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Conference Preamble

ICRPHGIRES-2021 shares an insight into the recent research and cutting-edge technologies in" **Electrical, Electronics and Energy Conversion"**, which gains immense interest with the exuberant presence of talented researchers, practicing engineers, and other professionals. ICRPHGIRES-2021 is the All India Council for Technical Education (AICTE) sponsored and emerging technical conference and exposition for energy conversion solutions. ICRPHGIRES-2021 includes peer-reviewed technical presentations, interactive sessions, and the exposition. Exhibitors from various industries showcase state-of-the-art technologies, products, and solutions, creating a highly interactive networking environment.

The International Conference on Research Perspectives: IoT in Hybrid Grid Integrated Renewable Energy Sources (ICRPHGIRES-2021) focus on Internet of Things (IoT) applications enabled for smart grids and smart environments, such as smart cities, smart homes, smart metering, and energy management infrastructures to investigate the development of the EI based IoT applications. These applications are promising key areas of the EI concept, since the IoT is considered one of the most important driving factors of the EI and also discuss the challenges, open issues, and future research opportunities for the EI concept based on IoT applications and addressed some important research areas.

ICRPHGIRES-2021 aims to provide an environment where the authors and participants can establish research relations and collaborations with various eminent academicians, research fellows, scientists from India and abroad.

Call for Papers

The ICRPHGIRES-2021 invites full length original research contributions not submitted to any other journal/conferences. We invite technical papers on, but not limited to, following domains.

Track 1

Smart Grid Architectures (EEE)

- National/International Energy Security
- Smart Grid Strategy and Planning
- Smart Grid Architectures and Models
- Smart Grid Security and Reliability Management
- Smart Grid Market Operations
- Smart Grid Standards

Track 2

Smart Grid Interconnection (EEE)

- Smart Grid Networking and Communications
- Integration of Distributed Resources
- Smart Grid Cyber and Physical Security
- Bi-Directional Energy Transfer
- Wide-Area Monitoring and Control
- Communication-Based Control and Protection
- Advanced Control of Grid-Connected Inverters for Power Quality and Renewable Energy Integration
- Energy Storage Systems for Resilience and Robustness Improvement in Smart Grid
- Portable and Smart Solution of Power Electronics for High Voltage Conversion with Renewable Energy and Grid Integration

Track 3

Smart Grid Implementation (ECE / EEE)

- Smart Grid Implementation and Field trials
- Energy Management Systems for Smart Grid
- Smart Grid Testing and Assessing Technologies
- Smart Sensors and Metering Infrastructure
- Smart Grid Demand Response
- Smart Grid Interactive Technologies
- Optimization Techniques in Smart Grid

Track 4

Power and Energy Engineering (ECE / EEE)

- 5G technologies
- Electronic systems & technologies
- Printable and planar electronics, 3-D electronics and miniaturization
- Electricity Networks for the Future
- Energy Storage and Distributed Energy Resources
- Power Generation, Transmission and Distribution
- Intelligent Monitoring and Outage Management
- Fault Monitoring and Predictive Maintenance
- Power Systems and Automation
- Energy Management, VPP (Virtual Power Plant) and ERAB (Energy Resource Aggregation Businesses) for RESSs

- Condition Monitoring of Power Apparatus
- High Voltage Engineering
- Power Semiconductor Devices, Renewable Energy
- Inverter and Converter Technology
- Advanced AC / DC Drives
- AI Techniques & Advanced Algorithms in Power Electronics
- Power Quality, HVAC, HVDC and FACTS
- Electrical Machines and Industrial Drives
- Smart Inverters using IOT
- VLSI
- Embedded / VLSI Systems

Track 5

Clean and Renewable Energy (All Sciences / MECH / AUTO)

- Photovoltaic Systems and Solar Energy Engineering
- Plug-in Vehicles and Low-C Transportation Alternatives
- Energy-Efficient Technologies
- Wind Energy Generation
- Renewable Energy Utilizations
- New Energy Materials and Devices
- Nano Technology in Energy Sector
- Optimization Techniques in Renewable Energy Systems
- PV systems and other Distributed Energy Resources in grids: challenges, monitoring, and power quality assessment
- Integration of EV's to Grid
- Material for energy Storage and Conversion
- Intelligent Transport systems
- Automation in Manufacturing of Construction Materials
- Smart Materials & Structures
- Smart Materials in Solar PV Cells and Challenges in Grid Integration of RES

Track 6

IoT (ISE / CSE / MCA)

- IoT network design and Cloud networks
- Network virtualization technologies

- Wireless networks for IoT and Cloud
- IoT-enabled home networks
- IoT and Smart cities
- IoT enabled Software Architectures and Middleware
- Software architecture for IoT and cloud
- Services provisioning and management
- Hybrid cloud infrastructure for IoT
- IoT based Application development
- IoT Service integration
- IoT based data acquisition, knowledge management and semantics
- Mathematical modeling for IoT
- Signal processing for IoT
- Sensor Systems for IoT
- IoT applications in Building Automation

Track 7

Smart Cities (CIVIL / MECH / AUTO / MBA)

- Smart Cities Solutions Management
- Smart Buildings and Home Automation
- Renewable Energy Systems in Smart Cities
- Hybrid Electric Vehicle / Autonomous Vehicle
- Advanced Safety Technologies
- Advanced 3D Modeling Techniques and Simulation
- Green Building Technologies
- Android / IOS Applications
- Net Zero Energy Building Technologies
- New Approaches in Lightings
- Materials for environmental remediation

Track 8

Automation (MECH / ECE / EEE)

- Control System, Distributed Control System in Smart Grid
- Intelligent Automation, Medical Imaging
- Multi-Objective Optimization, Multivariable Control in Smart Grid
- Non-Linear Control , PLC, SCADA based Systems in Smart Grid
- Process Control & Sensors in Smart Grid
- Robotics and Automation in Renewable Energy Systems

- Sensor Networks, Smart Sensors in Renewable Energy Systems
- Virtual Instrumentation & Biomedical Applications in Renewable Energy Systems
- Path Prediction and Estimation for Autonomous Vehicles

Track 9

Artificial Intelligence (CSE / ISE / MCA)

- AI Techniques in Renewable Energy System (RES)
- AI based Power Quality Improvement in RES
- Advanced Control of RES in Micro grid
- AI Based Battery Energy Management system
- AI Based Power system stability improvement
- AI based Renewable Energy Power management system.
- Machine Learning / Deep Learning for RES

Track 10

Management & Emerging Technologies (MBA / ECE / BSH / CSE / CIVIL)

- Business Sustainability
- Agile Management
- Green Management
- Sustainability challenges in turbulent environments
- Design thinking
- Education and technical skills to build smart cities
- Block chain and Artificial intelligence.
- General management related topics
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CONTENTS

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Comparison of Different Passive Filter Topologies for Harmonic Analysis of a Line Commutated Converter based HVDC System

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ABSTRACT

In the modern power system, the usage of high voltage direct current (HVDC) transmission is increasing rapidly for grid interconnections and integration of renewable energy sources, particularly offshore wind farms. Research on applications like providing infeed connections to grids of large cities by HVDC, replacing Extremely High Voltage AC (EHVAC), is going on. In all the applications, it is required to carry out harmonic analysis and maintain harmonic levels as per grid codes. In this paper, a traditional Line-Commutated Converter (LCC) based HVDC system is modelled using DigSILENT Power Factory and its harmonic analysis is performed. Based on the results, passive filters with different topologies are designed, implemented, compared and discussed.

Keywords - HVDC, harmonics, harmonic analysis, passive filters

I. INTRODUCTION

HVDC transmission is widely renowned for being effective and useful for large-scale, long-distance power delivery, asynchronous interconnections and long submarine power transmission connections. The authors of [1] and [2] have discussed the numerous economic, functional and environmental advantages that HVDC systems have over HVAC systems. Different operational parameters of HVAC and HVDC have been compared in [3]–[6].

Power converters used in HVDC systems induce harmonics in both, the AC network, and also in the DC line. The harmonic characteristics of HVDC systems are discussed in [7], along with methods for reduction of harmonics. Most grid codes have specifications for permissible limits of harmonic distortion. The mitigation of harmonics is done using harmonic filters, that are designed based on the order and magnitude of harmonic components present.

In this paper, emphasis has thus been laid not only on performing harmonic analysis of an LCC-based HVDC system but design and implementation of different passive filter topologies and their comparison. Section II discusses the different topologies and technologies used in HVDC transmission systems. A test system is modelled in Section III, and the analysis of the system is done in section IV. Based on the results, different topologies of passive filters are designed, implemented, and their effects are analyzed in section V. The results are discussed in section VI followed by conclusions.

II. HVDC TOPOLOGIES AND TECHNOLOGIES

HVDC transmission systems, or HVDC links are classified into three topologies, viz. monopolar, bipolar and homopolar, as described in [8]. Two types of converter technologies are used in HVDC transmission systems. They are discussed below along with their relative advantages and disadvantages.

A. Classic HVDC based on LCC

Typically, 12-pulse thyristor-based LCC are used for HVDC systems having advantage of the harmonics produced of the order 12n+1 and 12n-1 as opposed to 6n+1 and 6n-1, in the 6-pulse configuration, on the ac side. The harmonics on the dc side are of the order of 12n, instead of 6n in the 6-pulse mode. The layout of a typical LCC-based HVDC system is shown in Fig. 1.

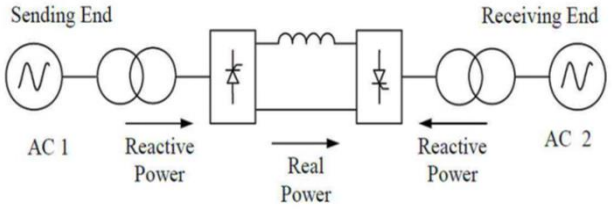

Fig. 1 LCC-based HVDC system

The process demands reactive power from filters, shunt banks, or series capacitors which are an integral part of the converter station. Any surplus or deficit in reactive power is accommodated by the ac system. This difference in reactive power needs to be kept within a given band to keep the ac voltage within the desired tolerance. The weaker the system or the further away from generation, the tighter the reactive power exchange must be to stay within the desired voltage tolerance.

B. HVDC systems based on Voltage source converters (VSC):

HVDC transmission using VSC with pulse-width modulation (PWM) are force commutated with insulated- gate bipolar transistor (IGBT) valves and solid-dielectric, extruded HVDC cables. The typical layout of a VSC-based system is shown in Fig. 2. The simplest VSC topology is the conventional two-level three-phase bridge. It must be noted that multiple IGBTs can be connected in series to increase the voltage level. The antiparallel diode is also needed in order to ensure the four-quadrant operation of the converter. A dc-link capacitor provides the energy storage, and also filters harmonics on the dc side. Other topologies also can be used for the VSC. Most modern converters use sinusoidal pulse width modulation (SPWM).

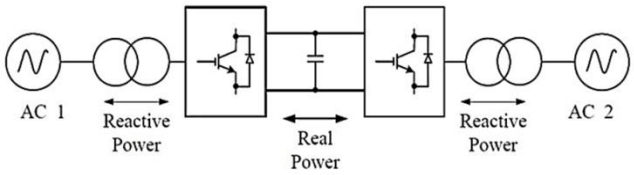

Fig. 2 VSC-based HVDC system

Although VSC-based systems have operational advantages over LCC-based systems, LCC-based systems can be seen widely in operation, due to the following reasons:

- Higher transmission capability developed to 9GW
- The converters have a simpler design and the thyristor switches are less expensive
- The capital and operational expenses are significantly lower
- The control of LCC converters is less complex

III. MODELLING OF LCC-BASED HVDC TEST SYSTEM

An LCC-based test HVDC system is modelled in DigSILENT Power Factory as shown in Fig. 3. A grid connecter to a 345kV bus supplies 1000MW power to a second grid connected to a 230kV bus via a 500kV, 300km monopolar link

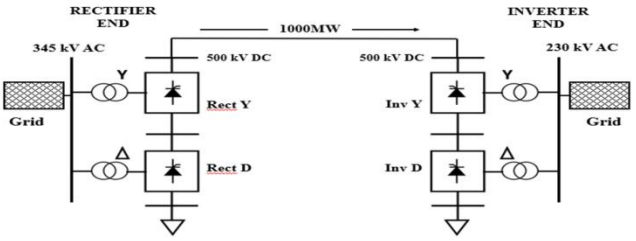

Fig. 3 Layout of the test system

A. Modelling of converters:

The converters at both the ends are thyristor-based, 12-pulse line-commutated converters, formed by connecting two 6-pulse converters in series, with their supply voltages differing in phase by 30°.The operation of each the converters is defined by Average dc voltage in rectifier mode,

$$V_d = \frac{3\sqrt{2}}{\pi} E_{LL} cos\alpha - R_c I_d \quad (1)$$

$$V_d = V_{do} cos\alpha - R_c I_d \quad (2)$$

$$\text{Where, } V_{do} = \frac{3\sqrt{2}}{\pi} E_{LL} \quad (3)$$

where, E_{LL} is the line voltage at converter input and α is the firing angle. R_c is the commutation resistance and I_d is the DC current.

In inverter mode,

$$V_{di} = V_{doi} cos\gamma - R_{ci} I_d \quad (4)$$

where, the suffix I indicates inverter side parameters

The ratings of individual converters are as given in Tables 1. The voltage set points are set to 1.01 and 0.99 p.u. at the rectifier and inverter ends respectively, to create a voltage difference to result in dc power flow from the rectifier end to the inverter end.

Table 1 Converter Specifications

	Rectifier End	Inverter End
Rated AC voltage	345 kV	230 kV
Rated DC voltage	250 kV	250 kV
DC voltage setpoint	1.01 p.u.	0.99 p.u.
Rated DC current	2 kA	2 kA
Rated active power	500 MW	500 MW
Rated apparent power	800 MVA	800 MVA

B. Modelling of DC transmission line:

The dc line is modelled as a 300km overhead line with steel-reinforced aluminum conductor. Smoothing reactors of 600mH have been provided at either side for smoothing out current ripples due to sudden changes or large switching operation like turning on/off. A dc shunt capacitor of 25 μF has been provided at the midpoint of the transmission line for smoothing voltage ripples.

IV. ANALYSIS OF THE HVDC SYSTEM:

The steady-state analysis of the test system is done by performing load flow studies and harmonic analysis of the system. In base case, no shunt compensation has been provided to the system at either end.

A. Load flow analysis:

Three-phase balanced load flow studies have been performed on the test system. The results of the load flow are presented in Table 2 for line elements and Table 4 for bus elements. It can be observed that 1010 MW power is sent from the rectifier end, and 990 MW is received. The 20 MW power difference is lost during transmission. The converters at both the ends draw reactive power – each converter at rectifier end draws reactive power of 270.59 MVAR and each converter at the inverter end draws 263.60 MVAR reactive power.

The reactive power requirements of the converters are met by the corresponding grids, resulting in reduction of power factor at the grid connection point, which is undesirable

Table 1 Load Flow Results For Line Elements

Line Element	Current (kA)	Active Power (MW)	Reactive Power (MVAR)	Power Factor
Grid-1➔ 345kV bus	1.92	1010.00	541.18	0.88
345kV bus ➔ Rectifier Y	0.96	505.00	270.59	0.88
345kV bus ➔ Rectifier D	0.96	505.00	270.59	0.88
DC line input	2.00	1010.00	0.00	1.00
DC line output	2.00	990.00	0.00	1.00
Inv Y ➔ 230kV bus	1.41	495.00	-263.60	0.88
Inv D➔ 230kV bus	1.41	495.00	-263.60	0.88
230kV➔ Grid-2	2.82	990.00	-527.20	0.88

Table 2 Load Flow Results For Bus Elements

Bus Element	Voltage (kV)	Voltage (p.u.)
345kV AC bus	345.00 (Line)	1.00
500kV DC bus (Rectifier)	505.00	1.01
500kV DC bus (Inverter)	495.00	0.99
230kV AC bus	230.00 (Line)	1.00

B. Harmonic Analysis:

Following the load flow studies on the system, harmonic analysis is performed on the system. The results are presented and discussed below. The harmonic analysis has been performed upto a frequency of 1250 Hz or 25th order. The individual harmonic distortion values at rectifier and inverter ac buses are as given in Table 4.

Table 3 Rectifier End Harmonic Distortion

	Rectifier End		Inverter End	
Order of harmonics	%HD (Voltage)	%HD (Current)	%HD (Voltage)	%HD (Current)
11	41.808	9.091	24.554	9.091
13	41.807	7.692	24.554	7.692
23	41.806	4.348	24.553	4.348
25	41.806	4.000	24.553	4.000

The harmonic distortion plots for the rectifier and inverter voltages and currents are shown in Fig. 4 and Fig. 5. These harmonics are caused by the converters. It can be observed that the harmonics are of the order 12n±1, which were expected from 12-pulse converters.

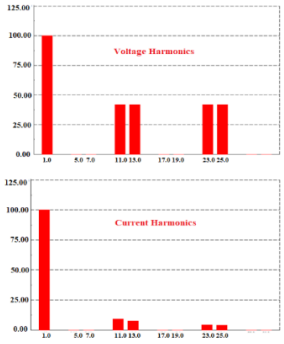

Fig. 2 Rectifier end distortion plots (base case)

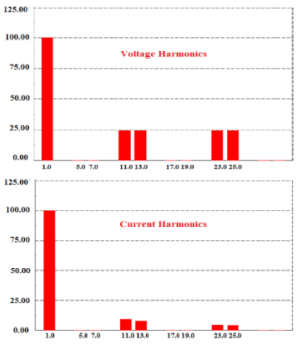

Fig. 3 Inverter-end distortion plots (base case)

The total harmonic distortion (THD) can be calculated using the following formula:

$$THD = \sqrt{\sum(\text{Individual HD in \%})^2} \quad (5)$$

At the rectifier end, the total harmonic distortion in the AC current is obtained to be 13.3%, and the total harmonic distortion obtained in the AC bus voltage is 83.61%. At the inverter end the total harmonic distortion obtained in the AC current and AC bus voltages are 13.3% and 49.11% respectively. The rectifier-end voltage and current waveforms are shown in Fig. 6, and the inverter-end voltage and current waveforms are shown in Fig. 7. Based on the results obtained, it can be concluded that, for a better, more ideal operation of the system, reactive power compensation, and harmonic mitigation are necessary. These objectives are achieved in this paper using passive filters.

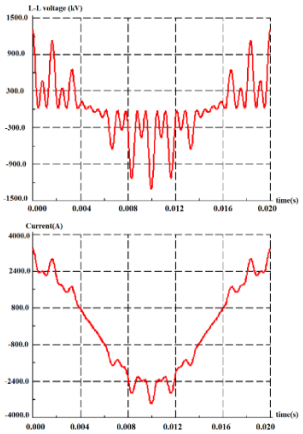

Fig. 4 Rectifier end voltage and current

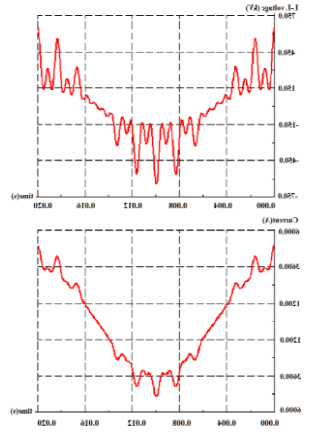

Fig. 5 Inverter end voltage and current

waveforms (base case) **waveforms (base case)**

V. DESIGN OF PASSIVE FILTERS

Passive filters are R-L-C branches that provide zero impedance at a high frequency, allowing a short circuit path for harmonics. At fundamental frequency, these filters perform the function of compensating reactive power. Thus, the passive filters have a dual functionality. Three types of passive filter configurations have been considered for comparison.

a) tuned filters for individual harmonics
b) damped filters tuned at 12th and 24th order
c) combination of tuned and high-pass filters
d) high pass filters with 6th order compensation

Based on the above discussion, there are two factors that are considered while designing a filter, viz. the reactive power to be compensated, and the magnitude of harmonics to be eliminated.

