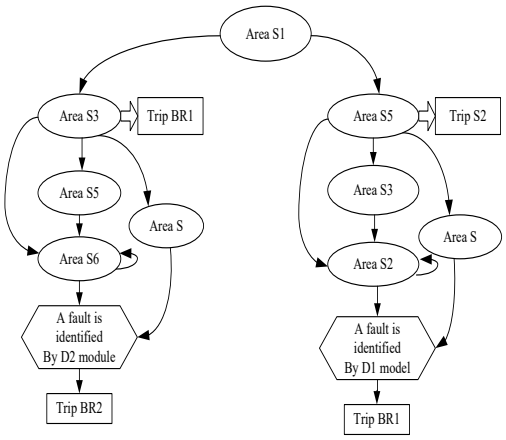

Fig. 6 a) Part I of proposed algorithm

Whenever the BR3 activates, the twin-stage power supply of the healthy circuit will fall, which would result in the transition of the device state into a state 2 or a state 3 according to the load conditions (Fig.6 (b)). Table 3 State Transition Situations of Part II could reduce. In the event of a faraway fault occurring on circuit 1, a fault will be detected and a specific function will be activated for C.B. BR1. In this scenario, if there is a distant fault in circuit 2, a CB-BR4 remote relay will be activated and the system will transition to state 5 or state 6 based on the load conditions. Under those circumstances, there is a remote defect detected on circuit 2, which would trigger a command to trip the C.B. BR2. In the event of external problems, the state

diagram is passed from state 1 to state 4. The system remains in state 4 until the fault is resolved by the relay.

The state moves back to state 1 when an external fault is removed. Besides that, the impedance modules provide the remote transmission system with backup protection. These modules evaluate impedance, such as the compensation of a mutual coupling effect using null-sequence evaluated currents. When an external failure has been removed before the 2nd area timer has expired and CBs BR1 and BR2 are tampered for insulating the failure. With inter-circuit failures involving similar phases in the two circuits, the locus of the parallel circuit currents may also be situated within S4. The impedance modules and these faults are included The Impedance modules provide fast operating speed for errors in their first protective zone and cover their second protective zone for end of the transmission line. In practice, these inter-circuit failures rarely occur due to the arrangement of the three phases of the configuration of the tour.

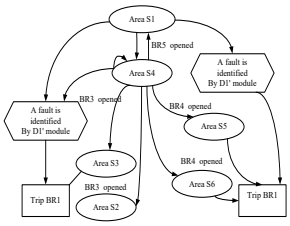

Fig. 6 b) Part II of proposed algorithm

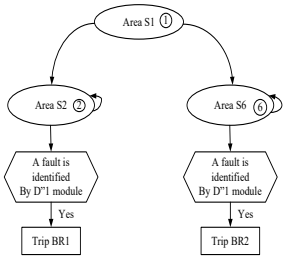

Fig. 6 c) Part III of proposed algorithm

Part III: The third part of the suggested technique is shown in Fig. 6(c). It is used to defend the transmission system in case one of the parallel circuits fails. As was already explained, the way the CT was arranged may have prevented the relay from detecting the zero-sequence current of the circuit that was turned off. The system transitions to state 2 when circuit 2 is disabled, since its phase currents are found to be zero. In state 2, the performance of the line impedance is continuously monitored. Should a high performance be discovered, a defect is computed.

Table 3. State transition for different conditions of part II

Case	Events	State transition
1	External fault on remote line, BR5 opened	1,4,1
2	Remote fault occurs on circuit 1, BR3 opened	1,4,3
3	Remote fault occurs on circuit 1, BR3 opened	1,2
4	Remote fault occurs on circuit 2, BR opened	1,4,5
5	Remote fault occurs on circuit 2, BR4 opened	1,4,6
6	Inter circuit fault detected by relay D'1 External fault not detected by the associated relay, it can be identified by 2nd zone of D'1	1,4, D'1 output is high
7	Inter circuit fault detected by relay D'2 External fault not detected by the associated relay; it can be identified by 2nd zone of D'2	1,4, D'2 output is high

In order to reduce the impacts of mutual inductance and avoid erroneous tripping in the first zone of the distance relay as a result of external faults happening outside the remote bus, the zero-sequence current calculation has been utilized. In a similar manner, state 6 is reached when circuit 1 is turned off. In state 6, the transmission line is inhibited while it is in operation and the impedance module continuously measures the line's impedance.

Implementation of the Suggested Algorithm

The suggested approach makes use of a number of adjustments within the designated areas in order to identify various situations and draw a conclusion. For this particular use, state changes are stored in the buffer. Whenever there is a change in the state, the six-second buffer is updated. Every new transfer entry is subject to a review of its present condition. The buffer will be relocated and the current state will be saved in its upper cell if it is different from the previously stored state in the upper buffer cell. An approach based on locating the relevant circuits is employed in the division module. This was carried out in order to offer a strong algorithm during the temporary transfer of provinces. One counter is assigned to each of the six spaces provided. Every time a new sample enters its designated location, the values of each counter are successively increased. Alternatively, the new sample will be lowered by two if the counter is larger than zero and it is outside of the matching region. When the matching number above a certain threshold, the location indicator which is utilized in the transfer is updated to indicate to a new

site. Similarly, impedance-based modules employ an approach that varies according to the use case.

There is a limit to how many estimated impedance samples may be found inside the transmission region; only then is the module considered legitimate. Impedance transmission provides a strong error detection mechanism that compares the times an error occurs. The method based on state diagrams also evaluates the present state and generates a consistent subroutine accordingly. A state buffer is used in each subroutine to determine the order of various occurrences and reach a final conclusion.

Intimacy errors

Table 4 presents results for proximity errors in the AB transmission line, focusing on circuit 1 due to the identical nature of both circuits. The proposed defense algorithm consists of three identical three-phase protection units, each safeguarding corresponding categories of the circuits. In instances of multiple-stage errors, all three categories are affected. However, the last column highlights the error categories recognized by the planned algorithm, showcasing its potential for classifying different error types.

Proximity errors in the same transmission line pose a challenge, causing a false impairment in the healthy circuit. This leads to compensating for the current circuit error, creating a sequence of issues in calculating healthy circuit parameters. Fig. 7 displays the impedance output of circuit 2 in the sixth case, as presented in Table 4. Notably, when calculating the impedance of a healthy line by compensating for the current zero-sequence error circuit, the transmission distance is incorrectly assigned to category a healthy circuit.

In order to tackle this difficulty, the proposed method employs a state diagram to ascertain either line impedance ought to be computed regardless of compensate.

This methodology ensures the reliable identification of the closest error category in Table 5 for the affected circuit. When the nearest error falls within region 1, where both regions are the same, the suggested approach promptly recognizes the error. For example, in the first case of Table 4, the suggested approach identifies the error section at 10.4 ms, utilizing the output of the proposed differentiation method.

Table 4. Suggested approach response for close in faults on circuit 1

No.	Fault type	Rf (Ω)	Location (km)	Operation time (msec)			Faulted phases
				Unit A	Unit B	Unit C	
Both circuits in operation:							
1	AG	0.01	0.5	10.4	×	×	A_1
2	AB	0.01	0.5	10.4	11.1	×	A_1B_1
3	BG	3.00	5	×	12.5	×	B_1
4	BCG	0.01	5	×	12.5	10.4	B_1C_1
5	ACG	0.01	10	10.4	×	10.4	A_1C_1
6	AG	0.01	10	10.5	×	×	A_1
7	CG	3.00	10	×	×	10.4	C_1
8	AG	0.01	15	10.5	×	×	A_1
9	ABCG	0.01	15	10.4	12.5	10.4	$A_1B_1C_1$
Switched-off circuit grounded at both ends:							
10	AG	0.01	0.5	13.2	×	×	A_1
11	AB	0.01	5	16.7	16.7	×	A_1B_1
12	CG	3.00	5	×	×	15.3	C_1
13	ABG	0.01	15	16.0	16.7	×	A_1B_1
14	AG	0.01	15	14.1	×	×	A_1
Switched-off circuit open at both ends:							
15	AG	0.01	0.5	12.5	×	×	A_1
16	AB	0.01	5	16.7	16.7	×	A_1B_1
17	CG	3.00	5	×	×	14.6	C_1
18	ABG	0.01	15	16.7	16.0	×	A_1B_1
19	AG	0.01	15	13.2	×	×	A_1

Subsequently, unit A of the protection algorithm evaluates circuit block 2 to ascertain if the error changes to category A of circuit 2. In instances where circuit 2 is turned off, the area of the circuit falls within S6. In such scenarios (e.g., Cases 10-19 in Table 4), the impedance module utilizes the estimated zero-sequence current of circuit 2 to compensate for the coupling effect. This comprehensive approach underscores the effectiveness of the suggested methodology in accurately identifying and addressing proximity errors in the transmission line.

Table 5. Suggested approach for remote fault on circuit 1

No.	Fault type	Rf (Ω)	Location (km)	Operation time (msec)			Faulted phases
				Unit A	Unit B	Unit C	
Both circuits in operation:							
1	AG	0.01	112	20.2	×	×	A_1
2	BCG	1.00	112	×	24.3	18.1	B_1C_1
3	AG	0.01	115	23.6	×	×	A_1
4	BG	5.00	110	×	18.8	×	B_1
5	AB	0.01	115	25.7	25.7	×	A_1B_1
6	AG	0.01	125	54.2	×	×	A_1
7	AB	0.01	128	52.8	52.8	×	A_1B_1
8	BCG	5.00	128	×	50.7	48.6	B_1C_1
9	ABCG	0.01	129	54.2	51.4	48.6	$A_1B_1C_1$
Switched-off circuit grounded at both ends:							
10	AG	0.01	108	23.6	×	×	A_1
11	AB	0.01	115	25.0	25.0	×	A_1B_1
12	BCG	0.01	115	×	23.6	23.6	B_1C_1
Switched-off circuit open at both ends:							
14	AG	0.01	115	23.6	×	×	A_1
15	AB	0.01	115	25.0	25.0	×	A_1B_1
16	BCG	0.01	115	×	23.6	23.6	B_1C_1

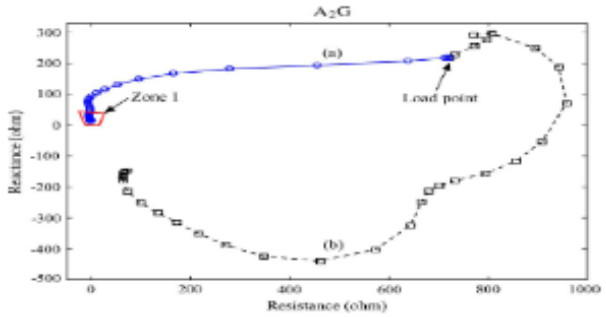

Fig. 7 Impedance trajectory for LG fault on circuit 1 a) with compensation of mutual coupling effect b) without compensation

Earlier stated, when the part of the circuit that is turned off is connected to the ground at both ends, the zero-sequence current may be determined using Eqn. (3). On the other hand, if the circuit that is turned off is open, the zero-sequence current is assumed to be zero. Across all examined instances, the suggested safeguarding method exhibits exceptional dependability. It accurately categorizes the faulty phases, guaranteeing that no incorrect interruptions happen on the functioning phases. The method reliably provides precise replies prior to, throughout, and following the fault-clearing interval.

Remote Faults

The results of modeling studies that particularly look at remote faults that form at circuit 1's terminal portion are shown in Table 5. It's important to note that the remote relay at bus B can quickly identify a close-in issue. It is supposed that the remote end breakers will activate for two cycles throughout the testing.

If a distant failure takes place on any of the two parallel circuits that are operational, the currents in the parallel circuits are restricted to region S4. At this point, the power line's current is flowing more than normal, which might be the result of an internal problem at the transmission line's end or an exterior issue that extends past the remote bus. The proposed method, which is based on state diagrams, effectively identifies the functioning of remote C.B.s that are activated by internal flaws by analyzing sequences of transitions between defined states. This technique eliminates the need for a communication link by speeding up relay operation for remote failures.

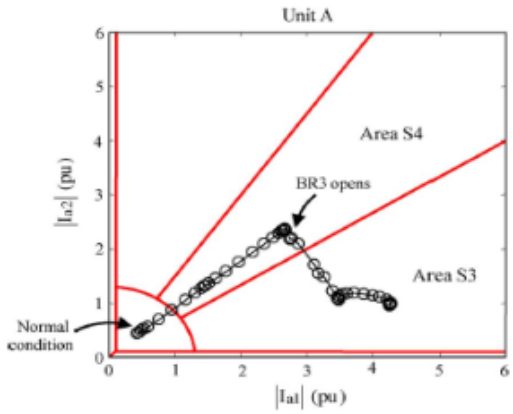

Fig. 8 Trajectory of the current amplitude of phase A for 6th case of table 5

To provide a clear example, let's examine the sixth instance from Table 5. In this case, the representation of the path taken by parallel line currents may be seen in Fig. 8. A remote phase-A-to-ground issue, located 125 km away from bus A, is promptly resolved by tripping the remote C.B. (CB BR3) within two cycles. When the faulty phase is activated, the path of the electrical currents in the parallel circuit shifts from region S4 to region S3. Hence, the proposed method skillfully detects the issue as an internal distant failure occurring on circuit 1. The relay in question has an operating time of around 54.2 ms, which is significantly faster than the operation time of traditional distance relay schemes. These schemes can take many hundreds of milliseconds to respond to similar failures.

When one of the parallel circuits is not functioning, the impedance module protects the transmission line, as shown in Fig.8.

To reiterate, when the circuit that is turned off is connected to the ground at both ends, the accuracy of estimating zero-sequence current for internal faults decreases, resulting in the underreach of the relay. Nonetheless, it is crucial to acknowledge that the accuracy of estimation is enhanced as the fault location recedes. In addressing this, configuring the impedance relay's first zone setting to 90% of the line's positive-sequence impedance proved effective, protecting 83% of the line length in the simulated parallel transmission system. Subsequently, the relay's second protective

zone effectively manages the remaining section of the transmission line.

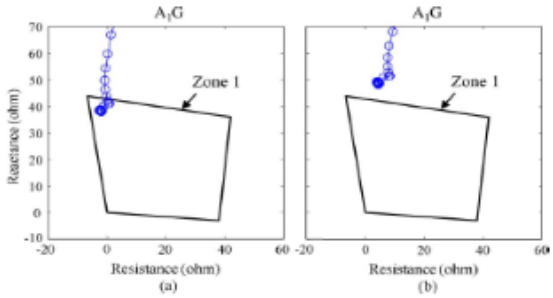

Fig. 9 illustrates the impedance of circuit 1 as measured by the AG element in response to an external fault on transmission line BC. Sub Fig. 9 (a) and (b) present the measured impedance by the conventional relay and the proposed algorithm, respectively.

External Faults

Multiple simulation experiments have been conducted to evaluate the effectiveness of the proposed method in situations including external faults. When both parallel circuits are functioning, the algorithm computes line impedances, taking into account compensation for the mutual coupling phenomenon. The integration yields an accurate determination of the fault's position. Nevertheless, in the event that a single parallel circuit is non-operational and is grounded at both ends, the relay encounters difficulties in detecting the zero-sequence current of the grounded circuit as a result of the configuration of CT.

The impedance recorded by a traditional distance relay in a specific case where transmission line BC has an exterior phase-A-to-ground fault is shown in Fig. 9. The distance between the fault and bus B is 5 kilometers. Furthermore, circuit 2 is grounded on both ends and out of service. Because the impedance is inside the relay's initial safety zone, the mutual coupling effect between parallel circuits causes the relay to overrun. Conversely, excessive extension is effectively avoided by the proposed impedance module, which uses the zero-sequence current computed using Eqn. (3) to counteract mutual coupling. The projected zero-sequence current of the grounded circuit is shown in Fig. 10, demonstrating the accurate valuation of the zero-sequence current for external faults that the recommended method is able to achieve.

High-Resistance Faults

Results from cases with extremely resistant mistakes are shown in Table 6. Although 50 ms is considered ideal error resistance, the study includes examples with higher resistance values to calculate the presentation of the suggested technique in different scenarios. Robustness and sensitivity to extremely resistant faults are demonstrated by the suggested segregation procedure. As a result, the protection algorithm correctly detects high-resistance defects on the secure transmission line while both parallel lines are functioning.

For example, in Table 6's second situation, a B-to-ground mistake with a resistance value of 200 happens 80 kilometers from bus A. The proposed method accurately detects this inaccuracy in 18.1ms. When faults arise at the conclusion of the secure transmission segment and are resolved by a distant C.B., the proposed method performs very well in determining the most resilient errors. Examine the seventh example in Table 6, where the most resistive fault (with a resistance value of 200) happens in circuit 1 129 kilometers from bus A.

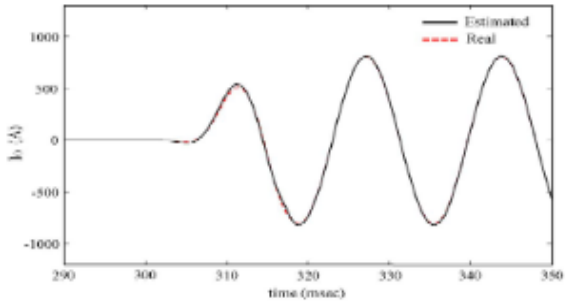

Fig. 10 estimated zero-sequence current of circuit 2 for the external fault on the transmission line BC.

After clearing the error, the current line moves from the S4 region to the S3 area, assuming that the distant C.B. runs in two cycles. As a result, the internal mistake is identified by the suggested protection mechanism. The suggested approach uses the outputs of impedance-based modules to identify inherent flaws in particular operating conditions when one of the circuits is not working. As a result, when error resistance rises, the protective method's initial scope may shrink.

In the worst-case scenario involving the most resistant errors, such errors occurring at the end of the transmission section pose a significant challenge. The

quadrilateral element employed for single-phase and low-grade component modules proves to be robust in detecting highly resistant errors, showcasing its effectiveness in identifying errors with resistances up to several ohms. While highly resistant errors are infrequent, the suggested approach integrates defences against such occurrences.

Table 6: Scenarios involving highly resistant errors

No.	Fault type	Rf (Ω)	Location (km)	Operation time (msec)			Faulted phases
				Unit A	Unit B	Unit C	
Both circuits in operation:							
1	AG	250	30	17.4	×	×	A_1
2	BG	200	80	×	18.1	×	B_1
3	ACG	30	110	23.5	×	25.4	A_1C_1
4	AG	30	110	25.7	×	×	A_1
5	AG	200	120	50.0	×	×	A_1
6	BG	200	128	×	52.8	×	B_1
7	ABG	200	129	50.7	48.9	×	A_1B_1
Switched-off circuit grounded at both ends:							
8	AG	20	100	27.1	×	×	A_1
9	AG	32	90	24.3	×	×	A_1
10	BCG	10	100	×	25.0	22.9	B_1C_1
11	AG	100	110	200	×	×	A_1
Switched-off circuit open at both ends:							
12	AG	20	106	24.3	×	×	A_1
13	AG	35	90	24.3	×	×	A_1
14	BCG	10	100	×	23.6	22.2	B_1C_1
15	AG	100	110	200	×	×	A_1

For instance, cases 11 and 15 in Table 6 demonstrate the implication results of category A-G errors with a resistance of 100 percent. In both cases, the fault is successfully identified with the activation of the second protection point. It is noteworthy that as resistance increases, the amplitude of current significantly decreases. Therefore, the second operating time is met even in scenarios with very high error resistance, underscoring the algorithm's capability to handle such challenging cases effectively.

Table 7: Key findings of proposed circuit error algorithm

No.	Fault type	Rf (Ω)	Location (km)	Operation time (msec)			Faulted phases
				Unit A	Unit B	Unit C	
1	A_1C_2G	0.01	3	10.4	×	11.1	A_1,C_2
2	C_1B_2	0.01	5	×	12.5	11.8	C_1,B_2
3	A_1B_2G	0.01	50	11.1	14.6	×	A_1,B_2
4	A_1B_2	0.01	50	11.1	12.5	×	A_1,B_2
5	$A_1B_1B_2G$	0.01	80	11.8	21.5	×	A_1,B_2,B_2
6	A_1A_2G	0.01	80	23.6	×	×	A_1,A_2
7	B_1B_2G	20	100	×	24.3	×	B_1,B_2
8	A_1C_2G	100	110	17.3	×	19.5	A_1,C_2
9	B_1C_2G	0.01	115	×	24.3	23.6	B_1,C_2

Inter-circuit Faults

Numerous simulation studies were undertaken to assess the efficacy of the planned circuit error algorithm, specifically addressing scenarios where both corresponding regions were implicated in errors. Key findings from these simulations are outlined in Table 7. Such errors are commonplace in circuit transmission lines that share the same towers. Identifying faulty sections in the event of circuit errors poses challenges for standard impedance protection systems, as the impedance measured by the transmission distance may not directly correlate to fault-loop impedance.

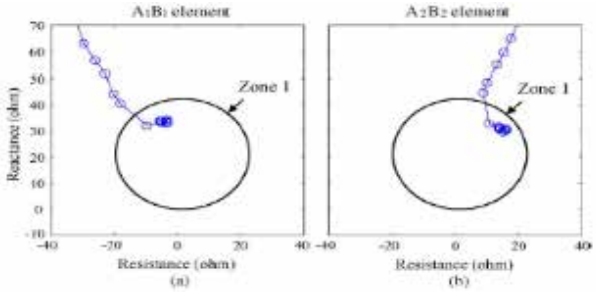

Fig. 11 Measured impedances by A-B elements of the conventional distance relay for the inter-circuit A1B2G fault on the transmission line (a) Impedance of circuit 1 (b)

The proposed defense mechanism employs three independent units to safeguard three distinct categories. Each unit utilizes the proposed 2-D separation process, protecting corresponding phases of both identical regions and guiding the relevant impedance-based units. Diverging from conventional range transfers, where multiphase errors are detected when any phase-to-phase range output is elevated, the suggested approach identifies multiphase errors through phase unit extraction. Across all case studies, the suggested approach adeptly distinguishes circuit errors with reliability and speed. It accurately identifies error categories for each region, providing a singular designation for error sections.

In cases of intermediate errors between different sections of the same line, the suggested approach appropriately identifies error categories using the separate modules of corresponding category units. Fig. 11 illustrates impedances measured by the AB components under standard third-grade transfer conditions from Table 7.

The standard referral system erroneously identifies this error as a phase-by-phase AB error in both regions. In contrast, the suggested approach accurately identifies error categories based on the release of 2-D modules of division A and B units. For inter circuit errors involving the same categories of parallel lines, the results of impedance-based modules are considered in the decision-making process. In such cases, where the difference between corresponding phase currents of the same lines is minimal, and local currents are found within area 4, the suggested approach ensures appropriate error categorization.

As elaborated in Phase III-A, the components of impedance-based modules in each unit merely determine whether the error includes a protected phase or not. Unit B of the suggested approach specifically assesses whether the error includes category B of any corresponding circuits. Consequently, even in the presence of such errors, where impedance measured during insertion falls within the transmission area, no travel signal is issued for category A of circuit 2. The proposed algorithm, as illustrated in Fig. 11 (b), ensures nuanced decision-making, incorporating impedance module outputs to accurately categorize and handle various circuit error scenarios.

Evolving Faults

Evolving faults, characterized by changing phases over time, necessitate a protection scheme capable of accurately identifying the faulted phase not just during the fault duration but throughout its entire span. To assess the proposed algorithm's performance in handling evolving faults, numerous simulations were conducted under diverse conditions where initial faults transitioned to other phases within the 10–50 ms timeframe. The results indicate that the new algorithm effectively classifies faulted phases across a spectrum of evolving fault scenarios. Notably, the algorithm demonstrates its robustness by avoiding false tripping of the C.B. This capability is crucial in maintaining the reliability of the protection system, ensuring that the identification of faulted phases remains accurate and free from erroneous tripping actions throughout the evolving fault conditions.

CONCLUSIONS

In conclusion, the research introduces an innovative solution for mitigating mutual coupling challenges in relay functioning for parallel transmission lines. An approach utilizes a two-dimensional space state map, combining cross-differential and impedance-based outputs to dynamically monitor impedance-based processes and reduce mutual coupling effects. Unlike conventional methods, an approach remains active even with inactivity in one parallel circuit.

In scenarios with one inactive parallel circuit grounded at both ends, our algorithm leverages the ground circuit's zero sequence current to counteract relay overreach. The state diagram algorithm issues trip commands accurately to the appropriate circuit breaker. Under operational conditions with both circuits active, our proposed approach responds rapidly to transients or changes in below the one cycle. The heightened sensitivity of the cross-differential technique ensures swift responses during operational changes and fault-clearing processes. Compared to other methods, our approach excels in accurately detecting inter-circuit and evolving faults, extending coverage to the end section by identifying remote-end circuit breaker operations. In summary, the introduced algorithm effectively detects faults, responds quickly, and provides comprehensive coverage, safeguarding parallel transmission lines from potential disruptions.

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Alternators in the Presence of FACTS Controller: LOE Relay

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ABSTRACT

The mho relaying is a very effective LOE relaying technique in use today. LOE results in the impedance that the relay detects to cross the network's and the generator's safe zones. So, it sends out a trip signal to disconnect the faulty alternator. in the event the error remains after being removed from of the network. In order to address problems with voltage regulation, transient stability enhancement, voltage instability prevention, and power oscillation damping, FACTS devices are employed in contemporary power systems. The LOE relay is delayed, as indicated, since the reactive power provided by the shunt-FACTS devices prevents the generator's terminal voltage from falling. Under-reach of the relays is possible in the presence of shunt-FACTS devices, e.g., during partial LOE or condensing-state operation of an alternator. Here, we look into how shunt FACTS devices affect an alternator's LOE (LOE) protection.

KEYWORDS *: Potential transformers (P.T), Relaying technique, Current transformers (C.T), LOE generator protection, FACTS controller.*

NOMENCLATURE

LOE	Loss of Excitation
DR	Distance Relay
P.T.	Potential Transformer
C.T.	Current Transformer
FACTS	Flexible AC Transmission Line

INTRODUCTION

Decrease in excitement is a typical form of synchronous machine fault (LOE). Whether it's a faulty LOE relay, a tripped field circuit breaker, or a short in the field winding, there are a few potential causes. A study in China found that loss of excitation accounts for 70% of all generating failure [1]. That both generator as well as the network could be harmed by LOE.

The mho relay with two zones of defense is one of the most widely utilized types of relays now in use to protect the generator against LOE failures. These would be linked to the generator's terminals, as well as the generator's impedance is measured using P.T and C.T [2-3]. Since FACTS devices have entered the market, designers of protective relays have had to adapt to a new set of constraints. Their primary function is to stabilize generators, regulate voltage, avoid voltage instability, damp power oscillations, and increase reliability by connecting in series or parallel with transmission lines. All the research done in the past on this subject can be roughly grouped into the following broad categories: Research into the effectiveness of FACTS devices like the TCSC and the SSSC in providing DR protection for transmission lines makes up the first group. There is extensive research on the effects of online protection

in [4-5]. What role TCSC plays in ensuring these relays work as intended is conditional on their current mode of operation. The impact of the SSSC is discussed extensively in [6]. Tripping properties of the distance relay has been demonstrated to be bifurcated when a zero-sequence current is fed by the SSSC.

Shunt-connected FACTS devices, have been the subject of research in the latter group. It has been shown in [7] that mho-based DRs can fail to reach if STATCOM is present in a faulty circuit[8-9].

GENERATOR SECURITY ASPECTS

It was tried in multiple frameworks in earlier studies on negative offset mho relays [10]. Due to the enable various setups, it isn't practical to analyses systems in all behave in certain situations. However, certain conclusions can be derived from such investigations that should assist us in understanding the concerns that need to be kept in mind when constructing a security strategy [11]. Particularly for the lack of excitement. The following are the findings:

- Because of the serious consequences of an LOE failure for the generator and the system as a whole, the LOE relay needs to be utilized for all generators in action.
- To recognize a LOE, appropriate relay parameters must be selected while maintaining the generator characteristics and system loaded circumstances in mind.
- The influence of power swing as well as all of the external elements stated previously on the relay's effectiveness must be evaluated.
- Voltage regulators often can induce the generator attributes to reach the protection system zones while attempting to keep the terminal voltage. Such issue only has been documented for particular kinds of regulators.

LOE PROTECTIVE STRATEGIES

Different LOE protection strategies were created over time. R-X, P-Q, V-I, and G-B schematics were examples of traditional algorithms. When contrasted to certain other systems, the R-X scheme has been more widely used in various industries. This section discusses in detail different existing and newly suggested LOE protections. [12-13]

The capability curve provided by the manufacturer specifies the maximum allowable output in terms of both power and quality (P & Q) for a given synchronous alternator. Factors including voltage stability, long-term stability, stator end region heating limits, field and armature current restrictions, and others have a big impact on a generator's Q characteristics. [14]. Compared to salient pole generators, stator end area heating seems to be more noticeable in cylindrical pole generators [15]. Limitations of a generator are plotted in the P-Q diagram in Fig. 1.

In the event that the generator's variables go beyond the UEL limit, an alarm will sound after half a second. After a one-minute tie wait, the relay can send out a trip signal if indeed the characteristics approach UEL but fall short of the operating zone.

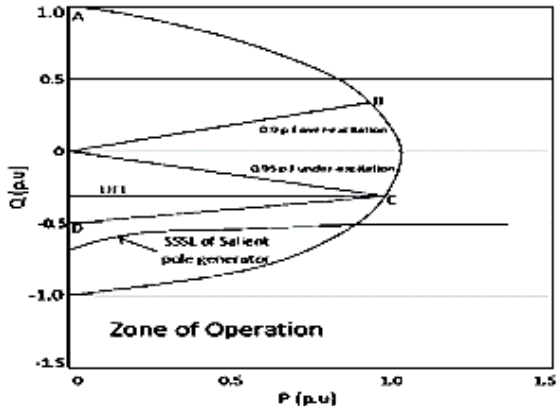


Fig. 1. P-Q plane

The V-I Scheme

Because Q is removed from the circuit when LOE occurs, current takes precedence over voltage. The present amplitude also appears to be larger than previous ones. An LOE flaw is detected with the use of a directed overcurrent relay in this method. The phase angle of the reference voltage and current determines the path of the current from the circuit to the generator, and the relay does not turn on until this comparison is complete. At a phase angle of 900, a device like a wattmeter produces the most torque [16-17]. The directed overcurrent operating feature gets programmed to trigger a trip signal after 2s. Fig. 2 depicts a common configuration.

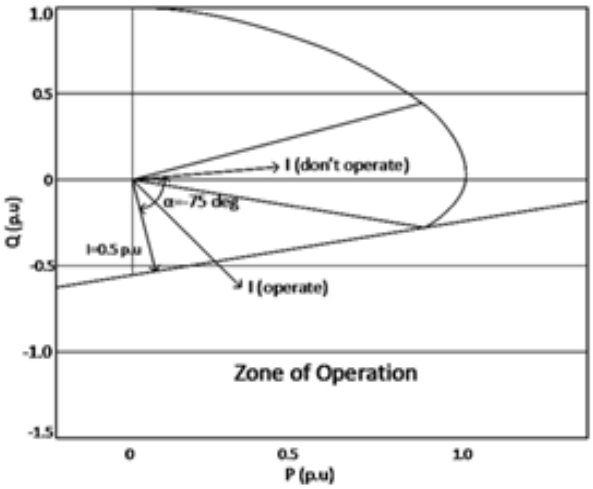


Fig. 2. V-I monitoring for LOE protection strategy

R-X Impedance Scheme

The generator's terminal impedance be calculated as follows:

$$\bar{Z} = \frac{\bar{V}}{\bar{I}} = \frac{V^2}{\bar{S}^*} = \frac{V^2}{P-jQ} = \frac{V^2*(P+jQ)}{P^2+Q^2} = \frac{V^2*P}{P^2+Q^2} + j\frac{V^2*Q}{P^2+Q^2} = R + jX \quad (1)$$

As demonstrated in Fig. 3 [18], a negative-offset mho relay having two zones of security has been employed in this article. As illustrated in Fig. 4 [19], a directing component has been utilized.

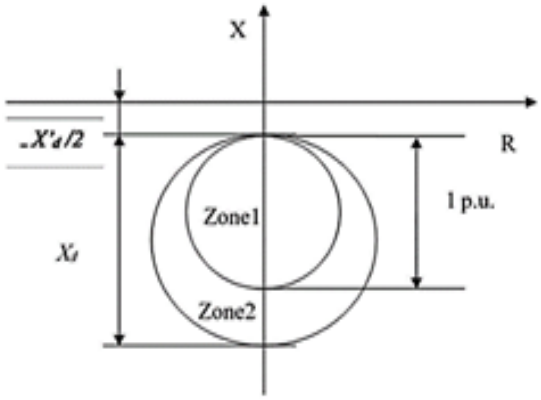


Fig. 3. offset mho

Zone 1 detects LOE when the generator gets substantially overloaded, while Zone 2 detects LOE whenever the generator has working in a low load level [20]. Fig. 4 depicts the two-zone security feature.

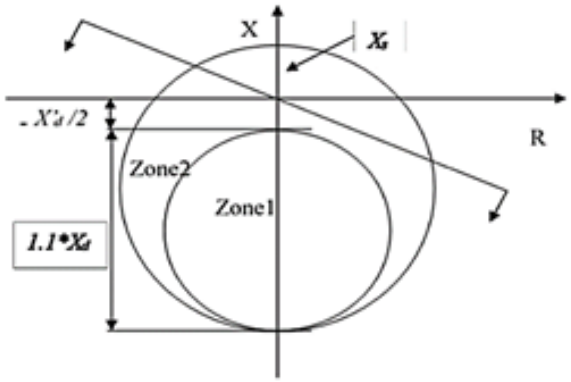


Fig. 4. mho and directional

The directed component has confided to emit an audible alarm in order to warn operators of an LOE event[21-23], whereas tripping signal is generated after a time lag of 0.2 to 0.3s for Zone 1 and 0.75s in Zone 2 [24-25].

$$\bar{Y} = \frac{\bar{I}}{\bar{V}} = \frac{\bar{I}}{\bar{V}} \times \frac{\bar{V}^*}{\bar{V}^*} = \frac{\bar{S}^*}{V^2} = \frac{P-jQ}{V^2} = G + jB \quad (2)$$

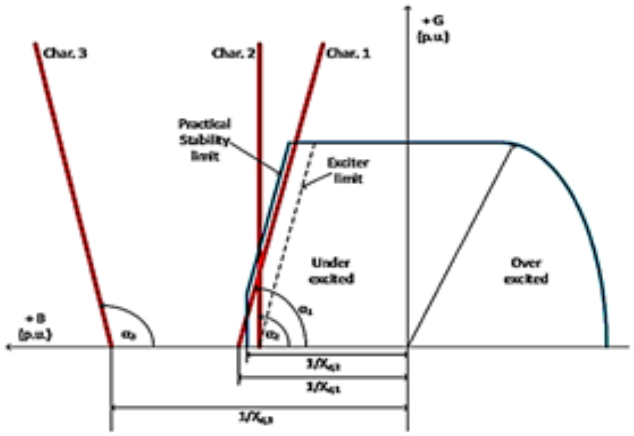


Fig. 5 depicts the admittance relay's operational zones

Configuring a relay for a salient pole generator

$$Char1: \frac{1}{x_1} = \frac{1}{x_d} + \frac{1}{2}\left(\frac{1}{x_q} - \frac{1}{x_d}\right), \alpha 1 \approx 80^o$$

$$Char2: \frac{1}{x_2} = \frac{1}{x_{d'}}, \alpha 2 \approx 100^o$$

$$Char3: \frac{1}{x_3} = \frac{2}{x_{d'}} + \frac{1}{2}, \alpha 3 \approx 100^o$$

LOE Index Framework

Such method has been suggested in [27-28], where it generator's terminal voltage as well as Q output are utilised to create an index that can aid in recognising LOE failure inside the generator. As illustrated in Fig. 6, the generator's terminal voltage steadily declines once stimulation is lost (a). Following LOE, the generator draws Q from the system. Within just few seconds of the LOE occurrence, the Q output approaches 0 and then begins to climb in a negative manner.

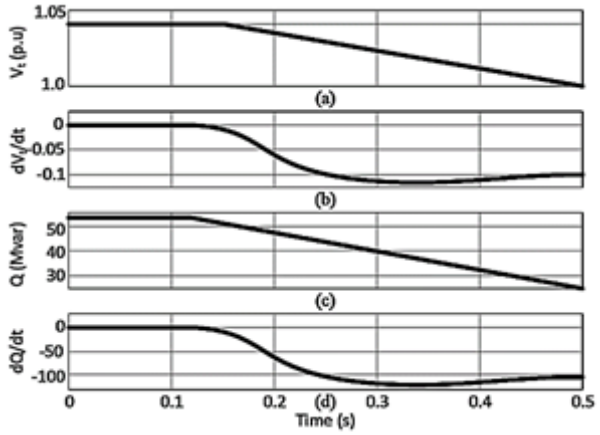


Fig. 6. Attributes post LOE

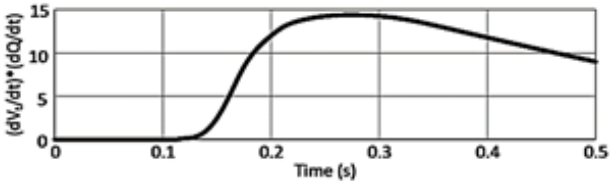


Fig. 7. Index post LOE

Fig. 7 depicts the product of the two equivalents. In addition to award a appropriately big rate to the LOE Index, the output gets adjusted in accordance with the formulation beneath.

$$LOEI = 10^{6} \times [V^{(K)} - V^{(K-1)}] \times [Q^{(K)} - Q^{(K-1)}] \quad (3)$$

This is essential to improve its visibility. The variable to be multiplied depends on the system in which this technique must be utilised, and an appropriate number in the range of 103 to 106 is enough.

dR/dt Framework

When it comes to safeguarding LOEs, [29-30] suggests yet another novel approach. This method takes use of the fact that the rate of change in resistance and then stays negative for a while afterwards.

Similarly, Fig. 9 shows a similar arrangement following LOE.

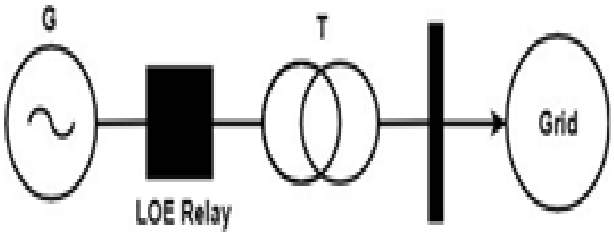


Fig. 8. Study system for investigation

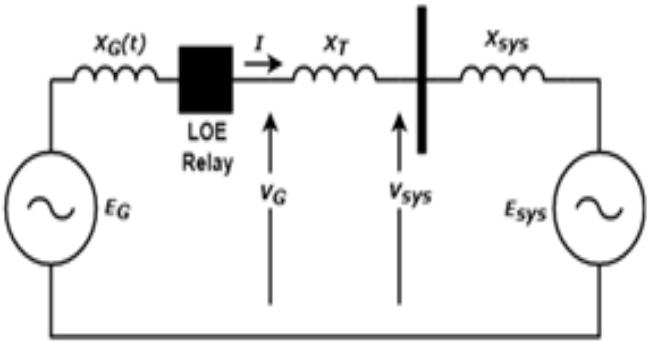


Fig. 9. Equivalent circuit post LOE

According to the schematic Fig.8 provided,

$$R(t) = \frac{m(t)\sin\delta}{1 + m^2(t) - 2m(t)cos\delta} X_{net}(t) \quad (4)$$

in which m E E = sys G /

After l OE, the value of m begins to increase, assuming that remains constant for a few seconds. We get by calculating the derivative of resistance with respect to time,

$$\frac{dR}{dt} = \frac{(1 - m^2(t))sin\delta}{(1 + m^2(t) - 2m(t)cos\delta)^2} \frac{dm}{dt} X_{net}(t) + \frac{m(t)sin\delta}{(1 + m^2(t) - 2m(t)cos\delta)} \frac{dX_{net}(t)}{dt} \quad (5)$$

After the rate of m 1 is 1, i.e., Esys EG, the leading term of eqn. (5) is positive, but the sign of the second term cannot be determined because Xnet continues to change after the LOE event.

dR/dt also can turn negative throughout a power swing. However, because d/dt oscillation have such a frequency

band of 0.3-6 or 7 Hz, the greatest time span of d/dt fluctuations may be determined by taking the inverse of 0.3 Hz, that provides us the timeframe as 3.33s. The sign of d/dt stays negative for half of this time frame, but again not more than that at a time. So, throughout a power swing, dR/dt can be negative for a maximum of 3.33/2 = 1.66 s. It could be used as the relay scheme's configuration criterion. To obtain the signal, a really short time delay of 0.1-0.2s can be used. This one is performed to compensate for oscillations in the system that seem to be shorter than 0.3 Hz.

COMPUTATION OUTCOMES

Case study

The Sim Power Systems toolkit was applied to create the model in the MATLAB/Simulink environment. A hydro turbine alternator's LOE is modelled. Two 555 MVA hydro turbine generators were linked together by Y connections step-up transformers and interconnecting transmission cables. The 220 km interconnecting transmission system is indeed a single circuit line with an STATCOM linked at 110 km for mid-point voltage adjustment [31].

This system has two synchronous hydro-turbine generators. With a few small changes in the relay configurations, the LOE methods are widely appropriate to both hydro turbine and steam turbine generators. The initial generator G1 being used for LOE simulations is a hydro turbine alternator [32].

Table 1
R-X scheme during complete LOE.

R-X Scheme	Without FACTS	With SVC
Zone 2	3.14 s	3.409 s
Alarm Time Delay	0.5 s	0.5 s
Trip Time Delay	1 s	1 s
Zone 1	3.74 s	3.924 s
Trip Time Delay	0.3 s	0.3 s
Alarm Signal	**3.64 s**	**3.909 s**
Tripping Signal	**4.04 s**	**4.224 s**

Excitation control allows for stability. The model includes a typical IEEE type PSS4B PSS. It accepts an alternator's rotor speed variation as input. and STATCOM data and other parameters are taken from literature [33].

Table 2
R-X (directional) scheme for complete LOE.

R-X (directional) Scheme	Without FACTS	With SVC
Directional Element	1.159 s	1.334 s
Alarm Time Delay	0.5 s	0.5 s
Zone 2	1.232 s	1.335 s
Trip Time Delay	2 s	2 s
Zone 1	2.582 s	2.84 s
Trip Time Delay	0.3 s	0.3 s
Alarm Signal	**1.659 s**	**1.834 s**
Tripping Signal	**2.882 s**	**3.14 s**

Table 3
G-B scheme for complete LOE.

G-B Scheme	Without FACTS	With SVC
Char 1	3.157 s	3.32 s
Alarm Time Delay	0.5 s	0.5 s
Trip Time Delay	10 s	10 s
Char 2	2.698 s	3.045 s
Trip Time Delay	1.5 s	1.5 s
Char 3	4.331 s	4.422 s
Trip Time Delay	0.3 s	0.3 s
Alarm Signal	**3.657 s**	**3.82 s**
Tripping Signal	**4.198 s**	**4.545 s**

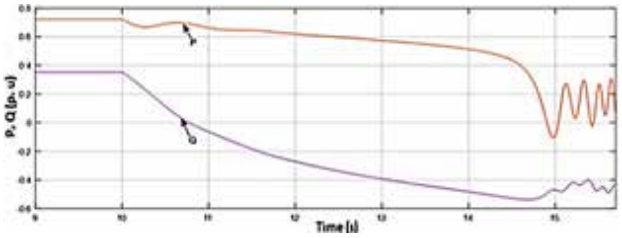


Fig. 10 (a) P and Q

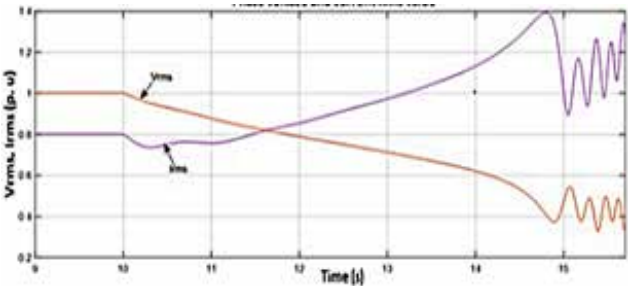


Fig. 10 (b) R.M.S. value of Iph and Vph

Fig. 10. Characteristic curves during complete LOE of Generator G1 (a) P and Q (b) R.M.S. value of V Iph and Iph Vph

Table 4
P-Q scheme for complete LOE.

P-Q Scheme	Without FACTS	With SVC
UEL	1.782 s	2.224 s
Alarm Time Delay	0.5 s	0.5 s
Operation Zone	2.08 s	2.69 s
Trip Time Delay	0.75 s	0.75 s
Alarm Signal	**2.282 s**	**2.724 s**
Tripping Signal	**2.83 s**	**3.44 s**

Via simulating the subsequent situations without FACTS and with a STATCOM for mid-point voltage regulation, we may analyze and evaluate the LOE relaying techniques of synchronous generators.

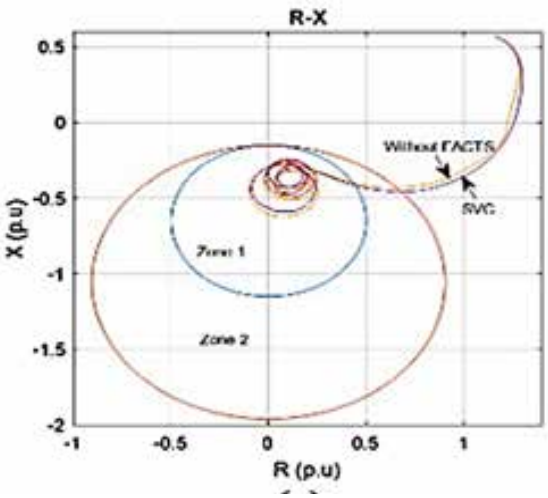
Total excitation loss

The delay of the generator G1 is 0.9 and it is operating at 80% load. During total LOE, the generator's field voltage drops to 0 because of the fault. Event LOE occurs at t = 10s.

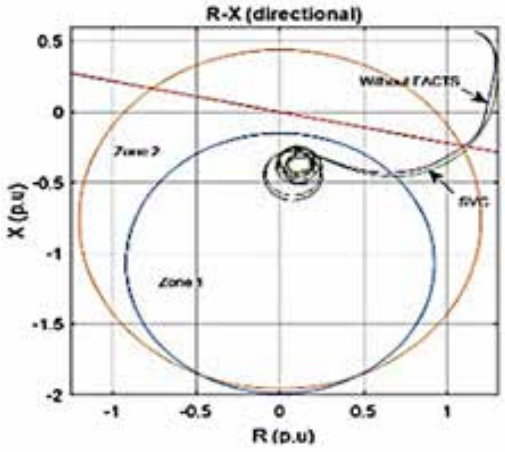
The P and Q output from the generator are displayed in Fig. 10. Q drops to 0 when LOE occurs because the generator must now import Q from the system. The massive quantity of Q imported causes the terminal voltage of the generator to drop and the current to climb. Before loss of entropy (LOE), the generator's P output was about 0.72 p.u. At 4.4s after LOE begins, the deviation drops to roughly 0.12p.u., where it stays until the generator leaves its synchronism (refer Tables 1-4).

Equally, after 0.6s, the Q output of the generator drops from 0.35p.u. to 0p.u. After 4.4s of decline, it reaches a minimum of 0.5p.u. The terminal Vph drops to 0.3p.u. and the Iph to rises to 1.3p.u. upon Q importing, but only before synchronization is broken.

One can see where these variables are located in each design, as seen from the input side, in Fig. 11. Several safe areas are shown in the illustration.



(a)



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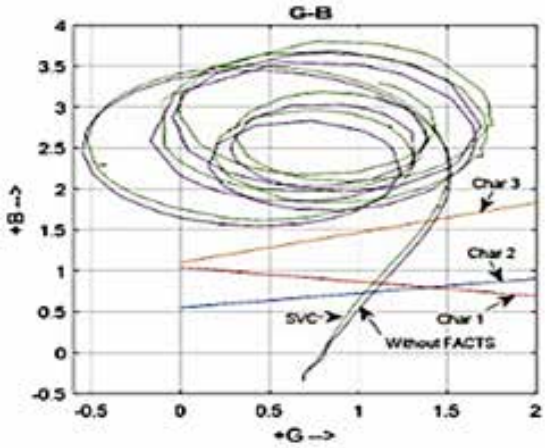
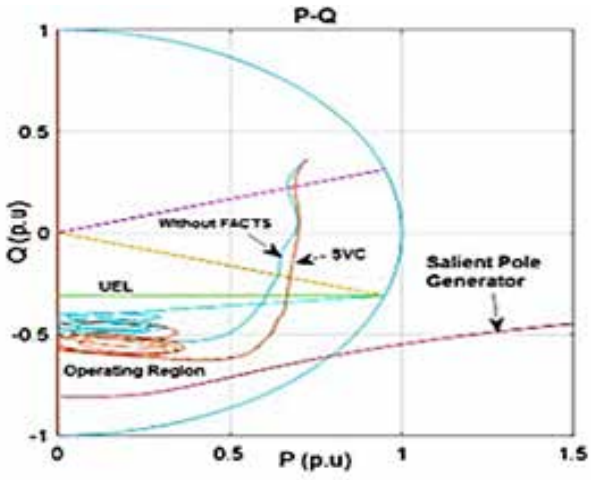


(c)



(d)

Fig. 11. LOE (a) R-X (b) R-X (directional) (c) G-B (d) P-Q

The tables then show the total data, including the alarm time and tripping time, as well as the time it took to enter the various protection zones. Fig. 12 shows the LOE (LOE) V-I waveforms, the LOE Index, and the dR/dt method (see Tables 5–7).

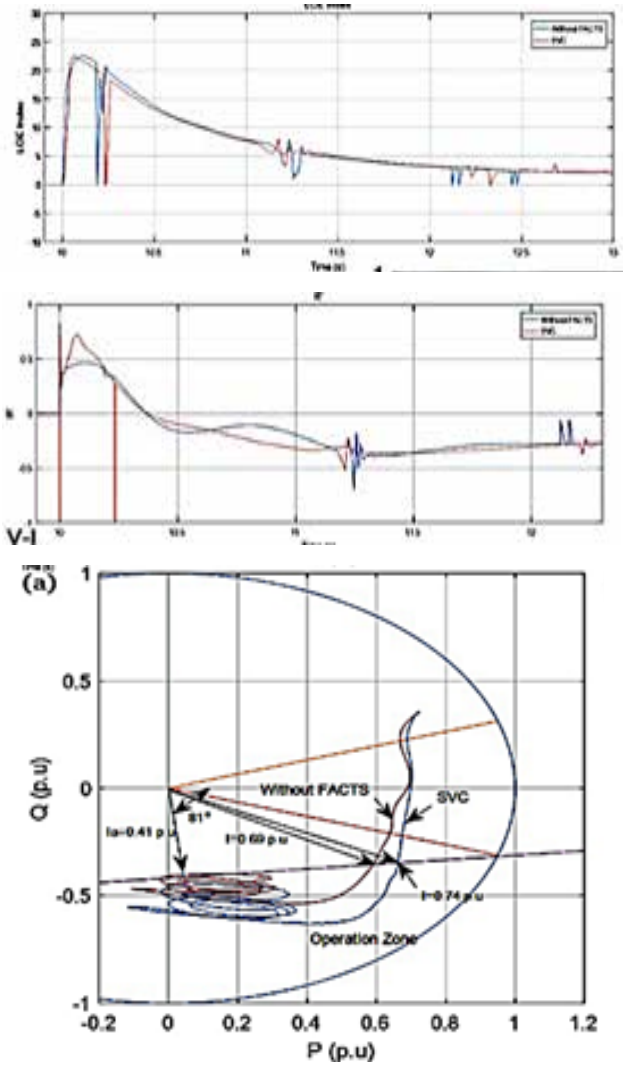


Fig. 12. LOE (a) LOE Index, (b) V-I (c) dR/dt

Table 5
V-I scheme for complete LOE.

V-I Scheme	Without FACTS	With SVC
Operation Zone	2.22 s	2.923 s
Alarm Time Delay	0.5 s	0.5 s
Trip Time Delay	2 s	2 s
V < 85%	1.2 s	5.02 s
I > 110%	3.1 s	8.3 s
Alarm Signal	**2.72 s**	**3.423 s**
Tripping Signal	**4.22 s**	**4.923 s**

Table 6
LOE index scheme for complete LOE.

LOE Index Scheme	Without FACTS	With SVC
Above Threshold value of 4	0.01 s	0.01 s
Time Duration above threshold	1.6 s	1.2 s
Trip Time Delay	1 s	1 s
Tripping Signal	**1.01 s**	**1.01 s**

Table 7
dR/dt scheme for complete LOE.

dR/dt Scheme	Without FACTS	With SVC
Becomes negative for more than 1.66 s	0.38 s	0.38 s
Trip Time Delay	1.8 s	1.8 s
Tripping Signal	**2.18 s**	**2.18 s**

CONCLUSIONS

Protection techniques for generators rely heavily on LOE relays. Without STATCOM, communication between these relays would be severely impeded. Results from a simulated system employing STATCOM for mid-point voltage regulation showed that conventional methods take a long time to zero in on the source of the problem. In terms of complete excitation loss, the R-X (directional) design of LOE relays excels in comparison to the industry norm. The agreement's massive buffer zone is a serious flaw. This safety zone can be proven to have been breached, proving that the features are no longer protected from outside threats. R-X is a reliable method, and the LOE across the alternator's condenser mode demonstrates that it identifies the issue much more quickly instead of LOE Index and the dR/dt method.

The LOE Index technique reliably identifies LOE, but it is also vulnerable to interference from the outside world. The dR/dt method was clever to notice the LOE defect more rapidly than any other conventional method, even in the presence of the entire LOE. User can't accomplish this method with traditional electromechanical relays; you'll need electronics and computer-based relays instead. Its primary benefits include being simple to implement, having better performance because LOE issues are instantly diagnosed, and being immune to external defects and power fluctuations.

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Optimizing Hybrid Electric Vehicle Efficiency: Performance of a Bidirectional Converter-Based System

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ABSTRACT

With growing environmental concerns and the instability of oil supply, electric vehicles (EVs) are gaining popularity. Regenerative braking stands out as a crucial mechanism to enhance the range of EVs. This article introduces a non-isolated bidirectional converter employed for regenerative braking in electric cars. During motoring, the converter utilizes battery power, and during regenerative braking, it charges the battery with back electromotive force (emf). The stored energy in the battery is effectively recovered and reused, significantly contributing to the conservation of braking energy. The implementation of regenerative braking proves beneficial for the batteries, consequently extending the driving range of electric vehicles. The system is simulated using MATLAB/Simulink, and the outcomes of the simulation are presented. Further validation through a prototype can offer practical insights and validate the findings of the simulation.

KEYWORDS *: Bidirectional converter, H-bridge (class E-chopper), Regenerative braking, Soft starting.*

INTRODUCTION

The escalating global energy demand has precipitated increased fuel consumption, contributing significantly to environmental degradation. Recognizing the profound impact of conserving energy at the consumption level—where every saved unit diminishes energy demand by 3 to 4 times—calls for a strategic approach to energy utilization and preservation. By deploying energy efficiently, this conservation endeavor can be achieved at a fraction of the cost of new capacity production, holding the potential to markedly alleviate the environmental toll of petroleum use.

In the realm of electric vehicles (EVs), the conventional braking systems exhibit a pronounced inefficiency, converting kinetic energy into wasteful heat through friction. This energy loss, predominantly manifested in the form of heat dissipated by regular braking systems, underscores the critical need for transformative solutions. Regenerative braking emerges as a pioneering energy-recovery method, fundamentally altering the landscape of vehicular efficiency. By converting kinetic energy into a usable form during braking, regenerative braking not only slows down the vehicle but also significantly minimizes energy wastage inherent in conventional braking systems.

Crucially, the implementation of regenerative braking in EVs, complemented by a bidirectional DC-DC converter, stands out as a paradigm shift in enhancing energy efficiency. This converter serves as a superior alternative for power transfer in EVs, augmenting the output voltage of electrical storage systems while reducing current output. Additionally, its ability to facilitate reverse power flow during regenerative braking further amplifies overall system efficiency, concurrently reducing the total cost, size, and weight of the vehicular power system.

Delving into the intricacies of regenerative braking mechanisms, the operational challenges of implementing regenerative braking in induction motors operating in the negative slip region become apparent. The need for complex control algorithms becomes evident, prompting innovative solutions. The design and implementation of a converter with a full bridge topology, accommodating three distinct operation modes—uncontrolled bridge rectifier, boost converter, and voltage source inverter—aims to maximize energy transfer from the DC machine

to the grid, thereby optimizing the overall system efficiency.

Transitioning to the domain of Brushless DC (BLDC) motor drive systems, the integration of non-linear effects introduces complexities that temper the amount of energy saved during regenerative braking. Notably, the study explores the application of an IGBT Buck-Boost converter connected to an ultra-capacitor bank, emphasizing regenerative braking during shorter intervals. However, the associated costs, particularly those arising from the use of an expensive and fast microcontroller, necessitate a judicious balance between performance and economic considerations.

Motivated by a commitment to simplicity and cost-effectiveness, recent methodologies advocate for the maintenance of constant voltage across battery terminals. Innovative approaches, such as a novel methodology utilizing regenerative braking, propose models comprising a DC machine, feedback-based boost converter, and microcontroller. This concerted effort aims to develop an efficient, cost-effective boost converter that ensures constant output voltage across the battery terminals, thereby enhancing energy savings.

In exploring the landscape of bidirectional DC-DC converters, the literature unfolds a rigorous examination of control methodologies and switching techniques. A pervasive focus on reducing converter size, weight, cost, and losses underscores the commitment to advancing the efficiency of these converters. The research extends its inquiry into two distinct methods of regenerative braking using bidirectional voltage-source inverters, elucidating the characteristics and implementation nuances of each.

Collectively, the reviewed literature encapsulates the diverse trajectories of research aimed at optimizing regenerative braking systems for electric vehicles. From the complexities of motor types and additional energy storage devices to innovative control methodologies and converter technologies, this body of work reflects a vibrant tapestry of exploration and innovation in pursuit of energy-efficient and sustainable vehicular propulsion systems.

SPECIFICATION & DESIGN

In system description, a brief introduction about the regenerative braking by using bidirectional converter is given with the literature review. The motivation and objectives are also discussed. This section comprises a detailed description of the system with help of block diagram.

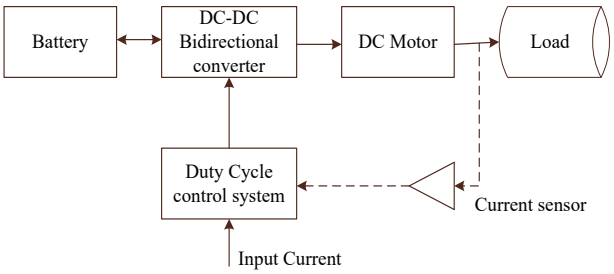

Fig 1- Block diagram of System

Figure 1 illustrates the system's block diagram, emphasizing the essential role of a rechargeable battery. Rechargeable batteries function by facilitating a reversible chemical process that enables the storage of charge even after discharging. Given the comprehensive power requirements, a reliable, portable, and efficient power source is imperative. The selection of the appropriate battery involves considering several factors. 12-volt batteries are available in various types, sizes, and materials. Depending on manufacturing processes, batteries exhibit diverse shapes and dimensions. Common types of rechargeable batteries include Lead-Acid, Nickel-Cadmium (NiCad), Nickel-Metal hydride (NiMH), Lithium-Ion (Li-ion), Lithium-Ion polymer (LiPo), and rechargeable alkaline batteries. Each type offers distinct characteristics to cater to specific needs.

IMPLEMENTATION

Design of System

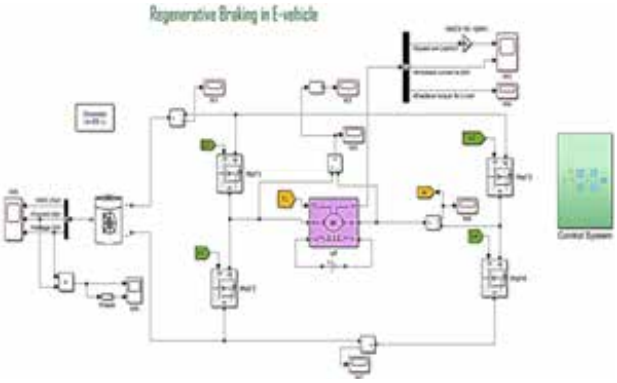

Fig 2- MATLAB System Model

The circuit configuration comprises a battery, a converter circuit connected to a separately excited DC motor in an H-Bridge arrangement. External gate pulses from a dedicated control system regulate the ON-OFF states of switches and monitor the battery discharge rate. The discharge rates at different duty cycles (90%, 70%, and 50%) under various load conditions are systematically compared.

The energy delivered from the battery to the motor (load) under these conditions is thoroughly analyzed, and the energy required for motoring is precisely calculated. Continuous motoring action could lead the battery to discharge to a lower threshold (Vmin), necessitating recharging.

Moreover, if motoring is succeeded by regenerative braking, the energy generated is utilized to partially recharge the battery. This strategic approach aims to prolong the recharging time of the battery, ensuring enhanced operational efficiency and sustained performance.

Control System

This is the control system designed for controlling the switches by activating their respective pulse ssignal. For giving that signal we have used the pulse generator with 10 KHz (cycle time period 0.1msec) switching frequency and trying to calculate discharge rate of battery by changing the speed at different load conditions.

Each MOSFET and load torque control subsystem has its own subsystem. All MOSFETs are function of Clock while, MOSFET 1 is function of both clock and Armature current (Ia). By sensing armature current respective duty ratio is given to MOSFET 1 to soft-starting of motor. The duty ratio output of the function block is sent to the pulse generator, and the respective duty ratio pulse generated by the pulse generator is given to the gate of the MOSFETs. Internally, the pulse generator is designed using PWM methods, using a square wave as reference signal.

This simulation is used for:

i. Different duty cycles for different operating condition of motor at same and different load conditions.

ii. For continuously operated in motoring mode, the discharge rate of battery is checked.

iii. Energy supplied from battery to load & to find its rate of discharge.

iv. At period of regenerative braking rate of charge of battery is checked.

v. By using regenerative mode, part of energy during regenerative braking is fed back to battery to reduce its recharging time.

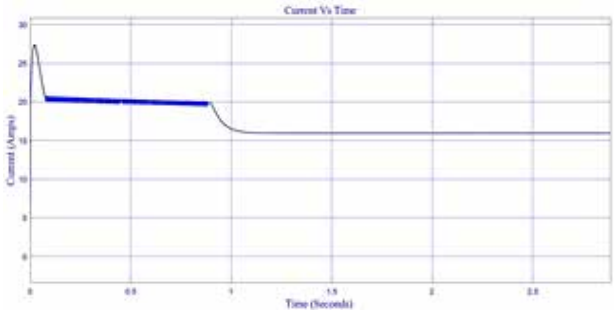

Fig 3.- MOSFET 1 control system

Table 1 Motor specifications

Loading	Starting Current	Steady state current
Full load	75 A	16.56 A
Half-load	73 A	8.6 A
Loading	Starting Current	steady state current
Full load	27 A	16.56 A
Half-load	27 A	8.6 A

Figure 3 shows the control system designed to reduce starting current, though it increases the time required by motor to attain its rated speed (pickup time) by 0.7 sec. Implying this starting current has been reduced by 64%.

Calculations

- Calculation at rated condition:

$$I_{FL} = \frac{InputPower(W)}{RatedVoltage(V)} \quad (1)$$

$$I_{FL} = \frac{5 \times 735.5}{240}$$

I_{FL} = 15.32 Amp

$$E_b = V - I_a R_a \quad (2)$$

= 240-15.32 × 2.58 = 200. 47 V

$$P_{in} = V \times I_a \quad (3)$$

= 240 x 15. 32

= 3677 Watt

$$P_{out} = E_b \times I_a \quad (4)$$

= 200.47 × 15.32

= 3071 Watt

$$P_{out} = T_e \times \omega \quad (5)$$

$$\omega = \frac{2\Pi N}{60}$$

$$\omega = \frac{2\Pi 0 \times 1750}{60} = 183.25\ rad/sec$$

$$T_e = P_{out} / \omega \quad (6)$$

= 3071 × 183.25

T_e = 16.75 N-m…. (Full load torque)

Calculation for duty cycle of MOSFET 1

In matlab/simulink models, the switching loss is absent (ideal). Reverse Fall Time (tRH) & Forward Rise Time (tFH) are ideally zero.

So, considered 90 % duty cycle of DC-DC for motor operation on practical basis

Calculation for Battery voltage

$V_s = V_{rated}/0.9$

$V_s = 240/0.9$

= 266.67 ≅ 270 V

To obtain rated voltage at motor terminal the battery voltage required is 270V.

MOSFET 2 duty ratio Consideration:

Table 2 shows results are taken at different duty ratio of MOSFET 2

Duty Ratio [Ton]	Energy recovered	Braking Current
40	195 J	17 A
50	258 J	25 A
60	292 J	33 A
70	323 J	41 A
80	218 J	50 A
90	142 J	57 A

From Table 2 result table, it is concluded that maximum energy is recovered at 70% duty ratio. So, for MOSFET 2 duty cycle applied is 70%. when the duty ratio is increased braking current increases which leads to increased braking torque.

RESULTS & EVALUATION

The earlier discussed design of the system is implemented. After the implementation the following results and evaluation is done as discussed in this chapter.

Two cases are implemented; they are as follows:

- Case 1: Motor Operated with Full Load Condition with
  - 2 sec motoring operation followed by braking
  - 4 sec motoring operation followed by braking

Case 1: Motor Operated with Full Load Condition

Results Calculated for 15.69 N-m full load at 16.5 Amp, speed for full load is 1936 rpm for analysis purpose and calculations done for motoring operation without regenerative braking and with regenerative braking.

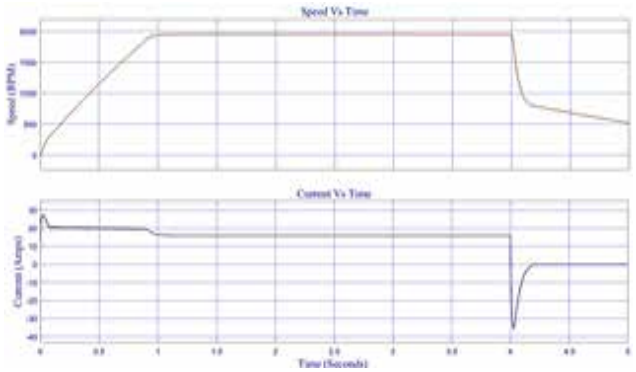

Fig 4 Speed & Current waveforms at full load with 0.9 duty ratio

Energy in rotating mass $= \frac{1}{2} j\omega^2 = \frac{1}{2} \times 0.02215 \times (202.73)^2 = 455.20$ J

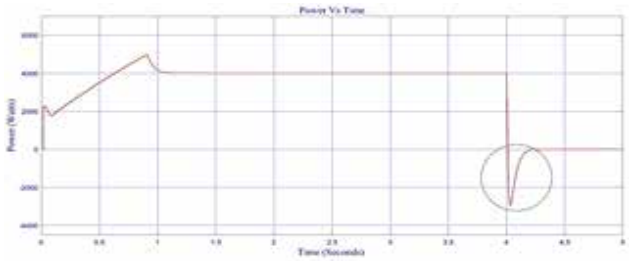

Fig 5. Power waveform at full load 0.9 duty ratio

Energy recovered by braking = 183 J

Percentage energy Recovered of rotating mass = 39.49 %

Energy required at starting = 2651 J

Energy required at starting + Motoring= 7325 J

Percentage energy Recovered of Starting = 6.88 %

The continuous motoring time is used as 2 sec and 4 sec before braking.

Performing 2 sec motoring operation following calculation are carried out,

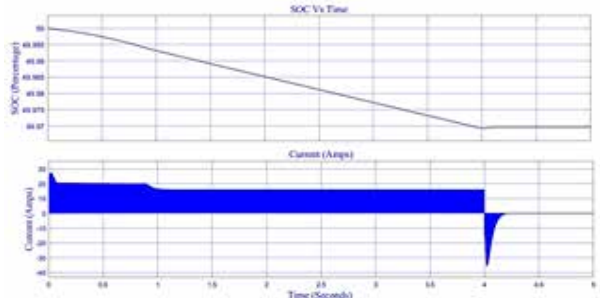

Fig 6. SOC & Current waveforms at source side at full load 0.9 duty ratio

Figure 6 shows SOC characteristics of battery. By finding slop of SOC during motoring and braking rate of discharge and charge are calculated respectively.

Rate of Discharge= 8.2×10^{-3} %/sec

$= 100/(8.2 \times 10^{-3})$

= 12195 sec

Time required to full discharge without regenerative braking = 3.38 Hrs.

Rate of charge during braking = 3×10^{-3} % / sec

Total Rate of charge during braking for 0.25 sec

$= 0.25 \times 3 \times 10^{-3}$ % / sec

$= 0.75 \times 10^{-3}$ %

No of Cycles required for 100% Discharge = $100/ (2 \times 8.2 \times 10^{-3}) = 6098$ Cycles

Total Braking charge in % = $6098 \times 0.75 \times 10^{-3} = 4.57$ %

Time extended before recharging of Battery due to regenerative braking = 4.57 % of 3.38 Hrs. = 9.26 min

Time required to full Discharge = Time required to full Discharge without regenerative braking +of battery Time extended before recharging of Battery due to regenerative braking = 3.38 Hrs. + 9.26 min = 3.53 hours.

Performing 4 sec motoring operation following calculations are carried out,

Time required to full Discharge = 3.46 Hrs.

No of Cycles required for 100% Discharge = $100/(4 \times 8.2 \times 10^{-3}) = 3049$ Cycles

Total Braking charge in % = $3049 \times 0.75 \times 10^{-3} = 2.285$ %

Time extended before recharging of Battery due to regenerative braking = 2.285 % of 3.38 Hrs. = 4.63 min

Time required to full Discharge = Time required to full Discharge without regenerative braking +

Time extended before recharging of Battery due to regenerative braking = 3.38 Hrs. + 4.63 min = 3.46 Hrs.

Table 3. Full load Torque = 16.75 N-m

Parameters	Case 1	Case 2	Case 3
Duty Cycle	0.9	0.7	0.5
Speed in rpm	1936	1415	897
Energy in rotating mass	455 J	243 J	98 J
Energy recovered by braking	182.5 J	118 J	48.19 J
Percentage energy Recovered of rotating mass	39.49%	48.55%	49.17%
Percentage energy Recovered of Starting	6.88%	6.30%	4.47%

Rate of Discharge in %/sec	8.2×10^{-3}	6.4×10^{-3}	4.4×10^{-3}
Rate of Charge in %/sec	3×10^{-3}	2×10^{-3}	1×10^{-3}
Time required to full Discharge without Regenerative braking	3.38 Hrs.	4.34 Hrs.	6.31 Hrs.
Time required to full Discharge with Regenerative braking	3.53 Hrs.	4.49 Hrs.	6.45 Hrs.

Table 3 shows the Results for 8.37 N-m Full load Torque with variation of duty cycles like 0.9, 0.7 and 0.5 are presented with 4 sec motoring operation.

Results from Table 3 indicates speed of motor is increased at half load compared to full load because torque required is less in half load and back emf is increased so percentage of recovered energy is more so life of battery is extended is by 70% more than full load and hence regenerative braking is more efficient in half load.

At higher duty cycle, with higher motor speed the energy stored in rotating mass is higher and vice versa. So, by comparing all the duty cycles, at 0.9 duty cycle speed of motor is high so, Time required to full Discharge of battery with Regenerative braking is high.

CONCLUSION

MATLAB modeling was employed to simulate both motoring and regenerative braking modes, with theoretical calculations validating the results. In continuous motoring mode at a 0.9 duty cycle, the battery required 3.38 hours for complete discharge under full load. The model underwent testing for diverse duty cycles and loading conditions, exploring variations in motoring and braking patterns.

The introduction of regenerative braking at full load notably extended the time before recharging the battery. Specifically, at a higher duty cycle (0.9), where speed is maximal, the tapped energy in the rotating mass increased, resulting in a more substantial extension of time before battery recharging due to regenerative braking. This observation underscores the positive impact of regenerative braking on the overall efficiency and operational duration of the system.

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Advancing Hybrid Electric Vehicle Performance via Enhanced Converter-Based Systems

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ABSTRACT

In response to the escalating demand for sustainable transportation and heightened environmental consciousness, HEVs have emerged as a focal point of interest. This paper investigates the optimization of HEV efficiency by introducing and evaluating an innovative technology-a bidirectional converter-based system tailored specifically for HEVs. Positioned to redefine operational dynamics, this system holds the potential to make substantial strides in energy utilization and overall performance. Traditional electric vehicles often suffer from kinetic energy dissipation as heat through friction in their braking systems, leading to energy wastage. The integration of regenerative braking, facilitated by bidirectional converters, presents a transformative solution. This technology not only captures and stores dissipated energy during braking but also enables its efficient reuse, contributing to an extended driving range and heightened overall efficiency. The bidirectional converter assumes a pivotal role in this system, facilitating both the charging and discharging of the vehicle's energy storage system. Its unique ability to alter power flow direction not only enables efficient regenerative braking but also enhances energy transfer, ultimately reducing the total cost, size, and weight of the system. Amidst the challenges of rising energy consumption and the environmental impacts of conventional fuel sources, this paper aims to explore, analyze, and optimize the performance of the bidirectional converter-based system in HEVs. Through this endeavor, the paper strives to contribute to the ongoing evolution of eco-friendly transportation solutions, fostering a more sustainable and energy-efficient future.

Simultaneously, addressing environmental concerns and uncertainties surrounding oil sources, the vehicle industry is increasingly embracing electricity as an alternative energy source. Regenerative braking emerges as an effective strategy to extend the driving range of battery-powered EVs. In this paper, regenerative braking for an electric vehicle is managed by a non-isolated bidirectional converter. During motoring, the converter utilizes the battery to supply energy to the motor. Conversely, during regenerative braking, the converter harnesses the available back emf to charge the battery. This process successfully captures and stores a substantial portion of the energy lost during braking, offering a sustainable means of energy recovery. The recovered energy is then stored in the battery, significantly improving battery performance and, consequently, enhancing the driving range. The simulation of this system is conducted using MATLAB/Simulink to validate the results through the creation of a real-world prototype. This paper report encompasses the simulation findings and sets the stage for potential advancements in electric vehicle technology.

KEYWORDS *: Bidirectional Converter, H-bridge (class E-chopper), Regenerative Braking, Soft starting.*

INTRODUCTION

Revolutionising HEVs: A Comprehensive Exploration of Bidirectional Converter-Based Systems for Enhanced Energy Utilization and Efficiency. In the face of growing environmental awareness and the urgent need for sustainable transportation solutions, Hybrid Electric Vehicles (HEVs) have gained widespread adoption. This thesis delves into a ground-breaking technology – a bidirectional converter-based system meticulously designed for HEVs. Positioned to

transform the operational paradigm of these vehicles, this system promises significant advancements in energy utilization and overall performance.

Conventional electric vehicles often dissipate kinetic energy as heat through friction during braking, resulting in substantial energy wastage. The integration of regenerative braking, facilitated by bidirectional converters, presents a transformative solution. This technology not only captures and stores dissipated energy during braking but also facilitates its efficient reuse, contributing to an extended driving range and heightened overall efficiency.

At the core of this transformative system lies the bidirectional converter, a pivotal component enabling both the charging and discharging of the vehicle's energy storage system. Its unique capability to alter the direction of power flow not only facilitates efficient regenerative braking but also enhances energy transfer, ultimately reducing the total cost, size, and weight of the system. In the context of escalating energy consumption and environmental concerns related to traditional fuel sources, this thesis aims to explore, analyze, and optimize the performance of bidirectional converter-based systems in HEVs. Through these efforts, we aspire to contribute to the continuous evolution of eco-friendly transportation solutions, paving the way for a more sustainable and energy-efficient future.

The literature review surrounding the optimization of HEV efficiency through bidirectional converter-based systems provides valuable insights into the challenges and advancements in this evolving field. Key aspects related to energy conservation, regenerative braking, and the role of bidirectional converters in enhancing overall efficiency are comprehensively covered.

Energy Conservation and Sustainability: The imperative of conserving energy and promoting sustainability is a recurring theme in the literature. As energy consumption continues to escalate, the environmental repercussions of conventional fuel sources have fuelled the demand for more energy-efficient transportation solutions.

Regenerative Braking in Electric Vehicles:

The focus on regenerative braking as an energy-recovery method in electric vehicles is a pivotal element in the literature. Conventional braking systems dissipate kinetic energy as heat through friction, resulting in substantial energy wastage. Regenerative braking, by converting kinetic energy into a reusable form during deceleration, stands out as an effective solution.

Bidirectional DC-DC Converters in Electric Vehicles

The bidirectional DC-DC converter emerges as a critical component in the literature, facilitating both the charging and discharging of energy storage systems in electric vehicles. Its unique ability to alter the direction of power flow during regenerative braking is highlighted as a key feature that enhances efficiency.

Role of Bidirectional Converters in Energy Transfer

The literature emphasizes the pivotal role of bidirectional converters in efficient energy transfer. By enabling reverse power flow during regenerative braking, bidirectional converters contribute to elevated efficiency levels. Their application in enhancing the output voltage of electrical storage systems, subsequently decreasing current output, is highlighted as a significant factor in optimizing energy utilization.

Challenges and Complexities in System Integration

Several studies delve into the challenges and complexities associated with integrating bidirectional converter-based systems in electric vehicles.

Contributions to Sustainable Transportation

The literature collectively emphasizes the motivation behind optimizing bidirectional converter-based systems in HEVs. Contributions to sustainable transportation, including extended driving range, reduced energy loss, and simplified system designs, are identified as key objectives.

Emphasizing regenerative braking during shorter periods, specifically less than 1 or 2 seconds, this research outlines a methodology involving a boost converter and a microcontroller to maintain a constant output voltage. However, the use of an expensive and fast microcontroller is noted, which contributes to increased costs. It is evident from the collective research that the complexity of the system and control algorithm is contingent on factors such as the type of motor selected, the inclusion of additional energy storage devices, and the chosen mode of operation. The motivation underlying these investigations is to

pioneer the development of simple and cost-effective systems. This motivation is explicitly outlined in a novel methodology that utilizes regenerative braking, incorporating a model comprising a DC machine, feedback-based boost converter, and microcontroller.

The bidirectional DC-DC converter (BDC) is the subject of a detailed review, concentrating on control methodology and switching techniques. The overarching research goal is to reduce the size, weight, cost, and losses associated with these converters. The paper conducts a comparative analysis of two regenerative braking methods using bidirectional voltage-source inverters, elucidating the characteristics and implementations of each.

SPECIFICATION & DESIGN

Lithium-Ion Battery

Lithium-Ion batteries charge quicker, last longer, and offer a higher power density than conventional batteries, allowing for more battery life in a smaller package. Table 1 shows Battery Specification.

Table 1 Battery Specifications

Battery Parameters	Ratings
Nominal Voltage (v)	260
Rated Capacity (Ah)	50
Initial State of Charge (%)	50
Battery response time (sec)	30
Cut-off voltage (v)	195
Fully charged voltage (v)	302.63
Nominal discharge current (A)	21.73
Internal Resistance (Ohms)	0.052

The Fig.1 shows the nominal current discharge characteristics there is time in hours on x-axis and voltage in volts on y-axis.