A. Tuned filters for individual harmonics

The use of tuned filters is the simplest method for mitigation of ac harmonics when the harmonic orders are clearly known [7]. In this case, tuned harmonics with resonance frequency at 11th, 13th, 23rd and 35th harmonics have been designed. Each filter branch is designed to supply 125 MVAR reactive power at fundamental frequency.

These filters are L-C series branches, with very negligible resistance. [9] The values of inductor and capacitor for each tuned filter branch are obtained using the following equations:

$$\text{Capacitance, } C = \frac{n^2}{n^2+1}\frac{Q}{V_L^2 w} \qquad (6)$$

where, n = harmonic order for which filter is tuned, Q = reactive power required, V_L = line voltage, w = fundamental angular frequency

$$\text{Inductance, } L = \frac{1}{w_n^2 C} \qquad (7)$$

where, w_n = angular frequency of n^{th} order harmonic, i.e., the tuned frequency of the filter. The values of inductance and capacitance at the rectifier and inverter buses for each tuned frequency are obtained as shown in Table 5. The value of capacitance has been calculated keeping same reactive power supply in mind for each branch, hence the value of capacitance remains is constant. [7]

Table 4 Parameters For Tuned Filters

	Rectifier End		Inverter End	
Order	*L (mH)*	*C(μF)*	*L (mH)*	*C(μF)*
11	25.050	3.343	11.137	7.521
13	17.935	3.343	7.971	7.521
23	5.729	3.343	2.546	7.521
25	4.825	3.343	2.153	7.521

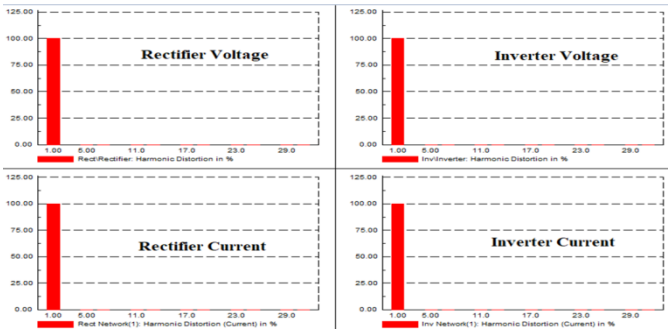

Fig. 6 Harmonic Distortion Plots (tuned filters)

Table 5 Load Flow Results After Tuned Filters

Line Element	Current (kA)	Active Power (MW)	Reactive Power (MVAR)	Power Factor
Grid-1➔ 345kV bus	1.70	1010.00	-36.01	1.00
345kV bus ➔ Rectifier Y	0.96	505.00	270.59	0.88
345kV bus ➔ Rectifier	0.96	505.00	270.59	0.88

D				
DC line input	2.00	1010.00	0.00	1.00
DC line output	2.00	990.00	0.00	1.00
Inv Y ➔ 230kV bus	1.41	495.00	-263.60	0.88
Inv D➔ 230kV bus	1.41	495.00	-263.60	0.88
230kV➔ Grid-2	2.50	990.00	50.00	1.00
Filters (each)	0.21	0.00	125	0.00

Additionally, a shunt capacitor rated to supply 75 MVAR has also been provided at each end. It can be expected that these filters will completely eliminate the harmonics of the corresponding resonance frequency, Harmonic analysis of the system after connecting these filters on the buses, show that the harmonic distortion get completely reduced to zero. The harmonic distortion plots for rectifier and inverter voltages and currents are as shown in Fig. 8, wherein only the fundamental frequency component can be seen. The load flow results are shown in Table 6. The filters, at fundamental frequency, supply 125 MVAR reactive power. Being purely reactive, they do not consume any real power at all. The power factor at the ac buses is restored to unity.

B. Damped filters tuned for 12th and 24th order:

In this case, damped filters are designed for 12th and 24th order harmonics. The nature of the damped filter ensures that the neighboring harmonics, i.e., 11th, 13th, 23rd and 25th order harmonics, are mitigated. The damped filters are designed to each compensate 250 MVAr reactive power at fundamental frequency. The damped harmonics are designed by adding a resistive element to the L-C series. The value of the resistance is determined by the optimum quality factor (Q_o) the filter. The value of Q_o for a damped filter is typically greater than 20 [8]. In this study case, the value of Q_o is chosen as 20.

$$\text{Resistance, } R = \frac{1}{Q_o}\sqrt{\frac{L}{C}} \qquad (8)$$

The values of resistance, capacitance and inductance for the rectifier and inverter end filters are given in Table 7.

Table 6 Parameters Of Damped Filters

Rectifier End			
Order	L (mH)	C(μF)	R (Ω)
12	10.5241	6.6858	1.9837
24	2.6310	6.6858	0.9918
Inverter End			
12	4.6674	15.043	0.8807
24	1.1693	15.043	0.4408

The distortion plots for the rectifier and inverter end voltages and currents are shown in Fig. 9. All the individual harmonics are reduced to less than 1%. The THD of voltages at both ends is reduced to 0.85% and the current THD is reduced to 0.2% and 0.3% at the rectifier and inverter buses respectively. The actual values of harmonic distortion are shown in Table 8. The load flow results in Table 9 show that the entire reactive power requirement of the converters is met by the filters at fundamental frequency. The power factor is brought to unity. Damped filters, by virtue of containing resistive elements, draw active power of 1.5MW at both ends.

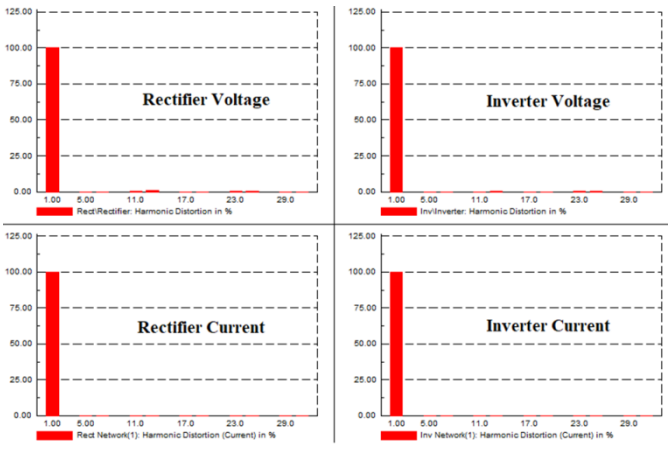

Fig. 7 Harmonic Distortion Plots (Damped Filters)

Table 7 Harmonic Distortion Values With Damped Filters

	Rectifier End		Inverter End	
Order	%HD (Voltage)	%HD (Current)	%HD (Voltage)	%HD (Current)
11	0.544	0.133	0.542	0.227
13	0.746	0.155	0.715	0.254
23	0.178	0.021	0.174	0.035
25	0.163	0.018	0.163	0.030

Table 8 Load Flow Results With Damped Filters

Line Element	Current (kA)	Active Power (MW)	Reactive Power (MVAR)	Power Factor
Grid-1➔ 345kV bus	1.70	1011.50	-35.97	1.00
345kV bus ➔ Rectifier Y	0.96	505.00	270.59	0.88
345kV bus ➔ Rectifier D	0.96	505.00	270.59	0.88
DC line input	2.00	1010.00	0.00	1.00
DC line output	2.00	990.00	0.00	1.00
Inv Y ➔ 230kV bus	1.41	495.00	-263.60	0.88
Inv D➔ 230kV bus	1.41	495.00	-263.60	0.88
230kV➔ Grid-2	2.49	988.50	49.98	1.00
Filters (each)	0.42	0.75	250	0.00

C. Tuned Filters for 11th and 13th order harmonics and high pass filter for higher order harmonics:

In this case, tuned filters are implemented for mitigating the 11th and 13th order harmonics, and high pass filter is implemented for higher order harmonics. The values of elements of the tuned filter are same as we obtained in case i. The high pass filter is designed with a cutoff frequency just below the 23rd order. The tuned filters are designed to compensate 125 MVAR reactive power each at fundamental frequency, and the high pass filter is designed to deliver 250 MVAR reactive power. The only difference between a high pass filter and damped filter is the Q factor value. A typical high-pass filter has a quality factor of 0.5 to 5. In this case, the quality factor is chosen as 5. The parameters of the filters are given in Table 10. Harmonic analysis is performed, and the distortion plots obtained at the rectifier and inverter buses are presented in Fig. 10.

Table 9 Filter Parameters For Tuned + High-Pass Filter Topology

	Rectifier End			Inverter End		
Order	L (mH)	C(μF)	R (Ω)	L (mH)	C(μF)	R (Ω)
11	10.52	6.686	-	11.137	7.521	-
13	25.05	3.343	-	7.971	7.521	-
23	2.63	6.686	0.992	1.1693	15.043	1.7632

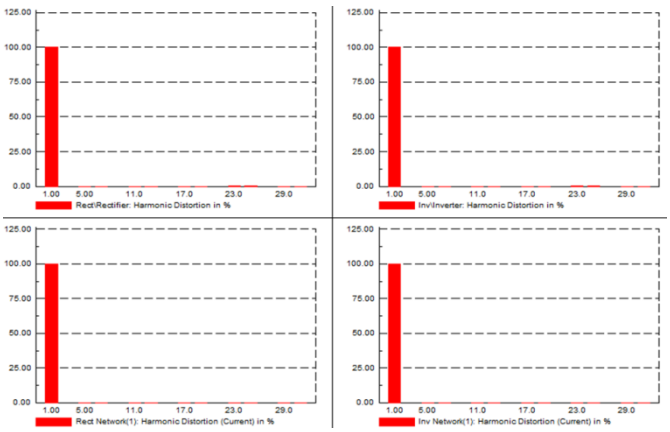

Fig. 8 Harmonic Distortion Plots (tuned + high-pass)

Table 10 Rectifier End Harmonic Distortion (Tuned + Hpf)

	Rectifier End		Inverter End	
Order of	*%HD*	*%HD*	*%HD*	*%HD*

harmonics	*(Voltage)*	*(Current)*	*(Voltage)*	*(Current)*
11	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000
23	0.179	0.021	0.174	0.035
25	0.167	0.018	0.163	0.030

The values of individual harmonics after using the composite filter arrangement are as shown in Table 11. The THD at the rectifier end is 0.25% for voltage and zero for current. The THD at the inverter end is 0.24% for voltage and zero for current. Load flow analysis on the system show that the reactive power requirement is completely met by the filters at fundamental frequency, and the power factor is restored to unity. The high pass filter draws an active power of roughly 2 MW due to its resistance. The result of load flow is shown in Table 12. It is observed that the waveforms of the ac currents and voltages at both the ends in the three cases discussed so far are almost purely sinusoidal.

Table 11 Load Flow Results With Tuned + High-Pass Filters

Line Element	*Current (kA)*	*Active Power (MW)*	*Reactive Power (MVAR)*	*Power Factor*
Grid-1➔ 345kV bus	1.70	1012.02	-36.01	1.00
345kV bus ➔ Rectifier Y	0.96	505.00	270.59	0.88
345kV bus ➔ Rectifier D	0.96	505.00	270.59	0.88
DC line input	2.00	1010.00	0.00	1.00
DC line output	2.00	990.00	0.00	1.00
Inv Y ➔ 230kV bus	1.41	495.00	-263.60	0.88
Inv D➔ 230kV bus	1.41	495.00	-263.60	0.88
230kV➔	2.49	987.90	49.98	1.00
Grid-2				
Filters (each)	0.42 (HPF)	2.09 (HPF)	250 (HPF)	0.00
	0.21 (tuned)	0.00	125 (tuned)	0.00

D. High pass filters for all harmonics above 11th order, with damped filtering for 6th order harmonics (in case of converter failure):

In this case we use a high pass filter, with cutoff frequency at 10th order, to mitigate all the harmonics from 11th order and above. Along with this, a damped filter for 6th order harmonics is included. The 6th order filter becomes important when one of the two 6-pulse converters fail, and the HVDC link operates at half power. Both the filters are rated to supply 250 MVAR reactive power at fundamental frequency. An additional shunt capacitor rated to provide 75 MVAR is also included.

The harmonic analysis of the system after connecting these filters is performed and the results have been presented below. The distortion plots are presented in Fig. 11 and 12. The values of individual harmonic distortion for the ac voltages and currents at both the ends are presented in Table 13. The THD values at rectifier end are: 3.17% for voltage and 0.6% for current. The THD values at the inverter end are: 3.14% for voltage and 1.0% for current. These values are sufficient as per IEEE 519 standards. [10] The voltage and current waveforms at the rectifier and inverter ends in this case are shown in Fig. 13 and 14 respectively.

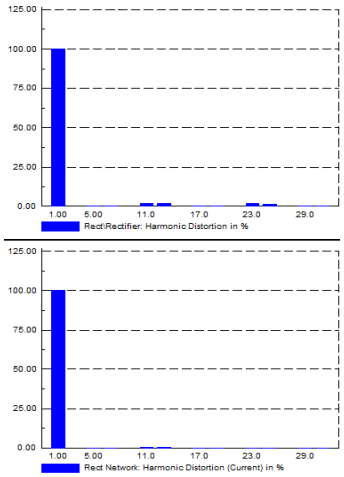

Fig. 9 Rectifier end distortion plots (with HPF)

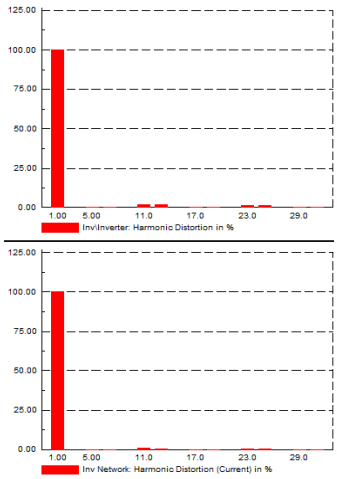

Fig. 10 Inverter end distortion plots (with HPF)

Table 12 Rectifier End Harmonic Distortion (Hpf)

	Rectifier End		Inverter End	
Order of harmonics	*%HD (Voltage)*	*%HD (Current)*	*%HD (Voltage)*	*%HD (Current)*
11	1.621	0.393	1.621	0.393
13	1.686	0.346	1.686	0.346
23	1.594	0.185	1.594	0.185
25	1.417	0.151	1.417	0.151

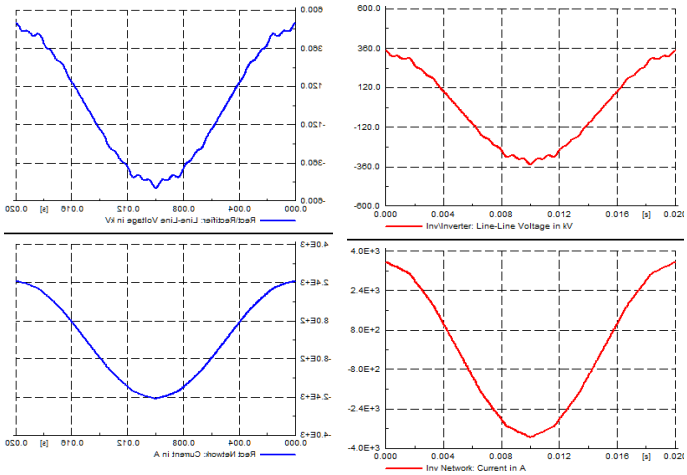

Fig. 11 Rectifier end waveforms after using High-pass filters

Fig. 12 Inverter end waveforms after using high-pass filters

The results of load flow are presented in Table 19. The 6th order filters at each end draw active power of 14MW and the high-pass filters draw very low active power of 0.15MW. The reactive power requirement of the converters is completely met by the converters, and a power factor of unity is restored.

Table 13 Load Flow Results With High Pass Filters

Line Element	*Current (kA)*	*Active Power (MW)*	*Reactive Power (MVAR)*	*Power Factor*
Grid-1345kV bus	1.72	1024.10	-35.20	1.00
345kV bus-Rectifier Y	0.96	505.00	270.59	0.88
345kV bus → Rectifier D	0.96	505.00	270.59	0.88
DC line input	2.00	1010.00	0.00	1.00
DC line output	2.00	990.00	0.00	1.00
Inv Y → 230kV bus	1.41	495.00	-263.60	0.88
Inv D→ 230kV bus	1.41	495.00	-263.60	0.88
230kV→ Grid-2	2.46	975.84	49.20	0.99
Filters (6th order)	0.42	14.00	250.00	-
High-pass filters	0.42	0.15	250.00	-

VI.CONCLUSION

In this paper the comparison of four different topologies of passive filters for and LCC-based HVDC test system has been conducted and the results have been presented. The passive filters have the advantage of simple design and low cost. The performance of each filter topology is

comparable, with the tuned filter design being the most effective in mitigating the harmonics, while the high pass filter topology has only one filter arm and less components, resulting in mitigating harmonics to the values prescribed by IEEE 519 standards. In practical applications, the choice is based on the availability of standard filter designs and the cost of the filters. Moreover, in many applications, the usage of more complex and active filter topologies can prove to be effective.

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Implementation of Smart E-Vehicle Charging Station Powered By Renewable Energy

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ABSTRACT

Electric vehicles are a moderately on-going innovation that is looking for its spot on the lookout. It has a few favorable circumstances, for example, the decreased nursery outflows, fuel reserve funds and its convenience. Lately, establishment of sustainable power offices is expanding quickly in light of the development to stifle the arrival of nursery gasses answerable for the warming of the earth and to save petroleum products, which are becoming progressively valuable. Besides, the expense of photovoltaic frameworks is diminishing step by step. Along these lines, it is accepted that cost of photovoltaic force will be falling later on. Nonetheless, in Japan, the enormous measure of surplus power from photovoltaic frameworks applies an awful impact on the force network. In this project, an EV charging station using sustainable power is proposed. The proposed EV charging station draws energy from photovoltaic frameworks and wind turbine at a low cost and uses that ability to charge a fixed battery. At that point the force is being utilized to charge electric vehicles; it also presents a few opportunities for electric force supply from sustainable wellsprings of electric vehicle charging stations. This project conjointly introduces associate in Nursing energy management and management methodology for power offer of electrical vehicles charging station. Solar photovoltaic arrays and wind turbine are integrated to interchange energy from fuel and reduce pollution from carbon emissions.

An additional main supply is also added in order to maintain regular power supply to the system, here we are using proteus software to simulate the circuit.

Keywords - Electric vehicles, Smart E-vehicle, Renewable energy.