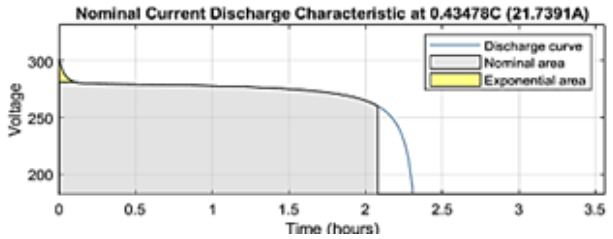

Fig. 1. Nominal current discharge characteristics

If battery operating in nominal current, it will last long for 2.3 Hrs. Shaded area shows the operating hours of battery up to 2.1 hours with a voltage range of 280V to 250V and after that voltage reduces gradually.

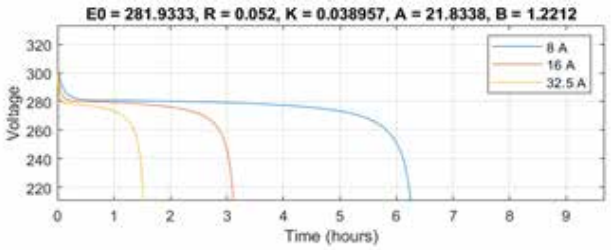

Fig. 2 discharge characteristics at different loading

The Fig. 2 shows discharge characteristics there is time in hours on x-axis and voltage in volts on y-axis at different loading conditions like 8 A, 16A, 32.5 A, so their respective discharge time is 6.3 Hrs., 3.1 Hrs., 1.5 Hrs. As the load torque is greater the battery discharge rate is faster [15].

DC-DC Converter

These days, dependable power sources, compact design, reduced weight, and enhanced quality are necessities for the majority of electronic products. Because they rely on the principle of a voltage and current divider, energy regulators are inefficient. Switched regulators are thus employed in applications requiring a great deal of power. To toggle between a on and off state, they employ power electronics semiconductor switches, such as IGBTs or MOSFETs. When the switch is turned off, there is no current flowing through it and the voltage across it is low, thus there is almost no power loss. So, switching regulators improve the conversion efficiency of energy [16].

In DC-DC converters, electronic processors with high power frequencies are utilized. So, a direct current (DC)-to-direct current (DC-DC) converter is a circuit that takes an unregulated DC input voltage and changes it into a regulated DC output voltage of a certain level. Many modern electrical devices, such laptops, mobile phones, etc., rely heavily on these converters. It is necessary to convert the voltage of the one fixed-voltage battery that powers all of these devices. Not having to buy more power sources is an enormous expense and area saver [17].

Bidirectional DC-DC Converter

Motoring and braking are two operations that every electric machine possesses. Figure 3 illustrates the torque-speed plane, with torque shown on the x-axis and speed on the y-axis. In this plane, quadrants I and III correspond to the forward and reverse motor regions of operation, while quadrants II and IV correspond to the forward and reverse brake regions of operation, respectively. There are three modes of electrical braking: regenerative braking, reverse-voltage braking or plugging, and rheostat braking [18].

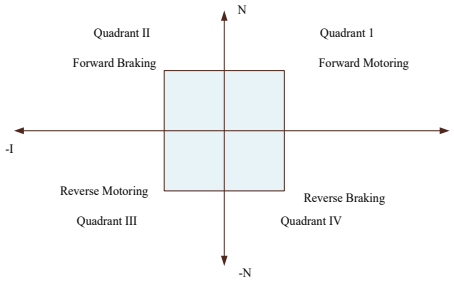

Fig. 3 Interconnected smart grids

Regenerative brake technology involves the conversion of the rotor's kinetic energy into electricity, which is then returned to the power source. The power source for machines can be either a direct current (DC) power supply or an alternating current (AC) power supply. Alternatively, a direct current source can be connected to a suitable controlled power converter, such as a DC-DC or DC-AC converter. The plugging or reverse voltage braking method entails reversing the voltage that is put across the electric machine to aid the back electromotive force (EMF) in compelling the machine currents to flow in the other direction, so generating braking torque. This implies that the generation of braking torque is accomplished by harnessing energy from the power source. Rheostat braking involves connecting a bank of resistors across the electric machine, causing the kinetic energy of the rotor to be converted into heat within the resistor bank. Thus, it is evident that among the three forms of electric braking, regenerative braking stands out as the sole type that returns electricity to the power source. The objective of this study is to provide a comprehensive and precise examination of the regenerative braking capacity in converter-controlled electric machines that are powered by a DC source [19].

Four-quadrant Chopper/Type-E Chopper

Figure 4 displays the power circuit diagram of a four-quadrant chopper. The chopper has four semiconductor switches, labeled S1 to S4, and four diodes, labeled D1 to D4, which operate in an antiparallel configuration. The operation of this chopper in all four quadrants is described.

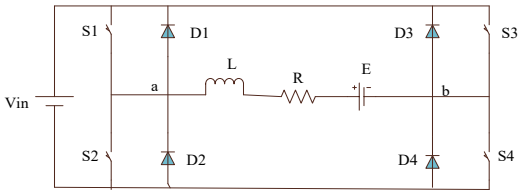

Fig. 4 Type E-chopper

In order to perform operations in the first quadrant in figure 5 (a) and (b), switch S4 remains in the on position, switch S3 remains in the off position, and switch S1 is activated. When S1 and S4 are turned on, the load is directly linked to the source, causing the armature voltage (Vo = Vin) and armature current (lo) to start flowing. Both Vo and lo are positive, indicating first quadrant operation.

When S1 is deactivated, a positive electric current flow freely through S4 and D2. By controlling Vo and lo in the first quadrant, the motor rotates in the forward direction, which is referred to as Forward Motoring [20].

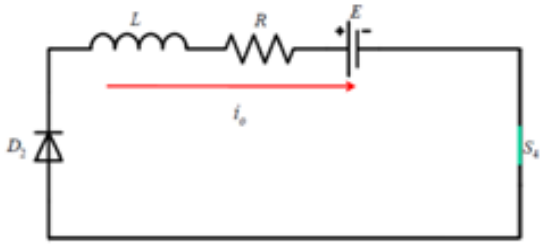

Fig 5 (a) Forward motoring

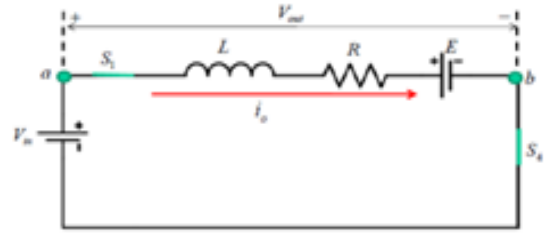

Fig. 5(b) Freewheeling operation

In Figure 6, switch S2 is activated while switches S1, S3, and S4 are deactivated. When S2 is activated, a reverse or negative current passes through L, S2, D4, and E. While S2 is active, the armature inductance 'L' accumulates energy.

Consequently, S2 is deactivated, causing the current to be redirected back to the source via diodes D1 and D4. It is important to observe that the value of (E-L(di/dt)) is greater than the source voltage Vs due to the positive Vs and negative lo. This indicates a second quadrant operation, which corresponds to the forward braking mode. The armature feeds electricity back to the source. The term used to describe this is Forward Regenerative Braking [21].

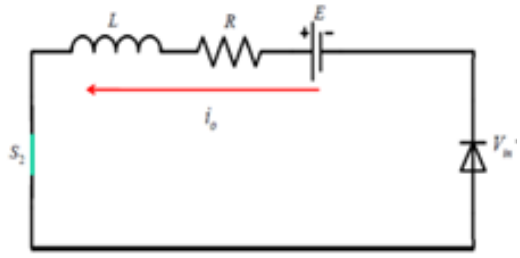

Fig.6 (a) Freewheeling action

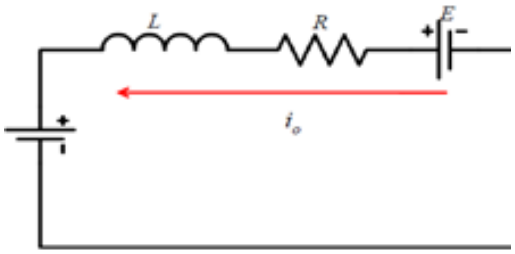

Fig.6 (b) Fed back operation

In the third quadrant operation, as shown in figure 7 (a) and (b), Switch S1 is deactivated, Switch S2 is activated, and Switch S3 is activated. In order to achieve the desired quadrant action, it is necessary to flip the polarity of the armature's back electromotive force (EMF) (E). When switch S3 is turned on, the armature is connected to the source Vs, resulting in both Vo and lo being negative. This causes the operation to occur in the third quadrant.

When S3 is off, a negative current bypasses S2 and flows through D4 without any resistance. Only Vout and lo may be regulated in the third quadrant using this method. Reverse Motoring refers to the phenomenon when the motor rotates in the opposite direction.

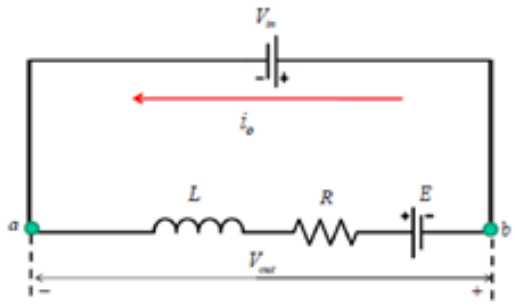

Fig.7 (a) Reverse Motoring

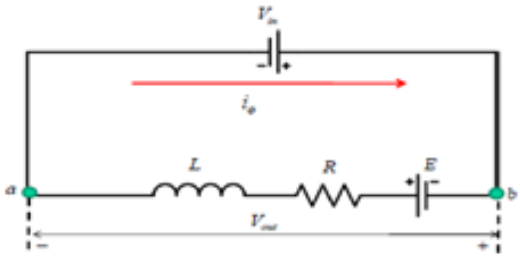

Fig. 7(b) Freewheeling Action

In figure 8, switch S4 is activated while other devices remain deactivated. In this scenario, it is necessary to reverse the polarity of the back electromotive force (E), similar to the operation in the third quadrant. When S4 is turned on, an electric current with a positive charge passes via S4, D2, L, and E (the armature). The armature inductance L accumulates energy when the time S4 is active. When S4 is turned off, diodes D2 and D3 allow the current to be returned to the source. The armature voltage Va is in the negative range, while la is in the positive range, leading to the operation of the chopper drive function in the fourth quadrant. The armature also returns power to the source. The term used to describe this is Reverse Regenerative Braking [22].

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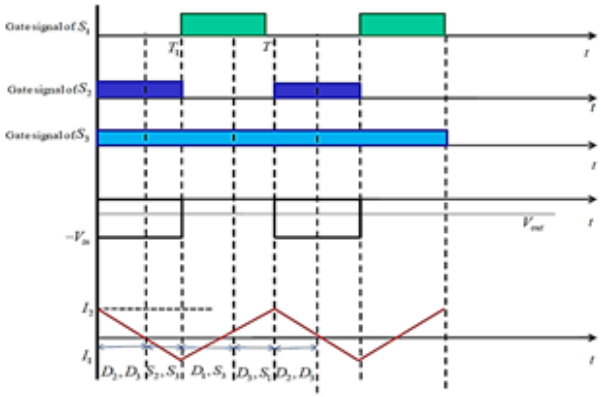

Fig.8 Output Waveform of third and fourth quadrant

As we are going to work in Forward motoring and forward braking action, first two quadrants are used in paper.

Separately Excited DC Motor

In an independently excited DC motor, the supply is provided to the field and armature windings individually. The main feature of this type of DC motor as shown in Table 2 is that the field windings are energized by a separate DC source, so the current through the armature doesn't flow through them. This can be understood in a better way from the following diagram [23].

Table 2 Specification of Motor

Motor Parameters	Ratings
Output Power (HP)	5
Armature Voltage (V)	240
Speed (RPM)	1750
Armature Resistance (ohm)	2.581
Inductance (H)	0.028
Total Inertia	0.02215
Viscous friction coefficient (N.m.)	0.002953
Coulomb friction coefficient (N.m.)	0.5161

The field coil of an independently excited DC motor is powered by an external DC source, as seen in Figure 9. The separately excited DC motor is most suitable for applications that necessitate a wide range of speed fluctuation, ranging from extremely low to very high values. These motors [23] are being utilized in various industries and others.

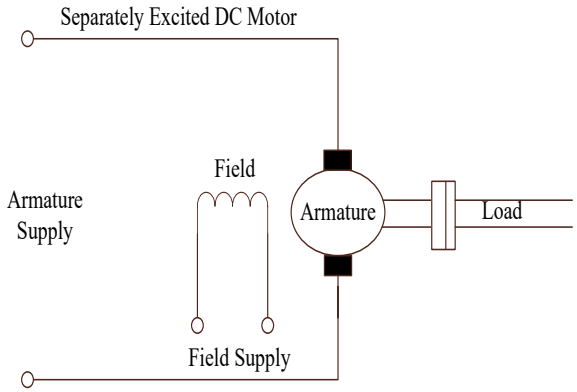

Fig 9. DC separately excited motor

Concept of Back Emf

When the motor armature keeps rotating as a result of motor activity, the armature conductors intersect with the magnetic flux, causing induced electromotive forces (emfs) in them. The induced electromotive force (emf), commonly referred to as reverse emf, is oriented in a manner that opposes the applied voltage. The magnitude of the reverse electromotive force (emf) is determined by the generator activity.

$$E_b = \frac{\phi ZN}{60} \times \frac{P}{A} \quad (1)$$

I_a in terms of V, E, and R_a is given in Eq. (2)

$$I_a = \frac{V - E_b}{R_a} \quad (2)$$

The induced EMF in the armature of a motor, denoted as Eb, is influenced by various elements, including the speed of the armature. The armature current, on the other hand, is determined by the back EMF Eb, when a constant voltage is applied and the armature resistance remains constant. When the armature speed is high, the magnitude of the back EMF, Eb will be substantial, resulting in a correspondingly low armature current. When the armature speed is low, the EMF, Eb will decrease, causing the armature current Ia to increase. This leads to the generation of a significant torque [24].

The existence of back emf enables the DC motor to function as a self-regulating device. This means that the dc motor will only draw enough armature current to generate the necessary load torque.

STUDY SYSTEM IMPLEMENTATION

In fig. 10, this circuit comprises of Battery, converter circuit with separately excited DC motor connected in H- Bridge manner. The Gate pulse is given externally from a separate control system designed to control the ON-OFF condition of Switches and monitoring the discharge rate of battery. The discharge rate at various duty cycles like 90 %, 70%, and 50% for the different load conditions is compared.

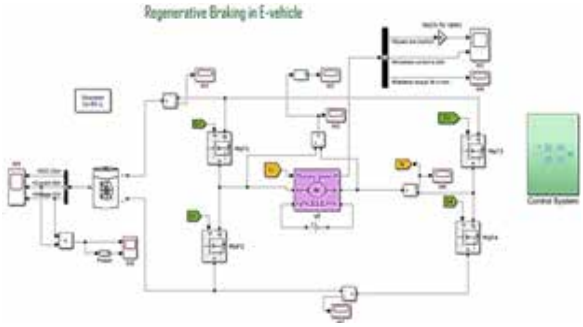

Fig. 10 Study Model

At all this conditions energy delivered to the motor i.e., load from battery is analyzed and the energy required for the motoring is calculated. If motoring action performed continuously the battery will discharge to lower threshold (Vmin) value and requires recharging [24]. If motoring is followed by regenerative braking, energy is used for charging the battery partially. This is the aim to extend the time of recharging of the battery.

Soft-starting

In DC separately excited motor at starting speed is zero, so as generated Eb is nearly zero. As the armature current given in motor is shown in Eq. (3)

$$I_a = \frac{V - E_b}{R_a} \tag{3}$$

As armature resistance is small and value of Eb near zero, the armature current at starting is very high. It is about 5-6 times of rated current. So, to limit starting current armature control method is implemented. In this system armature current sensed and fed back to duty ratio control system. By control of MOSFET 1 duty ratio at respective armature current starting current is limited at some extend. Table 3 shows the starting current of motor before soft-starting, which is nearly 72 Amps

Table 3 Armature Current with soft starting

Motor Parameters	Ratings
Output Power (HP)	5
Armature Voltage (V)	240
Speed (RPM)	1750
Armature Resistance (ohm)	2.581
Inductive Reactance (ohm)	0.028

Capacitor (UC)

The UC system is driven by a paradigm that focuses on the transfer of useable energy. The power capacity of the UC is determined based on the driving cycle need at periods of peak power, when quick discharging occurs. The basic calculations governing capacitors are represented by Eq. (3).

$$i = C\frac{dv}{dt} \;\&\; E = \frac{1}{2}CV^2 \tag{3}$$

The V decays over t is given by Eq. (4)

$$E|_k^{k+1} = \frac{1}{2}C\left(V_k^2 - V_{k+1}^2\right) \tag{4}$$

As demonstrated in Eq. (5), voltage discharge ratio determines usable energy.

$$V_{dr} = \frac{V_{min}}{V_{max}} * 100 \tag{5}$$

Usable energy derived as per Eq. (6),

$$E_u = \frac{1}{2}CV_{max}^2 - \frac{1}{2}CV_{min}^2 = \frac{1}{2}CV_{max}^2\left(1 - \left(\frac{V_{dr}}{100}\right)^2\right) \tag{6}$$

The equation (7) provides the total amount of useful energy derived from a specific number of UCs.

$$E_T = nE_u = \frac{1}{2}nCV_{max}^2\left(1 - \left(\frac{V_{dr}}{100}\right)^2\right) \tag{7}$$

The quantity of UCs (n) is determined using Equation (8)

$$n = \frac{2E_T}{CV_{max}^2\left(1-\left(\frac{V_{dr}}{100}\right)^2\right)} \quad (8)$$

The battery and UC are classified according on the specific electrical load demands. Various sources are accessible, each with distinct power and energy densities. The utilization of a high-power density source and an energy-dense source significantly increases the driving range of vehicles while simultaneously reducing the weight and expense of the energy storage system.

Motor operation at repetitive cycle

Motoring Operation done for repeated cycles while motor speed is reduced and braking at less than rated speed with different load pattern to calculate recovered energy and energy required at the time of repetition of motoring Operation of motor at 0.9 duty cycle shown in Fig.11.

The Table 4 shows the results for operation of motor in repeated cycles. The first cycle is on full load and second cycle is on half load in both cycles braking is done at less than rated speed of motor. Since starting energy required for motoring for full load is 2308 J and recovered energy is 106 J so energy is recovered by 6% of starting energy with regenerative braking.

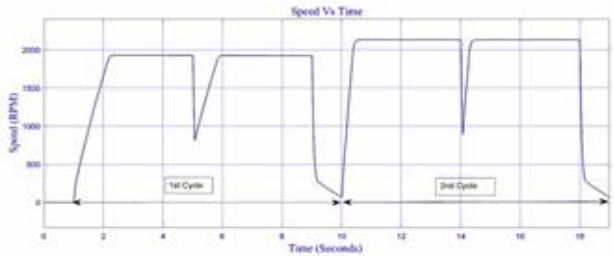

Fig. 11. Repeated cycle operation of motor for full load & half load

Table 4 Result at repetitive operation of motor

Parameters	Full Load (15.7 N-m) 16.5 A	Half Load (7.8 N-m) 9 A
Speed (RPM)	1936→892→193 →60	2141→ 892→2141→0
Energy in rotating mass (Joules)	455 J	556 J
Energy required for starting of motor (Joules)	2308 J	1841 J
Recovered Energy (Joules)	106 J	190 J

Starting energy required for motoring at half load is 1841 J and recovered energy is 190 J so energy is recovered by 10% of starting energy with regenerative braking. Table 5 & 6 shows conclusion at full load & half load respectively.

Table 5 Conclusion at full load

Duty Cycle	Energy Recovered by braking (Joules)	Battery Extension time (Minutes)
0.9	182.5	9.26
0.7	118	9.36
0.5	48	8.6

Table 6 Conclusion at half load

Duty Cycle	Energy Recovered by braking (Joules)	Battery Extension time (Minutes)
0.9	216	22
0.7	153.12	25
0.5	82	29

CONCLUSION

In conclusion, our comprehensive MATLAB modeling, incorporating both motoring and regenerative braking modes, has undergone rigorous execution, complemented by theoretical calculations. The analysis of diverse operational scenarios has yielded valuable insights into the system's performance. In continuous motoring mode with a 0.9 duty cycle, the battery's complete discharge time stands at 3.38 hours at full load and extends to 6.31 hours at half load. Varied duty cycles and loading conditions have been explored, introducing nuances in motoring and braking patterns.

The impact of regenerative braking on extending the time before recharging the battery is particularly pronounced, evident across both full and half loads. Notably, at a higher duty cycle (0.9), maximum speed results in increased tapped energy in the rotating mass, consequently prolonging the time before recharging due

to regenerative braking. At half load and a 0.9 duty cycle, higher speed contributes to greater energy recovery during braking compared to full load operation, further extending the time before recharging.

To expedite simulation and analysis, the motor was operated for 2 and 4 seconds in motoring mode before braking, considering computational demands for longer time operations. The implementation of an armature control method has proven crucial for limiting the starting current, enhancing system stability by sensing armature current and providing feedback to the duty ratio control system.

In repeated cycle operations with braking at less than the rated speed, the starting energy required for full-load motoring is determined to be 2308 J, with a recovered energy of 106 J during regeneration. This signifies that 6% of the starting energy is fulfilled by regeneration during the first cycle. These findings collectively highlight the intricate dynamics of the system under various operating conditions, providing a comprehensive understanding of the interplay between motoring, regenerative braking, and the efficacy of the implemented control methods.

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Optimizing Water Resources: Advanced Water Management and Pump Control

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ABSTRACT

Effective water management is crucial for sustainable resource utilization and environmental conservation. As the global water demand continues to rise, the integration of advanced technologies becomes essential for optimizing water distribution and consumption. This abstract presents an overview of a comprehensive system designed for water management, with a specific focus on water pump control. The proposed system incorporates a network of sensors, microcontrollers, and actuators to monitor and control various aspects of water distribution. Moisture sensors are strategically placed to assess soil conditions, providing real-time data on the moisture levels in different areas. This information is critical for irrigation processes, allowing the system to optimize water usage by activating or deactivating water pumps based on the specific needs of the soil. A central microcontroller, such as the ESP32, serves as the brain of the system. It processes data from the moisture sensors, analyses environmental conditions, and executes control commands to manage water pumps, valves, and other components. The system's intelligence is further enhanced by connectivity to Blink software, enabling remote monitoring and control via smartphones or computers. The water pump control mechanism involves servo motors, valves, and a relay system.

The servo motors regulate the position of valves, adjusting the flow of water as needed. The relay controls the operation of water pumps, ensuring efficient water distribution across different zones. Power management is a critical aspect of the system, addressed through components such as transformers, rectifiers, capacitors, and voltage regulators. These elements contribute to a reliable and stable power supply for the entire water management system. The integrated approach to water management and pump control not only enhances efficiency but also promotes water conservation by preventing over-irrigation in areas with sufficient moisture levels. The system's adaptability to varying soil conditions and the ability to remotely monitor and control operations make it suitable for diverse applications, from agricultural irrigation to urban water distribution networks. In conclusion, the proposed water management and pump control system offers a holistic solution to address the challenges of water scarcity and inefficient water distribution. By leveraging advanced technologies and intelligent control mechanisms, the system contributes to sustainable water resource management, ensuring optimal usage while minimizing environmental impact.

KEYWORDS *: ESP board moisture sensor, Solar panel, GSM module, Motor, Driver jumper wires.*

INTRODUCTION

Water, as a finite and essential resource, plays a pivotal role in sustaining life and supporting various sectors, including agriculture, industry, and urban development [1]. However, the increasing water demand, coupled with environmental challenges and climate variability, has underscored the need for effective water management strategies [2]. This introduction provides an overview of the importance of water management and introduces the concept of water pump control as a critical component in optimizing water distribution. The Imperative of Water Management: The responsible and sustainable use of water resources

is a global priority. With growing populations, changing climate patterns, and increased water scarcity in many regions, the significance of efficient water management cannot be overstated [3]. Proper water management involves balancing the supply and demand of water resources, ensuring equitable distribution, and minimizing wastage. Challenges in Water Distribution Water distribution pose a unique set of challenges, especially in agriculture and urban settings. Uneven distribution of rainfall, varying soil moisture levels, and the need for precise irrigation contribute to the complexity of water management[4-5].

In urban areas, aging infrastructure and increasing water demand necessitate innovative solutions for optimizing water distribution. The Role of Technology in Water Management: Advances in technology have opened avenues for more sophisticated and responsive water management systems. Smart sensors, microcontrollers, and automation mechanisms allow for real-time monitoring of environmental conditions, enabling data-driven decision-making. These technologies form the backbone of modern water management systems [6]. Water Pump Control as a Crucial Element: Central to effective water management is the control of water pumps, which are instrumental in transporting and distributing water. Water pump control systems integrate sensor data, microcontrollers, and actuators to regulate pump operations based on the specific needs of the environment. This not only enhances efficiency but also contributes to resource conservation. Objectives of Water Pump Control: The primary objectives of water pump control systems include optimizing irrigation processes, preventing over-irrigation in areas with sufficient moisture levels, minimizing energy consumption, and ensuring equitable water distribution [7-8]. Additionally, these systems often incorporate remote monitoring and control capabilities for enhanced adaptability. Scope of the Document: This document delves into the design and functionality of a comprehensive water management and pump control system. It explores the integration of moisture sensors, microcontrollers (such as the ESP32), servo motors, and relay systems to create an intelligent and responsive solution [9]. The discussion encompasses the components, operational principles, and the potential impact of such systems on sustainable water resource management [10]. In summary, the introduction establishes the critical need for efficient water management and introduces the concept of water pump control as a technological solution to address the challenges associated with water distribution. The subsequent sections will delve into the various components and functionalities of a sophisticated water management system, emphasizing the role of technology in achieving sustainable water use practices.

OPERATION

Power Supply The power supply provides electrical energy to the entire system. You mentioned a transformer that converts the input voltage from 220V to 12V, followed by a rectifier to convert AC to DC. Microcontroller (ESP32) The ESP32 serves as the brain of the system, connecting to the Blink software [11]. It receives input from various sensors, controls switches, and communicates with external devices. Switches and Lights Connected switches turn on when the power supply is given, and lights blink to indicate the system is active. This could be part of an initialization or status indication process [12]. Moisture Sensors Two moisture sensors provide readings based on soil moisture levels. If the soil is wet, a reading of zero is displayed; otherwise, a reading corresponding to the dryness level is shown. Valve Control (Servo Motor): A servo motor controls a valve by turning it left or right [13-14]. The servo motor is initially positioned at 90 degrees and can move to 70 degrees left or right, possibly controlling the flow of water through the valve. The Pump Valve and Relay pump valve is connected to a single-phase motor controlled by a relay[15].

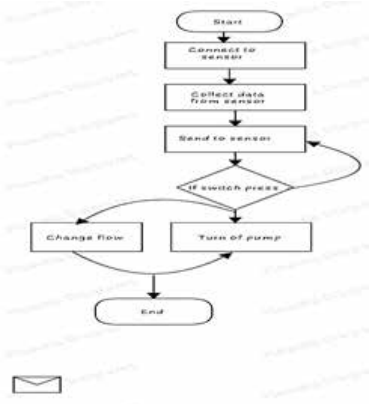

Fig 1- Block diagram of Water Control System

The relay is operated by the ESP32, and the pump valve is turned on or off accordingly. Power Conversion Components (Transformer, Rectifier, Capacitor, IC 7850): The transformer converts the voltage from 220V to 12V. The rectifier then converts AC to DC. The capacitor filters the DC signal, and the IC 7850 regulates the voltage to 5VAutomation Logic the ESP32 executes the automation logic based on sensor readings [16-17]. For example, if the moisture sensor detects dry soil, it may trigger the valve to allow water flow, and if the soil is wet, it may stop the pump valve. This system appears to be designed for automated irrigation based on soil moisture levels. The ESP32, with its ability to interface with sensors and control various components, plays a central role in making decisions and executing actions in response to environmental conditions [18]. Additionally, the use of the Blink software suggests remote monitoring and control capabilities.

SOFTWARE

The software used in Water Management and water pump control

Arduino IDE

Feature	C	C++
Paradigm	Procedural	Multi-paradigm
Object-oriented	No	Yes
Standard Library	C Standard Library, Small	Larger, C++ standard library
Memory Management	Manual	Manual and automated modes are supported.
Main Function	Required	Required

Auridon IDE

Feature	Description
Purpose	Development environment for Arduino programming
Supported Platforms	Windows, macOS, Linux
Programming Language	C/C++
Board Compatibility	Yes
Integrated Serial Monitor	Built-in
Extensibility	Custom libraries and tools can be created

COMPONENTS

Sensor Module

The sensor module incorporates a buck-boost converter, a Wi-Fi module, and a relay system, each serving a distinct function within the module.

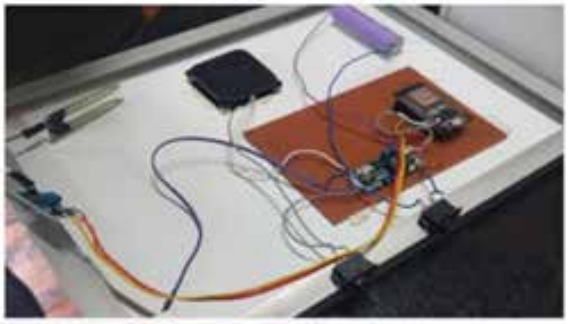

Fig.2 Sensor Module

The buck-boost converter is a versatile electronic component that generates a DC output voltage. This output can be greater or lesser than its DC input voltage, combining the step-down functionality of a buck converter with the step-up capabilities of a boost converter [19].

Wi-Fi modules or Wi-Fi microcontrollers enable wireless data transmission and reception over Wi-Fi networks. They can also process commands received via Wi-Fi, making them integral in communications between devices, particularly in the realm of the Internet of Things (IoT). The relay module's core purpose is to manage the switching of electrical devices or systems. It provides an interface that allows low-power control circuits, such as those found in microcontrollers, to operate high-voltage and high-current equipment safely [20]. Additionally, this sensor module is equipped with two switches connected to a solar panel. The first switch is dedicated to the solar panel itself, while the second is connected to the sensor. A jack is also provided, allowing the solar panel to be charged via a battery in the absence of solar energy, ensuring an uninterrupted power supply to the module [21]. A lithium-ion battery is utilized as the power source within the system, supplying energy to the sensor array, which includes an ESP moisture sensor. Lithium-ion batteries are chosen for their high energy density, rechargeability, and longevity, making them suitable for applications where compact and reliable power sources are required. The battery provides a stable voltage to the sensors, ensuring

they function effectively for monitoring moisture levels and other environmental parameters as needed

Valve Control Unit

The sensor module includes a relay system, a Wi-Fi module, and a buck-boost converter, each of which has a specific purpose inside the module. A flexible electrical component that produces a DC output voltage is the buck-boost converter. This output combines the step-up and step-down capabilities of a boost converter with the DC input voltage flexibility of a buck converter. Wireless data transmission and reception over Wi-Fi networks are made possible by Wi-Fi modules or Wi-Fi microcontrollers. They are essential to device communications, especially in the context of the Internet of Things (IoT), because they can also handle commands received through Wi-Fi. The management of electrical devices or system switching is the primary function of the relay module.

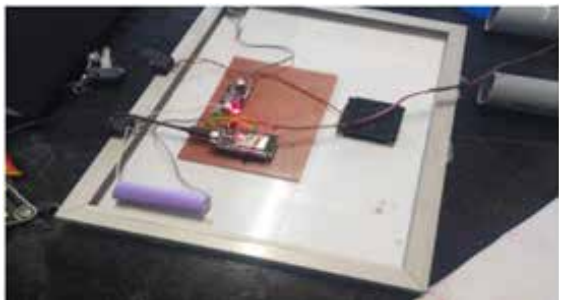

Fig. 3 Valve Control Unit

It gives low-power operation through its interface. In the valve control system, the configuration mirrors that of the sensor module, with the primary difference being the substitution of the moisture sensor with a servo motor. Servo motors are selected for this role due to their capability to provide precise control of angular position, velocity, and acceleration. They are equipped with a feedback mechanism, typically in the form of an encoder, which enables the system to adjust the motor's position to the desired angle as dictated by the control signal. The servo motor's role is to interpret the control signals sent by the controller and translate them into the specific angular displacement or angular velocity required at the motor's output shaft. This precise positioning is crucial in the operation of valves, which must be opened or closed to exact degrees to regulate the flow of fluids within the system accurately. The feedback system ensures that the valve reaches and maintains the correct position as conditions change or as per the controller's commands.

Relay Module

In the relay control system, a transformer is used to step down the voltage from 220V AC to 12V AC. This lower voltage AC is then fed into a rectifier, which converts it into DC. Following rectification, the current passes through a capacitor, which acts to filter out any impurities in the form of electrical noise or fluctuations, ensuring a smoother DC output. The cleaned DC is then routed to a voltage regulator. In this case, a 7805 IC is used, which is a common regulator IC that outputs a steady 5V DC [23].

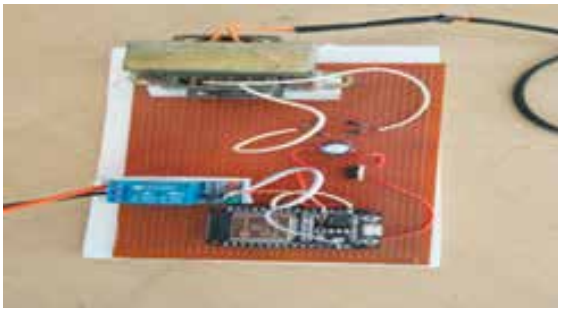

Fig 4 Relay Module

The regulated 5V DC is essential for powering sensitive electronics that require a stable power supply, such as the relay and the ESP module. The relay, which operates on the 5V supply, acts as an electrically operated switch. It can control the connection to the single-phase motor, turning it on or off based on the signals it receives from the ESP module or another control mechanism. The ESP module, which also receives the 5V power, can be programmed to send control signals to the relay based on various inputs, allowing for automated control of the motor. This setup is crucial for applications where the motor needs to be switched in response to certain conditions, such as in a home automation system or industrial control processes

Transformer

Indeed, a voltage transformer, sometimes referred to as a voltage converter, is a device that modifies a power source's electrical voltage to meet the voltage needs of a particular system or device. Voltage transformers come in two main varieties:

Step-Up Transformer: This sort of transformer is used to increase the voltage from a lower level (e.g., 110 volts) to a higher level (e.g., 220 or 240 volts). When a gadget needs a higher voltage than what the power source can provide, this is frequently utilized.

Fig. 5 Transformer

Step-Down Transformer: This kind of transformer lowers voltage from a higher voltage (240 or 220 volts, for example) to a lower voltage (110 or 120 volts, for example).

ESP 32

A family of low-cost, low-power system-on-chip (SoC) microcontrollers with built-in Bluetooth and Wi-Fi capabilities is called the ESP32. Es Press if Systems, a Chinese business that specializes in creating and producing Internet of Things (IoT) solutions, is the one developing it. The ESP32 is an improved version of the ESP8266, which it replaced.

Fig. 6 ESP 32

It has analog and digital pins Analog Pins are connected to analog connections and digital pins are connected to digital connections Some of the ESP32's primary features are: Dual-Core CPU: The ESP32 is more capable of handling sophisticated programs because of its dual-core CPU, which enables it to handle numerous tasks at once. Wi-Fi Connectivity: The ESP32 is appropriate for Internet of Things applications that need wireless connection because it has built-in Wi-Fi connectivity. Bluetooth Connectivity: The ESP32 has Bluetooth connectivity, including Bluetooth Low Energy (BLE), in addition to Wi-Fi. Because of this, it is adaptable to a wide range of uses, including those involving

Toggle Switches

Generally speaking, a switch for water management control refers to an apparatus that lets you regulate the water flow or availability in a system. For use in water management applications, a variety of switches and control mechanisms are available. Here are few instances: Float Switches: Float switches are frequently seen in sump pumps and water tanks. They are made up of a switch and a buoyant float. The float moves to activate or deactivate the switch in response to changes in the water level.

Fig. 7 Toggle Switches

Float switches are frequently employed for tank water level maintenance or pump control. Pressurization Switches: Water pumps are managed by pressure switches in reaction to variations in water pressure. As soon as the pressure falls below

Moisture Sensor

A moisture sensor is a device that measures the moisture content in a substance, typically soil or other materials. These sensors are commonly used in agriculture, gardening, and various industrial applications to monitor and control moisture levels.

Fig. 8 Moisture Sensor

Here are the key aspects of moisture sensors: Moisture sensors are typically inserted into the soil at the root level of plants. The depth of insertion depends on the

type of plants and their root structure. Some sensors are designed for surface-level placement, while others are buried in the soil. The goal is to obtain accurate readings representative of the moisture conditions surrounding the plant roots. Calibration is essential for accurate moisture measurements. The sensor's response to moisture can vary based on factors such as soil type, temperature, and sensor aging. Calibration ensures that the sensor readings are accurate and reliable. Moisture sensors contribute to more efficient water usage by providing real-time information about soil moisture conditions, helping users make informed decisions about irrigation and water management.

Li-ion Battery

A lithium-ion (Li-ion) battery is a type of rechargeable battery that has become widely popular for various electronic devices and electric vehicles due to its high energy density, relatively lightweight design, and the absence of the "memory effect" found in some other rechargeable battery chemistries.

Fig. 9 Li-Ion Battery

Servo Motor

Servo motors are commonly used in water management systems for their precision, control, and ability to perform specific movements based on feedback signals. Here are several reasons why servo motors might be employed in water management systems Precision Control Servo motors provide precise control over the position and speed of the motor shaft.

Fig. 10 Servo Motor

This level of precision is essential in water management systems where accurate control of valves, gates, or other mechanisms is required to regulate the flow of water. Feedback Mechanism Servo motors are often equipped with feedback devices such as encoders or resolvers. These devices provide real-time information about the motor's position, allowing for closed-loop control. In water management, feedback is crucial for ensuring that valves or gates are in the desired position, and adjustments can be made if there are deviations. Automation and Programmability Servo motors can be easily integrated into automated systems and controlled through programmable logic controllers (PLCs) or microcontrollers. This allows for the automation of various processes in water management, improving efficiency and reducing the need for manual intervention.

RESULT AND DISCUSSION

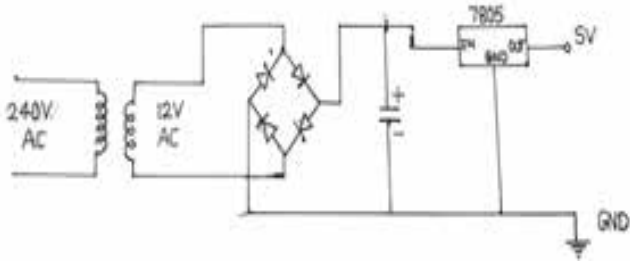

Fig.11 Circuit Diagram

Fig.12 Actual Model

The outputs of an effective water management and water pump control system is multifaceted and contribute to improved efficiency, sustainability, and resource conservation. Here are some key outputs and benefits: Optimized Water Distribution The system ensures that water is distributed efficiently based on real-time data from moisture sensors and other environmental parameters.

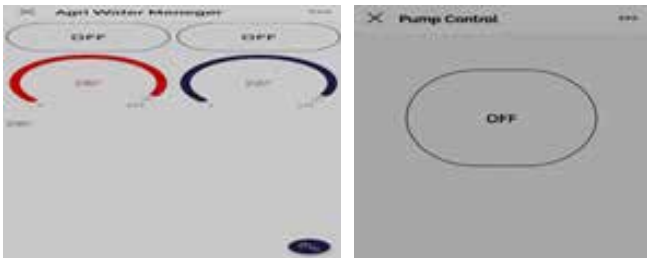

Fig 13 Reading of Moisture Sensor and Pump Control in off-condition

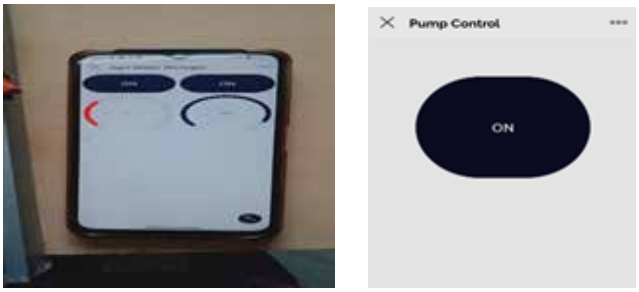

Fig.14 Reading of Moisture Sensor and Pump control in on condition

Fig. 15 Water Management and Pump Control System

This optimization prevents over-irrigation in areas with sufficient moisture levels, reducing water wastage. Precise Irrigation Practices With moisture sensors providing accurate readings, the water management system can implement precise irrigation practices. This targeted approach promotes healthier plant growth, maximizes water utilization, and minimizes the risk of waterlogging. Energy Efficiency Water pump control mechanisms, incorporating servo motors and intelligent relay systems, contribute to energy efficiency. Pumps operate only when necessary, reducing energy consumption and lowering operational costs. Resource Conservation The system actively contributes to the conservation of water resources. By preventing unnecessary water usage and optimizing distribution, it aligns with sustainable water management practices, addressing the challenges of water scarcity and environmental conservation. Remote Monitoring and Control: Integration with platforms like Blynk enables remote monitoring and control of the water management system. Users can access real-time data, receive alerts, and adjust settings remotely, enhancing convenience and adaptability. Data-Driven Decision-Making The system generates valuable data from various sensors and feedback mechanisms. This data becomes a powerful tool for data-driven decision-making, enabling users to make informed choices about water usage, irrigation schedules, and system adjustments. Reduced Operational Costs: By optimizing water distribution and pump operations, the system contributes to reduced operational costs. Efficient use of water resources and energy translates into financial Precise irrigation practices and moisture level monitoring contribute to improved soil health. Avoiding waterlogging and providing the right amount of moisture enhances soil structure, nutrient availability, and overall agricultural productivity. Resilience to Climate Variability The system's adaptability to changing environmental conditions, facilitated by advanced technologies, enhances resilience to climate variability. The system can adjust irrigation practices in response to shifts in temperature, precipitation, and other climate factors. Environmental Impact Mitigation: The overall impact on the environment is positive, with the system minimizing water wastage, reducing energy consumption, and promoting sustainable practices. This aligns with broader environmental goals and regulatory standards. Community Engagement:

Community engagement and awareness are potential outputs, as the system may include features for educating users about water conservation practices. This can foster a sense of responsibility and participation in sustainable water management.

In summary, the outputs of a well-designed water management and pump control system extend beyond immediate operational benefits. They encompass environmental stewardship, resource conservation, and the promotion of sustainable practices that contribute to a more resilient and responsible approach to water management.

CONCLUSIONS

As technology continues to evolve, the future of water management holds the promise of even more sophisticated and interconnected systems. Continued research and development in areas such as artificial intelligence, machine learning, and sensor technologies will likely contribute to further improvements in water efficiency and conservation. In conclusion, the collaborative efforts of researchers, engineers, and policymakers in advancing water management and pump control systems are critical for addressing the complex challenges posed by water scarcity and environmental changes. By embracing innovative solutions and leveraging technological advancements, societies can move towards a more resilient, adaptive, and sustainable approach to managing one of the Earth's most precious resources water.

The future scope of water management and water pump control holds immense potential for advancements and innovations that can further enhance efficiency, sustainability, and adaptability in the face of evolving challenges. Several key areas represent the future scope for these technologies: More connections can be made of sensors in the future if needed.

Programming for Sensor Module

```
#define BLYNK_TEMPLATE_ID "TMPL3e3CItFS_"
#define BLYNK_TEMPLATE_NAME "agri water meneger"
#define BLYNK_AUTH_TOKEN "QMLt4m7aellHowDnYw_mvGGMFM2FJoEr"
#define BLYNK_PRINT Serial
#include <WiFi.h>
 #include <ESP32Servo.h>
 int a;
Servo myservo;  // create servo object to control a servo
// 16 servo objects can be created on the ESP32
int pos = 0;    // variable to store the servo position
// Recommended PWM GPIO pins on the ESP32 include 2,4,12-19,21-23,25-27,32-33
int servoPin = 18;
#include <BlynkSimpleEsp32.h>
const int sensor_pin = 34;
const float sensitivity = 0.1;  // Sensitivity of the sensor in mV/g
const float displacement = 1.0; // Amplitude of vibration in mm

float c;
float t;
int v;
int relay = 5;
char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = "project";  // type your wifi name
char pass[] = "PROJECT@123";   // type your wifi password
BlynkTimer timer;
void sendSensor(){
float moisture_percentage;
  int sensor_analog;
  sensor_analog = analogRead(sensor_pin);
          moisture_percentage = (100-((sensor_analog/1023.00)*-100));
  Serial.println("Moisture Percentage = ");
  Serial.println(moisture_percentage-290);
    Blynk.virtualWrite(V1, moisture_percentage-265);
}
void setup()
{  ESP32PWM::allocateTimer(0);
          ESP32PWM::allocateTimer(1);
          ESP32PWM::allocateTimer(2);
          ESP32PWM::allocateTimer(3);
          myservo.setPeriodHertz(50);      // standard 50 hz servo
          myservo.attach(servoPin, 500, 2400); // attaches the servo on pin 18 to the servo object
          // using default min/max of 1000us and 2000us
          // different servos may require different min/max settings
          // for an accurate 0 to 180 sweep
a=0;
  Serial.begin(115200);
```

```
  Blynk.begin(auth, ssid, pass);
  timer.setInterval(100L, sendSensor);
pinMode(18, OUTPUT);}
void loop()
{
  Blynk.run();
     timer.run();
 }
```

Programming for Valve Control Unit

```
#define BLYNK_TEMPLATE_ID “TMPL3e3CItFS_”
#define BLYNK_TEMPLATE_NAME “agri water meneger”
#define BLYNK_AUTH_TOKEN “QMLt4m7aellHowDnYw_mvGGMFM2FJoEr”
#define BLYNK_PRINT Serial
#include <WiFi.h>
 #include <ESP32Servo.h>
 int a;
 int b;
Servo myservo;  // create servo object to control a servo
// 16 servo objects can be created on the ESP32
int pos = 0;    // variable to store the servo position
// Recommended PWM GPIO pins on the ESP32 include 2,4,12-19,21-23,25-27,32-33
int servoPin = 18;
#include <BlynkSimpleEsp32.h>
const int sensor_pin = 34;
const float sensitivity = 0.1;  // Sensitivity of the sensor in mV/g
const float displacement = 1.0; // Amplitude of vibration in mm
float c;
float t;
int v;
int relay = 5;
char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = “project”;  // type your wifi name
char pass[] = “PROJECT@123”;   // type your wifi password
BlynkTimer timer;
void sendSensor(){
  }
BLYNK_WRITE(V4)
{
  int value = param.asInt();
  Serial.println(value);
  if (value == 1)
  {
myservo.write(115);
 Serial.println(“value1”);
  }
  if (value == 0)
  {myservo.write(95);
  }
}
BLYNK_WRITE(V3)
{
  int value = param.asInt();
  Serial.println(value);
  if (value == 1)
  {
   myservo.write(72);  Serial.println(“2”);
  }
  if (value == 0)
  {myservo.write(95);
  }

}
void setup()
{   ESP32PWM::allocateTimer(0);
        ESP32PWM::allocateTimer(1);
        ESP32PWM::allocateTimer(2);
        ESP32PWM::allocateTimer(3);
        myservo.setPeriodHertz(50);      // standard 50 hz servo
        myservo.attach(servoPin, 500, 2400); // attaches the servo on pin 18 to the servo object
        // using default min/max of 1000us and 2000us
```

```
        // different servos may require different min/
max settings
        // for an accurate 0 to 180 sweep
a=0;
b=0;
myservo.write(95);
 Serial.begin(115200);
 Blynk.begin(auth, ssid, pass);
 timer.setInterval(100L, sendSensor);
}
void loop()
{
 Blynk.run();
    timer.run();
}
```

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Hexapod Robot for Efficient and Precise Pipe Inspection

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ABSTRACT

In today's fast-changing engineering environment, professionals are continuously confronted with the difficulty of translating revolutionary concepts and ideas into practical, practical solutions. One significant issue that shows this dilemma is the examination of large gas pipelines that vary in size and span huge distances. Researchers have made tremendous progress in tackling this difficult issue by building a revolutionary robot with active pipe-diameter adaption and autonomous traction force modification capabilities. This amazing robot has a creatively built exterior featuring three distinct sets of parallelogram wheels and foot motions precisely placed at arranged in a 120° interval. This clever design allows the robot to adapt to changing pipe widths while maintaining appropriate tractive pressure thresholds. The robot glides expertly through pipelines ranging in size between 15.748 inches to 23.62 inches, thanks to innovative mechanical designs and cutting-edge control algorithms. The cutting-edge robot, as a small carrier, has transformed pipeline inspection by simplifying visual examination and non-destructive evaluation of numerous aspects such as blockages, corrosion, fractures, flaws, and wall thicknesses; greatly increasing the inspecting range by more than 1000 meters. This revolutionary device is equipped with an array of advanced technology, such as a camera with a high-resolution module for continuous surveillance of pipeline conditions, an MQ-3 gas sensor to identify leaks, and the application of red-oxide sealing for improved performance. Field trials in genuine underground gas pipes demonstrate the robot's excellent pipe-size adaption and moving force adjustment capabilities, as well as the correctness of its theoretical analysis. Finally, this ground-breaking prototype promises to significantly improve security and productivity levels in underground environments, representing a significant step forward in developing engineering techniques across numerous industries.

KEYWORDS *: Pipe inspection robot, Active adaption of pipe diameter, Motion force, Gas pipelines, MQ gas sensor, Red oxide spraying system, Metal Detector.*

INTRODUCTION

This study offers a pioneering six-legged pipe inspection robot with an unusual flexible pipe diameter feature to efficiently meet the issues related to pipe inspection and maintenance [1]. Unlike many typical pipe inspection models, such cutting-edge robot successfully addresses the majority of the problems observed in its predecessors. The six-legged pipe inspection robot, which is equipped with an innovative wireless camera, can display crisp images from within the pipes, enabling a more accurate diagnosis of internal rust development [2]. To battle rust effectively, red oxide spraying is included in the robot's function, which immediately sprays red oxide on problematic regions and inhibits future rust expansion or damage. Furthermore, the robot has a novel leakage prevention system that employs a chemical solution that solidifies on application, successfully sealing any leaking locations with the assistance of a motorized sprayer. Because all activities are skilfully handled by the robot via remote direction by an operator, this smart technology removes the necessity for human involvement inside pipes for inspection reasons [3]. The robot not only identifies and controls rust and leakage issues, but it also provides crucial data about the status of the pipe, including photographs and videos. Revealed in a study that robotic crawlers have tremendous promise for interior inspection and non-destructive testing in

various processing facilities. This innovative six-legged pipe inspection robot model's continual testing and advancements promise to alter the industry's method for pipeline inspection and maintenance. Phases [4-5].

[6]This study offers a revolutionary leak detection system for water pipelines that addresses earlier approaches' drawbacks. It displays a prototype tested at a manufacturing plant with a 52mm inner diameter pipeline and provides a way to detect true leaks from false alarms. [7]

The research describes a novel approach for checking the inner circumferential of plant process pipes for flaws that include corrosion and cracking. It discusses the design and installation of an automated arm with changeable tractive force for use in longer, varying-diameter pipelines [8-9]. The study details the construction, control circuitry, and field trials, emphasizing the robot's capacity to undertake visual examinations and non-destructive testing to detect pipeline faults [10].

The research focuses on employing visual serving to improve the maneuvering of flying robots. It proposes the FLADRC system (Fuzzy Adaptive Linear Active Disturbance Rejection Control) to solve concerns such as delayed reaction and weak interference resistance. The research also proposes a rapid connectivity visual positioning algorithm and compares FLADRC's performance in simulated studies with other control approaches.[11]

OPERATION

The pipe inspection robot, a game-changing breakthrough in the field of pipe servicing, is meticulously developed and manufactured. The camera, a device that is mounted for the main reason of performing inspections, is the major element of this robot. With its high resolution, this camera gives a clear view of possible risks such as cracks, impediments, defects, corrosion, and holes.

An additional feature for non-insulated pipelines is the setting up of a fluorescent light on the pipe's inspection robot. This light has two functions: it illuminates the inside of the pipe and assists in the identification of damage. If a pipe is fractured as well as holed, the light's beam might escape via the crack, highlighting the damaged areas.

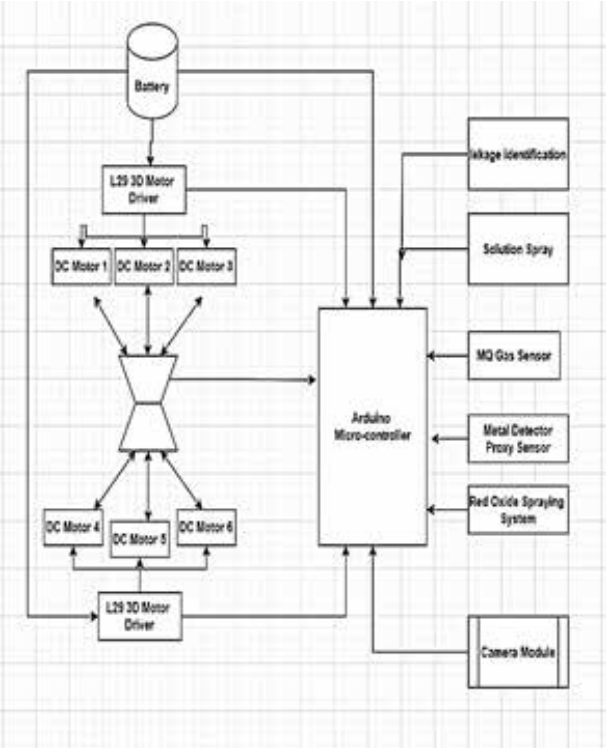

Fig. 1- Block diagram of Six-leg pipe inspection robot

The robot is outfitted with 3 springs, each of which serves a distinct purpose. Two of those springs are positioned on both the front and rear of the robot, giving all six arms a tight hold. This keeps the robot stable and keeps it from sliding within the pipe. The third spring, placed in the center [13], gives the robot the flexibility it requires to traverse tight twists inside the pipe. The pipe inspection robot's operation is simple and user-friendly. It is operated via the wired remote, which allows for precision control and mobility.

A wireless webcam with a battery bank is also linked to the robot. This configuration directs a clear view within the pipe to a handheld gadget, providing real-time visual input during the examination process. Technology has enormous potential for advancement. Future incarnations of the robot might not only identify but also remedy a variety of pipe maintenance concerns [12]. Among the possible uses are fracture detection and gas leak detection. As a result, pipe inspection robots represent a substantial advancement in the realm of pipe maintenance, providing both better efficiency and safety.

SOFTWARE

The software used in the six-leg robot for pipe inspection is listed below:

Table 1: C and C++

Feature	C	C++
Paradigm	Procedural	Multi-paradigm
Object-oriented	No	Yes
Standard Library	C Standard Library, Small	Larger, C++ standard library
Memory Management	Manual	Manual and automated modes are supported.
Main Function	Required	Required

Table 2: Auridon IDE

Feature	Description
Purpose	Development environment for Arduino programming
Supported Platforms	Windows, macOS, Linux
Programming Language	C/C++
Board Compatibility	Yes
Integrated Serial Monitor	Built-in
Extensibility	Custom libraries and tools can be created

COMPONENTS

Camera Module

C Standard, Small Wireless cameras are transmitters that use wireless technology to broadcast camera signals. Figure 3 depicts each component individually. The signal passes through the camera and its receiving device after being connected to a wirelessly transmitter. It works similarly to a radio. Wireless cameras are assigned a channel. As the receiver's channel is selected, the image is taken. The wireless camera image is delivered by the transmitter and gathered and displayed on a computing device/television monitor by the receiver, based on the type of receiver library.

Fig. 2. Camera Module

- Input Volt (Volt) = 5
- Serial Peripheral Interface flash = 32 Mbit
- Random-access memory=4MB PSRAM plus 520KB SRAM
- Bluetooth = Version 4.2 BR/EDR & BLE Specification
- Wi-Fi = 802.11 b/g/n
- UART Baud-rate = 14400 Bps
- Frequency Range = 2412 to 2484 MHz

Metal Detector

A metal detector generates the electric current (AC) magnetic field, often in the 10 to 15 kHz range, using a transmitter coil. The surrounding search coil detects magnetic field perturbations generated by metal objects. A tiny current is generated whenever a metal component crosses the search coil's field. This current is then picked up by the receiver coil and transformed into in two ways a signal with sound or a display that is visible.

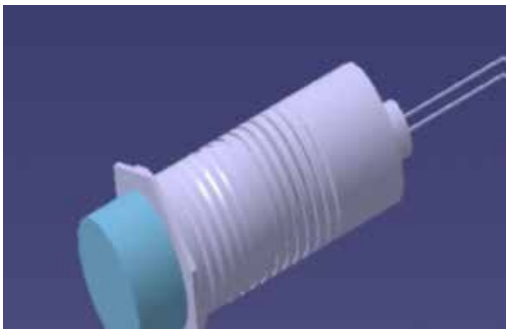

Fig.3 Metal Detector

The signal strength reveals the size and kind of metal item. The metal detector's display directs the user to the position of the detected metal. Some detectors also display information about the metal found. Metal detectors are available for a variety of uses, including general usage, silver or gold detection, coin detection, and archaeological investigations. Each type is built with unique attributes to maximize productivity for its intended use.

Table 3: Metal Detector

Model type	Range RM18-3008 NA
Voltage of operation	6.36 VDC
Sensing Distance	8 mm
Size of the outer thread	M18
Type of object	Inductive
Type of Output	NPN Normally Opens three-line
Type of installation	Unshielded
Max Output Current	20mA
Distance of setting	0-5.6 mm
Resistance of insulation	50 MΩ
Operating Temp	-25°C-70°C
Weight	100gm

DC motor for the rotation of the camera

An electric motor drives nearly all of the mechanical movements we see in our environment. Electric equipment can transform energy. Motors convert electrical energy into mechanical energy. Hundreds of gadgets driven by electric motors are essential to our everyday lives. Motors come in a variety of sizes. Powerful motors with numerous horsepower in capacity for load are widespread in the industry. Metal rolling mills, e-transports, hoists, and elevators are just a few examples of large motor applications. Handheld power instruments, food blenders, vehicles, and robotics are all examples of motor applications [14]. There are several medical applications for micro machinery, that are electrically powered with parts that are the dimension of red blood cells. In this example, three DC motors are used: for continuous pipe movement, one for gripping (i.e., vice), and to drive the cutter blade. The qualities are as follows: RPM = 10 revolutions per minute DC motor of 12 v [15].

Wheels

A wheel is a technological device that spins across an axle bearing. The wheel is a critical component of the wheel & and axle, being one of six essential machines. Massive things may be moved with ease when wheels and axles operate together, which renders them faster to be transported or move whether carrying a cargo or running machinery. Flywheels, potters' wheels, and steering wheels are among more used for wheels. Six rubberized wheels are used here for better traction.

Toggle Switches

Toggle switches are simple electrical devices that is utilized in a variety of applications, including industrial machinery and automobiles. To power gadgets, toggle switches that regulate electricity are employed. A toggle switch can be as basic as a single-pole single-throw (SPST) or as complex as a double-pole double-throw (DPDT). The intricacy of these switches ranges from simple toggle switches to industrialized toggle switches. It may be beneficial to become acquainted with the foundations of toggle switches to understand the electric toggle switch type required for your unique machine. [16].

Arduino

Arduino Uno is a microcontroller based on ATmeg328 that includes six analog inputs, fourteen digital I/O pins (six of which are used as PWM results), a button to reset it, a header for ICSP, a connector for power, a USB connection, as well as a 16 MHz ceramics resonator.

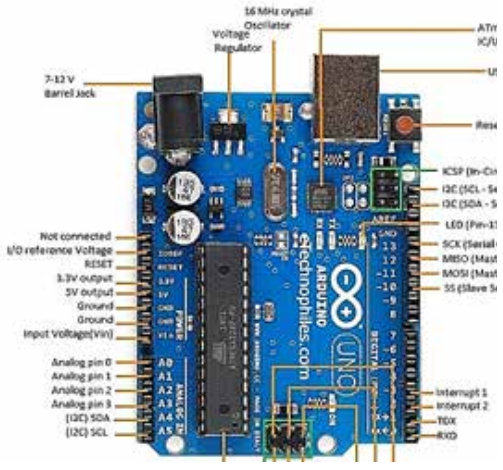

Fig. 4 Arduino Uno

MQ3 Gas Sensor

Fig. 5: MQ3 Gas Sensor

The MQ3 Gas Sensor creates an analog voltage based on its observations of the concentration of gases in the air. can detect concentration levels up to 0.04 mg/L up to 4 mg/L. Sensors function in the -10 to 50°C temperature range and use a maximum of 150 mA on 5 V.

To keep the sensor's heating (H) pins hot enough for proper functioning, five volts are placed across them. The sensor creates a voltage that is analogous to the other pins if its A or B ports are connected to five volts. By connecting the output pins of the detector

The detector's sensitivity may be altered by connecting ground and a resistive load in series. The resistor is a nice place to start, but you should utilize a datasheet's calculations to discover the amount of resistance that's best for your application. The following constitute the MQ3 Alcoholic Gas Sensor specifications:

Extremely gas sensitive, long lifespan, or low cost. The basic driving mechanism technical data on the MQ3 alcohol gas sensor:

- Gas Identification: The concentration ranges from 0.4% and 4% of a Litter.
- 24 V supply voltage
- 1.5V 0.1V (Lower), 5.0V 0.2V (the high) heater voltage
- Adaptable resistance for loading
- Heater resistance: 31 3
- Heater power requirement: below 900 Mw

RED OXIDE SPRAYING

Red oxide is sprayed on a surface using a red oxide-containing primer or paint. Red oxide primer is a popular rust-inhibiting coating used to protect metal surfaces against corrosion. It contains iron oxide, which causes rust, together with other components that prevent rust from growing and spreading on metal surfaces. Red oxide primer, as the name suggests, is often red or reddish-brown in colour [17].

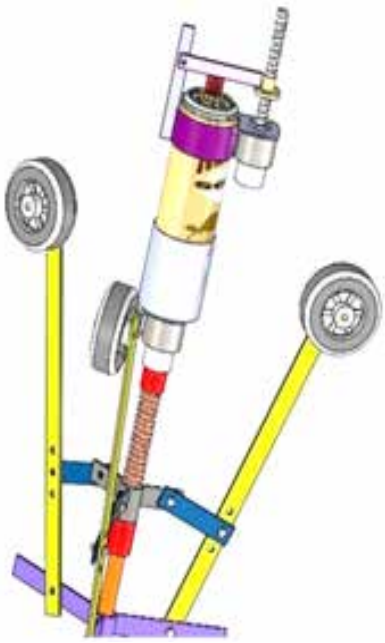

Fig. 6. Red oxide spraying

Multiple Coats: Depending on the condition of the surface and the instructions on the packaging, you may need to apply more than one coat of red oxide primer. Allow the previous coat to dry fully before applying the next. In general, you should wait a minimum of twenty-four hours between coats. Cleaning: Use the appropriate solvent to gently clean the spray apparatus after spraying, as instructed in the product's instructions[18]. Trash should be disposed of per municipal regulations. Cleaning: After spraying, use a suitable solvent to carefully clean the spray device, as directed by the product's instructions. Trash should be properly disposed of in conformity with local ordinances.

DESIGN OF WALKING MACHINE

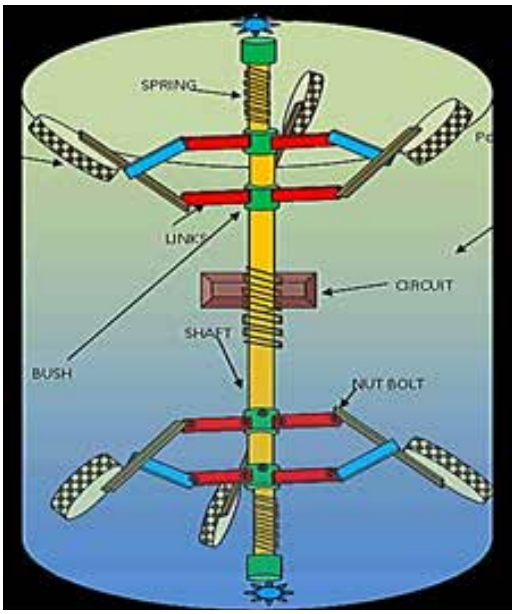

Fig.7. Six Leg Pipe Inspection Robots

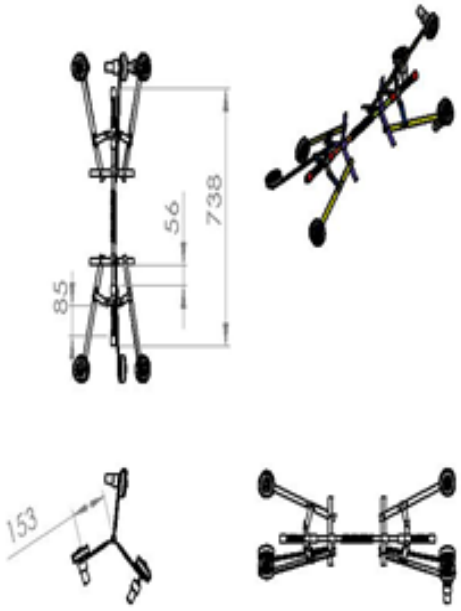

Fig. 8 Six-robot

Central Frame

The principal frame bar, which holds the attachments of all the key elements, such as the translational part, front-end and back connections, and rear-end linkages, is the distinguishing feature of a central frame. It functions as the core stem for the whole robot body as well as the main support backbone of the inspection robot. The final phase once the metal framework is built is buffing. The illustration depicts the structure.

Translation Element

To regulate fuel flow, governor systems in autos usually use the sleeve, a critical translational component. A pipe inspection robot's sleeve functions differently because it employs a compression spring to adjust the linkage length based on pipe diameter.

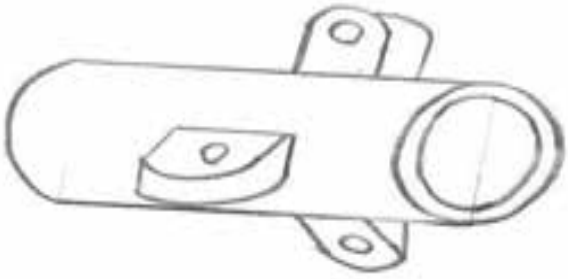

Fig.9. Sleeve of Six-Leg Pipe Inspection Robot

Helical Spring and linkage

To regulate fuel flow, governor systems in autos usually use the sleeve, a critical translational component. A pipe inspection robot's sleeve functions differently because it employs a compression spring to adjust the linkage length To regulate the translation of the sleeve, several spring materials are employed; the type of spring used is determined by parameters such as surroundings, resistance to shock, and durability requirements [19]. For specialized applications, high-carbon metals such as steel, aluminum alloy metals, stainless steels, copper-base alloys, nickel-base metal alloys, and non-ferrous materials such as titanium, phosphor bronze, & beryllium copper are available. To connect the joints, linkages are provided on pipe diameter.

CALCULATIONS

Design of motor

Motor Power (P)= 10 Nm/s

Motor Rpm (N)= 10 rpm

Torque and Final speed calculations

$P = (2*\pi*N*T) / 60$

$10 = (2*\pi*N*T) / 60$

T = 9.55 N/m

T = 9549 N/mm.

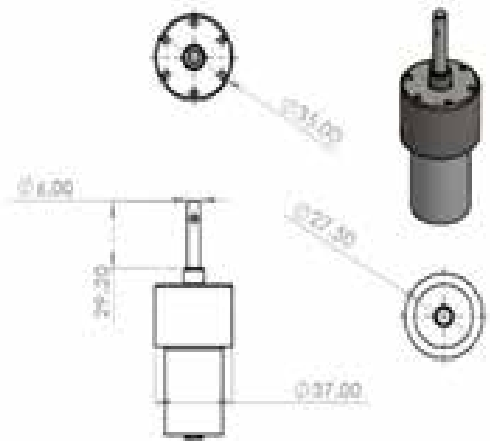

Fig. 10 Motor Size

Three motors yield a combined torque of 28,644 N-mm. With a 40% motor efficiency, the resultant power output is 11,457 N-mm.

Force generated by robot wheel

Transmitted Torque

T = Force × Robot Wheel Radius

11,457 = F × 37.5

F = (305.6 N)

F = (305.6 N) / 9.81

F = 31.15 Kg

F is the force generated by the robot.

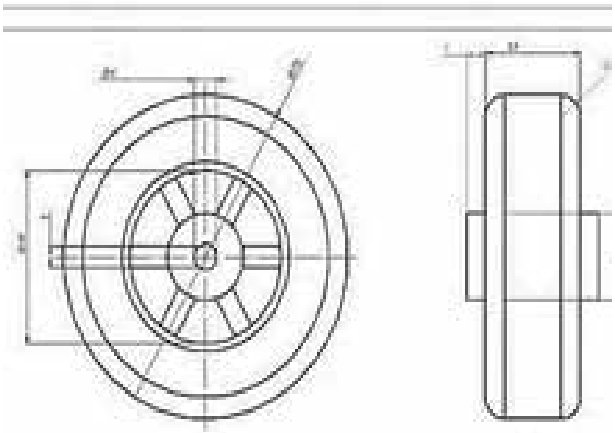

Fig.11 Wheel Size

Gripping force generated by spring. For gripping pipe

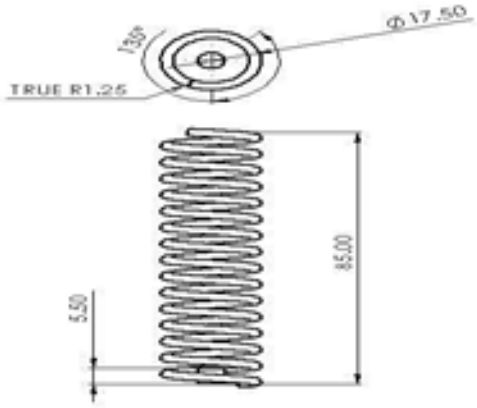

Fig. 12 Spring Dimension

Spring expands three robot legs upward to grip a pipe surface. Through trial and error, a spring with a 15 mm inner diameter is chosen to fit within the shaft size constraints.

Din = 15 mm

For a life of 42.0 N / mm².

Wire's diameter ranging(d) 2.5 mm

Mean diameter (D) = 17.5 mm

Spring's outer diameter (Dout) = Din+(2.5*2.5)

Dout = 20 m m.

Spring's load-bearing capacity

Spring's index = C = D/d = 17.5 ÷2.5= 7.0

C = 7.0

K = [(4C – 1) /(4C-4)]- (0.615 / C)= 0.51/7

K = 0.070

For

C = 7 K= 0.070

Now to find 'P',

Shear stress = (8 K P Dout)/3.14 d3

P = {[42*3.14*(2.53)]/(8*0.07*20)}

P = 184.0 N

P = 18.75 = 18.7 kg

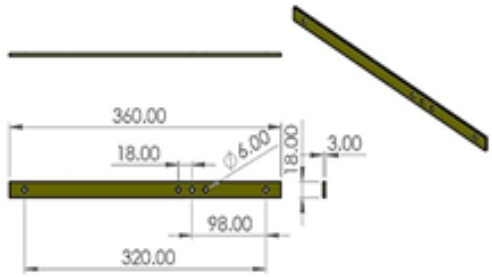

Fig.13 Arm Size

To accommodate a weight limit of 20 kg, two springs, each exerting a force of 184.0 N (18.70 kg), are employed.

Equilibrium equations

F1 * L1 = F2 * L2

F1 * 320 = 18.7 * 98

F1 = 1832.6 ÷320 = 5.57 kg

Due to the use of three arms, and spring load on each one arms is 1.90 kg = 18.70 N.

Pipe inspection robot's speed

V= (π*D*N)/60

V = 3.142*0.075*10 ÷ 60

V = 0.039 m-s

1 m-s = 3.60 km / hr

So,

V = 0.14 km / hr

Design of a robot wheel motor shaft that may break due to a combination of twisting and bending

Weight of shaft in total

W=1.9 kg= 18.7 N

M= F*L

M= 18.7 * 20 =374.72 N/mm

Te= √M2+T2= √374.722+95492

Te=9555.3 N-mm

Te=π/16 x135xd3

d= 7 mm

The motor is safe as the shaft of the motor is 8mm.

Design arm which may fail under bending

t = Arms thickness in mm

Fb = 270.0 N-mm2

B = Arm width(mm) =

B = 3 mm

The load is acting like a cantilever.

W = max force

M = W*L

M = 18.7 * 360 = 6732 N/mm

Section modulus = Z = 1/6*b*h2

Z = (1/6) * 3 *182

Z = 162.0 mm3.

As,

Fb = M / Z

Fb= 6732/ 162

Fb= 41.55 N / mm2

Because the induced stress is less than the allowed limit (270 N/mm2), the design is safe.

Design of bolt

The bolt must be firmly tightened and must withstand rotational loads. The stress for C-45 steel is of 420 kg/ cm^2.

The standard nominal diameter of the bolt is 4 mm. According to the table design data book, the diameter of an M-6 bolt is 5 mm.

Let us check the strength: -

Initial tension after fully tightening the bolt.

P = 18.4 N is the value of force

P = 18.4 N

Also, P = π /4 dc2x σ

σ = (18.4 x 4/314 x (4)2 73.6/50.2 = 1.46 N / mm2

The calculated σ is less than the σ tensile and σ shear hence our design is safe.

RESULT AND OUTPUT

Its 6-legged pipe inspection robot has six DC motors and drives to allow flexible movement throughout pipes for varied diameters. It can investigate pipes since it is equipped with a camera module, a metallic detection proximity sensor, and an MQ gas sensor.

Under certain circumstances, identify metal content, and detect gas leaks. When a leak is identified, the robotic device may apply a red oxide chemical to combat rust. It may also use a PU coating to prevent leaks in a variety of scenarios. The robot can identify problems such as corrosion, leaking, and fractures and provides treatments including red oxide spraying as well as PU solutions treatment.

Fig.14- Six Leg Robot

A metal detector is provided to differentiate between PVC and metallic pipes. For illustrative reasons, a 300-millimeter diameter coated with powder sheet plastic pipe with rubber footpads is used, while high friction footpads might be required in practical use. At the start, the spring-loaded arms are half-extended.

The robot is put through a pace test, which involves timing its progress over a predetermined distance. Turning slows you down by half, leading to an average speed ranging from 0.6 - 0.79 m/min. Pipes required illumination & and cameras to identify holes from the outside, compared to mobile devices where fractures are immediately evident.

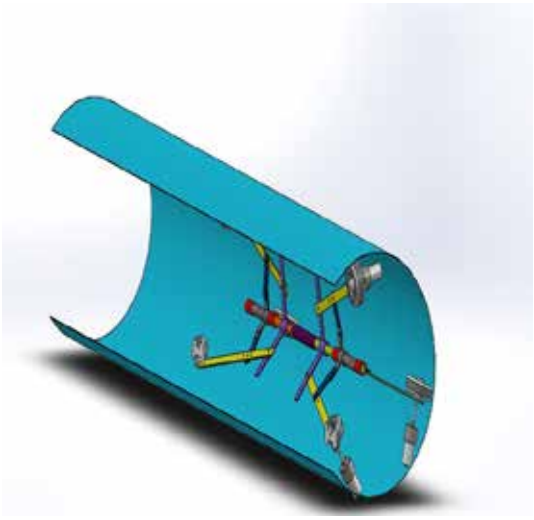

Fig. 15 Six-leg robot and spraying mechanism.

CONCLUSIONS

A pipe inspection robot's design and construction have been demonstrated successfully. The test camera functions admirably, providing a clear view of any cracks, obstructions, defects, corrosion, or holes. When an LED light is attached to a non-insulated pipe onto a pipe examination robot, the beam of light shines through any cuts and fractures in the pipe, displaying the damaged regions. Three springs are connected to the robot and function appropriately. Both of them spring to the machine's sides giving a firm grip for each of the six robot arms.

This robot can navigate pipes with diameters between 300 to 500 mm. The red oxide sprayer functions as predicted, spraying red oxide over the area of harm to prevent further rust damage within the pipe. The leak prevention/stoppage sprayer also functions well, spraying a leak avoidance spray on the area where the leaking is taking place. Under this scenario, the pipe inspection robot represents a wed(wireless) camera allowing visual pipe inspection. More progress is now conceivable, allowing a robot to identify and address a wide range of pipe maintenance concerns. Gas detection, underwater welding process, fracture detection, as well as other techniques are among them.

Pipe improvements can be accomplished in a variety of ways, depending on whether conditions have altered since the last inspection. Use the spinning root-cutting blade linked with a segmented rotating chain to

clean it, or spray chemical foam to prevent new root development. if only minor damage is discovered, these sites might be dug and then repaired. By coating the pipe using a textile liner comprised of an inflated or chemically stiffened material after it has been passed through the pipe. In severe circumstances, excavation or replacement of a pipe with more modern materials may be required. If this robot is equipped with the requisite sensors, pipe form recognition might be one of its uses.

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Improving the Energy Efficiency of HVDC Grids by Implementing Approaches to Current Flow Control

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ABSTRACT

The escalating global demand for energy and the widespread integration of RES have reshaped the requisites of modern electricity grids. Modern grids must change to accommodate the transition to sustainable energy systems. HVDC technology emerges as a key facilitator for this transformation, offering advantages over traditional AC systems. However, the absence of strong and dependable safety mechanisms for DC fault clearance poses a significant obstacle to the implementation of HVDC grids.

The primary challenge associated with the VSC-HVDC system is the vulnerability to SC faults, which can result in damage to both the converter valves and the line network. Additionally, the existing DC breakers suffer from prolonged fault-clearing times, rendering them insufficiently fast and reliable for providing adequate protection on multi-terminal networks. To overcome these challenges, the integration of CFCs with a hybrid DC circuit breaker proves essential. This innovative approach aims to enhance the overall performance and resilience of the HVDC system, ensuring effective management of power flows and robust protection against DC faults.

KEYWORDS *: VSC, DC circuit protector, CFCs, HVDC grid.*

INTRODUCTION

HVDC systems have developed quickly in the past several years, and the number of HVDC projects worldwide has significantly increased. This increase is indicative of a resurgence of interest in VSC-HVDC technology. Concurrently, the effectiveness of MT-HVDC networks is growing increasingly when considering future power systems. It is anticipated that the networks will make it easier for electricity grids to incorporate large-scale renewable energy generation, allowing for cross-border energy trade. Currently, two MT-VSC-HVDC systems are operational: the 3-terminal Nano HVDC system and the five-terminal Zhou Shan network. Additionally, various alternative DC grid configurations have been recommended to outline the potential architecture of an upcoming European grid Meshed HVDC (MHVDC) networks face difficulties in managing power flows in addition to protection concerns, especially when they take on the intricate structure of MT-HVDC grids [6] [7]. Furthermore, there are several ways for current to flow between various nodes. CFCs are integrated with DCCB to address these issues.

CFCs are essential in meshed grids to prevent cable currents from overloading. In a meshed circuit, there are two main approaches to control current flow: modifying branch resistances and introducing a voltage source. Among various topologies, CFCs relying on de-de converters offer superior flexibility without the requirement for isolation transformers, distinguishing them from AC converter conversions. DCCB, on the other hand, functions when the power electronics path permits mechanical breakers to swiftly interrupt the DC and are crucial for protection against DC failures.

Fault protection and CFC functions can be combined into one cohesive system, as they currently exist as distinct functions. The coordination of CFCs in the design of a hybrid DC circuit breaker is examined in this work, with an emphasis on PHCBs (Proactive Hybrid

Circuit Breakers), particularly those that incorporate a load commutation switch (LCS). Power electronics components need to remain consistently linked to the DC power-carrying line for the proper functioning of the hybrid DCCB and CFC. The configuration of the converter (de-de), comprising two half-bridge converters connected to capacitors, with each half-bridge in series with the DC line, dictates the control and functioning of CFCs. Subsequently, a detailed examination of integrating DCCBs into CFCs is presented, offering insights into the two systems under investigation in this study.