I. INTRODUCTION

Across the globe, governments are concerned about air-pollution which is caused due to the emission of byproducts from combustion process. The air has to be clean and pure, for this every public and private sector should invest on clean energy. A transition has to be made in transforming ordinary homes to wise homes and vehicles to Electric vehicles (EVs).To make this possible renewable Energy sources such as Solar, wind and other bioenergy sources has to be implemented.[1]

In recent years, installation of renewable energy facilities is increasing chop-chop and electrical vehicles also are increasing, during this project each these ideas area unit combined along to form a sensible and eco-friendly charging station. [2]

Due to the electric power distribution limitation, electrical Vehicles charging ought to be performed in effective means. This projected sensible electrical Vehicle Charging station having several advance options, it'll mechanically maintain the facility from totally different supply and automatic switch the supply supported handiness of the supply.[3]

Recently, there's a move towards turning out with solar-powered charging stations that supply clean electricity. With the reduction in star prices and improvement in star potency, building solar-powered unit of measuring charging station presents associate excel-lent likelihood to inexperienced if your transportation desires, creating EVs end-to-end environmentally positive. whereas PV systems could even be place in on rooftops to make such charging stations, star canopies place in on parking tons build associate fantastic different for star-powered unit of measuring charging stations as a results of it not entirely generate clean electricity however place along supply shade to the vehicle.[4]

In this implementation we have a tendency to area unit victimization four totally different supply, system, turbine system and main offer. The controller can automatic switch the supply supported its priority.[5]

User is going to be ready to see charging standing and quantity in liquid crystal display. Once charging are going to be completed, the device can mechanically stop the charging and overcharging won't occur to the electrical vehicle. Within the last decade, EVs became widespread, chiefly because of less flue gas emissions and slighter dependence on oil. It's countable that by next year, EVs area unit is getting to be over thirty 5 million among the planet. However, an essential draw back with EVs their high penetration raises branch, high electricity demand towards the power grid and device congestion [6]

One economical approach to alleviate the impact is to integrate native power sources like RESs into the energy charging unit. Sufficient studies is not available regarding integration and interaction of Electric Vehicles with renewable sources, the flexibility grid, the charging unit and thus the way to decrease pollution as quickly. This chapter tells us the integration of EVs with renewable energy sources and methods in greatly reducing greenhouse gas emissions. [7]

The structure is shown as follows: in this section , a top view of the solution is explained in order to reduce dioxide emissions in road transportation. Also section 3 discusses work unit interaction. Along with this, integration with RESs is also discussed. In addition to this, coordination in electric vehicle, distribution grid management with electrical network integration is also discussed . [8]

II. ADVANCED SMART ELECTRIC VEHICLES

A. Smart Vehicle

A promising future is incontestable by electrical vehicles. If system is a hybrid reversible automotive or a completely electric, it completely requires help from the charging stations. However, by using existing grid facilities directly for charging new-energy electrical vehicle has many bottlenecks, it's significantly important, for instance, for developing replacement kind of inexperienced energy integrated power offer theme, both fast charging and grid capability, matter of electricity transferring is observed. Oversized variety of charging machine to the ability grid. Thus energy reading, calculation and also storing them within the grid is achieved. [9]

Two necessary renewable resources square measure solar power and wind energy. However, they're all discontinuous energy sources as a result of seasonal changes and weather changes. Fortuitously, hybrid energy storage system helps in complete usage of the quality of the 2 sources. This may distribute intermittent storage of solar source energy along with wind generation. Hence, clean pure electricity may be made properly with required machine desires. This

paper styles associate degree integrated electrical vehicle charging station power provide package that integrates electrical phenomenon alternative energy, wind generation along with its utilization. This paper also explains clearly about battery energy storage technology. DC-DC conversion possessing high efficiency is clearly mentioned. Also, if these methods fail, alternative applications are also provided. This is not only meant for betterment, but also reduces the impact caused by the huge destructive sounds that arrives from the grid. [10]

Charging stations for electrical vehicles might not desire a heap of new infrastructure in developed to developing countries, but delivering a replacement various fuel over a replacement network. The stations will leverage the present electrical grid and residential recharging is associate choice, since most driving is native over short distances that reduce the necessity for charging mid-trip. as an example, within the us, seventy eight of commutes area unit but forty miles (64 km) round-trip.

People, who love long drives, must make sure that charging stations are readily available in between the roads that connect one city to another. This is the only hope from them to commute. Thus charging stations are very much necessary to be installed in cities as well for their day to day commute purposes. This directly or indirectly increases the demand of more purchases. [11]

Currently charging stations area unit being put in by public authorities, business enterprises and a few major employers so as to stimulate the marketplace for vehicles that use various fuels to gas and diesel fuels. For this reason, most charge stations area unit presently either provided freed from charge or accessible to members of sure teams while not vital charge. Charging stations just deliver the energy to the vehicle, sometimes within the kind of a high voltage AC or DC provide. they do not usually have the functions of the charger that should rework the current into a type which might be applied on to the battery.[12]

From the wide selection of potential customers noted higher than, it are often seen that the energy unit community desires many power provide choices. broadly, completely different power levels are outlined however among these levels a awfully wide selection of choices area unit accessible to accommodate the various existing installation standards of the national electricity generating utilities, varied ways exist for recharging the batteries of electrical cars. Currently, the most important concern encompassing electrical vehicle transportation is that the total travel varies accessible before the necessity to recharge. The longest vary recorded to this point was 606.2 miles, achieved by a Tesla Model three. However, this was conducted in terribly controlled conditions wherever the automobile maintained a relentless speed while not the additional drain of the air con mechanical device. Generally, the battery would last for roughly three hundred miles - the corresponding to 3 days of town traveling in hotter weather, or someday in colder weather. With these limitations, long-distance journeys area unit presently incompatible for an electrical automobile unless speedy charging stations area unit accessible on the route of the trip.

B. Vehicles Charging Station

To handle Electric Vehicles (EV) charging methods, in light of clever cycle in veil task in future. Because of the electrical force conveyance constraint, Electric Vehicles charging ought to be acted in viable manner. Force transmission line likewise unrealistic to give at each street, parkway and slope station. Client need to invest bunches of energy with vehicle in manual and existing evolving framework. [13]

Because of expanding electrical vehicle step by step, we need to actualize programmed framework for electrical vehicle charging station. The framework ought to create the force for charging vehicle and exchanging should programme in various force source. The client likewise ought to get all data about charging status. This framework will make the force

age programmed and it will expand the productivity of framework. Electrical vehicle will get charge by inexhaustible force source so its an excess of practical and usage of sustainable source. This framework will build the battery existence with cheating insurance framework. The primary goal of this task is making vehicle charging station utilizing programmed strategy. By utilizing this framework client will get continuous force by utilizing diverse force source and client will ready to see all data on LCD show. The charging will naturally stop once it will be full charge. The block diagram is shown in figure-1

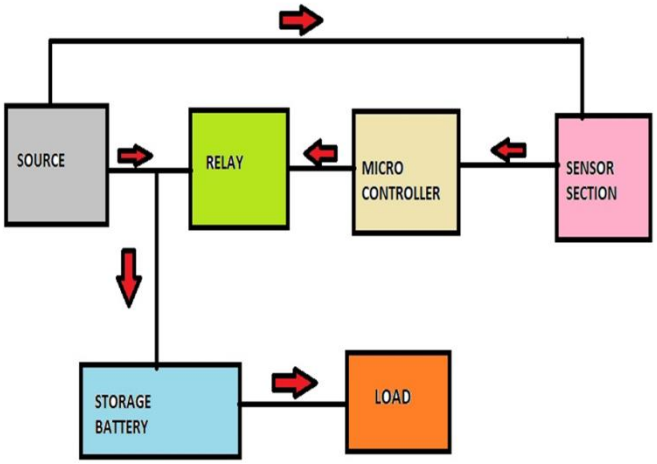

Fig. 1. Block Diagram of Battery Charging

III. ARDUINO UNO

Arduino Uno could also be a microcontroller supported with 8-bit ATmega328P microcontroller. It has various parts such as oscillator, transformer, serial communication, etc. to support microcontroller.

TABLE.1 TECHNICAL SPECIFICATIONS

Details	Range
Input voltage	7-20 Volt
DC current per I/O pin	20 milliamps
Operating voltage	5 Volt
Flash memory	32 Kilobyte
Clock frequency	16 MHz

Arduino Uno has fourteen digital input/output pins (out of that vi may be used as PWM outputs), vi analog input pins, a USB association, an influence barrel jack, associate ICSP header and a push button is shown in table 1. The fourteen digital input/output pins is used as input or output pins by exploitation pin Mode (), digital Read () and digital Write () functions in arduino programming. Every pin operate at 5V and might give or receive a most of 40mA current, and has an indoor pull-up resistance of 20-50 KΩ that square measure disconnected by default. Out of those fourteen pins, some pins have specific functions as listed below and also mentioned in Table.2.

1. Serial Pins zero (Rx) and one (TX): Rx and Lone-Star State pins square measure accustomed receive and transmit TTL serial knowledge. They're connected with the ATmega328P USB to TTL serial chip.
2. External Interrupt Pins two AND 3: These pins are designed to trigger an interrupt on an occasional price, a rising or falling edge, or a amendment in price.
3. PWM Pins three, 5, 6, nine AND 11: These pins give an 8-bit PWM output by exploitation analog Write () perform.
4. SPI Pins ten (SS), 11 (MOSI), twelve (MISO) and thirteen (SCK): These pins square measure used for SPI communication.
5. In-built junction rectifier Pin 13: This pin is connected with AN intrinsically junction rectifier, once pin thirteen is HIGH – junction rectifier is on and once pin thirteen is LOW, its off.

TABLE. 2 ARDUINO UNO TECHNICAL SPECIFICATIONS

Details	Range
Microcontroller ATmega328P	8 bit AVR family microcontroller
Operating Voltage	5Volts
Recommended Input Voltage	(7-12)Volts
Input Voltage Limits	(6-201)Volts

Analog Input Pins	6 ($A_0 – A_5$)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 milliamps
DC Current on 3.3Volt Pin	50 milliamps
Flash Memory	32 Kilobyte (0.5 KB is employed to Boot loader)
S-RAM	2 Kilobyte
EEP-ROM	1 Kilobyte
Frequency (Clock Speed)	16 MHz

IV. RESULTS AND DISCUSSION

The block diagram of battery charging station is implemented in Proteus software is shown in figure.2

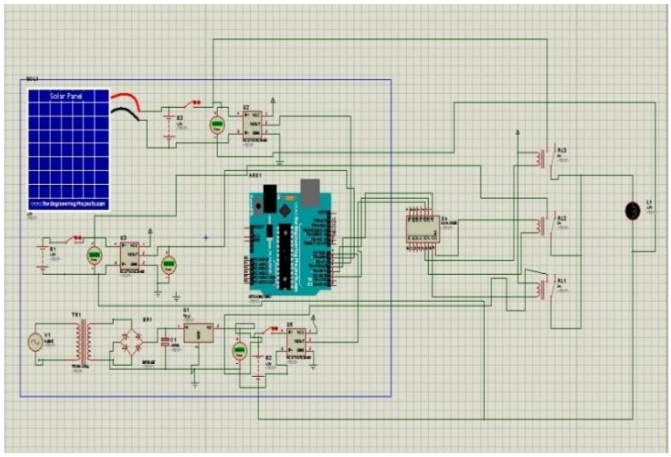

Fig. 2. Implementation in PROTEUS

Figure. 2 shows the circuit diagram, which shows that an electric vehicle charging station, conjointly referred to as energy unit charging station, electrical recharging purpose, charging purpose, charge purpose, electronic charging station (ECS), and electrical vehicle offer instrumentation (EVSE), is also a machine that provides electrical energy for the recharging of plug-in electrical vehicles—including electrical cars, neighbourhood electrical vehicles and plug-in hybrids.

1. The charging station consists of three sources for charging the electric vehicle
2. Sources include two renewable sources of energy and one grid source
3. Renewable sources include Solar and Wind, based on the priority of the source the relay switching occurs
4. The voltage produced by the sources is sensed by voltage sensor, which is connected to the micro controller
5. If the voltage is more the threshold value based on the priority of the source the relay switching takes place
6. The first priority is given to Solar than the wind, if all the three sources are available the first priority is given to the solar than the wind and at last the grid
7. Relay switching takes place and the battery charges with the help of source, the energy is stored in the storage battery and electric vehicle comes in contact with the charging station and get charged
8. The output charging status is displayed on the LCD display

Based on the implementation in figure.2, the following advantages are mentioned below.

Decreased Pollution

The transportation space is presently the most important wellspring of dioxide emanations. The proceeded with incorporation of EVs can facilitate decrease this result since they manufacture fifty four percent less dioxide outflows per mile than a daily vehicle.

Cost Savings

EV batteries convert fifty nine to sixty two percent of energy into vehicle development whereas gas oil-fired vehicles utilize seventeen and twenty one p.c. work unit drivers pay regarding $1.2 per gallon to charge, not precisely an outsized portion of the value of gas. the traditional operating expense of AN work unit is $485 yearly contrasted with $1,117 for a daily vehicle.

Monetary Growth

As indicated by the U.S. Branch of Energy, in 2017, the U.S. foreign nineteen percent of the oil it used. Utilizing electrical Vehicles will reduce the energy reliance abroad and uphold the U.S. economy through the age of recent openings, particularly in gifted electrical exchanges.

V. CONCLUSION

EVs speak to extraordinary compared to other promising advances for healthy and practical transportation frameworks. The rise in infiltration of EVs will have beneficial outcomes and advantages, for example, lesser petroleum product dependence, critical decrease of GHG and poisonous toxin emanations, just the ability to contribute for the mix of environmentally friendly power into existing electric matrices, association and mix of EVs with RESs, for example, wind energy, sunlight based photovoltaic and EV coordination for maintainable portability in altogether lessening air contamination. In this project, we depicted an enormous scope quick EV charging approach that considers wind turbines AND Solar as a fuel source and a principle supply. The advantages of this methodology can be seen from the diminished reliance on centricity lattices, battery stockpiling frameworks, and energy transformation power hardware. We led some simulations in proteus programming and effectively got the outcomes. This project really helps to reduce the carbon emissions and help to maintain the city clean, the rural areas will be benefitted and also helps in economic growth.

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Interleaved Boost Converter for Electric Vehicles

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ABSTRACT
A novel interleaved boost converter has been proposed which is suitable for Electric Vehicle due to its high voltage gain. The real voltage conversion ratio, however, may be greatly decreased by the circuit's parasitic resistance effect because at a high step-up operation, the input current will be large and thus the voltage drop cannot be overlooked. This paper analyzes the effects on the voltage gain and experimentally tests the outcome. Consequently, it is found that the voltage gain is mainly influenced by resistance and the number of turns increases in the integrated magnetic portion of the proposed converter, and particularly when the duty cycle is greater than 0.5.

Keywords: Voltage Gain, Coupled-Inductor, Duty Cycle, Electric Vehicles, High Step-up Converter

I. INTRODUCTION

Electric vehicles (HEVs) are now commonly produced with high-voltage and high-energy battery packs in order to store the energy needed to supply the adequate torque and speed required for users' daily needs[1]-[5]. At the same time, by time and cycling, a high-capacity battery storage device appears to be depleted over its shelf life. These issues carry high costs to the system [6].

In addition, this battery pack provides a highly rated voltage to maintain a minimum voltage level to be boosted by the DC-DC converter which interfaces the battery and the motor through inverter[7]-[9] to maintain a suitable performance, as shown in Fig 1.

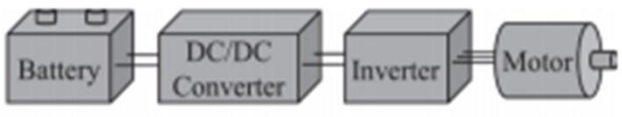


Fig. 1. Electric power train in HEVs.

However, it is well-known that the battery pack contributes with a desired amount of weight and volume due to the number of battery required to offer the voltage, in addition to the high cost which is carrying. Therefore, the battery pack downsizing and a power density improvement of the electric power train offer a mass and volume reduction of the vehicle. In[10],[11], the design and size of the battery pack has been identified as effective strategies for improving battery use, allowing fast clearance from battery faults and decreases the cost of the battery.

This downsizing of the battery pack, however, can lead to a drastic decrease in the voltage of the battery that will increase the power losses of the DC-DC converter that interfaces the storage unit with the drive of the motor because it has to be operate at a high conversion ratio[12]-[14].

Thus, traditional topologies have been introduced in EVs, such as the basic boost converter, and recently fresh topologies have been proposed due to their

downsizing features, such as interleaved converter with coupled-inductor. However, the similar output voltage is still present in these traditional and recent topologies.

This study proposes an interleaved bidirectional boost converter for EVs with coupled-inductor which combines three windings into a magnetic core. The efficient techniques of maintaining a high output voltage and the voltage boosting presented in the proposed converter with coupled inductor is shown in the fig 2.

The input current in the case of boost mode, and the output current, in the case of buck mode, appears to be large when boost operation is presented in a power converter. Consequently, the efficiency of the converter and the output voltage itself, the voltage drop in the internal component becomes important. The analysis of effect of the parasitic resistance should therefore not be overlooked.

Motor drive typically requires high voltage input in vehicle propulsion; thus, voltage drop at semiconductor switches and rectifiers seldom affects the overall behaviour of the circuit, such as the conversion ratio. In particular, in high current applications, IGBTs and diodes have comparatively small equal on-resistance because the PN voltage drop limits their voltage drop. Conduction losses on the windings, on the other hand, tend to have a greater effect because they can produce higher voltage drops in high current applications than these semiconductor devices.

The effect of parasitic resistance on output voltage in the buck mode of the interleaved converter is appropriate for automotive applications, was carried out in this research. As a motor drive needs a high voltage output in order to resolve the back electromotive force in the motor, it was decided to study only the step-up operation. It is therefore important whether or not it can generate high voltages. On the other hand, the parasitic resistance will definitely lower the efficiency in the step-down operation; however, compared to the step-up operation, it does not seriously impact the motor driving ability. The study of the step-up operation was therefore targeted in this article.

This paper interprets the design of the converter and operation of the converter. The output voltage gain is presented in the boost mode. The modelling of the equivalent parasitic resistance in the sequence provided in the coupled-inductor windings is then carried out. Then, the effective steady-state analysis with the parasitic effect included and the non-ideal voltage conversion behaviour is measured and compared to the traditional boost and interleaved boost converters. Finally, experimental test results of the proposed converter prototype operating at various values of output resistance are shown.

II. PROPOSED INTERLEAVE BOOST CONVERTER

A. Circuit configuration

An interleaved converter with coupled inductor consisting of a special magnetic coupling formed by the inductor made of three windings is arranged in core is the proposed bidirectional boost converter, see Fig. 2. The external windings are coupled in this inductor where an air-gap is suppressing the induction of the DC flux. Furthermore, external winding L1 and L2, is attached to the battery pack, and the central winding LC is connected between the freewheeling diode cathodes of the S3 and S4 switches. Finally, two key power switches are included in this converter. S1 and S2 with a 180-degree shift step and four additional S3-S6 switches and one output condenser Co. Therefore, though S4 and S5 to S2, S3 and S6 are commuted complementarily to S1.

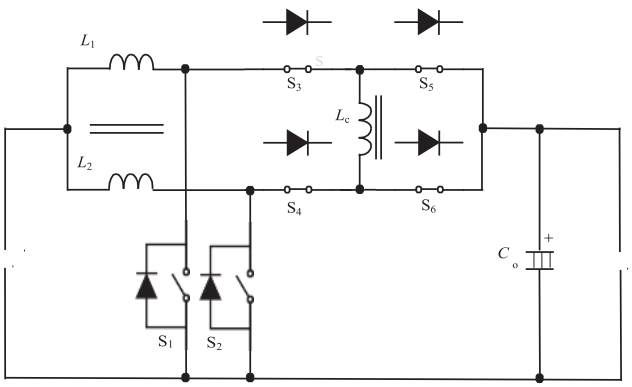


FIG .2. PROPOSED INTERLEAVED DC–DC CONVERTER

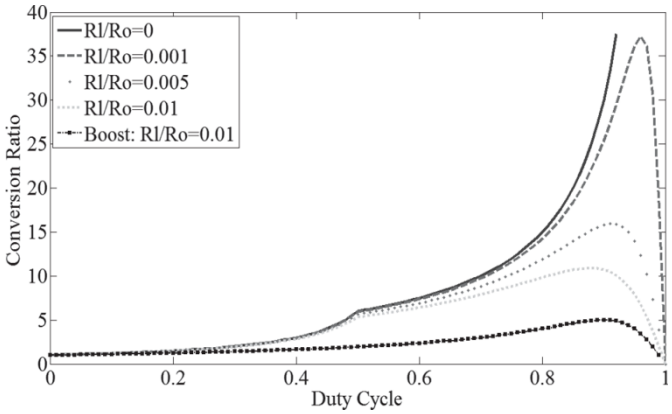
B. Operation Principle

Mode 1: Switch S1 will be ON and switches S2-S6 will be OFF. By winding L1 and the switch S1, the battery current flows. In addition, L2, the body diodes of S4 and S5,LC, C and the motor also conduct the battery current.

Mode 2: S2 is turned ON and S1 is turned OFF by S3-S6. Via winding L2 and the switch S2, the battery current flows. In addition, L1, the body diodes of S3and S6, LC, C and the motor also conduct the battery current.

Mode 3: S1-S6 are switched OFF. The battery current flows through the S3 and S5, C, body diodes through the winding L1, and through L1, the S4 and S6, C and motor body diodes.

Mode 4: S1 and-S2 turn ON and S3-S6 turn OFF. The battery current flows through the L1 and S1 windings, and through the L2 and S2 windings. Furthermore, the capacitor is discharged into the motor.



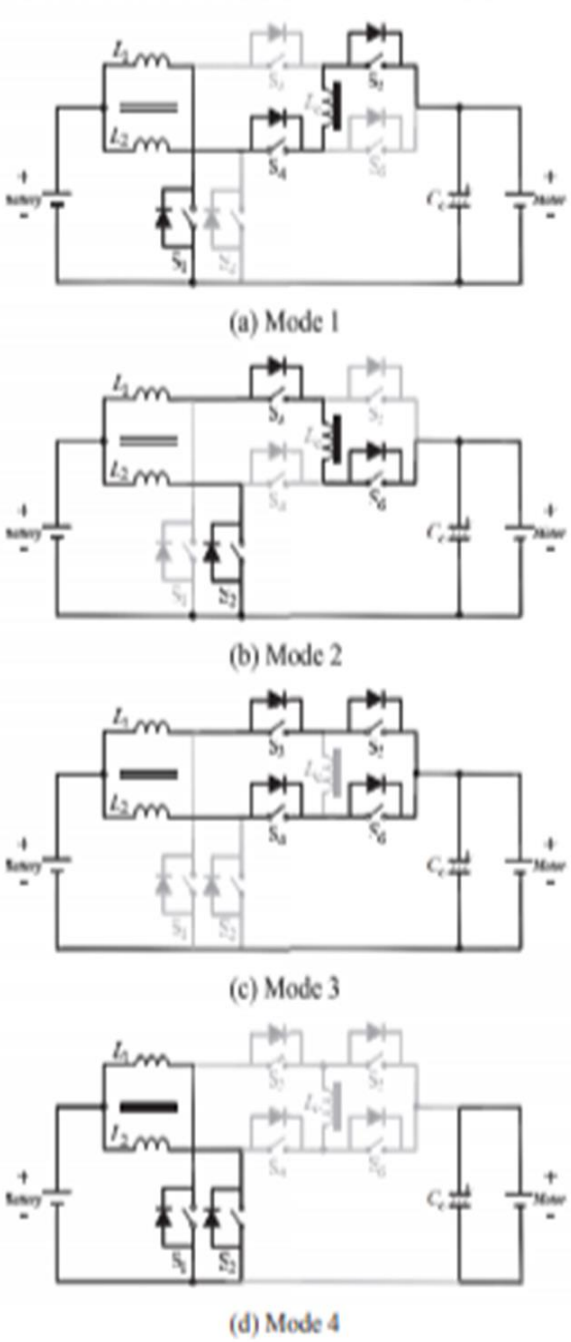


Fig. 3. Modes of operation

III. EXPERIMENTAL VALIDATION

The obtained output waveforms for the following values shown in the table

Table 1: Experimental values

Parameters	Range			
Load, Ro	200 Ω	154 Ω	98 Ω	65 Ω
Input Voltage, Vi	100V	97V	78V	65V
Output Voltage, Vo	130V	123V	99V	80V
Output Current, Io	0.7A	0.8A	0.99A	1.2A
Output Power, Po	98W	98W	98W	98W
Frequency, f	30 kHz			

IV. EFFICIENCY

Finally, several efficiency tests have been carried out in order to gain a better understanding of the advantages of the proposed high step-up converter. In these studies, in order to obtain the converter efficiency under the parasitic resistance effect, the ratios of RL/Ro studied in the previous section were evaluated.

V. CONCLUSION

This paper proposed a novel two-way, high-step, two-phase, interleaved booster converter with a coupled-inducer made of three windings into one core and analyzed the effect of the parasitic resistance presented in these windings. First, the configuration of the converter and the operating principle of the proposed converter were presented. The calculation of the conversion ratio performance of the proposed bi-directional converter and the effect of the parasitic resistance presented in the couplings of the coupling-inducer were then analyzed. In addition, several experimental tests were performed to validate theoretical calculations. Conclusively, it has been found that the voltage gain is reduced when the parasitic resistance is present. In addition, it has been found that parasitic resistance is largely affected as the ratio of the number of turns in the integrated magnetic component increases in the proposed converter and, in particular, when the duty cycle is greater than 0.5. However, its voltage conversion ratio is higher than that of conventional topologies. Finally, efficacy experimental tests have been conducted and the efficacy has been shown to decrease as parasitic resistance increases.

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A Comprehensive Study on Applications of AI Based Tools and Techniques for COVID-19

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ABSTRACT
In recent times, the application of Artificial Intelligence (AI) is highly appreciated and in practice and demand.AI manages machine intelligence and builds the chance of achievement and exactness rate. It has an incredible effect in different fields like medical image processing or in analysis of data. The new technologies like Internet of Things, Text mining, Natural language processing, and their contribution towards computational biology and medicine is highly effective in this field. AI is utilized for diagnosis tasks in medical care as it is a troublesome assignment for people without the assistance of clever machines. Subsequently, AI is applied in battling against COVID 19 pandemic. This paper presents an extensive study of tools involving AI, machine learning and deep learning methods used to fight against the pandemic COVID 19 and likewise layout the data sets that are available identified with COVID 19. It likewise features the best in class of AI applications in handling the episode and spurs specialists soon.

Keywords: Artificial Intelligence, COVID-19, Machine Learning, Deep Learning.

I. INTRODUCTION

The novel Coronavirus also named as SARS-CoV-2 arose in December 2019.Soon it took a form of pandemic of respiratory disease called as COVID-19. It is a confounded disease that showed up in various structures and the force of danger differed from mild to severe. It causes a smooth self-confining respiratory package sickness outrageous reformist pneumonia, multi-organ disillusionment, and passing [3]. It has made the whole globe in an extraordinary circumstance which makes the life in all the nation a fixed state and affirmation on human lives. As the quantity of cases due to COVID 19 expands step by step and it is a genuine danger to society.

There is a need to be colossally stressed over the consequences of this viral defilement after the huge progression of the pandemic and rising number of the affirmed cases and patients who experience serious respiratory disappointment and cardiovascular diseases. Determining proper ways to deal with arrive at answers for the COVID-19 related issues have gotten a lot of consideration. Not with standing, another tremendous issue that specialists and chiefs need to manage is the large expansion in volume of the data, known as big data that challenges them during the time spent battling against the virus. This legitimizes how much Artificial Intelligence (AI) is crucial in making, implementing and updating medical services systems on a large scale.

AI has attracted expanding research endeavors towards settling the perplexing issues in various fields, including designing, medication, economy and psychology. Uniquely, medical imaging and picture preparing strategies could exploit from AI which is conceivably fit to help medical concerns. It has not been properly utilized to serve medical-care systems in their battle against Corona virus [3].

The primary concern is now to discover cure for groups who are facing COVID-19 and are at high risk. The authors in [3] showed how ANN-based strategies, like Extreme Learning Machine (ELM), Convolutional Neural Networks (CNN), Long/Short Term Memory (LSTM)and Generative Adversarial Networks (GANs) could be used. It is important to keep the registry of patients suffered or suffering from COVID-19 so that it can be used to highlight cardiovascular complications. Since it encourages the identification of the example of cardiovascular complications and promotes building up a risk model for heart complications. It helps to assist with identification and/or prediction of the reaction to various kinds of treatment methods.There are many methods and approaches has been taken into account to build arsenal platforms and tools to deal with deaths caused by COVID-19 so that more lives could be saved.

This paper examines how AI and profound learning encourages human cutoff points fighting against infections. In this paper, segment II examines the current strategies in determination and expectation of Coronavirus, area III portrays AI based AI and profound learning techniques and calculations, segment IV provides the required datasets which could be useful for Coronavirus applications and segment V talks about the devices accessible to battle against Coronavirus and segment VI gives the conclusion.

II. LITERATURE SURVEY

It is right now evident that the world necessities a catalyst and faster response for contain and tackle the further spread of COVID-19 over the world with the guide of non-clinical methodologies, for example, data mining draws near, extended insight and other man-made consciousness strategies to assuage the enormous load on the medical care system while giving the best means to patients' decision and speculation of the 2019-nCoV pandemic successfully [23]. The authors in [13] introduced a review of AI and big data and the way it helps to distinguish the applications used for battling against COVID-19, next featured difficulties and problems related with state-of-the-art solutions.

Artificial intelligence tools have shown great results in medical field issues. It gave a huge motivation to deal with COVID-19 using it. The designers in [1] gave a layout of various insight methodology and procedures which has been applied as a data for different pandemic. They ordered the current AI procedures in clinical data investigation, including neural frameworks, classic SVM method and edge significant learning. Likewise, accentuation has been made on locales that use AI-oriented cloud computing in battling different comparative viruses to COVID-19. The investigation in [1] is an endeavor to profit clinical specialists and clinical scientists in overwhelming their confronted troubles while taking care of COVID-19 big data.

The authors in [28] gave a review of ongoing investigations utilizing Machine Learning and, all the more comprehensively, Artificial Intelligence, to deal with various pieces of the COVID-19 emergency at different scales including sub-nuclear, clinical, and social applications. They likewise audit datasets, tools, and assets expected to encourage AI research. The authors talked about key contemplations identified with the operational execution of ventures, multidisciplinary associations, and open science.

The authors in [6] examined papers into different get-togethers that include: significant learning counts for clinical picture dealing with, data science, AI, Internet of Things (IoT), and especially deep learning, has increased uncommon advances and liberal ground in long-standing fields and strategies to fight against the pandemic. For example we can consider PC vision and games or Natural language processing (NLP). The most important advantage of Deep learning over other traditional machine learning techniques is its ability to deal with huge unstructured and different types of data, for instance text, video, image and audio data. Different endeavors, for instance equipment, vehicle, security, retail, agribusiness, clinical administrations and clinical assessment, have achieved better outcomes and points of interest by using significant learning and AI procedures. It is expected that AI models can be used to fight against the COVID-19 pandemic [6].

The authors in [7] discussed how AI gives ensured, exact and beneficial imaging blueprints in predictions and applications of COVID-19.The sharp imaging stages, clinical purpose, and initiating research are studied in detail, which covers the entire pipeline of AI-empowered imaging applications in COVID-19.The keen imaging stages, clinical conclusion, and spearheading research are surveyed in detail, which covers the whole pipeline of AI-enabled imaging applications in COVID-19. It is significant that imaging just provides data about COVID-19 patients. Here, AI will demonstrate the natural capacity to combine data from multiple sources to perform accurate and efficient diagnosis for better development. Hence, for better screening, detection and diagnosis of COVID-19 it is necessary to combine image data with both clinical and research facility examination results [7].

The authors in [8] portrayed different systems of AI that have been used in the past in the estimate, disclosure and the heads of overwhelming diseases. It is also displayed that how these contraptions are being brought into picture in the battle against COVID-19. Moreover, we besides talk about their applications in different periods of the pandemic, the central focus, obstacles and expected traps.

III. AI BASED MACHINE AND DEEP LEARNING APPROACHES USED FOR DIAGNOSIS, DETECTION AND PREDICTION OF COVID 19

AI based systems have accepted a fundamental capacity in the territory of clinical picture getting ready, PC helped end, picture interpretation, picture mix, picture selection, picture division, picture guided treatment, picture recuperation, and assessment strategies [9]. Artificial Intelligence aids in extracting information from the images and represents information effectively and efficiently. Artificial intelligence empowers and helps authorities and other clinical experts to investigate different afflictions while clearing out human screw up and accelerating and accuracy of recognizable proof. These systems overhaul the limits of experts and researchers to perceive how to separate the ordinary varieties which cause the sickness in any case.

Among various parts of AI, AI and profound learning (DL) are two critical methodologies. For the most part, ML alludes to the ability to take in and remove important examples from the information, and the presentation of ML-based calculations and frameworks are vigorously subject to the delegate highlights [13].

A very powerful role has been played by AI tools for manufacture of drugs and facilitation of COVID 19 vaccine. AI became capable to suggest necessary tools and intelligent systems or frameworks for the prediction of efficient and safe drugs or vaccines which will help to fight against COVID 19. These suggestions could be done using the datasets acquired from healthcare or Government organizations or private clinical labs and patients. These efforts will benefit both scientific as well as economic perspectives [13].

AI can give sensible ways to fight against the pandemic by a couple of novel habits. For example, AI has shown extremely powerful results in COVID detection just as infodemiology and infoveillance through Demand and Supply metrics and leveraging learning-based techniques.For example, ML and DL models for grouping, and estimation of COVID-19. Moreover, CT is an important segment in the assessment of patients who are suspected to be COVID positive or COVID contamination. In any case, CT alone may have restricted negative prescient incentive for precluding COVID-19 contamination, as certain patients may discover customary radiological issues at beginning phases of the illness. In this examination, AI has been utilized for calculations and coordinate chest CT discoveries with clinical manifestations, presentation history and research center testing to rapidly analyze patients who are COVID-19 positive [5].

A. Machine Learning

Machine learning is an automated technology for information investigation in different areas like clinical designing, budgetary area, business area, instructive spaces and other related areas. Machine learning is used to distinguish designs, dissect information through different datasets and settle on right choices with no human intervention or less human interference. Machine Learning is thoroughly orchestrated into three segments specifically Supervised learning, Unsupervised learning and Reinforcement learning [30].

Superior learning implies that the machine or model learns through multiple datasets. But in directed learning, class-level data is accessible in the preparation datasets. While Unsupervised learning implies learning of models without an instructor or at the end of the day learning algorithms adapt progressively with bunching algorithms or assistance. Supervised and Unsupervised learning strategies are blend to form Reinforcement learning [22].

a. Supervised learning

Supervised learning is a preprogrammed task which allows a function to coordinate the input output pairs. The main motto behind a supervised learning is for being able to deliver a function which is capable of mapping the input-output (the vector supervision signal) pair. The algorithm shall permit a superlative scenario to mark the acquired information correctly to determine the classes. This can be known as conceptual learning, in the terms of human psychology [11]

Support-vector Machines (SVM) is a supervised technique for utilizing regression, classifications and likewise detecting anomaly. The main purpose of Support vector is to establish hyper plane in an N-dimensional space, where N represents the quantity of features that particularly arranges the information data. After considering all the factors, SVM will be able to locate a plane where extreme separation between the data purposes of free classes is maximum. Backing vectors are data which focuses on those which are closest to the hyper plane. All these data influence the position and direction of the hyper plane [11].

In India variety of regression models have been used for COVID-19 data analysis. It depends on information given away by Kaggle from1stMarch 2020 to 11th April 2020. Here, we have used six regression analyses on the basis of different models namely quadratic, 3rddegree, 4th degree, 5th degree, 6thdegree, and exponential polynomial with respect to the datasets of COVID-2019 [22].

In statistics, the logistic regression is being utilized to display the likelihood; each of the examples are assigned with a likelihood between 0 and 1. It tends to extend few of the event classes in request to show control for instance of different objects in a picture. Rather than CNN, the logistic regression likewise might be applied in the inside and out investigation of the cause of COVID-19. The logistic regression was applied to values that were received from ROC analysis at the point of investigation of clinical and

CT which indicated the seriousness of COVID-19 was discussed. It was discovered from the logistic regression that the clinical factors relating to serious/basic COVID-19 pneumonia, or the patients of age more than 50 years established chest pain, breathlessness, comorbidities and cough [11].

The authors in [15] aims to perform the future prediction on different factors like on the basis of passing rate, the number of confirmed infected cases in last few days on daily basis, and the number of recuperation cases in the next 10 days. Four ML moves have been taken which are suitable for the forecasting. At first, the dataset was preprocessed for this examination to end the global statistics of confirmed cases, recoveries and deaths on daily basis. The dataset that was taken into account in the investigation contains day to day time arrangement rundown tables, along with the number of recoveries, confirmed cases and deaths in the last few days due to which the pandemic occurred. Four regression models have been utilized for the investigation of COVID-19 future forecasting and those are Linear Regression (LR), LASSO Regression, Exponential Smoothing (ES) and Support Vector Machine (SVM) [29]. The dataset utilized in this prediction has been obtained from different sources 5and one of them is GitHub archive provided by the Center to Systems Science and Engineering, Johns Hopkins University.

b. Unsupervised learning

Unsupervised learning has been successfully utilized in the investigation of COVID-19. Unsupervised learning looks for previously undetected models or prototypes in an information stream without pre-existing marks and insignificant human intercession as compared to Supervised Machine learning. It helps to show the densities of likelihood on the sections. This algorithm makes it conceivable to identify irregular pieces of information which doesn't compare to any gathering [23]. It is applied in the field of estimation of the density in statistics. The k-means clustering is a vector quantization algorithm under unsupervised learning that is utilized for COVID 19. It segments n perceptions into k clusters where every comment fills in as of the cluster and has a place in the cluster with neighboring mean [11].

Unsupervised learning has the advantage of not requiring named information to even now prepare itself; it makes an extraordinary possibility for any sort of clinical application inside AI. We decided to actualize the Self-Organizing Feature Map (SOFM) algorithm for its capacity to be proficiently deployed for consistent and real-time learning. Our objective with this examination is to show that a SOFM is a compelling method to cluster an information set of COVID-19 chest x-ray pictures while additionally extracting which highlights caused the clustering of every characterization [25].

c. Reinforcement Learning

The progressing flare-up of the Covid infection 2019 (COVID-19) has immediately gotten a pandemic. It requires for brief activity in distinguishing suspected cases at a beginning phase through danger prediction. To stifle its further spread, we misuse the social connections between cell phones in the Social Internet of Things (SIoT) to help control its proliferation by dispensing the restricted defensive assets to the inertial alleged high-degree people to stem the tide of hastened spreading. The C-LOR (co-found item relationship of SIoT projects the geographic area and the SOR (social article relationship) measures the contact intensity and these are valuable for distinguishing the danger of infection in people. The proposed procedure in [30] is famously reasonable for disease control and avoidance by depending on the early distinguishing proof of COVID-19 cases.

B. Deep learning

As of late, deep learning based man-made reasoning (AI) innovation has exhibited huge accomplishment in the field of clinical information investigation because of its ability of separating rich highlights

from various clinical datasets. Already, deep learning was produced for diagnosing and recognizing bacterial and viral pneumonia from thoracic imaging information. Furthermore, endeavors have been made to identify different chest CT imaging highlights [26].

A pitifully supervised deep learning system for quick and completely mechanized detection and order of COVID-19 infection utilizing reflectively removed CT images from multi-scanners and multi-focuses. It can likewise pinpoint the specific situation of the sores or irritations brought about by the COVID-19, and in this manner can likewise possibly give exhortation on understanding seriousness to direct the accompanying emergency and treatment [26].

Deep learning is the center innovation of the rising man-made reasoning and has revealed huge demonstrative exactness in clinical imaging for programmed detection of lung diseases. This paper's main objective is to improve the acknowledgment of worldwide deep learning model utilizing cutting-edge information, and put in itself from such information to make better acknowledgment of COVID-19 victims dependent on registered tomography (CT) cuts. Also, the reconciliation of blockchain and unified taking in innovation gathers the information from various hospitals without releasing the protection of the information. Initially, we gather genuine COVID-19 patients' information open to the examination network. Also, we utilize particular significant learning models such as DenseNet, VGG, AlexNet, Capsule Network, MobileNetand ResNetto see the models through COVID-19 patients' lung screening [21].

A Convolutional Neural Network (CNN) is an algorithm of Deep Learning which accepts a picture as an input and assigns study loads to different objects or highlights in the picture to have the option to separate one picture from the other [11]. Coronavirus Net is a deep convolutional neural organization which have customized configuration for the detection of COVID-19 cases from CXR images. It is open source and accessible to the overall population. Moreover, we examine how COVID-Net make the predictions using a logic strategy that tries to not add deeper experiences into basic variables related with COVID cases, which can help medical authorities in improved screening. It is settling on decisions dependent on applicable data from the CXR images in COVID-Net [14].