THE PHYSICAL HYBRID CIRCUIT BREAKER (PHCB)

The primary, secondary, and energy-absorption branches make up the PHCB. The main branch has a mechanical switch (UFO) and a small set of semiconductor switches called the LCS. The secondary branch, on the other hand, has a considerable selection of semiconductor switches [1] [2]. The secondary branch, which is in charge of current-limiting functions in this architecture, is closely linked with the energy absorption branch.

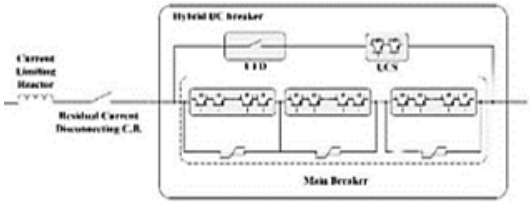

Fig. 1 PHCB

An essential part of the PHCB is the LCS, which diverts current from the mechanical switch and directs it into a circuit breaker that resembles a semiconductor [3]. Fig. 1 [13] analyzes and shows how to use and regulate this circuit breaker; further, more precise information is provided in [14] The concept of operation of the PHCB is illustrated in Fig. 1. Figure 2(a). When the current rises by 20% above the standard threshold, the system goes into fault case mode. The turn-off signal for the LCS is then recommended after a specific period. The current flow across the LCS during a transient fault is depicted in Fig. 2(b). [16]. Furthermore, research has been done on the design of alternative circuit breakers that are made up of comparable switches or LCSs [17-18].

Operation of PHCB

Fig. 2 depicts the PHCB working principle. As shown in Fig. 2(a), the IL normally travels via the UFD & the LCS. When the current is above the standard threshold by 20%, the system enters fault case mode. The LCS's turn-off signal is then suggested following a predetermined amount of time. The current flow during a short-lived fault across the LCS is as seen in Fig. 2(b).

The UFD disengages the LCS on one side and reroutes the current to the main breaker path immediately upon the LCS tripping. At this point, the current can be disconnected from the fault current using the main breaker [8–9]. Fig. 2(c) shows the current flowing via the route of the primary breaker. Lastly, the arrester linked in parallel across the main breaker dissipates the energy produced during the fault, as seen in Fig. 2(d).

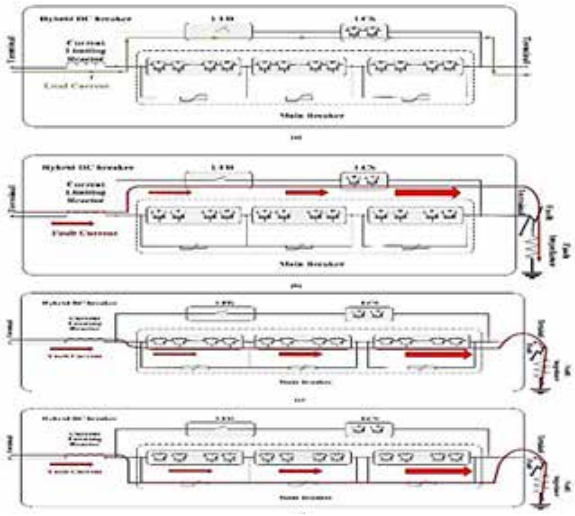

Fig.2 Protective HCB Operational

To reduce the amount of current that flows through the lines during faults, a reactor is connected in series with the main breaker and LCS.

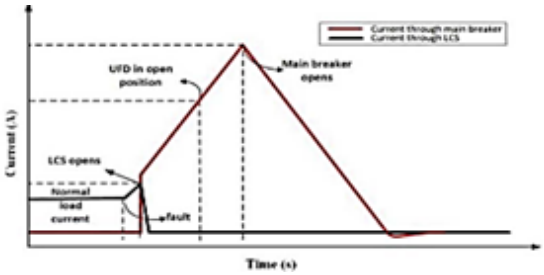

Fig. 3 I Control sequence of Proactive HCB

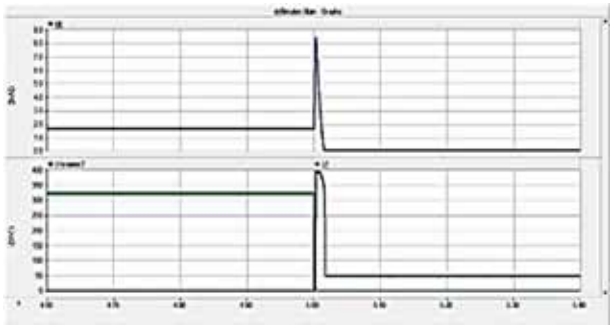

Fig. 4 Proactive HCB I and V O/p

Fig. 5 PHCB MB o/p

Fig. 3 [19] shows how the PHCB's control current flows. Fig 4 displays the PHCB's output voltage and current at 1.8 kA and 320 kV, respectively, while Fig. 5 displays the PHCB's MB output.

CURRENT FLOW CONTROLLER (CFC)

Fig. 6 shows the CFC diagram. The CFC is composed of eight different IGBT switches. A description of the CFC topology used in this work may be found in [12]. In essence, the CFC creates different voltage sources and keeps the line from overloading by removing power from one line to other. By circulating the DC along the lines of the HVDC grid, this process efficiently modifies the DC.

Table 1. Alternate CFC States

Mode	Higher Current	Current Direction	Switching States							
			Sa1	Sa2	Sb1	Sb2	Sc1	Sc2	Sd1	Sd2
1	I1	Forward	0	0	0	1	PWM	PWM	0	0
2	I2	Forward	0	0	1	0	PWM	PWM	0	0
3	I3	Reverse	PWM	PWM	0	0	0	0	0	1
4	I4	Reverse	PWM	PWM	0	0	0	0	1	0

In table I the input current is shown as "i," and the 2 branch currents are shown as "i" and "i z," that is, i, i", i z > 0. There are 4 modes of operation available to the CFC as it only regulates two wires (currents). First, two forward modes occur when currents flow out of the CFC in a forward direction, and two reverse modes occur when currents flow into the CFC in a reverse direction, where "0" indicates that the switch is in the off position and "1" indicates that the switch is on.

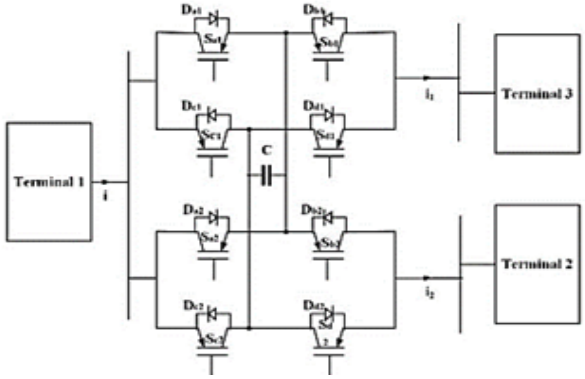

Fig.6. H-Bridge Dual CFC Topology

Computational Modeling of CFC

The CFC is capable of efficiently controlling cable current by combining certain switch states from Table I [20]. When handling overload problems, this functionality comes in handy because the CFC can switch the current from one line to another. The greater line current is used to charge the capacitor in the first mode of CFC operation, as shown by the following set of equations.

$$V = R_1 i_1 + L1L_1 \frac{di}{dt} + v_c + V_1 \quad (1)$$

$$V = R_2 i_2 + L_2 \frac{di_2}{dt} + V_2 \quad (2)$$

$$i1 = C \frac{dv_c}{dt} \quad (3)$$

By defining x, = [il iz vc] ' The aforementioned equations (1) through (3) can be classified in matrix form as where "T" denotes the transposition operation.

$$\begin{bmatrix} L_1 & 0 & 0 \\ 0 & L_2 & 0 \\ 0 & 0 & C \end{bmatrix} \frac{d}{dt} \begin{bmatrix} i_1 \\ i_2 \\ v_c \end{bmatrix} = \begin{bmatrix} -R_1 & 0 & -1 \\ 0 & -R_2 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ v_c \end{bmatrix} + \begin{bmatrix} 1 & -1 & 0 \\ 0 & 0 & -1 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} V \\ V_1 \\ V_2 \end{bmatrix} \quad (4)$$

Where, V is the bus voltage to which the CFCs is connected, V_z is the voltage at the terminal ends of the 1st and 2nd lines, and V_c is the capacitor voltage. L" RI and L_z' IS, respectively, stand for the first and second cables' series inductance and resistance.

In this way, the equations are given for the mode I capacitor discharge time, which occurs when the capacitor discharges from the lower line current i_z'.

$$V = R_1 i_1 + L1L_1 \frac{di}{dt} + V_1 \quad (5)$$

$$V = R_2 i_2 + L_2 \frac{di_2}{dt} - v_c + V_2 \quad (6)$$

$$i1 = -C \frac{dv_c}{dt} \quad (7)$$

Equations (5), (6), and (7) can therefore be rearranged as follows:

$$\begin{bmatrix} L_1 & 0 & 0 \\ 0 & L_2 & 0 \\ 0 & 0 & C \end{bmatrix} \frac{d}{dt} \begin{bmatrix} i_1 \\ i_2 \\ v_c \end{bmatrix} = \begin{bmatrix} -R_1 & 0 & 0 \\ 0 & -R_2 & 0 \\ 0 & -1 & 0 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ v_c \end{bmatrix} + \begin{bmatrix} 1 & -1 & 0 \\ 0 & 0 & -1 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} V \\ V_1 \\ V_2 \end{bmatrix} \quad (8)$$

The average model for CFC during i, > i z is obtained by multiplying equations (4) and (8) by (I-D) and D. The following equation is the result of combining this result with the charging mode of operation's duty ratio.

$$\begin{bmatrix} L_1 & 0 & 0 \\ 0 & L_2 & 0 \\ 0 & 0 & C \end{bmatrix} \frac{d}{dt} \begin{bmatrix} i_1 \\ i_2 \\ v_c \end{bmatrix} = \begin{bmatrix} -R_1 & 0 & -D \\ 0 & -R_2 & 1-D \\ D & -1+D & 0 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ v_c \end{bmatrix} + \begin{bmatrix} 1 & -1 & 0 \\ 1 & 0 & -1 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} V \\ V_1 \\ V_2 \end{bmatrix} \quad (8)$$

B=D* BI + (I -D) * Bz and A=D* Al +(I -D)* Az. The following is the form of equation (9) under steady-state conditions.

$$\begin{bmatrix} -R_1 & 0 & -1 \\ 0 & -R_2 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ v_c \end{bmatrix} + \begin{bmatrix} 1 & -1 & 0 \\ 0 & 0 & -1 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} V \\ V_1 \\ V_2 \end{bmatrix} = 0 \quad (10)$$

By solving equation (10), the stable-state value for the Vc can be expressed as:

$$V_c = \frac{\frac{R_2}{R_1} D(V-V1) + (V2-V)(1-D)}{\frac{R_2}{R_1} D^2 + (1-D)^2} \quad (11)$$

SYSTEM OVERVIEW AND MODELING FRAMEWORK

A single VSC powers each of the four stations that make up the M-HVDC grid. The stations are connected by four cables. A hybrid- CB is placed at each line termination, as shown in Fig. 7, and a CFC is addressed at Station 1. Two direct current CBs help the CFC coordinate its operations.

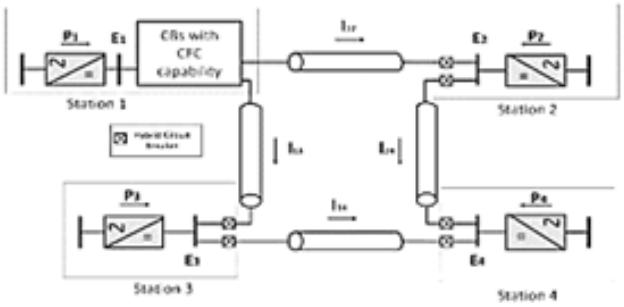

Fig. 7. One line diagram of Combined CFC and CBs

Computation of voltage source converter-based HVDC

Fig. 8 shows a four-terminal VSC-HVDC network made up of capacitors, a DC chopper, a DC inductor (DE), a PHCB, and high-pass filters that operate at 200 kV. In this setup, the rectifier and inverter use three-level NPC-VSC devices and neighboring IGBT/Diodes. Two 100 km lines and two 8 ml-l smoothing reactors are needed to combine the rectifier and inverter [5-6].

Even though the VSC-HVDC sector is currently seeing a rise in the use of CFC, three-level converters are still the preferred choice for many authorized projects. Thus, it is critical to take into account important interactions since the integration of CFC and the three-level composition may be crucial for future multi-Terminal direct current (MT-dc) grids. The midpoints of each

three-level converter are grounded by this MT system's grounding setup.

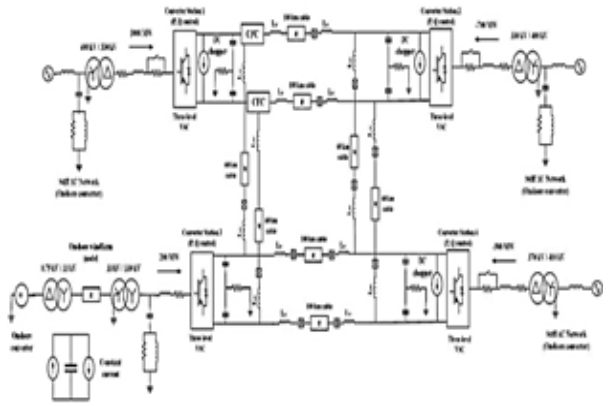

Fig. 8. Diagrammatic presentation of MT- VSC HVDC system

The three-level NPC design is built using phase reactors, transformers, switching IGBTs (insulated gate bipolar transistors), and capacitors (dc). The VSC-HVDC-MT system utilizes multiple control strategies, including voltage margin control and voltage droop [21] as shown in Fig 8. However, the P-Q control approach is utilized in this particular three-level model.

A number of DC choppers have been used in comparable configurations [23], and Table 2 contains an extensive list of them. The parameters related to the circuit breaker are also included in Table 3. The fundamental formulas that regulate the movement of both active and reactive power in a VSC-HVDC system are outlined below:

$$P = \frac{V_s V_c}{X} \sin \delta \tag{12}$$

$$Q = \frac{V_s(V_s - V_c \cos \delta)}{X} \tag{13}$$

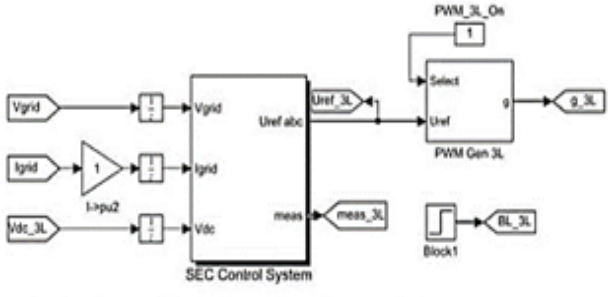

Fig. 9 System of Control at the Sending End Conversion

Equations (12) and (13) show that it is possible to regulate the two converter voltages' amplitudes to change reactive power, and to change the phase angle of the two converter voltages to control active power. When the converter's voltage Vc is at a greater angle than the source voltage (θS), it acts as a rectifier; otherwise, it acts as an inverter.

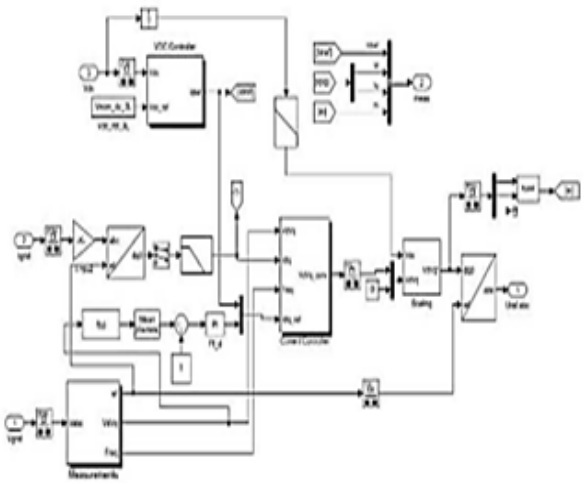

Fig. 10. Sending End Converter Control subsystem

Figures 9 and 10 depict the SEC's control system and subsystem. A current controller and three-level PWM are used to manage the rectifier side converter stations. Fig. 11 provides more information about the PLL, initializing filters, P-Q control, and the REC control system. All of these parts work together to guarantee the inverter side converter stations run smoothly.

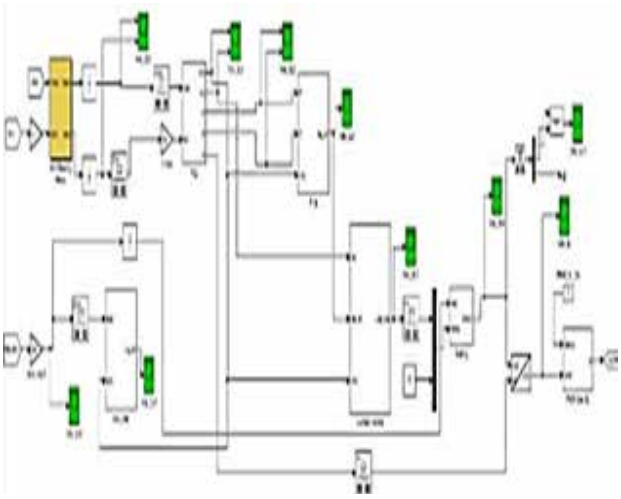

Fig. 11. Converter's Receiving End Control System

Table: 2 V & I Connection of DC chopper

Voltage (per unit)	Current (kA)
1	0
1.01	0
1.02	0.5
1.03	1
1.05	1.25
1.15	1.25

Table 3 Specification of CB

Parameters	Values
Stray Inductance (L1/Ls)	30 H
LCS snubber capacitance	5.5 F
LCS varistors knee voltage rating	7.92 kV
Main breaker snubber capacitor	0234 F
Main breaker knee voltage rating	320 kV
DC-line inductor	100 mH
Mech. Operating time	2 ms

SIMULATION OUTCOMES AND ANALYSIS

Fig. 12 displays the direct-axis reference current at 1.5 per unit along with the direct and quadrature-axis current at the SEC. Potential conflicts within the systems are shown by the Q and Q output at the REC that is shown in Fig. 13.

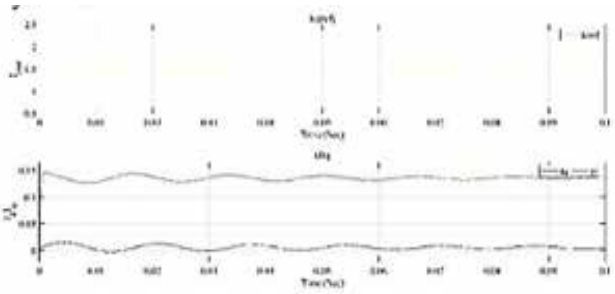

Fig. 12 d, q-axis Sending End CS current.

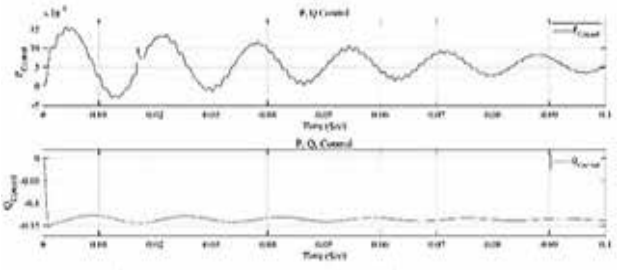

Fig.13 P, Q o/p at Receiving End CS

The response of the designed control system was evaluated by simulating the system depicted in Fig. 8 through the use of MATLAB SIMULINK software. Three-level NPC-VSC was employed for the entire simulation. The VSC-HVDC system effectively manages the flow of both active and reactive power, along with AC voltage regulation, as long as the load constitutes an active AC system. Two significant studies discuss the operation of PHCB, with or without CFC coordination support.

Study 1

Study 1 shows that in a four-terminal VSC-HVDC system, the second and fourth converters work as inverters to maintain DC voltage, while the first and third converters act as rectifiers to maintain P and Q power. The rectifier side's three-phase voltage and current are examined in Fig. 14. P and Q power parameters are both fixed at 0.17 watts per unit. The study's findings are shown in Fig. 15, 16, and 17, in that order.

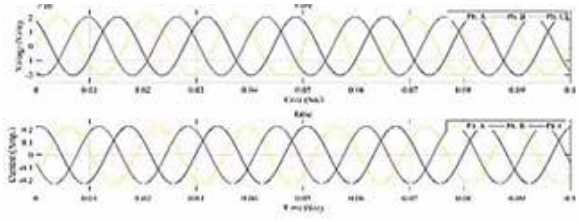

Fig. 14 3-ϕ Alternating V & I

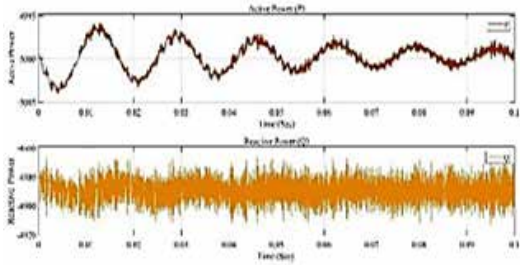

Fig 15. P and Q Power

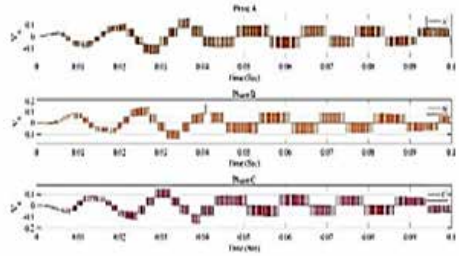

Fig. 16 I/p Signal for 3-level VSC

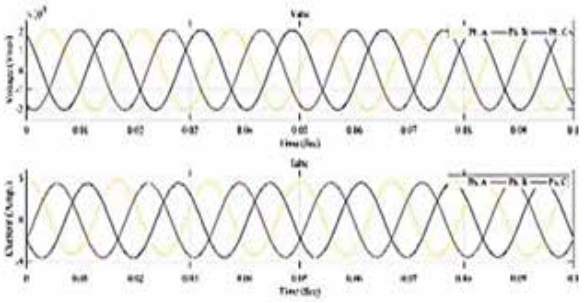

Fig. 17. 3-ϕ V-I Measurement

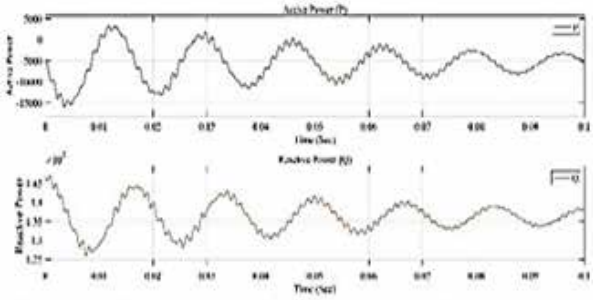

Fig. 18. P & Q at Supply Terminal

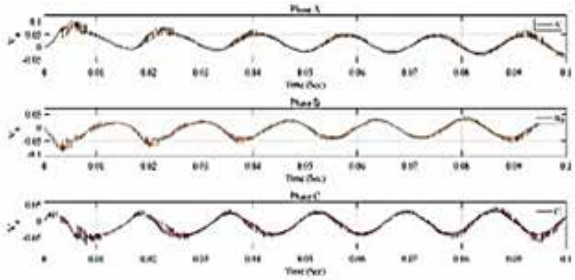

Fig.19. I/p Signal at 3-level VSC

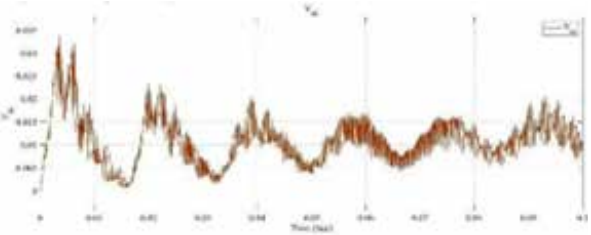

Fig. 20. O/p Signal at 3-level VSC

CONCLUSION

There are many benefits to integrating CFC with hybrid circuit breaker designs. A four-terminal VSC grid with a two-independent-converter architecture has been used to validate this notion. To minimize overall grid power losses or avoid overloading separate conductors, the CFC actively regulates the current inside the DC grid. In addition, the controller can oversee other grid functions like line switching and perhaps reduce the number of switching devices. The findings show that fewer space requirements and power losses occur from the CFC and circuit breaker working together. Additionally, the DC circuit breaker shields the CFC from overvoltage. The breaker's action diverts current away from the CFC during transient DC fault currents. When compared to independent systems, this voltage reduction permits a depletion of power losses in the combined case studies.

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Advanced DC-DC Boost Converter: Enhancing Voltage Gain and Reducing Voltage Stress in PV and EV Applications

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ABSTRACT

The primary focus of the research is on developing methods to increase the voltage output of solar cells for use in EVs and the grid. To accomplish this, a block of high-gain DC-DC power boost converters are transformed into crucial transitional topologies. Because of their lightweight, efficient, and inexpensive construction, single-switched and transformer-less converters are the best option.. The suggested converter stands out from the competition due to its ability to deliver high voltages with fewer duty cycles. Because of this, power switches can remain off for longer while operating in Continuous Current Mode (CCM), which increases efficiency and decreases dynamic losses. Unlike multi-switched structures, the suggested converter just requires a single power switch to operate across a wide range of input voltages, output powers, and loads, greatly simplifying the control process. The investigation offers thorough computations for effectiveness, voltage ripples, currents, and gain. The results of the tests on a 300 W power sample validate the predictions made in the theory.

KEYWORDS *: Enhanced voltage gain, Robustness, Sustainable energy, Single-switched boost converter.*

INTRODUCTION

The scope of the research includes a photovoltaic (PV) energy conversion device known as an interleaved step-up converter[1]. This converter uses interleaved boost converters and coupled-inductor technology to maximize power output while decreasing output ripple current. A common grounded Z-source DC-DC converter optimized for PV applications is another new development; this converter reduces voltage strains on the switches and diodes while increasing voltage gain [2]. The authors also suggest a 500-W experimentally validated soft-switched interleaved boost converter to solve the issues of conduction loss and reverse recovery.

In the framework of grid-connected power systems, the research presents a bidirectional DC/DC converter utilizing an LCLC resonant circuit, highlighting the benefits of both isolated and non-isolated converters. In addition, we present a totem pole bridgeless boost PFC converter that aspires to zero-voltage switching (ZVS) operation while minimizing core and conduction losses [3]. It investigates DC-DC boost converters that combine switched-capacitor (SC) and switched-inductor-based (SI) technologies to increase voltage gain, particularly for problems caused by high current loads on power switches and diodes. Taking into account the trade-offs between input current levels, efficiency, and voltage gain, we examine various types of DC-DC converters [4-5], including those based on coupled-inductor technology. As an approach to improve reliability, interleaved connections at the input side are shown to apply to many kinds of DC-DC converters used in high-power applications.

It is possible to reduce the high component count, which is a possible downside, by making deliberate changes to design parameters like the number of phases and transformer turns ratio [6]. One major drawback of the suggested converter is that it uses two switches, which means it needs an extra insulated gate drive circuit and costs more. To back up the study and highlight the converter's strengths, experimental data have been presented. By discussing problems, offering answers, and presenting new topologies, this article helps move DC-DC converter technology forward for high-power

applications, making them more efficient and reliable. [7]

An improved model and simulation of a switched-capacitor DC-DC boost converter with high voltage gain for use in photovoltaic applications are the goals of this research. With an emphasis on implementing an SMC Controller, the converter will be examined through the lens of both closed-loop and open-loop control techniques [8]. A high-voltage gain DC-DC boost converter based on the switched-capacitor approach, suited for photovoltaic applications, has to have its hardware circuit constructed. The following is the outline of the article. Aim, scope, and motivation are all laid out in Section 1, which also serves as an introduction to the subject. The methodology will be put into action after a comprehensive literature evaluation. In Section 2, It will find an extensive review of the program specifications, major system terminologies, a block diagram showing expected learning results, and the system's advantages and disadvantages. In Section 3, we have a detailed system design of traditional converters, complete with waveform simulations. Part 4 deals with actually making the converter that was proposed. The conclusion is found in Section 5.

SYSTEM DESCRIPTION WITH PROPOSED CONVERTER

Transforming solar radiation into usable electricity is the backbone of our work. This device uses a SMC to increase the voltage of solar panels from 24 volts to 240 volts.

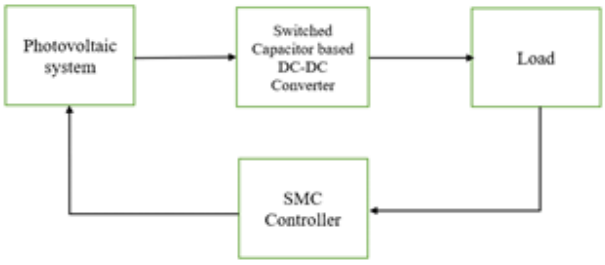

Fig. 1-Block Diagram of Proposed Converter

It can see the solar system, DC-DC converter, load (BLDC motor), and SMC controller in the illustration [9], which is an exploded view of the converter that has been suggested. The block diagram of the proposed converter is shown in Fig 1. PV applications are the main focus of this research. PV systems provide an input voltage of 24V DC. The system's architecture prioritizes the optimal utilization of photovoltaic cells, which transform sunlight into DC electricity. By using voltage feedback to keep the output stable, the boost converter is essential in boosting the variable DC voltage from the solar panels to a higher, more constant level [10].

i) DC electricity can be produced by photovoltaic cells and used to charge batteries that power DC-operated electronics. Contrarily, alternating current (AC) is the most common form of electricity supplied via transmission and distribution systems [11].

ii) When compared to conventional SC converters, this one has superior regulation capabilities and continuous input current while reducing conducted electromagnetic interference during the switch ON stage, the inductor is charged with "Boosted Energy," and the capacitor filters out any sudden voltage changes [12].

iii) The project draws power from a Brushless DC Electric Motor (BLDC), which is electronically commutated and supplied by direct current voltage, setting it apart from traditional DC motors [13].

iv) One way to make the jump from 24V to 240V in control systems is by using sliding mode control (SMC). One nonlinear approach is sliding mode control, which uses a discontinuous control signal to alter the dynamics of a nonlinear system, causing it to "slide" along a segment of its typical behavior. As a function of time, the state-feedback control law does not remain constant. Slide mode control has many benefits, such as reducing orders, simplifying decoupling design techniques, rejecting disturbances, being insensitive to changes in parameters, and being easy to apply using traditional techniques [14].

SYSTEM DESIGN AND APPLIED METHODOLOGY

When it comes to fuel cells and PV, DC-DC boost converters are crucial [15]. The boost converter is essential in increasing the voltage from these sources to levels that are suitable for grid applications because the voltage they create is particular and limited.

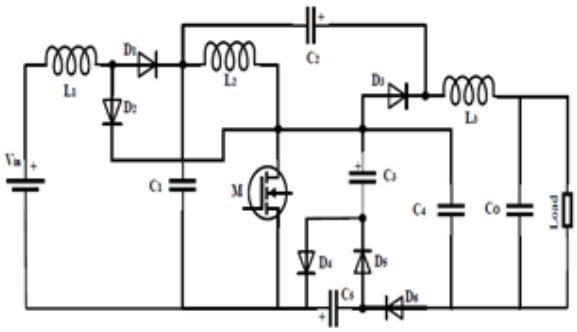

Fig. 2-Proposed Converter

The suggested converter has two separate modes of operation: "ON State" versus "OFF State" as shown in Fig 2.

MODE OF OPERATION

ON State Mode

As shown in Fig 3 when operating in the ON state, the power switch (MOSFET) is turned on, and the following diodes are in the OFF state: D2, D5, and D1, and D3, D4, and D6 are in the ON state. Inductor L1 charges linearly up to a voltage that is equal to the input voltage at this stage. In this mode of operation, capacitors C2 and C4 discharge at the same time, and capacitor C5 receives the voltage that discharges from capacitor C3 [16-17]. In this mode of operation, the positive voltage on inductor L3 causes the inductor to start charging, which in turn affects the voltage on

$VL1 = Vi,$

$VC_3 = VC_5$

$VL_2 = VC_1,$

$VL_3 = VC_1 + VC_2 + VC_5 + VC_4 - VC_o - VC_3.$

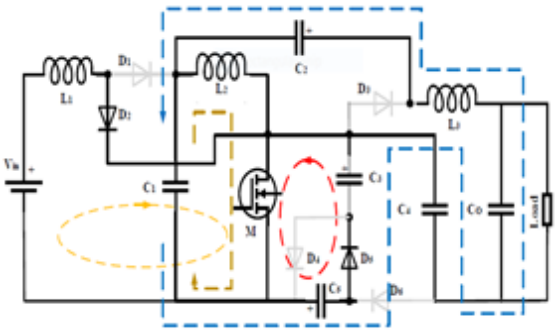

Fig. 3-MODE 1(ON state)

OFF State Mode

As shown in fig 4 when turned off, the device enters its second operational phase. This mode is characterized by the deactivation of the power switch (MOSFET), the OFF states of diodes D_2 and D_5, and the ON states of the remaining diodes (D_1, D_3, D_4, and D_6). This configuration involves discharging the voltage on inductors L_1 and L_2 and charging the remaining inductor L_3. In particular, $-V_i - VC_2$ is the voltage on inductor L_1, $-VC_2$ is the voltage on inductor L_2, and $VC_4 - VC_2$ is the voltage on inductor L_3 [12-13]. A brief summary of the equations governing these parts in this mode is as [18-19]

$VL_1 = V_{in} - VC_1$

$VL_2 = - VC_2$

$VL_2 = VC_1 - VC_3$

$VL_3 = VC_4 - V_o$

$VC_4 = VC_3 + VC_5$

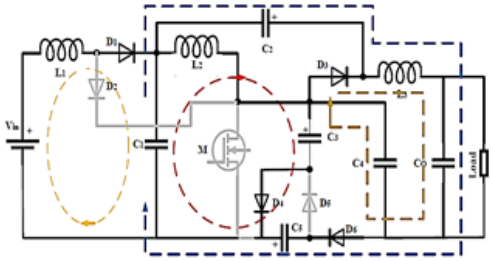

Fig. 4 -ODE 2(OFF state)

EXPERIMENTAL/SIMULATION RESULTS

Fig.5 shows a schematic of the open-loop power converter that has been suggested. M is the power switch, L1, L2, and L3 are the inductors, D1–D6 are the power diodes, and C1–C5 and CO are the capacitors. [20]

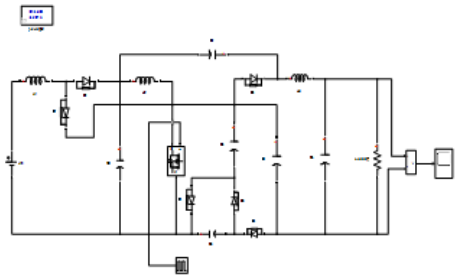

Fig. 5-Proposed Converter in Open loop

The input and output voltage waveforms, inductor current, capacitor voltages, and diode voltages during boost mode are illustrated in detail in Figures 6 to 9.

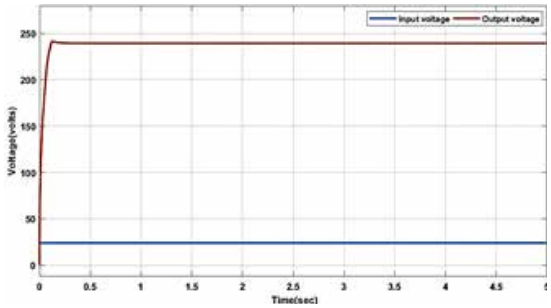

Fig. 6-Input & Output waveform (Proposed converter)

As seen in Fig. 6, when the switch is started at 50 kHz with an input voltage of 24 V, the output voltage is 240V.

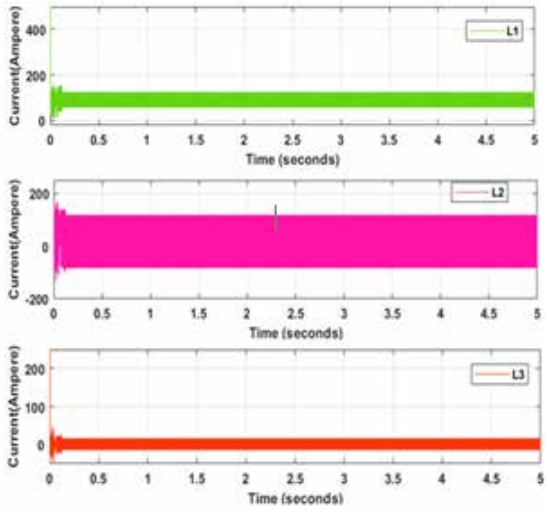

Fig. 7-Current waveforms of Inductor

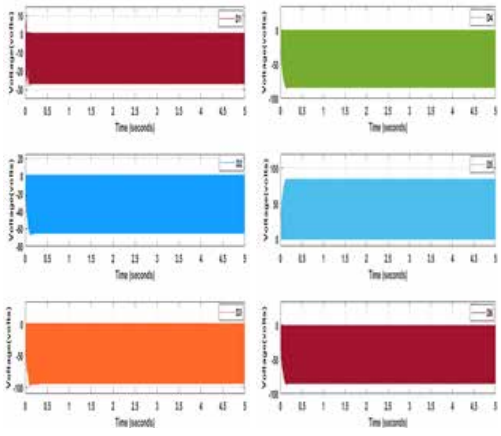

Fig 8-Voltage waveforms of Capacitors

During the on-state, inductors L1, L2, and L3 store energy; during the off-state, they release that energy. According to Figure 7, the inductor currents for L1, L2, and L3 are 56.77 A, -48.23 A, and -8.55 A, respectively. Input Voltage- 24V, Output Voltage – 239.2 V, Switching Frequency – 50kHz

Waveforms of voltage across capacitors C1–C6 and diode states are shown in Figures 8 and 9, respectively. In Fig. 8, it can be seen that the voltage across C1, C2, C3, C4, C5, and C6 is 31.62V, 66.89V, 88.51V, 173.2V, 83.68V, and 239.2V, respectively[21].

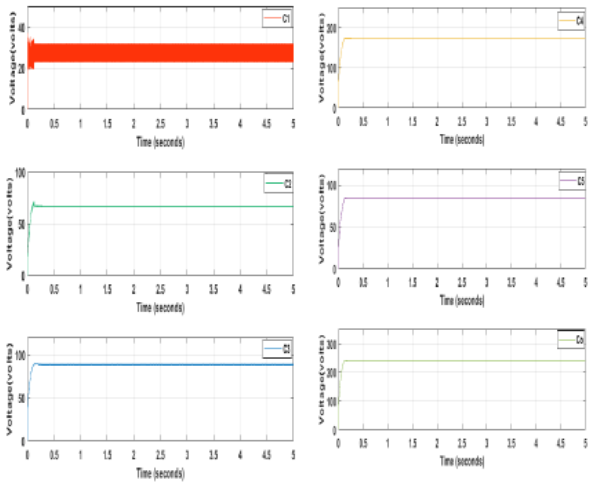

Fig 9-Voltage waveforms of Diodes

It is proven by the theoretical diode states shown in Fig.9 that the theorem states that only one of the diodes D1 and D2 can be engaged at the same time. Furthermore, the findings confirm that diodes D3, D4, and D6 are deactivated during periods when diode D5 is turned on, and the reverse is also true [22]. The voltage across the first six diodes is -3.043V, then 0.856V, then -70.79V, then -60.79V, then 22.89V, and finally -61.77V.

The suggested converter is tested in both the ON and OFF modes. To analyze the input and output waveforms, the chosen converter is simulated open-loop.

SYSTEM DEVELOPMENT AND DESIGN

With a duty cycle (D) of 0.5 and an input voltage of 24V DC, we hope to achieve an expected output voltage of about 240VDC according to Eq. In a real-world setup, four 230/12-0-12 1Amp transformers are linked to the input side of the converter. The computed results

dictate the selection of component values and attributes. With a peak-to-peak voltage of approximately 20V at the LM7805 power MOSFET driver's gate-source and drain-source pins, we aim to obtain a 240VDC output. The power MOSFET can be switched by linking this IC to the controller [23-24]. A voltage of around 46V is seen across the drain-source pins when Vin = 24VDC and Vout = 240VDC, as shown in Fig 10. This confirms the theoretical calculations given in section 2. It can see the input and output voltages on the screen; the output nodes measure about 232VDC.[25]

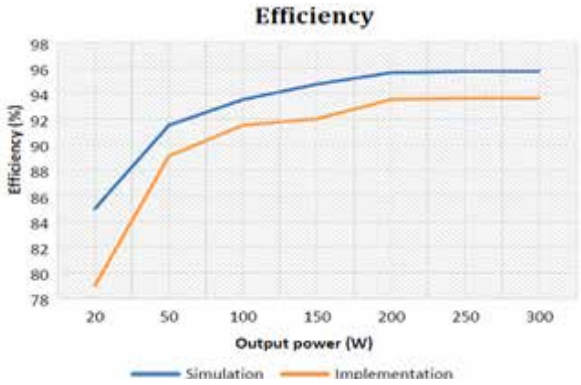

Fig. 10- The proposed DC-DC converter's efficiency

All three inductors charge and discharge at the same time, as shown by the voltages across them. In every given time interval, this proves that only one of the power diodes D1 and D2 can be turned on. Diodes D3 and D4 activate and deactivate simultaneously, but diodes D5 and D6 operate asynchronously, as confirmed by the voltage across them reaching 45V during deactivation intervals. Consistent with theoretical and computational predictions, it is worth noting that the voltage across capacitor C4 is equal to the sum of the voltages across capacitors C3 and C5.

In line with the 2.2A predicted by the simulation, a ripple of around 3A has been recorded. Simulated and real-world currents of about 7A confirm the results under varying duty cycles (D = 0.75 and D = 0.80) and the controller's behavior with and without a second load. The converter's viability for high-gain applications is demonstrated in further testing using a DC voltage with an amplitude of approximately 680VDC and a ripple of 30V. We provide the efficiency curves for the hardware testing and the simulations, all of which take internal resistance into account. When taking into account components like parasitic capacitors and component resistance, particularly at higher switching frequencies, discrepancies between practical and computational findings are understandable. [26-27].

CONCLUSION

In this study, output load was connected to the power switch via a strategically positioned switched capacitor block. This block's critical significance in enhancing the converter's functionality has been illuminated by a thorough investigation of its states throughout both the ON and OFF phases of the power switch.

It emphasizes the converter's potential in renewable energy scenarios through its use in photovoltaic (PV) systems. One important feature is operating with low-duty cycles, which directly leads to lower dynamic losses in the circuit and improved overall efficiency. The importance of the suggested switched-capacitor block in stress mitigation is shown by the inverse relationship between voltage stressors across power semiconductors, especially the power switch, and the duty cycle.

With just one power switch and a simple controller, our design's simplicity is a notable advantage. On the other hand, adding more switches to a configuration usually means more complicated controller functions, which means more trouble during implementation.

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Synergizing Power Sources: An Innovative Approach to Electric Vehicle Energy Management

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ABSTRACT

This research focuses on improving energy management for electric vehicles by implementing a frequency-sharing technique. The FC system, which is essential for fulfilling the requirements of the traction/propulsion system, is enhanced by the use of lithium-ion batteries and SC. Battery and supercapacitor (SC) connections are made easier by bidirectional Buck-Boost converters, which also smoothly incorporate the SC into the DC-Bus. The main contribution of this research is the optimization of the energy distribution across fuel cells, lithium-ion batteries, and SC. Each energy source's electrical capabilities and dynamic responses are taken into account during this optimization. MATLAB software is utilized to obtain computational outputs that validate the efficiency of the chosen control technique.

KEYWORDS *: Converter, Buck-boost Converter, Supercapacitor, FC, MATLAB*

NOMENCLATURE

Supercapacitor	SC
Fuel Cell	FC
PWM	Pulse Width Modulation
PMSM	permanent magnet synchronous motor
ESD	Energy Storage Device
TFC	Temperature of the Cell
PH2	Partial Pressure of Hydrogen
PO2	Partial Pressure of Oxygen
V_C	Capacitor Voltage
EV	Electric vehicle

INTRODUCTION

Various applications, including microgrids, hybrid electric boats, and electric cars (EVs), can benefit from fully electric multi-source systems. Not only do these systems use only electricity, which is known for being clean and easy to control, but they also drastically lessen their influence on the environment because they are electric only [1-3]. Within the framework of electric vehicle applications, this research investigates such systems. Depending on the road conditions and the driver's actions, electric car energy consumption might vary greatly.

The primary power source, which is usually an FC, has problems dealing with demand fluctuations, which can reduce its health and shorten its lifespan to overcome this restriction, a workaround involves enhancing the primary power source with auxiliary sources that exhibit greater dynamism and responsiveness to power peaks. The configuration of the multi-source system in question is illustrated in Fig. 1. The PMSM is linked to the DC-Bus through a two-level inverter, facilitating speed and torque control of the synchronous machine. Weight, resistance forces, and driving circumstances are just some of the loads that the DC machine simulates. [4]

The primary contribution of this article is the introduction of a frequency-sharing mechanism that is based on energy management. Using this method, the main source FC is less affected by variations in load power, and the dynamic response of each source is optimized. At the end of the day, it shrinks the primary source by cutting down on energy storage needs [5].

FC AND ESD ANALYSIS

FC Modeling

FCs produce electrical energy via an electrochemical method. The first expression represents the voltage output of the FC [4-5].

$$V_{Cell} = E_{Nernst} - V_{act} - V_{ohm} - V_{conc} \quad (1)$$

The thermodynamic potential of the cell, ENernst, is determined by the TFC, the PH2, and the PO2. This value is calculated using Eqn. (2).

$$E_{Nernst} = 1.22 - 0.85 \times 10^{-3} \times (T_{FC} - 298.15) + 4.3085 \times 10^{-5} \times T_{FC} \times \left[In(P_{H2}) + 0.5 In(P_{O2}) \right] \quad (2)$$

The activation overvoltage Vac can be determined using the formula (3):

$$V_{act} = -\left[\xi_1 + \xi_2 \times T_{FC} + \xi_3 \times T_{FC} \times In(C_{O2}) + \xi_4 \times T_{FC} \times In(I_{FC}) \right] \quad (3)$$

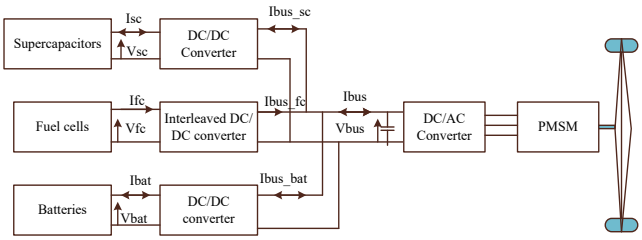

Fig.1.EV configuration

The modification coefficients ξi (where iϵ{1, 2, 3, 4}) are used to compute the current of the cell (IFC) and CO2, which is determined by Eqn. (4).

$$C_{O2} = \frac{P_{O2}}{5.08 \times 10^{6} \times \exp\left(\frac{-498}{T_{FC}}\right)} \quad (4)$$

The ohmic voltage loss can be calculated using formula (5), wherein RC represents a constant value and RM as defined in expression (6).

$$V_{ohm} = (R_C + R_M) \times I_{FC} \quad (5)$$

$$R_M = \frac{\rho_M \times l}{A} \quad (6)$$

The Eqn. (7) is capable of being used to calculate the specific resistivity.

$$\rho_M = \frac{181.6 \left[1 + 0.03 \left(\frac{I_{FC}}{A} \right) + 0.062 \left(\frac{T_{FC}}{A} \right)^2 \times \left(\frac{I_{FC}}{A} \right)^{2.5} \right]}{\left[\lambda_M - 0.634 - 3 \left(\frac{I_{FC}}{A} \right) \right] \times \exp\left[4.8 \left(T_{FC} - \frac{303}{T_{FC}} \right) \right]} \quad (7)$$

In which l is the cell's active surface area and A is its membrane thickness. λM represents the mean amount of water in the pores of the membrane. It is possible to express the amount of voltage drop, V_{conc}, as in Eqn. (8).

$$\begin{cases} V_{conc} = -\frac{R \times T_{FC}}{2F} In\left(1 - \frac{J}{j_{max}}\right) \\ J = \frac{I_{FC}}{A} \end{cases} \quad (8)$$

To mimic the transient dynamics of the PEMFC, with the variable capacitance determined by expression (9).

$$C_{act} = \frac{1}{\xi_5 \times R_{act}} \quad (9)$$

The constant ξ5 and the resistance Ract can be determined using expression (10).

$$R_{act} = \frac{V_{act}}{I_{FC}} \quad (10)$$

The expression (11) defines the VC, which replaces the activation overvoltage Vact.

$$\frac{dV_C}{dt} = \frac{1}{C_{act}} \times \left(I_{FC} - \frac{V_C}{R_{act}} \right) \quad (11)$$

Therefore, the in Eqn. (12)

$$V_{Cell} = E_{Nernst} - V_C - V_{ohm} - V_{conc} \quad (12)$$

The Vo of the FC stack is determined using expression (13), with NS_FC representing the number of cells connected in series.

$$V_{FC} = N_{S\_FC} \times V_{Cell} \quad (13)$$

Table 1 displays the PEMFC model variables utilized in this investigation. To validate the model's accuracy, we compared the computer simulation output with the practical curves provided in the producer's documentation [6].

Table 1 FC parameters

Parameter	Symbol	Value
Temperature	TFC	333.15K
Partial hydrogen pressure	PH2	2atm
Partial oxygen pressure	PO2	0.21atm
Ohmic resistance	RC	20.5mΩ
Membrane thickness	l	0.0178cm
Active surface of the cell	A	67cm2
Average water content of the membrane	λM	11
Perfect gas constant	R	8.3145J/(mol. K)
Faraday Constant	F	96.485C/mol
Maximum current density	j_{max}	0.622A/cm2
Number of cells in series	NS_FC	288
Adjustment coefficients	ξ1; ξ2; ξ3; ξ4; ξ5	-1.09; 3.48x10-3; 5.8x10-5; -9x10-5; 20
Specific power	ρPF_c	59W/Kg

The used Lithium battery model is shown in Fig. 2, with Rs and two parallel RC circuits, denoted as R1//C1 and R2//C2 [7], this model shows itself to be stable enough for use in multi-source simulations. The variables NS Bat and NP Bat, and the mathematical formulation of Voc and SoC is according to (14). VBat and IBat stand for the voltage across the battery pack and the current passing through it, respectively. Table 2 lists the coefficients of the Voc formula that vary on SoC. Table 3 lists the parameters that define the lithium battery pack.[7]

$$\begin{cases} SoC = SoC_0 - \int_0^t \dfrac{I_{Bat}}{3600 \cdot N_{P\_Bat} \cdot Q_{Cell}} dt \\ Voc_{ch} = -a_5 \cdot SoC^5 + a_4 \cdot SoC^4 - a_3 \cdot SoC^3 + a_2 \cdot SoC^2 + a_1 \cdot SoC + a_0 \\ Voc_{di} = -a_5 \cdot SoC^5 + a_4 \cdot SoC^4 - a_3 \cdot SoC^3 + a_2 \cdot SoC^2 - a_1 \cdot SoC + a_0 \\ V_{1,2} = R_{1,2} \cdot \left(I_{Bat} - C_{1,2} \cdot \dfrac{dV_{1,2}}{dt} \right) \\ V_{Bat} = N_{S\_Bat} \cdot VoC + \dfrac{N_{S\_Bat}}{N_{P\_Bat}} \cdot (R_S \cdot I_{Bat} + V_1 + V_2) \end{cases} \quad (14)$$

Table 2. Voc charge and discharge coefficients

	a_0	a_1	a_2	a_3	a_4	a_5
Battery charging ($I_{Bat} < 0$)	1.13	9.89	12.21	27.03	65.21	33.64
Battery discharging ($I_{Bat} >= 0$)	2.54	13.72	82.41	189.51	194.6	72.97

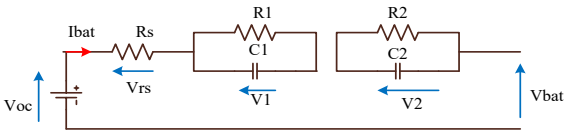

Fig.2. Lithium battery model

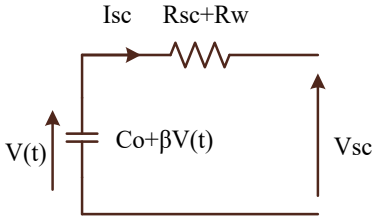

Fig.3.SC model

Table 3. Specification of battery

Parameter	Symbol	Value
Operating voltage range	V_{Batmin}; V_{Batmax}	2.8V;3.8V
Battery series resistance in charge mode	R_{ch}	0.83 mΩ
Battery series resistance in discharge mode	R_{disch}	0.69 mΩ
First branch resistance R_1C_1	R_1	0.033 Ω
First branch capacitance R_1C_1	C_1	92 F
Second branch resistance R_2C_2	R_2	0.375 Ω
Second branch capacitance R_2C_2	C_2	499 F
Specific power	ρP_{Bat}	310W/K_g
Specific energy	ρE_{Bat}	102W_h/K_g
Number of batteries in series	N_{S_Bat}	58
Number of batteries in parallel	N_{P_Bat}	1

SC modeling

ESDs that have a lower power density generally rely on SC, which are renowned for their high-power density. Fig. 3 shows the employed SC model, which includes a series resistance (Rsc+Rw) and a capacitor (2.β.V(t)+C0). The model explains how the SC acts during charging and discharging processes. See Table IV for the predicted BOOST-SC CAP parameters (2.7V/3000F). Fig. (15) [8][9] shows the analytical model.

$$V_{SC} = V_{t0} - \frac{N_{S\_SC}}{N_{P\_SC}} \cdot \left(\int_0^t \frac{I_{SC}}{C_0 + 2 \cdot \beta \cdot V(t)} dt + (R_W + R_{SC}) \cdot I_{SC} \right) \quad (15)$$

Table 4. SC parameters

Parameter	Symbol	Value
Series resistance	RSC	0.428mΩ
Wiring Resistance	RW	0.497mΩ
Constant component of capacitance	C0	2573F
Specific component of the capacitance	β	60 F/V
Specific power	ρPSc	5.9 kW/Kg
Specific energy	ρES_c	6 Wh/Kg
Number of SC in series	NS_SC	70
Number of SC in parallel	NP_SC	1
Initial voltage of SC module	Vt0	187 V

CONVERTERS MODELING

PMSM modeling

It is easier to manage alternative current machines using the dq frame (16), which is where the PMSM paradigm is formed because continuous currents (Id and Iq) are utilized rather than other types. Table V includes the PMSM variables [10]

$$\begin{cases} V_{sd} = R_S \cdot I_{sd} + L_d \cdot \dfrac{dI_{sd}}{dt} - p \cdot \Omega \cdot L_q \cdot I_{sq} \\ V_{sq} = R_S \cdot I_{sq} + L_q \cdot \dfrac{dI_{sq}}{dt} - p \cdot \Omega \cdot \left(L_d \cdot I_{sd} + \Psi\right) \\ C_{em} = \dfrac{3}{2} \cdot p \cdot \left[\left(L_d - L_q\right) \cdot I_{sq} \cdot I_{sd} + \Psi \cdot I_{sq}\right] \end{cases} \quad (16)$$

Table 5. PMSM parameters

Parameter	Symbol	Value
PMSM stator resistance	Rs	1.95 Ω
PMSM stator inductance	Ls	13.6 mH
Rated power	Pn	2.26 Kw
Rotor permanent magnet flux	ψ	0.234 Wb
Moment of inertia	J	9.3x10-4 kg/m2
Pole pairs	p	3
Viscous friction coefficient	f	6.24x10-6 Nms/rad

Interleaved Boost Converter Modeling

The FC serves as the primary source in this investigation. The corresponding duty cycle of the converter is represented by αph1, αph2, and αph3 in the mathematical framework provided in Eqn. (17) [11].

$$\begin{cases} V_{L1} = L_1 \cdot \dfrac{dI_{L1}}{dt} = V_{FC} - \alpha_{ph1} \cdot V_{BUS} \\ V_{L2} = L_2 \cdot \dfrac{dI_{L2}}{dt} = V_{FC} - \alpha_{ph2} \cdot V_{BUS} \\ V_{L3} = L_3 \cdot \dfrac{dI_{L3}}{dt} = V_{FC} - \alpha_{ph3} \cdot V_{BUS} \end{cases} \quad (17)$$

Buck-Boost converter modeling

In Eqn. (17), the mathematical representation of bidirectional buck-boost converters is provided, with αBat representing the duty cycles of batteries and αSC representing the duty cycles of SC controlling the converters, accordingly. Depending on the sign of the current, K_{Bat} and k_{SC} denote the buck and boost modes, respectively [12].

$$\begin{cases} V_{LB} = L_{Bat} \cdot \dfrac{dI_{Bat}}{dt} = k_{Bat} \cdot \left(V_{Bat} - \alpha_{Bat} \cdot V_{BUS}\right) \\ V_{LSC} = L_{SC} \cdot \dfrac{dI_{SC}}{dt} = k_{SC} \cdot \left(V_{SC} - \alpha_{SC} \cdot V_{BUS}\right) \end{cases} \quad (18)$$

During traction mode, the bidirectional DC-AC converter operates as an inverter, empowering the operator to control the machine at the selected speed while being connected to the DC bus. Conversely, in braking mode [13], the converter transforms into a rectifier, facilitating the recuperation of energy generated during braking maneuvers and sudden decelerations. The analytical model of the inverter mode, with Sa, Sb, and Sc representing the PWM signals, is elucidated in (19). The machine's 3-phase voltages are denoted as V_{sa}, V_{sb}, and V_{sc} [13-14].

$$\begin{cases} V_{sa} = \dfrac{V_{BUS}}{3} \cdot \left(2 \cdot S_a - S_b - S_c\right) \\ V_{sb} = \dfrac{V_{BUS}}{3} \cdot \left(2 \cdot S_b - S_c - S_a\right) \\ V_{sc} = \dfrac{V_{BUS}}{3} \cdot \left(2 \cdot S_c - S_a - S_b\right) \end{cases} \quad (20)$$

ENERGY FOCUSED VIA SHARING OF FREQUENCIES

Load solicitation current

There are three power sources in the system under study: an FC, which is responsible for keeping the VDCbus at a constant value, a battery pack, and a pack of SC, which provides backup power to the main source during the mission. All three sources are unique in their dynamics and performance for the amount of electricity they produce and store. A strategy for energy management centered around frequency sharing is under investigation to prolong the lifespan of the utilized sources and ensure a robust SOH. This approach is illustrated in Fig. 4.

The individual energy sources, the SC charges the high-frequency segment, the batteries charge the medium-frequency component, and the FC system charges the low-frequency section [15]. Two filters must be

included to calculate the two time constants that are needed to regulate the current distribution between the three sources. Eqn. (20) can be used to calculate these time constants, where the energy and power densities (ρEbat, ρEsc) and their respective values are given [16–17].

$$\begin{cases} \tau_1 = \dfrac{\rho_{ESC}}{2 \cdot \pi \cdot \rho_{PSC}} = 0.5827s \\ \tau_2 = \dfrac{\rho_{Ebat}}{2 \cdot \pi \cdot \rho_{Pbat}} = 188.5216s \end{cases} \quad (20)$$

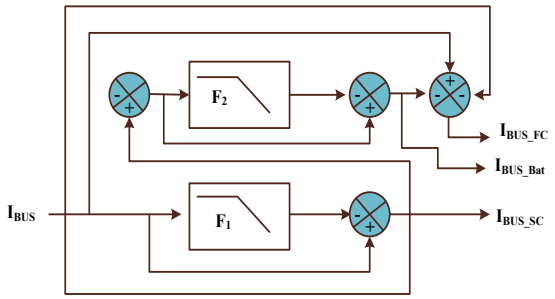

Fig.4. Frequency Control Method

Employing a polynomial-based control approach, the VDC bus now adheres to the chosen set point, and the currents from the energy sources align with the patterns established through the frequency-sharing method.

V_{DCbus} Control

Typically, two cascaded loops are employed for V_{DCbus} control, with the inner loop being responsible for current control and the outer loop for voltage control. To regulate the voltage in this setup, just one control loop is needed. We can calculate the FC current by subtracting the vehicle's demand from the total current generated by the ESDs, which includes batteries and SC. [18] Using polynomial correctors allows positive disturbance rejection and the achievement of the least static error possible (21).

$$\begin{cases} S_{FCV}\left(z^{-1}\right) = 1 - z^{-1} \\ R_{FCV}\left(z^{-1}\right) = T_{FCV}\left(z^{-1}\right) = r_{0BUS} - r_{1BUS} \cdot z^{-1} \end{cases} \quad (21)$$

The closed loop evaluation yields the polynomial controller coefficients given in Eqn. (22) where Ct is the total DC-Bus capacitor.

$$\begin{cases} r_{0BUS} = 2 \cdot (1 - e^{(-\omega_{BUS} \cdot T_e)}) \cdot \dfrac{C_t}{T_e} \\ r_{1BUS} = \left(e^{(-2 \cdot \omega_{BUS} \cdot T_e)} - 1\right) \cdot \dfrac{C_t}{T_e} \\ C_t = C_{BUS} + C_{SC} + C_{Bat} + C_{FC} \\ \omega_{BUS} = 0.0628 \cdot f_p \end{cases} \quad (22)$$

Current component control

Bidirectional DC-DC converters control the flow of energy from the ESS to the traction/propulsion system. On display in Fig. 6 and 7 are the operational plans. The reference currents on the DC-Bus side are determined through the frequency-sharing method, as depicted in Fig. 4. Considering a conversion efficiency of 1, the side currents of the ESS are as per Eqn. (23) calculated using power conservation ends.

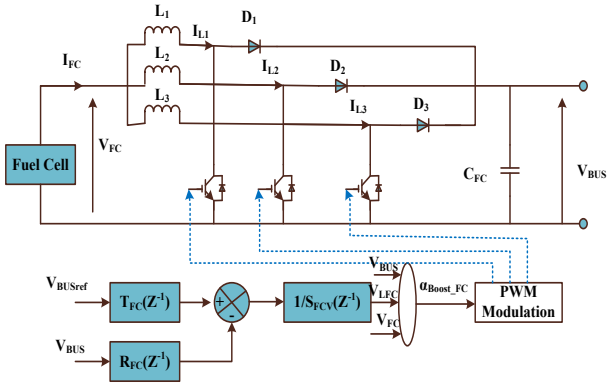

Fig.5.Control of VDC bus

$$\begin{cases} I_{Batref} = \dfrac{V_{BUS}}{V_{Bat}} \cdot I_{BUS\_Bat} \\ I_{SCref} = \dfrac{V_{BUS}}{V_{SC}} \cdot I_{BUS\_SC} \end{cases} \quad (23)$$

To accomplish effective disturbance rejection and minimize static error, polynomial correctors are employed (24).

$$\begin{cases} S_{Bat\_SC}(Z^{-1}) = 1 - Z^{-1} \\ R_{Bat\_SC}(Z^{-1}) = T_{Bat\_SC}(Z^{-1}) = r_{0Bat\_SC} - r_{1Bat\_SC} \cdot Z^{-1} \end{cases} \quad (24)$$

The control values for the ESS, namely batteries and SC, can be calculated by utilizing formula (25). In this calculation, LBat and LSC represent the smoothing inductances of the converters, while Te and fp denote the sampling time and the control frequency of the converters, accordingly [19].

$$\begin{cases} r_{0Bat\_SC} = 2 \cdot (1 - e^{(-\omega_{Bat\_SC} \cdot T_e)}) \cdot \dfrac{L_{Bat\_SC}}{T_e} \\ r_{1Bat\_SC} = \left(e^{(-2\omega_{Bat\_SC} \cdot T_e)} - 1\right) \cdot \dfrac{L_{Bat\_SC}}{T_e} \\ \omega_{SC} = 6.28 \cdot f_P \\ \omega_{Bat} = \dfrac{\omega_{SC}}{2} \end{cases} \quad (25)$$

By plugging the duty cycles into expression (26), we can determine the function.

$$\begin{cases} \alpha_{Buck\_Bat,SC} = \dfrac{V_{Bat,SC} + V_{LB,LSC}}{V_{BUS}} \\ \alpha_{Boost\_Bat,SC} = 1 - \dfrac{V_{Bat,SC} - V_{LB,LSC}}{V_{BUS}} \end{cases} \quad (26)$$

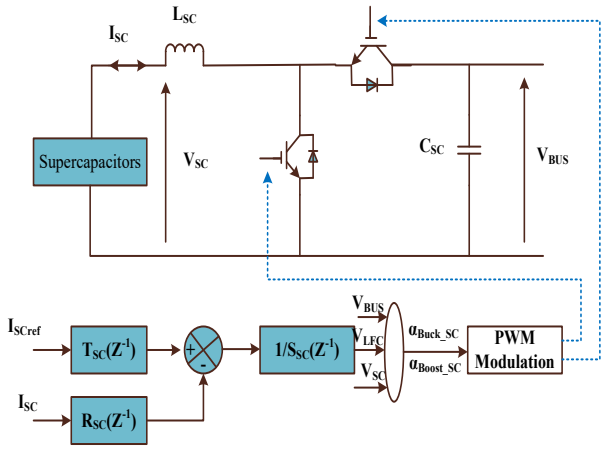

Fig. 6. SC current control

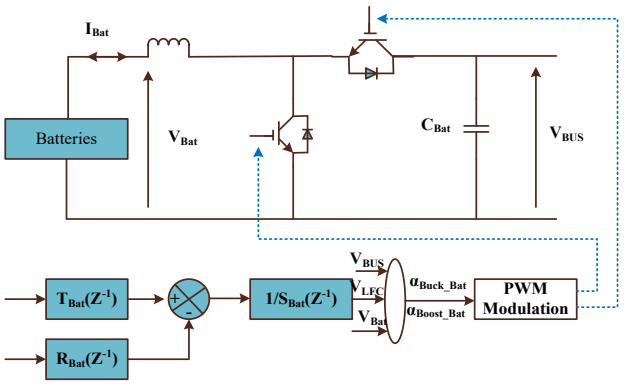

Fig.7. Batteries current control

EV PERFORMANCE

The implemented energy management strategy is tested in MATLAB/Simulink to demonstrate its viability. The characteristics listed in Table 6 are used to build models of the behavior of electric vehicles.[20]

Table 6. Specifications for model

Parameter	Symbol	Value
DC-Bus voltage reference	V_{BUSref}	374 V
Polynomial R_{Bus}(z-1) coefficients	r_{0BUS}; r_{1BUS}	3.39; 3.32
Polynomial R_{Bat}(z-1) coefficients	r_{0Bat}; r_{1Bat}	989.47; 581.53
Polynomial R_{SC}(z-1) coefficients	r_{0SC}; r_{1SC}	116.3; 59.94
PWM frequency	f_P	2 kHz

The outcome of the VDC bus regulation is shown in Fig. 8. Despite variations in load demand, the VDC bus measurement remains near the target reference, as seen in Fig. The VDCbus s regulation, said simply, meets expectations.

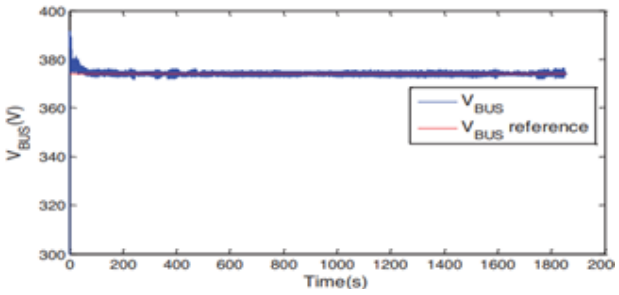

Fig. 8. VDC bus output

The DC-Bus side load current solicitation is shown in Fig. 9. Lithium batteries, SC, and FCs are the three

power sources that are contributing to the current demands.

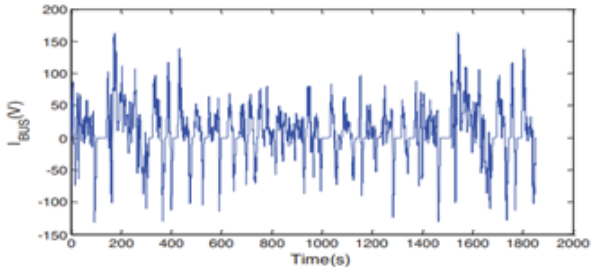

Fig. 9. DC-Bus view

Three current components are produced high frequency component is supplied by the pack of SC, as seen in Fig. 10. Fig. 12 shows that is supplied by the battery pack. [21-22].

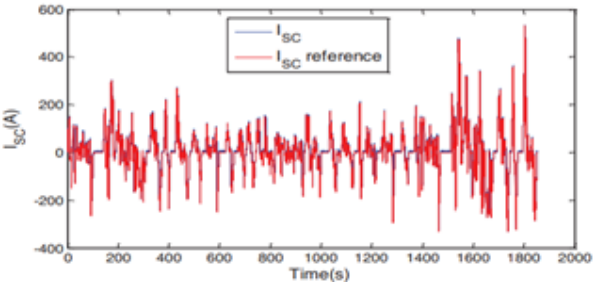

Fig. 10. SC current contribution

With such tight agreement between the measured values and the prescribed set-points, it is clear that the regulation system is working as intended. Fig. 11 and 13 show the terminal voltages of SC and batteries, accordingly, which are storage of energy technologies. Those following two numbers demonstrate that energy storage systems guarantee most of the load's swings. Thus, the effects of oscillations on the efficiency and lifespan of FCs are mitigated by the energy management system [24-25].

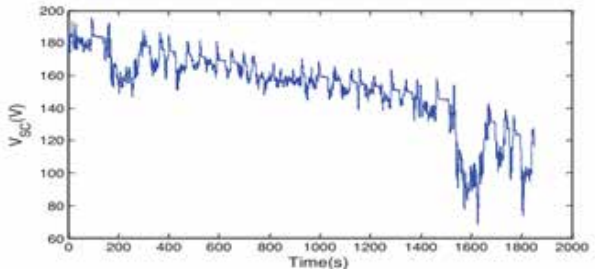

Fig.11.SC terminal voltage

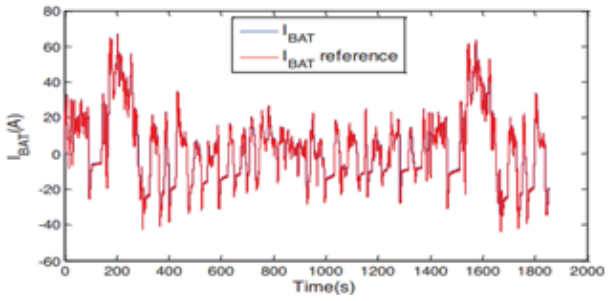

Fig.12.Batteries current contribution

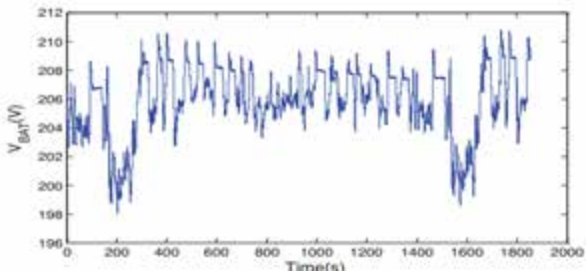

Fig.13.Batteries terminal voltage

FC contributions are seen in Fig. 14 and 15. Its health and lifespan are greatly improved by the impact, which is favorable but not very substantial, and which displays fewer changes in voltage and current than the currents produced by ESD (batteries and SC [26].

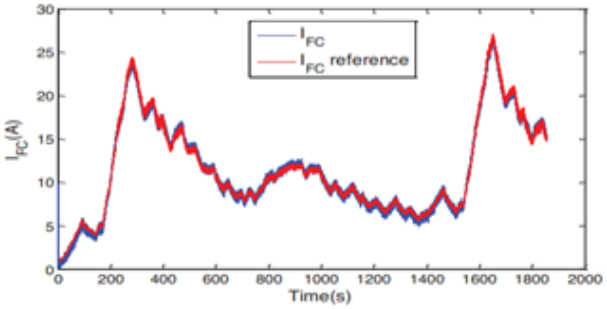

Fig.14. FC current

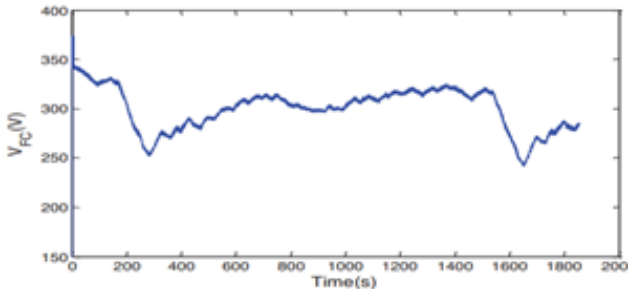

Fig.15.Voltage across the FC

CONCLUSION

A frequency separation method for energy management is presented in this article. This approach enables sufficient load demand separation based on the quantity and nature of available energy sources. Findings from the simulations demonstrate the method's viability for multi-source systems containing a variety of sources and loads. Based on the results of this research, we can say that high-power-density storage units, such as SC, are required to meet the high-frequency demand. A less powerful energy storage technology, such as batteries, will supply the medium frequency component. Lastly, the primary power source is responsible for supplying the low frequency component. Because it accounts for the intrinsic nature of the sources, the frequency separation method has a smaller effect on the energy sources and makes it possible to use smaller ESDs.

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Optimizing Automotive Performance: A Comprehensive Comparison of DC-DC Converters

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ABSTRACT

To effectively manage power in line with Energy Management controller recommendations, a bidirectional DC/DC converter must be meticulously chosen for use in battery/ultracapacitor (UC) electric vehicle (EV) applications. After thoroughly comparing three-level DC/DC converters with traditional two-level and interleaved bidirectional buck/boost designs, this study firmly supports their use. We cover all the bases in our review, including the size or the weight of the magnetic components and their overall efficiency.

Unlike earlier comparative studies that rely on fixed input and output parameters, this method offers a new perspective by using power references from a wavelet transform based energy management strategy. This allows for a more accurate evaluation of the converter's performance in dynamic operational settings by accounting for fluctuations in the voltages of the energy sources and the traction power. Thorough evaluations reveal that the three-level converter is the best, exhibiting not just improved overall efficiency but also a smaller inductor. A meticulously designed proof-of-concept These results are supported by a 1-kW bidirectional three-level DC/DC converter, which achieves a remarkable peak efficiency of 93.2% at a switching frequency of 200 kHz. The three-level converter's innovative approach and convincing evidence make it a practical and effective choice for battery/UC EV power processing.

KEYWORDS *: EV, Interleaved converter, Ultracapacitor, Non-isolated dc to dc converter, Three level converters.*

INTRODUCTION

EVs with UCs can become attractive substitutes for battery-only models with large capacity batteries [1]. Based on factors like efficiency, control complexity, and performance, several drivetrain topologies with active or passive UC control are put forth and contrasted [2].

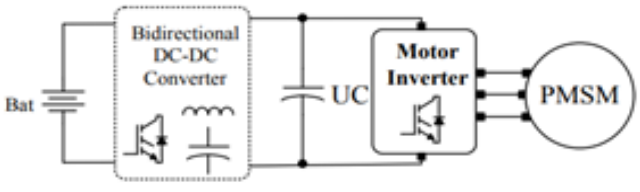
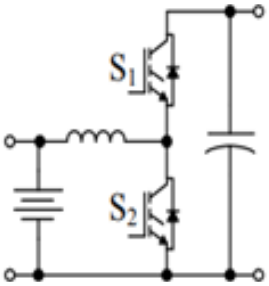
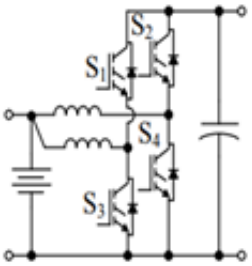


Fig. 1. The battery/UC vehicle's drive train features a converter

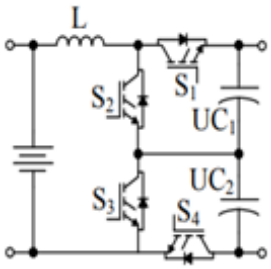
Fig. 1 illustrates the usual connection type, where the UC is directly linked to the dc link and functions as a power buffer. With the bidirectional dc to dc converter serving as the only controllable unit, UC must regulate the voltage within the top and lower operational limits of the inverter in order to meet high power needs.



(a) 2-level (CBC)



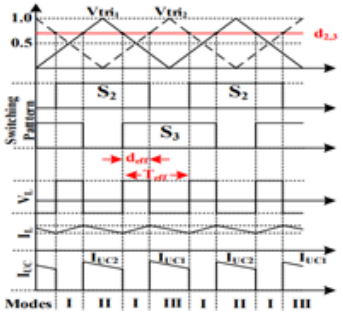
b) Interleaved (BIC)



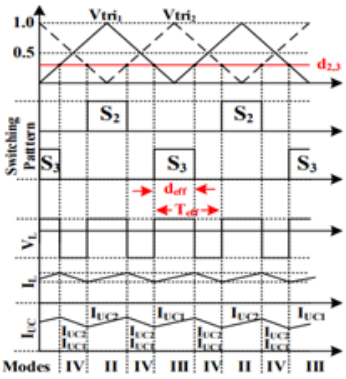
(c) 3-level (TLC).

Fig. 2. buck/boost converters

Due to it has a significant impact on the system performance overall, choosing a bidirectional converter hierarchy is essential.



(a)d > 0.5



(b)d<0.5

Fig.3.Switchingscheme

Previous works have suggested and examined bidirectional dc to dc converters for EVs; the majority of these studies gives efficiency assessments for specific power circumstances with defined input and output characteristics [3]. A study of DC-to-DC converters in EVs. According to this study, the bidirectional dc/dc converter in EVs should be a 3-Level Converter (TLC). [4]. It compares this converter which are shown in Fig. 2 [5]. As the drive cycle, use the Urban Dynamometer Driving Schedule (UDDS).

Together with the appropriate UC and battery voltages, the power distribution which is calculated using 3-level Discrete Wavelet Transformation in [6] is employed in estimates of efficiency and magnetic parameter size.

In order to determine which converter has the highest efficiency and the smallest magnetic component size, efficiency models that have been developed are utilized to calculate the converters' overall efficiency over the course of the driving cycle. It is possible to extend this analytical pathway to additional applications, such as fuel-cell, PHEV [6]

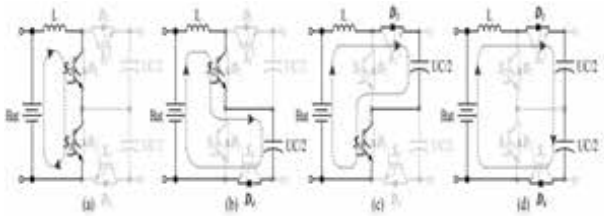


Fig. 4. Functionality of Boost mode

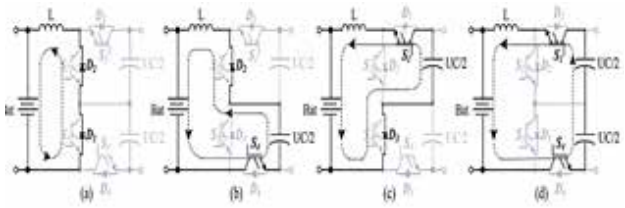


Fig. 5. Buck mode operation

On the other hand, the boost inductor in CBC becomes an important part in high-power applications, adding to the system's weight, volume, and cost. Higher losses are also a result of the requirement for high-voltage switches in CBC. Compared to the CBC, the use of a Three-Level Converter (TLC) is a viable substitute that offers significant advantages [7-8].