The AI based CNN could be actualized as a quick analytic instrument to signal the suspected COVID-19 infected patients when CT images as well as lab data are accessible and radiologists may survey these speculated cases recognized by AI tools with a greater need [5]

The authors in [16] show how move getting from significant learning models can be utilized to perform COVID-19 recognizable proof utilizing pictures from three most generally utilized clinical imaging modes X-Ray, Ultrasound, and CT examine. The point is to give over-focused on clinical experts a second pair of eyes through keen deep learning picture grouping models.

Chest X-Rays of COVID-19 patients have end up being a significant elective pointer in COVID-19 screening. In any case, once more, exactness relies on radiological ability. An analysis framework that can help the specialist to inspect the lung images of the patients will reduce the symptomatic weight of the specialist. Four diverse deep CNN models were explored on images of chest X-Rays for conclusion of COVID-19 [17][18].

The authors in [18] present a computerized reasoning method dependent on a deep convolutional neural organization (CNN) to identify COVID-19 patients utilizing genuine world datasets. Our framework inspects chest X-beam images to distinguish such patients. Our discoveries demonstrate that such an investigation is important in COVID-19 finding as X-beams are advantageously accessible rapidly and at low expenses.

In [19], the authors approve and adjust a deep CNN for the characterization of COVID-19 chest X-beam images which is also called as DeTraC (Decompose,

Transfer and Compose). It uses a class Decomposition instrument to manage and examine any abnormalities in the image datasets. The trial outcomes indicated the capabilities of DeTraC in detection and prediction of COVID-19 cases from dataset of images which are collected from hospitals all over the globe.

The technique Rubik's solid shape Pro is a self-supervised learning method [20] which was proposed to extricate facts of negative CT volumes and COVID-19. Two types of delicate marks (i.e., 'trouble' and 'variety') are produced for each negative sample at that point by figuring the earth mover's division (EMD) between the highlights of COVID-19 records. The information about the 'estimation' of negative samples can be quantitatively assessed from the delicate marks. A pre-set number of negative samples were chosen dependent on the joint positioning of 'trouble' and 'variety', and took care of to the neural organization for preparing the COVID-19 records along with that.

This paper proposes the AI based characterization of Pneumonia patients and COVID-19 patients based onthe different deep learning element that utilizes ResNet152 on chest X-beam images. It also helps to adjust the imbalanced information of normal patients and COVID-19 victims. This non-intrusive and early prediction of novel corona virus is done by dissecting reports of chest X-beams and the spread of the infection in asymptomatic patients [24].

The detection of Corona virus from X-beam images of chest presents a difficult issue because of the abnormalities and the restricted accessibility of commented on cases. Another CNN model, which is also known as Self Supervised Super Sample Decomposition for Transfer learning (4S-DT) model has also been used. It has been relied upon to acclimate to such testing issues by changing a self-guided model weakening way to deal with oversee produce pseudo-names for the social affair of unlabeled chest X-shaft pictures as an affection learning task. 4S-DT has additionally the capacity to manage information inconsistencies by a class-decomposition adjusted in its downstream learning segment. 4S-DT has shown its adequacy and proficiencyin datasets with its inconsistent distribution in detection and prediction of COVID-19 cases [27].

IV. DATASETS USED FOR COVID 19 APPLICATIONS

The initial step is collection of data for creating machine learning techniques for COVID-19 applications. Despite the fact that there is huge availability of public CT or X-beam datasets for lung infections, both CT and X-rays checks for COVID-19 applications are not widely accessible. This enormously hinders and effects the improvement and research of AI strategies. As of late, a few take at COVID-19 data collection have been accounted [7]. These datasets helps to provide an efficient depiction of the applications.

A. Novel Coronavirus Visual Dashboard 2019

It is has been taken by the Johns Hopkins University Center for Systems Science and Engineering (JHU CSSE). The data was acquired from 18 sources, for example, the WHO or other organization like CDC and other government organizations, accumulated and shared them as an intuitive guide of the COVID-19 circumstance map. The database incorporates the quantity of every day tainting, dynamic, recuperation and demise. It additionally included the area, state or country or longitude and latitude or any province, occurrence rate, number of individuals tried and hospitalization rate [11].

Table I. An analysis of different approaches used in prediction, examination and detection of COVID 19 with datasets

References	Machine learning	Deep learning	Type of Dataset	Datasets	Prediction	Diagnosis	Detection
[15]	Regression models (Linear Regression, LASSO Regression, Support Vector Machine, Exponential Smoothing)		patient stats dataset	GitHub repository	√		
[22]	Regression analysis methods		Date and confirmed cases-COVID19	Kaggle and World Health Organization (WHO) website	√		
[23]	Decision tree, support vector machine, naïve Bayes, logistic regression, random forest, and K-nearest neighbor algorithms		Epidemiological dataset	Kagge Website	√		
[25]	Unsupervised learning- Self-Organizing Feature Maps (SOFM)		Chest X-Ray	Cohen, Morrison, and Dao's database of COVID-19			√
[24]	Logistic Regression (LR), k-Nearest Neighbour (kNN), Decision Tree (DT), Adaboost and Naive Bayes (NB), XGBoost	Synthetic minority oversampling technique (SMOTE)	Chest X-Ray Images	Publicly available datasets: Chest X-Ray Images (Pneumonia) and COVID-19 public dataset from Italy	√		
[14], [17]		Convolutional Neural Network	Chest X-Ray	GitHub repository	√	√	
[16]		VGG19 model	X-Ray, Ultrasound and CT scans	Publicly available COVID19			√
[18]		PA, ARIMA, and LSTM VGG16	Chest X-ray	Kaggle database	√	√	
[19]		DeTraC (deep CNN)	Chest X-ray	Japanese Society of Radiological Technology (JSRT)			√
[20]		Self supervised Learning	CT scans	2,675 3D volumetric non-contrast thoracic CT exams from 2,595 patients acquired at over 10 medical centers		√	√
[21]		VGG, DenseNet, AlexNet, MobileNet, ResNet, and Capsule Network	CT scans	CC-19			√
[26]		Supervised deep learning	CT images	Open dataset (TCIA dataset)			√
[27]		deep convolutional neural network - Self Supervised Super Sample Decomposition for Transfer learning (4S-DT) model.	Chest X-Ray	COVID 19 dataset			√

B. Twitter dataset for COVID-19

This dataset is a collection of increasing tweets IDs related with COVID-19. These types oftweet IDs included"Pandemic", "Coronavirus" and "COVID-19" etc. The data mainly focused on the tweets from January 28, 2020. They followed certain records and patterns which were similar to the way of WHO and other organizations like HHSGov and CDCgov [11].

C. COVID-CT

The image data collection for Corona virus was done by gathering clinical pictures from sites and distributions, and at present 123 frontal view X-rays are available. The CT dataset for COVID [10] incorporates 288 CT slices for affirmed cases of COVID 19. It is gathered from more than 700 preprinted writing on COVID-19 from medRxiv and

bioRxiv. Likewise, the CT division for COVID-19 dataset (medicalsegmentation.com/covid19/) contains 100 axial CT slices from 60 patients and they were manually segmented, as JPG images. Similarly, the confirmed instances of COVID-19 cases are available on the site (coronacases.org). Presently, it incorporates 3D CT images of 10 affirmed COVID-19 cases. It is significant that the current public datasets still have a predetermined number of pictures for preparing and testing of AI calculations and the nature of datasets isn't adequate [7].

D. CORD-19

CORD-19 dataset is freely available and downloadable and every week it gets updated. Presently, the collection contains more than 128,000 publications (out of which 59,000 of them have full content starting at 26 May 2020) on COVID-19 infection or content related to this. It is essential source of inspiration to the AI community and to develop AI techniques to create new insights to aid the battle against COVID-19 [4].

E. COVIDx Dataset

The dataset used to prepare and configure the proposed COVID-Net includes a total of 13,975 CXR images across 13,870 patient cases which will be eluded as COVIDx. The open access to the COVIDxdatase is very significant with respect to the amount of positive cases of COVID-19, according to the best author's data [14]. CC-19, identified with the most recent family of coronavirus for example COVID-19. The dataset contains 34,006 CT filter slices (pictures) having a place with 89 subjects [21].

V. AI BASED TOOLS

AI using significant learning advancement has indicated unimaginable achievement in the clinical imaging zone as a result of its high capacity of feature extraction. It's also been made to perceive diverse imaging features of chest CT. Chest X-pillar and CT are commonly used in the screening and finding of COVID-19. In particular, to distinguish and separate bacterial and viral pneumonia based on chest radiographs, deep learning was applied. Endeavors have additionally been made to identify different imaging highlights of CT of chests [7].A couple of investigation bundles have begun hoping to automated thinking (AI) as a gadget for examining and stalling X-radiates and enrolled tomography (CT) yields, and supporting the screening, predicting and diagnosing of COVID-19.

A. COVNet

COVNet is a 3D profound learning structure built for the identification of COVID-19. It can separate both 2D and 3D neighborhood worldwide delegate highlights. The structure ofCOVNetcomprises of RestNet50 as the spine, which takes a CT cuts progression as information and produces highlights for the comparing cuts. By a maximum pooling activity, the separated highlights from all cuts are then joined. A completely associated layer and softmax enactmentcapacity was formed from the last component. It helpsto produce a same score for each kind CAP, non-pneumonia and COVID-19 [12]. To test the strength of the model sweeps of network obtained from other non-pneumonia lung diseases and CAP pneumonia were also included.

B. qXR AI-Based Chest X-ray Interpretation Tool

2.5 million Chest X-rays datasetshave been used to train qXR. In qXRthe AI naturally sees 20 lung variations from the norm and utilizations those discoveries to recognize likely instances of tuberculosis and other ailments related respiratory systems. Once the COVID-19 emergency started, the organization quickly pondered growing qXR to likewise screen for discoveries that are firmly reminiscent of that infection [2].

C. qScout

qScout had been planning to track tuberculosis which is in application stage, has now been extended to incorporate COVID-19.Icolung, utilized clinically for measurement of lung pathology on chest CT checks in conceded COVID-19 victims [2]. qScout incorporates an AI-based following segment that keeps up secure patient data about starting and proceeding with singular wellbeing status or an electronic clinical record (EMR), so medical systems can give customized care; and tracks more broad epidemiological and topographical information, which can help wellbeing associations do contact following and start proper moderation endeavors [2].

D. WellAI

For cross examination of the CORD-19 dataset,Well AI has built up a Machine Learning (ML) search and examination device fusing the total rundown of NIH clinical classes Unified Medical Language System (UMLS) semantic sorts. The Well AI COVID-19 application utilizes NLP neural organizations to 'learn' from the CORD-19 dataset to sum up existing information. Significantly, they manage synonymy, and by including the entirety of the equivalent words, the quantity of ideas from UMLS expanded to 4,224,512! , out of which only 60,892 ideas are utilized in the Well AI model for COVID-19, gathered into 69 classifications (or UMLS semantic sorts). A progression of Well AI neural organization models have been used to learn connections between clinical ideas [4].

E. SciSight

SciSight is a tool which is used to explain the association and relationship between the appearing visualizing concept of the emerging network around COVID 19 and CORD-19 datasets. It is a visualization tool powered by AI. There are four types of search options under this one are used to visualize the research growth and ties of COVID-19 and it is known as “Network of Science” search. The other two options falls under scientific concepts and which is considered as an important factor in study of COVID-19. Those two search options are “Diseases/chemicals” and “Proteins/genes/cells”. The last search option is “Faceted search” [4].

F. Contact tracing

In the age of digitalization where almost everything is transformed into digital, the contact tracing can be achieved and integrated in an application with the help ofdatasets and diagnostic test results. Contact tracing app has been deployed in Singapore asTraceTogether. The app uses a smartphone’s Bluetooth network to notify every TraceTogether user, who are present within the range of 2 meters for more than 30 mins and found to be COVID 19 positive [4].

G. α-Satellite

A model of an AI-based framework, to be specific **α**-Satellite, is proposed to evaluate the irresistible danger of a given geological region at network levels. The framework gathers different kinds of enormous scope and ongoing information from heterogeneous sources, for example, number of cases and passings, segment information, traffic thickness and web-based media information, e.g., Reddit posts [31].

H. ACEMod (Australian Census based Epidemic Model)

ACEMod (Australian Census based Epidemic Model), recently utilized for flu pandemic reenactment for demonstrating the COVID-19 pandemic across Australia after some time. The ACEMod is adjusted to demonstrate particulars of the COVID-19 pandemic dependent on key illness transmission boundaries. A

few intercession procedures including social separating, school terminations, travel boycotts, and case detachment are then assessed utilizing this adapted model. The outcomes from the tests show that a blend of a few procedures is expected to relieve and smother the COVID-19 outbreak. The best methodology recommended by the model is to consolidate global appearance limitations, case separation and social removing in at any rate 13 weeks with the consistence level of 80% or above [32].

VI.CONCLUSION

This paper focused on the applications of machine learning and deep learning techniques supported in the battle of COVID-19 outbreak. In the face of overstretched health care networks, we must work on our health systems to make it stronger enough so that it could sustain services beyond the control and management of COVID-19. This paper featured cutting edge advances help in battling against the pandemic and how it very well may be utilized to battle future pandemics. The examination empowers medical services policymakers to set up their nation against the flare-up of the illness and settle on very much educated choices.

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Thyroid Disease Classification in Big Data on Machine Learning

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ABSTRACT

Thyroid diseases are widespread worldwide. In India too, there is a significant problems caused due to thyroid diseases. Various research studies estimates that about many million people in India suffer from thyroid diseases. Female is more affected than male due to thyroid disease. Two types of thyroid diseases are i) Hyperthyroidism-produces a lot of thyroid hormone in the blood and ii) Hypothyroidism-produce less thyroid hormone in the blood. Hypothyroidism is a condition which underlies not only chronic degenerative diseases but also hormone irregularities and results in a weakened immune system. A variety of algorithms used are Random Forest, Support Vector Machine, Decision Tree, Linear Regression. This paper presents a review of recent ML algorithms applied in the prediction and diagnosis of thyroid detection. The proposed system is used for thyroid disease prediction of patients used many attributes and values, based on various symptoms and reports of thyroid. With comparative study, different ML techniques are used by the proposed system to achieve better accuracy in disease prediction. Among these, Decision tree algorithm is found to be better with the accuracy of 99.5%.As a result, the decision tree classifies the thyroid data-set into three classes of thyroid disorders.

Keywords-Linear Regression, Decision Tree, Random Forest, Support Vector Machine, Thyroid Prediction.

I. INTRODUCTION

This Thyroid disease is a very common disease widely spread in today's world and it often causes severe affliction to life and body. It affects functioning of thyroid gland which in turn results into excess secretion of thyroid hormones. It is very necessary for every person to know about every symptom of thyroid as like: Fatigue (tired), Cold Intolerance, Skin dry, Weight gain, Face Swelling, Menstrual Cycles, and Hair Fall etc. According to the survey, it states that on an average one out of 38000 people in the world are suffering from congenital hypothyroidism. In developing countries like India, there are almost 42 million people suffering from thyroid disease. According to statistics, thyroid disorders are on the rise in India and discussed about the problems in thyroid and how hypothyroid and hyperthyroid symptoms and causes increases are included. In this papers, the main aim is to predict the accuracy and level of thyroid affected by peoples in gender wise.

A. Thyroid Disorders

Thyroid disorders are the situations that artificial by thyroid gland as a butterfly-shaped gland in the neck which is present in front side. It has an important role that can regulate numerous metabolic processes throughout the body. A thin area of tissue in the glands middle known to be as isthmus. It joins two

thyroid lobes o each of the sides. The primary hormones produced by the gland. The function of the thyroid gland is regulated by a feedback mechanism involving the brain.

B. Thyroid Hormones

The two hormones that are produced in the thyroid are L-thyroxine (T4) and tri-iodothyronine (T3). They regulate human body's metabolic functions such as heat generation, and the utilization of carbohydrates, proteins, and fats. Regulatory hormones from different parts of the brain control the thyroid's production of T4 and T3. The pituitary gland acts like a thermostat to control the production of the hormone. When they are more in the bloodstream, the pituitary releases less TSH. When there are little in the bloodstream, the pituitary releases more TSH. With the help of this feedback system, the production of thyroid hormone is tightly controlled.

C. Hyperthyroidism

Increase in the hormone production can cause hyperthyroidism. In medical field, “hyper” indicates too much. Hyperthyroidism crop up when the gland produces excess hormones. The most common cause for hyperthyroidism is the autoimmune disorder Graves’ disease. It is also known as an overactive thyroid, the hormone overload can cause an extensive range of physical changes. Many symptoms that in some includes Heat intolerance, irregular menses, diarrhea and increased perspiration.

D. Hypothyroid

Decrease in the hormone production can cause hypothyroidism. In medical field, the term hypo means deficient or not enough. For example, hypoglycemia is a term for low blood sugar. Hypothyroidism is a condition that the thyroid gland does not produce required hormones. Inflammation and damage to the gland causes hypothyroidism. Weight gain or failure to lose weight despite a proper weight loss regime.

II. METHODOLOGY

Machine Learning Algorithms

Artificial neural network being an application of machine learning is a very powerful algorithm. It can work on structured data and it is always able to derive pattern from a dataset of any size. A large number of attributes are considered in the dataset and considering the attributes and the vividness of the data we have shortlisted five algorithms for implementation out of which the best will be selected.

A. Decision Tree

It is one of the most important classification and prediction method in supervised learning. A decision tree classifier has a tree type structure which provides stability and high accuracy. Decision tree is also referred to as CART (Classification and Regression Trees). Decision tree applies simple if else rules to construct the trees. Decision tree algorithm commonly uses gini index, information gain, chi-square, and reduction in variance to make a strategic split.

Multilayer Feed Forward Neural Network

In neural networks the nodes are initialized these nodes are connected with each other. The line connecting them have a predefined weight, for many years there was no optimized technique to decide these weights, but now these weights are considered to be affecting the prediction results so they need to be optimized for which an iterative method is used which optimizes the results.

B. Support Vector Machine (SVM)

It is a very useful algorithm sometimes in case of large data it gives very good efficiency it is used for classification purpose, it classifies the data into various sets and trains the model using this set and then it successfully predicts the data using this trained model. First it plots the attributes in the graph and separates it broadly using a boundary and the nodes which lie on this boundary are named as the support vectors.

C. Logistic Regression

Logistic regression conducts regression analysis when the dependent variable has dichotomous results (binary). Logistic regression is a very strong technique for doing predictive analysis. It defines the data very efficiently and explains the relation between one dependent binary variable and one or more nominal independent variable. One of the important consideration done while selecting the logistic regression model is the model fit. Selection of variables is another important because more the number of scrap variable lesser will be efficiency of the algorithm.

D. Random Forest

Random Forest is a supervised learning algorithm. The general idea behind the bagging method is that a combination of learning models increases the overall result. One big advantage of random forest is, that it can be used for both classification and regression problems, which form the majority of current machine learning systems. Random Forest has almost the same hyper parameters as a decision tree or a bagging classifier.

III. PROPOSED FRAMEWORK

After In this diagram as shown in the figure 1: Framework of proposed work contains the input dataset, Preprocessing, Future selection and classification. The framework of the proposed work is shown in the figure 1. The proposed work is based on the input from the UCI repository which involves 7200 multivariate type of records. Each record has 14 attributes.