The TLC converter's switching architecture is displayed

in the Fig. 3. The phase-shifted switch turn-on periods result in a ripple frequency in the effective inductor current is twice that of usual designs [9].Fig. 4 and 5, respectively, show the boost and buck operation modes of the TLC. The boost mode is the one being explained, even though both modes do similar tasks. There are four distinct modes of circuit operation, and the corresponding circuits are classified according to the duty cycle value. The duty cycle's climax value, represented by the letter "d," is 0.5. The comparable circuit sequence repeats as IV-II-IV-III for d< 0.5. An control signal overlap happens as the duty cycle rises over 0.5, creating a new equivalent circuit sequence, I-II-I-III[10-11].

DIFFERENT ANALYSIS

Comparing TLC to the most sophisticated CBC and BIC converters reveals a number of advantages. The voltage across the switch controls a significant amount of the switching loss. Specifically, exposing the switches to half of the output voltage, even in the absence of soft-switching, can significantly lower the parasitic capacitance's switching loss as compared to CBC. Indeed, employing low voltage switches is expected to significantly reduce losses due to parasitic capacitance [12]. This section compares and contrasts the two different topologies for bidirectional buck/boost dc-dc converters shown in Fig. 2, accounting for the power handled by the converter as well as the dynamic fluctuations of the battery and UC voltages. The comparison is based on the size and efficiency of their magnetic components over the entire drive cycle range. Obtain Cycle A. Common Elements was established. The dynamic voltage changes of the energy sources and the load power have a significant impact on the efficiency of the bidirectional converter.

In the drive train architecture depicted in Fig. 1 the energy sources and batteries. Because the UDDS driving cycle simulates a 7.5-mile urban route with numerous pauses, it was used for this experiment [13]. When operating in a linear mode, the battery voltage can fluctuate between 350V and 380V. The UC's voltage is limited to 350V by the inverter's minimum working voltage, even though it is directly connected to the DC connection and so cannot exceed 600V. A voltage swing from 600V to 350V can be stored in the UC for a total energy of C•118.75kJ, where C is the capacitance of the UC. This is due to the fact that the UC's energy storage is exactly proportional to the voltage squared. [14].

Table 1. Currents of Conversion During Four UDDS

	CBC 200µH	TLC 100µH	BIC 200µH
Max. Bat. Cur. [A] (i_{bat_max})	138.64	130	123.2
Ripple Cur. @ i_{bat_max} [A]	30.86	4.28	15.43
Max. Ind. Cur. [A] (i_{L_max})	138.64	130	77.03
Ripple Cur. @ i_{L_max} [A]	30.86	4.28	30.86
Max. Ripple Cur. [A] (Δi_{bat})	32.94	11.5	15.8
Max. Ripple Cur. [A] (Δi_L)	32.94	11.5	31.6
Max. Ind. Rms Cur. [A]	126.89	126.86	63.49

In the current study, three-level wavelet decomposition was used to derive reference powers for the battery and UC [23].

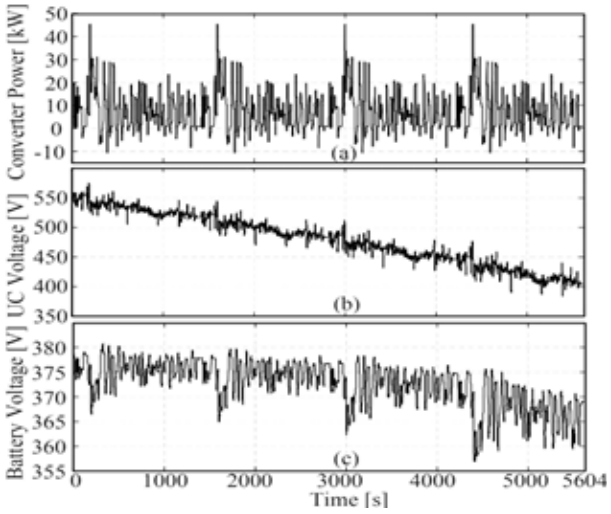


Fig. 6. Dynamic Fluctuation of state variables

Fig. 6 displays the battery, UC voltage fluctuations, and converter power throughout the course of four UDDS cycles. In this instance, we're assuming that the battery started off with a SOC of 80%.

In the sections that follow, size and efficiency studies will be carried out using this data. The scale of the magnetic component B. Peak flux density is inversely related to the size of the magnetic component and is determined by the peak current flowing through the core. This is how the battery's current ripple appears in CBC: [15-16].

$$\Delta_i bat_{boost(d)} = \frac{V_o}{Lf_s} d(1-d) \quad (1)$$

The TLC's battery current ripple is,

$$\Delta_i bat_{-TL}(d) = \frac{V_0}{2Lf_s} d_{eff}(1 - d_{eff}) \quad (2)$$

The relationship between the duty cycle of a switch in a transverse light-coupler (TLC) converter and the ripple current may obtained by altering the duty cycles that are effective from Eq. (1) & (2) and it became as shown in Eq. (3)[17].

$$\Delta_i bat_{-TL}(d) = \begin{cases} v_o \\ Lfs \end{cases} d(1 - d) \quad (3)$$

Two inductor currents added together make up the BIC converter's input current as shown in Eq.(4). If the switches duty cycles are below 50%, the input current ripple will develop into

$$\Delta_i bat_{-Interleaved}(d) = \frac{2V_{in} - v_o}{Lf_s}\left(1 - \frac{V_{in}}{V_o}\right) \quad (4)$$

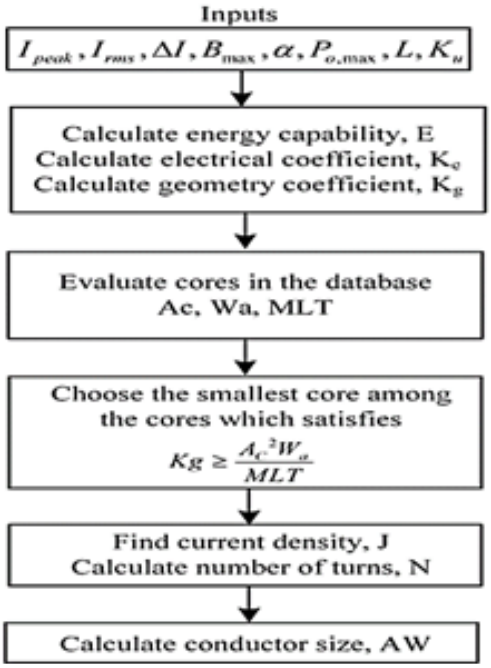


Fig. 7. Flow diagram for the core geometry estimation approach-based inductor design method

A ripple in the input current is defined as a situation where the duty cycle is over fifty percent. as refer in Eq. (5).

$$\Delta_i bat_{-Interleaved}(d) = \frac{V_o - 2v_{in}}{Lf_s}\left(\frac{V_{in}}{V_o}\right) \quad (5)$$

Assuming that Eq. (6) is satisfied for the current ripple of all interleaving inductors,

$$\Delta_i bat_{-Interleaved}(d) = \frac{v_o}{Lf_s} d(1 - d) \quad (6)$$

At 75% duty cycles, BIC and TLC reach the greatest input ripple current, while CBC reaches their highest at 50%. The inductance needed by CBC is four times greater than that of TLC for the same peak ripple in battery current.

The size of the magnetic core can be determined by measuring the extreme inductor current and necessary inductance. In light of this, the drive cycle depicted in Fig. 6 has been assessed using a switching transitional converter operating at a frequency of 20 kHz.

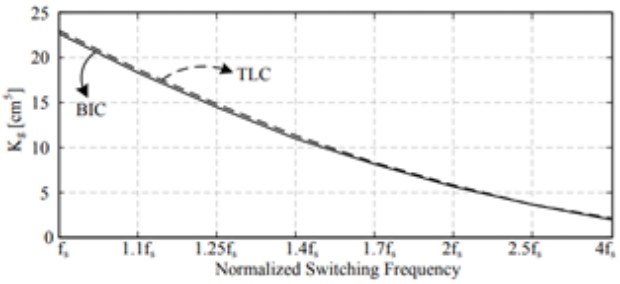


Fig.8. BIC and TLC core weights

Table 2Size of CBC, TLC, and BIC inductor

	CBC (200μH)	TLC (100μH)	BIC (200μHx2)
K_e	0.164	0.164	0.0853
K_g	170.1	42.5245	
J [A/cm^2]	263.2	263.2	336
N	38	38	42
AW [cm^2]	AWG#1/0	AWG#1	AWG#4
Wire	AWG#20 ×105	AWG#22 ×167	AWG20 ×49
W_a [cm^2]	46.8	46.8	24.41
A_c [cm^2]	13.56	6.78	7.16
Core	0077339A7 ×2	0077339A7 ×1	0077907A7 ×6
Weight [Kg]	1.3×2	1.3	0.262×6

However, 400μH produces a very big magnetic core, as will be discussed later. Thus, 200μH is chosen as the CBC's inductance [18-19]. Table1 shows that 138.7A, with a ripple of 32.9A, is the maximum current that may be taken from the battery in CBC. An inductor current ripple of 30.8A is used to get the maximum inductor current of 77A for BIC Even though this ripple has no effect on the battery itself, itlooks at how it impacts the core losses in the sections that follow.

Estimate the magnetic component's magnitude using the core geometry methodology. To estimate the core

size, various elements must be determined, such as the needed inductance (L), window utilization factor (Ku), maximum flux density (Bmax), regulation (α), peak current (Ipeak), rms current (Irms)and regulation (α) [20].

Table 3 Analyzed Converter Specifications

	CBC	TLC	BIC
Input Voltage [V]	357-381	357-381	357-381
Output Voltage [V]	384-575	384-575	384-575
Peak Prop. Power [kW]	45.32	45.32	45.32
Peak Regen. Power [kW]	-10.78	-10.78	-10.78
Power Switch	IXFB30 N120P	IXFX80 N60P3	IXFB30 N120P
Switch Ratings	1200V/30A	600V/80A	1200V/30A
No. of Switches	12	8	12
Swit. Freq. [kHz]	20	20	20
Ind. Ripple Freq. [kHz]	20	40	40
Inductance [μH]	200	100	200
No. of Cores	2	1	6
Cores Weight [kg]	2.6	1.3	1.6

This is influenced by the magnetic and electric factors.

$$E^2 = K_g . K_e . \propto \quad (7)$$

The electrical coefficient, denoted as E, can be calculated using the formula 0.5·L·Ipeak2, where L represents the magnetic quantity and Ipeak represents the electrical quantity shown in Eq. (8).

$$K_g = 0.145\ P_o B_{\max}^{-4} \quad (8)$$

The identification and evaluation of kg are essential components of the estimation approach. However, some of the core makers directly supply the Kg [cm5] value linked with every core. A mathematical representation of the relationship between area product and Kg is as follows with reference of Eq. (9):

$$K_g \geq \frac{A_c^2 W_a}{MLT} \quad (9)$$

The term mean length per turn, or MLT is used. The maximum flux density can be divided by the area to find the current density as in Eq. (10).

$$J = \frac{2.E.10^4}{B_{\max}.\ A_c\ W_a\ K_u} \quad (10)$$

The wire size is determined by the current density in Eq. (11).

$$J = \frac{I_{rms}}{J} \quad (11)$$

From Eq. (12), the total amount of turns could be determined by using the provided wire size as well as winding area.

$$N = \frac{W_a K_u}{A_w} \quad (12)$$

Fig. 7 shows the schematic of the choosing an inductor core process. What matters most is the core material you choose for the maximum flux density. The cores with distributed air gap having a saturation flux density of 1.1–1.5 T are known as magnetic or iron powder cores. These cores find their most common use in power inductors, more especially in DC inductors and the switched mode power supply (SMPS) output filters. Eq. (13) & (14) show that increasing the maximum operational flux decreases the area product of the core, an estimate of the core size; yet, increasing the core losses causes the area product to grow.

In this example, it is expected that the maximum flux density is roughly 0.5 T, which is the value commonly used as Bmax/2. The standard value of the fill factor Ku is 0.4. The control α is usually set at 1% in low power applications, but as power grows, it is frequently bounded to a lower level. The maximum power, 45.23kW, is reached before regulation is capped at 0.1%. The remaining parameters Ipeak, Irms, ΔI, L, and Po,max are necessary to determine the product area and, by extension, the core size. They are derived from the dynamic modeling of four UDDS drive cycles. For measuring core size, the kg is a helpful unit of measurement [21]. The calculated kilogram (Kg) values for TLC and BIC for different switching frequencies are shown in Fig. 8. Fig. 8 omits the CBC because its kilogram value is much greater. It clearly shows that Kg is somewhat greater for TLC converters, but else it is much the same for BIC converters. Please be aware that the BIC values include the total kilograms for two identical cores. Since commercially available cores do not always have the precise winding and cross-sectional areas predicted by Kg, the former is not always applicable to actual implementation. An iterative technique is utilized to generate approximate core sizes for Kool Mu (sendust core) cores based on the given requirements.

When compared to powdered iron cores, these cores are recognized for their much superior thermal

characteristics, reduced losses, and modest cost. Fig. 7 provides an illustration of the algorithm. The area product of this core type can reach up to 791 cm4 of the cores stored in the database, the algorithm chooses the most useful one. Table 2 presents the findings related to the basic design. The core weights of TLC, BIC, and CBC converters are respectively 1.3 kg, 0.662 kg, and 2*1.3 kg. Part C: Rules for Choosing Semiconductors It is important to evaluate the current and voltage pressures on the power switches before making a selection. Unlike TLC, where the switches are exposed to half of the output voltage, CBC and BIC expose the switches to the whole output voltage. The results of the calculations presented in previous section.

A Indicate that 575V Is the upper limit for ultra-capacitors. It follows that TLC switches should have ratings greater than 287V and CBC and BIC switches should have values greater than 575V. Furthermore, due to the hard-switched nature of the converters, the circuit's parasitic output capacitances and inductances may resonate, raising the peak voltage across the switches well above this threshold. Therefore, it is imperative to allocate a margin of safety. We can see that TLC needs 600V switches, but CBC and BIC need 1200V switches based on this value of 2. It can be shown from Table 1.

When considering these parameters, IGBTs stand out as possible semiconductor devices, while MOSFETs are more suited as switching devices for frequencies between 20 and 40 kHz. On the other hand, high current rating discrete MOSFETs with voltage ratings of 1200V or even 600V are not easy to come by. High power IGBT modules or parallel linked [22].

MOSFETs are the two options that are dictated by these restrictions. The feasibility of a parallel-connected MOSFET structure is determined by taking the switching frequency and switch cost into account. Since many manufacturers use different standards to sell their products, we choose 600V and 1200V MOSFETs from the same brand and category/family so that we can compare them fairly. Considering these factors, the 1200V/30A power MOSFETs IXFB30N120P and the 600V/80A IXFX80N60P3 were chosen for the TLC and two-level converters of CBC and BIC, respectively. Twelve IXFB30N120P MOSFETs are employed in the CBC and BIC converters collectively, and eight IXFX80N60P3 MOSFETs in the TLC [23].

PERFORMANCE ASSESSMENT

We design and analyze complete efficiency models that account for a range of losses, in order to assess the energy loss and overall converter efficiency during the driving cycle. 5605 data points are analyze for every converter in this thorough investigation utilizing the parameters indicated in Table 3.

Switching Losses

At frequencies higher than 20 kHz, power dissipation is caused by four main components of switching losses. These parts are described below:

Overlap Power Losses (VDS and ID) in MOSFETs

The switching instant is when the current and voltage bleed over, causing these losses. The region under the drain current (ID) as well as drain-source voltage (VDS) waveforms quantitatively depicts them.

Charge Loss at the Gate (Qt)

The charge that is discharged to the ground in each switching cycle from the gate capacitance, which is charged with gate voltage (VG), is the source of Qt. Due of this, it is considered a switching loss.

Capacitance Losses in Parasites (COSS)

When the MOSFET is turned off, the charge in the parasitic output capacitor (COSS) causes power to be dissipated.

Problems with the MOSFET's Body Diode's Reverse Recovery (Q_{rr} and V_{rr})

The return time (t_{rr}) of the body diode of the MOSFET is associated with these losses. By removing the extra charge (Q_{rr}) from the drift area prior to the diode junction becoming reverse-biased, the diode is able to switch off. The unwanted reverse recovery voltage (V_{rr}) is caused by this excess Q_{rr}.

The following formula encompasses the equation for switching losses in Three-Level Converters (TLC), Bidirectional Inverter Converters (BIC), and Conventional Buck/Boost Converters (CBC). It takes into account the cumulative influence of these distinct loss components. To characterize and reduce switching

losses in various converter designs, this comprehensive knowledge is crucial.

$$P_{sw} = f_s.N_{ps}.N_{pc}.\left(0.5.V_{DS}(t)I_D(t)\left(t_r + t_f\right) + 0.5.V_{DS}^2(t)C_{oss} + Q_tV_G\right) + V_{rr}(t)Q_{rr}) \quad (13)$$

The switching frequency, denoted as fs, is associated with the number of paralleled-switches (NPS) and parallel converter (Npc). For the CBC configuration, there are 6 paralleled-switches and 1 parallel converters. For the BIC configuration, there are 3 paralleled-switches and 2 paralleled converters. Lastly, for the TLC configuration, there are 2 paralleled-switches and 1 paralleled converter. Furthermore, the terms tr and tf represent the time it takes for MOSFETs to change from the low-to-high and high-to-low states, respectively, throughout switching intervals [24].

Dielectric Losses

Conduction loss, which is mostly caused by low switching frequencies, is measured by the MOSFET drain's RMS current (ISRMS) and on-state resistance (RDSon). The conduction loss for both CBC and BIC may be computed by the following formula.

$$P_{CDCBC-BIC} = N_{pc}.\left(R_{DS(on)}\frac{I_{SRMS}^2(t)}{N_{PS}} + N_{PS}V_FI_{Davg}(t)\right) \quad (14)$$

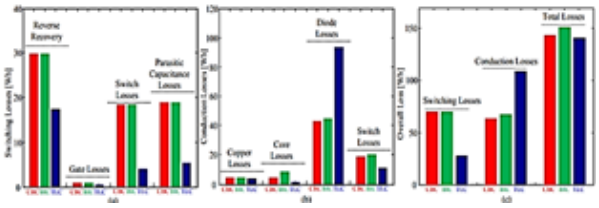


Fig. 9 Energy losses at a 20 kHz switching frequency a) Switching losses, b) core and conduction losses , c) and overall loss

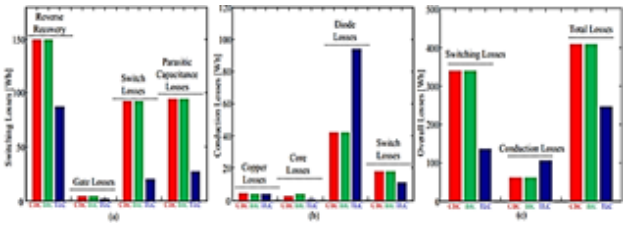


Fig. 10. Energy losses at 100 kHz switching frequency (a) Switching losses, (b) Conduction and core losses, (c) Overall loss

As indicated by Eq. (15), VF and IDavg are obtained by multiplying the core volume Ve and the core loss density Pe (Bac, fs), which are derived from the AC magnetic flux density Bac and the operating frequency fs.

$$P_{Cu} = V_eP_e(B_{ac}(t), f_s \quad (15)$$

The permeability indicated above (u_r = 60) was actually supplied by Magnetics Inc. for the calculation of Pe (Bac, f_s) using the Eq. (16) [25].

$$P_e(B_{ac}, f_s) = 193B_{ac}^{2.01}(t)\frac{f_s}{1000}^{1.29}{}_e \quad (16)$$

Efficiency Analysis

The converter losses are computed using Equations (14)–(16) taking into consideration the voltage profiles and dynamic power mentioned in the unit above. Fig. 9 displays the energy losses as a consequence for each of the three converters operating at a switching frequency of 20 kHz.

In a similar vein, parasitic capacitances MOSFETs have much reduced losses. For the specified switching frequency, gate losses are negligible. Fig. 9(b) shows the conduction losses, core losses, and copper losses shown. To begin with, TLC uses fewer switches than other converters, which means that its conduction losses are lower. On the other hand, when more diodes are used, the loss due to diode breakdown is greater. Fig. 9(c) displays the total losses of all converters. Despite having greater total conduction losses, TLC shows somewhat better efficiency than alternatives. In, you can see the outcomes at a switching frequency of 100 kHz [26].

The investigational waveforms for the TLC boost mode with a duty cycle (d) of 0.48 are shown in Fig. 10. There are three voltages involved in this system: 67V for the input, 130V for the output, and 500W for the output power. The waveforms show the following: a) the input voltage, output current, and voltages across switches S1 and S4; b) the voltages across switches S2 and S3; and c) the voltages across the inductor.

Fig.10. There is a clear indication that the efficiency gain is far larger here. This further demonstrates that greater switching frequencies make TLC more advantageous. It

is possible to calculate the converters' total efficiencies over the whole drive cycle by consulting therefore mentioned charts and doing the following:

$$\cap = \frac{P_o}{P_o + P_{SW} + P_{CD} + P_{CU} + P_C} \quad (17)$$

CBC has an efficiency of 98.7%, BIC of 98.5%, and TLC of 98.8%from Eq. (17). As the switching frequency increases to 100 kHz, the efficiencies decrease to 96.4%, 96.3%, and 98%, sequentially. The analysis revealed that, depending on the driving cycle conditions and the size of the magnetic components, TLC converters function more efficiently than CBC and BIC converters. A larger efficiency gap is produced by greater switching frequencies [27].

Control Complexity

Because it uses a single carrier signal to produce two PWM pulses, the control mechanism of a conventional buck/boost converter (CBC) is very simple because there are fewer switches. The Bidirectional Inverter Converter (BIC) and Three-Level Converter (TLC), on the other hand, need two carrier signals phase-shifted 180 degrees. Importantly, TLC and BIC are similar in that they both generate PWM. The existence of a floating ground makes TLC more complicated and expensive, as it requires independent gate drivers for three switches [28-29].

The neutral-point voltage balancing controller is the main source of complication in TLC control. Assuming perfect symmetry in the drive and main circuits, the DC link capacitor voltages should be half of the dc link voltage in an ideal world. However, DC bus capacitor Equivalent Series Resistance (ESR), drive circuit inhomogeneity, and switch asymmetry all contribute to the observed discrepancies. The result is that capacitor voltages are not uniform, this causes switches and dc-link capacitors to experience varying voltage strains. TLC thus needs a different voltage balancing control. Identifying the top or bottom capacitor voltage and adjusting S2 or S3's duty cycle in boost mode and S1 or S4's duty cycle in buck mode correspondingly is one effective technique. By using this compensating duty cycle, the switch's pulse width is changed in relation to its complimentary switch. This corrects voltage discrepancies in the dc link capacitors and guarantees that voltage stressors are distributed uniformly. When it comes to maximizing the TLC converter's performance and reliability in real-world operating situations, this complex control method is crucial [30-31].

RESULT AND DISCUSSION

A 1kW TLC proof-of-concept prototype has been painstakingly designed. The converter's 100 kHz switching frequency produces an effective ripple frequency of 200 kHz when it is in operation. In order to make this work, a 100µH inductor is chosen with great care. The IRFP350 switches used have a breakdown voltage of 400V and can handle a constant drain current of 16A. A low-priced dsPIC30f4011 microcontroller is employed for control functions. The current flowing via the inductor is tracked by an LEM CAS-25 sensor.

The outcomes in boost mode at three different operating points. Different voltages are applied to diodes and switches in each situation; significant voltage spikes are created by hard-switching and parasitic inductances on the PCB. As demonstrated by the findings for the switching frequency and the doubled inductor current frequency converter with the parameters indicated in Table 3, these contributions to oscillations become apparent at a system frequency of 200 kHz.

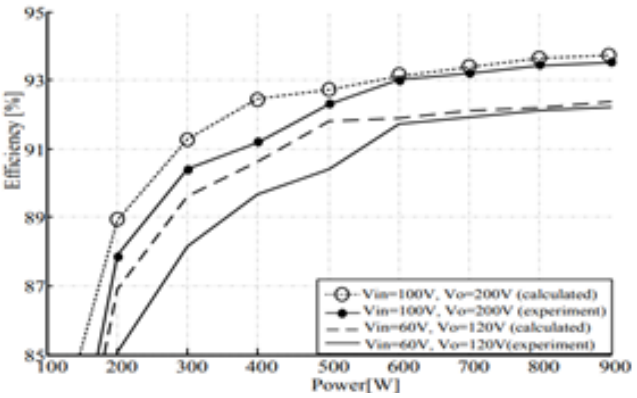


Fig. 11 Efficiency curve of the three-level converter

Fig. 11 shows the efficiency curves that were obtained from various voltage and power experiments. These curves were then compared with the calculated efficiencies that were also obtained under the same conditions. The accuracy of the created loss model is confirmed by this examination. At a switching frequency of 200 kHz and a power of 900W, the model's efficiency

curves remarkably match those seen experimentally, reaching a peak efficiency of 93.2%. This proves that the suggested loss model is accurate and dependable, and it shows that it can accurately forecast how the 1kW TLC converter would operate.

CONCLUSIONS

Because it significantly affects system size and efficiency in controlling battery power, the choice of bidirectional dc/dc converter architecture is crucial to the performance of battery/UC hybrid EV. The efficiency of the converter decreases with increasing switching losses, and this impact is more pronounced at higher switching frequencies. This study proposes a three-level non-isolated bidirectional dc/dc converter (TLC) as the power electronics interface between the battery and UC in place of the traditional two-quadrant buck/boost converter (CBC). This modification is anticipated to increase conversion efficiency and decrease the size of magnetic components.

The study focuses on the three-level converter in particular, comparing its magnetic component size and performance to that of CBC and interleaved bidirectional converters. UDDS drive cycles are used to test these parameters. The results show that the TLC converter has the smallest magnetic component size and is the most efficient while all of the driving cycle conditions are met, especially at high switching frequencies. Battery/UC hybrid EVs may benefit from the three-level, non-isolated bidirectional dc to dc converter architecture, as these features.

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Boosting the Performance of PV-based Inverter Systems Adopting the Particle Swarm Optimization (PSO) Approach

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ABSTRACT

The PV system's maximum power point (MPP) is nonlinear and depends on irradiance and temperature. Some situations allow many local maxima, but there is only one real MPP. This affects PV system power output, dependability, and complexity. Traditional approaches are slow and inaccurate for MPP determination. PSO is better for reducing steady-state oscillations in the inverter output current and voltage waveform. PSO is used to optimize inverter switching. In MATLAB, a PSO-based control algorithm and PI controller generate an error voltage, which is analyzed by the PSO controller to enhance switching. The photovoltaic bridge inverter system to reduce Total Harmonic Distortion (THD) and enhance power quality includes the PV array, DC-DC converter coupled in series, inverter fed by PSO-based controller, filter circuit, voltage and current sensors, and load. This model predicts PV system performance better when irradiance varies slowly. Photovoltaic power systems use controlled DC/DC boost converters called Peak Power trackers. Controlling the DC/DC converter conversion ratio maximizes solar panel output power. DC-DC converters connect modules and loads. Boost mode DC/DC converters are the most significant switching regulators. The PSO-based technology iteratively improves inverter switching and constant current and voltage waveform over a set time interval. This article analyses PV systems without and with PSO. PSO improves current and voltage waveforms, reducing steady-state oscillations. FFT study reveals that THD (IEEE Std.519) with PSO-based controller meets IEEE standards. System dependability increases.

KEYWORDS *: Maximum power point (MPP), Total harmonic distortion (THD), Photovoltaic.*

INTRODUCTION

Due to expanding populations and technology, global energy consumption is rising daily. But our unstable electricity grid is causing major power shortages. India and China consume the most energy. Clean energy and energy efficiency are needed to fulfill projected energy demands due to worldwide warming. Energy engineers worldwide are focused on solar projects to increase generation capacity. Solar modules form solar systems. Cells create modules, which are joined to form the PV system. The panel's DC voltage is transformed to AC for grid power [1]. Notwithstanding advancements in technology, grid-connected PV systems are always complicated. The latest soft computing approaches enhance inverter switching under various environmental situations. PSO [2] is an efficient meta-heuristic for finding optimal solutions. Swarm behavior-based PSO is easy to design. PSO-based controller architecture improves inverters' switching effectiveness.

According to the publication "An improved particle swarm optimization" by [3] a PSO-based control technique is crucial for damping steady-state oscillations. They suggest a new maximum power tracking method based on a modified PSO technique for inverter-fed PV systems. They also suggested a way to monitor the MPP in the face of severe climatic shifts, such as significant variations in insolation or a partially shaded area. In addition, MATLAB simulations are performed under highly difficult conditions, such as

sudden changes in irradiance, sudden changes in load, and partial shadowing of the PV array, to assess the efficacy of the suggested strategy.

They propose a novel MPPT algorithm by introducing a PSO technique, as described in their paper titled "MPPT of multiple photovoltaic arrays: A PSO Approach," which was presented at [4]. Using this PSO approach, the authors proposed a PV system in which the global MPP could be found in a relatively short amount of time. Lower costs, greater overall efficiency, and ease of implementation are the results of the suggested algorithm's use of a single pair of sensors to operate many PV arrays. The algorithm's reliability was tested under a variety of challenging partial shading scenarios.

In their study titled "Particle swarm optimization," the authors [5] present a notion for the optimization of a non-linear function using particle swarm methods. Several models' histories are summarized, and a model's actual implementation is addressed. Applications, such as the optimization of nonlinear functions and the training of neural networks, have been suggested, and benchmark tests of the model are given. It is explained how PSO is related to both AI and genetic algorithms.

When applied to a single-phase grid-tied photovoltaic system, the research in [6] demonstrates that an MPPT strategy based on the PSO method is both practical and performance-oriented. Due to the nonlinear nature of the voltage-current characteristic curves of solar panels, local and global maximum power points can manifest under partial shade situations. However, most conventional MPPT approaches fail to localize the optimal PV array location for maximum power extraction. To get over this issue and get the most power out of photovoltaic setups, an MPPT-PSO-based technique is employed to find the optimal global point. The efficiency of the suggested MPPT method may be shown through numerical simulations by contrasting it to the standard Perturb and Observe (P&O) method.

According to the "Particle swarm optimization" study [7], it is possible to use PSO as an alternative MPPT methodology. When the PV setup is subjected to a circumstance like partial shading, the suggested method will locate the point of the highest global power output. Several PSO-based MPPT strategies have been detailed [8] in published works. The investigation's technique, nonetheless, encompasses a variety of approaches, both in terms of its mode of execution and the number of particles employed to locate the highest global PowerPoint.

The provisions of the article in the following order: Section 1 introduces the basics of the papers. Section 2 discusses the methodology and PV-based inverter research and methods for continuous output to improve switching. Section 3 explains system model development. Section 4 discusses the findings of the paper and last section 5 concludes.

METHODOLOGY

The goal of this MATLAB/Simulation-based study is to bring total harmonic distortions down to inside a suitable range in a PV-based inverter system. Here, a soft-computing methodology known as PSO is employed for this reason. The article's central idea is to apply a PSO-based control technique to enhance the inverter's switching performance for PV systems. To meet the load requirement without interruptions, there are several ways to boost the system's switching effectiveness.

Inverter Modulation Techniques

To provide an output voltage that is as near to a sinusoidal waveform as possible, inverters employ a modulation method [9]. To lessen the impact of harmonics and cut down on switching losses, a wide variety of modulation methods have been devised. As may be seen in Fig. 1 [9], inverters' modulation techniques can be categorized in terms of switching frequency. Many commutations of the power semiconductors occur during the fundamental output voltage period in methods that work at high switching frequencies. The traditional carrier-based sinusoidal pulse width modulation (SPWM) is widely used in industrial settings because of its efficacy at lowering load voltage harmonic distortion through phase shifting. The SVM approach [10], which has been implemented in three-level inverters, is still another intriguing alternative.

The output voltages of these methods have a staircase waveform because one or two commutations of the power semiconductors are performed per output voltage cycle at low switching frequencies. Both space-vector control (SVC) and PSO-based selective harmonic elimination

fall under this category. Wide linear modulation range, reduced switching loss, lesser THD in the spectrum of switching waveform, easy implementation, less memory space, and less computation time on implementing in digital processors are just some of the goals of the various methods developed for inverters [11]. Carrier-based PWM (sine-triangle PWM or SPWM) and space vector-based PWM are the two most used PWM algorithms for multi-level inverters. It is difficult to extend SPWM schemes into the over-modulation range, although they are more versatile and easier to implement than PWM. However, the maximum peak of the basic element in the output voltage is set at 50% of the DC link voltage. In SVPWM systems [12], the inverter switching vectors and their durations within a sampling period are calculated by repeatedly sampling a reference space vector. The instantaneous amplitudes of reference phase voltages are all that's needed in a space phasor-based PWM method for multi-level inverters.

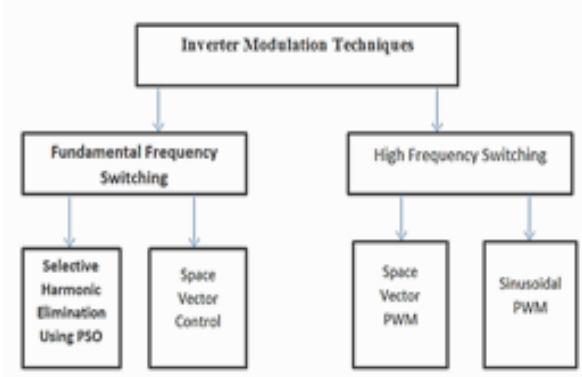

Figure 1. Strategies for Modulating Inverter Outputs

THD optimization using PSO

THD analysis of a PSO-optimized, single-phase, cascaded inverter. This will reduce the number of unwanted harmonics in the voltage signal produced by the inverter. To achieve a THD of less than 5% with as few semiconductors as possible, the inverter's operational settings have been varied in terms of stage count, source voltage, and switching pattern. Harmonic elimination and thus THD reduction in an inverter-based PV system are highly dependent on the inverters' control technique. Injecting sinusoidal current into the utility grid while keeping harmonic distortion to a minimum is the primary goal of every grid-connected PV inverter's design [13]. Because of this, the inverter's current management and harmonic compensation approach is the focus of this study to effectively reduce the impact of the higher-order harmonics. PSO has been used effectively in a wide variety of fields. It is shown that PSO achieves better outcomes in a shorter amount of time and at a lower cost than competing methods [14]. PSO's simplicity in configuration is another selling point. With some tweaks, the same version can serve many purposes. Many different kinds of applications have been found useful for particle swarm optimization, both general-purpose ones and those tailored to meet a very specific need.

SYSTEM DEVELOPMENT

The I-V Characteristic of an STC-Tested PV Considering into account just one PV module hooked up to a load, as in Fig. 3. The load could be a battery or a dc motor powering a pump. The module in the sun will generate an open-circuit voltage VOC before the load is connected, but no current will flow. The short-circuit current ISC will flow if the module's terminals are connected, but the output voltage will remain at 0 volts [15]. No energy is transferred from the module to the load or vice versa since power is the product of current and voltage. Some current and voltage will result and power will be transmitted when the load is truly connected. The I-V characteristic curves of both the module and the load must be taken into account to calculate the required amount of power.

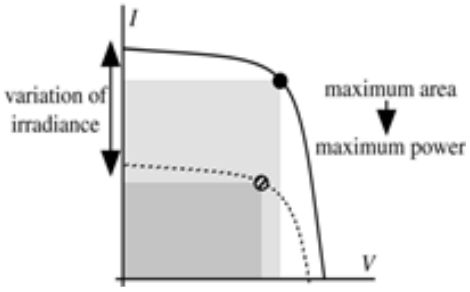

Figure 2: The Solar Cell's I-V Phenomenon

Figure 2 depicts an I-V curve typical of a PV module, from which we may determine the open-circuit voltage VOC and the short-circuit current ISC, among other important metrics. The module's output power, calculated by multiplying the voltage by the current, is also displayed. Because either the current or the voltage is 0 at the two extremes of the I-V curve, the output

power is also zero. The MPP occurs when the product of current and voltage is at its highest point at the knee of the I-V curve [16]. Depending on the particular facts that align with theoretical test settings [17], the voltage and current at the MPP may be referred to as Vm and Im for the overall scenario, or VR and IR (for rated voltage and rated current), respectively.

Fill Factor

Finding the largest rectangle that fits under the I-V curve is another mental exercise that might help you picture where the maximum power point is located. Figure 6 illustrates that power is represented by the size of the rectangle whose sides represent current and voltage. The fill factor (FF) is another metric used to describe module effectiveness [17]. The FF can be thought of as the ratio of two square areas since it is the ratio of the power at the greatest power point to the product of the volume of the enclosure (VOC) and the internal surface area (ISC).

Fill Factor = Vm * Im

VOC*ISC (1)

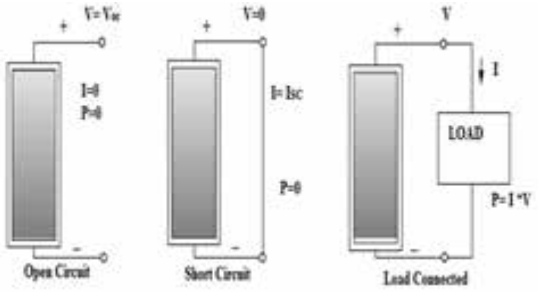

Figure 3: Open circuit PV Figure 4: Short circuit PV Figure 5: Load-connected PV

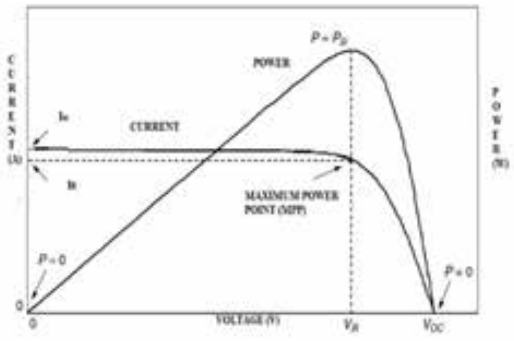

Figure 6: Under Standard Test Conditions, the I-V curve and power output of a solar cell module

Standard test conditions (STC) have been devised to allow for fair comparisons between modules, as PV I-V curves fluctuate all over the place when insolation changes and as the temperature of the cells varies [18]. These conditions involve an air mass ratio of 1, which is equivalent to a solar irradiation of 1 kW/m2 with a spectral distribution. For most tests, it is recommended that the cells be kept at 25 degrees Celsius (this refers to the temperature inside the test cells, not the room temperature).

Total harmonic distortion (THD)

To quantify the degree of harmonic distortion in a signal, we can calculate its THD by dividing the sum of the powers of all harmonic components by the power of the fundamental frequency [19]. Both the linearity of audio systems and the quality of electric power are measured and described with THD. The phrase distortion factor can be considered a synonym for this one. The THD of a power system can be reduced by decreasing peak currents, heating, emissions, and motor core loss. The efficiency and effectiveness of power management and use are profoundly impacted by [20] distribution system power quality. Particularly after the second part of the twentieth century, when various new electronic power sources distorted power system waveforms, this became the case.

Non-linear loads posed by power generators cause a distorted, harmonically rich waveform to be drawn [21]. In addition to disrupting phone transmissions, these harmonics can damage motors and transformers by degrading their conductors and insulators. The cumulative impact of these harmonics must be calculated. THD refers to the accumulated effect of all the system's harmonics. This section will make an effort to define THD and discuss its implications for electrical devices [22]. APT's series of programmable sources have a low THD, which will be discussed along with its usefulness in testing. Understanding THD can be difficult. It's not hard to grasp the concept once you learn the fundamentals of harmonics and distortion. Think of an AC power supply and an electrical demand.

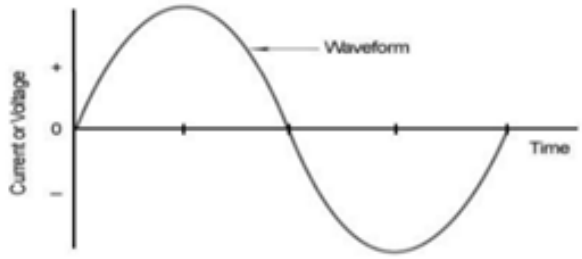

Figure 7: Ideal Sine wave

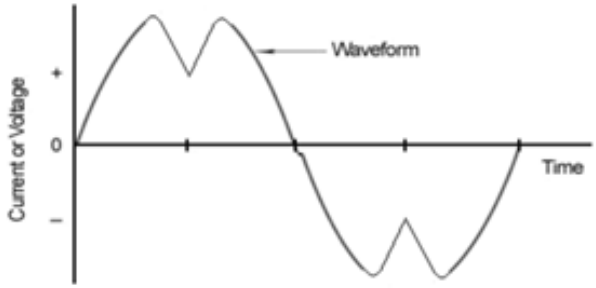

Figure 8: Distorted Waveform

Now, picture this burden falling into one of two broad categories: linear or nonlinear. The power quality of the system is going to change depending on the sort of load. This is because different loads require different amounts of current. Sinusoidal in nature, the current drawn by linear loads does not significantly alter the waveform. Typically, we refer to home appliances as linear loads. However, non-linear loads are capable of requiring a non-sinusoidal current draw [23]. Due to the deviation of the current waveform from a pure sine wave, distortions in the voltage waveform are produced.

The sinusoid's shape may be significantly changed by waveform distortions, as seen by the pattern of waves in Figure 8. The fundamental waves are a combination of several waveforms known as harmonics, regardless of how complicated they may be. Integer multiples of the fundamental frequency of the shape of the wave make up the ranges of harmonics. The second, third, fourth, and fifth harmonic parts, for instance, will be at 100Hz, 150Hz, 200Hz, and 250Hz, accordingly, for a waveform with a fundamental frequency of 50Hz. As a result of adding together all of these harmonic components, distortion caused by harmonics is the degree to which a waveform departs from perfect sine values. The perfect sine wave contains no harmonics. In such a situation, nothing can alter this flawless wave. The average of all the harmonic elements that make up a voltage or current waveform measured versus the basic element is known as a total distortion of harmonics or THD.

The ratio of the root-sum-square value of the harmonic makeup of the voltage to the root-mean-square value of the basic voltage is referred to as the overall harmonic distortion of the voltage waveforms.

$$\%V_{THD} = \sqrt{\frac{V_2^2 + V_3^2 + V_4^2 + V_5^2}{V_1}} \times 100 \quad (2)$$

Harmonic to the max root sum square value of the harmonic substance of the current divided by the root mean square value of the simplest present is the distortion of the waveform at the moment.

$$\%I_{THD} = \sqrt{\frac{I_2^2 + I_3^2 + I_4^2 + I_5^2}{I_1}} \times 100 \quad (3)$$

The eqn. (2) & (3) calculate %THD for voltage and current signals. The outcome is a percentage of harmonic elements that correspond to signal fundamentals. The main signal aberration increases with percentage. Harmonic distortion destroys electrical components. Inappropriate distortion raises electrical system current & and neutral conductor along with distribution transformer heat. Higher frequency harmonics induce motor core loss and overheating. Higher-order harmonics that oscillate at the transmit frequency can likewise impact information lines. Extreme temperatures and interference can harm electrical systems and limit the lifespan of electronic gadgets.

Modifying Inverter Switching with PSO

When used in conjunction with a PI controller, PSO can improve power quality by bringing THD levels down to within IEEE tolerance limits by maintaining a constant output waveform of current and voltage at the inverter's output. PSO searches begin with a random beginning guess, and the search region can be explored through continual duty cycle updates, which aid in dampening steady-state oscillations near MPP. The capacity to enhance inverter switching in harsh environments and the lack of steady-state oscillations at MPP are the two main features. The initial duty cycle selection is a drawback. When the duty cycle values fall outside of a

known range, the number of iterations required by the method to find the global maximum increases. Because of this, power generation is diminished. As a result, initial duty cycle constraints must be defined.

PSO Technique for Utilization

First, establish a bound on the particle's position and velocity, as well as the number of particles and search parameters. Phase two: Initiate at Sporadic Particle position and motion is calculated. Phase three: Determine each particle's fitness level. In the fourth stage, the particle with the highest fitness value is designated as Gbest (Global Best). The fifth step is to revise each particle's position and velocity in light of the Gbest. Repeat steps 3 and 4 until an optimal solution is found (6th step). The last iteration's value, indicated by the variable Gbest, is the one that has been optimized. Eighth, use the provided formula to determine the duty cycle.

PSO with Adapted Species for Harmonic Elimination in Inverter Devices

A particular strategy employs a specialized form of PSO to cut down on inverter harmonics. An inverter's harmonic elimination issue is a nonlinear transcendental solution optimization issue with many local minima. Species-based PSO (SPSO) represents a revolutionary PSO strategy, and it is used here to solve the harmonic elimination issue. The initial version of SPSO was tweaked, making it a more reliable method for locating the search space's global optimum. When the number of switching angles increases, the suggested approach can locate the optimal ones, whereas traditional iterative approaches and the resulting theory method are unable to do so. The output voltage has very low overall harmonic distortion and switching frequency, and the findings reveal that the suggested approach successfully minimizes a significant number of specific harmonics.

Simulation Study

Power electronics and MATLAB have many uses, including but not limited to robotic controls; industrial automation; automotive; industrial drives; power quality; energy from renewable sources systems; and automation in industries. Particularly, MATLAB can be utilized to choose the system according to needs and to determine particular parts for the Solar PV applications when the power plant is even installed. In this article, we'll investigate the usefulness of MATLAB and the toolboxes it comes with for modeling and simulating solar PV systems, with a focus on evaluation and development.

Here, different subsystems are built in a MATLAB program for constructing a PV system with or without PSO. The PV system is one such thing. Analyzing PV modules using their data sheets. This device is set up for series connections thanks to its IPV input. It is a temperature-independent static model. Logic Gate The developed subsystem has the following specifications: Short Circuit current = 8.83 A, Voc = 37.4V, Imax = 8.31 A, and Vmax = 30.1V. The diode is used as a bypass. This is done to prevent hotspots in partial shade situations and to avoid reverse current flow when connecting strings in parallel.

Implementation of PV-based Inverter System without PSO

Both the PSO-free and PSO-based versions of an MPPT-based photovoltaic converter can be implemented in MATLAB. A PV array, DC/DC boost converter, inverter, PID controller, and RL load make up the system. The controlled voltage for the boost converter comes from the PV voltage VPV produced by the PV array. To dampen voltage swings from the PV array, a MOSFET switch, an inductor L of 0.1mH, and a capacitor connected across the array make up the DC/DC boost converter. The PWM technology used to operate the switch has a switching frequency of 20kHz.

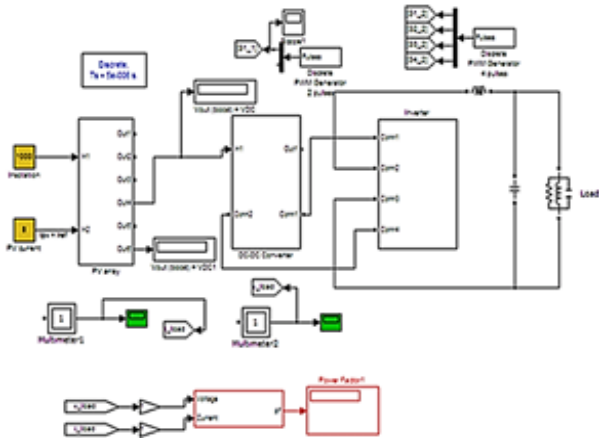

Figure 9: Using MATLAB/Simulation to Build a PV Inverter Without a Power-Sharing Organizer

FINDINGS AND DISCUSSION

Figures 10 and 11 display the current and voltage waveforms without PSO, while Figures 12 and 13 display the same data with PSO. This suggests that the output power changes and does not remain constant over the stated time frame, as evidenced by the current and voltage waveforms showing some peaks over this range. That's why they're to blame for the strategy's complicated burden.

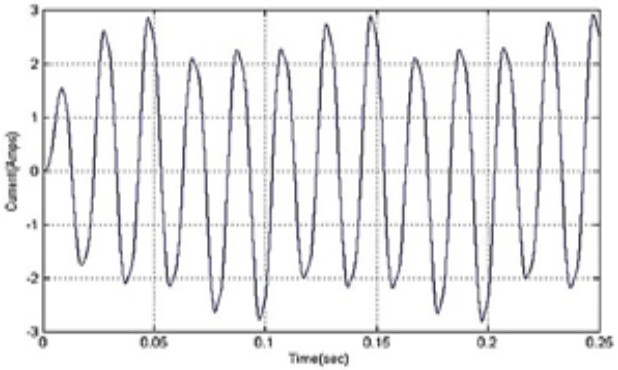

Figure 10: Current waveform excluding PSO

On the contrary, it has been noted that if the photovoltaic system is modeled and simulated using the PSO control method, the resulting current as well as voltage waveforms indicates steady state value for both current and voltage, thus the output power is kept constant throughout the time interval.

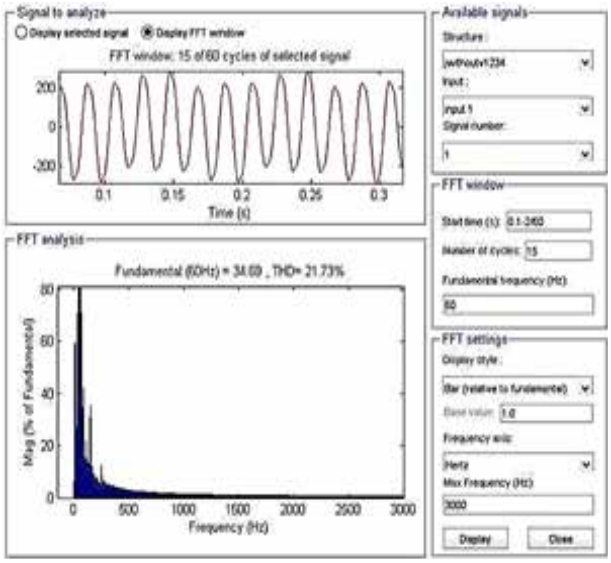

Figure 11: FFT analysis excluding PSO

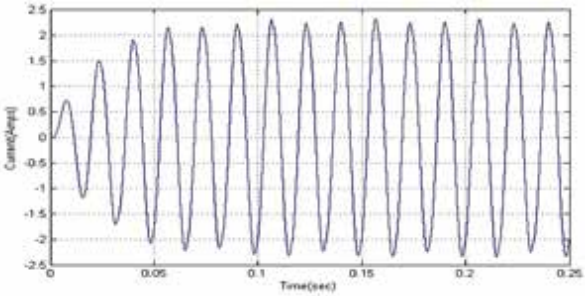

Figure 12: Current waveform including PSO

FFT investigation is performed with waveform evaluation. Figure 12 shows that without PSO, the PV technique's Total Harmonic Distortions represent 21.80%, while Figure 13 shows that they are a manageable 2.80%, well within IEEE limits.

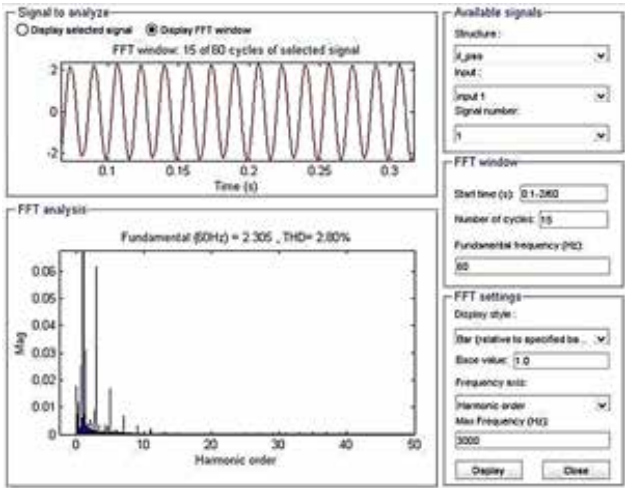

Figure 13. FFT analysis including PSO

Total Harmonic Distortions are 21.80% for a PV system without PSO, as shown, while Fig.13 shows that the entire system meets the requirements of the IEEE with just 2.80%. Thus, PSO allows for a more exact implementation of PV-based inverter systems by reducing %THD when compared with systems having PSO. The advantages are self-evident

CONCLUSION

This article creates a MATLAB simulation of a PV-based inverter system utilizing PSO without including it. The presented model shows that this PV system is employed to lower THD and, by extension, boost the quality of the electricity produced. It is made up of a digital controller, the PSO-based controller, that can

improve the inverter switching and make the system work for any given load and duration. The THD has been decreased by this. By contrasting the inverter's output both with and without the PSO method, one can find that the latter yields better outcomes.

Therefore, the PSO method can be used in photovoltaic systems to bring down THD to manageable levels. Last but not least, this boosts the system's dependability. Not only does this system increase the inverter's switching under extreme circumstances, but it additionally stabilizes itself by decreasing steady-state oscillations at MPP. Yet, ensuring optimal performance of the equipment and a longer life lifetime is made possible by maintaining low THD levels on an entire system.

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Using A Laser Security Application, An Automatic Gate System

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ABSTRACT

This article uses an Arduino UNO, a buzzer, a laser light, and straightforward software for forming a security system. With this technology, we can set up a security alarm for unauthorized intruders anywhere. Safety is more and more important in all fields as technology develops and grows daily. Everyone wants their private area which only they can access. Therefore, we need to protect our room, office, locker, etc. The "Password-based gate lock system by using Arduino" has been created in the suggested work. This item is a password- or pin-protected computerized gate lock. Which requires the user to enter the proper password or PIN code to access the gate? In this paper, a basic IOT gateway implementation proposal for use in a home IOT environment is presented. It is based on the Arduino microcontroller. The author focused their study on the system's security and performance. The performance and capacity limits of the implemented gateway were examined through load experiments and denial-of-service attacks.

KEYWORDS *: Security system, Laser, Arduino, Face detention, IOT.*

INTRODUCTION

Considering the present scenario, security is a key consideration. Every day, new technology is developed worldwide. The criminal organization develops new technology to carry out its operations [1]. Therefore, security technology needs to be up-to-date and resilient to safeguard against crime. In this article, a vast area has been covered using laser light. We know laser light travels through long distances without scattering effects [2]. The conventional approach requires an excessive quantity of paperwork and is more prone to human error. By removing the drawbacks of conventional techniques and concentrating on enhancing their benefits, highlighting the most recent technical developments can help in the development of innovative systems. [3]. Here is a security device that makes use of a cheap laser torch that is typically included with a key chain. The benefit of this security lock is that any laser pointer or torch that is readily accessible in toy stores can be used [4].

Author J.A. Dharne's automatic gate management system utilizing number plate recognition and OCR: Every day, new technology is developed worldwide. The criminal gangs of today continue to advance their technology to run their business. Therefore, security technology must advance over time to keep the globe free from crime [5]. A microcontroller called Arduino Uno is employed in the suggested setup. In the suggested system, Arduino is primarily used to offer a platform for digital devices to connect with interactive items that can sense and control physical equipment. [6]. These two characteristics enable us to create a cutting-edge security system that we might refer to as the "Laser Security System. "Anytime a person or item passes in front of the laser light, the buzzer automatically sounds[7].Automatic railway gate management

by Chandan Ray using an Arduino [8]: Presently, transportation is a necessary mode of transportation that many people use regularly. The main focus of this post is the automatic railway gate control using Arduino UNO, buzzer, LED, IR sensor, etc.[9]. For additional safety purposes, a GSM module is used. Railways are one of those transportation mediums. Controlling automatic train gates with an Arduino Chandan Ray, the author in today's society, transportation has developed into an indispensable tool and is now a common part of many people's everyday lives. Railroads are one of those transportation modes, and this article primarily concentrates on railroad automation, specifica lly an Arduino UNO, a buzzer based automatic railway gate control [10]. You can more precisely control who has access to your property thanks to these tools. Automated gates increase protection and improve perimeter control. You can cut down on the likelihood of crimes like larceny and vandalism because you have control over who has access to your property [11].

Unauthorized access can be prevented by having a lock that holds the fingerprints of one or more users and opens the system when a match is found[12]. The skin on our hands and soles displays a flow-like pattern of ridges on each fingertip that is distinct and unchanging, making biometric authorization one of the greatest characteristics [13]. As a result, everyone may be identified by their fingerprints. Recent hand-held gadgets like mobile phones and computers feature fingerprint scanners, which makes it simple to infer their popularity and dependability [14]. With biometrics, a special pattern will be utilized as the key. We will utilize a fingerprint as the key in this case to implement the article. The security lock will be implemented using a variety of gadgets, each with a unique function to raise the level of security, in this Arduino article [15].

Simply put, we might say that we are using Arduino to create a door access system that analyzes fingerprints to decide who we should let inside and who we shouldn't. To keep the device's price as low as possible, we are attempting to create it using a typical, basic door lock that is installed in every home [16]. One kind of security system that uses lasers to find intruders is a laser security system. The device operates by directing a laser beam through a room or other area and then detecting any disturbances in the beam caused by an intruder [17]. If the beam is disturbed, an alarm is triggered, alerting the owner of the system to the presence of an intruder. Laser security systems are often used in high-security environments, such as banks, museums, and government buildings. For deployment, experimental results and Simulation can be used, and the modeling results indicate the improved proposed controller performance[18]. This paper describes in the following sections, the methodology that is adopted, some of the reviews based on observation, and the overall conclusion which has the base of previous sections.

METHODOLOGY

This section goes into great depth about the processes and methods used in the conception, creation, and use of an automatic gate. The automated gate was constructed using both mechanical and electronic components. The single-phase electric motor, the Arduino Uno IR sensor buzzer, and the relay circuit are the electrical parts used to build the control circuit for the automatic gate Magnetic connections; and control keys for both heat overload valves and circuit breakers. Cables, breakers, an alert circuit, and signal lights [19] [20].

Creating a fingerprint-based security system using an Arduino board and a fingerprint sensor is important because thefts are getting worse daily, and security has become a key issue. Therefore, securing our home or locker is made simple by a digital fingerprint lock [21] You'll be able to follow the proper fingerprint entry. A fingerprint-based door lock system allows only authorized people access to the restricted ones. The entire article is controlled by the Arduino [22].

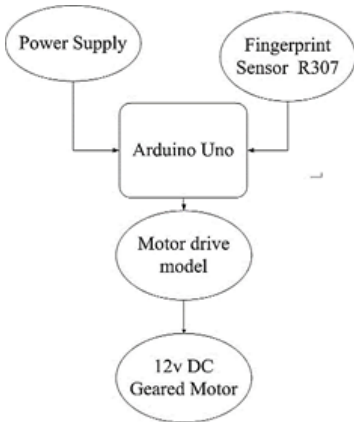

Fig. 1 Laser Security & Automatic Gate Way System

Arduino UNO

The Arduino UNO is the best board for learning to code and solder circuits. If this is your first experience experimenting with the platform, the UNO is the most robust board you could start with. The most well-known and thoroughly documented device in the Arduino family is the UNO board. [23]. This is made with the open-source Arduino platform. With Arduino, you can use a piece of software called the IDE (Integrated Development Environment) that runs on your computer to create and upload computer code to a physical programmable circuit board, also known as a microcontroller [24].

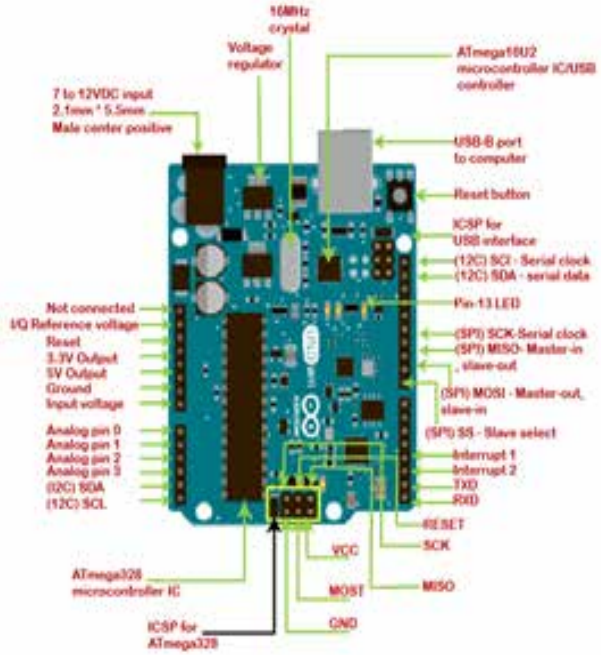

Fig. 2 Arduino UNO

The Arduino may be programmed and started from a different location via these pins. These pins facilitate communication between multiple Arduino boards and enable firmware uploading. When programming or starting the Arduino, the ICSP pins function like an AVR programmer [25]. The Arduino board itself has a push button on top that is designated as the RESET key. It may be blue or white. Pressing it has the same effect as turning the power source on and off again [26]. The board will not begin executing any of the instructions in the sketch until after a new design has been uploaded.

A TTL-USB converter is needed for direct module connection to the PC without an intermediary microcontroller or comparable platform. The LM358 may be used as a DC gain block and transducer amplifier. A voltage regulator is a part that delivers a constant output voltage regardless of variations in the input voltage. A three or more-pin integrated circuit (IC) is what it is. The Arduino's digital inputs (also known as digital I/O) are what enable you to connect other integrated circuits (ICs), actuators, and sensors to the board. When a barrel plug is put into the jack, the jack's spring pulls against the plug's outer sleeve, forcing the jack's central pin to make contact with the plug's inner sleeve.

With its on-chip trimming, this fixed regulator can achieve its voltage output tolerance of 1% while offering much protection and stability for your article. These voltage regulators each have a maximum output current of 800 mA.This fixed regulator offers excellent stability and safety for your article, and because of its on-chip trimming, it can achieve an output voltage accuracy of less than 1%. Each of these regulators for voltage has a maximum output current capacity of 800 mA [27].

The Multi-Flex's Tx and Rx LEDs show whether it is transmitting or receiving messages over the RS485 network. Each time the multi-flex responds to the E2 by sending a signal, the Tx LED blinks once. When a message is received by the Multi-Flex, the Rx LED blinks once.

Resonators perform similarly to crystals but are less expensive and do not need additional caps. The temperature range for these resonators is +/-0.5% or better. There is no need for external caps because these resonators contain built-in load capacitors [28].

ICSP for ATMege328p

ICSP programming is a method of programming microcontrollers while they are still connected to a circuit. This allows for the programming of the microcontroller without having to remove it from the circuit. The Atmega328p microcontroller, which is commonly used in Arduino boards, can be programmed using the ICSP method. The programming is done through six pins on the microcontroller that are used to transfer data and commands [29].

ATmega328p Microcontroller

The ATmega328P is a microcontroller that is commonly used in Arduino boards. This 8-bit, low-power CMOS microcontroller has AVR upgrades and is based on the RISC architecture [30]. It features 32KB of flash memory, 2KB of SRAM, and 1KB of EEPROM for non-volatile data storage, together with 32KB of flash memory for storing code. It contains 6 analog inputs, 23 general-purpose I/O pins, 6 PWM output pins, and 6 general-purpose I/O pins. It also has a variety of communication interfaces, including SPI, 12C, and USART. The ATmega328P is a versatile microcontroller that is used in a wide range of applications, from robotics to home [31].

Analogue inputs

The Arduino can input and output analog signals in addition to digital signals. An analog signal can have any number of values, in contrast to a digital signal, which only has two values: HIGH and LOW.

Motor drive model

CPU: ESP8266(LX106) Community Developer: ESP8266 Opensource Introductory Power:

The L293 is a popular motor driver IC that can control two DC motors or one stepper motor. It is an H-bridge driver, which means that it can control the direction of the motor by reversing the polarity of the voltage applied to it. The L293 can handle a maximum current of 600mA per channel and can operate on a wide range of voltages, from 4.5V to 36V. It also has built-in protection diodes that prevent damage to the IC from the back EMF generated by the motor. The L293 is commonly used in robotics, automation, and other applications that require motor control [32]. There are more nonlinear loads in the system, which introduce harmonics and cause a variety of power quality issues [33].

Fig. 3 Motor drive model

Finger-prints sensor R307

The fingerprint sensor module shown in the accompanying image made it easier and more economical to include fingerprint identification in this article [34]. This suggests that collecting, registering, comparing, and searching for fingerprints is fairly straightforward. These modules can store fingerprints in FLASH memory and may be used with any microcontroller or TTL serial system [35]. These elements can be included in security systems. the door locks, the clocks.

Fig. 4 Finger-prints sensor R307

12 V DC geared motor

A DC motor is any spinning electric motor that generates mechanical energy using direct current (DC) power. The most common types rely on the forces produced by the generated magnetic fields that the coil's current induces. To keep the intended DC working voltage, a finite energy storage capacitor terminates the voltage-sourced converter on the DC side. Therefore, the converter's functioning switch array serves as the conduit via which the DC capacitor communicates with the AC system.By injecting both current and voltage into the line at a subsynchronous frequency component, network damping may be increased. to occasionally change the current's direction in a particular section of the motor [36], Nearly every kind of DC motor has an internal mechanism. This system might be electrical or electromechanical. The functioning of a brushed electric motor including a two-pole rotor (armature) and a permanent magnet stator. On the magnets' inside axis faces, polarities are indicated by the letters "N" and "S"; the opposing polarities are shown on the outer faces.

Fig. 5 12 V DC geared motor

LDR Sensor

LDR Sensor Light Resistance: 50-100 Ohms LDR Rated Power: 200 W, Diameter: 3-20 mm, Application: Phot- resistor.

Fig. 6 LDR Sensor

Laser

A laser is a technology that causes light to be emitted at specific wavelengths and then amplifies that light, creating a highly narrow beam of radiation. Visible, infrared, or ultraviolet wavelengths are often only briefly covered by the emission. The features of the many distinct types of lasers that have been produced are quite diverse. The word "laser" is an abbreviation for "light amplification by the stimulated emission of radiation [37].

Fig. 7 Laser

Fingerprint Sensor Interface

Over half of all biometric safety devices use fingerprint scanning, the most used biometric technology, and it is easy to see why. We save an ever-increasing amount of data on the devices we use and distribute it in ever-more-dangerous ways online. Most of the time, simply a few hurriedly selected digits are used in our passwords to safeguard our financial and personal data.

The fingerprint sensor works on the principle of processing which includes two elements enrolment & matching. In enrolment, each individual has to put the finger on the sensor device, so that the device checks the fingerprints to process & generate the finger pattern & it will be stored [42]. In matching, once an individual places the finger then the system will generate a pattern of the finger &compare it with the stored data. So a fingerprint sensor is used to authenticate and recognize the fingerprints of a person. These sensors are very reliable and secure devices used for any security authentication [43].

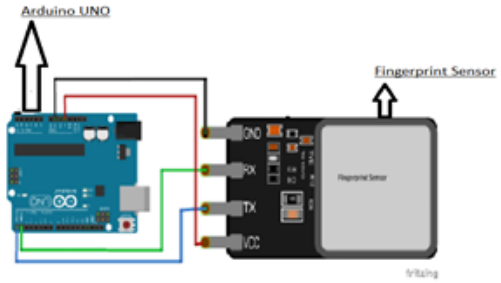

Fig. 8 Fingerprint sensor

Laser Security

A laser-based security system is one kind of security system that uses lasers to detect intruders. The system which works by emitting a laser beam across a room or other area and then detecting any disturbances in the beam caused by an intruder [44].

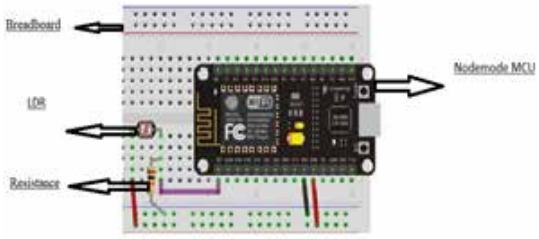

Fig. 9 Fingerprint sensor

If the beam is disturbed, an alarm is triggered, alerting the owner of the system to the presence of an intruder. Laser security systems are often used in high-security environments, such as banks, museums, and government buildings [45]

RESULT AND ANALYSIS

This section goes into great length regarding the steps involved in designing, building, and utilizing an automatic gate [38]. The control circuit for the automated gate was created using electric motors, Arduino Uno IR sensors, buzzers, and relay circuits. Control switches and a contractor. Circuit breaker and thermal overflow relay. Circuit breakers, signal lights, cables, and an alert system [39]. The metal framing, the metal gear in the gate rack, the rollers, the cantilever rollers, the counterbalance post, the last post, and the counterbalance are a few of the mechanical components used in the design and construction of an automated gate.

Fig 10 Laser Security Result

We are demonstrating the parts for the Arduino-based fingerprint gate lock and connecting them to the power source [40]. This approach is based on enhancing security and registers the owner's fingerprint into the Arduino using a fingerprint sensor. The cable used for uploading code has also been utilized to supply the Arduino with 5 volts of electricity. After signing in, placing your thumb on the fingerprint sensor will release the solenoid lock. This will cause the solenoid lock to lock if you repeat it. Since locking and unlocking the solenoid lock takes less than one second, it is used in this article [41].

OBSERVATIONAL CASES

Case 1: The lock will open

Fig 11 Automatic Gate lock will be open condition

In this system, the gate latch is connected to the fingerprint scanner, which the user will input their fingerprints into. The machine scans the print, and then searches its database for a match. If a match is discovered, the latch releases, unlocking the gate [46]. The user has the same issue while trying to lock the door. If the fingerprint is accurate, the latch will close and the gate will lock behind the person.

Case 2: The lock will not open

Fig 12: Automatic Gate lock will be not an open condition

The door will remain locked if the fingerprint is entered incorrectly, forcing the user to retry until the door is opened. If the wrong fingerprint is scanned, the user will be informed to restart immediately [47].

CONCLUSION

The methods used in the design, construction, and use of an automatic gate are covered in great depth in this section. The control circuit for the automated gate was created using electric motors, Arduino UNO, IR sensors,

buzzers, and relay circuits. Control switches and a magnetic contactor. Relay for thermal overload and circuit breaker. cables, alarm systems, circuit breakers, and signal lights. Some of the mechanical elements used in the design and building of an automatic gate include the metal framing, the gate rack metal gear, the rollers, the cantilever rollers, and the counterbalance.

Since each fingerprint is distinct, the sensor can recognize every print during testing. It gives access to sites that are prohibited more control. This system has various downsides, including the fact that it is a closed system and is challenging to modify in terms of hardware. Additionally, it requires a lot of electricity to run, making it occasionally difficult to supply constant power using batteries. It won't operate if there's a power outage. In such a scenario, we may either connect the system to an IPS or upgrade the system with rechargeable batteries.

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Design and Development of Wheelchair cum Bed using Joystick Mechanism

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ABSTRACT

The design and Development of a Wheelchair cum Stretcher integrating a Joystick for wheelchair movement is a versatile solution for enhanced patient care in medical settings. This multifunctional apparatus combines the mobility features of a wheelchair with stretcher support, catering to diverse patient needs during transit. Incorporating a Wiper Motor ensures smooth movements, while the Heartbeat Sensor monitors health status. The IR Sensor and Buzzer enhance safety through obstacle detection and alerts. Additionally, the Joystick feature aids wheelchair navigation, especially beneficial for visually impaired individuals. This amalgamation of technologies prioritizes patient well-being and seamless transportation, reflecting a holistic approach to healthcare in medical facilities.

KEYWORDS *: Wheelchair, Bed, Joystick, Heart beat sensor, Ir sensor & buzzer notification, GSM module.*

INTRODUCTION

The creative combination of a wheelchair and stretcher with cutting-edge electronic components such as an IR sensor, heartbeat sensor, buzzer, and wiper motor represents a significant advancement in the field of health-related transportation solutions. There is a pressing need for flexible devices that can accommodate a range of patient needs due to the aging global population and growing needs for flexible medical equipment. The objective of this project is to satisfy this need by designing an intricate and multipurpose device that combines the features of a stretcher and wheelchair in a seamless manner, meeting a variety of patient needs.

One of the main features is the addition of a wiper motor, which provides accurate and controlled action that is essential for navigating the dynamic and frequently crowded spaces seen in healthcare facilities. In addition, the device's incorporation of a heart rate sensor adds a crucial component for healthcare monitoring. Continuous vital sign monitoring is critical when it comes to patient transportation. The Heartbeat Sensor makes it possible to track a person's pulse in real time, giving medical professionals quick insight into how they are feeling physiologically while in travel. This raises the bar for treatment and makes it possible to act quickly to address abnormalities. The integration of health monitoring and mobility functionalities emphasizes a patient-centered approach in healthcare settings.

The wheelchair/buddy stretcher's efficiency and safety are further enhanced by the addition of an infrared sensor and buzzer. The IR Sensor serves as a barriers detection system, enabling the device to recognize and avoid possible obstructions in its route. This is especially important in crowded areas like hospital hallways.

In addition, the Buzzer functions as an audio alert system, guaranteeing that in the event that impediments are identified, both the person using it and medical experts are notified. This feature dramatically reduces the likelihood of collisions, improving general patient safety while in transit.

In addition, the inclusion of joystick-operated navigation in the multipurpose device is worthy of note. The wheelchair can be easily maneuvered by using a joystick, which makes it more user-friendly and beneficial for people with restricted movement or vision impairment. This function highlights the inclusive features of the gadget by offering a feasible mobility solution for people with visual impairments in addition to making wheelchair operation easier.

The Pneumatically Managed Wheelchair Conversion Ambulated

Stretcher is designed to reduce the difficulties involved in moving clients from a wheelchair to a bed or stretcher in both home and medical environments. Two pneumatic cylinders, a compressor, a 5/2 valve directional control valve, and user-operated controls make up the main parts of the system. There are three main uses for the apparatus: raising the wheelchair and reassembling the stretcher. Depending on the mode chosen, the 5/2 Sensor Directional Controlling Valve directs pressurized air to the proper cylinder. Five to ten bars of pressure in the atmosphere are produced by the compressor. The hand rest's two push buttons make lifting and converting easier and are very user-friendly. Wheelchair mobility is managed by vertically positioned Cylinder C1. [1]

The primary goal of the study is to maximize patient comfort and transfer effectiveness while reducing the amount of muscle strain that patients endure during these changes. The system's adaptability makes it possible to use it for patient transfers in both households and medical facilities, providing mobility alternatives for senior citizens. They focus on designing and constructing a wheelchair-cum stretcher, which provides a useful and affordable alternative for moving patients between medical facilities.

Wheelchair to stretcher to bed and bed to wheelchair transfers are frequent challenges that can lead to stress, discomfort, and even mishaps for patients and caregivers. wheelchair and stretcher in working order Moreover, the system's hydraulic jack enables the stretcher's height to be raised or dropped, guaranteeing that it can accommodate varying bed heights. One noteworthy aspect of the initiative that makes it accessible to a larger range of healthcare facilities—especially those which cannot afford pricey automated technology—is its emphasis on cost-effectiveness. The research's authors emphasize the model's affordability, robustness, versatility, and low maintenance expenses.

When patients need to be moved from stretchers to vehicles in an emergency, the initiative might be useful.[2]

The amazingly creative Reconfigurable Wheelchair/ Bed Systems (RWBS) were developed by Aixue Ye, Wei Zou, Kui Yuan, Zhengdong

Xu, and Yanan Ren Department of Automated Chinese Academy of Sciences as a solution for the elderly and disabled. This system is centered around a reconfigurable wheelchair that has an advanced control system that includes a movement control unit, sensors handling device, intelligent interface between human and machine (HMI) unit, motion control unit, and main control unit.

The wheelchair may be used as a regular motorized wheelchair thanks to this extensive control system, which also allows the user to change the wheelchair's position and even turn it into a stationary bed. Notably, the touch screen technology allows the system to easily transition between various modes. This innovation's ability to convert from a docking to an adjustable bed frame with the push of a button, made possible via a visual feedback-controlled device, is one of its most notable characteristics. Given the nonholonomic motion limits wheelchairs usually encounter, this automation greatly lessens physical strain on users. The work provides evidence of the RWBS's efficacy in addition to merely explaining the hardware architecture. The research study reports on successful trials that validate the RWBY's capacity to meet the needs of the aged and disabled. Visual feedback control techniques are used to make sure the wheelchair docks into the bed frame smoothly.[3]

The wheelchair bed's dimensions are determined by taking the final users' physical measurements during the project's development, which adheres to ergonomic norms. The researchers use techniques like

value analysis and Quality Functional Deployment, or QFD, to establish technological components based on user requirements. This led to the creation of a wheelchair bed with a number of features, such as a lifting structure that allows medical experts to adjust the height of the bed to three different angles. It also has a foldable and expandable bed rail, a foot platform with a footplate which serves as the user's footrest, and a more comfortable and thinner mattress material. Every design decision starts with the user's comfort, safety, and convenience of use in mind.[4]

The goal of this study is to create assistive technologies that will improve the lives of patients and caregivers. Patients frequently face challenges after a stroke that call for nursing care and support. Healthcare workers who manually move objects and assist patients with bed transfers are more likely to develop musculoskeletal disorders. According to a startling survey, 78% of workers report having discomfort and pain in their upper limbs and back. The urgency of this issue led the researchers to design a bed that is easily obtainable, aiming to reduce the risks involved with direct patient care.[5]

The state-of-the-art accessibility solution developed by Doujin Wang and Hongliu Yu includes hardware and software that allows voice commands for driving and posture corrections, going beyond traditional electrical wheelchairs. The project underwent intensive testing and debugging to guarantee that spoken instructions would be successfully identified and utilized for controlling the wheelchair. This work presents the voice module, which is crucial for controlling driving and posture corrections.

Using the developmental insights from the voice control system, the subsequent research phase will execute the wheelchair design and perfect the wheelchair's mechanical components based on the prototype. Furthermore, there is a great deal of room for further research and creative expression with the freshly launched voice module. It establishes the framework for docking.[6]

Xingnan Liang, Xiuzhi Li, Songmin Jia, and Yanjun Sun present a docking control system that achieves dependable and effective docking by utilizing ultrasound in conjunction with a basic artificial landmark. Locating the artificial landmark inside the additional bed is the first step in the procedure. Using this point of reference, the global coordinates system will be built.

During the visual stage, the wheelchair's precise orientation and location in respect to the auxiliary bed are determined by the system using this landmark.

The wheelchair then uses ultrasonic distance sensors to go to the secondary bed, thereby completing the docking process. This docking process is carried out by programs such as WINCE and the Robotic Operating System (ROS). The technique's real-time capabilities are validated by these experimental results.[7]

Chentao Diao, Songmin Jia, Guoliang Zhang, Yanjun Sun, Xiangyin Zhang, Yuying Xue, and Xiuzhi Li have extensively investigated intelligent wheelchair beds (IWBs). Their research primarily focuses on the development of an obstacle avoidance program utilizing the Artificial Potential Field (APF) concept. In their work, ultrasonic sensors are employed to enable IWBs to continually and instantly navigate around obstacles [8].

With the help of its eleven ultrasonic sensors, the IWB is able to continuously monitor its surroundings. The ultrasonic sensors' relative measurements enable the device to accurately pinpoint barriers' locations. The recently developed APF approach, which essentially determines the IWB's future direction of motion based on positional coordinates, is then used to compute repulsive forces.

Introducing a Smart Wheelchair for Monitoring User Physiological Stress and Physical Activity strives to present an innovative wheelchair embedded with sensors and a robust platform for comprehensive data acquisition, processing, and communication. This cutting-edge system incorporates a multifunction I/O module and an embedded PC, integrating E-textile electrodes onto the wheelchair arms, accompanied by a discreet 3D MEMS accelerometer for monitoring physiological stress parameters and motion activity. Furthermore, the measurement of contact ECG and

skin conductivity is enhanced by the integration of piezoresistive flexible force sensors. The server application, meticulously crafted in LabVIEW and hosted on the embedded computer, transmits meticulously processed signals to a client application on various mobile platforms, including tablet PCs and smartphones [9].

Sumit Desai, Dr. S. S. Mantha, Dr. V.M. Phalle explores the prevalence of disability as a significant public health concern in India, underscoring the crucial role of wheelchairs as essential aids for personal mobility in "Advances in Smart Wheelchair Technology". The emphasis is on smart wheelchairs, specifically crafted for individuals confronting challenges such as visual acuity limitations, lack of motor skills, and strength issues, potentially impeding the use of conventional power wheelchairs. The integration of mobile robot technologies, in conjunction with advancements in fields like computer science, robotics, Artificial Intelligence (AI), and sensor technology, has paved the way for the development of smart wheelchairs. The paper introduces diverse prototypes devised by researchers, showcasing the evolving features within this domain [10].