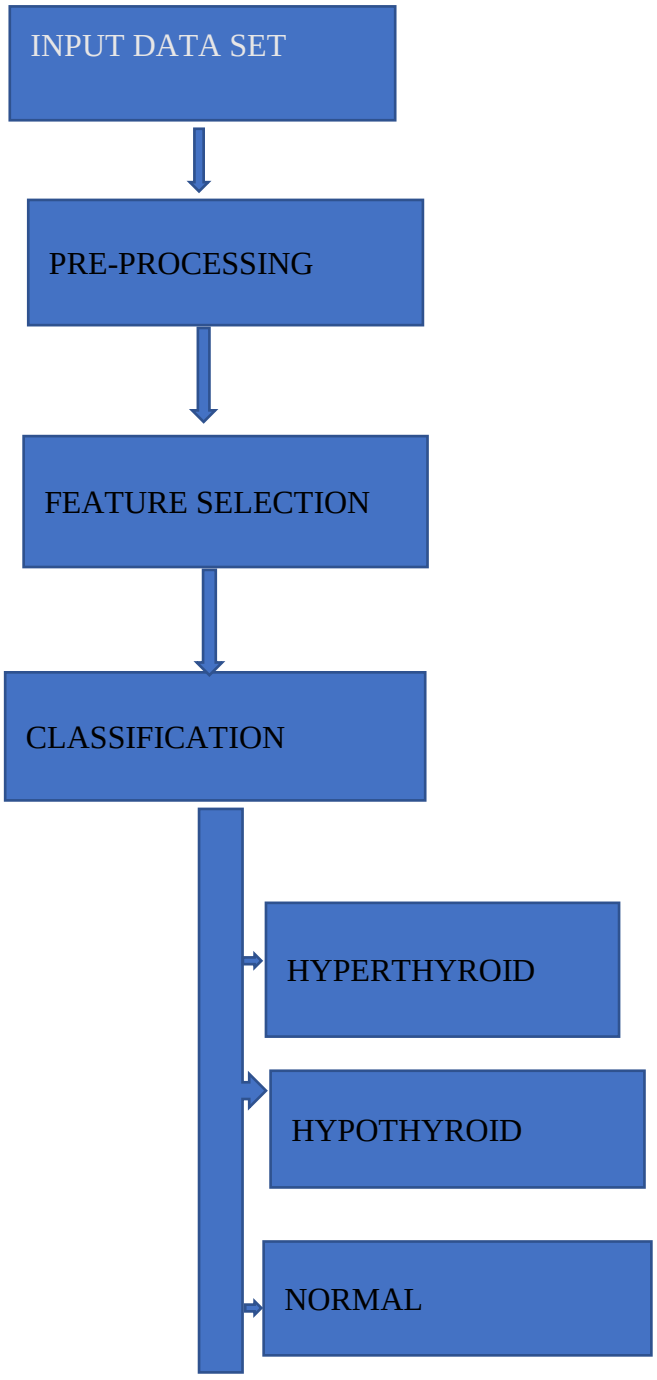


Figure 1: Framework for Proposed System

A. Input Data set

Data Description. The dataset is obtained from several sources like thyroid disease dataset from UCI machine learning repository and other such repositories which consists of 6500 records in total. There are total many features, out of which six features are real attributes and remaining are categorical attributes. To improve the quality of dataset obtained, pre-processing is carried out for further analysis (Table 1).

Table 1: Attributes and value types

Sl.No	Attribute	Value Type
1	Name	Random
2	Age	Continuous
3	Sex	Male, Female
4	On_Thyroxine	True, False
5	Query_on_thyroxine	True, False
6	Thyroid_surgery	True, False
7	Query_hypothyroid	True, False
8	Query_hyperthyroid	True, False
9	Tumor	True, False
10	Lithium	True, False
11	Goitre	True, False
12	Pregnant	True, False
13	Sick	True, False
14	TSH_Measured	True, False

Implementation:

In this implementation part, the dataset collected from the source and have used such algorithms Support vector Machine Algorithm, Decision Tree Algorithm, Random Forest Algorithm, Linear Regression Algorithm and the accuracy for this algorithms evaluated based on performance matrix and in future selection contains the highest accuracy.

B. Preprocessing

Preprocessing is a Mining technique that transforms the raw material into the technique understandable format to Real-world data frequently incomplete, in consist and lacking in certain trends and behaviors that us likely contains many errors and to solve many issues the preprocessing have used. The missing data can also be preprocessed and the whole data is processed by using algorithms which used in the paper. Moreover, the existing algorithms processed.

In this proposed work, datas are taken from UCI repository that contains the datas both discrete and continuous that endures for pre-processing. In this, the missing value and not in number constraint checked using the masking method. The missing value or Not a Number (NaN) values which is presented, the replaced mean value to be added in the appropriate column and as shown in the figure 2 data pre-processing techniques.

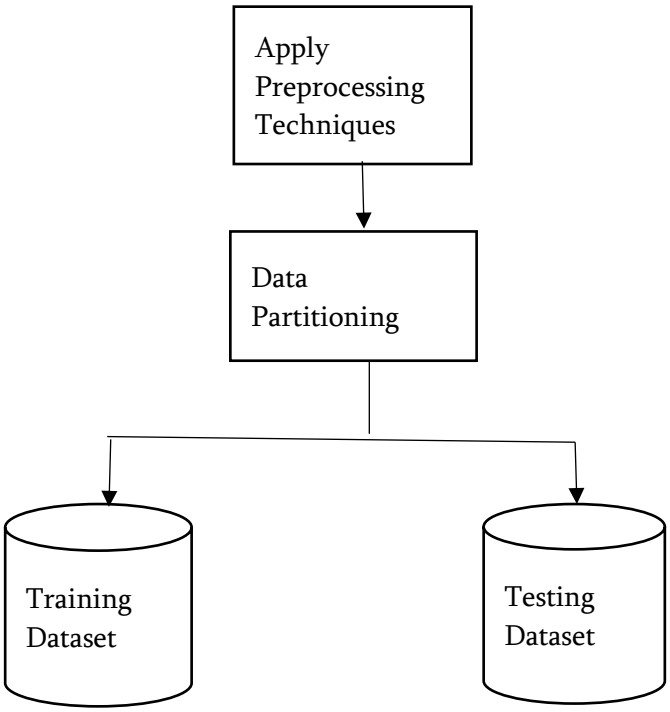


Figure 2: Data Preprocessing Techniques

C. Feature Selection

In Machine learning feature selection, it is otherwise called as attribute selection. The technique of choosing the features that related to it and to simplify the users to understand the models and used to time shorter at taking training, it is different when compared to feature extraction. In dataset, the correlation attribute evaluation method to decrease the evaluation. Select the related attributes that moderate to negative and positive correlation and those attribute values to remove that closer to the zero. Finally, it takes the values to zero.

Experimental Results:

Experimental result section, Thyroid data are collected from the UCI repository and the record contains 6500 datas and the dataset contains the preprocessing and feature selection techniques are resulted and applied then the data preprocessing given input to the clustering and classification technique and it gives the better results and accuracy then applied SVM Algorithm for the thyroid dataset to diagnose and predicted. The results are visually shown in the following figures.

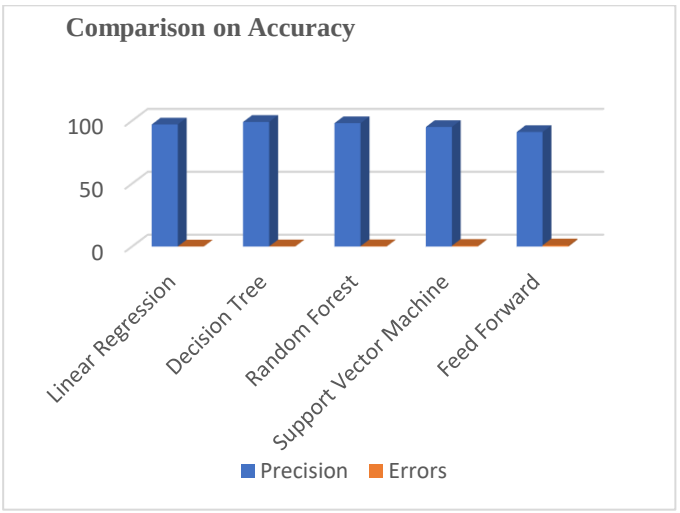
Result Analysis:

Where,

$$Ac=CP+CN/N$$

Ac=accuracy
CP=correctly predicted positive samples
CN=correctly predicted negative samples
N=Number of total samples in dataset testing

From all this above mentioned algorithms, the comparison observed in between all the algorithms and the result of that has predicted based on accuracy. The Decision tree algorithm has 99.5% accuracy and it is the highest accuracy of all algorithms. Random forest accuracy also close to that decision tree which is 99.3%. The next algorithm regression accuracy is 97.25%. Support Vector machine algorithm has the accuracy level is 95.2% and the multilayer feed forward obtains the ranking percentage level as 93.55%



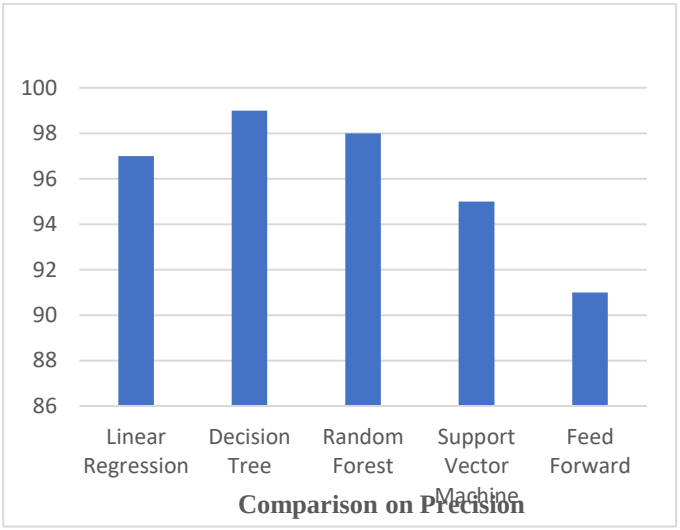


Figure 3: Comparison on Accuracy and Prediction

$$Precision=P/NP$$

Where,
Pr is a Position
P is a Positive samples
NP is a total number of positive reported sample values

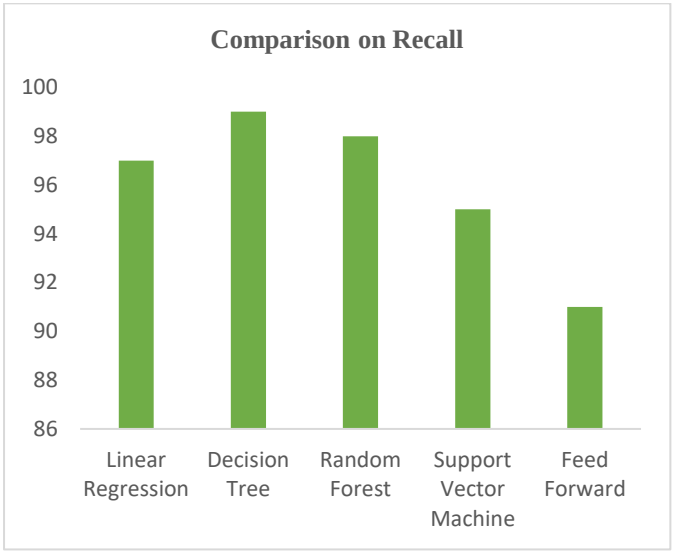
As it observed in the above figure 3 the Decision tree and the random forest algorithm became precision of 0.99 and Support vector machine has 0.95 and the logistic regression has precision of 0.97, then finally the multilayer feedforward has least precision of 0.93.

$$Recall=P/NP$$

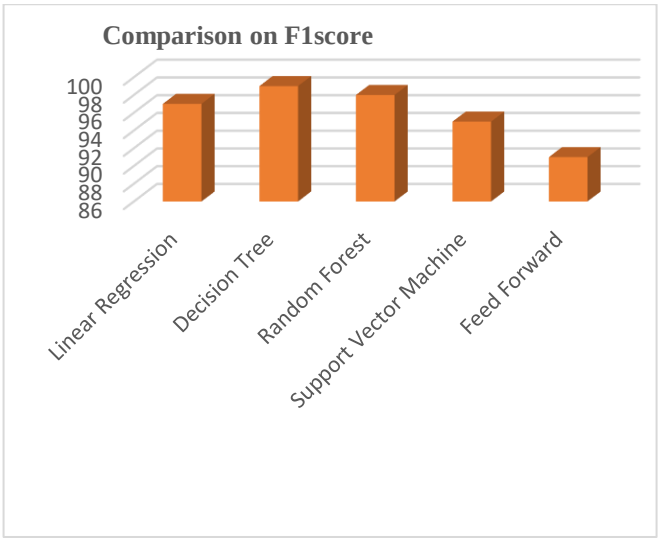
Where,

P is a positive samples predicted true value

NP is a testing set of total positive samples



Recall



F1score

Figure 4: Comparison on Recall and F1score

Figure 4 shows the Comparison on Recall and F1score that measures the accuracy of considering the model values using precision and recall simultaneously.

It is observed in the decision tree and random forest has the highest F1-score of 0.99 whereas multilayer feed forward has the least F1-score of 0.91 showed in table 2.

Table 2: Comparison of various Parameters and Algorithms

Algorithms	Accuracy	Precision	Recall	F1Score
Support Vector Machine	95.2%	0.95%	0.95%	0.95%
Random Forest	99.3%	0.99%	0.99%	0.99%
Linear Regression	97.25%	0.97%	0.97%	0.97%
Decision Tree	99.5%	0.99%	0.99%	0.99%
Feed Forward	93.5%	0.93%	0.91%	0.91%

IV.CONCLUSION

The objective of this study is taken from the various machine learning algorithms to predict with the thyroid disease classification which is hypothyroidism, hyperthyroidism and normal. The results showed that the used algorithm to analyze the accuracy, precision and F1Score. It was taken the dataset in UCI repository that contains 14 various attributes. After performing the comparative study, to find the most precise and accurate algorithm to predict and can concluded the decision tree algorithm that gives most accurate and precise results with the accuracy of 99.5% and precision of 0.99%.

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Study on Dynamic Behavior of Photovoltaic Mixer Grinder

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ABSTRACT

This paper presents the dynamic behavior of a PWM controlled mixer motor drive fed from a PV panel. In particular, qualitative changes that occur in the behavior of motor current have been explored against variation in irradiance and load torque. The output from PV panel is used to charge a battery using a buck-boost converter whose duty cycle is controlled by applying perturb and observe algorithm for the purpose of maximum power point (mppt) tracking. This battery in turn supplies a mixer motor through a PWM controlled buck converter using PI controller. The buck converter has been operated in voltage mode control. In this study a universal motor has been considered for the mixer grinder application. The proposed application of PV panel for a 0.5hp mixer motor has been simulated using MATLAB software.

Keywords - Bifurcation, Chaos, Mixing, Mppt, Photovoltaic, Universal Motor.

I. INTRODUCTION

The need for modernization is the cause of the growing rate of urbanization and this has led to the construction of a large number of multistoried buildings. The obvious outcome of this is the increased demand for electrical energy which is an alarming fact considering the available amount of conventional energy resources. Modern civilization is thus becoming more and more conscious regarding the use of renewable sources of energy like wind, solar, tidal, geothermal etc. along with the conventional energy sources [1]- [4]. However, another feasible solution is to adopt the eco-friendly concept of green building The idea of Green building means efficient use of energy along with utilization of renewable energy resources. Among the available options for renewable energy, solar is the best choice for India considering its geographical location. Several investigations are present describing methods for harvesting and utilizing solar energy. Solar energy stations can either be standalone generating unit for supplying local load or can be grid connected depending on the availability of a grid. The combined idea of green building and grid connected solar station has also promoted smart metering [5] – [6]. The green building market in India is estimated to get double by 2022. Thus, analysis of the performance of a mixer grinder fed by PV panel is actually a need of the hour .

The voltage output obtained from a PV module is needed to be boosted up for any practical application. The obvious solution for stepping up the PV panel output is to connect a boost chopper at its output terminals [7] The voltage obtained from a solar photovoltaic cell depends on different factors like luminosity, tilt angle, atmospheric temperature etc.

and thus nonlinear in nature. Therefore, performance of the electrical load can exhibit different nonlinear behaviors like limit cycle oscillation, quasi-periodic and higher

periodic behaviors including chaos [7]-[13]. However, voltage gain of the same is limited by parasitic resistance of the switching device and reactive components present in the system. In order to avoid this problem, output voltage from the PV panel can be connected to either buck-boost converter or cuk converter.

The mixing application needs high starting torque and so a dc series motor can be the ideal choice. However, universal motor can also replace conventional dc series motor. In the literature of power electronics and drives many investigations are present describing nonlinear dynamics of a PWM chopper controlled dc series motor [14] – [15]. However, very little investigations are present for exploring the behavior of a photovoltaic system of mixer grinder. Therefore, in this study an attempt is made to present the nonlinear dynamics of a PWM controlled universal motor fed from a battery, the battery in turn being charged by a MPPT controlled buck-boost converter fed from a PV panel.

The organization of this paper is as follows. Section II describes the system along its mathematical model. The proposed system has been simulated in MATLAB software. The simulation results are present in section III. In particular, bifurcation behavior of the motor current against variation in in luminosity and load torque have been presented in this section. Moreover, calculation of maximum Lyapunov exponent for each bifurcation diagram.

II. SYSTEM DESCRIPTION

The equivalent circuit of the PV panel is shown in Fig.1. The output from PV panel is used for charging battery through a buck-boost converter whose duty cycle is controlled by using maximum power point tracking method employing the perturb and observe algoritm. This battery is used to drive the universal motor using a PWM controlled buck conveter. The Buck converter is operated in voltage control mode usong a PI control loop.The battery voltage although varies according to solar insolation, but voltage fluctuation is much slower than the frequency of carrier voltage. Thus the battery can be mathematically modeled as a constant voltage souce. The proposed photovoltaic application including a universal motor has been presnted in Fig.2.

A. Photovoltaic Panel

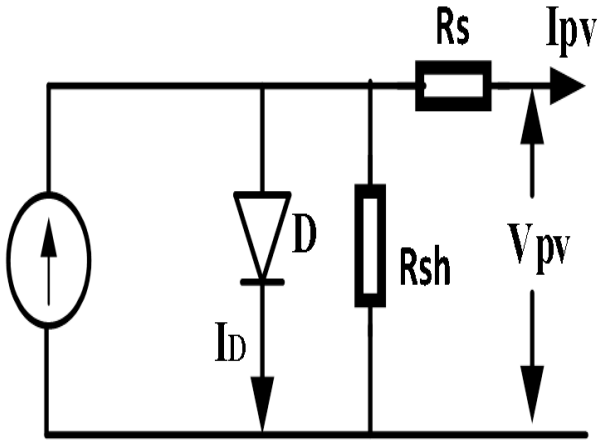

Fig. 1. Equivalent circuit of PV panel

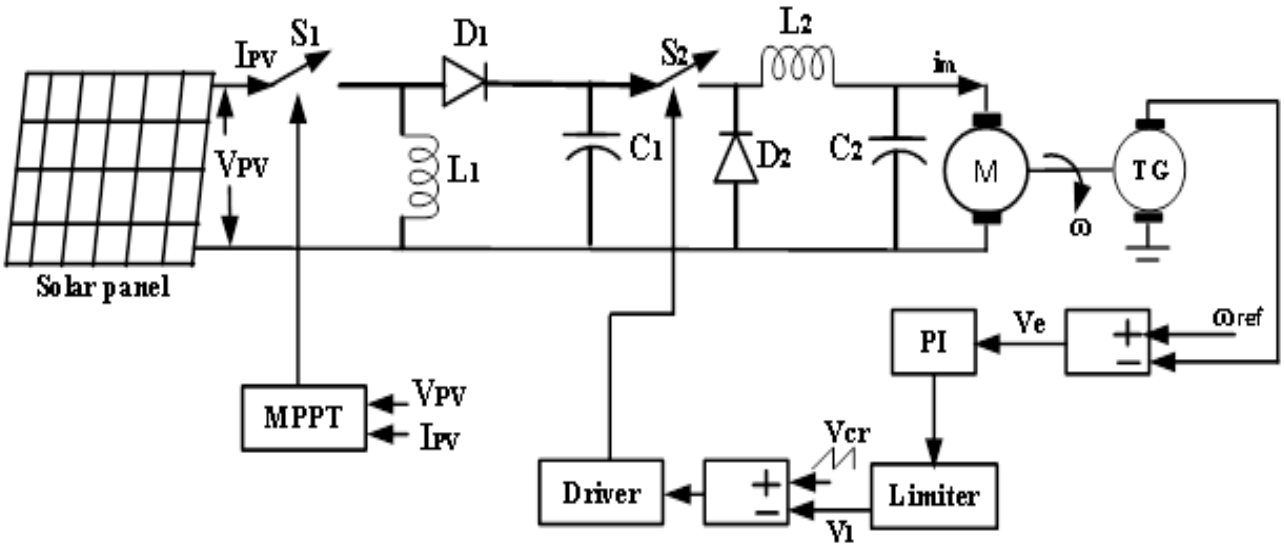

Fig. 2. Schematic diagram of PV panel fed mixer grinder with intermediate two stage power conversion

The V-I characteristic of the PV panel can be obtained by solving the transcendental equation as described in (1).

$$I_{PV} = I_{ph} - I_o\left[exp\left(\frac{q(V_{pv}+I_{pv}R_S)}{nKN_sT}\right) - 1\right] - \left(\frac{V_{pv}+I_{PV}R_s}{R_{sh}}\right) \quad (1)$$

The terms *n, K, Ns, T, q* in (1) represent ideality factor of the diode, Boltzmann's constant ($1.38X10^{-23}$ J/K), number of cells in series , operating temperature in Kelvin and charge of an electron ($1.6X10^{-19}$C) respectively. The photo current *(I_{ph})* and saturation current (Io) in (1) take the forms as presented in (2) and (3) respectively.

$$I_{ph} = [I_{sc} + k_i(T - 298)]\frac{G}{1000} \quad (2)$$

$$I_o = \frac{I_{sc}}{e^{\left(\frac{qV_{oc}}{nKN_sT}\right)-1}}\left(\frac{T}{T_n}\right)^3 e^{\left(\frac{qE_{go}\left(\frac{1}{T_n}-\frac{1}{T}\right)}{nK}\right)} \quad (3)$$

The terms *K_i, G, V_{oc}, I_{sc},, E_{go}* in (2) and (3) represent short circuit current of the cell at 25˚C and 1000W/m2, solar irradiation in W/m2,open circuit voltage in volt, short circuit current in Ampere and band gap energy of the semiconductor in ev respectively.

B. Buck-Boost converter with MPPT Control Specifications

The components S_1, D_1, L_1 in Fig. 1 together form the buck-boost converter. The two switching states of the converter can be stated as state 1 and state 2. State 1 means S_1 is On and D_1 is in off state . However, in state 2 S2 turns off and d1 conducts to freewheel energy stored in inductor during state 1. Considering current through L1 and voltage across C_1 as the phase variables and considering switch S2 in off state the state equations in both the switching states take the form as in (4) and (5) respectively.

$$\begin{bmatrix}\frac{di_{L_1}}{dt}\\ \frac{dv_{C_1}}{dt}\end{bmatrix} = \begin{bmatrix}\frac{V_{PV}}{L_1}\\ \frac{i_{L_1}}{C1}\end{bmatrix} \quad (4)$$

$$\begin{bmatrix}\frac{di_{L_1}}{dt}\\ \frac{dv_{C_1}}{dt}\end{bmatrix} = \begin{bmatrix}-\frac{v_{C_1}}{L_1}\\ -\frac{i_{L_1}}{C_1}\end{bmatrix} \quad (5)$$

The duty cycle of the switch S_1 is controlled by perturb and observe algorithm as shown in Fig. 3 below.

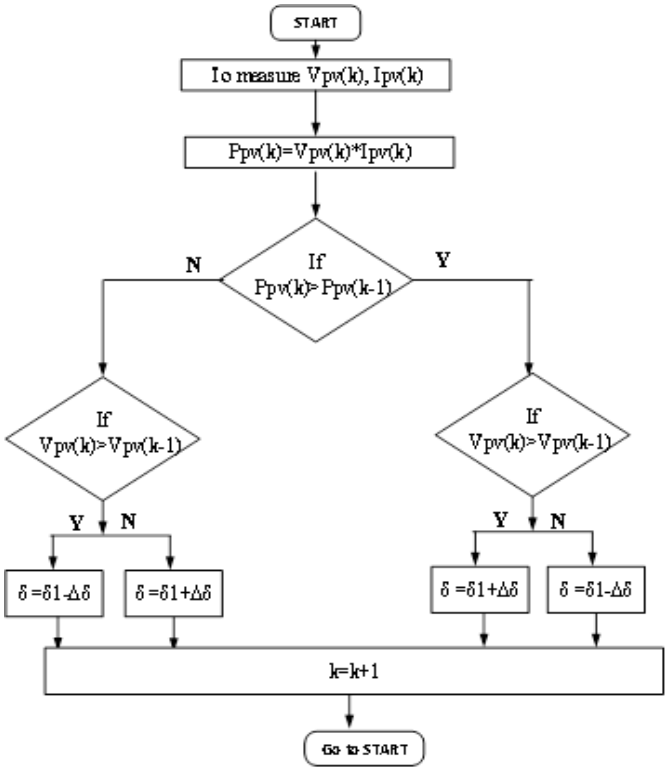

Fig. 3. Perturb and observe algorithm for maximum power point control

C. The Mixer Motor Drive

The universal motor acts aa load for the buck converter which is fed by the battery (C1) charged by buck-boost converter which is connected with the output terminal of PV panel. The switch S2, inductor L2 and diode D2 form the buck converter system. Considering device switching pulse for S2 as in Fig. 4, the two switching modes of buck

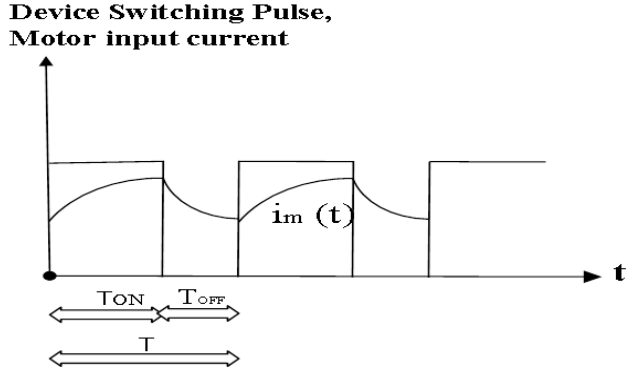

Fig. 4. Switching pulse for switch S_2

converter can be described as mode 1 (T_{ON})- when S_2 is on and D_2 is off and mode 2 (T_{OFF})in which S_2 remains in off state and D_2 conducts to freewheel energy stored in motor inductance during mode 1. The actual speed of the motor is compared with reference speed $\omega_{ref(t)}$ and the error voltage Ve(t) is fed to a PI controller with limiter. Output of the limiter circuit V_l (t) is compared with the carrier voltage V_{cr}(t) which is a saw tooth waveform of amplitude A and switching period T as presented in (6).

$$V_{cr}(t) = \frac{A}{T}\,t \tag{6}$$

Considering gain of the Pi controller as kp- ki, the output of PI $_{controller}$ with limiter can be described as in (7)

$$V_l(t) = k_p \begin{pmatrix} \omega_{ref}(t) \\ -\omega(t) \end{pmatrix} + k_i \int \left(\omega_{ref}(t) - \omega(t)\right) dt \tag{7}$$

Assuming linear magnetic circuit of the motor and considering motor current i_m(t), motor speed ω (t), current through L_2, voltage across C_2 and input to the integral controller as the phase variables x_1, x_2, x_3, x_4, x_5 respectively mathematical model of the drive system during mode 1take the form as in (8) and the same for mode 2 can be described by (9)

Mode-1

$$\begin{bmatrix} \dot{x_1}(t) \\ \dot{x_2}(t) \\ \dot{x_3}(t) \\ \dot{x_4}(t) \\ \dot{x_5}(t) \end{bmatrix} = \begin{bmatrix} \frac{x_4(t) - x_1(t) r_m - k_e x_1(t) x_2(t)}{l_m} \\ \frac{k_T x_1(t) x_1(t) - B x_2(t) - T_L}{J} \\ \frac{D_{MPPT} V_{PV} - x_4(t)}{L_2} \\ \frac{1}{C_2}\left(x_4(t) - x_1(t)\right) \\ \omega_{ref}(t) - \omega(t) \end{bmatrix} \tag{8}$$

Mode-2

$$\begin{bmatrix} \dot{x_1}(t) \\ \dot{x_2}(t) \\ \dot{x_3}(t) \\ \dot{x_4}(t) \\ \dot{x_5}(t) \end{bmatrix} = \begin{bmatrix} \frac{-x_1(t) r_m - k_e x_1(t) x_2(t)}{l_m} \\ \frac{k_T x_1(t) x_1(t) - B x_2(t) - T_L}{J} \\ \frac{D_{MPPT} V_{PV} - x_4(t)}{L_2} \\ \frac{1}{C_2}\left(x_4(t) - x_1(t)\right) \\ \omega_{ref}(t) - \omega(t) \end{bmatrix} \tag{9}$$

The terms k_e, k_T, r_m, l_m B, J , T_L, D_{MPPT} in (8) – (9) represent back emf constant, torque constant, armature resistance, armature inductance , viscous coefficient constant ,moment of inertia of the motor , load torque and duty cycle of the respectively.

III. SIMULATION RESULTS

The universal motor drive system showing application of PV panel has been simulated in MATLAB with following parameters as presented in Table 1.

TABLE1: Values of System Parameters

Sl. No	System parameters	
	Name of the parameter	Value
1	ki	0.0032
2	Tn	298
3	n	1.3
4	N_s	100
5	R_s	0.221Ω
6	R_{sh}	415Ω
7	B	0.001
8	J	0.001
9	r_m	30Ω
10	l_m	0.07H
9	T_L	1Nm
10	k_e	0.13
11	k_T	0.13
12	C_1	0.0047uF
13	C_2	0.0063uF
14	L_1, L_2	0.02H, 0.04H

The nature of variation of motor current against changes in luminous intensity is as shown in Fig. 5

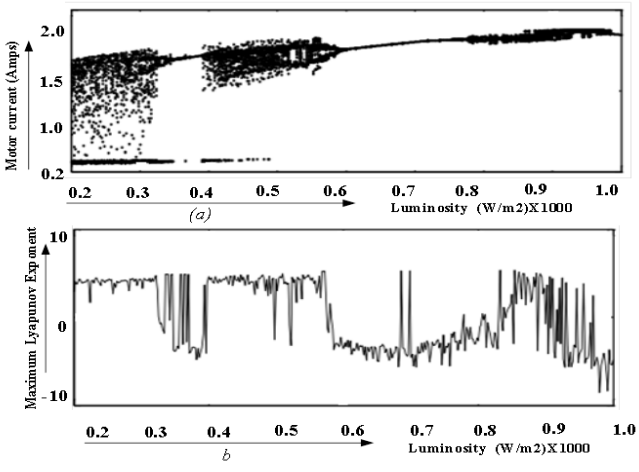

Fig. 5. Bifurcation behavior of motor current against variation in luminous intensity

a. Variation in motor current, b. variation in maximum Lyapunov exponent

All the bifurcation diagrams in this study have been obtained by stroboscopic sampling of the phase variables. Thus, in the bifurcation behavior of any phase variable, if the particular phase variable has only one value corresponding to a value of the bifurcation parameter, then it will be treated as period-1 behavior. If, however the phase variable possesses two values for any setting of the bifurcation parameter then the system is said to have period-2 evolution. Similarly, when the phase variable takes infinite values for any setting of the bifurcation parameter, the system is said to have chaotic evolution. It has been observed from Fig. 5 that for low value of luminous intensity the motor current shows chaotic evolution. Chaotic dynamics can be characterized by positive Lyapunov exponent which means occurrence of chaotic motion inside a mixing vessel. However, when luminous intensity increases beyond 600W/m^2 motor current shows stable nominal period-1 motion. Bifurcation behavior of motor current against variation in per unit value of load torque is presented in Fig. 6. It has been observed from Fig. 6 that for low values of load torque, evolution of motor current is periodic. However, when per unit value of load torque reaches nearly the value of 0.3, period doubling bifurcation takes place. Further period doubling bifurcation takes place, when per unit value of load torque reaches nearly the value of 0.35. Chaotic evolution of motor current is found after per unit value of load torque increases beyond 0.4. It is interesting to note that the drive system has period-1 motion for a short span of variation in per unit value of load torque ranges between 0.67 to 0.69 approximately. Occurrence of period -1 motion has been quantified by negative value of maximum Lyapunov exponent.

IV.CONCLUSION

This study is intended to explore effect of variation in solar insolation on the performance of mixer motor. This analysis is very helpful for implementing the idea solar powered mixer grinder which is indeed a smart idea for the green building.

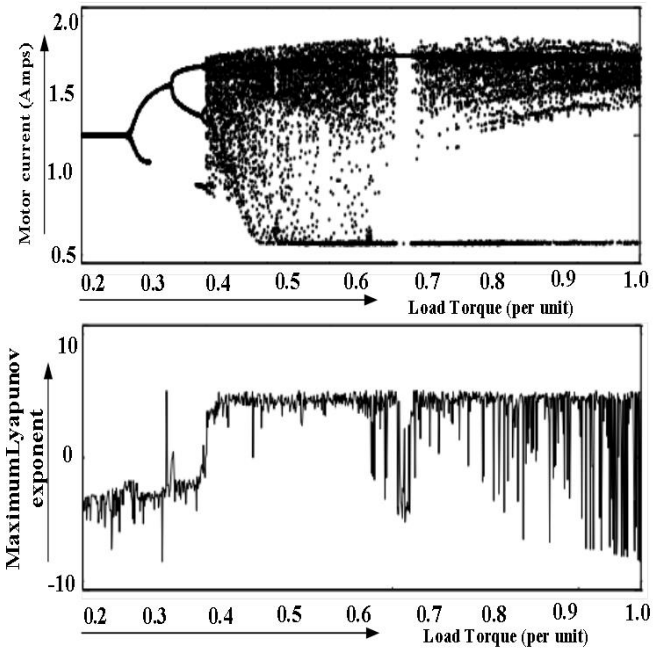

Fig. 6. Bifurcation behavior of motor current against variation in per unit value of load torque

Investigations show that, even with low value of solar insolation the mixer motor can run satisfactorily, rather better as mixing is considered. An attempt is also made is to investigate effect of variation in load torque on the performance of the drive motor and it has been found that for the solar mixer grinder mixing efficiency increases with high value of load torque. The increase in mixing efficiency can be claimed as occurrence of chaos e enhances mixing process.

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Review of Trust Management and Machine Learning Based Intrusion Detection in Wireless Sensor Networks

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ABSTRACT

Wireless sensor network (WSN) is a talented technology for practical applications since its size, inexpensive also simply distributed environment. By reason of several exterior otherwise interior components, WSN can update dynamically. Thus it necessitates reform the network. In traditional WSN, intrusion detection (ID) approaches based on trust management. The Trust management procedure is measuring trust with properties which manipulate trust. It creates several problems, for example, limitation of necessary valuation data, require of big data procedure, the demand of easy trust correlation appearance as well as expectation of automation. To solve these issues, machine learning (ML) techniques can be functional to respond accordingly. In this review, we explain different Trust management algorithm for WSNs with their benefits, limitations and complexity. In addition, we discuss the ML, classification, and several machine learning approaches.

Keywords - Machine Learning, Types pf Machine Learning, Trust Management, Performance Metrics.

I. INTRODUCTION

Wireless sensor network (WSN) is the major anticipating technologies for some real-time applications since its inexpensive, size, also simply distribute scenery. The role of WSN is to observe an area of concern also collect certain data also communicate them to the base station. A WSN contains a large number of sensor nodes, and it may adjust dynamically. Thus it may influence localization, routing strategies, latency, coverage, fault detection, Quality of Service, link quality, etc.

Trust management is the method of measuring the trust value employing assigns which involve trust. It is extensively utilized in dissimilar areas to assist decision making. Trust judgment established on malicious node recognizing can assist make sure the security. Trust measurement assists users to establish relationships, diminish the risk of actions also enhance the network quality. Trust measurement moreover applied to make sure protected fundamental interaction among automated agents also to advance the accomplishment of automation. It identifies interactional objects, assuring resource contribution with friendly also battling malevolent. Additionally, it used to service requesters choose a suitable service from a huge number of candidates.

In the meantime, the trust evaluation is suitable great predictably owing to the rapid growth of mobile transactions, services of online as well as social networking. Owing to the multifaceted, high-dimensional, as well as changeable features, it is hard

to carry out trust assessment in an actual, confused, and also difficult in large data situation. Traditional trust valuation approaches are unsuccessful in compute trust values which can be analyzed established on proficiencies of big data. As a significant also usually applied method for distributing with big data, ML can methodically also efficiently procedure data also enhance computational competence.

ML is a method in which repeatedly learns from the experience also plays lacking unambiguously programmed.ML computing procedure is a well-organized, dependable as well as cost-effective. ML makes an example through examining still extent composite data repeatedly, speedily also correctly. ML mostly categorized into supervised, unsupervised learning, semi-supervised as well as reinforcement.

II. REVIEW OF TRUST MANAGEMENT AND ML TECHNIQUE

2.1 Trust Evaluation

Trust is an essential certainty otherwise guess also it is a multidisciplinary idea. It is an entity's subjective prospects of the future features of other entities. Number of authors gives dissimilar trust definitions. Even though trust in dissimilar fields, trust demonstrates the adopting logical features such as context-awareness, active, subjectivity, imperfect transitivity, time decompose, irregularity, as well as quantifiability.

Trust assessment demonstrates variety in dissimilar applications. Trust approaches mostly apply trust-related properties to measure trust. Table 1 explains the benefits, limitations, and complexity of trust assessment approaches. Even though these approaches can calculate the trust, they furthermore transmit great proper numerical needs for measurement. Occasionally, it is inflexible to concern the examples. The selection of trust-related attributes and the formulation of rules greatly affect the accuracy of trust evaluation. It misses intelligence, as well as active maintain.

Several trust approaches relate linear aggregation for collecting dissimilar trust-impact properties throughout trust assessment in these application areas like service environments, multi-agent systems, as well as a network of ad-hoc and social. During the analysis of the above application, the earlier knowledge is missing; also, it is no longer applicable. Simultaneously, applying linear arrangement for combining trust characteristics for example, recommendations, experience, knowledge, and so on to communicate trust appears irregular lacking theoretical as well as practical support. Therefore, trust assessment correctness could be doubtful.

Below is the table which explains about the comparison of several trust approaches through the benefits, limitations of trust assessment approaches. Also it includes the advantages of each trust manage approach.

Table.1 - Comparison of Several Trust approaches through the benefits, limitations, and complexity of trust assessment approaches:

Approaches	Trust Evaluation	Advantages	Limitations	Complexity
Group based TM approach	History of communication time as well as recommendations.	Can't need complex mathematical computations	Can't able to detect the malicious nodes.	Complexity is less.
Hybrid Trust	Measured the	Preserve the node	Forwarder node	It creates an

calculation Approach	Reputation data communication.	resources	is easily captured by attacker nodes	additional time delay.
Bayes Theorem based trust computation	Reputation is received via the past transaction	Accessible multi-hop routing.	It does not consider merged interaction and data trust.	Complexity is less.
Geo Graphic Routing	Position based trust computation	Detect the selective forwarding attacks, Blackhole, Sybil attacks	Can't detect the collaborative attacks.	Required highest memory storage
Efficient Reputation-based Routing	Computation through the suggestion from neighbour nodes.	Can avoid the outcome of unfriendly nodes.	It utilizes more amount of energy.	Complexity is less.
Trust-Aware Routing	Ratio of Trust and treatment is computed.	The amount of malicious node increases it performs well.	It performs well only scalable for dense network.	Need Additional hardware.
Trust-based Cross-Layer Model	Bayesian statistics and Beta distribution.	Can work excellently even if the percent of malicious nodes is high.	It suitable only dense networks.	Need Additional hardware
Determining Faulty Readings	Established by trust voting	Calculation of trust value is accurate	Can't detect the collusion attacks.	Increases the network complexity
Mechanisms established on Data Life Cycle	Computed the Trust value by the life cycle of data is precise.	Calculation of trust value is accurate.	Can't detect the malicious attacks	Complexity is Less.
Trust established on transaction trust, Energy trust as well as Data trust	Multi-angle trust contains trust of data, transaction, as well as energy trust.	Incorporation value of trust is more consistent.	Can't update the trust values	Lesser complexity.
Trust Computation method using Fuzzy Logic	Trust is computed by previous activities.	Applying fuzzy deduction can quantize unsure or inaccurate data.	This scheme is not suitable large-scale network.	Additional memory required to store history actions.
Node Behavioral strategies Banding	Trust is computed by detecting the	Computed trust is precise.	Necessitate extra energy as	Need excess memory.

belief theory	neighbour nodes.		well as time owing to the cooperation and communication with neighbours.	
Agent-based Trust model	Trust is computed by space of reputation as well as trust.	Detect the malicious node attack, for example, on–of attack bad-mouthing attack, and conflicting behaviors attack.	Susceptible to malicious agent nodes.	Computational complexity is less.