The research by Siddhant Pawar1, Yogesh Kanade2, Hemant Singh3 explores the rising popularity of electric wheelchairs and investigates avenues for creating a durable, lightweight, and economically efficient design. Design and Analysis of Electric Wheelchair cum Stretcher highlights inventive engineering solutions in the chassis, motor, and powertrain system, with the goal of offering a comprehensive solution. Furthermore, the paper introduces the innovative concept of transforming the wheelchair into a stretcher, addressing the transport requirements for patients and goods in various settings like hospitals and industries. It encompasses detailed examinations of designs, calculations, and analyses for crucial mechanical components, including power transmission, chassis, and the stretcher mechanism.[11]

OPERATION

A wheelchair-cum stretcher that combines ease and adaptability with numerous essential elements improves performance. A linear actuator, an apparatus that can transform rotary motion into linear motion, is used in the conversion mechanism.

The linear actuator is utilized in this instance to enable the conversion of wheelchair and stretcher designs. The user may effortlessly transition between both modes thanks to the actuator's integration with the framework, guaranteeing flexibility in a range of situations.

The wheelchair is propelled by the wiper motor, a sturdy and dependable engine typically utilized in automotive settings. The wheelchair-cum stretcher obtains efficient and controlled motion by adding this motor. The strength and accuracy of the wiper motor contribute to steady movement and seamless transitions, improving the user's experience. An infrared (IR) detection system is used to identify obstacles. On the wheelchair/straddle stretcher, these sensors are positioned thoughtfully to identify obstructions in the surrounding area.

When an obstacle is detected, the system alerts the user by sounding a buzzer. This function increases safety and provides the user with the trust they need to navigate by immediately alerting them to possible obstructions. The wheelchair/stretcher design incorporates a heart rate sensor to offer vital health monitoring functions. The user-worn heart rate sensor and an Arduino microcontroller work together flawlessly.

The person's heart rate can be continuously monitored thanks to this integration, which offers vital health insights. If any abnormalities are found, the system can quickly indicate or sound an alert, guaranteeing that the user's welfare is attended to right away. Furthermore, the system's capabilities are further enhanced by the incorporation of both GSM and GPS modules. The Arduino is triggered when its heart rate sensor notices an anomaly, and the Arduino then gets in touch with its GSM module.

When something goes wrong, like a sudden,

dangerously high heart rate or an ignition of an emergency toggle switch, the programmed Arduino notifies the GSM module of the situation. This initiates the sending of a short message to approved caregivers that includes information about the user's increased heart rate as well as the wheelchair's exact GPS location, guaranteeing prompt assistance in emergency scenarios.

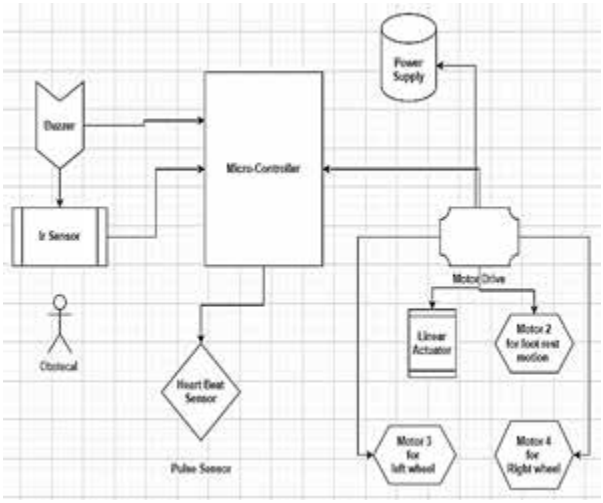

Fig.1: Basic Block Diagram

A smart and user-focused wheelchair/stretcher is created by the combination of these parts: the heart rate sensor, GPS and GSM for health monitoring, IR sensor for recognizing obstacles, wiper motor for mobility, and linear actuator for converting. The microcontroller inside. The Arduino serves as the brains behind the smooth integration of these components, improving user safety and functionality.

SOFTWARE, COMPONENTS AND CALCULATIONS

The software used in Wheelchair cum Bed control:

Arduino:

The microcontroller board based on the ATmega2560, known as the Arduino Mega 2560 (datasheet), is a powerful platform. Featuring a 16 MHz ceramic resonator, it offers a substantial 16 analog inputs, along with 54 digital input/output pins (of which 15 can serve as PWM outputs). Additionally, the board includes a USB port, a power connector, an ICSP header, and a reset button. All necessary components to support the microcontroller are provided, requiring only a power source like a battery or an AC-to-DC adapter, or a connection to a computer via a USB cable. Distinguishing itself from its predecessors, the Mega 2560 does not employ the FTDI USB-to-serial driver chip. Instead, it utilizes the Atmega16U2 (or the Atmega8U2 up to version R2) configured as a serial-to-USB converter, as specified in its datasheet.

Table 1: Arduino UNO

Feature	Description
Purpose	Development environment for Arduino programming
Supported Platforms	Windows, macOs, Linux
Programming Language	C/C++
Board Compatibility	Yes
Integrated Serial Monitor	Built-in
Extensibility	Custom libraries and tools can be created

Fig 2: Arduino UNO

Wiper Motor

A wiper motor is an essential part of industrial and automotive systems; it is mostly used to operate automobile windshield wipers. It performs the vital job of producing the mechanical motion needed to move the wiper blades along a windshield, guaranteeing the driver's visibility in inclement weather like rain, snow, or sleet. The wiper motor, which is usually an electric motor, gets commands from the wiper control system of the car and activates the wipers at varied speeds to adjust for varying levels of precipitation. Modern car design incorporates the wiper motor as it is an essential component because of its efficiency and

dependability in improving driver safety and general vehicle operation in inclement weather.

Fig 3: Wiper Motor

Linear actuator

An electromechanical device that can be used in a variety of applications, a linear actuator transforms rotary motion into linear motion to enable precise and controlled motion in a straight line. Linear actuators are widely used in many different industries and are essential to robots, automation, and machinery. The capacity of these devices to extend or withdraw a rod or spindles makes it possible to manipulate machinery or items along a straight line. Pneumatic, hydraulic, or electric power sources can be used to drive linear actuators, providing a variety of alternatives for varying operational needs. In many technical and industrial applications, linear actuators greatly improve accuracy, productivity, and automation capabilities thanks to their small size and programmable features.

Fig 4: Linear Actuator

Joystick

The X-Y Axis joystick module gives users two-dimensional control over movement or direction. Generally speaking, movement across the horizontal plane is represented by the X-axis and movement across the vertical plane by the Y-axis. Applications for X-Y Axis joystick modules include gaming controllers, robotic systems, remote-controlled devices, and more. They can be interfaced with controllers or additional electronics to manage motors or servos, and they provide precise control of movement in two dimensions.

These modules frequently feature pins or contacts that make it simple to integrate them with other electronic parts or microcontrollers, such as Raspberry Pi, Arduino, etc. Users can control various movements or functionalities in their projects by reading the analog signals produced by the joystick. Joystick modules are made of different materials and have different dimensions. You can select from several designs, such as thumb joysticks, wider panel-mounted joysticks, or tiny joysticks appropriate for small devices, based on the particular requirements of the project.

Fig 5 : Joystick

IR Sensor

Avoiding Obstacles Using Infrared Module for IR Sensor (Active Low)

Two infrared communication tubes are included in the Infra Objection Avoidance IR Sensor Modules (Active Low).When the transmitted light waves are reflected back, the reflected infrared radiation is sent to the reception tube. The green indicator LED illuminates when the processing is completed by the onboard comparator circuit. The module has a three-wire interface, with pins for Vcc, GND, and output on the tail. Between 3.3 and 5V, it functions flawlessly.The output pin responds to blockage or

reflection by producing a digital signal, often known as a low-level signal. The inbuilt preset helps to change the operational range, and the effective proximity range is 2 to 80 cm.

Fig 6: IR Sensor

Motor driver

A motor driver is a crucial electronic component that plays a pivotal role in controlling and powering electric motors. Its primary function is to translate low-power control signals from a microcontroller or other control circuitry into high-power signals suitable for driving motors. Motor drivers are commonly used in various applications, from robotics to automotive systems, providing the necessary voltage and current to drive the motor efficiently.

Heart Beat sensor

This signal essentially represents an AC component synchronized with the heartbeat, stemming from pulsatile variations in arterial blood volume superimposed on a DC signal associated with tissues and blood volume. The isolation of this AC component is imperative due to its critical nature. Pulse Sensor Amped enhances the hardware by incorporating circuits for amplification and noise cancellation, facilitating the acquisition of reliable pulse measurements in a significantly quicker and more straightforward manner. The Pulse Sensor Amped is compatible with either a 3V or 5V Arduino.

The output from the sensor undergoes initial filtration via a two-stage HP-LP circuit to extract the AC signal. Subsequently, it is converted into digital pulses through either a comparator circuit or a basic ADC. A microcontroller receives these digital pulses and utilizes the formula BPM (beats per minute) = 60*f to calculate the heart rate.

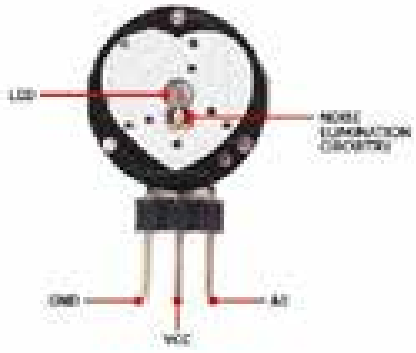

Fig 7: Heart Beat Sensor

GSM Module

GSM Module SIM900 This indicates that the module is capable of 900MHz band communication. We are from India, where the 900 MHz band is used by the majority of mobile network carriers. If you are foreign national, you must verify the available mobile network band in your region. Most US mobile networks run in the 850 MHz spectrum, which can be either 1900 MHz or 850 MHz. 1900 MHz is the primary frequency band used in Canada.

Fig 8: GSM Module

Torque generated by motor

Power of motor = 350 N- m /s

Rpm of motor = 600 rpm

CALCULATION FOR FINAL SPEED & TORQUE

$P = 2_{\pi 60} NT$

$350 = 2\pi \times 60\ 600 \times T$ x motor efficiency

(Motor efficiency = 60%)

T = 5.57 x 0.6 N-m

T = 3.34 N-m = 3342 N-mm

Force generated at wheel

TORQUE = FORCE X RADIUS

F = 3342/75mm

FORCE = 44.56 N

Speed of wheel chair

Speed of wheelchair

V= π DN/60

V= 3.12 x 0.150 x 600/60 V= 4.695 m/sec= 16.9 Km/hr

Range

Motor power 350 watt

2 battery power 12v x 8 amp=192 watt

192/350 = 0.54

0.54 x 60 min = 32.91 min

V= 16.9 Km/hr

Range = 8.7 km

Charging time of battery by charger

13 v 2 amp = 26 watt

192/26 watt = 7.38 hrs

RESULT AND DISCUSSION

The motor was evaluated to produce a torque of approximately 3.34 N-m (or 3342 N-mm) with a power output of 350 N-m/s and operating at 600 rpm, considering a motor efficiency of 60%. This torque, when translated to the wheel radius of 75 mm, generated an estimated force of around 44.56 N at the wheel. Moreover, the wheelchair's speed was calculated using the wheel's diameter of 150 mm and the motor's RPM, resulting in an approximate speed of 16.9 km/hr or 4.695 m/s. Additionally, the range of the wheelchair was estimated based on the motor power of 350 watts and the two batteries, each rated at 12V and 8Ah. This calculation indicated an expected range of 8.7 km at the determined speed.

Fig 9: Wheelchair View

Fig 10: Stretcher View

CONCLUSIONS

There are a number of advantages to the design and development of the wheelchair-cum stretcher that uses an IR sensor, buzzer, and wiper motor in addition to a heartbeat sensor. Above all, the combination of these cutting-edge technologies may produce a medical mobility solution that 5. is extremely flexible and easy to use. The Wiper motor's effortless change between wheelchair and stretcher modes has the potential to greatly increase the effectiveness of patient transportation inside medical facilities. Real-time health monitoring is made possible by the integration of a heartbeat sensor, which promotes a more secure and 6. accommodating patient care environment. By lowering the chance of crashes and guaranteeing a prompt reaction to possible dangers, the Infrared Sensor and Buzzer improve safety by detecting obstacles and issuing auditory alerts. All things considered, the effective development 7 and application of this novel device may result in enhanced patient comfort, greater productivity for medical staff, and a greater level of security in medical transportation situations.

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IoT Applications in Healthcare: A Comprehensive Evaluation of E-health Monitoring Systems in Real-world Applications

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ABSTRACT

E-health monitoring systems are thoroughly evaluated in this study to explore the revolutionary implications of IoT technology on healthcare. The study recognizes the relevance of personalized and continuous health monitoring by focusing on the fusion of Arduino microcontrollers with cardiac sensors. It investigates the ability of Arduino-based systems to go beyond cardiovascular activity, with the goal of gaining a more detailed picture of individual health. The study presents insights through actual implementations represented in Block diagrams A and B, addressing major research needs such as scalability concerns, user interface refinement, and security considerations related to Arduino-driven E-health monitoring. The findings highlight the potential of Internet of Things (IoT) technologies to alter healthcare by offering precise and timely monitoring for enhanced patient care and healthcare services.

KEYWORDS *: IoT, E-health monitoring, Arduino microcontrollers, Heartbeat sensors, Real-time monitoring.*

INTRODUCTION

The introduction of Internet of Things (IoT) technology has brought about a significant change in the healthcare industry by introducing novel approaches to the administration and monitoring of health data. An important development in e-health monitoring systems is the combination of heartbeat sensors with Arduino microcontrollers. This confluence is a critical step toward ongoing, individualised health monitoring that satisfies the growing needs of contemporary healthcare paradigms [1]. Known for their versatility and intuitive interface, Arduino microcontrollers are essential to developing affordable and expandable electronic health solutions. These microcontrollers are the cornerstone of real-time cardiac activity data collection when paired with heartbeat sensors, providing the groundwork for thorough health evaluations [2]. For e-health monitoring systems to perform as well as possible, hardware—represented by microcontrollers—and software—facilitated by the Arduino Integrated Development Environment (IDE)—must work together harmoniously [4]. This study investigates real-world uses for Arduino-based e-health monitoring systems and examines their applicability in real-world healthcare settings [5]. The ensuing assessment explores the many advantages of integrated IoT systems, taking into account elements like affordability, scalability, and the collection of real-time health data. Furthermore, the research addresses possible obstacles in the execution of IoT-based e-health monitoring systems, illuminating prospects for improvement and novelty in the domain [3]. By tackling these issues, the study hopes to bring insightful observations to the continuing conversation on the relationship between IoT devices and healthcare.

Overview of IoT Technologies in Healthcare

The advent of a new era in patient care, data

management, and monitoring has been brought about by the integration of Internet of Things (IoT) technology in the healthcare industry. IoT, a network of linked devices with seamless information exchange, has several uses in the healthcare industry and provides creative answers to persistent problems. IoT technologies collect, transmit, and analyse real-time data in the healthcare industry by utilising smart devices, sensors, and networked systems. Because of this interconnection, medical staff may monitor patients from a distance, facilitate communication between medical equipment, and improve overall operational effectiveness in healthcare institutions. Wearable technology, medical sensors, and data analytics platforms are important elements of IoT technologies in the healthcare industry. Vital signs, physical activity, and other health-related metrics may be continuously monitored thanks to wearable technology. Personalized treatment plans and prompt interventions are made possible by real-time data on patient conditions provided by medical sensors that are incorporated into a variety of healthcare equipment [6]. Data analytics solutions handle the massive volumes of data produced by Internet of Things devices and provide insightful information for research, predictive analytics, and healthcare decision-making. The utilisation of IoT technology in the healthcare industry has led to better disease management, better patient outcomes, and more operational efficiency for healthcare providers. Among the observable advantages of IoT integration in healthcare are remote patient monitoring, medical equipment predictive maintenance, and effective inventory management. The obstacles associated with this technical growth include privacy and data security concerns, interoperability issues, and the requirement for strong legal frameworks. Research and innovation must continue as the healthcare industry embraces IoT in order to overcome these obstacles and realise the full potential of IoT technology in raising the standard and accessibility of healthcare services.

Significance of Arduino Microcontrollers and Heartbeat Sensors

A major development in the field of E-health monitoring systems, the combination of heartbeat sensors and Arduino microcontrollers has a number of important ramifications for the medical field. Because of its influence on the precision, economy, and expandability of health monitoring systems, this combination is extremely significant. Due to their popularity and intuitive interface, Arduino microcontrollers are very versatile and play a key role in the creation of affordable E-health solutions. Customized health monitoring systems may be made without breaking the bank because to the versatile foundation these microcontrollers provide, which can support a wide range of sensors and peripherals. Real-time cardiac activity data is provided by heartbeat sensors, which are essential components of this integration. Continuous heart rate monitoring is essential for evaluating cardiovascular health, identifying abnormalities, and enabling prompt therapies [7]. The combination of cardiac sensors and Arduino microcontrollers creates a platform for thorough and precise health examinations. An essential software component that makes microcontroller programming and connecting easier is the Arduino Integrated Development Environment (IDE). Because of its user-friendly design, E-health monitoring systems' developers, medical experts, and enthusiasts may all build and edit code with ease, facilitating a smooth and seamless integration of hardware and software. Microcontrollers from Arduino greatly enhance the scalability of e-health systems. They may be used in a variety of healthcare environments due to their flexibility in responding to different sensor inputs and their simplicity in integrating with other components. The capacity to scale is crucial for allowing for the integration of various patient groups and healthcare contexts. Innovation in health monitoring technology is based on the combination of Arduino microcontrollers with heartbeat sensors. It opens doors for more thorough health evaluations by promoting the investigation of novel indicators beyond heart activity. This capacity for innovation helps E-health systems develop by enabling ongoing advancements in diagnostics and patient care.

LITERATURE REVIEW

This survey takes a close look at the literature and explores the many ways that Internet of Things (IoT) technology is being used in the healthcare industry. The research that are being reviewed address a wide range of important topics, such as customised telemedicine systems for older adults who live alone and GDPR-

compliant frameworks that use blockchain technology to protect personal health information. The study also includes studies on how IoT and big data work together to monitor mental health, how capacitance sensors are used in IoT-driven structural health monitoring, and how multi-level IoT data is used to predict health outcomes. Every research adds unique insights, which when taken as a whole improve our all-encompassing comprehension of how IoT may successfully tackle certain healthcare issues and deepen our grasp of its numerous applications in the field. The review of the literature highlights the importance of the Gokul Prasad et al. [11] Decision Tree (DT) structure for an Internet of Things (IoT)-based Blood Oxygen and Heart Rate Monitor, with a focus on automating data preservation. Using 16PF Big Data, Liu [12] carried out an empirical investigation on gender differences and mental health among college students. In order to solve security problems in IoT-based smart healthcare, Jerald and Rabara [13] proposed a secure architecture that is intended to safeguard confidential medical information. IoT was used by Shalini's [14] research on a Smart Healthcare Monitoring System to track health in real-time. An IoT-based risk prediction algorithm for maternal health care was studied by Ahmed and Kashem [15]. By emphasising distinctive features including data management, risk prediction, real-time monitoring, security, and mental health analysis, these collaborative efforts greatly advance the field of IoT in health monitoring. Every research offers a unique technique, lists difficulties, and displays findings.

Much research has been done on the integration of Internet of Things (IoT) into healthcare systems, offering creative ways to improve patient care, monitoring, and system performance as a whole. Kumar et al. evaluated the relationship between Industry 4.0 and the healthcare system, with a focus on mental health, in research that was presented at the 1st International Conference on Intelligent Computing and Research Trends [16]. Investigations were conducted on the potential synergies between developing Industry 4.0 technology and mental health applications. In their talk at the International Conference on Advances in Computing, Communication, and Applied Informatics, Ahmed et al. [17] added to the discourse by revealing an intelligent machine learning-enabled IoT-based healthcare monitoring system. Their research emphasises how cutting-edge computer methods might be integrated to improve healthcare monitoring's efficacy. As stated in the First International Conference on Big Data, IoT, Web Intelligence, and Applications, Hayat and Réda [18] tackled the problem of occupational health hazards using a novel IoT and geographic Big Data-based architecture. An IoT framework for tracking health issues was developed in part by Rasyid et al. [19], and it was showcased at the International Electronics Symposium. Finally, Khong Duc et al. [20] presented an IoT node with an organic pressure sensor at the International Conference on Green and Human Information Technology, with the focus of their study being structural health monitoring. All these studies show how the Internet of Things can be used for a variety of purposes in the healthcare industry, including monitoring general health conditions, mental health, surveillance, occupational health risks, and structural health monitoring. As a result, these studies greatly advance the development of networked healthcare systems.

METHODOLOGY

This work closes current knowledge gaps on Arduino-based E-health systems, emphasising the use of a rigorous research approach to increase monitoring capabilities beyond cardiac activity. After conducting a comprehensive literature assessment to identify research gaps, the article discusses the creation and application of Arduino programmes that incorporate a range of health sensors [21]. To guarantee data safety and usability, it emphasises user interface optimization and takes security and privacy concerns carefully. It also evaluates how well these systems scale for a variety of healthcare scenarios. Hardware installation, data analysis, and strict adherence to ethical norms are all part of the technique. The goal of this research is to shed light on the feasibility, efficacy, and difficulties of developing Arduino-based E-health systems for ongoing.

Feasibility Study of Extending Arduino-based E-health Systems

This research's feasibility analysis carefully considers whether expanding the use of Arduino-based E-health systems beyond conventional heart monitoring is

possible. In order to provide a more thorough health evaluation, this step comprises locating and adding other health factors, such as vital signs and activity levels [22]. This study evaluates the interoperability of Arduino microcontrollers with different sensors, emphasising the need of smooth integration for precise data collection. Creating customised Arduino programmes and algorithms is essential for efficiently interpreting and analysing a wide range of health data [23]. In order to reconcile improved monitoring capabilities with real-world limitations, the adaptation of current hardware configurations to new sensors is investigated. Power consumption and system efficiency issues are also addressed. In order to provide the groundwork for a reliable and flexible Arduino-based E-health monitoring system, preliminary testing is carried out to confirm the viability of the extended system in controlled situations.

Hardware and Software components

Essential hardware components for real-time health data collecting and display are included in the Arduino-based E-health monitoring system. These parts, which each contribute differently to the operation of the system, are the Heart Rate Sensor, I2C Module, LCD Display, Arduino Uno microcontroller, and NodeMCU [24].

Heart Rate Sensor

A key element that uses photoplethysmography (PPG) technology to identify variations in blood volume is the heart rate sensor. The sensor yields vital information for determining beats per minute (BPM), which is the basis for thorough health evaluations, by translating these fluctuations into electrical impulses.

Fig. 1. Heart Rate Sensor

I2C Module

The Inter-Integrated Circuit (I2C) module is a crucial piece of hardware that enables serial communication within the system. It serves as the conduit for data, facilitating easy interchange of information between different parts. Maintaining coordinated activities and effective communication requires this module.

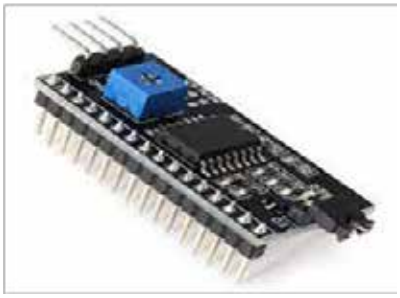


Fig. 2. I2C Module

LCD Display

The E-health monitoring system's visual interface is the Liquid Crystal Display (LCD), which provides real-time input on several health metrics. By displaying data like heart rate, it improves user experience and adds to the system's overall usefulness by giving users a handy way to keep an eye on their vital indicators [25].

Fig. 3. LCD Display

Arduino Uno Microcontroller

The Arduino Uno microcontroller, which is at the heart of the system, is home to the Atmega328 microcontroller, which offers input/output and processing capability. Serving as the system's brain, it carries out preprogrammed commands, analyses heart rate sensor data, and controls communication with other parts to guarantee precise computations and the presentation of health parameters.

Fig. 4. Arduino UNO

NodeMCU

The NodeMCU provides wireless access to the system by running on the ESP8266 Wi-Fi module. Data transfer to cloud servers is made possible by this feature, which also makes working with healthcare experts easier and increases monitoring possibilities. By facilitating data exchange and remote monitoring, the NodeMCU expands the system's functionality and adds to the overall comprehensiveness of the healthcare solution.

Fig. 5. Node MCU

Arduino IDE

Programming Arduino microcontrollers is made easy with the help of the user-friendly Arduino Integrated Development Environment (IDE). With features like syntax highlighting and error checking, the Arduino programming language is supported by a flexible code editor included in the IDE. This simplifies the process of developing code. Code is converted into machine-readable instructions by its built-in compiler, and the uploader makes it easy to transmit compiled code to Arduino boards [26]. The Serial Monitor makes real-time data monitoring possible, which helps with debugging. The IDE increases productivity with a Library Manager that provides prewritten code libraries and a Board Manager that offers a variety of hardware support. Its ability to be accessed by both inexperienced and seasoned developers through integrated help and documentation resources solidifies its pivotal role in the development of Arduino-based applications, such as E-health monitoring systems.

Fig. 6. Arduino IDE

Block Diagram Module A

Block Diagram A depicts a comprehensive Arduino Uno-based E-health monitoring system centered around a PPG heart rate sensor. The PPG sensor detects blood volume changes, and its analog signals are processed by the ADC, facilitating real-time digital data. The Arduino Uno microcontroller, programmed through the Arduino IDE, interprets the digital signals, calculates the heart rate, and oversees the system's functionality. The calculated heart rate is visually displayed on an LCD, providing users with instant feedback. A green LED indicator signifies the system's operational status. The block diagram emphasizes the integration of components, real-time processing, and user-friendly display, highlighting the efficiency and simplicity of the Arduino Uno in E-health monitoring applications.

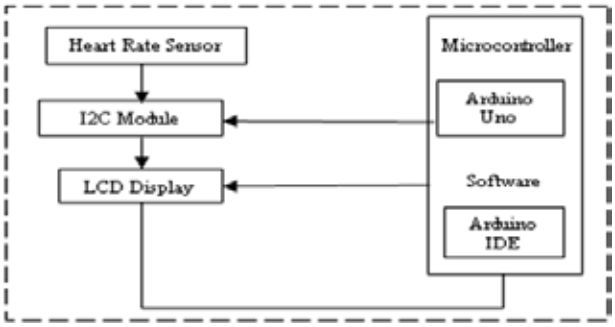


Fig. 7. Block Diagram Module A

Block Diagram Module B

Block Diagram B shows a heart rate monitor based on an Arduino Nano that measures blood volume accurately using PPG technology. The PPG sensor, which senses variations in blood volume and transforms them into an analogue signal, communicates with the Arduino Nano, which serves as the microcontroller. The analogue signal is converted into a digital representation by the ADC so it may be processed. BPM computation and real-time processing are made easier by programme execution, which is directed by code written in the Arduino IDE. Visual feedback of the heart rate is provided via the LCD display, and additional features like Wi-Fi connectivity and power supply add to the device's capabilities. The schematic illustration highlights the adaptability of the Arduino Nano in creating a small and effective heart rate monitoring system, showcasing possible uses in both do-it-yourself endeavours and producing prototypes.

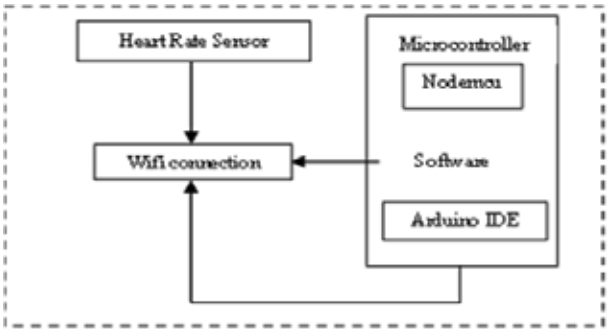


Fig. 8. Block Diagram Module B

EXPERIMENTAL RESULTS

Block Diagram module 1

Analyzing IoT technology in the healthcare industry offers ground-breaking approaches to better data management and monitoring. Heartbeat sensors and Arduino microcontrollers together represent a major improvement in e-health monitoring systems. The versatility and ease of use of Arduino are essential in developing affordable and expandable E-health solutions, and heartbeat sensors offer vital real-time cardiac activity information for comprehensive health evaluations. One essential piece of software that simplifies microcontroller interface and programming is the Arduino Integrated Development Environment (IDE). A thorough understanding of the hardware-software interaction is essential for maximising the effectiveness of E-health monitoring systems. The increasing need for individualised and ongoing health monitoring highlights the importance of Internet of Things (IoT) applications in the healthcare industry, particularly those that use Arduino-based solutions. This module establishes the foundation for a detailed exploration of specific applications, advantages, challenges, and avenues for improvement within the domain of IoT-based E-health monitoring systems.

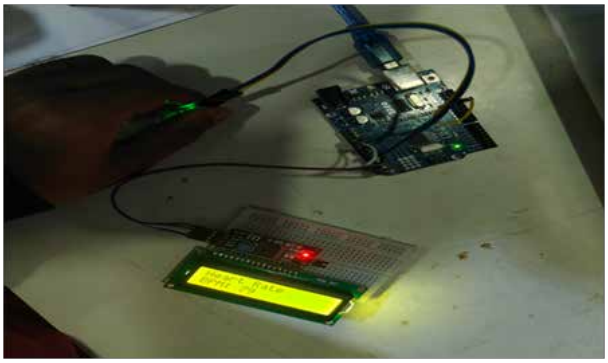


Fig. 9. Real time heart Rate data

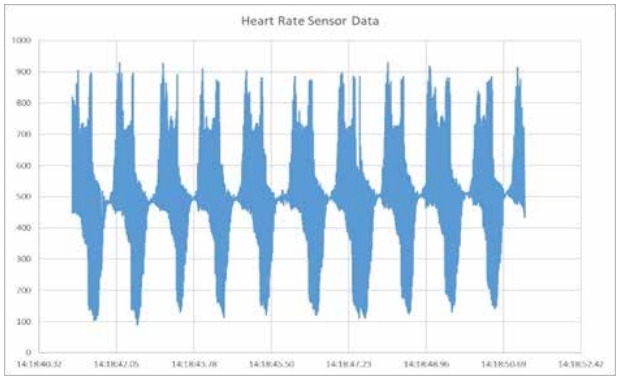
The Arduino UNO functions as the system's central processing unit, coordinating all of its operations. When the Arduino UNO is attached to the heart rate sensor, it can record cardiac activity in real time and provide vital health data. The addition of an LCD display with I2C provides an easy-to-use interface for instant feedback and streamlines the visual depiction of health data. The Arduino UNO and LCD display may communicate more effectively thanks to the I2C integration. One essential component that is essential to measuring and tracking heart rate and contributing to thorough health evaluations is the heart rate sensor. It's important to note that this module operates independently without

IoT integration, focusing on local data generation and display.

Block Diagram module 2

As IoT features are added, the E-health monitoring system changes, using NodeMCU for wireless communication. The heartbeat sensor, which records cardiac activity data in real time, continues to be the system's brain. The ESP8266 Wi-Fi module, through the NodeMCU, provides wireless communication to the configuration. This makes it possible for health data to be sent to cloud servers for further observation and professional cooperation. This module's data storage technique is one of its key features; it effectively saves all health-related data in Microsoft Excel format. This makes data administration and analysis easier and enables a thorough picture of health patterns across time. By integrating IoT, the system becomes more versatile and allows data exchange and remote monitoring outside local contexts. This module offers chances for advanced analytics and cooperative healthcare practises, marking a step forward toward an increasingly linked and data-driven approach to E-health monitoring.

Fig. 10. Arduino Ide real time data



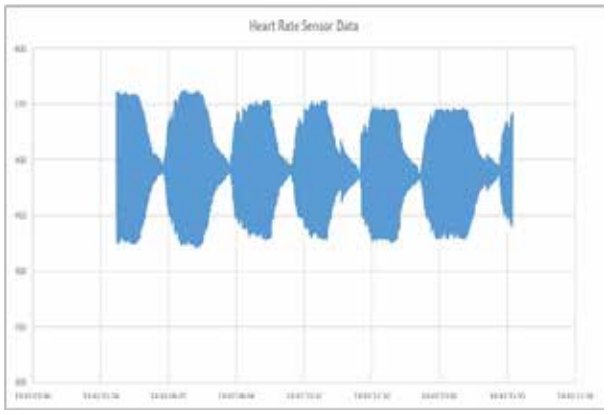


Fig. 11. Real time heart rate sensor data using IOT of persons

CONCLUSION

This research explores the rapidly evolving field of Internet of Things (IoT) applications in the healthcare industry, concentrating on E-health monitoring systems based on Arduino. The combination of cardiac sensors with Arduino microcontrollers is a significant development that lays the groundwork for ongoing, individualised health monitoring. A wide range of IoT applications are covered in detail in the literature review, including predictive analytics, mental health monitoring, secure healthcare architectures, telemedicine systems, and structural health assessment. Every research offers unique insights that deepen our comprehension of the complex role that IoT plays in resolving different healthcare issues. The importance of heartbeat sensors and Arduino microcontrollers is highlighted, demonstrating how they affect the precision, economy, and scalability of health monitoring systems. The feasibility research looks into how Arduino-based E-health systems may be used for more than just heart monitoring, including more health metrics for a more thorough evaluation. The crucial responsibilities that hardware and software components play in building a reliable monitoring system are illustrated in detail. The testing findings show two modules: the first integrates IoT capabilities for wireless networking, data storage, and remote monitoring; the second provides real-time heart rate data with a local display. These modules show how Arduino-based E-health systems may be customised by moving from local monitoring to a more networked and data-driven approach.

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Design and Implementation of Clusters of Microcontroller for Various Sensors Data on Real Time using Embedded System

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ABSTRACT

The need for an efficient and scalable system for real-time collection, processing, and management of data from various sensors using embedded systems. The proposed solution involves the design and implementation of clusters of microcontrollers, providing a distributed architecture capable of handling diverse sensor types in a seamless and energy-efficient manner. The Key parameters for development of embedded systems optimized for low power consumption, the establishment of real-time communication protocols for data exchange within clusters, and the integration of fault-tolerant mechanisms to ensure the robustness of the system. Clusters are dynamically formed, allowing for the addition of new sensors and microcontrollers to accommodate evolving requirements. The microcontrollers within the clusters are tasked with real-time processing of sensor data, including computations, filtering, and aggregation. Customizable sensor data fusion algorithms are implemented to enhance the accuracy and reliability of the collected data. Energy efficiency is a focal point, ensuring that the system is well-suited for deployment in resource-constrained environments, such as remote or inaccessible locations.

KEYWORDS *: Arduino, Clustering, Master slave, Realtime.*

INTRODUCTION

In this research, we advocate for the utilization of distributed systems as a viable alternative to enhance existing embedded technologies. Distributed systems offer augmented processing capabilities, enabling the execution of tasks that would otherwise be time-consuming on a single processing core. Moreover, they afford the integration of a greater number of electronic sensing devices, thereby enhancing the system's capacity to collect and analyze data comprehensively.

Our proposal centers on leveraging distributed systems theory within 8-bit CMOS (Complementary Metal-Oxide Semiconductor) microcontrollers, specifically those manufactured by Microchip, which boast a diced and limited architecture. Through this approach, we outline the development of a low-power embedded system tailored to execute multiple operations and tasks efficiently, with a keen focus on real-time constraints. To facilitate seamless data distribution, we advocate for the use of hard-wired embedded communication protocols within the system.

Employing a cluster system of microcontrollers, as opposed to microprocessor-based distributed systems or single-core embedded systems, offers notable advantages including significant cost reduction, enhanced size flexibility for diverse applications, and the capacity to adapt the initial design and functionality to meet user requirements dynamically. Furthermore, our development endeavors to establish an easily scalable distributed system, capable of accommodating varying user needs.

The amalgamation of these features renders the proposed system highly conducive for educational purposes, given its inherent simplicity, which makes it particularly suitable for students studying topics related to distributed systems. Through this research, we aim to contribute to the advancement of embedded technologies and foster a deeper understanding of distributed systems among students and practitioners alike.

LITERATURE REVIEW

n modern military operations, effective communication plays a pivotal role in achieving mission success and ensuring the safety of personnel. Long-Range (LoRa) wireless technology has emerged as a valuable asset in addressing the communication challenges faced in military environments. This paper introduces the concept of employing LoRa wireless communication using two Arduino boards for military purposes, highlighting its potential to revolutionize information exchange in the field[1].

Communication is the backbone of any military operation, enabling coordination, information dissemination, and real-time decision-making. In dynamic and complex scenarios, such as combat zones or remote deployments, traditional communication methods may encounter limitations due to terrain obstacles, signal interference, and power constraints. To overcome these challenges, innovative technologies like LoRa are being explored to establish robust and resilient communication networks[2]

LoRa stands out as a wireless modulation technique designed to provide long-range communication with minimal power consumption LoRa's ability to transmit data over extended distances, sometimes exceeding several kilometres, while consuming very little energy, makes it an appealing solution for military applications[3].

Arduino, an open-source hardware and software platform. Its potential within military communication lies in its capability to serve as a foundation for building customized communication systems. By integrating LoRa modules into Arduino boards, military personnel can swiftly create communication setups tailored to specific operational requirements [4]

SYSTEM ARCHITECTURE

The system architecture employs a hierarchical structure with clusters of Arduino microcontrollers responsible for collecting, processing, and aggregating sensor data. The architecture is designed to be scalable, energy-efficient, and capable of real-time communication.

Components

Sensor Nodes: Arduino microcontrollers equipped with various sensors such as temperature, humidity, and motion sensors. Each sensor node is responsible for collecting data from its sensors and transmitting it to the cluster head.

Cluster Heads: Selected Arduino microcontrollers act as cluster heads. They are responsible for aggregating data from multiple sensor nodes within their cluster, performing initial processing, and transmitting the aggregated data to a central unit or gateway.

Central Unit/Gateway: At the highest level, a central unit or gateway is responsible for receiving data from multiple cluster heads, performing further processing if necessary, and transmitting the final data to external systems or storage platforms.

Communication

Wireless Communication: Arduinos communicate wirelessly using protocols such as Zigbee or Bluetooth, allowing seamless communication between sensor nodes and cluster heads. This wireless communication ensures flexibility and ease of deployment in various environments.Serial Communication: Arduino microcontrollers within a cluster communicate with each other using serial communication. This enables real-time data exchange, allowing efficient aggregation and processing of sensor data at the cluster head.

Components of the Implementation

Hardware Implementation

Arduino Microcontrollers: Deploy low-cost, energy-efficient Arduino boards (e.g., Arduino Uno, Arduino Nano) as the primary microcontrollers for both sensor nodes and cluster heads. Sensors: Integrate various sensors compatible with Arduino boards. For instance, use DHT sensors for temperature and humidity, PIR motion sensors, or other sensors based on the application requirements.

Software Implementation

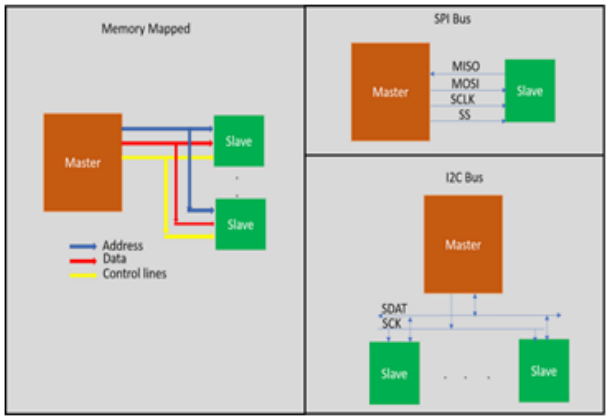
Arduino IDE: Develop the firmware using the Arduino IDE, incorporating Arduino-specific programming language (based on C/C++). Write code for sensor data collection, real-time communication, and aggregation algorithms.

Real-Time Processing Algorithms: Implement

algorithms for real-time data processing directly on Arduino boards. For example, perform basic calculations, filtering, or aggregation of sensor data to reduce the amount of transmitted information.

MASTER SLAVE CONCEPT

The master-slave concept is a communication paradigm commonly used in embedded systems and microcontroller-based applications. It involves one primary device (master) controlling and interacting with one or more secondary devices (slaves). The Arduino platform, with its various models and capabilities, is often employed in master-slave configurations for diverse applications. Let's explore the master-slave concept in the context of Arduino:



Components of a Master-Slave System using Arduino:

Arduino Boards

Master Arduino: This board assumes the role of the master device, typically responsible for initiating communication and controlling one or more slave devices.

Slave Arduino(s): These boards act as subordinate devices, responding to commands from the master and possibly performing specific tasks or providing data.

Communication Protocols

Serial Communication: Arduino boards often communicate using UART serial communication. The master and slave devices can exchange data through the serial ports of their respective Arduino boards.

I2C (Inter-Integrated Circuit): In scenarios where multiple slaves need to communicate with a master, I2C can be employed. The master initiates communication and addresses specific slaves on the bus.

SPI (Serial Peripheral Interface): Similar to I2C, SPI is another protocol suitable for communication between a master and multiple slaves. It involves a master device controlling the communication with one slave at a time.

Implementation Steps:

Master Initialization: The master Arduino initializes the communication interface and sets parameters such as baud rate (for serial communication) or I2C/SPI configurations.

Slave Configuration

Each slave Arduino is configured to listen for commands or data from the master. The slave may be programmed to execute specific tasks upon receiving instructions.

Communication Protocol Handling

The master sends commands or queries to the slave devices using the chosen communication protocol. This could involve sending data, requesting information, or instructing the slaves to perform specific actions.

Slave Response

Upon receiving a command or request, each slave processes the information and responds accordingly. Responses may include sending data back to the master or acknowledging the successful execution of a command.

Error Handling

Both master and slave devices implement error-handling mechanisms to manage communication failures, ensuring the reliability of the system.

CONCLUSION

the master-slave concept in the context of Arduino provides a versatile and scalable framework for communication and coordination between devices in embedded systems. This communication paradigm is particularly useful for scenarios where one central device (the master) needs to control and interact with one or more peripheral devices (the slaves). The simplicity and accessibility of Arduino make it an ideal platform for implementing master-slave configurations in various applications.

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Design and Implementation of Fire Security Alarm with Voice Interaction Using IOT

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ABSTRACT

The project "Design and Implementation of Fire Alarm with Voice Interaction using IOT" aims Industrial environments present unique fire safety challenges due to the presence of flammable materials, complex layouts, and high noise levels. Existing fire alarms often struggle to effectively alert personnel in such settings, potentially leading to delayed evacuations and catastrophic consequences. This paper proposes an innovative IoT-based fire security alarm system with voice interaction specifically designed for industrial applications. The system leverages a network of interconnected sensors, a central processing unit, and voice-enabled communication to provide precise fire detection, clear evacuation guidance, and enhanced situational awareness for occupants.

INTRODUCTION

Fire incidents in industrial facilities can have devastating consequences, resulting in substantial property damage, injuries, and fatalities. The inherent noise levels and complex layouts often hinder the effectiveness of traditional fire alarm systems, which rely primarily on audible alerts. This research investigates the development of a novel IoT-based fire security alarm system with voice interaction to address these shortcomings and significantly improve industrial fire safety. Fire incidents pose significant risks to life and property, necessitating the use of advanced fire security systems that can detect hazards promptly and alert occupants effectively. Traditional fire Fire incidents in industrial facilities can have devastating consequences, resulting in substantial property damage, injuries, and fatalities. The inherent noise levels and

Fire incidents in industrial facilities can have devastating consequences, resulting in substantial property damage, injuries, and fatalities. The inherent noise levels and complex layouts often hinder the effectiveness of traditional fire alarm systems, which rely primarily on audible alerts. This research investigates the development of a novel IoT-based fire security alarm system with voice interaction to address these shortcomings and significantly improve industrial fire safety.

Fire incidents pose significant risks to life and property, necessitating the use of advanced fire security systems that can detect hazards promptly and alert occupants effectively. Traditional fire alarms, while essential, often lack the capability to provide intuitive communication during emergencies. To address this limitation, the project "Design and Implementation of Fire Security Alarm with Voice Interaction using IoT" aims to develop a cutting-edge fire security system that integrates IoT technology and voice interaction capabilities.

Background and Context

The rapid advancement of IoT technology has revolutionized various industries, including home automation and security. IoT enables the interconnection of devices, allowing them to communicate and exchange data seamlessly. In the context of fire security, IoT can be leveraged to create a network of sensors and devices that work together to detect fires, communicate alerts, and facilitate responsive actions.

Rationale for Voice Interaction

Voice interaction has emerged as a natural and accessible interface for human-machine communication. By incorporating voice commands and responses into the fire security system, users can interact with the system more intuitively, especially in high-stress situations where manual input may be challenging. Voice interaction also enhances accessibility for users with disabilities or those in environments where manual input is impractical.

The proposed system comprises four key components:

- Sensor Network: A strategically placed network of heat detectors, smoke detectors, and gas sensors ensures comprehensive coverage of the industrial facility. Sensor data is transmitted wirelessly to the central processing unit.
- Central Processing Unit (CPU): An edge computing unit or a cloud-based server receives and analyzes sensor data in real-time. Sensor fusion algorithms combine data from various sources to minimize false alarms and accurately pinpoint fire locations.
- Voice Interaction Module: A text-to-speech engine and strategically positioned speakers deliver clear and location-specific evacuation instructions in real-time based on the identified fire location and hazard zone.

IoT Connectivity: Secure wireless communication protocols like Wi-Fi, LPWAN, or cellular networks facilitate seamless data exchange between sensors, the CPU, and the voice interaction module.

LITERATURE REVIEW

[1].This research explored integrating voice assistants like Google Assistant into fire alarm systems. They emphasized the benefits of natural language interaction for reporting emergencies, controlling smart home devices for fire mitigation (e.g., unlocking doors, shutting off gas), and providing evacuation guidance. Their work highlights the potential of voice interaction for enhanced user experience and emergency response during fires.

[2]This study focused on improving speech recognition accuracy in noisy fire environments. They developed a noise cancellation algorithm and integrated it with a cloud-based notification system to send real-time fire alerts to smartphones and designated contacts. Their research addresses a crucial challenge in voice-based fire alarms, ensuring reliable communication even amidst chaos.

[3]This research implemented an IoT-enabled fire alarm system with remote monitoring and control capabilities. They used sensors, microcontrollers, and cloud platforms to gather data, analyze fire risks, and remotely activate actuators like water sprinklers or ventilation systems. Their work showcases the potential of IoT for proactive fire prevention and intervention.[4] This study explored using machine learning algorithms on sensor data to predict fire risks and trigger pre-emptive measures. They trained models on historical fire data to identify patterns and anomalies, enabling early detection and proactive warnings before flames even appear. Their research highlights the potential of machine learning for revolutionizing fire prevention strategies.[5] This research focused on personalizing evacuation guidance based on building layout and real-time fire information. They used voice instructions to direct occupants to the nearest safe exits, considering factors like fire location, smoke spread, and individual mobility limitations. Their work addresses a critical gap in traditional fire alarms, providing personalized directions for safer and faster evacuation.

METHODOLOGY

Sensor Network Deployment

- Method 1: Grid-based placement: Divide the facility into zones and place sensors (heat, smoke, gas) at equidistant points for uniform coverage.
- Method 2: Hazard-based placement: Prioritize high-risk areas like fuel storage, electrical panels, and production lines for denser sensor placement.
- Method 3: Dynamic sensor adjustment: Implement a system that adjusts sensor activation thresholds and placement based on real-time data and changing environmental conditions.

Data Acquisition and Analysis

- Method 4: Edge computing: Utilize an on-site processing unit for real-time analysis of sensor data,

minimizing communication delays and optimizing response times.

- Method 5: Cloud-based analysis: Send sensor data to a cloud server for centralized analysis and advanced algorithms, enabling historical data evaluation and predictive maintenance.
- Method 6: Sensor fusion: Combine data from different sensor types (heat, smoke, gas) using data fusion algorithms to improve fire detection accuracy and reduce false alarms.
- Method 7: Machine learning: Train machine learning models on historical data to identify fire patterns and predict potential fire hazards before they occur.

Voice Interaction Module Development

- Method 1: Pre-recorded messages: Store pre-recorded evacuation instructions in different languages for immediate playback upon fire detection.
- Method 2: Text-to-speech synthesis: Implement a text-to-speech engine that dynamically generates evacuation instructions based on real-time data and location, offering flexibility and personalization.
- Method 3: Speaker integration: Strategically position speakers throughout the facility, considering ambient noise levels and coverage area, to ensure clear and audible voice alerts.
- Method 4: Multi-language support: Prioritize languages spoken by your workforce and implement automatic language detection or user selection options for inclusive communication.

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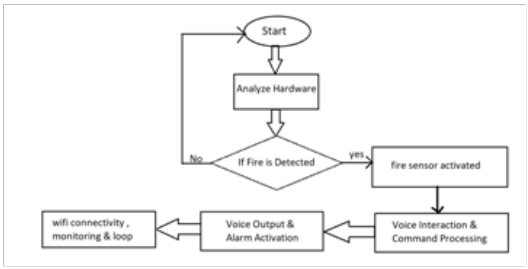

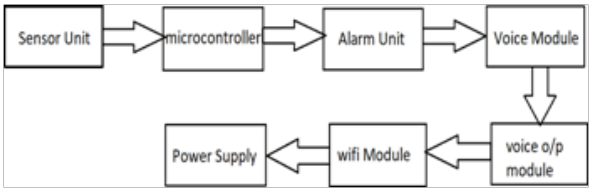

SYSTEM BENEFITS

- Enhanced Fire Detection: Sensor fusion and real-time data analysis lead to earlier and more accurate fire detection, minimizing response delays.
- Improved Evacuation Efficiency: Clear and precise voice instructions specific to each zone guide personnel toward the nearest safe exits, reducing confusion and potentially saving lives.
- Language Inclusivity: Text-to-speech capabilities allow safety announcements to be translated into multiple languages, ensuring inclusivity for a diverse workforce.
- Remote Monitoring and Maintenance: Remote access to system data enables centralized monitoring of fire safety status and proactive maintenance efforts.

CONCLUSION AND FUTURE WORK

This IoT-based fire security alarm system with voice interaction holds immense potential for revolutionizing industrial fire safety. Future work will focus on expanding functionalities, including:

- Integration with emergency response systems for faster intervention.
- Dynamic route optimization for evacuation procedures based on real-time fire spread.
- Personalized voice instructions tailored to user roles and locations.

By leveraging the power of IoT and voice technology, we can create safer and more resilient industrial environments, protecting lives and ensuring business continuity.

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Development of Android-based Real-time Observing and Control System for Renewable Energy Sources

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ABSTRACT

This project presents the development of Android-based online monitoring and control system tailored for Renewable Energy Sources, fondly known as RES. The system aims to enhance the effectiveness and operation of renewable energy installations by feeding real- time data monitoring and remote- control capabilities through a client friendly mobile software. The system, like, integrates various sensors deployed in renewable energy systems, such as solar panels and wind turbines, to collect essential data. This data is transmitted to a cloud-based platform for real-time processing and storage. The Android application serves as the user interface, offering comprehensive insights into energy production, consumption, and system status.

We all know energy is like super important, so having this system is like totally crucial for monitoring and controlling renewable energy sources. It's like the ultimate tech solution for improving the efficiency of energy installations. Plus, with the amazing sensors and the cloud processing, you can monitor everything like a boss. Go green with RES and be energy-smart with this android-based system.

Let's embrace the power of renewable energy and make a difference with this high-tech monitoring and control system.

KEYWORDS *: Renewable energy sources (RES), Real time data monitoring, Sensors, Solar panels, Wind turbines, Data transmission, Cloud-based platform, Android application.*

INTRODUCTION

Android based Real-time Observing and Control System for Renewable Energy Sources.

The raising request for cleaner and maintainable vitality arrangements has driven a surge within the appropriation of Renewable Vitality Sources (RES) such as sun powered, wind, and hydroelectric control. Be that as it may, the effective utilization of these assets requires advanced checking and control frameworks that can adjust to the energetic nature of renewable vitality era. In reaction to this request, our extend centers on the improvement of an Android-based online observing and control framework outlined to address the challenges confronted by RES partners. The framework leverages the ubiquity and user-friendliness of Android gadgets to form a seamless and open interface for both specialists and non-experts within the renewable vitality space. The essential objectives of this venture incorporate:

Real-Time Observing- The framework joins state-of-the-art sensors to assemble real-time information from renewable vitality establishments. This information is at that point prepared and displayed to clients through an Android application, permitting for immediate experiences into vitality generation and framework execution.

Farther Control Usefulness: With an accentuation on client strengthening, the Android application empowers inaccessible control of renewable vitality frameworks. Clients can make alterations, fine-tune parameters, and react to energetic natural conditions, optimizing the in general effectiveness of their establishments.

User-Friendly Interface: Recognizing the different client base within the renewable vitality segment, the Android application gloats a natural and outwardly engaging interface. This plan guarantees that clients, notwithstanding of their specialized mastery, can effortlessly comprehend and associated with the observing and control highlights.

Cloud Integration: The framework utilizes cloud-based advances to encourage consistent communication between the Android application and the renewable vitality foundation. This integration empowers real-time information synchronization, guaranteeing that clients get exact and opportune data.

Security Measures: In light of the touchy nature of energy-related information, robust security conventions are actualized to protect against unauthorized get to and information breaches. The keenness and privacy of the framework are fundamental in building up client believe.

This extend stands at the crossing point of innovation and supportability, advertising a comprehensive arrangement to upgrade the execution and administration of renewable vitality sources. Through the advancement of this Android-based observing and control framework, we point to contribute to a more economical and flexible vitality future!

LITERATURE REVIEW

[1] In Development of a Self-adaptive based Renewable Energy Management in Smart Micro Grid- in this paper Identification and evaluation of self-adaptation algorithms that dynamically adjust energy management parameters based on real-time conditions. [2] Investigation on Sizing of Voltage Source for a Battery Energy Storage System in Microgrid- in this paper the load profile analysis helps identify the energy consumption patterns, peak demand periods, and load variability within the microgrid. [3] IoT Application for On-line Monitoring of 1 kWp Photovoltaic System Based on Node MCU ESP8266 and Android Application- In this paper the Nodemcu ESP8266 is employed as a central node for data acquisition from PV system sensors. The collected data is then transmitted to the cloud for storage and processing. An Android application serves as the user interface, allowing users to access real-time data and control system parameters remotely. [4] Digital Control System for Solar Power plant using IoT- This project presents a solution that combines PLCs and SCADA for comprehensive solar power monitoring. [5] Development of Android based on-line monitoring and control system for Renewable Energy- in this paper system aims to enhance the efficiency and management of renewable energy installations by providing real-time data monitoring and remote-control capabilities through a user-friendly mobile application. [6] Development of a data acquisition system for remote monitoring of renewable energy systems- In this paper a Data Acquisition System (DAS) designed for remote monitoring plays a pivotal role in gathering, processing, and transmitting essential data from renewable energy installations to a central monitoring station.

METHODOLOGY

Algorithm

1. In Data Acquisition data is collected from the sensors measuring renewable energy parameters like solar irradiance, wind speed, battery voltage. Ensure proper calibration and conversion of raw sensor data.
2. Then we have to Establish communication channels between the Android app and the renewable energy system. Utilizing appropriate communication protocols like MQTT, RESTful APIs for real-time data exchange.
3. In Data Processing raw data is collected from the sensors. Appling that raw data filtering algorithms to remove noise from sensor data and smoothing the data to provide a more stable representation.
4. Data Analysis - Analyze Actual data to identify patterns and trends. Use algorithms to read unborn energy generation and consumption.
5. Control Logic Decision Making Implement control algorithms based on the anatomized data. Determine optimal control conduct considering renewable energy source conditions and user-defined preferences.

6. Safety Checks Include safety mechanisms to help conduct that may harm the system or violate functional limits. apply unfailing to handle sudden scenarios.

7. Human (Client) Interface – Real time Visualization Display real- time data on the Android app, furnishing client with perceptivity into the current state of the renewable energy system.

8. Control Interface produce client-friendly interface for Actual to configure settings and control conduct. apply features for setting thresholds and cautions.

9. Security Data Encryption Implement secure communication styles to cover data during transmission. Use encryption algorithms to guard sensitive information.

10. Human (Client) Authentication Incorporate human (client) authentication mechanisms to control access to monitoring and control functionalities.

11. Feedback Medium client announcements give announcements to clients for significant events or changes in the renewable energy system. Include cautions for system warnings.

12. Nonstop Monitoring - Deviating Medium produce a nonstop circle for monitoring and control conduct. Regularly modernize the Android app with the rearmost data.

13. Error Handling - Exception Handling Implement robust error- handling mechanisms to manage unanticipated events or communication failures.

14. Testing Unit - Testing Perform unit testing for individual components of the algorithm. Conduct integration testing to ensure flawless interaction between different modules.

15. Optimization - Optimize the algorithm for performance and resource effectiveness. Consider the limitations of mobile devices and ensure the algorithm runs easily on Android.

FLOWCHART

Fig.1 Monitoring system Flowchart

HARDWARE DESIGN AND IMPLEMENTATION

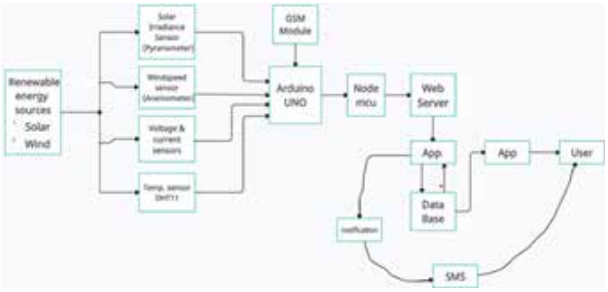

Fig.2 Block diagram of Android based Real-time Observing and Control System for Renewable Energy Sources.

Sensor Selection and Integration

- Solar Panels: Solar irradiance sensor, Temperature sensor, Voltage/current sensor.

- Wind Turbines: Anemometer (wind speed sensor),
- Temperature sensor, Rotational speed sensor
- Battery System: Voltage and current sensors

Microcontroller: Select a microcontroller (e.g., Arduino or Raspberry Pi) capable of handling sensor inputs and supporting communication modules.

Ensure compatibility with the selected sensors and communication protocols.

Communication Module: Select a communication module to transfer data to your Android application. Options include Wi-Fi, Bluetooth, or GSM modules depending on application requirements and deployment environment.

Power Supply: Design reliable power systems. Use solar panels or other renewable resources to power the monitoring system to ensure sustainability. Integrate rechargeable batteries or energy storage systems for continuous operation with low energy production.

Microcontroller Sensor Interface: Establishes the connection between the microcontroller and the sensor. Use the appropriate interface (analogue, digital) depending on the sensor specifications. Implement analogue to digital conversion.

SMARTPHONE USER INTERFACE AND IOT CLOUD SERVER

Smartphone User Interface

- Dashboard Design Intuitive dashboard with clear plates representing real data. Add several contraptions, maps, and graphs to display important information similar as energy product, consumption, and system status.
- User Authentication: apply a secure client authentication system to control access to IoT systems. cover client credentials with strong encryption.
- Real- time monitoring Enables real- time monitoring of renewable energy system parameters. It provides client to live updates on solar panel performance, wind turbine speed, battery status, and other affiliated data.
- Literal Data Analysis Adds functionality that allows client to dissect trends in literal data. apply an interactive map that allows clients to explore data at specific time intervals.
- Control medium Contains client friendly controls for remote operation of renewable energy systems. apply switches, sliders, or buttons to allow clients to control connected bias or acclimate system settings.
- Cautions and announcements Integrate alert systems to notify clients of important events and system anomalies. Allows clients to customize announcement settings, including exemplifications dispatch, push announcements.
- Energy effectiveness perceptivity Provides energy effectiveness perceptivity and suggests optimizations grounded on literal data. Provides clients with recommendations to ameliorate overall system performance.
- Weather Integration: Integrate rainfall information to help clients understand how environmental conditions affect energy product. View rainfall vaticinations and real- time rainfall vaticinations more easily.
- Client Profile Management Allows client to produce and manage biographies with substantiated settings. apply a client-friendly interface for streamlining settings and contact information.

Fig. 3. Smartphone User Interface

IoT Cloud Server

- Data Reception and Storage - Establish a robust data event medium to admit data from connected IoT devices. apply a cloud- based storage solution for efficiently storing large volumes of data.
- Data Processing and Analysis - Develop algorithms for processing and assaying incoming data. Use machine learning or statistical models to decide perceptivity and trends from the collected data.
- Security Measures - Apply strict security measures to guard data during transmission and storage. Use encryption protocols, secure APIs, and access controls to cover sensitive information.
- Communication Protocols - Support standard IoT communication protocols (e.g., MQTT, CoAP) for flawless integration with connected devices. Ensure compatibility with a variety of IoT devices and platforms.
- APIs for Integration - Give well- proved APIs to allow third- party integrations or custom operations. Support integration with other IoT platforms or smart home systems.
- Scalability - Design the cloud server to be scalable, allowing it to accommodate more devices and data as the IoT system expands. use scalable cloud services. Data Visualization Offer data visualization tools for client to cover the performance of their IoT devices. give customizable dashboards and reports.
- Trust ability and Redundancy - Ensure high trust ability by enforcing redundancy measures. apply backup and recovery strategies to help data loss.
- Client Access Controls - Implement client access controls and authorizations to regulate who can penetrate specific data or perform certain conduct. give an inspection trail for covering stoner conditioning.
- for Remote Device Operation Implement features for remotely managing connected devices. Allow firmware updates, configuration changes, and troubleshooting actions. Remote Device Operation Implement features for remotely managing connected devices. Allow firmware updates, configuration changes, and troubleshooting actions.

By fastening on these aspects for both the smartphone user interface and the IoT cloud server, you can produce a comprehensive and client-friendly IoT system for monitoring and controlling renewable energy devices.

CONCLUSION

In summary, the development of an Android based Real-time observing and control system for renewable energy sources holds great significance in promoting sustainability and client commission. Despite challenges in specialized complexity and data security, the system's capability to enhance functional effectiveness, give remote availability, and enable smart grid integration makes it a precious asset. Upcoming directions may involve incorporating machine learning, optimizing energy storage, and expanding community and grid interactions. With scalability in mind, these systems have the possibility to shape a more sustainable and technologically advanced energy geography.

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Design and Development of an RTC based Relay Board for Precision Control of Industrial Motors

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ABSTRACT

An Arduino-based time-regulated electrical apparatus control mechanism undertakes the responsibility of activating and deactivating electric equipment as per a pre-set timetable. This exploration introduces an option to manual switching by elevating technology in a manner that is more secure and more user-efficient. It showcases an integrated clock that updates in real-time, turning the associated device on or off when real-time aligns with the scheduled time. The input control panel enables users to alter the switching schedule at their convenience, while the numeric display illustrates the current time.

KEYWORDS *: Arduino, Liquid crystal display (LCD), Temporal clock, Relay unit, Control inputs.*

INTRODUCTION

We are encompassed by numerous embedded devices, and our everyday life hinges on the proper functioning of these contrivances. Employing handheld devices in our workplace empowers us to carry out tasks efficiently, encompassing activities such as operating televisions, radios, and kitchen appliances. With technological advancements, tasks become more straightforward, and through automation, devices are regulated to diminish human labor in the production of goods and services. A pressing issue in our society pertains to the misuse of electricity and ensuing energy wastage, either intentionally or unintentionally. This initiative endeavors to tackle the aforementioned challenges head-on, aiming to provide effective solutions and pave the way for lasting improvements.

A time-regulated electrical apparatus control mechanism, grounded in Arduino, emerges as the focal point of this endeavor. Initial manual systems imposed precision requirements on individuals, creating a necessity for continuous training and management oversight. The manual approach proved inefficient, requiring considerable effort and physical space. This system, in contrast, is poised to offer accuracy, flexibility, and rapid response times, overcoming the challenges posed by manual systems.

LITERATURE REVIEWS

The amalgamation of Arduino-based systems for time-regulated electrical apparatus control has garnered considerable attention in contemporary research. Automation, fueled by strides in embedded technology, stands pivotal in amplifying the efficacy and sustainability of daily activities. The literature review delves into key facets concerning the utilization of Arduino in time-based electrical apparatus control systems, underscoring the advantages and advancements in this ddomain.

Automation in Daily Existence

The reliance on embedded products for daily undertakings, such as operating electronic gadgets, has become widespread. Automation, as emphasized by researchers, simplifies these tasks, delivering convenience and curbing human intervention in production.

Energy Conservation and Electrical Prudence

An Arduino-centric solution emerges to counteract the societal predicament of electricity misuse. The temporal control system serves as a remedy, ensuring precision and curtailing superfluous power consumption.

Technological Strides

The literature underscores the pivotal role of technological progress in easing tasks. Arduino, a versatile open-source platform, plays a crucial part in crafting and implementing temporal control systems, integrating real-time clocks, LCD displays, and relay modules for heightened efficiency and reliability.

Manual System Drawbacks

Comparative analyses accentuate the pitfalls of manual systems, necessitating continuous training, liable to errors, and sluggish in response. Arduino-driven automated systems, as illuminated in the literature, surmount these challenges, offering accuracy and expedited response times.

User-Interactive Interfaces

A recurrent theme in the literature is the inclusion of user-friendly interfaces, such as keypads and numeric displays. The significance lies in empowering users to effortlessly modify schedules and stay abreast of the current time, augmenting the overall effectiveness of Arduino-based control systems.

Sustainability Aspects

The literature, amid the global pursuit of sustainability, underscores the contribution of automated systems in reducing energy wastage. Arduino-fueled temporal controls align with the broader objective of fostering eco-friendly solutions for electrical appliance management.

Future Trajectories

As technology evolves, the literature beckons future research avenues. These include exploring additional functionalities, refining energy efficiency, and ensuring compatibility with emerging technologies.

In summation, the literature review establishes the significance of Arduino-based time-regulated electrical apparatus control systems in mitigating challenges linked to manual switching. The integration of advanced technologies promises to augment efficiency, reduce energy misusage, and foster a more sustainable and user-effective approach in daily life.

PROPOSED SOLUTION

Our proposed work predominantly centers on designing and fabricating a microcomputer-based system to govern electrical appliances, such as lights and fans. The input control panel is utilized for editing activation inputs based on real-time integration of CMOS on IC DS 1307. Arduino, LCD, and RTC 1307 are employed to illustrate the control time.

Arduino Description

Arduino serves as an open-source computer hardware and software endeavoring to render interactive objects and their surroundings more accessible. The hardware encompasses a board designed around an 8-bit ATMEL AVR microcontroller or a 32-bit ARM. The Arduino UNO, reliant on ATMEGA328, is pivotal in this project. Nestled within its electronic framework are 14 meticulously designed digital I/O pins, including 6 finely tuned PWM outputs, accompanied by a 16 MHz ceramic resonator, an ICSP header, a seamlessly integrated USB connection, a power jack exhibiting functional elegance, and a strategically placed reset button.

Figure 1: Arduino UNO module

Various Arduino iterations are available, with Arduino UNO R3 and Arduino Nano V3 being the primary official versions. They operate at 16 MHz, featuring an ATMEL ATmega328p 8-bit microcontroller, 32 KB of flash RAM, 14 digital I/O with 6 analog I/O, and 32 KB.

RTC MODULE

A real-time clock module, essentially a time-monitoring device, provides current time and date details. The DS

1307-based RTC module is employed in this project, operating on the I2C protocol. It furnishes information such as seconds, minutes, hours, day of the week, day of the month, month, and year. The module operates in either 12-hour or 24-hour format, with a negligible current consumption in the nanoampere range. Communication with the microcontroller transpires through the serial communication protocol, I2C.

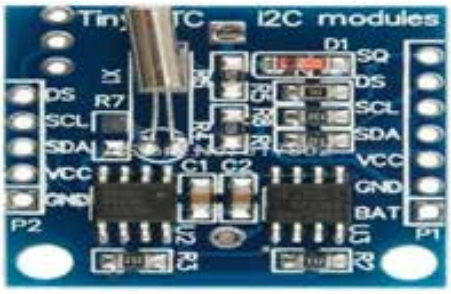

Figure 2: RTC Module

DS1307 will act as slave in communication network. The Arduino embarks on its operational journey by orchestrating a commencement scenario, seamlessly intertwining a start condition and a meticulously assigned device address, ushering communication with the awaiting slave. The commencement of Arduino's operation unfolds with the orchestration of a distinctive start condition, coupled with the conveyance of a device address to the awaiting slave. Subsequently, a journey into the data realm necessitates the transmission of the register number, unlocking access to the concealed values within. The conduit for this interaction lies in the simplicity of the I2C interface, where the SDA and SCL pins intricately interlace with their corresponding counterparts on the Arduino, creating a synchronized dance of communication. On the software front, the choreography is directed by the Wire library, a digital maestro orchestrating the harmonious dialogue between Arduino and I2C/TWT devices.

LCD DISPLAY

The LCD display module, housing 20*4 characters, features an RW1063 controller IC with interface options including 6800, 4-line SPI, or I2C. The display module is governed by SPLC780D, akin to the common HD44780. Display control is achievable through a single-wire serial interface using a serial-enabled LCD backpack.

Figure 3: LCD display

Features of LCD

- A multitude of characters, 20 in each line, spans the narrative across 4 lines, weaving a tapestry of textual intricacy
- Character table : English-european
- Viewing area :77.0*26.5 mm
- Dot size : 0.55*0.55mm
- Dot pitch: 0.60*0.60mm,
- character size: 2.95*4.75mm
- Character pitch : 3.55*5.35 mm
- LCD type : yellow/Green STN positive, transflective
- Backlight type : yellow/green LED
- Supply voltage for logic : 5v
- Supply voltage for backlight :3.8-4.2v
- Operating voltage : 20 to +70 0 c.

Relay Module

The relay module, operable at 5V and accommodating a current of 10A, is equipped with a 2-channel relay interface board. This module facilitates the control of various appliances and equipment with substantial current requirements. Direct control from Arduino is viable with 3.3V or 5V logic signals.

Figure 4: Relay module

- Ground (GND): Connects to 0V.
- Input 1 (IN1): Controls relay 1, active low. Relay turns ON when this input falls below approximately 2.0V.
- Input 2 (IN2): Controls relay 2, active low. Relay turns OFF when this input falls below approximately 2.0V.
- Voltage Common Collector (VCC): Connects to 5V.

A second pin header, 13 (2.54mm pitch), supplies the relay side of the board with 5V. A jumper on this header, at delivery, selects the 5V signal from the 14 pin to power the relays.

CIRCUIT DESCRIPTION

The ensuing diagram delineates the use case diagram of the time-regulated electrical appliances control system.

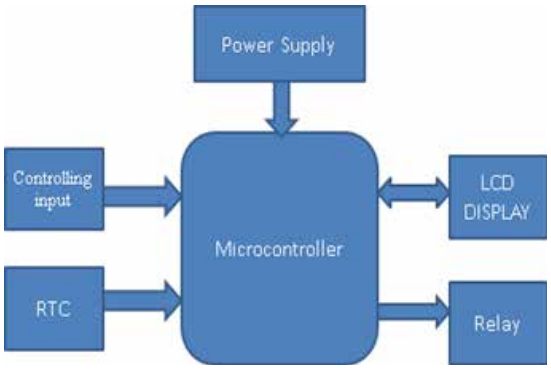

Figure 5: Block diagram

The system administrator of the time-regulated electrical appliances control system using Arduino possesses the capability to append or erase diverse appliances and their functionalities. Users can issue directives to existing devices, retrieve device statuses, and configure the operations of varied appliances. Arduino emerges as an economical solution to electronically regulate myriad processes. Use case diagrams play a pivotal role in modeling the system output, portraying a set of use cases and their interconnections. The circuit encompasses two relays for fan and light control, a keypad for input control, an LCD for instructional display, and a power supply circuit for AC to DC conversion. Arduino functions as the centerpiece in automated devices, with the system activating when Arduino is in operation.

The RTC module interfaces through four wires: VCC, GND, serial data line, and serial clock line. VCC and GND link to Arduino's 5V and GND, providing operational biasing voltage. Communication between Arduino and the RTC DS 1307 occurs via these two pins. Five push buttons serve as inputs to Arduino, pulled down to ground through 10K resistors. Depression of any button results in a logic 1 (HIGH) input on the corresponding Arduino pin. The LCD's D4-D7 data pins link to Arduino pins 10-13, while control pins Rs and En connect to pins 8 and 9, respectively. Control pins RW and VEE ground. The LCD's backlight LED receives a 5V supply.

WORKING

The choreography of operational stages unfolds as the circuit gracefully executes its intricate ballet of functionality.

1. Upon powering the circuit via USB, the initial state is OFF for both the relay and the device.
2. The user sets the device's ON and OFF times. The initial LCD message reads "Device ON time."
3. The user configures the device's ON time using the push buttons.
4. The LCD screen illuminates with the message "Device ON time successfully configured to XX:XX:XX."
5. Similarly, the user sets the device's OFF time, and the LCD confirms the setting with "Device OFF time set to XX:XX:XX."
6. After a 2-second delay, the circuit becomes operational.
7. Arduino reads the current time from the RTC module, displaying it on the LCD as "Time: - XX:XX:XX." The LCD also shows the set device ON and OFF times as Lon, Loff, Fon, and Foff.
8. Continuous monitoring checks if the current time and device ON time coincide. Upon a match, the relay and device activate, with the LCD signaling "Device is ON."

RESULT

Electrical devices, whether in a factory, home, or other settings, consume electrical power. The imperative lies

in power conservation, prompting the need for effective and efficient control of electric devices at any time and from anywhere. This project, designed for the precise control of electrical appliances, relies on temporal dependencies to regulate different devices at distinct times. Applicable in industrial and domestic settings, this design minimizes human intervention and enhances life's ease without compromising appliance efficiency. Functioning autonomously as an automated circuit, it has the potential to monitor hazardous situations, offering real-time implementation and contributing significantly to minimizing energy wastage in diverse applications.

CONCLUSION

This paper concludes with the implementation of a low-cost, adaptable electrical control system. The time-regulated electrical appliances control system, tailored for switching devices based on time, caters to both home and commercial domains. This design curbs electrical hazards and facilitates post-operation monitoring. Its utility spans various industries for time-dependent device control. Future iterations aim to streamline the circuit complexity and integrate memory card interfaces through the incorporation of ARM technology.

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Design Development and Performance Evaluation of Domestic Refrigerator by Using LPG as Refrigerant

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ABSTRACT

This experimental investigation delves into the practical implications of utilizing a propane-butane mixture, categorized as liquefied petroleum gas (LPG), as the refrigerant in domestic refrigerators. Comprising 24.4% propane, 56.4% butane, and 17.2% isobutene, the specific composition may vary among suppliers. Notably, LPG is locally abundant and economically viable, offering an environmental friendly alternative with ozone free depletion potential (ODP). Widely employed for cooking purposes globally, LPG's versatility extends to refrigeration in this study. The research centers on a medium-sized refrigerator boasting a gross capacity of 125 liters, engineered specifically to operate optimally on LPG. In-depth discussions encompass various refrigeration methods based on conventional refrigerants, providing a context for the development of this modified refrigerator. The design process is detailed, highlighting key modifications to ensure compatibility and efficiency with LPG. Performance assessments, including measures of cooling efficiency, energy consumption, and environmental impact, provide a comprehensive evaluation of the refrigerator's functionality on LPG. This study not only explores the technical aspects of adapting refrigeration systems to LPG but also addresses the broader implications of integrating an environmentally conscious refrigerant in domestic cooling applications.

KEYWORDS *: Domestic refrigerator, LPG refrigerant, COP, Cooling efficiency, Refrigeration, Propane-butane mixture, Ozone depletion potential (ODP), Cost-effective, Energy consumption, Sustainable refrigerant.*

INTRODUCTION

In response to the escalating global concern over environmental sustainability, particularly within the context of refrigeration technologies, this research embarks on a comprehensive exploration of alternative refrigerants. The specific focus is on the design, development, and subsequent performance evaluation of a domestic refrigerator, and the pivotal shift lies in adopting Liquefied Petroleum Gas (LPG) as the refrigerant. LPG, comprised mainly of propane and butane, is not only locally accessible but also economically viable, presenting an intriguing alternative to conventional refrigerants. What sets LPG apart is its environmentally friendly profile, characterized by the absence of ozone depletion potential, a significant consideration in the quest for eco-conscious cooling solutions.

The rationale behind this research is rooted in the imperative to address the ecological impact of traditional refrigerants, which has led to a growing urgency for sustainable alternatives. This study, therefore, positions itself at the intersection of technological innovation and environmental responsibility, aiming to elucidate the feasibility and effectiveness of integrating LPG into domestic refrigeration systems. As contemporary refrigerants face heightened scrutiny for their contribution to climate change, the investigation into LPG as a refrigerant emerges as a timely and pertinent endeavor.

This introductory phase serves not only to set the stage for the subsequent detailed analysis but also to underscore the broader significance of this research within the evolving landscape of refrigeration technology. By focusing on LPG, this study aspires to contribute valuable insights and potential solutions to the pressing challenges posed by conventional refrigerants, thereby charting a course towards a more sustainable and environmentally conscious future for domestic cooling systems.

HISTORY OF REFRIGERATION

The history of refrigeration indeed has a fascinating journey, spanning centuries and involving various civilizations and scientific advancements. Let's delve into some key points in the timeline of refrigeration:

Ancient Cooling Methods

- Hebrews, Greeks, and Romans: These civilizations used inventive techniques for cooling. Storing snow in insulated pits and utilizing evaporative cooling were among the methods employed.
- Egyptians: Earthen jars filled with boiled water were placed on rooftops to exploit the night's cool air.

Chemical Cooling in the 16th Century

- In 1550, there are records of the use of chemicals like sodium nitrate and potassium nitrate mixed with water to induce a cooling effect.

17th Century Advances in France

- By 1600 in France, cooling drinks gained popularity. People would rotate bottles in water infused with saltpeter for more effective cooling.
- This method allowed for the production of low temperatures and ice, marking a notable advancement.

Rise of Iced Liquors and Frozen Juices

- By the late 17th century, iced liquors and frozen juices became fashionable in French society. This marked a significant milestone in the historical timeline of refrigeration.

19th Century Developments

- The mid-19th century saw the gradual evolution of cooling methods. Early scientists developed rudimentary refrigeration machines for recreational purposes.
- Collaborative efforts by scientists towards the end of the century led to the creation of more reliable refrigeration machines.

Introduction of Rotary Compressors and Gas Turbines

- Efficient rotary compressors and gas turbines were introduced, propelling refrigeration science to new heights.

20th Century and Beyond

- The 20th century witnessed continuous advancements, with the exploration of alternative refrigerants like LPG in the design, development, and performance evaluation of domestic refrigerators.

The history of refrigeration is a testament to human ingenuity and the persistent quest for more efficient ways to cool and preserve perishable items. From ancient methods to cutting-edge technologies, the journey of refrigeration has significantly impacted various aspects of daily life, from food preservation to medical applications.

CONSTRUCTION

The detailed construction and design of the LPG refrigeration system for domestic use showcase a thoughtful approach towards efficiency, safety, and performance. Let's break down the key components and aspects of this system:

Plywood Box

- Dimensions: 724457381 mm^3.
- Sheet thickness: 12mm.

Evaporator Placement

- Crucial element positioned on the upper portion of the box internally.

Thermo-coal Sheets

- Strategically placed for enhanced insulation and prevention of cold air transfer from inside to outside.

LPG Gas Tank

- Integral component connected through pipes.
- Connected to the capillary tube.

Capillary Tube

- Regulates the flow of LPG within the refrigeration system.
- Connected to the gas tank and fitted with the evaporator.

Gas Circulation Pipe

- Connects the coiled end of the evaporator to the stove.
- Forms a closed-loop system for efficient operation.

Pressure Gauges

- Positioned at two key points: between the capillary tube and the gas tank, and at the end of the evaporator.
- Enables real-time monitoring of the system's pressure dynamics.

Closed-Loop System

- The gas circulation pipe, capillary tube, and evaporator together create a closed-loop system for the circulation of LPG.

Efficiency and Safety Considerations

- Emphasis on maximizing efficiency in the utilization of LPG as a refrigerant.
- Structural aspects and component placement designed to ensure safety in domestic cooling applications.

10. Performance Evaluation

- The design intricacies suggest a focus on performance evaluation to guarantee the system's effectiveness in maintaining optimal cooling conditions.

This construction not only reflects a comprehensive understanding of refrigeration principles but also emphasizes the importance of each component's role in achieving the desired functionality. The incorporation of pressure gauges and the closed-loop system highlights a commitment to real-time monitoring and control, ensuring the safety and efficiency of the LPG-based refrigeration process for domestic use.

UNITS OF REFRIGERATION

The utilization of the tonne of refrigeration (TR) as a unit for assessing the performance of domestic refrigerators, including those designed with LPG as the refrigerant, provides a standardized measure across different regions. The calculation for one tonne of refrigeration is based on the amount of refrigeration effect needed to uniformly melt one tonne (1000 kg) of ice from 0 ºC in 24 hours, considering the latent heat of ice.

The calculation is as follows:

$1\ TR = (1000\ kg) \times (335\ kJ/kg)\ (24\ hours) \times (60\ minutes) \approx 232.6\ kJ/min$ $1TR = (24hours) \times (60minutes)(1000kg) \times (335kJ/kg) \approx 232.6kJ/min$

In practical terms, one tonne of refrigeration is commonly approximated as equivalent to 210 kJ/min or 3.5 kW (kilowatts). This is also expressed as 3.5 kJ/s (kilojoules per second). Therefore, 1 TR is approximately equal to 3.5 kW.

This standardized unit allows for consistent evaluation of the refrigeration capacity and performance of domestic refrigerators, facilitating comparisons across different systems and ensuring a common metric for efficiency considerations. Whether measured in tons of refrigeration in the United States or in kilowatts elsewhere, this unit provides a useful benchmark for assessing the effectiveness of refrigeration systems.

WORKING OF VAR SYSTEM

The Vapor Absorption Refrigeration (VAR) system used in the design, development, and performance evaluation of a domestic refrigerator utilizing LPG as the refrigerant operates through a series of distinct processes. The VAR system is known for offering an energy-efficient alternative to traditional vapor compression systems.

Here's an overview of the working of the VAR system:

Absorption Process

- The VAR system begins with the absorption process, where the refrigerant (LPG in this case) is absorbed by a liquid absorbent, typically water or another solution.
- The absorbent and refrigerant form a solution, and this process occurs at a low temperature and pressure.

Pumping Process

- The mixture of refrigerant and absorbent is then pumped to a higher pressure. This process requires a relatively small amount of energy compared to the compression process in vapor compression systems.

Heat Input (Generator or Heat Source)

- The high-pressure mixture is then passed through a heat exchanger or a generator where an external heat source is applied.
- This heat source causes the refrigerant to vaporize, separating it from the absorbent.
- The absorbent remains in liquid form and is ready for the next absorption cycle.

Expansion Process

- The vaporized refrigerant is expanded through an expansion valve, reducing its pressure and temperature.
- This expansion process is similar to the expansion valve in a vapor compression system.

Evaporative Cooling Process

- The low-pressure and low-temperature refrigerant vapor is passed through the evaporator inside the refrigerator.
- It absorbs heat from the surroundings, causing it to evaporate and turn back into vapor.

Absorption Process (Repeating the Cycle)

- The vaporized refrigerant is then absorbed by the absorbent, starting the cycle anew.
- This completes the refrigeration cycle, and the process repeats to maintain the desired temperature inside the refrigerator.

Advantages of Vapor Absorption Refrigeration (VAR) Systems:

- Energy efficiency, especially in applications where waste heat is readily available.
- Absence of a mechanical compressor, reducing the need for electrical energy.
- Utilization of environmentally friendly refrigerants, such as LPG.

The Vapor Absorption Refrigeration system is particularly suitable for scenarios where a heat source is abundant or readily available, making it a promising option for sustainable and energy-efficient domestic refrigeration applications.

Compression or Absorption of Refrigerant

In lieu of a conventional compressor, the VAR system features an absorber where the refrigerant, in this case, ammonia, is absorbed by water acting as the absorbent. The water-ammonia mixture is then pumped and heated, causing an increase in both temperature and pressure of the ammonia. This heated and pressurized ammonia exits the absorber, ready for the subsequent stages. The work required for pumping is considerably lower compared to a compressor, resulting in significant electricity savings.

Condensation

The pressurized and heated ammonia refrigerant enters the condenser, where it undergoes a cooling process facilitated by water. This results in a reduction in both temperature and pressure, preparing the refrigerant for the next phase.

Expansion

Following condensation, the refrigerant undergoes expansion in a throttling valve or capillary tube. This process leads to a drastic and sudden reduction in both temperature and pressure of the ammonia refrigerant.

Evaporation

Your description provides a continuation of the Vapor Absorption Refrigeration (VAR) cycle, focusing on the low-pressure and low-temperature state of the refrigerant

as it enters the evaporator. Here's a breakdown of this part of the cycle:

Evaporator Stage

- The low-pressure and low-temperature refrigerant, now in vapor form, enters the evaporator.
- Within the evaporator, the refrigerant absorbs heat from its surroundings. This heat absorption causes the refrigerant to undergo a phase change from vapor to liquid.
- The primary purpose of the evaporator is to produce a cooling effect within the system.

Heat Absorption and Cooling Effect

- As the refrigerant absorbs heat from the surroundings, it cools the space or objects within the evaporator.
- This cooling effect is the desired outcome of the refrigeration system, maintaining a low temperature inside the refrigerator.

Vapor State Leaving the Evaporator

- After absorbing heat in the evaporator, the refrigerant leaves in a vapor state.
- The low-pressure, low-temperature vapour is now ready to re-enter the absorption process, starting a new cycle.

Initiating the Absorption Process

- The vaporized refrigerant, now leaving the evaporator, moves back to the absorber, where it will be absorbed by the absorbent (water) to restart the absorption process.

This completes the basic refrigeration cycle for the Vapour Absorption Refrigeration system. The VAR system, as described, offers an alternative to traditional vapour compression systems, utilizing the principles of absorption, pumping, heating, and evaporative cooling to achieve the desired refrigeration effect. The efficiency and energy savings, particularly in scenarios where waste heat is available, make VAR systems suitable for various applications, including domestic refrigeration.

ABSORPTION AND PUMPING:

Re-entry into the Absorber

- The vaporized refrigerant from the evaporator enters the absorber.
- In the absorber, the refrigerant is absorbed by the absorbent, which is water in this case.
- The resulting mixture sets the stage for the next cycle.

Pumping and Restarting the Cycle

- The mixture is then pumped to a higher pressure, restarting the cycle by returning to either the compression or absorption stage.
- This pumping process requires considerably less energy compared to the compression stage in traditional vapor compression systems.

Continuous Cooling Effect

- The cyclic process continues, providing a continuous cooling effect within the refrigerator.
- The efficiency of this process contributes to the consistent maintenance of low temperatures inside the refrigerated space.

Key Advantage: Reduced Electricity Consumption

- A key advantage of the VAR system is its reduced electricity consumption for pumping compared to traditional vapor compression systems.
- This energy efficiency makes VAR systems particularly attractive in scenarios where minimizing electricity consumption is a priority.

Additional Heat Source Requirement

- While an additional heat source, such as steam, is required for the heating stage (generator), the overall energy savings in the pumping process can outweigh the energy input from the external heat source.

Energy Efficiency and Sustainability with LPG

- The integration of LPG as the refrigerant further emphasizes the VAR system's commitment to energy efficiency and sustainability, especially in the context of domestic refrigeration.

- LPG is chosen for its thermodynamic properties and environmental considerations, aligning with the goal of reducing the ecological footprint.

In summary, the VAR system offers a continuous and energy-efficient refrigeration cycle, demonstrating advantages in reduced electricity consumption and sustainability. The integration of LPG as the refrigerant enhances the overall efficiency and aligns with the system's emphasis on energy-conscious and environmentally friendly domestic refrigeration.

PROBLEM IDENTIFICATION

In our daily life, we use the refrigerator to cool water for drinking, food storage, etc. The electricity is required to run the refrigerator. The hotels or restaurants provide the customers with cool water, where they have to use refrigerators. So, the water cooling requires electricity, and food cooking requires LPG gas which causes loss to owners. As LPG is readily available in hotels and if these two (Cooking and Cooling) can be achieved in one system then it will be beneficial for them. Thus, such a system will save electricity and also be eco-friendly will be useful. Hence, we have to develop a refrigeration system that can utilize LPG as a refrigerant for cooling and gas for cooking.

PROJECT EXECUTION PLAN

The following methodology has been applied from the start of the project to the end of the submission. It has been carried out in several stages which are shown in the following flow diagram. Overview of Applications of Cooling Tower Problem Identification Study of the Problem Modelling of Cooling Tower Material Selection and Cost Analysis of Materials Fabrication of Experimental Set-up Performance Analysis on Experimental Set-up Final.

PROPERTIES OF LPG

The key properties of Liquefied Petroleum Gas (LPG) in the context of its use as a refrigerant in domestic refrigerators is thorough and insightful. Let's recap and emphasize the significance of each property:

Colorless and Odorless

- Inherently colorless and odorless, but an odorant is commonly added for leak detection, underlining the importance of safety measures.

Flammable

- LPG is highly flammable, necessitating stringent safety precautions during handling and use.

Heavier than Air

- Being heavier than air, the behavior and movement of LPG are influenced, impacting safety considerations.

Nontoxic but Asphyxiant

- While non-toxic, high concentrations of LPG can lead to asphyxiation, emphasizing the need for proper ventilation.

Expansive Nature

- Exhibits significant expansion upon release, with 1 liter of liquid forming approximately 250 liters of vapor.

Composition

- Mainly composed of Propane (C3H8), Butane (C4H10), or a mix of both, making it a clean alternative fuel.

Boiling Point

- Boiling point ranges from -42 ºC to 0 ºC, dependent on the mixture percentage of Butane and Propane.

Combustion Characteristics

- Combustion produces carbon dioxide (CO2) and water vapor. Inadequate ventilation can lead to toxic carbon monoxide production.

Vapor Pressure

- Stored as a liquid under pressure, with vapor pressure inside a closed container equal to its temperature.

Ignition Temperature

- Requires a temperature of around 500 ºC for ignition in the air.

Calorific Value

- Has a calorific value about 2.5 times higher than the main gas, resulting in increased heat production.

Toxicity and Safety

- Non-toxic, with added odorants for smell detection. Generally non-corrosive to steel and copper alloys. Safety precautions are crucial for correct handling.

Understanding these properties is indeed vital for ensuring the safe and efficient utilization of LPG as a refrigerant in domestic refrigerators. Balancing its flammability with its effectiveness as an eco-friendly alternative requires careful consideration of these characteristics throughout the design, development, and performance evaluation stages.

APPLICATIONS OF LPG AS REFRIGERANT

Applications of Liquefied Petroleum Gas (LPG) in various contexts, including heating appliances, cooking, oxy-fuel applications, transport fuel, and closed-cycle refrigeration, highlights the versatility and efficiency of LPG. Let's summarize the key points:

Heating Appliances

- LPG's high calorific value makes it ideal for heating appliances, offering ease of combustion, portability, and clean-burning attributes.
- Specific LPG products, such as Propane, Butane, and mixtures, cater to different climates.
- Propane is suitable for cold climates, while Butane is more suited to hot climates. Propane/Butane mixtures find application in moderate climates.

Cooking

- LPG is preferred over electricity by professional chefs due to efficient combustion and precise temperature control.

Oxy-Fuel Applications

- LPG performs excellently in large-scale oxy-fuel burn applications, showcasing its versatility beyond traditional heating and cooking uses.

Transport Fuel

- LPG is a reliable fuel source for forklifts and indoor vehicles in warehouses and factories, offering efficient combustion and no noxious exhaust gases.
- Increasingly utilized as a clean automotive fuel in regions combating air pollution.

Closed-Cycle Refrigerants

- The low boiling points of Propane and Butane within LPG make them suitable for closed-cycle refrigerant characteristics, particularly valuable in the development of domestic refrigerators.

Experimental Observations

- Conducting experiments under specified operational parameters for the designed refrigerator, including size, atmospheric temperature, initial water temperature, inlet pressure of LPG, and initial evaporator temperature.
- These observations provide valuable insights into the real-world performance of LPG as a refrigerant.
- Serving as a foundation for ongoing design development and performance evaluation, demonstrating the practicality and adaptability of LPG in diverse refrigeration applications.

Exploration of LPG's applications showcases its efficacy in various fields, underlining its role as a versatile and environmentally friendly fuel. The experimental observations further contribute to the understanding of LPG's performance, ensuring its practical implementation in different settings, including domestic refrigeration.

CONCLUSION

In conclusion, the "Design Development and Performance Evaluation of Domestic Refrigerator by Using LPG as Refrigerant" project successfully establishes the feasibility and efficiency of employing Liquefied Petroleum Gas (LPG) as a refrigerant in a non-electric refrigerator. The fully open regulating valve, coupled with the use of a capillary tube as a throttling device, demonstrates effective temperature reduction in the chamber, showcasing the system's operational prowess. The cooling efficiency is substantiated by the experiment's ability to lower the water temperature within a plastic bottle from 35 ºC to 23.5ºC in 60 minutes. The system's cost-effectiveness, minimal maintenance requirements, and suitability for high LPG consumption environments,

such as hotels and industries, underscore its practical viability. Additionally, the project highlights the eco-friendly nature of LPG as a refrigerant, contributing to a sustainable and energy-efficient approach in the realm of domestic refrigeration.

ACKNOWLEDGMENT

It is with profound gratitude that we express our appreciation to our esteemed academic mentor, Prof. Mohan D. Karambe, whose unwavering guidance and continuous encouragement have been instrumental in the successful completion of the project on the "Design Development and Performance Evaluation of Domestic Refrigerator by Using LPG as Refrigerant." Working under the tutelage of such a renowned teacher has been a source of great pride and privilege, and his expertise has significantly enriched our academic journey. We extend our heartfelt thanks to Dr. Hemant S. Sonare, Director, and Dr. S. A. Chavan, Principal of GWCET, Nagpur, as well as Prof. N. H. Chahande, Head of the Mechanical Department, for imparting not only valuable knowledge throughout our B. Tech. program but also for fostering a passion for engineering and technology. The duration of this project has been enlightening, providing immense satisfaction and contributing to our overall learning experience.

Sensitivity Analysis of Independent and Dependent π Terms in Performance of Cupola Furnace

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ABSTRACT

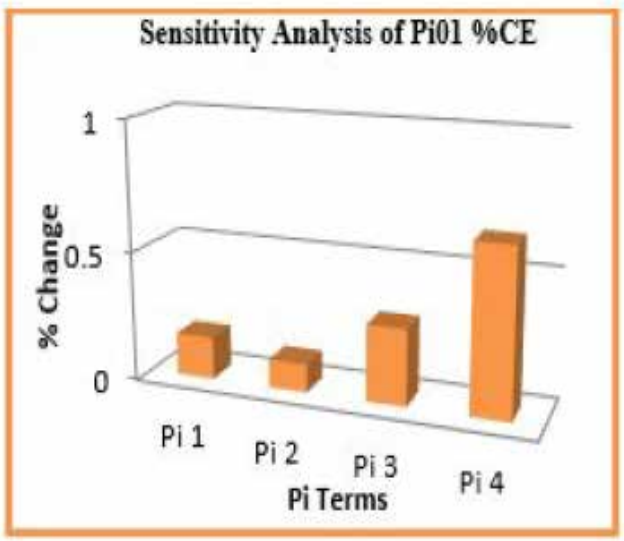
Analyzing various π terms in the model unveils the influence of independent ones. Through sensitivity analysis, we gauge how a ±10% change in individual π terms independently affects the dependent ones, creating a total 20% change range. This change's impact on the dependent π term is assessed, yielding average values. These define sensitivity—the total % changes in output for ±10% changes in input. Tables (a) & (b) illustrate response variables, attributing variation to increased independent π term values. Table (c) showcases the sequence of influence, while the figure displays graphs of sensitivity analysis for dependent π terms.

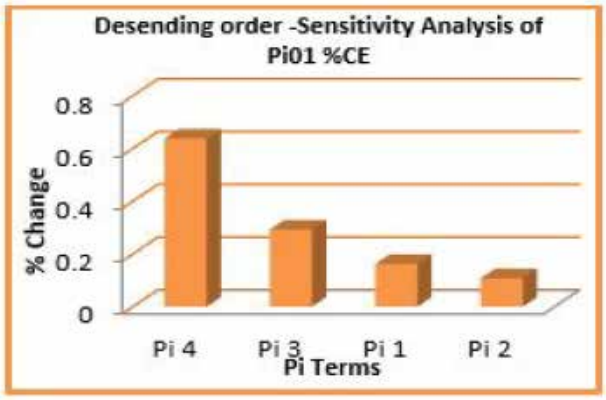
KEYWORDS *: Sensitivity, Cupola furnace, Dependent and independent pi terms.*

EFFECT OF INTRODUCED CHANGE ON THE DEPENDENT PI TERM π01

Introducing a total ±10% change in the independent π4 term yields a 0.638032% shift in π01. In contrast, changes caused by π2, π3, and π1 are merely 0.1083%, 0.293%, and 0.162% respectively. Notably, π4 emerges as the most sensitive (highest change), while π2 proves the least sensitive. The sensitivity sequence is π4, π3, π1, and π2.

From Sensitivity analysis of Π01ie. % of Carbon Equivalent (%CE), phase transformation Temperature(π4) sensitivity is most and raw material and cupola Specifications(π2) sensitivity is least for model Π01 and ultimately strong improvementis needed.



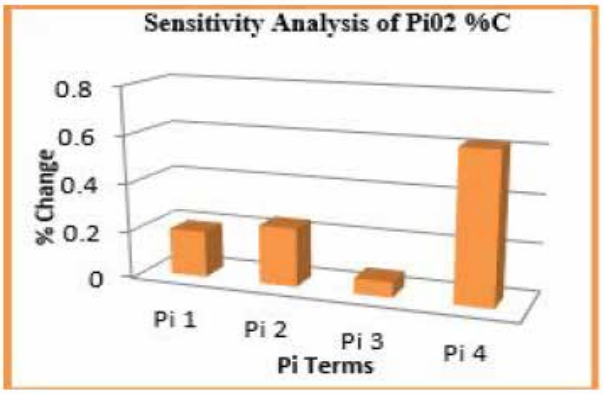


Sensitivity: Figure Sensitivity analysis of Π01,(%CE)

EFFECT OF INTRODUCED CHANGE ON THE DEPENDENT PI TERM π02

Introducing a comprehensive ±10% range variation in the independent pi term π4 yields a notable 0.619% shift in the computed value of π02. In contrast, altering the values of other independent pi terms, such as π3, induces much smaller changes, with only a 0.0642% effect. Additionally, adjustments in π3 and π1 result in changes of approximately 0.244% and 0.194%, respectively, in the value of π02.

The pi term π4 stands out with the most significant impact, contrasting with the minimal effect of π23. This positions π4 as the most sensitive and π3 as the least. The sensitivity sequence is π4, π2, π1, and π3. In the sensitivity analysis of Π02, focusing on % of Carbon (%C) and phase transformation Temperature, π4 proves most influential, while π3 (raw material and Miscellaneous Ingredients) shows the least sensitivity. This underscores the urgent requirement for substantial improvements in the case of Π02.



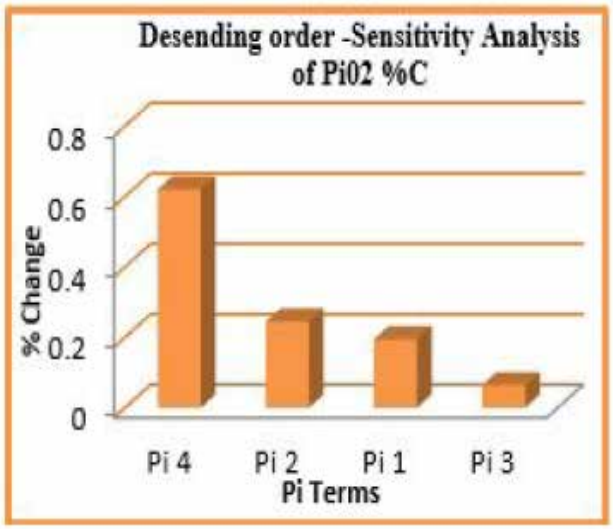
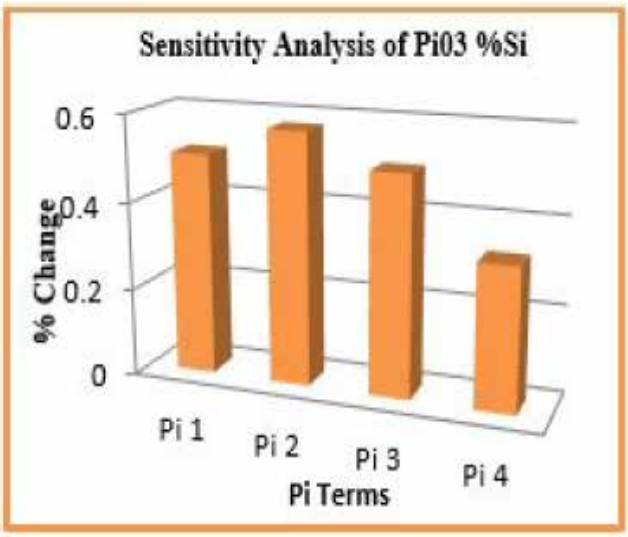


Figure: Sensitivity analysis of Π02, (%C)

EFFECT OF INTRODUCED CHANGE ON THE DEPENDENT PI TERM π03

Introducing a ±10% change in the independent π2 term results in a 0.5738% shift in π03, whereas changes caused by π4, π1, and π3 are only 0.32506%, 0.5077%, and 0.499% respectively. Notably, π2 emerges as the most sensitive (highest change), while π4 proves the least sensitive. The sensitivity sequence is π2, π1, π3, and π4. In the context of sensitivity analysis for Π03, % of Silicon Content (%Si) (π2) stands out as the most sensitive, whereas phase transformation Temperature (π4) shows the least sensitivity, emphasizing the need for improvement.



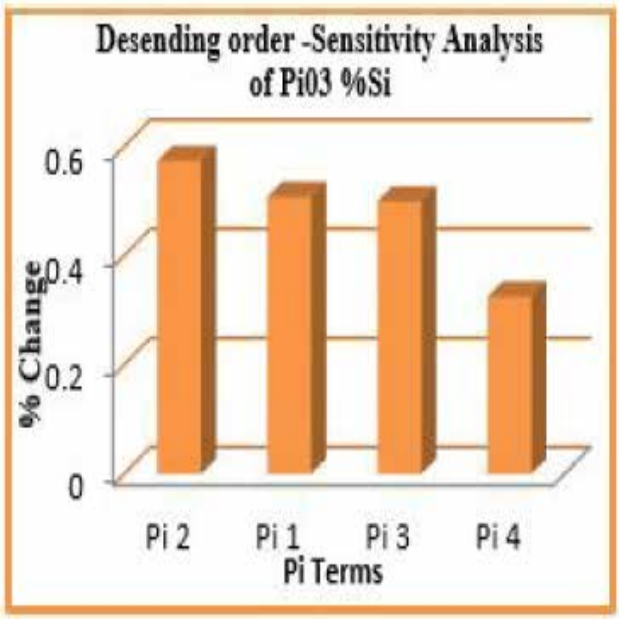


Figure: Sensitivity analysis of Π03, (%Si)

EFFECT OF INTRODUCED CHANGE ON THE DEPENDENT PI TERM π04

Introducing a ±10% change in the independent π1 term leads to a 4.376% shift in π04, while changes due to π3, π4, and π2 are only 0.405%, 3.478%, and 0.985% respectively. Notably, π1 emerges as the most sensitive (highest change), while π3 proves the least sensitive. The sensitivity sequence is π1, π4, π2, and π3. In the context of sensitivity analysis for Π04, Slag at outlet (Sg), input Metals (π1) stands out as the most sensitive, whereas Miscellaneous Ingredients (π3) shows the least sensitivity, underscoring the need for improvement.

EFFECT OF INTRODUCED CHANGE ON THE DEPENDENT PI TERM π05

Introducing a ±10% change in the independent π4 term results in a 4.755% shift in π05, while changes due to π3, π1, and π2 are only 0.2688%, 4.033%, and 0.4495% respectively. Notably, π4 emerges as the most sensitive (highest change), while π3 proves the least sensitive. The sensitivity sequence is π4, π1, π2, and π3. In the context of sensitivity analysis for Π05, Wood at outlet (Wd), phase transformation Temperature (π4) stands out as the most sensitive, whereas Miscellaneous Ingredients (π3) show the least sensitivity, emphasizing the need for improvement.

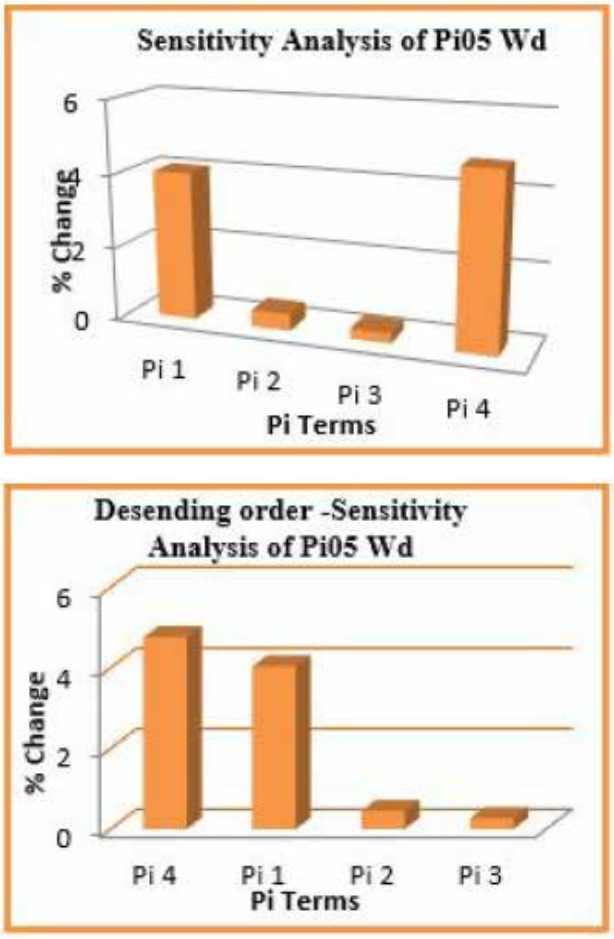
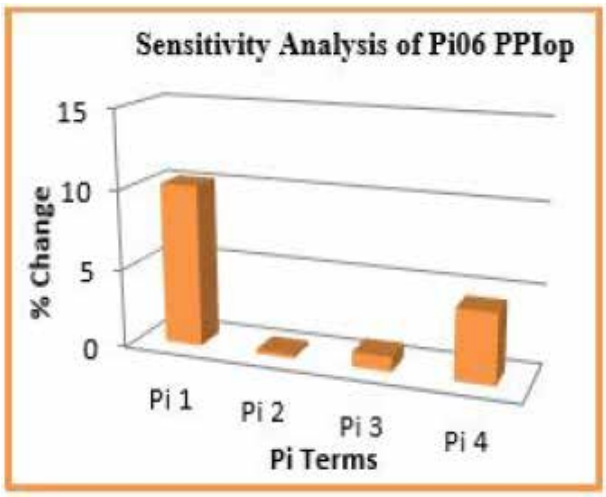


Figure: Sensitivity analysis of Π05, (Wd)

EFFECT OF INTRODUCED CHANGE ON THE DEPENDENT PI TERM π06

Introducing a ±10% range variation in the independent pi term π1 results in a significant 10.196% shift in the computed value of π06. In contrast, adjustments to other independent pi terms, like π2, lead to much smaller changes, with only a 0.24% effect. Similarly, changes in the values of π4 and π3 bring about approximately 4.411% and 0.9148% variations, respectively, in the value of π06.The pi term π1 exhibits the greatest variation, contrasting with the minimal change associated with π2. Consequently, π1 is the most sensitive, while π2 demonstrates the least sensitivity among the pi terms. The sensitivity sequence follows the descending order: π1, π4, π3, and π2.From Sensitivity analysis of Π06ie. Pure Pig Iron outlet (PPIop), input Metals (π1) is most sensitive and raw material and cupola Specifications

(π2) sensitivityis least for model Π06 and ultimately strong improvement needed.



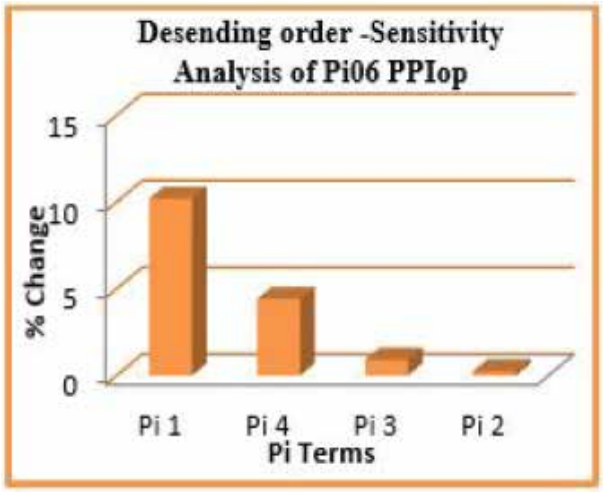
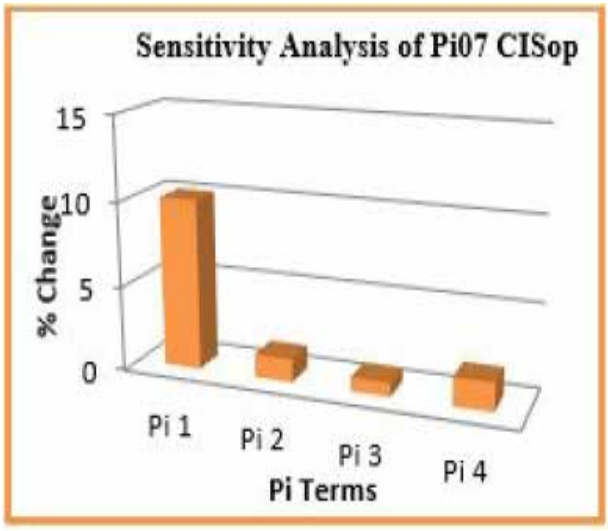


Figure: Sensitivity analysis of Π06, (PPIop)

EFFECT OF INTRODUCED CHANGE ON THE DEPENDENT PI TERM π07

Introducing a ±10% change in the independent π1 term triggers a 10.058% shift in π07, while changes due to π3, π2, and π3 are only 0.822%, 1.67%, and 1.37% respectively. Notably, π1 emerges as the most sensitive (highest change), while π3 proves the least sensitive. The sensitivity sequence is π1, π4, π2, and π3. In the context of sensitivity analysis for Π07, Cast Iron Scrap outlet (CISop), input Metals (π1) stands out as the most sensitive, whereas Miscellaneous Ingredients (π3) show the least sensitivity, emphasizing the need for improvement.



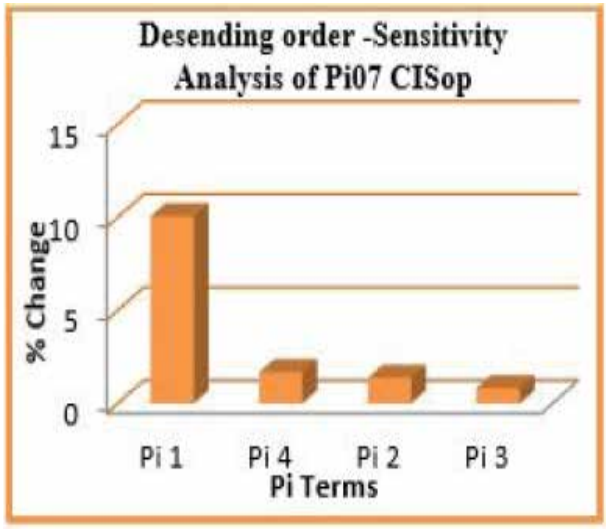
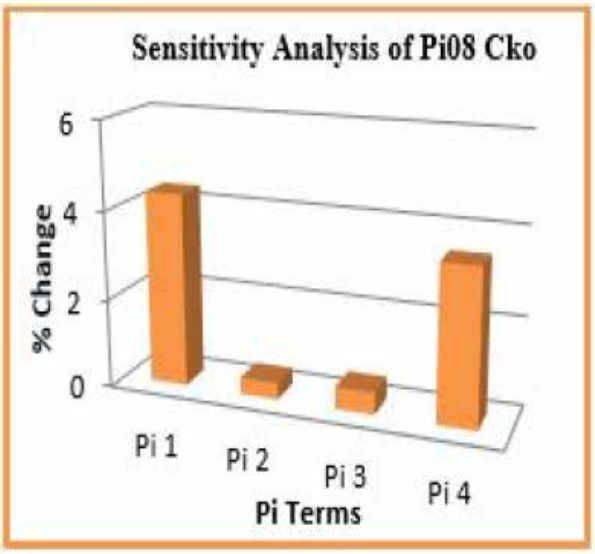


Figure: Sensitivity analysis of Π07,(CISop)

EFFECT OF INTRODUCED CHANGE ON THE DEPENDENT PI TERM π08

Introducing a ±10% change in the independent π1 term results in a 4.35% shift in π08, while changes due to π2, π4, and π3 are only 0.3712%, 3.48%, and 0.4915% respectively. Notably, π1 emerges as the most sensitive (highest change), while π2 proves the least sensitive. The sensitivity sequence is π1, π4, π3, and π2. In the context of sensitivity analysis for Π08, Coke at outlet (Cko), input Metals (π1) stands out as the most sensitive, whereas raw material and cupola Specifications (π2) show the least sensitivity, underscoring the need for improvement.



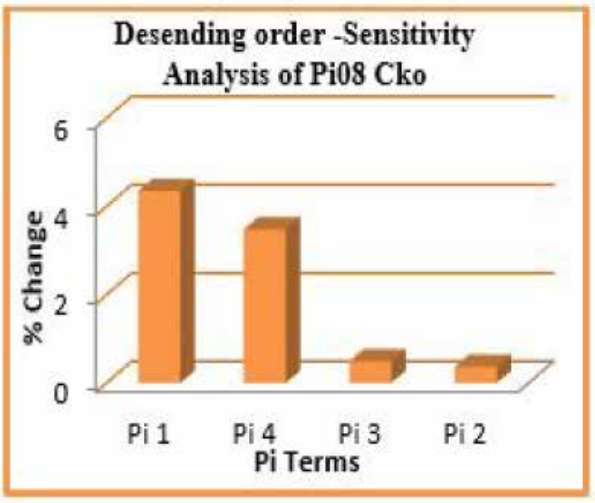
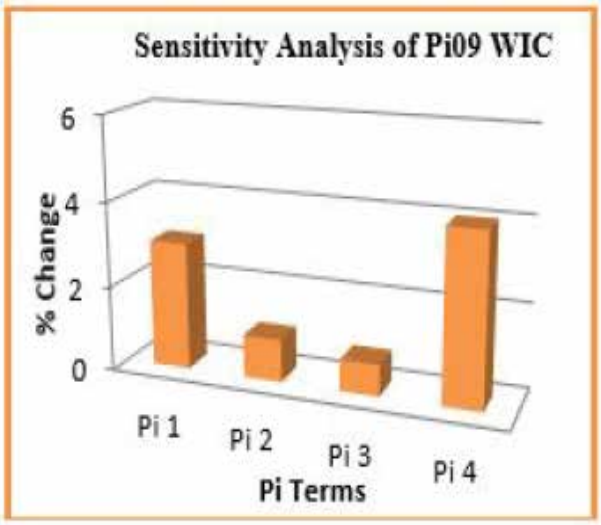


Figure: Sensitivity analysis of Π08,Coke at outlet(Cko)



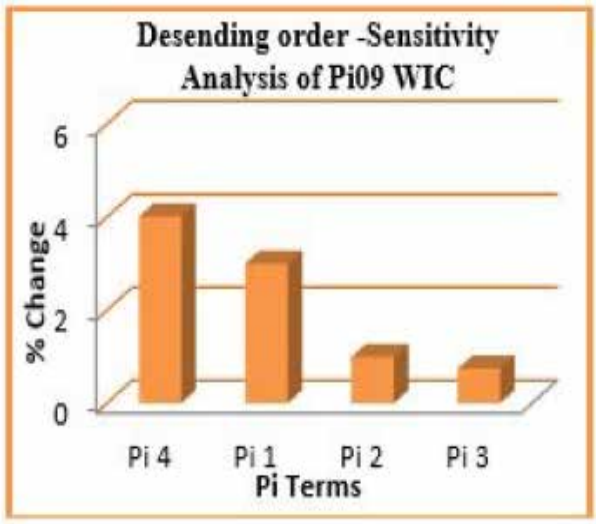


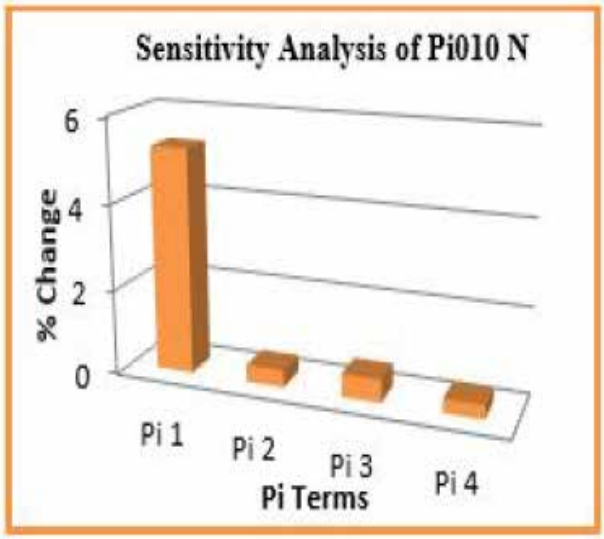
Figure: Sensitivity analysis of Π09, (WIC)

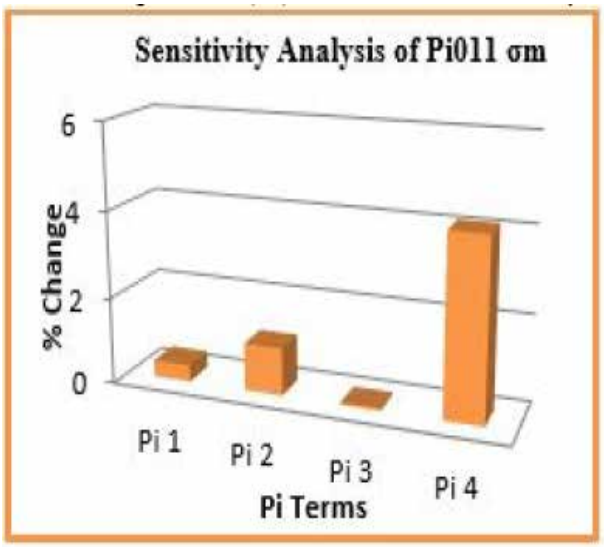
EFFECT OF INTRODUCED CHANGE ON THE DEPENDENT PI TERM π09

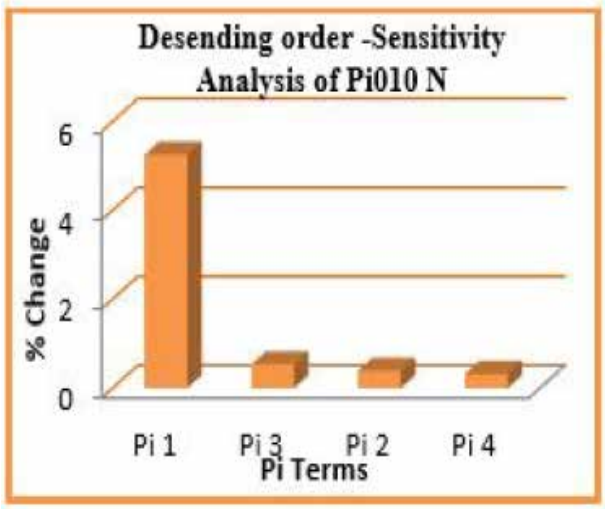
Introducing a ±10% change in the independent π4 term triggers a 4.0157% shift in π09, while changes due to π3, π1, and π2 are only 0.742%, 3.001%, and 0.999% respectively. Notably, π4 emerges as the most sensitive (highest change), while π3 proves the least sensitive. The sensitivity sequence is π4, π1, π2, and π3. In the context of sensitivity analysis for Π09, Waste In front of Cupola (WIC), phase transformation Temperature (π4) stands out as the most sensitive, whereas Miscellaneous Ingredients (π3) show the least sensitivity, underscoring the need for improvement.

EFFECT OF INTRODUCED CHANGE ON THE DEPENDENT PI TERM π010

Introducing a ±10% change in the independent π4 term triggers a 5.253% shift in π010, while changes due to π4, π3, and π2 are only 0.323%, 0.5377%, and 0.397% respectively. Notably, π1 emerges as the most sensitive (highest change), while π4 proves the least sensitive. The sensitivity sequence is π1, π3, π2, and π4. In the context of sensitivity analysis for Π010, Number of Actual Charging required (N), input Metals (π1) stands out as the most sensitive, whereas phase transformation Temperature (π4) shows the least sensitivity, underscoring the need for improvement.







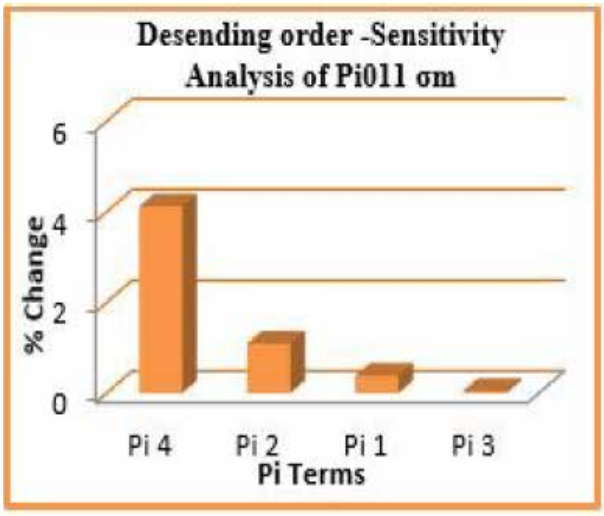


Figure: Sensitivity analysis of Π010,(N)

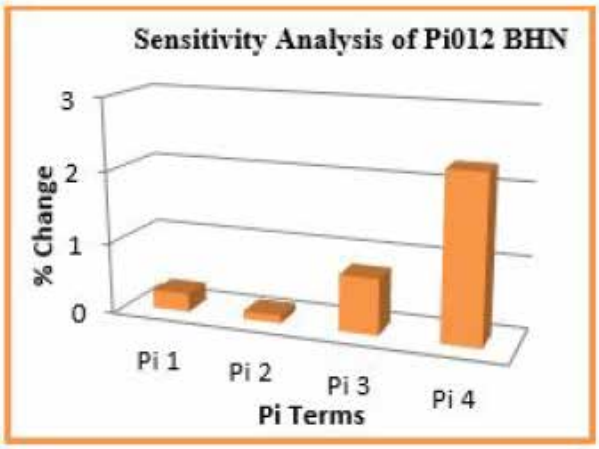
Figure:Sensitivity analysis of Π011,(σm)

EFFECT OF INTRODUCED CHANGE ON THE DEPENDENT PI TERM π011

Introducing a ±10% change in the independent π4 term triggers a 4.12% shift in π011, while changes due to π3, π2, and π1 are only 0.054%, 1.0959%, and 0.387% respectively. Notably, π4 emerges as the most sensitive (highest change), while π3 proves the least sensitive. The sensitivity sequence is π4, π2, π1, and π3. In the context of sensitivity analysis for Π011, Strength of Material output (σm), phase transformation Temperature (π4) stands out as the most sensitive, whereas Miscellaneous Ingredients (π3) show the least sensitivity, underscoring the need for improvement.

EFFECT OF INTRODUCED CHANGE ON THE DEPENDENT PI TERM π012

Introducing a ±10% change in the independent π4 term triggers a 2.291% shift in π012, while changes due to π2, π3, and π1 are only 0.11%, 0.776%, and 0.2588% respectively. Notably, π4 emerges as the most sensitive (highest change), while π2 proves the least sensitive. The sensitivity sequence is π4, π3, π1, and π2. In the context of sensitivity analysis for Π012, Hardness of output Material (BHN), phase transformation Temperature (π4) stands out as the most sensitive, whereas raw material and cupola Specifications (π2) show the least sensitivity, underscoring the need for improvement.



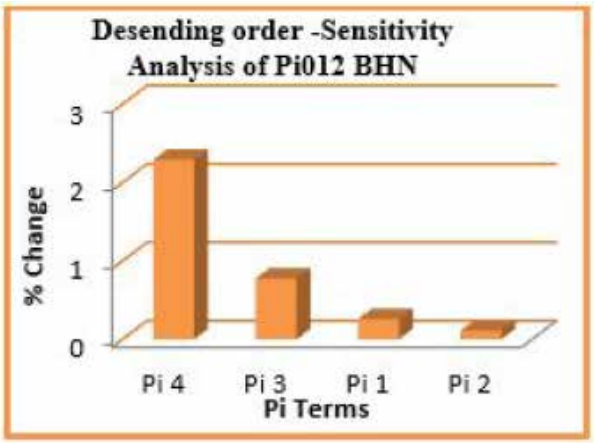


Figure: Sensitivity analysis of II012,(BHN)

Table (a):Sensitivity Analysis for metal melting process in Cupola furnace

	±10% change in Independent Terms				πD1	πD2	πD3	πD4	πD6	πD8
	PI 1	PI 2	PI 3	PI 4	%CE	%C	%Si	Sg	Wd	PPlop
Avg.	5E+11	1229	3E+10	0.535	4.259	3.608	2.233	784.3	82.43	4846
10%	6E+11	1229	3E+10	0.535	4.263	3.605	2.228	800.8	84.03	5088
-10%	5E+11	1229	3E+10	0.535	4.258	3.612	2.239	768.6	80.71	4592
	% Change				0.183	0.186	0.608	4.378	4.034	10.2
Avg.	5E+11	1229	3E+10	0.535	4.259	3.608	2.233	784.3	82.43	4846
10%	5E+11	1352	3E+10	0.535	4.262	3.613	2.238	788	82.81	4861
-10%	5E+11	1106	3E+10	0.535	4.257	3.604	2.228	780.2	82.24	4839
	% Change				0.108	0.245	0.674	0.986	0.449	0.241
Avg.	5E+11	1229	3E+10	0.535	4.259	3.608	2.233	784.3	82.43	4846
10%	5E+11	1229	4E+10	0.535	4.263	3.607	2.238	782.8	82.64	4887
-10%	5E+11	1229	3E+10	0.535	4.256	3.61	2.227	788	82.32	4822
	% Change				0.293	0.084	0.6	0.406	0.269	0.916
Avg.	5E+11	1229	3E+10	0.535	4.259	3.608	2.233	784.3	82.43	4846
10%	5E+11	1229	3E+10	0.588	4.272	3.619	2.237	771.6	80.8	4745
-10%	5E+11	1229	3E+10	0.481	4.245	3.487	2.229	788.7	84.62	4869
	% Change				0.838	0.82	0.326	3.479	4.758	4.412

±10% change in Independent Terms				πD7	πD8	πD9	πD10	πD11	πD12
PI 1	PI 2	PI 3	PI 4	CISop	Cko	WIC	N	cm	BHN
5E+11	1229	3E+10	0.535	5274	420	30.38	24.66	19.58	191.2
6E+11	1229	3E+10	0.535	5532	428.8	30.82	25.28	19.62	190.9
5E+11	1229	3E+10	0.535	5002	410.5	29.91	23.99	19.54	191.4
% Change				10.06	4.35	3.002	5.253	0.387	0.259
5E+11	1229	3E+10	0.535	5274	420	30.38	24.66	19.58	191.2
5E+11	1352	3E+10	0.535	5308	420.7	30.53	24.7	19.48	191.3
5E+11	1106	3E+10	0.535	5236	419.2	30.22	24.61	19.69	191
% Change				1.37	0.371	0.999	0.397	1.096	0.11
5E+11	1229	3E+10	0.535	5274	420	30.38	24.66	19.58	191.2
5E+11	1229	4E+10	0.535	5294	421	30.49	24.72	19.58	191.9
5E+11	1229	3E+10	0.535	5251	418.9	30.26	24.59	19.59	190.4
% Change				0.823	0.492	0.742	0.538	0.054	0.776
5E+11	1229	3E+10	0.535	5274	420	30.38	24.66	19.58	191.2
5E+11	1229	3E+10	0.588	5232	413.1	29.81	24.7	19.2	189.1
5E+11	1229	3E+10	0.481	5320	427.7	31.03	24.62	20.01	193.5
% Change				1.674	3.481	4.016	0.323	4.12	2.291

Table(b): Percentage of change because of Independent Pi terms

Pi term	% Change			
	Pi 1	Pi 2	Pi 3	Pi 4
Π01-(CE)	0.163	0.108	0.293	0.638
Π02- (c)	0.195	0.245	0.064	0.62
Π03- (si)	0.508	0.574	0.5	0.325
Π04- (Sg)	4.376	0.985	0.405	3.479
Π05- (Wd)	4.034	0.449	0.269	4.756
06-(PPIop)	10.2	0.241	0.915	4.412
Π07-(CISop)	10.06	1.37	0.823	1.674
Π08-(Cko)	4.35	0.371	0.492	3.481
Π09-(WIC)	3.002	0.999	0.742	4.016
Π010-(N)	5.253	0.397	0.538	0.323
Π011-(σm)	0.387	1.096	0.054	4.12
Π012-(BHN)	0.259	0.11	0.776	2.291

Table: Nature of variation in response variables due to increase in the values of independent pi terms

Response variables	Independent pi terms: π_1 (Input Metals)	π_2 (raw material and cupola Specifications)	π_3 (Miscellaneous Ingredients)	π_4 (phase transformation Temperature)
Π01-(CE)	Insignificant increase	Insignificant increase	Insignificant increase	Moderate increase
Π02- (C)	Insignificant increase	Insignificant increase	Insignificant increase	Moderate increase
Π03- (SI)	Moderate increase	Moderate increase	Moderate increase	Insignificant increase
Π04- (Sg)	Significant increase	Insignificant increase	Insignificant increase	Significant increase
Π05- (Wd)	Significant increase	Insignificant increase	Insignificant increase	Significant increase
Π06-(PPIop)	Significant increase	Insignificant increase	Insignificant increase	Significant increase
Π07-(CISop)	Significant increase	Moderate increase	Insignificant increase	Moderate increase
Π08-(Cko)	Significant increase	Insignificant increase	Insignificant increase	Significant increase
Π09-(WIC)	Significant increase	Insignificant increase	Insignificant increase	Significant increase
Π010-(N)	Significant increase	Insignificant increase	Insignificant increase	Insignificant increase
Π011-(σm)	Insignificant increase	Insignificant increase	Insignificant increase	Significant increase
Π012-(BHN)	Insignificant increase	Insignificant increase	Insignificant increase	Significant increase

Table: Sequence of influence of independent pi terms on dependent pi terms (Ascending order)

	πD1		πD2		πD3		πD4		πD5		πD6
Pi 2	0.108	Pi 3	0.064	Pi 4	0.325	Pi 3	0.405	Pi 3	0.269	Pi 2	0.241
Pi 1	0.163	Pi 1	0.195	Pi 3	0.5	Pi 2	0.985	Pi 2	0.449	Pi 3	0.915
Pi 3	0.293	Pi 2	0.245	Pi 1	0.508	Pi 4	3.479	Pi 1	4.034	Pi 4	4.412
Pi 4	0.638	Pi 4	0.62	Pi 2	0.574	Pi 1	4.376	Pi 4	4.756	Pi 1	10.2

	πD7		πD8		πD9		πD10		πD11		πD12
Pi 3	0.823	Pi 2	0.371	Pi 3	0.742	Pi 4	0.323	Pi 3	0.054	Pi 2	0.11
Pi 2	1.37	Pi 3	0.492	Pi 2	0.999	Pi 2	0.397	Pi 1	0.387	Pi 1	0.259
Pi 4	1.674	Pi 4	3.481	Pi 1	3.002	Pi 3	0.538	Pi 2	1.096	Pi 3	0.776
Pi 1	10.06	Pi 1	4.35	Pi 4	4.016	Pi 1	5.253	Pi 4	4.12	Pi 4	2.291

CONCLUSION

For Π01 (% of Carbon Equivalent), phase transformation Temperature (π4) is most sensitive, requiring significant improvement, while raw material and cupola Specifications (π2) show the least sensitivity.

In Π02 (% of Carbon), phase transformation Temperature (π4) is most sensitive, indicating the need for strong improvement, with Miscellaneous Ingredients (π3) being the least sensitive.

Sensitivity analysis of Π03 (% of Silicon Content) highlights raw material and cupola Specifications (π2) as most sensitive, with phase transformation Temperature (π4) being the least sensitive, necessitating substantial improvement.

For Π04 (Slag at outlet), input Metals (π1) is most sensitive, requiring significant improvement, while Miscellaneous Ingredients (π3) show the least sensitivity.

In Π05 (Wood at outlet), phase transformation Temperature (π4) is most sensitive, requiring substantial improvement, while Miscellaneous Ingredients (π3) show the least sensitivity.

For Π06 (Pure Pig Iron outlet), input Metals (π1) is most sensitive, with raw material and cupola Specifications (π2) being the least sensitive, demanding strong improvement.

Sensitivity analysis of Π07 (Cast-Iron Scrap outlet) identifies input Metals (π1) as most sensitive, requiring significant improvement, while Miscellaneous Ingredients (π3) show the least sensitivity.

In Π08 (Coke at outlet), input Metals (π1) is most sensitive, with raw material and cupola Specifications (π2) being the least sensitive, necessitating substantial improvement.

For Π09 (Waste In front of Cupola), phase transformation Temperature (π4) is most sensitive, demanding significant improvement, while Miscellaneous Ingredients (π3) show the least sensitivity.

Sensitivity analysis of Π010 (Number of Actual Charging required) indicates input Metals (π1) as most sensitive, requiring substantial improvement, while phase transformation Temperature (π4) is the least sensitive.

In Π011 (Strength of Material output), phase transformation Temperature (π4) is most sensitive, necessitating significant improvement, while Miscellaneous Ingredients (π3) show the least sensitivity.

Sensitivity analysis of Π012 (Hardness of output Material) highlights phase transformation Temperature (π4) as most sensitive and raw material and cupola Specifications (π2) as the least sensitive, ultimately requiring strong improvement.

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EPQ Model with Inventory Dependent Rate Parameter

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ABSTRACT

This work EPQ model for items which deteriorates with respect to time. The demand pattern used is mix type. Here inventory dependent demand rate is used when production is in process and assumes demand to be constant after maximum inventory level reaches. The optimum solution of the model is derived by using simple differential calculus method. The effect of rate at which inventory get consumed is discussed in this model. In this model the cost function shows the convexity. Mathematical Model gets verified by using numerical example and Sensitivity analysis.

KEYWORDS *: EPQ, Inventory dependent.*

INTRODUCTION

The EPQ models are extensively used to control inventories due to its ease in application. Traditional models assume that only perfect quality products produced during production and demand rate is also constant. .But actually it is not possible. When product is in maturity stage then constant demand may possible. Buying capacity of the customer increases if the stock is in bulk amount. In perishable items deterioration is the common phenomenon. Numerous researches had been carried out by number of researchers by considering different rate of demand and deterioration. Chung [1] developed model for production process which are imperfect and considered different rates of deterioration. Cheng et.al [2] suggested the EOQ model with demand varying with respect to stock available for deteriorating items. Their investigation shows that optimal solution is highly sensitive to demand and selling price. Chiu [3] presented EPQ model under random machine breakdown and consider corrective maintenance period as fixed. Gede and Hui [4] assumes that the demand parameter fluctuating with time and considered purchase cost as positive. Gerg et.al. [5] used LIFO policy to investigate the effect of imperfect production process. Jain and Sharma [6] studied inventory model for price and inventory dependent demand. Widyadana and Krishnamoorthy [7] considered machine failure with random repair time. Khedlekar [8] examined the effect of machine breakdown which occurs randomly on optimal run time and average cost with constant demand and backorder. Lin ad Gong [9] considers the effect of reworking on the EPQ model with backlogging. Lin ad Gong [10] taken random unavailability of machines and shortage due to it. Mishra and Singh [11] developed inventory model with exponential varying demand which depends on stock available and items deteriorates cubically. Min et.al. [12] suggested the inventory dependent demand which is price sensitive to construct the inventory model with two credit policies and price negotiation. Rosenblatt [13] considered the regular rework of defective items to convert them into finished goods and presented the defect sales return. Teng et.al. [14] presented an EPQ model for ramp type production and demand rate and considering deterioration as non-instantaneous and Weibull in nature. Shah and Patel [15] considered disrupted production system to establish model for an exponential demand. Teng et.al [16] assumes demand rate to be dependent on the retailer's current inventory level and developed a replenishment model with trade credit for deteriorating items. From the literature review revels various demand pattern discussed by number of

researchers for different production systems. Here in this article we assumed inventory dependent demand when production is in process and constant demand when sufficient stock gets build up. This paper is in four sections. Literature is in section 1. Mathematical model development is discussed in section 2. Section 3 has numerical analysis and finally concluded in section 4 .

MODEL DEVELOPMENT

Assumptions

Model is developed as follows with some basic assumptions.

a) Rate of production to be constant.

b) Demand rate is less than production rate.

Time where production stops will be

c) Constant rate and cost of deterioration.

d) Constant Inventory keeping cost

e) Items will deteriorate as they enter in stock.

f) No shortages

NOTATION-

I_1 – Items in Stock in build-up period.

I_2 – Items in Stock when production stops.

T_1 – Inventory build-up time.

T_2 – Time where production stops.

S –Production rate.

C – Basic demand rate.

σ – Deterioration rate.

β – Stock dependent demand rate parameter.

h – Holding cost.

C_d – Deterioration cost.

T – Total Production time.

TC – Total cost of Production

TCT – per unit time cost of items.

The production starts initially. As production is in process so inventory will be developed from time t = 0 to t = T1. During inventory build-up period demands depends on inventory. Maximum stock will be at time $t = T_1$. After time T_1 production stops and available inventory will be sufficient to fulfil the demand. The deterioration starts when item produced became the part of inventory. During no production time, demand assume as constant. Following equations will demonstrate the productions system

$$\frac{dI_1(t)}{dt} = S - C - \beta I_1(t) - \sigma I_1(t)$$

$$0 \le t \le T_1 \qquad (1)$$

$$\frac{dI_2(t)}{dt} = -C - \sigma I_1(t)$$

$$0 \le t \le T_2 \qquad (2)$$

With Initial boundary conditions $I_1(0) = 0$ and $I_2(T_2) = 0$, above equations are as follows.

$$I_1(t) = \frac{S-C}{\beta+\sigma}\left[1 - e^{-(\beta+\sigma)t}\right]$$

$$0 \le t \le T_1 \qquad (3)$$

$$I_2(t) = \frac{C}{\sigma}\left[e^{\sigma(T_2 - t)} - 1\right]$$

$$0 \le t \le T_2 \qquad (4)$$

By using boundary condition $I_1(T_1) = I_2(0)$

$$\frac{S-C}{\beta+\sigma}\left[1 - e^{-(\beta+\sigma)T_1}\right] = \frac{C}{\sigma}\left[e^{\sigma(T_2)} - 1\right]$$

$$T_2 = \frac{S-C}{C}\left[T_1 - \frac{(\beta+\sigma)T_1^2}{2}\right] \qquad (5)$$

Total inventory is given by following equation.

$$TI = \int_0^{T_1} I_1(t)\,dt + \int_0^{T_2} I_2(t)\,dt$$

Following equation will show total inventory.

$$TI = \frac{(S-C)T_1^2}{2} + \frac{CT_2^2}{2} \qquad (6)$$

Deteriorated items can be calculated as follows

$$TD = 0.5(S-C)(\beta+\sigma)T_1^3 - \beta\left(\frac{(S-C)T_1^2}{2}\right) \quad (7)$$

As all produced items get inspected so total inspection cost is

$$IC = c_i\left(\frac{(S-C)T_1^2}{2}\right)$$

Total cost is sum of Set up cost, Holding cost, Inspection cost and Deteriorating cost.

$$TC = A + h(TI) + IC + C_d(TD)$$

$$TC = A + h\left[\frac{(S-C)T_1^2}{2} + \frac{CT_2^2}{2}\right] + c_i\left(\frac{(S-C)T_1^2}{2}\right) + C_d\left[0.5(S-C)(\beta+\sigma)T_1^3 - \beta\left(\frac{(S-C)T_1^2}{2}\right)\right] \quad (8)$$

$$TCT = \frac{TC}{T}$$

$$T = T_1 + T_2$$

$$TCT = \frac{TC = A + h\left[\frac{(S-C)T_1^2}{2} + \frac{CT_2^2}{2}\right] + c_i\left(\frac{(S-C)T_1^2}{2}\right) + C_d\left[0.5(S-C)(\beta+\sigma)T_1^3 - \beta\left(\frac{(S-C)T_1^2}{2}\right)\right]}{T_1+T_2} \quad (9$$

The optimum production up time is represented by satisfying following condition (10).

$$\frac{dTCT}{dT_1} = 0 \quad (10)$$

Model Validation

Developed model has been validated by using numerical and sensitivity analysis. For validation data is adopted from Teng et al. (16).

A is set up cost and considered as Rs.30 per production cycle, C_d = Rs.4 /unit /unit time, , h = Rs.2.5 / unit, unit time, S = 2600 units / unit time, C = 1400 units / unit time, β = 0.5, σ = 0.1

Fig. 1 shows the relation between total cost per unit time and production time, which is convex in nature. The best possible value of production time is 0.124. The most desirable value of TCT is Rs.231.83. Parameters are changed one by one by -40% to +40%.

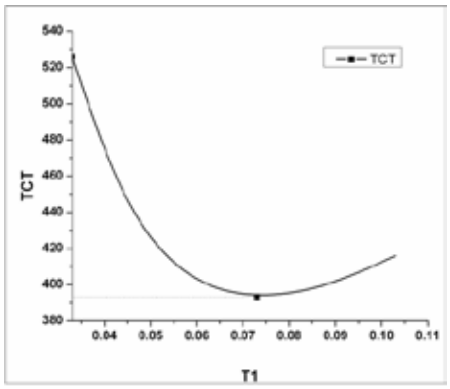

Fig. 1: T1 v/s TCT

Table No. 1

β	HC	T_1	T_2
0.3	30.75	0.108	0.114
0.4	34.76	0.115	0.121
0.5	39.95	0.124	0.127
0.6	47.56	0.136	0.140
0.7	58.49	0.152	0.154

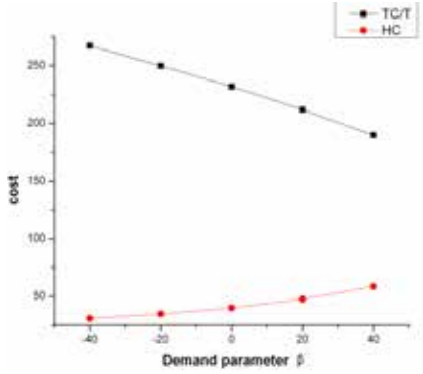

Fig.2 β v/s Cost

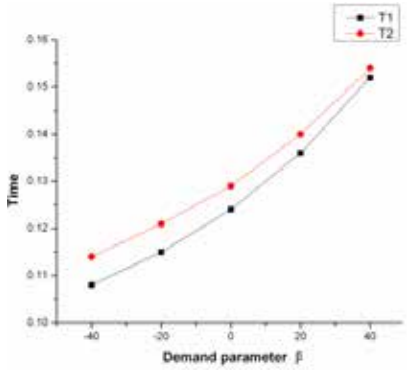

Fig.3 β v/s T

Fig.2 shows the relation between demand parameter and holding cost. But at the same time total cost goes on decreasing with increase in demand parameter. Relation shows that demand is higher at higher inventory level. Fig. 3 shows relation between production time and demand parameter. Production time increases due to increase in demand parameter. It means increase in inventory dependent consumption rate parameter increase demand. From fig 2 and fig 3 it is clear that demand parameter plays important role in inventory management.

CONCLUSION

EPQ model has been developed and studied theoretically for deteriorating items. By sensitivity analysis has given important observations. Stock dependent demand is used during stock build up period and constant demand after maximum inventory. Total cost per unit time decreases aa demand parameter increases. At the same time inventory holding cost increases due to maximum inventory. So proper selection of this parameter is important in decision making.

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Conception and Production of a Partially-Automated Multipurpose Floor Cleaning Tool

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ABSTRACT

Conventional floor cleaners are most frequently found in hospitals, bus shelters, shopping centers, and many other commercial spaces. These cleaners are useless because they require electricity to operate. The majority of floor cleaners in India are not used effectively because of the country's power crisis, which is worse in the summer. This is especially true near bus stops. It is therefore imperative to develop a floor cleaner that is easily accessible and user-friendly. The purpose of this project was to design a manual floor washer as a substitute for the ones that are currently in use. In this work, a floor cleaner's modeling and analysis were done using the appropriate commercial software. When designing the floor cleaning machine, consideration was given to the use of materials that are commonly used.

KEYWORDS *: Vacuuming, Mopping, Drying floors, Multipurpose.*

INTRODUCTION

Human health is supported and protected by efficient cleaning and disinfection, both directly and indirectly. Furthermore, eliminating residues that attract and nourish bees, other insects, and pests is another way that cleaning and disinfecting prevents pest infestation. The longevity of floors, walls, etc., is also increased with regular cleaning and maintenance. Nowadays, the majority of people prefer to travel by bus or train, so these means of transportation are crowded with items like drink bottles and biscuit wrappers. As a result, cleaning train stations and bus stops must be done frequently. The right kind of cleaning equipment and cleaning technology are essential for effective cleaning, and the equipment itself needs to be user-friendly. No single cleaning technique is suitable for every situation or environment [1]. It has been established that since cleaning tasks can be physically demanding, thorough ergonomic evaluation processes are required for new items. In recent years, busy and aging populations have come to rely more and more on floor cleaning robots due to a shortage of personnel. However, India has a higher unemployment rate, which makes the development of a cleaning machine that requires less manual labour necessary. The aim of this effort is to design, develop, and assess a floor washing machine that is operated manually [1][2]. Since cleaning is one of the most crucial hygienic and legal requirements, traditional floor cleaners have become increasingly common in airports, train stations, shopping malls, hospitals, and many other commercial locations. When maintaining these types of spaces, floor cleaning is the most crucial task.For tasks involving floor cleaning, common floor scrubbers are provided at these locations. Typically, electricity is used to power a floor washer. Most of India experiences power outages occasionally, especially in the summer. This makes using conventional floor washing machines to clean floors when they are not powered difficult. Creating a manually operated floor washer that could take the place of traditional floor washers in the case of a power outage was the aim of this project [3]. The original goals of manual floor washing were to clean both wet and dry surfaces in a

single motion, to be as cost-effective as possible, and to require the least amount of maintenance.. Since the finite element method has emerged as the most widely used method for designing mechanical parts in recent years, we decided to use it [3][4].

LITERATURE SURVEY

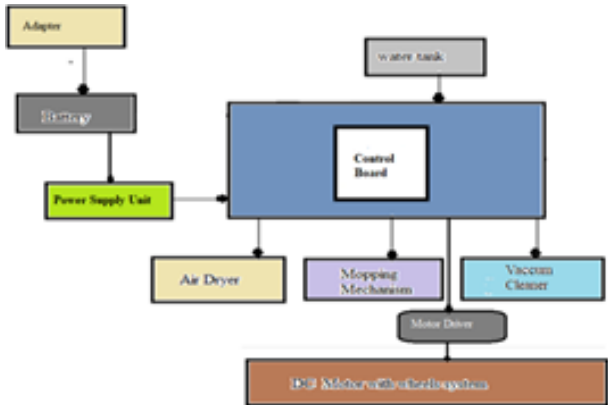
- Mohsen Azadbakht et. al. [2014]" Design and construction of a suction-blower system-equipped leaf collector powered by a tractor"- The authors provided instructions on how to construct a tractor blower-powered leaf collector. He constructed the machine's frame using a gearbox, hydraulic jack, pump, blower, and chassis. Their conclusion was that the machine has a 20-meter range and uses about 14634 W of power overall.
- Manreet Kaur et. al. [2014]"Design and construction of a robot floor sweeper (manual and automatic). A robot that can clean floors both manually and automatically was built by the author. His robot had an infrared obstacle detection system, four motors, and a water pump. His last point was the dual mode operation's ease of use for quick floor cleaning.
- Manyajain, Pankaj Singh Rawat (2016) Surfaces in homes and businesses can be automatically cleaned with this project. When activated, it moves across a floor or other surface, suckling up dust as it passes over it. These days, an automatic floor cleaner is essential.Consequently. The cleaner's design allows it to start the cleaning unit and clean the area with very little human labor.
- Sahil Bharti, S.R. Sandhave(2016) To develop an automatic cleaning tool that makes it easier to clean flat surfaces using a remote control and boosts productivity at work. The equipment that aids in surface cleaning is the surface cleaning machine that is suggested for this project. Motion control requires synchronization of numerous processes.M Ranjit Kumar et. al. (2016) The typical floor cleaning equipment is most commonly utilized at various company locations, airport terminal stages, railroad stages, healthcare facilities, transportation hubs, and retail establishments. These gadgets require electricity to operate and are challenging to use. A control emergency occurs in India, particularly during the summer, making it impossible to use the great majority of floor cleaning machines efficiently, particularly in transportation stands. The floor cleaning machine's demonstration and investigation were finished in this study using suitable, easily accessible programming. We can see from the limited component study that the physically stressed floor cleaning machine has the least amount of anxiety possible inside of it.
- Meshram, Sandeep J., and others [2016] Create and Develop a Tricycle-Powered Street Cleaning Tool. He invented a tricycle-powered instrument for cleaning streets. In the ensuing research. He developed an idea specifically for rural regions. He came to the conclusion that street cleaning is less effective..
- Akash Nagtode et al. (2017) "Solar-powered floor cleaning device." He created an energy-efficient cleaning system powered by solar energy. He has utilized a photovoltaic (PV) panel for this, which produces electricity by converting energy particles known as photons. He uses this renewable energy to power his cleaning equipment.
- Dr. J. Hameed Hussian et. al. (2017)" While cleaning the floor, this floor cleaning machine module powered by a microcontroller collects dust. A remote-controlled car with a gear motor mounted between the front wheels, a cleaning brush fastened to the motor up front, and a 12-volt battery linked to the gear motor's 9-volt battery are all included in this module. The micro controller operates the remote car".
- Liu et. al. 2017, This article used US-granted patents to conduct a technical investigation into home floor cleaning robots. They stated that, from a macroscopic perspective, Samsung is the top patent holder in the field of robot cleaning. They also mentioned the value of patent bibliometrics, patent maps, and macroscopic analysis of patents in providing an overview of particular technical themes.
- Imaekhai Lawrence and colleagues (2018) The evaluation in this paper showed how a

range of assessment methods could produce an extensive examination of the design, usability, and musculoskeletal burden of the operator. They claimed that more research would surely produce better results with larger sample sizes.

- In 2020, Abhishek Chakra and colleagues This study found that vehicle traffic on both paved and unpaved surfaces is the primary source of the load of dispersed particulates from roads. As a result, there is a dearth of information linking dust and traffic accidents. However, dust could cost some developing nations up to 0.02% of their GDP, or about $800 million, annually if 10% of these accidents result in fatalities.

PROBLEM IDENTIFICATION

Cleaning machines come in very handy when it comes to cleaning the floors and external surfaces of homes, hospitals, theaters, auditoriums, bus seats, and other public spaces. Nowadays, cleaning is necessary both indoors and outdoors.



Eliminating waste enhances our well-being and reduces the need for jobs. While there are many floor scrubbers available, the one we invented is very easy to assemble and operate. This is a device that anyone can easily operate. For this reason, it is very useful in hospitals and other large spaces. Cleaning is relatively inexpensive and takes a lot less time, reduced upkeep expenses. For this, a wide variety of machines are frequently employed. In our project, we drove the machine entirely mechanically using just a few electrical components. Anyone can safely operate the floor cleaner without any prior instruction thanks to its simple construction and ease of use. There is an urgent need for cleaning in this generation. Hospitals and colleges generally use a variety of cleaning techniques to get different types of surfaces clean. Several justifications exist for mopping the floor:• Slip and fall injuries are a common cause of accidents and fatalities.

- Accidents are frequently caused by improper floor cleaning techniques.
- Clearing debris and obstructions is necessary for floor decoration. Dust and allergens must be eliminated.

  Don't sand the surface down.
- Make improvements to the surrounds (kitchens).
- To avoid slippage, grip must be kept as strong as possible.

OBJECTIVES

1. To build a device that simplifies and expedites cleaning.
2. Provides an alternative method for highlighting pathways.
3. Reduces the need for human labor.
4. Conserve time.
5. To cut expenses.
6. To prevent potentially harmful slip-and-fall incidents. On level surfaces, trips and falls are the leading cause of injury and fatalities. One major cause of accidents is the use of inefficient floor cleaning techniques. Gets rid of scratches on surfaces and abrasive sand and gravel.
7. Clears debris from stains.

PROPOSED SYSTEM

- When a battery is used to store electric energy and a 12 volt adaptor is utilized. Machine power is provided by a 12 volt DC battery supply for the electrical switch board. The primary power for the vacuum cleaner comes from the electrical board, and when the vacuum cleaner and adapter are in use, they both receive DC power.
- Dust removal is a crucial task for vacuum cleaners

in cleaning operations. The mop rotates on a single D.C. motor as it cleans the central area covered by the chassis.

- Compared to the motor used for the driving machine, the DC motor used for rotation has a higher torque. The robot's front half is moved by the other two high RPM DC motors. In parallel, floors are quickly dried using an air dryer..
- The floor is mopped from the center slots during the summer, and the front cleaner machine removes any uneven particles that build up on the surface. Throughout the dry cleaning process, water is turned off.
- A wired remote control can be used to operate every function. A remote control, motor driver, DC motor, DC pump, air drier, vacuum cleaner, and other parts make up the system.

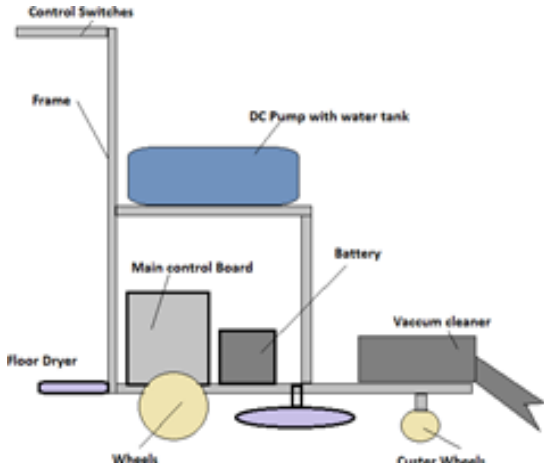


Fig.2. The floor cleaning machine's design

CONCLUSION

In our project, we showcased a floor-mopping robot for floor cleaning. The project's primary goal is to discuss the social implications of cleanliness. Numerous applications offer a variety of uses, including debris removal from roads, pipe cleaning, floor mopping for a thorough cleaning, and obstacle removal using a pick-and-place mechanism. This endeavor is crucial to keeping the country clean and is very beneficial to society. In some of those, the high rpm vibrates the entire system and the motor is not removable. If you change these features, it will work properly. All things considered, this is a successful product that can be utilized in contemporary Indian homes.

APPLICATIONS

1. Hospitals: Floor cleaning equipment is used in hospitals to perform both wet and dry floor cleaning. to get a surface that is hygienic.
2. To keep computer centers' cleaning surfaces at the appropriate level.
3. Universities: It's mainly used to clear dust at the surface.
4. Train station: All year round, the platform is available at the train station.
5. Shops and theaters, movie theatres.

ADVANTAGES

- Shorter operating time: Cleaning jobs can be finished more quickly because this machine uses a mop and motorized brushes, which reduce operating time.
- .Cleaning and polishing can be done simultaneously. We can use a mop to sweep up dust and debris and then use the same mop to polish the floor.
- .Less power is used:
- .Because a low voltage electric DC motor is being used, there is a reduction in power consumption.
- This equipment doesn't need much maintenance.
- The cleaning solution supply on this machine is controlled by an easy-to-use control valve.
- .In addition to rough surfaces, it can be used on other types of surfaces.
- With additional adjustment, the drive or movement can be controlled automatically

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Fabrication of Smart Phone Operated Sprayer Machine used for Agriculture Purpose

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ABSTRACT

Mechanical syringes represent purpose-built tools designed for the efficient and rapid injection of liquids, and they come in various types. This research focuses on solar-powered mechanical arrow sprinklers, which offer the capability to cover expansive areas, including large lawns swiftly and effortlessly. In India, where agriculture plays a vital role and 70% of the nation's food is locally produced, land is often subdivided among family members due to population growth. As a result, the average Indian farmer typically owns just two acres of land, making it financially challenging for them to invest in expensive farming equipment. This project introduces a mobile device that operates a wheeled insecticide sprayer, enabling the swift and efficient coverage of vast areas, including lawns. Such sprayers prove to be the most cost-effective solution for areas requiring extensive spraying. Additionally, the integration of a smartphone app allows for the wireless control of all sprayer functionalities, enhancing convenience and precision in the application process.

KEYWORDS *: Battery, Pesticide sprayer DC pump portable. Smartphone features. Application etc.*

INTRODUCTION

70% of the population of India depends on agricultural production, making it an agricultural nation. The lands are divided up among families as the population rises, thus an Indian farmer typically owns only 2 hectares of farmland. Additionally, due to their extreme financial hardship, farmers still rely on traditional farming practises because they cannot purchase expensive machinery. In order to control pests, plants are sprayed with liquids such as herbicides, insecticides, fungicides, and fertilisers using a mechanical device called a sprayer. A sprayer makes it easy to apply liquids like pesticides in the best possible way. Chemicals are frequently dispersed using atomizers and dusters. Differentiate between dusters and basic chemical application techniques. These are excellent for portable machines and typically call for simple tools. Due to their lower levels of dust pickup, these devices are, nevertheless, less effective than atomizers. Almost any equipment, whether domestic or industrial, including agricultural machinery, may now be fully monitored and controlled thanks to technical advancements, particularly in the area of Bluetooth communication and control systems. In light of this, we suggest developing a pesticide spraying system that use Bluetooth to be controlled by a smartphone.

PROBLEM IDENTIFICATION

In India, 73% of people depend on agriculture either directly or indirectly. India is now an agricultural nation as a result. However, farmers still have a lot of issues.

A. Pests: Pests pose a threat to farmers' output. With temperatures rising, carbon emissions rising, and illnesses, pests, and weeds emerging due to rainfall and drought, pests pose a serious danger to food supply. In order to adopt and develop new solutions in response

to the threat of climate change, it is necessary to have a better understanding of pest behaviour in various anticipated scenarios and

B. Lack of Mechanization: Despite the extensive mechanisation of agriculture in various regions of the nation, the majority of agricultural operations are still conducted by hand in the majority of those regions, employing straightforward conventional equipment and implements like wooden ploughs, sickles, etc. Particularly with small and marginal farms, this is the case.

C Short supply of electricity: In rural locations, the reliability of the power supply is a major issue. The majority of rural residents in nations like India depend on agriculture. The village also has an issue with erratic and inconsistent electricity delivery.

D. Existing methods The majority of spray technologies currently in use are either very labor- intensive or inadequately automated, which has negative effects on both health and the economy. There are significant attempts being made to speed up farm work, minimise stress and tiredness, and save money during agricultural production operations.

OBJECTIVE

The major goal is to make use of the battery and adapter power that comes with bike spraying jobs.

Lower the price of the injection moulding machine.

A smartphone application that uses Bluetooth mobile technology allows for wireless control of the device.

Lower operating costs by continuing to implement new mechanisms.

Lower labour expenses as a result of

Improvements in spraying techniques.

DC power supplies cut down on energy use.

Year-round, uninterrupted field spraying.

LITERATURE SURVEY

Agriculture as the Foundation of the Indian Economy and Culture: Agriculture has indeed beneath backbone of the Indian economy for centuries. It provides livelihoods to a significant portion of the population and contributes substantially to the country's GDP. Additionally, agriculture plays a crucial role in Indian culture, with many festivals and traditions revolving around farming and harvests.

Energy Intensive Agricultural Practices

Modern agriculture heavily relies on various energy-intensive practices, as you've mentioned, such as plowing, irrigation inter cultural operations, and the use of agricultural machinery and pesticides. The mechanization of farming has increased productivity but also energy consumption.

Energy Security and Transition to Renewables: With the world facing depleting fossil fuel resources and the associated environmental concerns energy security has become at apriority Shifting to renewable energy sources is a sustainable solution to address this challenge .India, like many other countries. has been investing in renewable energy technologies such as solar and wind power to reduce its dependence on finite fossil fuels.

Renewable Energy in Agriculture

Integrating renewable energy sources into agriculture can be highly beneficial. Solar pumps, for example, are increasingly used for irrigation in rural areas. They provide a cost-effective and sustainable alternative to traditional diesel or electric pumps. Additionally, wind and biomass energy can be amused for electricity and heat generation in rural areas.

Government Initiatives: The Indian government has launched several initiatives to promote renewable energy adoption in agriculture. Schemes like the Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM) aim to encourage the use of solar energy for irrigation and provide additional income to farmers through surplus power generation.

For example,

Joshua et al. (2010) created a two-stroke gasoline engine power sprayer. Since the operating costs were thought to be significant, a solar-powered sprayer was recommended.

Rao et al. (2013) reported on a fertiliser sprayer's performance that could use a fully charged battery to spray 580 litres of insecticide across around 5-6 acres of land.

Khan (2014) developed a spray jet that can be driven by a DC pump powered by solar energy.

Chavan et al. (2015) created a prototype 20 Wp PV module and brushless DC motor (12 V. 2.2 A) agricultural pesticide sprayer. In addition to these, literature is available with thorough details on a few other types of solar-powered pesticide sprayers.

Kulkarni et al., 2015, Lad et al., 2015; Patil et al., 2014; Sawalakhe et al., 2015, Few researchers have also created and developed a vehicle for carrying the sprayer with the goal of reducing human labour while spraying in the field while carrying a conventional sprayer on the user's back (Kshirsagar et al., 2016). The purpose of this study was to design and create a solar PV sprayer that could be pulled by a hand-drawn vehicle to go through the field.

JP SINHA et. al. Jan 2018, creation of a solar- powered backpack sprayer, This essay In India, there are 83% small and marginal farmers, who own 46.1% of the country's land and contribute 51.2% of its agricultural output. Because they are inexpensive and simple to use but produce less, backpack sprayers are widely utilised by small and marginal farmers in India to manage pests. A solar- powered sprayer with a higher output (0.3 ha/hr), less physiological energy use, less discomfort was developed. For protection against deep drain and overcharging of the battery for a longer operational life, an electronic control had been inserted. With in two hours of exposure. The system could be fully charged by solar energy and could run continuously for six hours. This guarantees a good spray with consistent droplet size throughout the swath .In order to ensure trouble-free operation and extend the life of the nozzle, an anti-clogging filter was also added before the nozzle in the nozzle head.

Kumawat Mukesh M et. al. May 2018 powered pesticide sprayer for use in agricultural. This essay discusses the numerous benefits of the solar- powered pesticide sprayer for use in agricultural. This essay discusses the numerous benefits of the Requires minimal up keep. The vibration is decreased. Comparison to pumps driven by internal combustion engines (ICES), the operation of solar- powered pumps is more cost-effective, primarily

because of lower operating and maintenance expenses. When there is no access to grid electricity, solar pumps are a good alternative, especially when compared to petrol sprayers. By performing the spraying procedure without hiring help, the farmer can increase spraying efficiency.

Ms. Avhad Jayshri et. al. 2019 The solar-operated spray pump system you described is a sustainable and efficient solution for covering large areas with liquids, particularly useful for applications like applying pesticides to lawns. Here's a breakdown of the key components and features mentioned in your project description:

Tank: The tank holds the liquid to be sprayed. It is an essential part of the sprayer system, ensuring a sufficient supply of the liquid for the spraying process.

Solar Panel: The solar panel serves as the power source for the system. It harnesses energy from the sun and converts it into electrical power to drive the pump and other components.

Motor: The motor is responsible for pumping the liquid from the tank and through the spray nozzles. It is powered by the energy generated by the solar panel.

Spray Nozzles: These are devices that disperse the liquid in a downward direction over a large area. The spray pattern can be adjusted to meet specific application requirements.

Ball Valves: Ball valves are likely used to control the flow of the liquid within the system. They provide a mechanism for regulating the release of the liquid when needed.

Chassis with Wheels: The sprayer is mounted on a chassis with wheels, allowing for easy mobility. This design facilitates the movement of the sprayer across the targeted area.

Hose Attachment: The hose attachment provides a flexible extension for spraying in areas that may be challenging to reach with the standard spray pattern. It enhances the versatility of the sprayer.

Mechanical Propulsion: The sprayer is mechanically propelled from behind, suggesting that it can be pushed or pulled by an operator. This design choice ensures ease of control and man severability.

Automatic Operation: The liquid is sprayed automatically as soon as the pump's power source is turned on. This feature streamlines the application process, making it more efficient.

Application of Pesticides: The primary use of this type of sprayer is for applying pesticides to lawns. It mentions the application of herbicides, insecticides, and fungicides, indicating a broad range of potential uses for pest control and plant health. Overall, the solar-operated spray pump system represents a sustainable and environmentally friendly approach to large-scale liquid application, making it an excellent choice for agricultural and landscaping purposes.

Spraying Methods

Back pack type spraying

The use of mechanical sprayers is one of the more popular ways to apply pesticides, especially in traditional agriculture.

Hand Driven Sprayer

Hand-operated pumps, as described, are versatile tools constructed with specific components to facilitate their functionality. Here's a breakdown of the key features and components of hand-operated pumps for applying herbicides:

Rigid Diaphragm Chamber: The diaphragm chamber is a critical part of the pump's construction. It is rigid, ensuring stability during operation. The diaphragm chamber houses the flexible synthetic rubber diaphragm and plays a key role in the pumping mechanism.

Flat or Ball-Type Intake and Output Valves: These valves control the flow of liquid into and out of the pump. The choice between flat or ball-type valves may influence the pump's efficiency and durability. Valves play a crucial role in maintaining the direction of fluid flow within the pump.

Flexible Synthetic Rubber Diaphragm: The diaphragm is a flexible, synthetic rubber component that expands and contracts during the pumping process. It is a crucial element for generating pressure within the pump, allowing it to draw in and expel liquids.

Crankshaft Mechanism: The crankshaft mechanism is responsible for converting the rotary motion from the pump handle into the reciprocating motion required to manipulate the diaphragm. It connects the pump handle to the diaphragm, ensuring the diaphragm moves in response to manual operation.

Pump Handle: The pump handle serves as the point of manual operation. It is connected to th crankshaft mechanism and allows the user to pump the handle, initiating the diaphragm's movement and the pumping action.

Pressure Range: Hand-operated pumps for herbicide application typically operate within a specific pressure range, mentioned as 1 to 3 bar (15-44 psi). This range is suitable for applications where larger droplets are needed to minimize spray drift, providing control over the size and distribution of the sprayed droplets.

Herbicide Application: These pumps are specifically designed for applying herbicides .The need for larger droplets addresses concerns related to spray drift, ensuring that the herbicide is effectively targeted and minimizing unintended environmental impact.

Manual Operation: Being hand-operated, these pumps do not rely on external power sources. Users manually operate the pump handle to generate the pressure required for spraying herbicides. In summary, hand-operated pumps for herbicide application are designed with a rigid diaphragm chamber, specific valves, a flexible synthetic rubber diaphragm, and a crankshaft mechanism.

Fuel Operated Sprayer

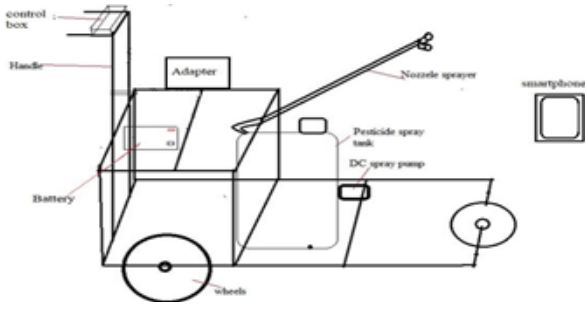


Fig. 1. Block Diagram

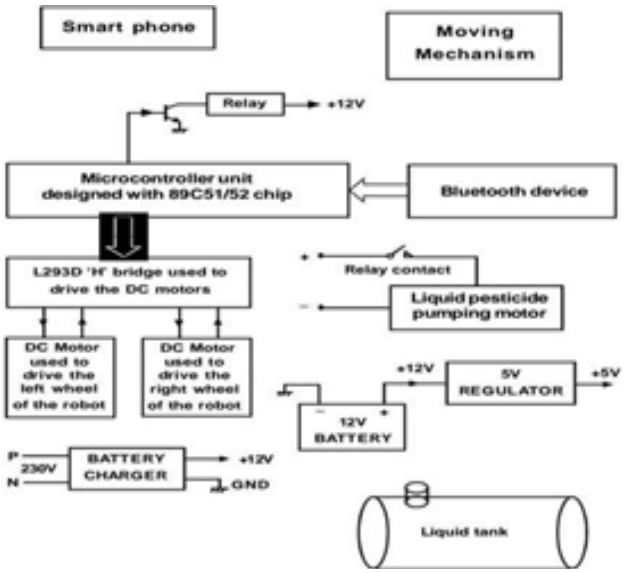


Fig. 2. Structural Diagram

An internal or external spray tank, a high pressure piston pump that is often powered by a petrol engine, a pressure regulating valve and a hose that can extend up to 50 meters make up the power sprayer. A sa backpack, spray tanks are too large to be worn. There are numerous varieties of the power sprayer developed. The most basic and typical setup consists of a 200 l drum, a hose, and a lance installed on an engine-driven pump frame without wheels. When using a basic power sprayer, restrictors and a pressure regulating valve are used to control the flow. Sprayers mounted on wheels and outfitted with pressure regulators are on the other end. Technically speaking, the motorized knapsack- sprayer and the power sprayer are very similar. The sprayer is often set up for large volume spraying and high pressure droplet conveyance. The preferred type of nozzles are hollow cone nozzles.

Battery operated sprayer

Battery-operated sprayers must be charged before use, and they can only be used in situations where electric power is not available.

Block Diagram

This method is easy to use. The energy is converted into electricity and supplied to the battery via the adapter. This power is used by the battery to recharge itself. The motor is then powered by this battery. A motor attached to the tank's base draws liquid from the tank and delivers it. The handle-mounted control switch is used to turn the motor on and off. There is a switch provided to control its operation. The switch is pushed, the gun's valve is released, and at the same time, the switches pushed, providing current to the motor.

The Bluetooth module serves as the sprayer's eyes. It receives a signal from a smartphone and carries out each action in accordance with it. A microprocessor that manages the operation of all the motors is interfaced to the sprayer and vehicle motors. In this manner, all functions are carried out using smartphone and feature-based applications.

Components

The component was chosen in accordance with the specifications. The list of parts is as follows,

1. Tank 2. Adapter 3. DC pump motor
4. DC Battery Blower 5. Connecting pipe
6. Charging Module 8. Retractable Link
7. Frame 9. Nozzle 10. Wheels
11. Control Boards 13. Wireless system
12. Other

Components Required Battery

High-Peak Power: High-peak power is crucial for providing the necessary burst of energy during acceleration or other high-demand situations in HEVs. It ensures quick response times and improved overall performance.

Pulse-Specific Power: Pulse-specific power refers to the ability of the battery to deliver high power in short bursts, such as during rapid acceleration or regenerative braking. This feature is important for optimizing energy efficiency and enhancing the dynamic performance of the vehicle.

High Specific Energy at Pulse Power: Specific energy is the amount of energy a battery can store per unit of weight or volume. Having high specific energy at pulse power means that the battery can deliver a significant amount of energy during short bursts without sacrificing overall energy density. This is beneficial for achieving efficient energy utilization in HEV applications.

High Charge Acceptance: High charge acceptance is essential for quickly and efficiently recharging the battery, especially during regenerative braking or other situations where energy is recovered. It maximizes the utilization of regenerative energy and contributes to overall energy efficiency in the hybrid system.

Extended Calendar and Cycle Life: Calendar life refers to the lifespan of the battery based on time, while cycle life refers to the number of charge-discharge cycles a battery can undergo before its performance significantly degrades. Extended calendar and cycle life are crucial for ensuring the long-term durability and reliability of the battery in HEV applications, contributing to lower maintenance costs and increased overall vehicle lifespan. These characteristics collectively contribute to the effectiveness and efficiency of the battery system in a hybrid electric vehicle, addressing the specific demands of variable power requirements, quick response times, and regenerative energy capture. Advanced battery technologies and materials are continuously being developed to enhance these characteristics and meet the evolving needs of the automotive industry in terms of performance, efficiency, and sustainability.

Solar Panel

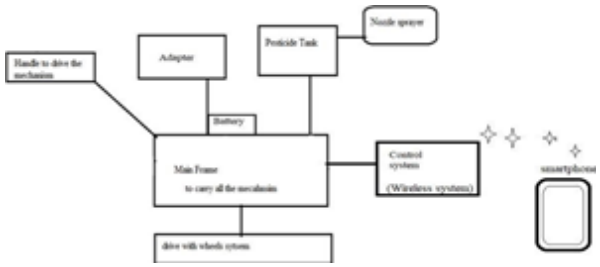


Fig. 3. Functional Diagram

Here's a more detailed breakdown of the energy transfer at the subatomic level within PV cells:

1. Photons and Solar Radiation: Solar radiation consists of photons, which are particles of light. These photons carry energy and travel from the Sun to Earth.

2. Interaction with Solar Cells: When sunlight strikes a solar cell, it interacts with the semiconductor material, usually silicon, that makes up the cell. Silicon is chosen for its semiconductor properties, which allow it to facilitate the movement of electrons.

3. Absorption of Photons: The photons from the sunlight are absorbed by the semiconductor material in the solar cell. This energy absorption excites electrons within the semiconductor.

4. Creation of Electron-Hole Pairs: The absorbed energy is sufficient to elevate some electrons to a higher energy state, creating electron-hole pairs. Electrons gain energy and move to a higher energy level, leaving behind "holes" or locations where electrons were previously located.

5. Electric Current Generation: The movement of these excited electrons creates an electric current. This flow of electrons constitutes the generation of electricity within the solar cell.

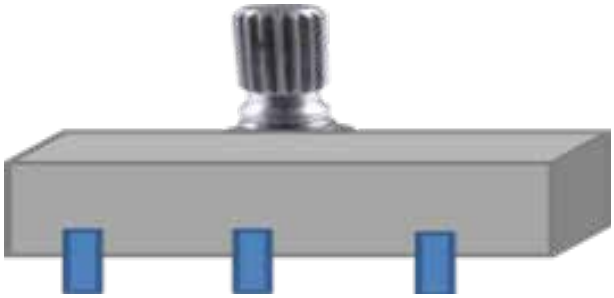
6. Electricity Output: The electric current generated within the solar cell is then collected and harnessed

for external use. This electricity can be used to power various devices or fed into an electrical grid.

The analogy to flappers striking a metal ball in a pinball machine captures the idea of energy transfer. In the case of PV cells, photons act as the external force (like the flappers) that imparts energy to the system, causing electrons to move and generate an electric current.

Silicon is a commonly used semiconductor material due to its abundance and its ability to conduct electricity when exposed to light. Other materials and technologies, including thin-film solar cells and organic photovoltaics, are also being explored to enhance efficiency and reduce costs in solar cell production.

Overall, the conversion of solar energy into electricity through photovoltaic cells is a remarkable example of harnessing energy at the subatomic level, providing a sustainable and clean source of power.



Tank

Pesticide solution is kept in a tank in this location. 10 litres can fit in the tank. Additionally, it has a manual pump in the event that the battery is dead.

Spray Gun

It is used to give direction to the pressured solution.

Potentiometer

Three-Terminal Resistor: A potentiometer has three terminals, typically labeled as the "input" or "source," the "output" or "wiper," and the "ground" or "reference." The resistor element is connected across the input and ground terminals.

Variable Voltage Divider: The potentiometer functions as a variable voltage divider. It allows you to adjust the voltage output between the input and ground terminals by manipulating the wiper position.

Sliding or Spinning Contact (Wiper): The sliding or spinning contact, known as the wiper, is a moveable connection that makes contact with the resistive element. The wiper position determines the output voltage. In a sliding potentiometer, the wiper slides along the resistor element, while in a rotary potentiometer, the wiper rotates around the resistor.

Potentiometers are widely used in electronic circuits for various purposes, such as volume controls in audio equipment, brightness controls in displays, and as adjustable resistors in sensor circuits. They provide a simple and effective way to control the level of voltage or resistance in a circuit, offering versatility in applications where manual adjustment is required.

Voltmeter

A voltmeter is a device that measures the difference in electrical potential between two locations in an electric circuit.

Calculations

Selection of Spray Pump

According to spraying capacity, the spray pump is selected Type: Centrifugal Pump. Liquid Discharge= 2.9 lit/min. Speed=3600rpm.Power=3.5W

Selection of Battery

According to pump operating power, battery is selected. Type: Lead acid battery. Voltage=12 V Current=8 A When the circuit is short then, Voltage=12V,Current=2.4 A

Power=Voltage x Current=12x2.4=28.8W

Selection of Adapter

According to battery output power, adapter is selected. Power=20W Dimensions:500mm x22mm x340 mm

Weight=2.0kgOpenCircuitVoltage=21.6VShort Circuit

Current=1.318AOperatingCurrent=1.176A

Current produced by panel and charging time of the battery

(i) The maximum power of the solar panel (P) and the battery's voltage rating (V), which are determined by the formula I = P/V, were used to compute the current produced by the solar panel(I).Ithusequals20/12,or

1.66 in A (ii). The ratio of the battery's ampere hour (Ah) rating to the total current delivered by the solar panel was used to calculate the charging time (T). T = (total current drawn by the solar panel / total ampere-hour rating of the battery)

Therefore ,T=8/1.66=4.79hr

Advantage

The solar sprayer has many advantages:

- Petrol transportation expenses are reduced.
- Solar sprayers require little up keep.
- There is less vibration than with a fuel sprayer.
- To lessen the operator's physical effort while boosting the quality of the spraying.
- The farmer can do the spraying procedure without hiring help, boosting the efficiency of the spraying process.
- It is a machine with several uses.
- Simple to use and intuitive.
- Other models suffer from far less pollution.

It is portable , and the unit price is quite reasonable.

- Low maintenance costs.
- Easy to put together.

Disadvantages

Since the cost prevents every former from receiving a solar spray system,it would be beneficial for them if the government assisted formers in obtaining such equipment.

How to apply? questions for past students. Before using such a system, formers must receive training in it.

Accurately align the solar panel's spray mechanism to prevent panel damage.

It can only function efficiently in the presence of sunshine or during the cloudy season.

RESULTS

Let's summarize the key details:

Solar Panel Specifications

- Voltage: 17V
- Current: 1A
- Operational Period: 9:30 AM to 4:30 PM

Battery Specifications

- Voltage: 12V
- Current Capacity: 8Ah

Charging Time

- Charging Current: 1.3A
- Charging Period: 7 hours

Operational Duration

- The 8Ah battery can power the module continuously for 7 to 8 hours.

Operational Efficiency

- The module can fully charge the battery during the 7-hour testing period, indicating a good balance between solar panel output and battery capacity.

Economic and Compatible

- The suggested model is described as economical, likely due to its efficient use of solar power and the ability to operate continuously for an extended period. Compatibility with other models suggests that it can seamlessly integrate with existing systems or technologies.

Continuous Operation

Unlike an electronic pesticide sprayer, this solar-powered module can operate continuously for 7 to 8 hours. This could be advantageous in scenarios where prolonged spraying is required without interruptions.

Daytime Operation

The testing and operational period during the day (9:30 AM to 4:30 PM) aligns with the availability of sunlight, maximizing the solar panel's efficiency.

In summary, the described solar-powered pesticide sprayer module appears to be a well-designed and efficient solution for continuous operation. The use of a 12V, 8Ah battery, combined with the solar panel's output, allows for effective charging during daylight hours, enabling extended operation without the need for frequent recharging or external power sources. The economic and compatible nature of the model further adds to its appeal, suggesting it could be a viable and practical choice for agricultural applications.

CONCLUSION

This specific agricultural adapter and battery sprayer pump model has garnered attention for its cost-effectiveness and ability to deliver superior spraying results. By utilizing an unconventional energy source that is readily available at no cost, it presents a compelling alternative to traditional sprayers, especially in a time when people are actively seeking innovative solutions to address their energy requirements. This product is particularly advantageous for farmers facing financial challenges and coping with electricity-related problems, such as load shedding. In a country like India, which is in a phase of significant development ,this product has the potential to gain wide spread recognition.

FUTURE SCOPE

The model weighs between 14 and 15 kg when the pesticide tank is fully filled. By adopting plastic moulding for the mechanical framework, the weight can be lowered by 2-3 kg. PWM scheme can be used to drive pumps and save additional energy.

1. Modelling approaches can be used to decrease the tank's overall weight.
2. By implementing certain new technologies in the electronic domains, the battery backup can be increased.

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Internet of Things and Cloud Based Intelligent City Data Analytics System

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ABSTRACT

This work is an attempt to muse on prospective results, problems, and degrees of future study. Concerning the development of intelligent cities in India, the internet of things and how it may soon alter people's daily lives are of paramount importance. To put it simply, the Internet of Things (IoT) is a network of physical and digital objects, services, and infrastructure that allows them to communicate with one another and share data in real time, regardless of physical location or connectivity conditions. Things may be found and managed remotely with the help of IoT by using the current system architecture. Thanks to the success of India's 100 Smart Urban Communities Data Analytics Project, the Internet of Things (IoT) seems to be a very promising concept. With the help of the Internet of Things, objects can be monitored and managed from anywhere using the existing web infrastructure. This paves the way for easier integration of the real physical world with virtual frameworks hosted on computers and the cloud, which in turn increases efficiency, accuracy, and financial gain. Everything would be uniquely recognizable because it could work together using an embedded computing architecture already present in the Internet infrastructure.

KEYWORDS *: Internet of Things (IoT), Virtual frameworks, Sensors, Data analytics, Smart urban, Cloud.*

INTRODUCTION

Applications in several fields demonstrate the expanding scope of the Internet of Things (IoT) concept. These domains include, but are not limited to, the transformation of beautiful urban groupings, the management of vital resources and frameworks, flexibility, transit, partnerships, etc. An increasing amount of structured data is being researched, encrypted, and communicated under varying circumstances, thanks to the growth of the application and the significance of this idea. This area of concern has been the subject of much research over the past few years due to the unpredictability of the Internet of Things (IoT) concept and the use of Automatic Identification and Data Capture (AIDC) advancements, both of which pose a risk of compromising key performance indicators. The optimal approach to storing, retrieving, and gaining access to personal and other data has undergone a sea shift recently [1]. The rapid development of frameworks has rendered the practice of transmitting personal or official data on a tangible device obsolete, since consumers may now access data virtually from any location. Devices and sensors or actuators are the two main contributors to the exponential growth of the network of interconnected devices. In the Internet of Things (IoT), devices communicate with one another and share data directly over the web and cloud computing. On the other hand, every day more and more "things or contraptions" are transmitting massive amounts of data that should be controlled, stored, and made available on the cloud. Thanks to the rapid development of information technology (IT), we now live in a hyper-associated world where everything is linked to our phones, the Internet, and each other. As is happening in many parts of the world right now, we need to be linked to everything at all times in the 21st century. The Internet of Things (IoT), also known as

Machine to Machine (M2M) communication or the Internet of Everything (IoE)[2], is the central concept of this highly interconnected society.

Recently, some local governments have been planning to implement an IoT-based smart city by creating an integrated foundation and a testing ground for IoT inspection. The city provides services to its citizens, who are essentially its customers, making it resemble an administrative organization. Aiming for smarter, more sustainable, more productive, and more practically minded city dwellers is a priority, as is improving our collective understanding of cities so that we can better predict and manage urban streams and coordinate the measurements of a provincial agglomeration's physical, technological, and institutional spaces [3]. There has been a shift towards innovation in urban development and transformation. Smart cities use a variety of data and communication innovations. Intelligent foundation, intelligent operation, intelligent administration and industry, intelligent training systems, and intelligent security systems are all inherent components of a city's biological system that an arrangement will inevitably contain. A smart city is one that measures the physical, institutional, and digital environments of a metropolis in harmony with one another. The method's primary objective is to help people understand how cities evolve, function, and progress via presenting various viewpoints such as connectivity, input, self-association, and adjustment [4].

Nowadays, cities are undergoing a metamorphosis from computerized to smart urban communities, which are more innovation-oriented versions of brilliant city concepts. A city is said to be "keen" when it has the following qualities: power, instrumentation, and connectivity, versatility, self-ruling, learning, and self-repairing. By using ICT to provide services to their locals and other partners, parts of its foundation and offices are meticulously linked and improved. The more comprehensive literature on digital, advanced, keen, and smart cities supports the idea of intelligent urban communities seen via the lens of innovations and segmentation, which has some valid features [5]. The term "smart urban areas" can refer to a wide range of electronic and computerized applications associated with modern group and community spaces, such as smart lattices, smart metres, and other infrastructure for water, power, and waste management.

Insightful urban places, derived from the new information of urban communities that speak to aggregated and appropriated understanding, and advanced urban areas, derived from computerized representation of urban areas, imply computerized illustrations of urban areas. New types of electronic devices, such as telephones, radios, televisions, personal computers, and personal digital assistants, have emerged as technology has advanced. In keeping with the trend of most technological advances, these devices often had exorbitant price tags before gradually dropping in price. Demand reduces costs, and research leads to improvements and reductions in size. Value that would have previously necessitated its own dedicated device may, in the end, be demonstrably fused into another. While television screens used to occupy a dedicated space in living rooms, modern flat-panel displays are more conventional, and technology has advanced to the point where a high-definition screen suitable for showing TV content can be integrated into a door frame or a kitchen unit. Even smaller screens can be found in mobile phones and music players. The same is true with personal computers; it has become so dated to embed a comprehensively useful microchip in appliances that your clothes washer could be running Linux, the register at the grocery store could be using Windows, and your media player could be using an OS X variant developed by Apple. Having basic computing capabilities isn't enough to support the Internet of Things, however, as we've shown quite lately. On the other side, maybe we're trying to find a way to link the Internet with electrical sensors and actuators that work in tandem with the here and now.

Collaboration between cloud and IoT is commonplace. With the almost limitless resources and capabilities of the cloud, the Internet of Things (IoT) may compensate for its physical constraints (such as capacity, handling, and energy). By expanding its reach to handle real items in real time and by delivering a large number of new administrations in a dispersed and dynamic style, the cloud may benefit from the Internet of Things (IoT). The fields of "self-care" and "medicinal services consultant" have emerged in response to the growing

interest in promoting health and wellness. The benefits of a healthy lifestyle have fueled innovation, which plays a crucial role in bringing healthcare closer to the patient, rather than only to a hospital or clinic. To make this vision a reality via empowering innovations, it is necessary to regularly collect data related to a man's health, lifestyle, and other essential criteria and provide it to his parents or guardians. Many different types of patients have become familiar with web-connected devices.

Some patients must have their health data tracked at all times, regardless of whether it comes from foetal screens, electrocardiograms, temperature displays, or blood glucose readings. Many of these steps need coordinating with an expert in social insurance. This paves the way for smarter devices to transmit more crucial data, decreasing the need for coordinated patient-doctor contact. Clinics have begun using "brilliant beds" that detect whether a patient is trying to rise up or is under the influence of a drug. It can also adapt to the patient's weight and support needs without the need for human involvement from medical professionals. When used in conjunction with home solution allocators, cutting-edge technology has the potential to improve patient care by alerting the care team when medication is missed or other important precautions need to be taken and then transferring the relevant data to the cloud. Sooner rather than later, individualized health assessments will be the norm. People will be provided tailor-influenced approaches to combat disease and societal innovations that will enable us to cope with our own distinctive health. We will learn how to increase our wealth and be inspired to take charge from the data that is generated. The incredible potential of the Internet of Things (IoT) will be fully realised — a never-ending display of intelligently linked systems designed to improve our health, condition, and profitability by making astute use of data. No matter whether it means letting us monitor and manage the air quality in our homes or equipping physicians with equipment that connect to the cloud so they can confer with patients who aren't even in the same room or city [14]. Everyday life presents us with a number of challenges, including those associated with travel (such as traffic, air pollution, time loss, etc.) and toll collection (such as having to wait a long time to pay the amount). Electronic Toll Collection (ETC), programmed toll gathering using methods for mint piece machines, and manual gathering are presently the usual approaches to toll accumulation. This is the newest method of collecting tolls, and it aims to eliminate delays on toll roads. With the ETC method, drivers don't have to stop or do anything special to pass past a toll booth. A well-maintained network of roads improves the efficiency of traffic flow and reduces the risk to drivers. Electronic toll collection (ETC) frameworks are ready to electronically charge a customer's account. One of the simplest ways to accumulate tolls is by physically having a collector operate from a tollbooth to collect the money. Automated mint piece machines eliminate the need for human collectors by batching various payment methods such as currencies, tokens, smart cards, and Visas. There has to be a smart and efficient alternative to the current toll collection method on the National Parkway since, considering the current improvement, the numbers of cars passing through a tollbooth are rather high. The primary goal of automated toll collection is to eliminate traffic delays caused by toll roads by collecting money automatically without the need for a customer [15]. In order to address the problems associated with healthcare facilities, the project is dependent on the Internet of Things. Power is wasted in healthcare facilities due to the excessive use of lights, fans, and other medical equipment. A major contributor to excessive energy consumption in healthcare facilities is the amount of electrical equipment, lights, and hardware that is kept on while not in use. The most obvious natural consequence of energy misuse is a rise in carbon footprint, but there are simple adjustments we can do to avoid this. For example, a decrease in the amount of ozone-depleting compounds released into the air occurs as a result of increased electrical usage caused by devices that are left on while they are not in use. The module regulates power consumption. The need for attendants or clinic personnel to constantly monitor the saline jug level is another critical concern with healing facilities. Consequently, the patient's death might result from the inadvertent or intentional misobservation of the saline container due to the negligence of the healthcare facility workers, an excessive number of patients, or both.

It is inconvenient to physically check the weather conditions. Casually, for a thousand years, and officially,

since the nineteenth century, people have tried to predict the weather. Accumulating quantitative data on the current state of the air at a specific location and using logical understanding of air processes to extrapolate the air's future development at that location allows one to make climate predictions. The Internet of Things (IoT) is a network of physical devices, software, data storage, and communication capabilities that enable everyday objects to collect and exchange data in order to perform actions based on that data. The Internet of Things is more than just a concept; it's a compositional framework that enables the integration and exchange of data between the real world and computer systems using preexisting infrastructure [28]. In order to detect and record environmental factors without human intervention, a mechanized climate station uses sensors. The effectiveness of rops may be improved and a safe working environment can be guaranteed in organizations by monitoring weather conditions, among other benefits. When compared to earlier methods, modern mechanical development makes a number of natural parameter quantifications more easier. As little electrical devices, sensors allow for the estimation of physical and natural properties. Accurate results are obtained by monitoring the weather with the sensors, and the whole system will be faster and more robust. The climate checking station's execution stream is shown in this document. Wi-Fi, or the IEEE 802.11 b/g standard for wireless local area networks, is a component of this system. Data is refreshed to the web page by the framework after occasionally monitoring the weather. By updating the data on the website, we can maintain a global record of a certain location's weather conditions. The system is equipped with sensors and hardware that can detect light power, temperature, humidity, precipitation, wind speed and direction, and wind bearing. The contrasting climatic variables may be measured by this sensor [36].

A blueprint for the magnificent parkways that will connect cities of the future. A few examples of the problems that regular city streets face are heavy traffic, which wastes valuable time, and the lack of any kind of visible indication indicating the current state of municipal activities. A network of remote sensors installed in metropolitan streets will collect data on pedestrian and vehicle movements and transmit it to digital displays or electronic billboards. The second component of the framework is the accident detection system. It uses the sound sensor to record any sounds that may indicate an accident, and then uses that information to determine whether an accident has occurred. If an accident is confirmed, the system will send a message, or MSG, to the nearest police station and medical facility through a GSM modem. In this framework, the next arrangement will determine the position of the extension flood. Overwhelming automobile influxes and kilometers-long lines of cars occur in many zones where water streams merge after rainstorms. In order to avoid this water, a flood sensor will collect data from the stream scaffold and transmit it to a control center, which will then display this data on dynamically controlled roads signs. Avalanches on uneven terrain, which cause roads to become parking lots and significant damage, are the subject of the fourth arrangement. Avalanche zones are located in inaccessible, out-of-the-way places where few specialized tools are available. This involves the use of ultrasonic sensors to locate avalanches, which will then communicate with the disaster management system using GSM or XBee.

Smart city frameworks and city information

Challenges in urban community planning, development, and operation are supporting innovative thinking across disciplines. Professionals in the fields of architecture, urban planning, construction, data innovation, frameworks and natural science, property advancement, finance, and city administration all work together to get a better understanding of partners and learn more about how to interact with them. Smart city developments might make use of framework models that can look deeply into how cities operate, how people use the city, how they feel about it, where the city has problems, and what kinds of progress can be linked. Different partners, including resident laborers, understudies, analyzers, financial specialists, and businesspeople, use a comparable structure all day, every day. There are many different types of stakeholder groups and associations within a city, each with their own set of advantages and disadvantages. These groups include local residents and businesses, metro associations, academic groups, and educational foundations. In addition to including local on-screen personalities, smart city plans should address local needs within a local context. Civil initiative, information technology and

broadcast communications companies, utilities, district specialized administrations, and network foundation specialist organizations are some of the trademark actors in the keen city. At several institutional levels, including families, communities, cities, enterprises, and administrations, both public and private, group interests may be seen. The level of interest and impact of partners in relation to the proposed venture can be better represented by surveying their dispositions. Key partners must form associations and implement solid joint effort methodologies and strategies in order to share research and advancement resources, such as emerging information and communication technology (ICT) tools, techniques, and knowledge; test innovation stages; and client groups for the purpose of experimenting with e-benefit applications and future web advancements. With the proliferation of data frameworks in urban settings, new opportunities have arisen to capture data that was previously unavailable. The major axes and city layout are shown here. Understanding the present relationships requires this outline. It is possible to develop and modify astute arrangements in linked domains of e-administrations application using massive amounts of data that depict what happens in the city. Various pieces of information and data are collected by the municipal government and other parties involved. This includes publicly available data on transportation, energy consumption, water conditions, data recorded by shippers at the source, and much more besides. The city's frameworks may be better understood if one is aware of the data and information resources available to the city.

PROPOSED WORK

Fast and painless administration is on the horizon thanks to Internet of Things (IoT) apps. A reliable and fast internet connection is essential to the administration's operations. The banking, railway, water and electricity, and other counters' physical proximity and line length are both reduced by this arrangement. The city will be influenced to clean up and become green by this proposal. In light of progress around 100 Intelligent urban swarms meander over India. In India, the government is actively pursuing projects to improve infrastructure, associations are thinking about creative things, and businesses are considering the benefits that the Internet of Things can bring. All of this bodes well for the future of the IoT in the country. With more research and funding, the Internet of Things (IoT) might achieve massively impressive growth. The indicators of Internet of Things use in India could be accurate if such push materializes. The several chapters in this publication each provide valuable suggestions for the future of smart cities. An overview of the application was provided in the introduction. Various perspectives are examined in literature reviews for various purposes. A comprehensive look of smart cities and their supporting infrastructure is presented in the Model of Smart City. Figure 1 shows the architecture and framework sections, which talk about the technologies utilised for the framework and the explicit roles of the various levels of the architecture.

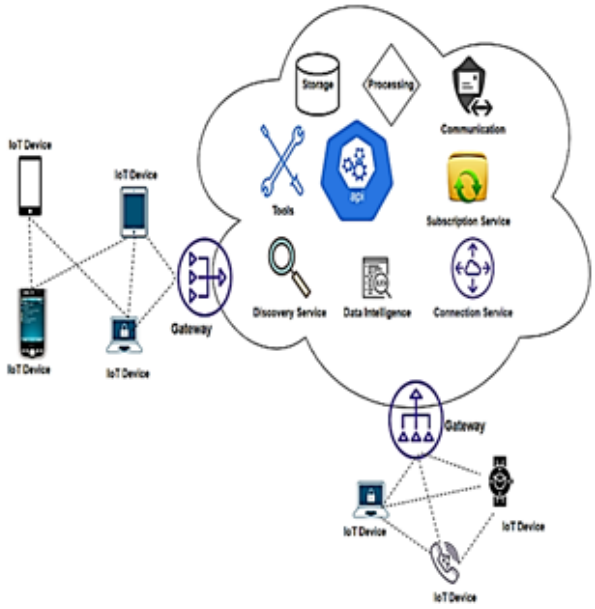

Figure 1. Cloud-based IoT System

COMPONENTS OF A CLOUD-BASED ANALYTICS SYSTEM FOR SMART CITIES

Below are the fundamental components that collaborate to support sustainability and urban development Sensors and data collection Data collection creates the system's foundation; different devices and sensors are applied throughout the city on different levels of urban life, for example, waste levels, energy consumption, air

quality, and traffic flow [9]. This data is later analyzed in real-time, thus providing valuable insights to decision-makers and city planners. For instance, data collected from traffic sensors can be utilized to reduce congestion and optimize traffic flow [10]. In contrast, data collected from air quality sensors can help identify pollution hotspots and help implement measures to improve them.

Cloud-based storage this acts as a depot for all the data collected from the sensors and ensures that it is securely stored and is easily accessible for analysis. When data is securely uploaded to cloud-based servers, they can accommodate large volumes of data, thus making it readily available for analysis and future reference [11].

Data transmission When the data is collected, the next step is to send it to a centralized location for further processing, ensuring it is available for analysis [12]. Essentially, data is transmitted over high-speed broadband networks, WI-FI hotspots, and different communication protocols that allow a seamless flow of data from sensors to cloud based storage and processing units.

Data processing and analytics technically, this is what carries the system. Cloud-based data processing and analytics incorporate techniques to get insights and patterns from the raw data. Tools such as statistical methods, machine learning algorithms, and big data analytics process the data [13]. Then, this analysis generates important insights like energy usage trends, waste levels, and traffic patterns.

Real-time data integration integrating real-time data is vital in ensuring a swift response to dynamic urban events and decision-making by making it easy for decision-makers to access live data streams [14]. Alert systems and dashboards are used to access and monitor real-time data, particularly useful in emergency response and traffic management where immediate action is needed.

MERGING CLOUD TECHNOLOGY AND IOT FOR SMART CITIES

Building smart cities requires integrating cloud and IoT technologies. This convergence is brought about by the large amount of data created by IoT applications and the critical need for computing skills such as real-time analytics and processing. In addition to allowing for savings, this integration opens the door to tremendous development and innovation possibilities.

For instance, if SMEs in the smart building and home power device industry don't use cloud integration, growing their customer base and product offers might become prohibitively costly. With the help of cloud integration, they can efficiently manage and analyse the data generated by sensors and wireless sensor networks (WSNs), which is crucial as they expand their customer base and amass more data. This is a budget-friendly choice that lets SMEs get into massive amounts of data from many sources. From intelligent power management and smart water control to transport systems and urban mobility, cloud-based infrastructure is crucial for smart city administration of a wide range of Internet of Things (IoT) applications [15]. With the aid of cloud integration, these apps can manage the massive amounts of data they generate.

There is less need to worry about having enough computer resources since cloud computing simplifies data management and speeds up the creation and release of these Internet of Things apps. By giving third parties access to public cloud computing providers like Azure, AWS, or Google Cloud, which have scalable infrastructure and are easily available, they are able to combine computer resources with data from Internet of Things (IoT) devices. This open access encourages the exchange of IoT data and services and supports the expansion of the IoT ecosystem. It shows how important IoT infrastructure and cloud computing have become in current urban settings. The architectural incompatibilities between cloud computing and the Internet of Things make integration difficult. The majority of IoT devices are located in different parts of the world, which means they have different processing powers, are expensive to transport or update, and might have restrictions on resources and access [16].

In contrast, resources in the cloud are centralised, flexible, and inexpensive, and they handle data quickly. Cloud deployment of sensors and devices helps bridge these architectural gaps by distributing data across various cloud resources and reducing discrepancies. Another feature that guarantees the secure transport of data from IoT devices to the cloud is the real-time execution of services and the collecting of sensor data.

Japan has found several uses for this cloud technology and Internet of Things integration, such as seismic mapping and radiation monitoring. For organisations and people seeking to store data from the Internet of Things (IoT) in the cloud, there are a number of choices, such as real-time cloud services and cloud sensors. These platforms often provide pay-as-you-go structures and powerful developer tools to enhance cloud systems, making them similar to IoT services in the cloud. Convergence holds the key to smart city innovation in data management, faster invention, and more streamlined service delivery, all of which will help create more dynamic and linked cityscapes.

CONCLUSION

One approach to on-demand data and resource provision is the cloud-based smart city. The article delves at two technologies—the Internet of Things (IoT) and cloud computing—that are used in the development of smart cities situated on the cloud. City infrastructure, including building maintenance, transit, traffic management, and pollution monitoring, may be tracked with the use of smart sensors. Thanks to the Internet of Things, this is now feasible. It is possible to foretell future movement using just historical and current data. Storage in the cloud is a function of cloud computing. Users have virtual access to resources via the cloud, which they may utilise from any location at any time. Through the use of fast internet, it may be accessed simultaneously from several places. A third party manages the cloud. Users are in the dark about the whereabouts of data and resources, including their own personal information. In cloud computing, users access resources virtually. The term "cloud computing" refers to a platform that allows service providers to provide virtual resources and data storage facilities; customers are not required to buy these resources.

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Synthesis, Structural Parameter and PL Characterization of Sm^{3+} doped BaB_8O_{13} phosphor

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ABSTRACT

Barium octaborate (BaB_8O_{13}) powder phosphors doped with Sm^{3+} were synthesized via solid-state diffusion. Characterization via X-ray diffraction (XRD) and photoluminescence (PL) confirmed their crystalline structure and homogeneous formation. With an average particle size of 34.57 nm, the phosphors are considered nano-materials. Emitting orange-red light at 605nm under 401nm excitation, they exhibit efficient luminescence. These phosphors hold promise for white light sources in UV LEDs and other light emitting devices.

KEYWORDS *: Barium octaborate, Photoluminescence, Sm^{3+} doping, Solid-state diffusion.*

INTRODUCTION

In urban life, essential technologies like Televisions, Mobile Displays, LED Lamps, and Traffic Signals rely on luminescence, which operates at normal temperatures. Coined by physicist Eilhardt Wiedemann in 1888, luminescence, derived from the Latin 'Lumen' meaning 'light,' is crucial for various fields such as Archaeology, Geology, Biomedical Engineering, Chemistry, Physics, and Industry. Luminescence involves energizing electrons to emit light, observed in nature in organisms like glow-worms and fireflies. Phosphors, solid luminescent materials, emit light when excited by an energy source like UV radiation, playing a vital role in applications ranging from Quality Control to Research and Development. Borates, compounds with unique crystal structures, exhibit enhanced UV transparency and resistance to laser damage, making them excellent hosts for luminescent materials, especially when doped with rare earth ions for various applications.

SAMPLE PREPARATION

Samarium-doped BaB_8O_{13} phosphors were synthesized using a conventional solid-state reaction technique, varying the concentration of Sm^{3+} ions (1%, 2%, 3%, and 4% mol%). High-purity chemicals $BaCo_3$, H_3Bo_3, and Sm_2O_3 were combined in stoichiometric ratios, dispersed in acetone, and ground thoroughly using an agate mortar. The resulting mixture was heated in an alumina crucible at 900°C for five hours in a programmable muffle furnace, then allowed to cool naturally. The sintered samples were finely ground and subjected to various characterizations. The crystalline structure was analyzed using high-resolution X-ray diffraction (XRD) with a Bruker D8 Advance Diffractometer, operating with nickel-filtered Cu-K-α radiation. Luminescent spectra were recorded using a Shimadzu spectrofluorophotometer with a Xenon flashlamp as the excitation source, while Time-Resolved Photoluminescence (TR-PL) spectral recordings were conducted with an Edinburgh FLSP 900 spectrofluorophotometer. All characterizations were performed at room temperature.

RESULTS AND DISCUSSION:

X-ray diffraction pattern of BaB_8O_{13}: Sm^{3+} phosphors

X-ray diffraction has long been instrumental in elucidating the structures of crystalline solids, ranging

from simple to intricate molecular arrangements. By determining relative atomic positions, it offers direct proof of atomic existence. The diffraction pattern reflects the periodic arrangement of atoms in crystals, with symmetry corresponding to atomic packing symmetry. X-ray radiation enables straightforward determination of interatomic spacing. Intensity of diffracted beams relates to atomic arrangement and atomic number within the unit cell, aiding in trial atomic position calculations. Notably, XRD patterns provide evidence of the desired compound's crystalline and homogeneous formation, without indicating the presence of unwanted constituents like nitrates or ammonia.

Graph X-ray diffraction pattern of $BaB_8O_{13}:Sm^{3+}$

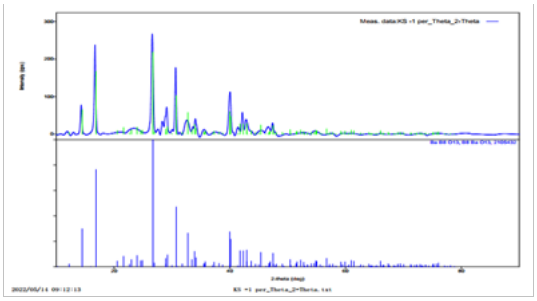

Fig. 3 a: Conc. (1 mol %) of $BaB_8O_{13}:Sm^{3+}$

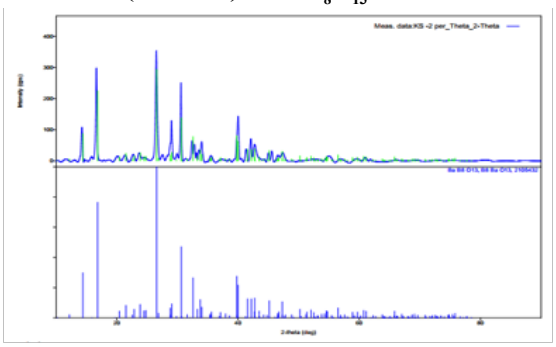

Fig. 3 b:Conc. (2 mol %) of $BaB_8O_{13}:Sm^{3+}$

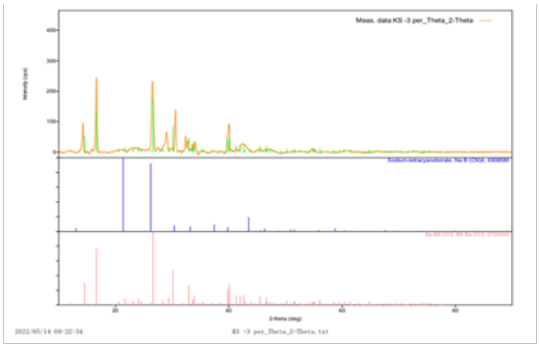

Fig. 3c: Conc. of (3 mol%) $BaB_8O_{13}:Sm^{3+}$

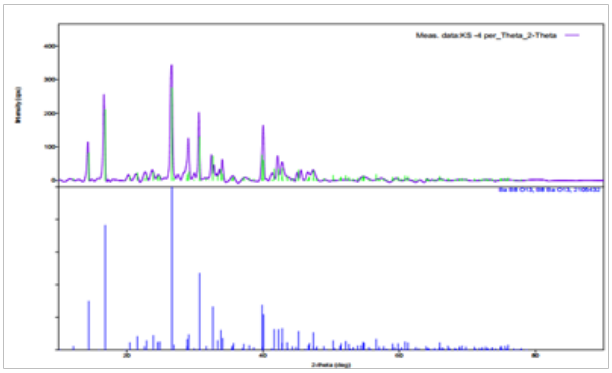

Fig. 3 d: Conc. of (4 mol%) $BaB_8O_{13}:Sm^{3+}$

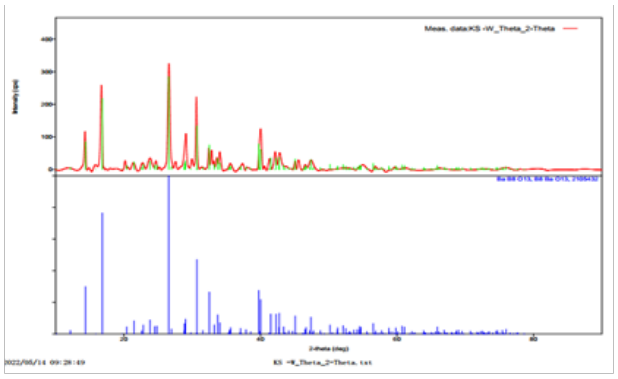

Fig. 3e: XRD pattern of without dopant of BaB_8O_{13} XRD of $BaB_8O_{13}:Sm^{3+}$

Figure (3a-3e) shows the XRD of BaB_8O_{13}: Sm^{3+} Phosphors the final product was formed in homogenous white powder form. From the graph it shows that the sample is in homogenous form.

Pos. [°2θ]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int.[%]	Area [cts*°2θ]	Particle size (nm)D	Strain (ε)	Density Dislocation
14.327	0.226	6.177	22.9	14.327	35.4496	0.0078420	0.0007957

15.887	0.20	5.574	3.8	15.887	40.1268	0.0062509	0.00062105
16.709	0.265	5.302	56.6	16.709	30.3180	0.0078697	0.0010879
20.17	0.24	4.398	5.6	20.17	33.6394	0.0058848	0.0008836
21.379	0.39	4.153	6.6	21.379	20.7412	0.0090104	0.0002324
22.78	0.36	3.900	6.7	22.78	22.5222	0.0077933	0.0001971
23.86	0.62	3.726	15.5	23.86	13.1028	0.00127976	0.0005824
24.69	0.26	3.604	4.8	24.69	31.2940	0.00518809	0.001021
26.565	0.340	3.3527	93.4	26.565	24.0199	0.00628116	0.001733
27.54	0.19	3.237	3.3	27.54	43.0711	0.00338114	0.0005390
29.116	0.333	3.0645	33.6	29.116	24.6606	0.0055920	0.001644
29.94	0.22	2.982	6.9	29.94	37.3979	0.00358820	0.0007149
30.615	0.207	2.9178	38.7	30.615	39.8100	0.0032982	0.0006309
32.40	0.15	2.7607	12.6	32.40	55.1798	0.00225165	0.0003284
32.81	0.17	2.728	11.1	32.81	48.7390	0.0025182	0.0004209
34.06	0.33	2.630	22.7	34.06	25.1904	0.00469850	0.001575
35.61	0.41	2.519	5.1	35.61	20.3614	0.0055674	0.002412
37.408	0.16	2.4021	7.3	37.408	52.4472	0.0020610	0.0003635
40.077	0.330	2.2480	36.7	40.077	25.6379	0.0039458	0.001521
41.31	0.24	2.184	5.9	41.31	35.3930	0.0027765	0.0007982
42.90	1.17	2.1064	36.0	42.90	7.2990	0.0129866	0.01877
45.60	0.63	1.9878	9.1	45.60	13.6857	0.00653604	0.005339
46.69	0.30	1.9441	3.8	46.69	28.8567	0.0030313	0.0012008
47.45	0.37	1.9144	10.8	47.45	23.4652	0.0036715	0.001816
47.87	0.20	1.8988	2.3	47.87	43.4806	0.00196560	0.0005289
51.452	0.15	1.7746	2.5	51.452	58.8189	0.0013576	0.0002890
55.00	0.51	1.6683	10.9	55.00	17.5701	0.0042725	0.003239
72.153	0.13	1.3081	1.2	72.153	75.6478	0.00077814	0.0001747
76.078	0.22	1.2501	6.4	76.078	45.8724	0.00122631	0.0004752

XRD pattern of BaB_8O_{13}: Sm^{3+} phosphors result indicates that the final product was formed in homogenous form. The average size of the particle to be at 34.574321 nm which proves that the prepared sample is nanomaterial. Mean dislocation density to be 0.0020358 nm-2and mean strain to be 0.00458263 XRD pattern of BaB8O13:Sm3+phosphors result indicates that the final product shows crystalline nature.

Photoluminescence of BaB_8O_{13}:Sm^{3+}

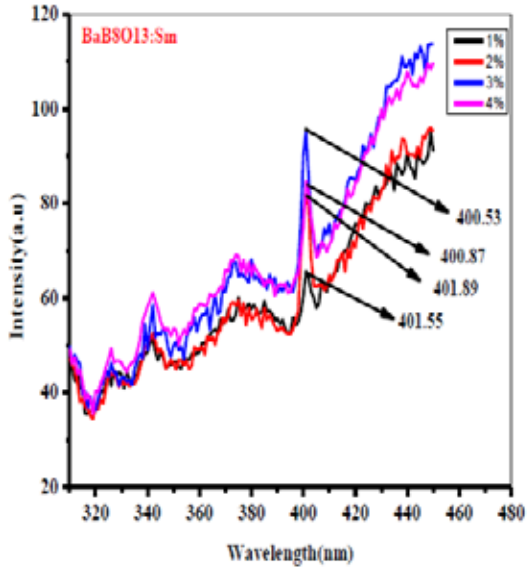

Fig. 4 (a) PL characteristic of BaB_8O_{13}: Sm^{3+} excitation

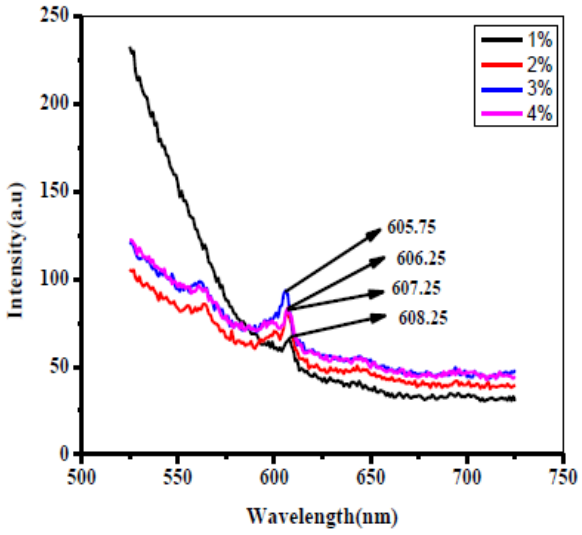

Fig. 4 (b) PL characteristic of BaB_8O_{13}: Sm^{3+} Emission

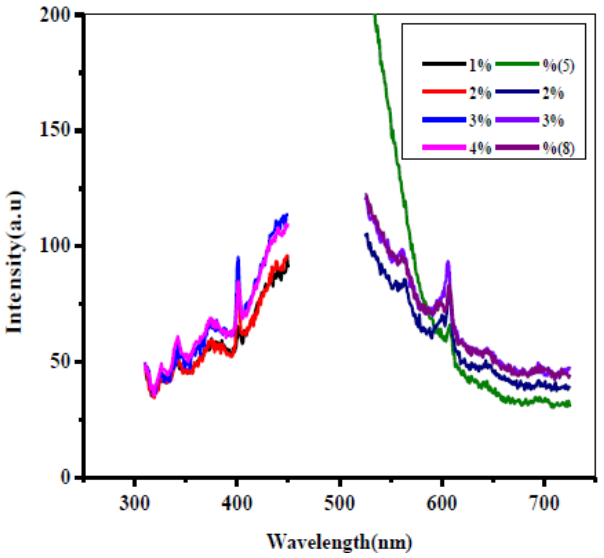

Fig. 4 (c) PL characteristic of BaB_8O_{13}: Sm^{3+}

Concentration	Excitation wavelength (nm)	Emission wavelength (nm)	Intensity (a. u.)
BaB8O13 (1%)	401.55 nm	608.25 nm	78
BaB8O13 (2%)	401.89 nm	607.25 nm	84
BaB8O13 (3%)	400.87 nm	606.25 nm	110
BaB8O13 (4%)	400.53 nm	605. 75 nm	90

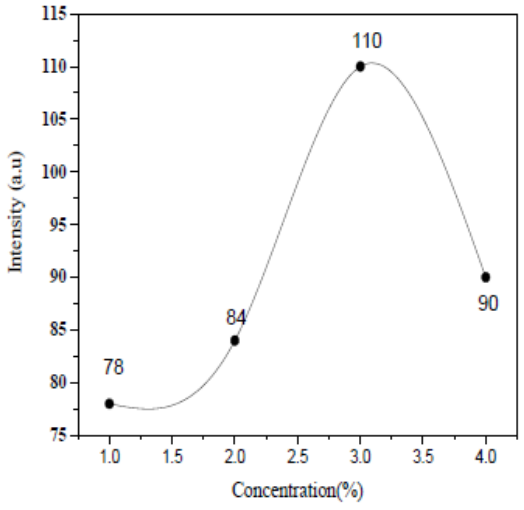

Fig. 4 (d) graph between conc. and emission intensity

To study the photoluminescence characteristics the excitation spectra was recorded for Sm^{3+} doped BaB_8O_{13} phosphors by monitoring the emission at 605.75 nm as depicted in fig 4.2 (b) upon this excitation the photoluminescence emission spectra for difficult concentration of Sm^{3+} ions was recorded in the spectral range 550 – 750 nm fig 4.2 (c) presents the excitation spectra BaB8O13: Sm3+ phosphors with dominant peak at 401 nm due to 6H5/2 4F7/2 transition. In the emission spectra of BaB8O13: Sm^{3+} the peak is located at 605 nm which is due to 4G5/2 6H7/2. It shows the significant orange red emission at 605.75 nm. It is found that the shape and profile for the emission spectra do not ray with the change of the Sm3+ doping concentration out the PL intensity changes greatly. The optimum concentration was determined to be 3 mole% to obtaining strongest PL emission intensity.

CONCLUSION

The XRD pattern of BaB8O13:Sm3+ phosphors confirms the homogeneous formation of the final product, with an average particle size of 34.57 nm, indicating its nanomaterial nature. Additionally, the mean dislocation density is measured at 0.0020358 nm-2 and the mean strain at 0.00458263. The crystalline nature of the final product is evident from the XRD pattern. Synthesized via high-temperature solid-state reaction, Sm3+ doped BaB8O13 phosphors exhibit photoluminescence properties, emitting orange-red light at 605nm under 401nm excitation. This makes BaB8O13:Sm3+ a promising candidate for efficient orange-red emitting phosphors, suitable for UV LED applications.

ACKNOWLEDGEMENTS

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Study of Dream 11 Fantasy Games by Mathematical Expectations

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ABSTRACT

Platform for fantasy sports Dream 11, with its $1 million price tag, has been the talk of Indian sports in recent years. The registration fee and squad selection for the main tournament are crucial components of taking part in the Dream 11 competition. We must pay an entry fee in addition to the registration price in order to compete in the tournament. The pool's size is determined by the admission charge. Dream11's revenue will make up a portion of this total; the winner will receive the remaining portion.

In order to investigate the distinction between calculation fees and entry fees, we will explore an example contest in this article, aware people by calculating winning probability of such contest. Dream 11 provides Football, Basketball, Kabaddi, and Fantasy Cricket games on its site..

KEYWORDS *: Probability, Mathematical Expectation, Dream 11.*

INTRODUCTION

Users can play fantasy basketball, hockey, football, cricket, and kabaddi on Dream11, an Indian fantasy gaming website created by Dream11 founder Harsh Jain. With a worth of more than $1 billion, the 2012-founded business became the first Indian gaming startup to join the prestigious "unicorn club". During the IPL baseball tournament broadcast, it reached over 70 million users and over a million concurrent online users.

The company charges users a nominal fee to play fantasy games, which helps to support its basic business strategy. It builds a system where users who form the most successful teams are rewarded with money taken in from user registration fees. For upcoming competitions, users must assemble their own teams within financial constraints. Each participant has a specific bonus, and he has to select individuals from the two competing teams. Every squad has to choose a minimum of players. There must be restrictions on the amount of bowlers, all-rounders, wicketkeepers, and batsmen. At the conclusion of the game, points are awarded to each player based on how well they performed with their predictions throughout. Money is awarded to the user who has the best fantasy squad. Some people believe that fantasy sports are an unlawful activity in India and that they are basically sophisticated kinds of gambling. A legal challenge to the legitimacy of fantasy game commercialization was launched, but the Supreme Court of India rejected the case, stating that fantasy games and betting do not adhere to the same criteria because their participation demands a high level of expertise.

Eight billion US dollars are the market capitalization as of right now. Is it a marvel that an exporting programme has gained so much traction and success in such a short period of time? This company achieved ultimate success thanks to a clever and well-thought-out business plan. Their business plan might also be effective for other startups. As a result, we will go over the complete Dream11 business model in this article.

The objective is to determine the Dream 11 results by comparing the entry price and run count for the India vs. West Indies match. Dream11's revenue makes up a portion of this cost; the remainder comes from winners.

The use of analysis and other mathematical techniques is restricted in cricket. To choose the top teams, a variety of ranking algorithms are currently in use, despite the fact that technology use has grown significantly in recent years. Basesmen are ranked based on performance metrics like four runs and sixes, batting average, and batting average. Lemer [1], Bure, and Mangen [2] are the owners of a portion of these works. A method to determine batting average while a player is not present was proposed by Kimber, Hansford [3], and Damodaran [4]. Oven and Buquiet [5], as well as Swartz et al. [6], investigated a mathematical model for batting order optimisation.

Lemer (7) suggested a method to calculate bowling average and bowling rating based on the amount of bowling performance. Lewis [8] suggested a metric that uses the Duckworth/Lewis percentile to assess players' performance. Teams were chosen in many fantasy leagues in the past purely on the basis of the ranking system. However, basic ranking techniques are insufficient because of budgetary and other limitations. Various machine learning and optimisation techniques have been utilised in numerous research over the years to assist fantasy players in selecting the best teams.

A selection of machine learning research projects is reviewed in this section. A support vector machine (SVM) based system that ranks players based on skill levels and lets the user select who to play was presented by Farhana et al. [9]. For player rating, Deep Prakash [10] suggested imitating the random forest-based prediction method. The regulations pertaining to T20 Internationals and IPL matches are the parameters sent into the Random Forest algorithm. By creating benchmarks in this manner, bias against players with longer playing histories is eliminated. MGA (memetic genetic algorithm) Sharpe et al. [11] created a maximum problem-based function equation for T20 team selection in order to choose performance-based values;

The choice variable shows if a specific skilled player will be chosen or not. Different statistics are combined, and unique indicators like batting and bowling average and rating are used to produce coefficients for various skills including batting, bowling, and fielding. Player selection based on a modified multi objective optimisation approach was proposed by Ahmed et al. [12] [13]. After calculating the balance between batsmen and bowlers using optimisation techniques, they make the following proposal further in their paper:

Dream 11 Business Plan

Indian online gaming site Dream 11 lets you play leagues of fantasy sports like basketball, hockey, cricket, and kabaddi. Additionally, it uses a free business model, so you can win cash prizes or play for nothing. However, there is a registration cost that needs to be paid in order to use.

Let's now discuss "Fantasy Sports". It's just a kind of game where you make a virtual squad out of actual people and play against other teams based on how well real voters perform in real life.

This is how it functions

Registering as a User: You have to register for an account on the Dream11 platform in order to utilise it. After that, you want to place the cash in their wallets. You can play a variety of games with this money.

Making a Game: Select the game you want to play, you have to form a group of actual players from the current player pool in order to accomplish this. In Dream 11, you may purchase players for your squad using virtual currency.

Entry price: In addition to the registration price, you must pay an entry fee to compete in the competition. The pool's size is determined by the admission cost. His income will make up a portion of this total; the winner will receive the remaining sum.

Gameplay: The user's score in the game is based on how well the players on their team perform. To see who can score the highest, users compete with one another. For this reason, it's critical to monitor how the players on your squad are performing.

Bonus distribution: Dream receives 11 points during the game and is determined by how well each player performs in the live match. The user with the best earning potential will receive the prize pool.

Please take note that the user's total deposit always exceeds the total cash reward. What will they do with the remaining funds then?

Sources of Income

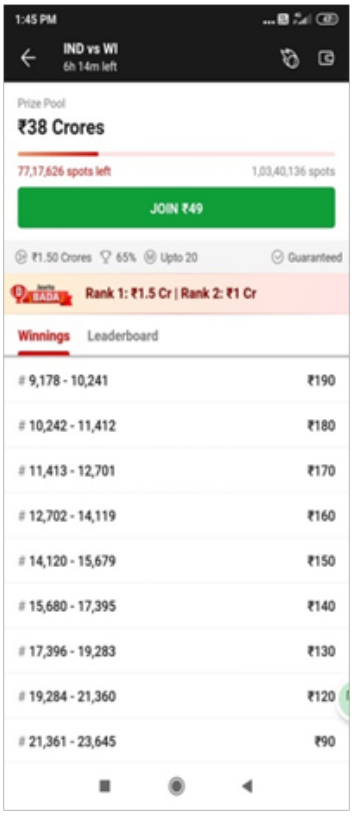
Dream 11 offers resources including advertising, funding, innovation in technology, an easy-to-use management interface, human capital, etc. He buys stuff with a lot of money. But the business is still profitable in spite of everything! How? due to the substantial advantages it obtains in return. Dream 11's business strategy depends heavily on income to pay for its overhead and benefits. It is the cornerstone of Dream 11's business strategy. Among Dream 11's primary revenue streams are:

Entry fees and registration charges

As you are aware, in order to take part in Dream League, you must register and pay a fee on the game's platform. Have you ever noticed that your salary is never greater than your overall income? A quarter of the money paid for the work will go to Dream 11. Their primary source of income is this. Revenue from affiliate marketing and advertising.

One Actual Example of Mega contest

In a Dream 11 fantasy contest total spots (participants) is 1,03,40,136 and prizes as 1 prize of Rs.1,50,00000/-, 1 prize of Rs. 1,0000000, 1 prize of Rs. 10,00000, 1 prize of Rs. 5,00000, 1 prize of Rs. 4,00000, 1 prize of Rs. 3,00000, 1 prize of Rs. 200000, 3 prizes of Rs. 1,00000, 5 prizes of Rs. 50,000 and so on...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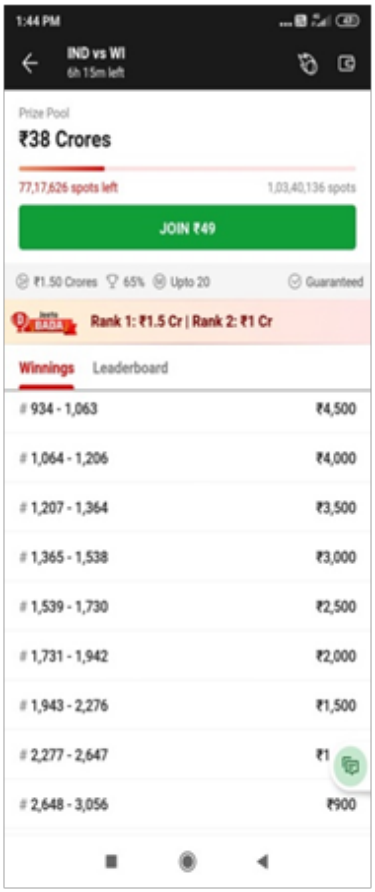
Prize Pool
₹38 Crores
77,17,626 spots left
1,03,40,136 spots
JOIN ₹49
₹1.50 Crores
65%
Upto 20
Guaranteed
Rank 1: ₹1.5 Cr | Rank 2: ₹1 Cr
Winnings
Leaderboard
9,178 - 10,241 ₹190
10,242 - 11,412 ₹180
11,413 - 12,701 ₹170
12,702 - 14,119 ₹160
14,120 - 15,679 ₹150
15,680 - 17,395 ₹140
17,396 - 19,283 ₹130
19,284 - 21,360 ₹120
21,361 - 23,645 ₹90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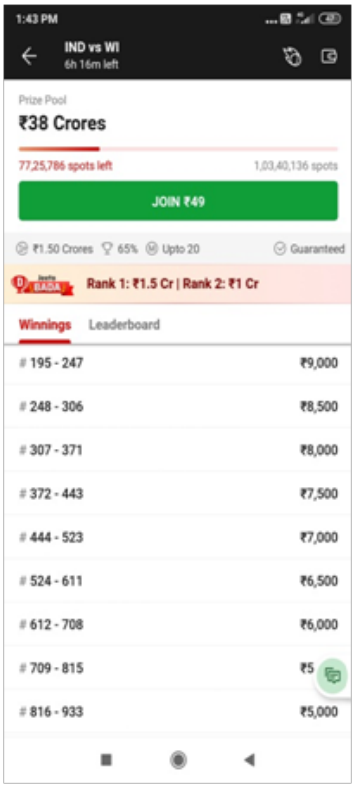
1,03,40,136 spots
JOIN ₹49
₹1.50 Crores
65%
Upto 20
Guaranteed
Rank 1: ₹1.5 Cr | Rank 2: ₹1 Cr
Winnings
Leaderboard
934 - 1,063 ₹4,500
1,064 - 1,206 ₹4,000
1,207 - 1,364 ₹3,500
1,365 - 1,538 ₹3,000
1,539 - 1,730 ₹2,500
1,731 - 1,942 ₹2,000
1,943 - 2,276 ₹1,500
2,277 - 2,647 ₹1
2,648 - 3,056 ₹900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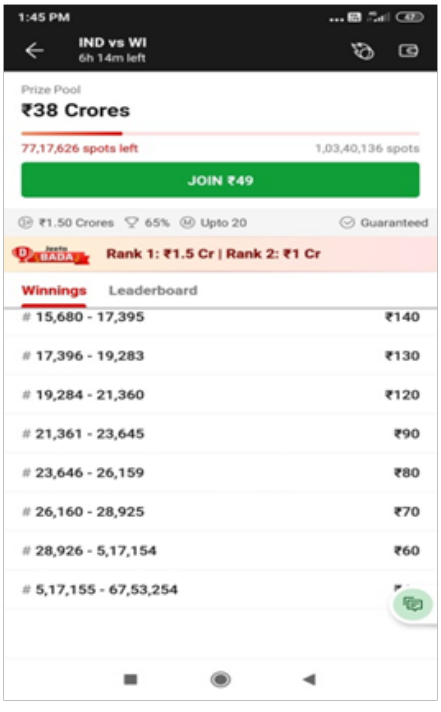
Prize Pool
₹38 Crores
77,25,786 spots left
1,03,40,136 spots
JOIN ₹49
₹1.50 Crores
65%
Upto 20
Guaranteed
Rank 1: ₹1.5 Cr | Rank 2: ₹1 Cr
Winnings
Leaderboard
195 - 247 ₹9,000
248 - 306 ₹8,500
307 - 371 ₹8,000
372 - 443 ₹7,500
444 - 523 ₹7,000
524 - 611 ₹6,500
612 - 708 ₹6,000
709 - 815 ₹5
816 - 933 ₹5,000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IND vs WI
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Prize Pool
₹38 Crores
77,17,626 spots left
1,03,40,136 spots
JOIN ₹49
₹1.50 Crores
65%
Upto 20
Guaranteed
Rank 1: ₹1.5 Cr | Rank 2: ₹1 Cr
Winnings
Leaderboard
15,680 - 17,395 ₹140
17,396 - 19,283 ₹130
19,284 - 21,360 ₹120
21,361 - 23,645 ₹90
23,646 - 26,159 ₹80
26,160 - 28,925 ₹70
28,926 - 5,17,154 ₹60
5,17,155 - 67,53,254

Winner Prize distribution and its probability distribution as shown in below table.

No. of Winners	Prize	Winning probability
1	1.50 Crores	0.000000097
1	1 Crore	0.000000097
1	10,00000	0.000000097
1	5,00000	0.000000097
1	4,00000	0.000000097
1	3,00000	0.000000097
1	2,00000	0.000000097
3	1,00000	0.00000029
5	50,000	0.00000048
2	45,000	0.00000019
3	40,000	0.00000029
4	35,000	0.00000039
6	30,000	0.00000058
10	25,000	0.00000097
19	20,000	0.00000184
44	15,000	0.00000329
43	10,000	0.000004159
48	9,500	0.000004642
53	9,000	0.000005126
59	8,500	0.00000571
65	8,000	0.000006286
72	7,500	0.000006963
80	7,000	0.0000077368
88	6,500	0.00000851053
97	6,000	0.0000093809
107	5,500	0.000010348
118	5,000	0.000011412
130	4,500	0.000012572
143	4,000	0.000013829
158	3,500	0.00001528
174	3,000	0.0000168276
192	2,500	0.000018568
212	2,000	0.0000205026
334	1,500	0.0000323013
371	1,000	0.0000358796
409	900	0.0000395546
450	800	0.0000435197
495	750	0.0000478717
545	700	0.000052707
600	600	0.000058026
660	500	0.000063829
726	400	0.00007021184
799	300	0.0000772717
879	250	0.00008500855
967	200	0.00009351908
1064	190	0.0001029
1171	180	0.000113248
1289	170	0.0001246598
1418	160	0.0001371355
1560	150	0.000150868
1716	140	0.000165955
1888	130	0.000182589
2077	120	0.00020086776
2285	90	0.00022098355
2514	80	0.0002431303
2766	70	0.0002675013
488229	60	0.047216884
6236099	49	0.6030964

By using this data expected entry price (E.P.) of this game without including other any charges be

E.P. =1.455+0.97+0.097+0.0485+0.0388+0.0291+0.0194+0.029+0.024+0.00855+0.0116+0.01365+0.0174+0.02425+0.0368+0.04935+0.04159+0.044099+0.046134+0.048535+0.050288+0.0522+0.05418+ 0.055315+0.056286+0.056914+0.05706+0.056565+0.05532+0.05348+0.05049+0.04642+0.041006+0.0484515+0.03588+0.0355995+0.034816+0.035835+0.036897+0.034818+0.031865+0.028046+ 0.0231525+0.02125215+0.018704+0.019551+0.02038464+0.0211922+0.02194176+0.0226305+ 0.0232344+0.0237367+0.0241044+0.01988856+0.0194504+0.01872507+2.83301304+29.5517293

E.P.=36.743181

Profit on each entry =49-36.743181=12.256819=12.25

Total Profit = 12.25* No. Of spots(10340136)= 12,66,66,666

Total fees = entry price * No. Of spots(10340136)= 50,66,66,664

Winners price =38,00,00,000

Profit Dream 11 for one mega contest= 126666664 (without including any expenses)

CONCLUSIONS

In this article we study the earning platform of Dream11 fantasy game. we take one real IPL Dream 11 contest as a example and calculate their Actual entry fee by using mathematical expectation formula. Calculate the difference between actual entry price and entry fee taken by Drem11 of one mega contest, Dream 11 Profit of that contest, and winning probability of each price is calculated.

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Digital Marketing as an Outstretched Method towards the Targeted Consumers

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ABSTRACT

The rapid pace of change in the marketing world necessitates staying ahead of the curve. Businesses need to constantly adapt and evolve to remain relevant in this fast-paced environment. This paper focuses on companies that have successfully adopted cutting-edge and competitive marketing strategies across various platforms. However, it lacks a few elements for a more impactful conclusion. Highlighting the specific findings: Briefly mention the key insights or takeaways from the research on the companies adopting innovative marketing strategies. This strengthens your argument and showcases the value of your paper.

Emphasizing the benefits of adopting these strategies: Briefly state the positive outcomes or potential benefits of implementing these cutting-edge marketing strategies. This helps readers understand the practical implications of your research.

KEYWORDS *: Digital marketing/online marketing, Marketing strategies.*

INTRODUCTION

The digital age, fuelled by technological advancements, has fundamentally changed how companies interact with customers. Marketers now have access to real-time information and a multitude of communication channels, allowing for personalized marketing strategies and direct customer engagement. Consumers have become active participants, sharing information and influencing brand perception through online platforms. Traditional marketing approaches no longer suffice, and full integration of digital media is crucial for building customer relationships. This sets a strong foundation for your paper on companies employing innovative marketing strategies. By highlighting the specific methods and outcomes observed in these successful companies, you can further solidify the impact of the digital revolution on the marketing landscape.

LITERATURE REVIEW

According to Chaffey (2011), digital marketing has "encouraged customer interaction on the company's website also through its social presence".

Waghmare (2012) analyzed in his research that different countries in Asia are the captivating advantage of e-commerce by opening up in old and newer markets through digital marketing, which is required for indorsing competition and movement of Internet and related technologies.

Component of Digital Marketing

Search Engine Marketing

Search engine marketing (SEM) leverages search engines like Google, Yahoo, and Bing to help users find the information they seek online. It aims to improve a website's ranking in search results (search engine

optimization or SEO) and employs paid advertising options to increase its visibility (paid search).

Social Media

Your statement highlights a significant aspect of social media's evolution: its transition from a personal connection tool to a powerful marketing platform. However, the information needs some clarification.

Specificity: While mentioning the "eighty-one billion mark" suggests impressive growth, it's unclear what this number specifically refers to. It would be beneficial to clarify what this figure represents (e.g., total social media users, and global advertising revenue) for a clear understanding of the scale.

Profitability vs. User Growth: The statement implies a disconnect between social media's profitability and user base. However, these are often intertwined. While social media platforms focus on profit through advertising, user growth often contributes to that profitability by expanding the potential audience for advertisers. Additionally, social media companies might reinvest profits into user acquisition and engagement strategies, further influencing growth.

Social media advertising has become increasingly profitable due to its vast reach and user engagement. While initially intended for personal connections, social media has evolved into a major marketing platform, attracting over [insert specific number] users globally.

Email

he provided text highlights the enduring power of email marketing, despite some limitations:

Strengths

High ROI: Email marketing generates a high return on investment (ROI) compared to other marketing channels.

Versatility: Email allows incorporating various marketing strategies like customization and automation without significantly increasing costs.

Adaptability: While not inherently focused on the latest trends, email can integrate new features like customized content and automation.

Versatility (repeated): The text emphasizes email's versatility again, suggesting its ability to support diverse marketing goals.

Affiliate Marketing

Businesses reward individuals or companies (affiliates) for driving traffic or sales to their website through marketing efforts. Affiliates promote products they like and earn a commission on each sale they generate.

Here are some additional points you might consider incorporating: Highlight the different ways affiliates can generate traffic: This could include methods like content creation, social media promotion, and email marketing.

Mention the variety of commission structures: Depending on the program, affiliates might earn a percentage of the sale, a fixed fee, or a commission based on other factors like leads generated.

Briefly touch upon the benefits for both affiliates and businesses: Affiliates can earn income by promoting products they believe in, while businesses gain access to a wider audience and potential customers through the efforts of their affiliates.

Online Display Advertising

It operates in the digital space, utilizing various online platforms like websites, mobile apps, and social media networks to reach target audiences.

Types of online display ads:

Video ads: Short video clips capturing attention and conveying messages creatively.

Banner ads: Rectangular or square graphic displays with text, images, or animations.

Interactive ads: Ads that allow users to engage with them through clicks, rollovers, or other actions.

Rich media ads: Combinations of various elements like video, audio, animation, and interactivity for a more immersive experience.

Benefits of online display advertising:

Captures attention: Eye-catching visuals can grab users' attention and spark interest in the advertised product or service.

Reaches a wider audience: Display ads can reach a broad online audience across various platforms.

Targeting capabilities: Advertisers can target specific demographics, interests, and online behavior to reach potential customers more effectively.

RELATION BETWEEN TRADITIONAL AND DIGITAL MARKETING

Traditional advertising and marketing is a maximum familiar aspect of advertising and marketing. Maximum consumers opt for traditional advertising and marketing because of its endurance. Some examples of conventional advertising and marketing encompass tangible objects like advertisements in a print medias like newspaper and journals. It additionally consists of a billboard, pamphlets, business on TV or radio, poster, etc. It is a non-virtual manner of advertising and marketing. But virtual advertising and marketing make use of diverse virtual channels to attain customers.

a) Interaction among the consumers: In traditional marketing consumer has limited or no alternatives receiving messages of his area of awareness whereas in modern marketing all channels through which have certain interactivity

(b) Tracking with the result: It is difficult to evaluate the results and influence of marketing whereas in modern marketing Focus is on consumer satisfaction and relationship building.

(c) Agility: Delivery through various labourious channels takes longer time duration whereas modern marketing competence related to 'quickness of service is developed at good speed.

(d) In traditional marketing Translations of the consumer is closer to product awareness and the level of interest increases whereas in modern marketing events targeted near to the 'end of the activities' relating them to utilization of goods and services

(e) In traditional marketing making of mass marketing techniques with a minimum personal touch whereas in modern marketing it increases with customer need and wants.

(f) In traditional marketing it is difficult to build an imagery brand because of base limitations whereas in modern marketing With high quality media/ video gaining importance.

Advantages of virtual advertising

a) Increases profit: The most relevant use of all business proposals is to raise profit above present revenue and through virtual ways.

b) Strengthening Brand presence: Through traditional channels, Marketing products is time-consuming when considered across boundaries and requires a large effort to accumulate a new idea base. Digital marketing helps assist upcoming and new target segments in a much shorter period and multiply brand presence numerous times.

(c) Provision for data-gathering and consumer retention exercise: The biggest application of Digital marketing for consumers is its impact through various channels to support the consumer's accumulation of data, comparing other commodities, and confirming consumers' buying decisions.

(d) Mixing online-offline media and multiple digital channels: With inventions like the incorporation of social media with e-commerce organizations to order products inclusion of special hashtags in their reply. With these newer facts, we realize the impact of most product-based companies like pharmaceuticals, agriculture, healthcare, etc.

(e) Response generation is an Instant mechanism to eliminate negative customer feedback.

Hypothesis

H0: There is a significant relationship between the use of digital marketing platforms and market reach

H1: There is no significant relationship between the use of digital marketing platforms and market reach

RESEARCH METHODOLOGY

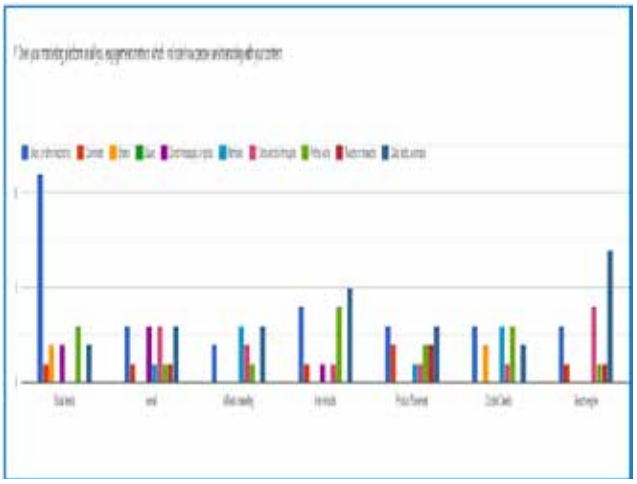
Research methodology is a lot of techniques and methods that are used in gathering, analyzing, and estimating the facts and figures in the exploration. It is an arena of work that has been made to determine results to look into research studies.

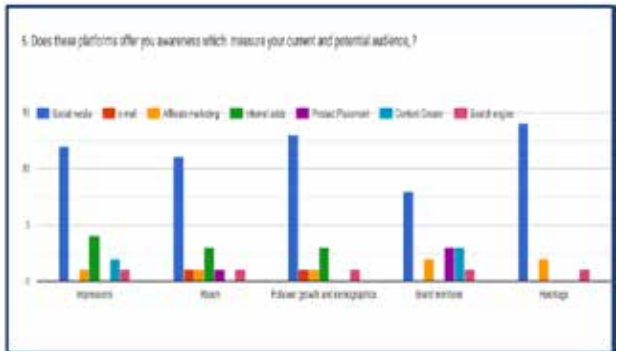
The research is descriptive in nature and hence it includes a descriptive research design. The research is informative in nature so it integrates an obvious research plan. This plan goes for withdrawing tide beside stream matters or problems completes a process of information gathering and authorizes the professional to show the situation.

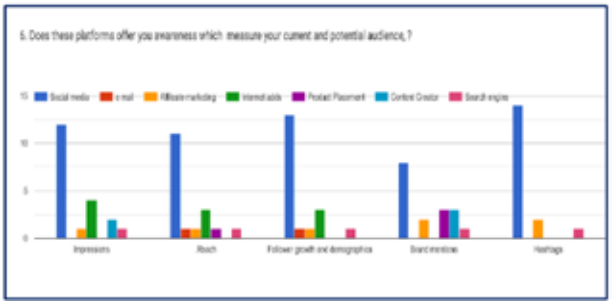
Trial Size: The trial size in this exploration comprises of 112 entrepreneurs

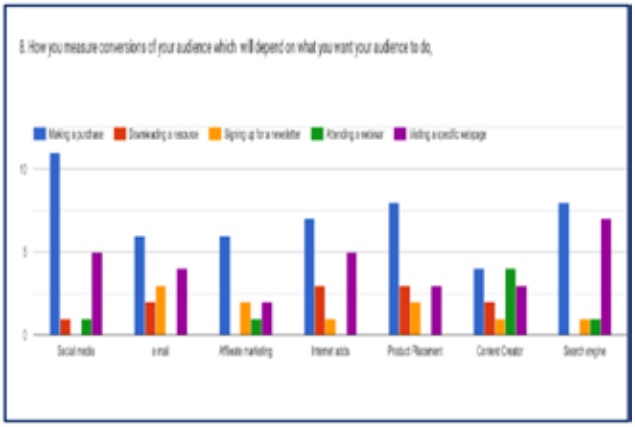
Data Analysis and Interpretation

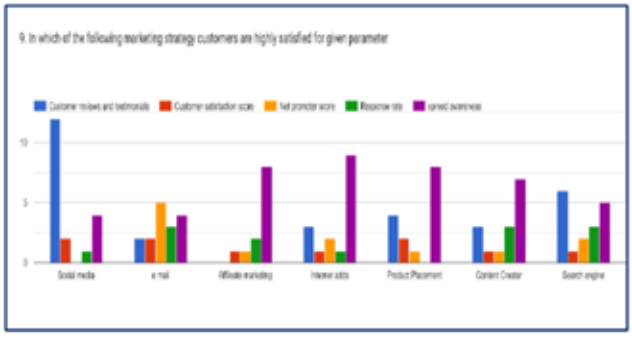
Data Interpretation











Hypothesis Testing

From the question, no 6 i.e. Do these platforms offer you awareness that measures your current and potential audience,? I can prove the hypothesis

H0: There is a significant relationship between the use of digital marketing platforms and market reach

H1: There is no significant relationship between the use of digital marketing platforms and market reach. t-Test: Two-Sample Assuming Equal Variances.

	Social media	Market Reach
Mean	4.089285714	3.892857143

Variance	1.55952381	1.628056628
Observations	112	112
Pooled Variance	1.593790219	
Hypothesized Mean Difference	0	
df	222	
t Stat	1.164348782	
P(T<=t) one-tail	0.122766215	
t Critical one-tail	1.651746359	
P(T<=t) two-tail	0.24553243	
t Critical two-tail	1.970707395	

Interpretation: t test value is 1.97 which is more than p. The Level of significance is 0.05 so an alternate hypothesis is accepted

Conclusion and Suggestion: The digital landscape is rapidly changing, and businesses that fail to adapt risk falling behind. Consumers are increasingly spending time online and utilizing various digital platforms, making these platforms crucial for effective marketing strategies.

Therefore, businesses must embrace digital platforms to reach their target audience effectively. This shift requires moving away from traditional marketing methods and implementing strategies tailored to the online world.

Failure to adapt to this digital reality could lead to difficulty competing in the market and potentially even closure.

The t-test value of 1.97 exceeding the significance level of 0.05 suggests that the alternative hypothesis is accepted. This could indicate a statistically significant difference between traditional and digital marketing approaches, potentially supporting the argument for embracing digital platforms.

RECOMMENDATIONS

Develop a comprehensive digital marketing strategy that incorporates various online channels like social media, content marketing, and search engine optimization.

Invest in building a strong online presence through a user-friendly website and engaging social media profiles.

Utilize data analytics to track the effectiveness of your digital marketing efforts and optimize your campaigns for better results.

By embracing these suggestions, businesses can leverage the power of digital platforms to reach a wider audience, enhance brand awareness, and ultimately achieve their marketing goals in the ever-evolving digital landscape.

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Financial Inclusion – A Study on the Social & Economic Empowerment in Nagpur City

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ABSTRACT

The study investigates the social and economic empowerment through financial inclusion in Nagpur city. The research was conducted through a survey of 40 participants consisting of male and female aged between 18 to 75 years old. The questions included were related to the various forms of financial inclusion such as savings and investment. The result indicates the difference in risk taken while making investment or savings. The findings of the study provide valuable insights in understanding the needs of the participants and to provide them the financial services as per their income or assist them to have a better future.

KEYWORDS *: Banking, Services, RBI.*

INTRODUCTION

Financial Inclusion means providing basic banking and financial services to all the individuals of the society without any unfairness. The prime aim is to involve all individuals of the society and giving them the financial services irrespective of their income. During the process the things which are considered are the transparency, provision of assistance and no hidden cost is involved. Few people don't have the access to financial services due to poverty or low income and they are they are unaware about the banks and its functions. So the prime concern is to make them aware about all the financial services provided by the financial institutions. Very few may be aware about the services but as they belong the category of BPL they can't get the facilities due to fulfillment of certain criteria.

So the central bank of India (RBI) has taken the first step to propagate various programs and plans under which the poor people can avail. RBI has framed certain rules and regulations which has to be followed by the other banks. So let us have a look on few programs introduced by RBI.

1. Each and every bank should have the minimum balance accounts or zero balance account for the unprivileged section of the society.
2. To make KYC essential for all the customers of the bank.
3. Opening of new branches in rural areas.
4. Provision of loan at affordable rate to low income customers.
5. Awareness programs should be scheduled on a regular basis.
6. Make them aware about the schemes and plans available.

LITERATURE REVIEW

According to V. Leladhar (2005), financial inclusion means provision of banking services at minimal cost to all sections of the society without any differentiation.

Dr K.C. Chakrabarty (2011), analysed that the service should be provided according to the need of the society and the process should be fair and transparent.

Das Prasan Kumar (2010), visualized the scope of the activities to be included so that the poor people can also

avail the benefits as a result which leads to the economic development of the nation.

OBJECTIVES

1. Analyze the parameters affecting the financial inclusion.
2. Understand the degree of awareness of financial inclusion among respondents.

Scope of Study

1. Study limited to Nagpur city.
2. Data is collected from various age groups to understand the need of financial inclusion.
3. Few variables considered are age, income, assets, pension plan and insurance plan.

Hypotheses

H0: There is no significant difference in taking risk while saving or making investment among male and female

H1: There is significant difference in taking risk while saving or making investment among male and female

Type Of Research

Descriptive research

Sampling

It is a necessary element in the sampling plan. Instead of taking whole census data we consider few elements as sample.

Sampling Area

Nagpur city.

Sampling Size: 40

Sampling Unit

Businessman/ Salaried/Self employment

Sampling Method

Random sampling

Data Instrument

Question are prepared and data is analyzed.

Limitations

1. The study is limited only to Nagpur city
2. The time limit constraint.

DATA INTERPRETATION

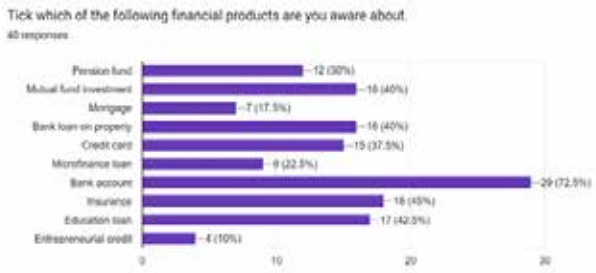
Characteristics of Respondents

		Numbers	%
Gender	Male	19	47.50%
	Female	21	52.50%
Age	18-28 years	26	65.00%
	29-38 years	5	12.50%
	39-48 years	6	15.00%
	49-58 years	1	2.50%
	Above 58 years	2	5.00%
Marital Status	Married	11	28%
	Single	29	7.50%
Source of Income	Salary	31	77.50%
	Self employed	7	17.50%
	Businessman	2	5%
Type of Organization	Government	2	5%
	Government aided	4	10%
	Private	34	85%
Annual Package	Rs. 1 to 2,00,000	16	40%
	Rs. 2,00,001 to 4,00,000	15	38%
	Rs. 400,001 to 6,00,000	4	10%
	Rs. 6,00,001 to 8,00,000	3	7.50%
	> Rs. 8,00,000	2	5%

Figure 1 showing responsible for day to decisions.

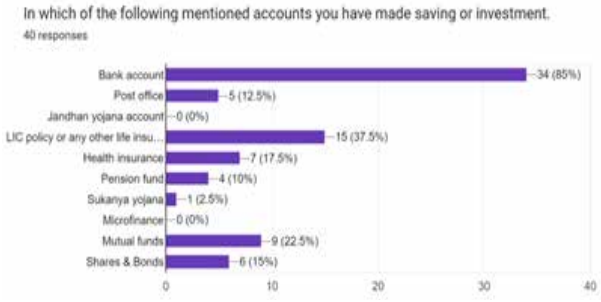
As we can see from graph that the 35% take household decisions regarding money by themselves following with 30% of the decision by all the family members.

Figure 2 showing awareness about financial products



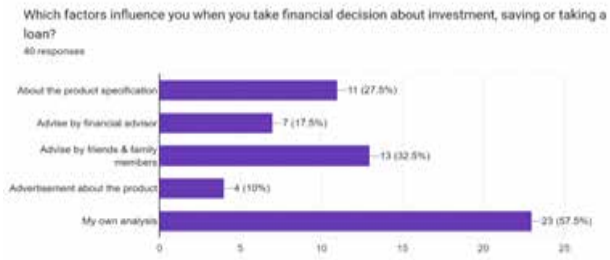
The figure depicts that 29 respondents are aware about Bank account, 18 respondents are aware of Insurance, 16 respondents are aware of Mutual fund investment & bank loan on property, 16 are aware of credit card and very few are aware Mortgage, microfinance credit & Entrepreneurial credit.

Figure 3 showing the saving/investment made by respondents



From the above figure it is clear that 34 respondents have bank account, 15 respondents have insurance policy, 9 had invested in Mutual funds, 7 respondents had taken health insurance, 5 respondents invested in shares & bonds, 5 respondents have saving in post office, 4 respondents contribute money for pension fund. The reason respondents don't have insurance policy is due to unaware about the schemes available & too expensive as per the responses.

Figure 4 showing factors influencing to take financial decisions



The major factor contributing toward saving & investment is self-analysis factor so financial literacy of the respondents is very essential.

Hypothesis Testing

H0: There is no significant difference in taking risk while saving or making investment among male and female

H1: There is significant difference in taking risk while saving or making investment among male and female

For testing the hypothesis, the researcher applied t-test with the help to MS Excel to analyze the results:

T- Test Values:

	M	F
Mean	4.105263158	3.80952381
Variance	0.65497076	1.461904762
Observations	19	21
Hypothesized Mean Difference	0	
df	35	
t Stat	0.916666964	
P(T<=t) one-tail	0.18279528	
t Critical one-tail	1.689572458	
P(T<=t) two-tail	0.36559056	
t Critical two-tail	2.030107928	

P value significance level 0.05

P value is 0.36>0.05 it means H1 is accepted i.e., there exists a significant difference in taking risk while saving or making investment among male and female.

CONCLUSION

It is found that all the respondents have bank account and done savings in form of RD or FD, but the other services such as health insurance, pension fund the contribution is done by few respondents which is a major concern. So overall there should be adequate knowledge regarding all the financial services so as to be able to meet day to day living and the future contingences.

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A Study on Work Life Balance of Women in Colleges of Nagpur City

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ABSTRACT

Globally the position of working women has evolved as a result of better social and economic situations as well as more chances for women to pursue higher education. Working women now face enormous pressure to advance their careers while maintaining an active personal life as a result of this. Women workers are feeling the effects of rising job pressure, which makes it challenging for them to take time for themselves. In addition to looking at how the work in teaching industry affects women, this study looks at the interaction between the various factors that influence work life balance.

KEYWORDS *: Work life balance, Personal life, Professional life.*

INTRODUCTION

Balance between serious and fun activities is a term that seems OK to a significant number of us yet can be subtle to accomplish. We as a whole know the inclination when requests are heaping onto the parametric scale of work-life balance and overwhelming our life. You may likewise know the sensation of unfulfilled dreams and wants on the opposite side of the scale. They gradually lift individuals into a dubious sensation of displeasure and withdrawal.

So, how might you deal with your significant investment such that leaves you feeling satisfied and connected all in all person? What can permit you to appear as the best version of yourself and keep away from mental weariness?

The balance between serious and fun activities is frequently used to depict a compromise. One has to balance the time invested on projects related to work versus the energy enjoyed by family members, companions, and individual aspects.

While working with colleges, everyone tries to adopt a positive and influencing style. For example, is it feasible for you to coordinate your work with your own requests? Might you at any point answer as needs be? How much take care of business and individual needs impede each other?

As per Gallup's Ladies in America report, the balance between serious and fun activities envelops all that goes into a masterfully carried-out life. The report proposes that numerous ladies view life and work comprehensively. Accordingly, they search for businesses that can energize and uphold them as individuals, not similarly as workers.

LITERATURE REVIEW

In addition, in examinations where WLB and related viewpoints are investigated, specialists have involved different functional definitions and estimations for the development. Kalliath and Brough (2008) have characterized WLB as "The singular's discernment that work and non-work exercises are viable and advance

development as per a singular's ongoing life needs." WLB is "a self-characterized, self-decided condition of prosperity that an individual can reach, or can lay out as an objective, that permits them to oversee numerous obligations at work, at home and locally; it upholds physical, profound, family, and local area wellbeing, and does as such without distress, stress or adverse consequence" (Canadian Division of Work, as referred to in Waters and Bardoel, 2006).

Robbins (2003) 3 The focal point of a research paper is the worker's perspective and circumstances. As representatives at the workplace stress over private/ family issues and think (on occasion over ponder) business-related problems at home. Likewise, presently everybody is understanding that responsibility is someplace straightforwardly or in a roundabout way removing their own as well as mental harmony. Individuals are perceiving that they are upset about it. Associations that neglect to accomplish a balance between serious and fun activities don't draw in and support representatives who are exceptionally talented and spurred. The justification behind work-life clashes as shown by numerous analysts is a direct result of working environment unevenness and not the tensions of time consumption or cutoff times. It is simply due to the mental impact and impedance of work in the life area as well as the other way around. This paper likewise expresses that each association should begin investing more energy in work-life coordination than investing energy in the executive's problems.

Summers and Hymans (2004) featured various significant hardships that are related to the experimental execution of work-life balance. A portion of these executions neglects to rehearse absence of formulation of strategies at the organizational level, inconsistent reception crosswise different areas and associations, limited representative's contribution in direction, Focussing as it were on organizational needs and benefits instead of on representatives, and amazingly even till date the homegrown obligations are on the mind of ladies independent of work status.

RESEARCH OBJECTIVE

To determine the various demographic, personal, and organizational factors related to the work-life balance of women in the teaching industry.

To study the work-life balance that affects working women in the teaching industry.

Hypothesis

H0: Personal factors affect the work-life balance of women employees in the education industry

H1: Personal factors affect the work-life balance of women employees in the education industry

RESEARCH METHODOLOGY

To obtain the objective of the study primary data and secondary data have been collected. Primary data has been collected through well-designed questionnaires, and secondary data through various magazines, and printed journals.

Personal Factors	Strongly Disagree	Disagree	Agree	Strongly agree
I get help from family	25.00%	34.00%	16.00%	25.00%
I have enough time to socialize with family	52.00%	20.00%	17.00%	11.00%
I have enough time to socialize with friends	27.00%	22.00%	24.00%	27.00%
I get time for my hobby	53.00%	19.00%	18.00%	10.00%
I don't take my college work to home	24.00%	33.00%	16.00%	25.00%
I believe that my work and other activities are balanced	49.00%	23.00%	15.00%	13.00%
Organizational factors	27.00%	22.00%	24.00%	27.00%
I don't work on weekends and holidays	51.00%	21.00%	18.00%	10.00%
Most of time I don't feel overworked	25.00%	24.00%	26.00%	25.00%
My superiors are happy with my performance	50.00%	20.00%	17.00%	13.00%

I get assistance from my team members	27.00%	22.00%	24.00%	27.00%
I get enough opportunities from my organization to grow my career	49.00%	23.00%	15.00%	13.00%
I am satisfied with my work schedule	27.00%	22.00%	24.00%	27.00%

Sample Area: Various educational institutes across Nagpur city were selected.

Sampling technique: A random sampling technique is used.

Personal factors	disagree	agree
Mean	0.298	0.331
Variance	0.008	0.015
Observations	6	6
Df	5	5
F	0.596503902	
P value	0.319105331	
F value	0.681894493	

Sample size: 93 female employees working at different levels in the educational institute was taken for the study.

Data Analysis & Interpretation

As per the statistics in above, responses for personal factors, 41% respondent agree that they receive help from their family members for household chores. Only 28% respondent agree that they get time to socialize with family members where as 41% agree that they get time to hang on with friends but there is somewhat lagging behind that they cannot balance the work at home and at workplace which is resulting in increase in stress level.

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Hypothesis Testing

A paired two sample t-test was performed to examine the relation between personal factors and work life balance. Here p value ie. 0.31 is greater than level of significance i.e., 0.05 which shows that personal factors does have a effect on work life balance.

CONCLUSION

Work can overwhelm the life. Perceiving what is significant and fundamental and taking a stab at what is esteemed will make a balance between fun and serious activities doable. Using the board abilities will empower me to have work fulfillment and harmony between work and home life. In the Indian setting ladies are the ones who manage the adolescents, care for the home front, and simultaneously manage their master life. If ladies work aggregately and energetically for life when we are at the office coordination can deal with own as well as expert living and alongside as require few investments for herself as well.

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A Study on Insights for Crop-Insurance in India

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ABSTRACT

India is an agricultural country and there is vast scope in agricultural area if there would be proper awareness and knowledge regarding the agriculture. Earlier our maximum share percentage of GDP was used to be from Agriculture which is been declining due to certain natural and unnatural occurrence in agriculture and there is need for us to enhance the education for agriculture in India as there is lot of scope. So this paper is in context of one of the parameter in agriculture which is related to the crop insurance. We had heard and seen that many farmers had committed suicide due to less or bad crop yield as they have been over debt burdened and they could not earn enough to make the payments. With the introduction of crop insurance there is ray of hope that there would be an increase employment in agriculture sector and we can expect that our GDP would also increase and the proportion of contribution of agriculture would also increase. Here the researchers had attempted to understand the various schemes available under crop insurance. The findings are that there should be proper awareness and education which has to be done from grass root level so that all the farmers can understand and avail the benefit.

KEYWORDS *: Crop, Insurance, Schemes.*

INTRODUCTION

LIC in 1942 has initiated the Crop-insurance H-4 Cotton and in future this outline was moved to GIC. This model linked crop-insurance with Institutional credit and was called all risk Comprehensive Crop-insurance Scheme (CCIS). The key drive of the system is to bid a degree of financial funding to agriculturalists in the occurrence of crop disaster due to usual mishaps such as famine, torrents, etc., to reestablish acclaim entitlement of farmers after a failure of crop for the next crop season. The scheme was multi-peril insurance in nature and basic unit of insurance was 'homogeneous area,' consisting of a development block or taluka. The premium amount as well as the guarantee rate for the crop which is notified was constant for all the protected agriculturalists irrespective of their genuine harvest. The CCIS was in operation till Rabi 1999. Another yield protection, called Rashtriya Kishi Bima Yoana (RKBY) or Public Farming Protection Plan (NATS) was sent off by the Head of the state on June 23, 1999. The reasoning of this plan is to shield the ranchers against loses de to edit disappointment by virtue of regular disasters like dry season, flood, hailstorm, typhoon. It was discretionary for states and carried out in 25 states and 2 association regions. This plan was necessary for ranchers developing told crops and benefiting of harvest focal point and discretionary for non-borrower ranchers developing advised crops

A Couple of Khart and Rabi season crops were covered for protection however they by and large vary from one state to another. The plan works based on region approach, i.e., characterized regions for each advised yield for far reaching disasters and on a singular reason for restricted catastrophes like hailstorm, avalanche, twister and flood. This plan was financed by the public authority and the Focal and State Legislatures

share how much appropriation on 50-50 premise. For the year 2008, the public authority has broadened the NAIS conspire on wheat and grain crops in the Rabi season against yield misfortunes from regular disasters. This plan is mandatory for both credited and non-lent ranchers. Under this plan, aggregate guaranteed reaches out to the worth of the limit yield of the harvest with a choice to conceal to 150% of normal of the harvest on installment of additional premium.

LITERATURE SURVEY

The National Agriculture Insurance Scheme (NAIS) in India was subjected to a critical analysis by Ramesh C. (2008), who also suggested several modifications to improve its functionality. It may be fixed at the same percentage as the national income derived from agriculture. Their results demonstrate that the nation's farmers do not find the overall performance of the commercial enterprises or the Agriculture Insurance Co. of India Ltd. [AIC] to be satisfactory at all.

Vatta, K. (2012) investigated Punjab's three agro-zones to determine the main agricultural risks. Through their research, they highlighted the key developments in Punjabi agriculture, associated risk concerns, and suggested several future directions, chief among them being the efficient application of agro-insurance programs.

Notable researcher Dhaliwal R. K. (2014) examined the history of crop insurance in India and noted the efficiency with which different agricultural schemes are run. Their research aimed to tackle the issue of diversification, wherein farm insurance could serve as a potent instrument for managing agricultural risks.

OBJECTIVES

1. To get acquaint about various crop insurance schemes.
2. To discuss about various issues and challenges.

FINDINGS

Pradhan Mantri Fasal Bima Yojana

There will be a uniform premium of simply 2% to be paid by ranchers for all Kharif crops and 1.5% for all Rabi crops. In the event of yearly business and green harvests, the premium to be paid by ranchers will be just 5%. The exceptional rates to be paid by ranchers are extremely low and equilibrium premium will be paid by the Public authority to give full guaranteed sum to the ranchers against crop misfortune by virtue of normal disasters. There could be no furthest breaking point on Government endowment. Regardless of whether balance premium is 90%, it will be borne by the Public authority. Prior, there was an arrangement of covering the superior rate which brought about low cases being paid to ranchers. This covering was finished to restrict Government outgo on the top notch appropriation. This covering has now been eliminated and ranchers will get guarantee against full total safeguarded with no decrease. The utilization of innovation will be urged generally. Advanced mobile phones will be utilized to catch and transfer information of harvest slicing to decrease the defers in guarantee installment to ranchers. Remote detecting will be utilized to lessen the quantity of harvest cutting investigations. PMFBY is a substitution plan of NAIS/MNAIS, there will be exclusion from Administration Expense responsibility of the multitude of administrations engaged with the execution of the plan. It is assessed that the new plan will guarantee around 75-80 percent of endowment for the ranchers in insurance payment.

Farm Income Insurance: This was started during 2003-04 to give revenue shield to the growers by assimilating

the medium of assuring produce as well as request pitfalls. In the scheme, the farmers revenue is assured by furnishing minimal guaranteed income.

Livestock Insurance: Public sector insurance companies provide a insurance cover for all the live stock. Typically, a livestock is ensured up to 100% of the request value. This scheme wasn't also veritably successful with growers as procedures for verification of claims and their agreement remain a source of constant frustration and subject of frequent gags.

Weather Based Crop Insurance Scheme/ Rainfall Insurance: This conception was innovated by private sector during 2003- 04. This product covers losses on the base of rainfall indicator like redundant or deficiency downfall, rarities in sun, temperature and moisture, etc. The finance minister Mr. P. Chidambram has blazoned in his budget speech(FY 2007- 08), that he's allocating Rs.1000 crore for rainfall insurance conditioning for the fiscal time ending 2008. The transnational reinsurers like Munich Re, Swiss Re, Paris Re and Lloyds of London are extending support to AIC's rainfall-grounded crop insurance scheme. Assiduity sources, believes that WBCIS is a more transparent scheme compared to the present NAIS scheme. The rainfall data is recorded automatically and there's no time pause. As similar, insured growers will be spared of the hassle of paperwork in claiming their plutocrat. It is, still, too beforehand to note on its acceptance by the growers.

EMERGING ISSUES AND CHALLENGES

The crop insurance was started in India in the year 1985, with the Comprehensive Crop insurance Scheme. This CCTS was replaced by the National Agriculture Insurance Scheme. Basics of Banking and Finance affect the growers' income, thereby causing request threat to impact its unborn earnings. It calls for the need of prosecution of request insurance to cover price threat rather than yield insurance. While designing the crop insurance scheme, the abecedarian issue is whether the scheme insurances all or definite specified drawbacks. The earlier is yield insurance whereas a scheme grounded on named threats is specific pitfall insurance. Still, there's enormous pressure from tilling community to conclude for individual approach. In addition to this, colorful issues related to NAIS were raised like reduction of insurance unit to Village Panchayat position, content threshold or guaranteed yield and base of its calculation, situations of reprisal, extending threat content to averted sowing or planting in adverse seasonal conditions, content of post-harvest losses, on-account agreement of claims and decoration sharing by fiscal institutions. For decades, the government has initiated colorful insurance schemes but unfortunately utmost of the schemes have gusto at huge losses due to lack of public support. The participation situations of the growers have been below anticipation, just 9 of the 138 million pastoral homes. Though the government is in favor of heavy subventions, the scheme witnessed a low penetration rate due to high decoration rates charged to the growers. The program also endured knowledge limitation among the bankers and quarter administration officers, burdensome executive costs and problems. with large geographic areas. The devilish detainments in claims agreement process where each claim had to be collectively assessed, led to cases when growers entered the claim quantum after 12 to 18 months, defeating the veritably purpose of insurance. The actuarial data is of consummate significance for the viability of any insurance product. It requires a sound actuarial base, complete with through analysis of the data, decide it and put forward protrusions grounded on the soothsaying styles, for designing products in the sphere of husbandry insurance. This isn't an easy task with the most advanced soothsaying ways being put to shame by nature's fury. Global warming is another factor responsible for impacting the rainfall patterns each over the world. The soil conditions and the felicity of the climate are also pre-requisite for the success of crops. Hence it calls for the need of insurance products which are grounded on area-wise studies and average yield of the area concerned. Above all, the challenges of moral hazard and adverse selection that insurers face have to be dived duly in order that husbandry insurance products turn out to be successful in the long run. Agrarian protection still to a great extent stays in open area circle and there's a need to advance confidential area cooperation in cultivation protection. As of second, there are around ten confidential area safety net providers in the overall protection business Dependence, Goodbye AIG, Imperial Sundaram, IFFCO-Tokio, Bajaj-Allianze, ICICI-Lombard, HDFC-

Chubb, Cholamandalam, ECGC and Star Wellbeing. ICICI-Lombard and IFFCO-Tokio General Protection(TG) were the main two organizations to explore different avenues regarding destruction protection and precipitation protection starting around 2003. The Protection Administrative and Improvement Authority(IRDA) have determined stem rules for the new guarantor entering general protection business to underwrite business in the peaceful area.

FUTURE SCOPE

The request for crop- insurance in India is vast. The active creation, strengthening marketing, supporting education and mindfulness about the benefits of colorful insurance products should grow through mass media, mindfulness camps and other effective measures. Growers must know the benefits and useful features of these schemes. This knowledge will enable them to choose an option most suited to their requirements. The distribution channels must also be expanded by including post services, general and life insurance agents, agrarian input suppliers and SHG groups and other applicable outlets having presence at the grassroots position in pastoral areas.

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A Study on Usage, Satisfaction and Awareness of Credit Card users in Nagpur City

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ABSTRACT

This study is to know about the usage and literacy of credit card users in Nagpur city. For this study the data is collected through questionnaire and the data collected was divided into three sections. The first section was related with the demographic information such as age, gender occupation etc., the second section related to the literacy i.e., information related to the credit card and the third is related with the awareness & the motivation factors of the respondents for the usage of credit card. The researcher had applied F test to understand the relationship between demographic characteristics of respondents and their credit card usage behavior.

KEYWORDS *: Credit card, Awareness, Behavior.*

INTRODUCTION

Credit cards popularity with the customers is from a very long period as it assists to the concept of "buy now and pay later." All over the world, the use of credit cards is done by the customers, vendors and financial institutions. The use of credit card has increased tremendously. From the recent data of RBI it can be seen that there is significant increase in credit card transactions. From the data we can analyse that the credit card usage has overtaken the debit card use with 25crores customer transactions as compared to 22crores transaction in last year 2022. The total value of credit card transactions are Rs.1.33 lakh crore as compared to Rs. 53000 crore of debit card transactions. The data comprises of the purchases made from electronic commerce platforms and retail outlets.

The major advantage of using credit card is that we don't need to carry cash all the time if we want to purchase we can do it just by using the plastic card which is the credit card. It is also safety and there are lots of options available to block the card if we lose the card. With this card we can purchase the goods and services right now without actually making the payment now, this is one of major convenient option available to us as if we don't have cash we would forego that goods and services but as we have credit card we are availing that option. We can use the card for travel purpose, for business purpose, for gaining reward and for shopping.

The usage of credit card has both advantages and disadvantages on the basis of usage of credit card by the users. It acts as beneficial tool if the card is used sensibly and used when required so as to optimize the liquidity and also it offers supplementary fund as per the requirement. It would also increase the unnecessary debt it the usage is not done properly. As the result, debt of the credit card would rise more rapidly. Such type of transactions has alarmed the policymakers and government to take initiative for making aware about the efficient use of credit card. The increase in consumption of the user would increase in the debt level of the credit card by which the user may face financial difficulties and also may lead to bankruptcy due to high burden of debt. Apart from the misuse of the credit card by the users there are also some hidden charges and other charges by which the credit card user is unaware and may be exploited for this.

PURPOSE

The rationale of the study is to understand the awareness, usage and satisfaction of credit card users. The study comprise of the primary & secondary data.

LITERATURE REVIEW

Brown et al, in (2017) had surveyed individuals based on the credit card use. The study reveals: most of the credit card users are using the credit card in a very responsible and careful manner. They are using the credit cards for their convenient and also only for the small amount of payment. It is also found that only few card users use credit card for the payment of high credit transaction.

Fulford (2017) has revealed that the amount available to the credit card users changes based on the business cycle, life cycle and the financial requirement of the individual. There is also increase in the credit limit according to the usage of the credit card and also according to the age of the user.

Objectives of the Research

1. To find the awareness about the credit card.
2. To understand the components affecting the usage of credit card.

Scope of the Research

1. The study is limited to Nagpur city.
2. The data collection consists of respondents of various age groups of Nagpur city.
3. The important variables considered are gender, age group, income & usage of credit card

Hypthesis

H0: There is no difference between male and female towards the intention to use the credit card.

H1: There is difference between male and female toward the intention to use the credit card

Type of Research

The research adopted here is descriptive. Here we are procuring data about credit card usage among different age groups.

Sampling

An important component of research design is the sampling plan and it is essential for the three questions such as: for whom to survey (sample unit) for how many to survey (sample size) and how the selection is done (sampling procedure). It is very difficult to study the entire population and also it requires time and money so the researcher has taken a sample from the population for the study.

Sample Area

The sample area is Nagpur city.

Sampling Size: 153

Sampling Unit

Businessman

Salaried

Self -occupation

Sampling Technique

Random sampling technique is used here.

Data Collection Techniques/ Tools

For the collection of the data Questionnaire has been used in which questions such as open ended and closed ended questions are mentioned and also few questions based on likert scale have been used for collection of data.

Data Analysis Techniques – use of Statistical Tools and Techniques

For the study the researcher has done Descriptive statistics and F test has been applied for the hypothesis testing.

For Descriptive statistics- Bar graphs have been used for analysing the questionnaire.

Statistics used for Hypothesis Testing- F test has been used

Limitations

1. The study is limited only to Nagpur city
2. The time horizon for the study.
3. The sample size of 153 as compared to the total population of the Nagpur city.

ANALYSIS OF DATA

Table 1: Demographic Characteristics

		Numbers	%
Gender	Male	75	49%
	Female	78	51%

		Numbers	%
Age	< 20 years	2	1%
	21-30 years	23	15%
	31-40 years	78	51%
	41-50 years	46	30%
	Above 50 years	4	3%

		Numbers	%
Occupation	Business	15	10%
	Self-employed	46	30%
	Salaried	92	60%

		Numbers	%
Income	< Rs. 20,000	2	1%
	Rs.20,001 to Rs.40,000	119	78%
	Rs.40,001 to Rs.80,000	30	20%
	> Rs.80,000	2	1%

		Numbers	%
Qualification	High School	2	1%
	Graduate	30	19%
	Post-Graduate	101	66%
	Professional Degree	18	12%
	Diploma	2	2%

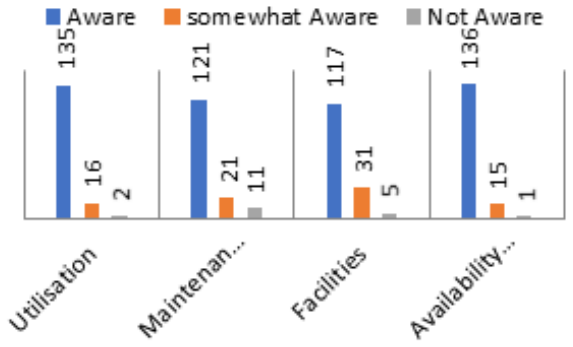

Figure 1 Awareness about credit card utilisation

From the above graph it is clear that maximum respondents are aware about the credit card usage.

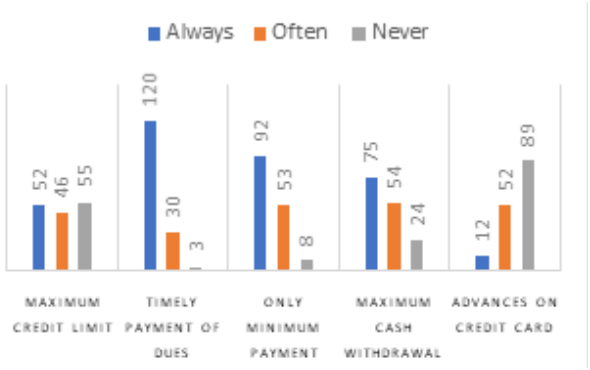

Figure 2 Credit card usage behaviour

From the above graph it is concluded that the respondents use credit cards but they are not aware about all the facilities.

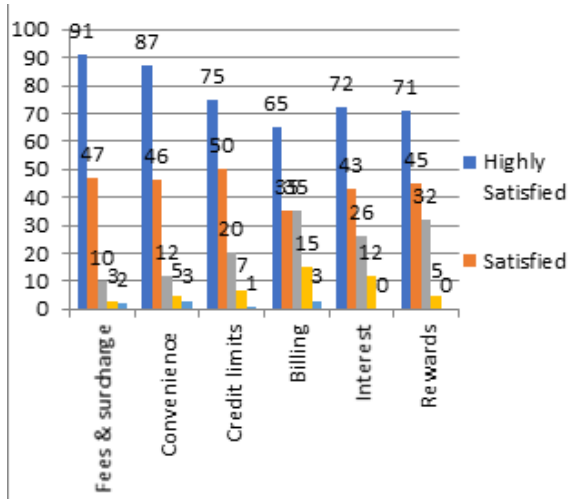

Figure 3 Credit Card Usage Satisfaction Level

From the picture it is concluded that the satisfaction level is high with the credit card usage. But if we see the usage of credit card for credit limits and billing maximum respondents satisfaction is low as compared to other usage of credit card.

Therefore, it is essential to enhance the information about the various features of a credit card with the users. By doing this it will boost up the users to use the card very consciously. Financial literacy is must to enhance the use. While doing so there is an immediate need to take into account the demographic dissimilarities while using the credit card. RBI & NGO should join in hands and work in collaboration and conduct training programs.

Hypothesis Testing

The researcher has used F-Test for testing the hypothesis

	Male	Female
Mean	2	2.077922078
Variance	0.513513514	0.572795625
Observations	75	77
df	74	76
F	0.896503902	
P value	0.319105331	
F value	0.681894493	

It is obvious from above that the F critical is low than the calculated F, Hence we reject the H0 and accept the H1. So our alternate hypothesis is accepted i.e., "There is significant difference between gender of the respondents and the intention to use the credit card."

CONCLUSION

Now with the inclusion of upgraded technology and convenience based approach which not only saves money but also efficient time management, the use of credit card has tremendously showing a upward graph. With the card there are cashless transactions, online purchases, cash back schemes and many more services can be opted. On one side there are benefits but on the other side there is a drawback that the use should be efficient and should be done in a conscious way otherwise it may lead to very high interest and may also lead to over debt burden. Over all we can conclude that credit cards are a source of convenience and flexible credit instrument.

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A Study of Compensation Management in Achieving Job Satisfaction Among the Educators of Management Institutions of Nagpur City During the Pandemic

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ABSTRACT

Pandemic have grandly shaken every organizations, and created a difficult and grueling terrain for employers, which necessitate to discover ingenious solution to make sure the continuity of respective organizations and to help the workers to cope by means of this extraordinary extremity. Reward is reparation so as to workers obtain for their achievements and assistance at job. The compensation reflected definitely on workers job satisfaction, commitment, enthusiasm, and presentation. Today's dominion of edification circumstances in present period, especially in the organized private management institutes, has chartered new avenues for the academicians. The role and implication of academicians has implicit paramount significance require inclination to alter point of reference, vitality and transformational management. Operational environment symbolize 'the foundation of rewarded exertion as well as service affairs. They cover up a wide-ranging of motif and issue, commencing effective instance (hours of job, break age, with employment schedule) to compensation, with the substantial circumstances and inner difficulty in the place of work. Calamity has radically distorted operational circumstances in organization. Certainly, to make sure their working permanence, the majority organizations have motivated to isolated working, requiring their workers to work from home. In every educational organization scholar and preceptors participate as crucial component. For this, it's imperative with the aim of the academicians should pleased in their work spaces so as they know how to resourcefully employ to deliver advanced edification and ethical morals & beliefs in their student.

KEYWORDS *: Pandemic, Management institutions, Academicians, Job satisfaction.*

INTRODUCTION

Job Satisfaction is the most important component which is core for any organization striving for excellence and growth in any domain. Employees need to be satisfied and being an important asset for organization's success, they need to be well embedded and nurtured in the organizational system to contribute optimally and effectively towards their organizational productivity and efficiency. Employee satisfaction means that the employee is happy with his work environment and climate; the reason can be his informal structure like colleagues and co-workers or the supervisors so as to enable him to perform well in his job also. Compensation acts as a vital function in decisive and workers intensity of job contentment. This may also perpetrate cognitively so as to cause emotional fulfillment that keeps him happy in his/her workplace. Remuneration practice connected to job fulfillment encompass in a different way by communal and concealed enterprise. Higher education is prominent in the improvement of a nation; it do not simply play the role as a contributor of comprehension but as a significant segment intended for the nation's

augmentation and communal welfare. The privileged edification institutions take part in a remarkable responsibility in expansion of skill, amplified financial system; consequently, elevated eminence of personnel is essential. Administration at contemporary educational institution require exceptional accomplishments to obtain and preserve extremely skillful staff to drive successfully in an enormously competitive atmosphere.

The rapidly evolving Indian educational system is witnessed by the rising trend of large number of new institutes in every nook and corner. Adverse operational circumstances and unappealing compensation correspondence have in the majority industry lead to skills relocation. Several researchers anticipate so as to shortage of endowment are departing to amplify well into the subsequently decade, which will edge the capacity of organization to amplify and will make vulnerable probability of endurance as universal antagonism become more passionate. There is no denial to the fact that the academician's offering in building future management leaders, entrepreneurs are indispensable but still, their satisfaction is at stake. Reward acts as essential function to attract, motivate and retain brilliant recruits. It inspire efficient people to stay in service for longer period. Moreover, munificent plunder maintain human resources and ultimately direct to job satisfaction, dedication and trustworthiness. Substantiation from earlier learning seem to imply to facilitate a constructive association among reward and work pleasure. Numerous researches have reported a affirmative connection between reward and employment.

In this backdrop, this research purports to analyze saliently the significance of work pleasure amongst academicians particularly in the organized management institutes. This would lead to optimum creation & maintenance of talented academicians who remain for long in a particular institute. In this era of globalization, where India is trying to become a developed country, it is important that the academicians come to the forefront and take up the prime responsibility of nurturing their MBA students to develop the right attitude and mindset for Ethical corporate, social and moral behavior in all walks of life. Since academicians have a propensity to be extremely logical, artistic and expressive and comparatively less pushy than other professional, administration of controlled institute should be further approachable to their requirements and potential to make sure retention. This is the key principle in the wake of this research which aim to examine the job contentment and compensation management among the academicians of management institutes of Nagpur city during the pandemic.

REVIEW OF LITERATURE

Locke (1976) given "Job Satisfaction is a pleasurable or positive emotional state resulting from the appraisal of one's job or job experiences." Job satisfaction is define as an amalgamation of emotions and feelings which an employee possesses in his organization. This is indeed a subjective construct which will vary from one academician to the other. Rather it also depends and is largely shaped by the individual's own ability to handle a given situation and his own perception & attitude. It also depends on the treatment given to the employees in an organization.

Compensation: Employer compensate employees for rendering the services like effort, time and skill. Which include together fixe pay with a variable pay attached with level of performance. Swanepoel acknowledged to reward as monetary and non-monetary extrinsic plunder provided by an company for the time, expertise and hard work through the employee in satisfying job requirements anticipated at achieve secretarial goals. Absar, report that employee reward is one of the main function of employees administration. Compensation is essential for both employer and employee as regards to attract, retain and motivate employees. Ray and Ray state reward as key for human resources as it is one of the major reasons peoples for job. Compensation includes claim on commodities and services compensated to a worker in the form of capital or a form that is rapidly and effortlessly redeemable into funds at the prudence of the reward or total compensation is "the total of all rewards provided to employees in return for their services". Salisu given a momentous constructive association between reward and work pleasure and accomplished the participant participate in their study with regard to plunder as one of the major contributor to their work pleasure. Others told that worker rewards persuade work pleasure in advanced edification institution. They also discovered that reward as part of

worker plunder are in advance attractiveness gradually for higher education institutions. They must employ compensation to please and preserve the extremely competent educational personnel. In radiance of these study, it seeks to find the relationship between reward, payback and work pleasure.

Fringe benefits: Payback comprises of correspondence and owner practice in addition the hard cash costs that workers receive. It comprise of wellbeing, earnings security, investments and retirement program offer safety measures for human resources and their family. A precise set of secretarial practice, policy and program, in addition a viewpoint that vigorously chains hard work to assist workers attain achievement at both employment and dwelling. In accumulation, the study by Artz revealed that extreme payback have a noteworthy and constructive association with work pleasure . Furthermore, he revealed that fringe benefits formulate a significant fraction of employer reward correspondence but their impact on worker work pleasure has given much consideration. In addition it attested that fringe benefits may influence job satisfaction in opposite ways. First of all, since fringe benefits are commonly a reduced amount of taxe than earnings, they can be purchase at less charge through an employer than if bought on the marketplace succeeding, fringe benefits are often attractive piece of reward relationship and so enhance work pleasure. It is marked that reward and fringe benefits have a momentous association from secretarial level; the literature is indistinct about upper edification institutions hence, the current study seek to fill up to facilitate space.

RESEARCH METHODOLOGY

A quantitative study method and a survey design were consider for investigation of the impact of reward, payback on work pleasure. Quantitative research is obtained with the essentials or reactions of participants, to define the situation at hand and thereby draw inferences from the hypotheses stated in the study. The research is based together with primary and secondary data. Primary data is composed of survey method as of from employees. 74 response are acknowledged during survey and used for the intention of study. Secondary data is composed of wide literature study, credentials available, theory existing online were access to develop a improved perceptive about the academicians, the experiences & contentment level. The sampling method used is Convenience sampling.

Objectives

1. To learn the correlation among compensation and work pleasure.
2. Learn the correlation among benefits and work pleasure.
3. To study the impact of compensation and benefit on work pleasure.
4. To analyze the Job satisfaction level of academicians of Nagpur city.

Hypothesis

H0: There is no noteworthy correlation among work pleasure and compensation Management.

H1: There is a noteworthy correlation among work pleasure and compensation Management.

STATISTICAL INVESTIGATION

Demographic distinctiveness of the respondents

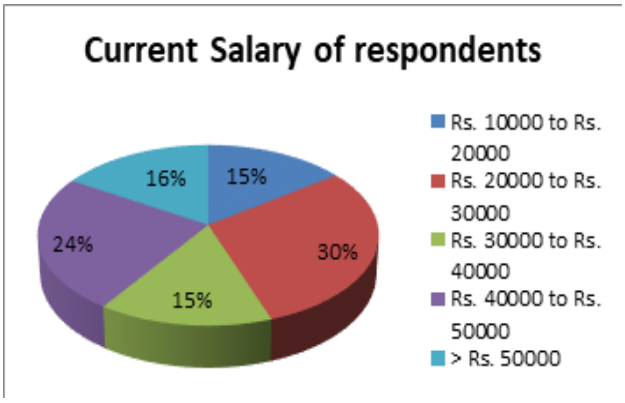
1.	Gender	Male	48
		Female	26
2.	Educational Qualification	Post Graduate	42
		Ph.D	42
		NET/SET	18
		M. Phil.	2
		Others	6
3.	Age Range	20-30 years	14
		31-40 years	34
		41-50 years	20
		Above 50 years	6
4.	Nature of employment	Full time approved	46
		Full time ad-hoc	26
		Part time	0
		Others	2

5.	Current Designation	Sr. Professor	0
		Professor	2
		Associate Professor	6
		Assistant Professor	66

Basis: Primary data

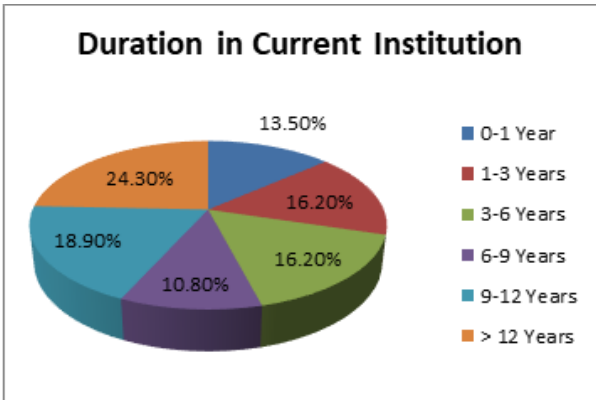
Above table gives us the idea that there may be 48 male respondents and 26 female respondent from which maximum of the respondents are doctorate. The maximum employees working in age range of 31 to 40 years and it is experiential maximum are full time approved and working as assistant professor level in the organization.

Current Remuneration of the employees



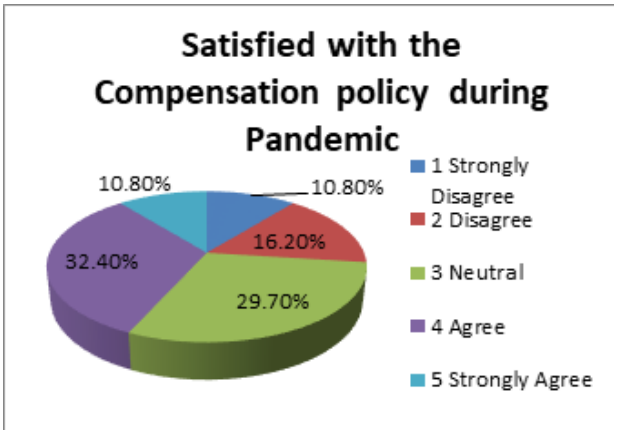
From the above graph it is clear that 30% of employees are in salary array of Rs.20,000 to Rs.30,000 follow by 24 % of the employees have salary between Rs.40,000 to Rs.50,000.

Working in the institute since



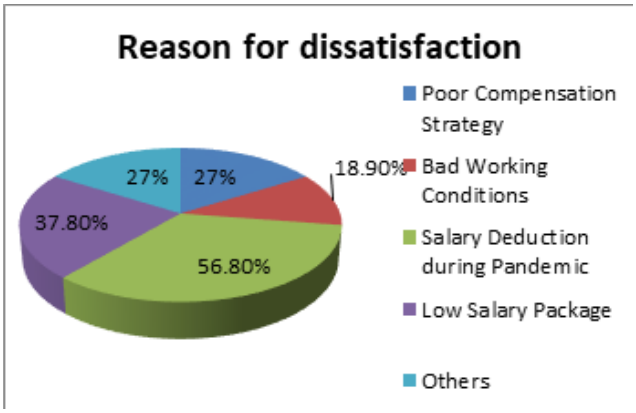
From the above graph it is clear that 24.3% of the respondents are working in the same organization since above 12 years followed by 18.9 % of employees working from last 12 years. So we can see that the maximum employees are working in same organization with good retention ratio.

Employees perception towards compensation in current institution



From above it is clear that overall 43% of employees are in the opinion that they were satisfied by the compensation policies used during Pandemic, 29.7% are in the state of neutral opinion and 31.6% of employees are not satisfied with the compensation policies used during Pandemic in the organization.

The probable reason towards dissatisfaction in Organisation



The major reson towards dissatisfaction in Organization is salary deduction during pandemic and the other reason is low salary package. The employees believe that they can get better job opportunities for their overall

development which may be lacking in the current organization which needs to be taken into consideration. Financial rewards are one of the strong parameter for the satisfaction of the employees so it is the other major reason for dissatisfaction and leaving the organization. The other reasons are poor compensation strategy and bad working conditions.

Other factors for Job satisfaction of employees

Factors	Extremely Pleased	Pleased	Neutral	Disappointed	Extremely Disappointed
Health with safety at workplace	20	28	14	8	4
Infrastructure provided	20	26	14	10	4
Delegation of responsibility	16	30	14	10	4
Respect and recognition of work done	22	26	10	8	8
Overall culture at the workplace	14	32	16	6	6
Social responsibility initiation of the organization	14	30	14	14	2
Support provided by management	14	26	10	18	6
Insurance and leave benefits	8	22	20	20	4

Basis: Primary data

Above table gives us the idea that maximum employees be pleased by their job.

Hypothesis Testing

t-Test: Two-Sample Assuming Equal Variances

	Compensation	Job satisfaction
Mean	3.136986301	3.424657534
Variance	1.314307458	1.831050228
Observations	74	74
Pooled Variance	1.572678843	
Hypothesized Mean Difference	0	
df	144	
t Stat	-1.38587112	
P(T<=t) one-tail	0.083964368	
t Critical one-tail	1.655504177	
P(T<=t) two-tail	0.167928736	
t Critical two-tail	1.976575066	

Results of t-test done to find the connection between work pleasure and compensation Management among the academicians of management institutes of Nagpur city during the pandemic. As the p value (p = 0.167928736) be larger than 0.05, hence alternate assumption is acknowledged and hence resulted that here is noteworthy correlation among work pleasure and compensation management.

CONCLUSION

After the study we find that better compensation administration results into job satisfaction . Job satisfaction is a reliable and relevant predictor of employee retention. Hence concluded the significant constructive correlation among reward management

with job pleasure which intends towards major concern and should be rectified .Employers are suggested to make a fuss of activities that promote encouraging functioning associations and payback; place of work pleasure increases when personnel, prefer to feel that the institute uses its skill and appreciate the commitment. Which substutute the better place of work contentment usually consequences in advanced level of job satisfaction less absenteeism and retention of the employees.

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During SARS-CoV-2, How the Workforce are Managed in Logically Manner

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ABSTRACT

The SARS-CoV-2 has began humble shared and commercial disturbance round the creation, plus the largest worldwide drop since the Boundless Unhappiness. Wide basis absences, counting nourishment shortages, were activated by basis sequence dilemmas. The pandemic has raised substances of cultural and possible vision, fitness justice, and the equilibrium between public health supplies and civil rights.

People are well-known as the key asset and the bristle of any institute who supports manage their objects. Consequently, to cope these humanoid capitals sustainably, the Human Resource supervisors of the society makes sequence of act concerning the rules and living out so that the group can run naturally. The ambition of this comprehensive assessment homework is to organize the number of HR follows & trial due to which many happenstances, campaigns, and the elections, which squelches to the Disruptive Improvements. This study is constructed on organizations; human resource management systems with situation to Applies and Plans to contest the SARS-CoV-2 impacts. Our study is based on the Secondary data which is composed through numerous records, poetry and the available Periodicals. The main area of this investigation is to inspect the influence of SARS-CoV-2on HRM, to classify the chief hearings and starts, and to bring dreams into upcoming rules in HRM. This newspaper also gives a new sympathetic to the diverse better-quality know- haws related to the numerous policies; events used throughout the SARS-CoV-2.

INTRODUCTION

Whether or not nearby determination be a complete yield to effort, improve desolated employed is watching foreseeable. With it will arise a surplus of imports and selections that will and have previously transformed the way we effort. We know from disruptive administrations that have been occupied at all for eons that this will not just up shot in new operational proprieties and applies. What effective disruptive organizations that have been employed greatly for many eons tell us is that it will also change the grading, organizational organization and critically nation and team subtleties of commercial forever.

Inside a heartbeat, disruptive revolution, foreshowed as the most significant corporate idea of the 21st century has become the new ordinary. The rapidity and capacity for communal to adjust and change their trades has been remarkable. Many have established their volume to do this.

The job gaining: Replying to final substance of disruptive innovation

SARS-CoV-2 has perhaps remained the major substance of disruptive innovation in our employed does in the straight retro in the past of exertion. As the reappearance to effort endures and the occupied from home trial has been a verified achievement, new choices for effort are developing and need to be careful. Many poverty to last employed from home-based, some are frightened to reappearance, others are scared about not recurring. What is robust is that there will

be augmented household occupied and so appealing employees and clients will claim inclination to acquire and revolutionise.

OBJECTIVES

- To study the construe effect of obstreperous tools of human resources supervision things.
- To translate the application of turbulent tools in the human resources supervision activity.
- To study the alteraction that had took in the human resources department
- To know the coming social control of obstreperous tools on the human resources department, the function of supervisor.

LITERATURE REVIEW

Whereas there is now a boundless arrangement of dialogue about the power of SARS-CoV-2 on and consequences for salaried observes and human resource supervision (HRM), much of the pleased and mention on these focuses inclines to be of a broad fauna, offering remarks and/or control that pursue to explain what a 'new normal' strength be. For example, that distant employed will develop the standard, or that employed does will develop suppler. While this may be certainly what occurs, since Covid-19 is a worldwide pandemic, we essential to comprehend its influence on employed practices, well-being and HRM in exact settings. It is likely numerous vicissitudes will be shared cross way republic settings, but we must also imagine, given official changes, that there will be contained shades. In Australia, finished appraisal of and meetings with bosses and others with persons management accountability, our on-going investigation has tinted some significant consequences.

First, though the mainstream of industries has been damagingly pretentious by SARS-CoV-2 , specific businesses and subdivisions have been pretentious definitely. For example, in Australia, middle precise gossips of undesirable impression, many defendants from healthcare and communal aid, public management, money and cover and removal have stated a optimistic in fluency.

Human resource management facing SARS-CoV-2

We have manifest that employee welfare and status from study have found that it is one of critical standing. It is seen to inaccessible worker working are not effecting to whole workforce. The never seen condition of completely lockdown have been seen enforced, mental plus physical condition of better living and related to their save condition was the concern.

The entangled their evidently are many. Few single had answered after the request and the was asked was how their are working in unbearable satiation, only in house circumstance also play an vital role in determiner related to their living condition. Prospect of worker force wellbeing make necessary of identifying the problems and something innovate human resources skilfulness which will help the organisations to implement the ideas.

Rrespondents has spotlight few man force conduct & action will appreciate that assistive the growth of firm. Ex:- employe feat that they should join forces.. Affirmative actions had alter only few organisations are able to balanve speedy revolutionize efficaciously. Unconstructive trait, communicator have shown the light what are the troubling and not able to adopt uncondition of worker, are many reasons of their conceptualization which are effecting wrongly in execution, that are leading to micro-managemen. Human resources professional are required to behaviour in best way which will apprise manager which will pull off execution from outback man force, few problems micromagt are frequently which need to balance the fulfilment of drawback of sup visor to fullfill the labour need 'invisible'.

Obstreperous Tools

Troublesome technology is an revolution that expressively revises the way that consumers, industries, or businesses work. A disruptive technology curves away the systems or practices it substitutes because it has qualities that are identifiably superior.

Obstreperous tools and HRM practices Very bad effect due to SARS-CoV-2

Many companies enactment are in front position of recent' courtesy stimulating circumstances current

gross domestic product, mainly decisive module chasing growth. Significant it is benign written down and established addicted to a paradigm. Company presentation & capability to find and convert dissimilar kinds of means.

The need for social separation is one outcome brought on by the blowout of infection. The presentation of salespeople was found to be secondarily impacted by social loneliness in measureable research.

Employing

Formative how extremely the SARS-CoV-2 had hit the pocket of many people & because of that they loss their savings. Halt convinced billings, just devoted and because of that many people had face problem financially.

Counselled are doing very watchful examining together present , up coming reserve wants. Many bases show that the plan of partly or totally hesitant the signing of new staffs is the greatest often used plan.

Employment Tactics

Staffs are an vital part of any group and importantly influence its output, achievement, and upcoming. This is the chief defence given by trades for selecting to devote a lot of cash on worker growth. In realism, workers' growth includes together their individual development and the growing of the firms as a entire. A additional creative personnel also interprets to better achievement for the business. Finest customs to provision workers' recital is finished worker development and raise.

Digitization

Firms are doing and trying to live stimulating SARS-CoV-2 retro and benefiting development chances & donated formation numerous novel chances and assistance novel skills, digitization has originate original habits is reorganizing a firms capitals Guiding principle for adopting disruptive technology in HRM practices it is been observed to improve presentation, remove stress from employees to work more effective to give productive out-put & to improve their health of employees. Applying new things like give rest to employees or providing them rest and enjoyment time after one or three hours will bring employees interested to work hard.

CONCLUSION

It has been nonfictional prose, as we now many things related to people and how to manage them to increase their work efforts during SARS-CoV-2. Apply exact development scheme for employees will be increasing their health mental, physically, their happiness and it will prove that it will increase the out-put of working of employees in their work place.

Due to the use of Disruptive technology, HR purpose has become affable which helped effectual. Almost very few things and working style boos of firms are required time. Organizations also needs assimilate because it are very essential for endurance. It gives asset like decreased costs and enhanced gainfulness.

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A Tool for Poverty Eradication – Empowering Women through Self Help Groups in Bhandara District

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ABSTRACT

Self-help groups have been formed to empower the rural women below the poverty line. The important concept of SHGs is for the Economic and Social empowerment of women. A common definition of microfinance is financial assistance for clients who are poor or have low incomes. The self-help group movement is an innovative initiative that connects group members, who did not, have a bank account or who have no access to financial services in a sustainable and accessible manner to become a member of SHG and avail of the facilities. In this paper, the researcher tried to know about the financial status of the members and whether it has increased or not after joining the SHG. The data analysis is done by statistical methods.

KEYWORDS *: SHGs, Socio-economic, Income, Savings, Microfinance.*

INTRODUCTION

Self-Help Groups

Self Help groups are shaped by the local area ladies, which have an explicit number of members in the range of 15- 20, in such an assembly the unluckiest ladies would meet up for crisis disaster, social explanation, and financial assistance to one another have the simplicity of discussion social communication and economic connections. Self Help groups (SHGs) are causal relationships of individuals who meet up to work on their norm of life. They help the poor, particularly women, build social capital. Their most significant capability is to urge the individuals to save their procuring, convince them to make an aggregate arrangement for creating extra pay, and to go about as a channel for formal financial administrations to contact them. SHGs operate similarly to microfinance institutions as collective guarantee systems. Thus, they have arisen as the most effective instrument for the conveyance to miniature money administrations to poor people.

LITERATURE REVIEW

Prasanta Sahoo, Ranjan Kumar shoo (2021) had mentioned in his article title "Study on economic growth among the SHGs that in KBK region the SHGs are more dominant by the tribal women and their overall economic, social, self-esteem and capacity building has shown a magnificent increase.

Dr. Richa Sharma, Dr seraph mishap, Dr. Shashikant Rai(2021) in their article title "Through microfinance during covid 19 A case study of women SHG" mentioned that the women who are in the self-help groups are working tremendously in India and are fighting to meet the day to day challenges with full courage ,safety and enthusiasm.

Danish Ahmad, Itismita, LailiIrani(2020) had mentioned in his article "Participation in microfinance based self-help groups in India" that there is need for programs in microfinance so that to observe their presence and also the retaining policies for the poor people so that they can cope up with the unfavourable situation.

Megha Tiwari(2020) has mentioned in her paper by title "Self-help groups in rural development" that SHGs is an informal group where people of rural areas come together work together in a team and with a team spirit, which would empower the women both socially and economically. The study has shown that the microfinance and SHGs are not only needed to resolve the issue of poverty but also for individual development

OBJECTIVES

1. To know the role of SHGs in socio-economic development of rural people in general.
2. To study about financial development of women's pre and post joining self-help group.

HYPOTHESIS

H0: There is no substantial increase in revenue of women's after joining SHGs

H1: There is a substantial increase in revenue of women after joining SHGs

Methodology of Study:

Primary & secondary data has been used for the study. The primary data has been collected from the selected people of the area through observations, questionnaires schedule. The questionnaire was given to the women members of self-help group in Bhandara. The sample size used for the study was 105 of 9 SHG.

DATA ANALYSIS

Table 1: Data Collection from Respondent's

Sr.No	Parameters	Variables	Percentage
1	Age	25-30	30
		30-35	10
		35-40	34
		>40	26
2	Marital status	Married	102
		Unmarried	0
		Widow	03
3	Qualification	Illiterate	15
		Primary education	68
		Secondary education	20
3	Qualification	Graduation	4
4	Occupation	Agriculture	60
		Non-agricultural labour	9
		Employed (Private)	9
		Housewife	29

Source: Primary Data

Table 2: Data showing income range of SHG members before and after joining SHG

Income	Pre Joining SHG	Post joining SHG
Rs. 0-1000	51	0
Rs. 1000-2000	10	12
Rs.2000-5000	38	60
>Rs.5000	16	43

Source: Primary Data

Table 3 : T-Test paired

	Before Joining SHG	After joining SHG
Mean	28.75	28.75
Variance	364.9167	762.25
Observation	4	4
Pearson Co-rrelation	-0.13794	
Mean Difference	0	
DF	03	
t Stat	0	
P(T<=t) one-tail	0.5	
t Critical one-tail	2.353363	
P value	1	
t value	3.182446	

Source: Primary Data

P value is less than t critical value i.e., 0.5<3.18 hence alternate hypothesis is accepted. "There is significant increase in income of women after joining SHGs."

CONCLUSION

The current study is an effort to define the part of microfinance as a means for 'Rural Women

Empowerment' with special reference to the Bhandara District. This research focuses on women empowerment related to economic empowerment. It is found from the study that most middle-aged women show a keen interest in joining SHGs looking forward to achieving economic empowerment. The study reveals that almost all members of the group attend their group meetings regularly which can be utilized for motivating them in bringing creative ideas to increase economic returns. Most of the sampled women respondents were illiterates prompting steps in up skilling and focusing more on the development of rural women through the microfinance group. Self Help Groups are most effective platforms to address the social issues of women in the unorganized sector.

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A Study on Benefits of Social Media Marketing

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ABSTRACT

Informal communication promoting is the most recent mantra for some brands after early last year. Advertisers are seeing the various potential outcomes in person to person communication and are beginning to present creative social missions more rapidly than any time in recent memory. Companies that use social networking ads have become more sophisticated. Global corporations have also recognized social media marketing as a potential marketing tool and used it to fuel their promotional strategy with inventions. This paper examines about the ideas of social promoting and web-based entertainment showcasing and Parts of social Advertising's '4ps', Online Entertainment Advertising in India, Ideas in Friendly Promoting Hypothesis, and Significant Elements of Social Promoting Hypothesis ,Types of social promoting ,Utilization of Virtual Entertainment Showcasing.

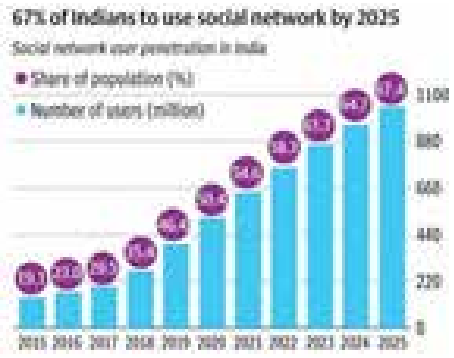
KEYWORDS *: Social media, Impact, Social marketing.*

INTRODUCTION

Social showcasing is a methodology for creating exercises to change or save human way of behaving to the benefit of residents and local area all in all. Social marketing is a tried-and-true strategy that combines ideas from the social sciences and commercial marketing to influence behavior in a cost-effective and sustainable way.

The absence of informal communication on the Web has empowered one person to associate with hundreds or even a large number of individuals all over the planet. Person to person communication prospered as a web-based conversation classification where you construct material, post it, join and organization in enormous measure. The two parts of long range interpersonal communication enable powerful gatherings to introduce one and one item. This person to person communication content is a sort for clients who need to gain from one another about products, brands, assets and difficulties. This content is another asset for online information. For instance, Face book, MySpace, Digg, Twitter, LinkedIn and Google+ are incorporated. Turn into a pioneer in issues going from the environment, political and mechanical to the diversion area because of their simple client, speed and extension. Also, that client's increase, virtual entertainments are essentially self-advancing. It is a mode for organizations to sell labor and products due to the viral nature of person to person communication. Virtual entertainment is a peculiarity in showcasing that is growing at this point. Advertisers are beginning to acknowledge how interpersonal interaction is utilized to draw in their clients through their informing strategies and advancements. The advertising disciplines that can utilize informal communities incorporate advancement, promoting insight, feeling research, advertising, showcasing correspondence and item and client the executives. The effect on advertising achievement (for example deal) is significant for any long range interpersonal communication website (like web journals, foundation of online discussion and online networks), so taking into account their general pertinence and interconnections is fundamental.

While most advertising techniques are equipped to the offer of labor and products, social show casing's "item" is human way of behaving. A quote from German U-boat commander Gerhard Weibe, who served in World War II, can be used to illustrate the philosophy behind this concept: Why aren't you able to sell brotherhood and reason like you can sell soap?



Many individuals don't be aware as promoting long haul, effectively recognizable social advertising efforts. Instances of this incorporate Mother against Tipsy Driving (MADD), who started a drivers' mission to tie their vehicles with a red lace which shows their devotion to solid, sober driving. The image of the red strip was likewise embraced for Helps mindfulness and the possibility of the 'string mindfulness crusade' immediately spread to different causes, specifically rose bosom disease, purple for Alzheimer's and yellow for troopers' families in dynamic business somewhere else. When these efforts are well executed, social messaging will be a potent and effective force in the direction of genuine progressive progress.

The most common way of setting an item cost, including customer credit accessibility, does exclude a money cost; it could be in a real sense the trading of time, assets or consideration for item or administrations.

Item: Determinations of the genuine item or administration and how it covers the cravings and wishes of the end client. An item's range normally requires parts of insurance like shields, confirmations and after-deals help.

Place: Where the product or service comes from, who distributes it, what industry or sector it is in, etc. It additionally applies with the impact on benefits of the climate in which the ware is appropriated.

Advancement: The various techniques for showcasing the item including its bundling, naming, commercial, arrangement and advertisements,

Social Advertising: Social showcasing isn't about purchaser promoting, however about friendly obligation or guaranteeing a fair and evenhanded conveyance of the item. There's really no need to focus on business showcasing. It shouldn't come as a surprise that this is a marketing phenomenon in which the term "social" refers to the marketing of products with a social priority:

- The actual shopper
- The products' quintessence
- The country's hypothesis of feasible development
- Face book promoting technique

Social Media Marketing Promotion in India

The advancement of person to person communication in India is an unmistakable result of the causes behind it. 60% of the long reach relational network activity come from Non-Metro-Urban communities the most eminent pattern producing city actually stays to be a Metro for example Mumbai The most noteworthy measure of dynamic clients are matured 15-24 however LinkedIn has different ages for dynamic clients, in other words, 25-34 ages. The male female proportion is steady with the overall isolation of the populace by sexual inclination, or at least, for men at 80:20. In India, electronic interpersonal interaction reached 60 individuals for every penny of the Indian web based assembling. Face book and Defeat, together oblige around 90 for each penny of the clients in the web based systems administration room. Face book is India's driving casual culture with a monstrous development which has nearly duplicated its clients over the last a portion of a year. The most elevated assorted electronic person to person communication swarm in India is somewhere in the range of 15 and 24 years old and is understudies who look for work or lead more examinations. The greatest clients come from the compensation section of 'under 2 lakhs p.a.' This is on the grounds that the young person significantly decides casual social orders Over 45% of Informal organization clients return the mid-afternoon. Facebook customers who return more than three times per day top the summary. The Indian people group of Face Bookers invests the greater part of its energy in intelligent games/applications and in this manner on examination. Photographs Under two charts show the significance of web-based entertainment promoting and its turn of events. The charts give an outline of the job of promotions in web- based entertainment.

Feature of Social Media Marketing

Web-based Entertainment Promoting in India

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Social media, for individuals or for companies, are currently unable to escape. Social networking cannot be distinguished from the cyber community nowadays. The conversations in the Social Networking network are no longer seen as web 2.0 fads. They are held in households, SMEs and boardrooms and are extended into the non-profit and education fields. A increasing number of people today talk of social networking merely as another medium or tactic, filling up with enthusiasm, news, confusion and overwhelm. Blogging will have a really beneficial impact on the branding and development of the business. According to the Hub spot survey, blogging customers collected 68 percent more leads than blogging customers. Today's social media have exponential capacity, and it is essential to consider. It is part of an increasing online network that discusses, comments, participates, shares and creates. If you are a person, start-up, small business or a big company, an online presence and a constant discussion with your constituents is the basic prerequisite – and time and skills are needed. Companies redirect capital and reconsider their conventional strategies of communication. And as the social network waves spill through the enormous ocean of encounters associated with them, the word itself would become a part of dictionaries and encyclopedias, embarking on a new age of understanding, accessibility and perception that is boundless by space, time, and physical walls. It is higSocial media, for individuals or for companies, is currently unable to escape. Social networking cannot be distinguished from the cyber community nowadays. The conversations in the Social Networking network are no longer seen as web 2.0 fads. They are held in households, SMEs and boardrooms and are extended into the non-profit and education fields. A increasing number of people today talk of social networking merely as another medium or tactic, filling up with enthusiasm, news, confusion and overwhelm. Blogging will have a really beneficial impact on the branding and development of the business. According to the Hub spot survey, blogging customers collected 68 percent more leads than blogging customers. Today's social media have exponential capacity, and it is essential to consider. It is part of an increasing online network that discusses, comments,p articipates, shares and creates. If you are a person, start-up, small business or a big company, an online presence.

CONCLUSION

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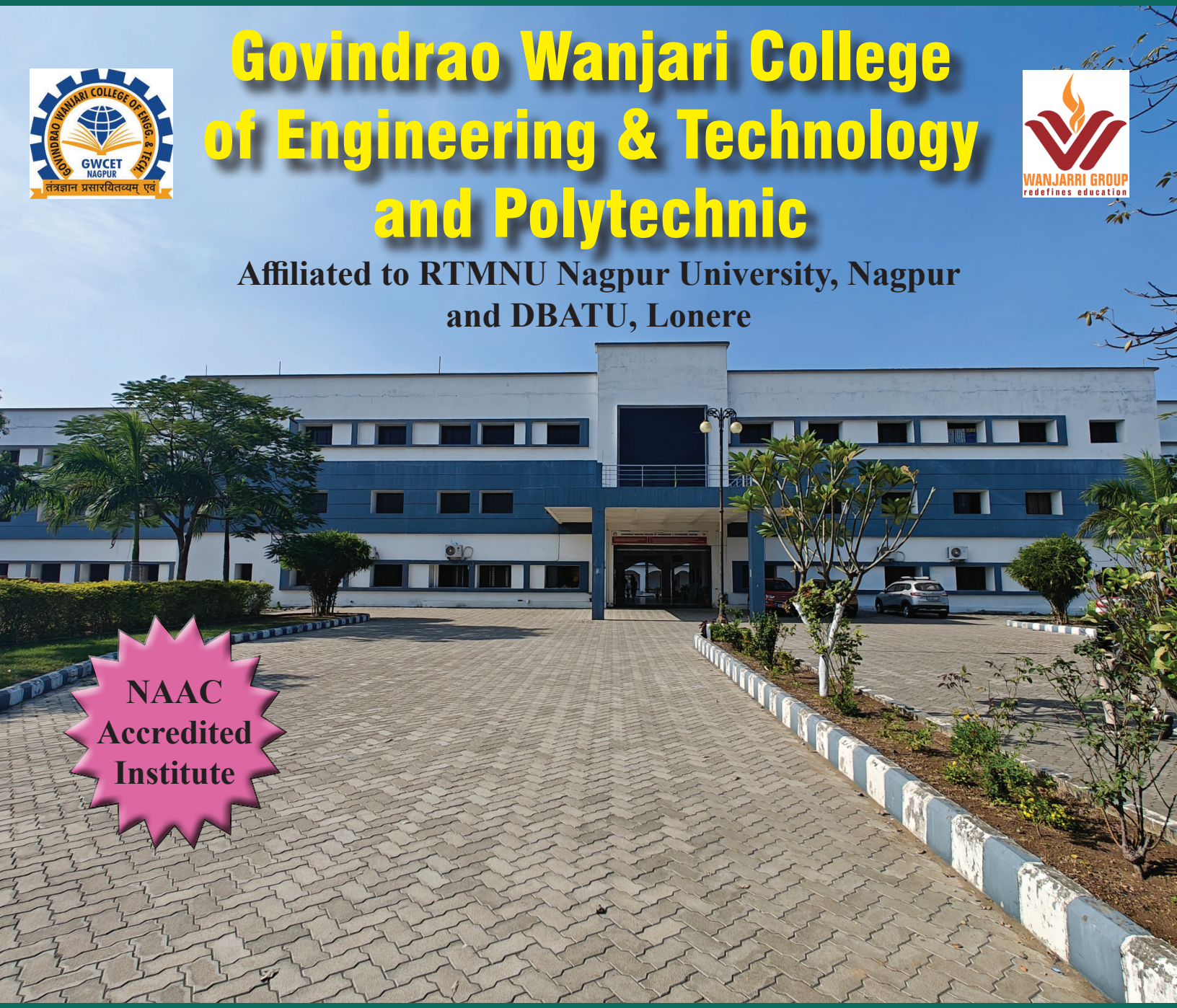

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