2.2 Machine Learning

ML concerns to prototype recognition, data mining, numerical learning, speech identification, language working, computer revelation, also intrusion detection. Owing to the necessitates of big data treating also requests of artificial intelligence in several areas, ML gets significant. ML has extensively employed into examining big data. An important target of ML is to create examples from data with computers. ML is classified into four types, such as supervised, unsupervised learning, semi-supervised, and reinforcement learning. The ML classification is shown in Figure 1.

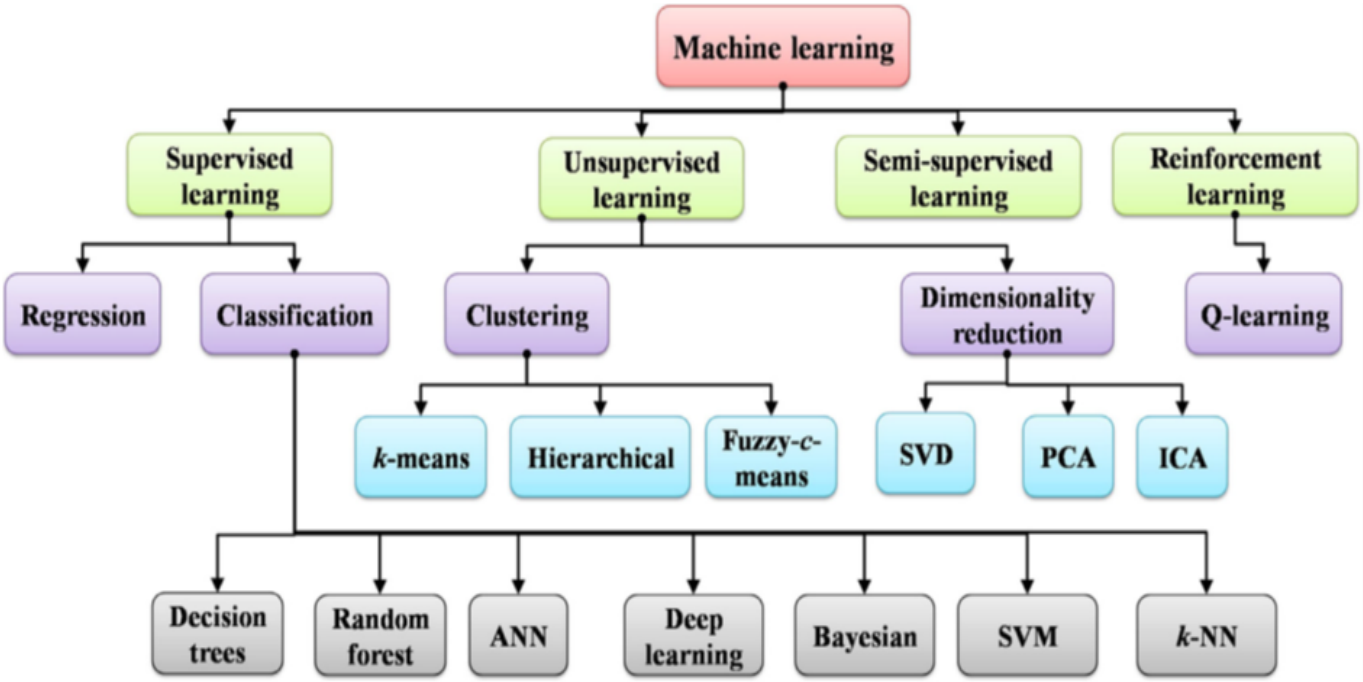

Figure.1 Machine Learning Classification

2.2.1 Supervised learning:

Supervised learning is a significant data functioning accesses in ML. This type of learning comprises a set of input as well as outputs, also it discovers the relative among them whilst training. Most important obligations of supervised learning techniques to create the model that presents relationships as well as dependency connections among input characteristics also predict objective outputs. This learning resolves several disputes, for example, coverage troubles, congestion control, localization, abnormality as well as detecting the fault, synchronization, routing data aggregation, energy harvesting, objective chasing and detecting occurrence. This type of learning is classified into regression as well as classification. Classification also split into logic (random forest as well as a decision tree), perception (deep learning as well as ANN), statistical learning (SVM as well as Bayesian) also instance (k -NN) techniques.

Regression:

This type of method is to forecast several values established on a specified set of features. The variable in the regression model is uninterrupted. It is an uncomplicated ML method also forecasts precise results with the smallest amount of errors [29]. This method is employed to resolve several effects, for example, data collection, localization, energy-saving, as well as the problem of connectivity.

Decision trees:

It is established by a set of if-then rules to improve the legibility. It comprises two types of nodes known as the leaf as well as decision nodes. It applies to forecast a class otherwise objective through making a training model established on decision formulas derived from training data.

The benefit of this method dilutes uncertainty in making decision, transparent, also permits for a complete analysis. This type is used to resolve several effects, for example, abnormality recognition, connectivity, selection of route as well as aggregation of data.

Random forest (RF):

It is an aggregation of trees also every tree offers a classification inside the forest. This method exploits in two levels, such as the formation of random forest classifier as well as the forecast of results. It precisely forecasts the omitted values. The conventional classification method is confronting important disputes owing to irritation of dimensionality as well as extremely linked data. RF classifier is a better suitable system for separating hyper-spectral data. RF technique has been employed to resolve several effects, for example, coverage as well as MAC protocol.

Artificial neural networks (ANN):

It is connected with an enormous number of neurons which action information also makes precise results. It usually functions on layers, and these layers associated with nodes also every node connected with an energetic operation. Every ANN consists of three layers known as the input layer; hidden layer(s) also output layers. Many practical applications have to apply ANN while it has great calculation necessity. In addition, it enhances the effectiveness of several problems together with routing, localization, discovering faulty nodes, data aggregation as well as congestion control.

Deep learning:

It is a subtype of ANN. It makes up with easy non-linear faculties which translates from lower layer to higher layer to attain the better resolution. It is prompted through transaction designs also information treating in nerve arrangements. The advantages of this learning are removing high-level characteristics from the data, also it can be trained to accomplish several aims. It is used in several fields, for example, business intelligence, social network, Bioinformatics, handwriting identification, image processing, and speech detection. This type of learning has dealt several problems, for example,

routing, energy-saving, data quality evaluation, an anomaly as well as fault detection.

Support vector machine (SVM):

It executes the better classification of applying hyperplane as well as coordinates personality surveillance. Generally, the training data is excess once a margin demonstrated as well as a set of indicates assists to recognize the boundary. SVM offers better classification from a specified set of data. Hence, the complexity is unchanged through the number of characteristics found in the training data. So, it is well fitted to an agreement with learning jobs. It dealt problems, for example, connectivity issues, congestion control, localization, fault detection, routing.

Bayesian:

It discovers the relationships between the datasets through learning the conditional independence applying many statistical methods. Bayesian learning permits changed possibility operations for dissimilar variables. This learning strategy is used to enhance the efficiency. It handles the problems are routing, localization, data collection, recognition event, coverage, recognition of anomaly and fault, synchronization, target tracking, as well as route selection.

k -Nearest neighbour:

It is usually classifies established on the distance among determined training samples as well as the test sample. It applies several distance operations for example distance of Hamming, Euclidean, Manhattan, Canberra, Minkowski as well as Chebychev. This method discovers the probable absent values from the feature space as well as minimizes the dimensionality.

2.2.2 Unsupervised learning

It is used to classifying the set of related patterns, decrease dimensionality, as well as anomaly detection. It undertakes several effects, for example, routing, recognition of anomaly, connectivity issues, as well as data collection. It is classified into clustering as well as dimensionality reduction.

k-means clustering:

It is simply building a definite number of clusters. Primarily k amount of arbitrary position is conceived also every one of the continuing points related to the nearby centers. Once the clusters are organized through dealing all the points, a recent centroid from every cluster is re-computed.

Hierarchical clustering:

Hierarchical clustering groups the similar objects into clusters which have a prearranged top-down otherwise bottom-up order. Top-down clustering is known as divisive clustering; here, a great solitary division divides algorithmic till cluster for every notice. Bottom-up clustering is also known as agglomerate clustering. Here, every watching attributes to its cluster established on density operations. This type of clustering, no past information necessitated about the number of clusters. It resolves the several troubles, for example, data aggregation, synchronization, as well as energy harvesting .

Fuzzy- c -means clustering (FCM):

Here, clusters are recognized established on the similarity capacity, for example, distance, intensity, otherwise connectivity. This method repeats on the clusters to discover the optimal cluster . It mainly calculates on the number of dimensions, clusters, data points, as well as iterations. This FCM is applied in several like Bioinformatics, pattern recognition, business intelligence, as well as image segmentation. The FCM time complexity is greater than the other techniques.

Singular value decomposition (SVD):

It is a matrix factorization technique that is utilized for minimizing the spatiality. Matrix factorization intends a matrix into a matrices production. This method assures the best low-rank data version. It deals with several problems such as routing as well as collecting data.

Principle component analysis (PCA):

This method merges entire information also loss the lesser priority data from the characteristic rate to decrease the dimensionality. The PCA outcome is a linear arrangement of experimental variables. It applied to distinguish anomalies, weakening, decrease the transaction overhead. It diminishes the overflow of the buffer that evades the congestion. FCA deals with several problems like intrusion discovery, localization, target tracking, as well as collecting data aggregation .

Independent component analysis (ICA)

It is a better method than PCA, and it eliminates the upper order dependences. This method examined data from several areas like digital images, web content, psychometric evaluations, business intelligence, as well as social networking, etc.

2.2.3 Semi-supervised learning

The supervised learning employment well on the labelled entropy also unsupervised learning employment well on unlabeled entropy. But, semi-supervised learning employment well on the entropy with the compounding of labeled as well as unlabeled. It contains two significant objectives such as forecast the labels on unlabeled entropy as well as forecast the labels on a future test. Regarding these objectives, this learning type is separated into two classes' namely Transudative learning as well as inductive learning. Transudative learning is applied to forecast the precise labels for specified unlabeled entropy. But, inductive semi-supervised accepted to be a superior forecaster. This type of learning corresponds with various applications, for example, speech recognition, protein sequence categorization, natural language treating, separating the web content, spam filtering as well as video surveillance.

2.2.4 Reinforcement learning (RL):

It is unceasingly to learn through inter behaving with the situation as well as collect the data to obtain definite activities. RL exploit the function through deciding the best result from the environment.

Table 2. Comparison of ML Types with Complexity

ML Types	Detection	Results	Complexity
k -Means	Hybrid anomaly	enhanced accurateness	Medium
k -NN	Random faults, Cyber-attacks	Time complexity is minimum	Lesser
Decision tree	Sinkhole	enhanced accurateness	Medium
SVM + PCA	Outliers detection	enhanced accurateness	Medium
SVM	Anomaly detection	Reduced time complexity	greater
Q-learning	DoS	Enhanced Lifespan	greater
Bayesian	outlier detection	enhanced accurateness	Medium
Regression	Anomaly detection	enhanced accurateness	Medium
Deep learning	Intrusion detection	enhanced accurateness	greater

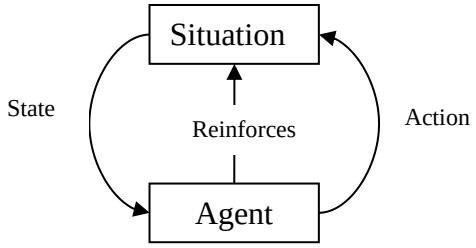

Figure.2 Reinforcement Learning

Figure 2 demonstrates the operation of the reinforcement learning. Q-learning method is the example free reinforcement learning. In Q-learning, every agent interrelates with situation also produce a sequence of examination as a state act reinforces. The Reinforces matrix R (S, A), here A as well as S denote a set of actions also a set of states correspondingly

Table 3. Comparison of Several ML applied for IDS

ML Approaches	Detection	ML Technique	Results
ML algorithms in context ID	Intrusion detection like remote to local, DoS, the user to remote attack	Decision tables, SVM, Naive Bayes	It attains the best function under the redundant characteristics
Ensemble of binary SVM classifiers	Intrusion detection	PCA	PCA feature extraction is better than a single feature extraction algorithm.
ID ML technique on Big Data environment	Intrusion detection	SVM	It attains better function also minimum false positive rate.
A self-adaptive deep learning system	Anomaly detection	Deep learning	It attains the accuracy of anomaly detection applying deep learning
Light-weight ID method	DoS	SVM	It attains the light-weight IDS
Ensemble Approach for ID method	Intrusion detection	Naive Bayes	It attains the best function.
ID in smart cities applying Restricted Boltzmann Machines	DDoS attack	K-means, RF, SVM.	It performs better than other techniques.
Attack and anomaly detection using the ML method	Attack and Anomaly detection	Regression, ANN, SVM.	This technique provides better result using IoT.

Table 2 explains the Comparison of ML Types with Complexity, and Table 3 indicates the Comparison of Several ML applied for the ID system in WSN.

III.CONCLUSION

In this review, Trust Management and Machine Learning based Intrusion Detection in WSN. Here, we described different Trust Management technique and ML technique briefly. The trust estimation approaches should assure to validate the quality of trust also remark of every approach benefit, as well as limitations, are described. We have explained the types of ML, and their applications are examined also highlighted several problems in WSNs treated through ML approaches. For example, routing, detection both of anomaly and fault nodes, synchronization, data collection, controlling congestion, energy saving.

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Review of Clustering Strategies with Artificial Intelligence Machine Learning Algorithm in MANET

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ABSTRACT

Mobile Ad hoc Network (MANET) is intrinsically wireless networks coordinated lacking pre-existing topography. MANETs are efficiently distributed in different surroundings, for example, Disaster Management, Armed Forces, Medical as well as other related incorporated Applications. Though, it is discovered which newer disputes also applications come up in MANETs. In large MANET preparations can possess an enormous amount of mobile nodes making new issues. To overcome this issue, clustering techniques are consistently applied to permit the organising into the group of clusters. In every Cluster, there is an exacting node playing as Cluster Head (CH). Clustering is s process, identifying the number of nodes to be grouped and an associated cluster head. This procedure acts as a vital role in improving resource management and network function. This review paper discusses several conventional clustering strategies established on Mobility, Identity, Topology, Weight and Energy clustering. In addition, describe the Artificial Intelligence Ma- chine Learning (AIML) features of the concept of AIML, the importance of AIML, Classification of AIML, and many AIML clustering approaches are done.

Index Terms - Mobile Ad hoc Network, Clustering, CH Selec- tion, Artificial Intelligence Machine Learning.

I. INTRODUCTION

MANET is a short-term independence structure collected through a group of movable nodes with wireless communica- tion, and it is a multi-hop radio network. When communicating information from such node is obtained through the entire nodes, representing the node present, the communication range [1]. Though, if both source and destination nodes are out of communication range, next, the in-between nodes can build the transmission path. Because of its scenery of node movement, every host has to operate autonomously. Application of this technology is witnessed in the industrial sector, educational and military [2]. In MANET, nodes are speculative locate in groups named Cluster. The nodes in MANET are usually zoned into individual clusters. A few nodes are worked as a Cluster Head (CH) in charge of allotting the resources to its cluster member nodes. Each node preserves complete information of its Cluster, ensuing in enhanced routing effi- ciency. However, traditional routing approaches have several drawbacks [3].

ML is examining how the computer to reproduce otherwise comprehends the learn human being behavior. The objective is to receive the recent

knowledge otherwise the ability, categorise the knowledge structure that can build reformist enhancement of it's possess function. It is the interior of AI; It is a basic method that facilitates the aptitude; its application is attained in several AI fields. It is mostly applying the mode of induction and the deduction but not the subtraction [4].

AI is a scheme which determines which the machine can perform rational actions as humans can perform several proce- dures at a time. A broader view of AI is the solving problem, arrangement of learning, awareness, as well as adopting new solutions. It also necessitates reasoning, as well as linguistic logic. ML is a method in which repeatedly learns from the experience also plays lacking unambiguously programmed. ML computing procedure is a well-organised, dependable as well as cost-effective. ML makes an example through examining still extent composite data repeatedly, speedily also correctly [5].

The AIML launches the understanding method based on the review of humanity via cognitive science, physiology, formulates every type of study, reviews the general technique containing on the hypothetical analysis, and demonstrates a study process with a precise application confronting the duty [6].

II. REVIEW OF CLUSTERING STRATEGIES WITH ARTIFICIAL INTELLIGENCE MACHINE LEARNING ALGORITHM IN MANET

A. Clustering In MANET

For forming wireless networks in large scale topography, it is apposite to build also preserve disseminated nodes in decided structures, such as dominating sets, spanning graphs, clusters to build system well-organised, consistent, and robust from transmission viewpoint. This moreover guides to wanted practice between nodes in a forever exchanging surroundings. In networks on the dynamic topography, clustering spatially neighboring nodes is sorted mutually through the network division. These clusters of nodes are distinguished through CHs. The entire nodes inside a cluster are associated with each other straight otherwise through neighbor nodes [7].

For alleviating proficient transaction between nodes, clus- tering is the significant procedure. Since nodes present a re- stricted power that cannot be substituted on will be dispatched; thus, the node becomes out of activity. This impact decreases the performance of the network. There is necessitates to save the energy at the entire times. As a result, it requires optimisation of communication range as well as reduction of energy utilisation [8].

The restricted bandwidth builds it is vital to make a virtual network and distinguish the route for transmitting packets. Nodes going to neighboring clusters transmit through margin node. Since this grouping, the nodes into typical clusters for structure suitable clusters are the MANET's main disputes. Thus, optimal clustering resolutions can significantly improve the capability as well as execution of MANETs [9].

Clustering nodes qualified into three dissimilar classes are as follows:

Cluster-Head (CH):

The node in each Cluster is selected as a CH that observes also controls transaction routes for all other nodes.

Cluster–Gateway (CG):

It presents in more than one Cluster also behaves as a bridge among CH clusters. CH, as well as Cluster Gateway nodes, are the stamina of the network.

Normal Node:

This kind of node transmits the information to CH that in twist sends the collected information to the following hops.

1) Benefits of Clustering:

The cluster intention assures well-organised function with regarding enormous, intense MANETs. The advantage of clustering is given below.

- It allows the approach for improving

performance through enhancing flexibility and throughput.

- It diminishes the scale of routing tables also increases the routing.
- Modifying the routing tables owing to topological update results in the diminution of communication overheads.
- It assists in decreasing the bandwidth necessity as well as energy expenditure

2) Disadvantage of Clustering:

- Clustering associated data exchange gains overhead on the network.
- Rebuilding of Cluster arrangement independence system arrangement modify is resource exhausting.
- Transaction Complexity rises owing to control message interchange.
- There is no universal resolution for clustering.

B. CLUSTERING APPROACHES IN MANET

Categorisation of several Clustering techniques is estab- lished on techniques and measures for CH choice [10].

1) Mobility Based Clustering:

This type of clustering, the clusters are formed by node mobility. Thus it attains better Stability. The mobility prediction for anticipating exchanges approach to reroute the braked route. Mobility based clustering approach which builds the clusters by node mobility parameter.

Relative mobility is a better parameter for clustering the nodes rather than plain IDs which are not representative of node mobility in MANETs [11].

D-hop clustering approach is established on the pattern of mobility that makes a variable-diameter. The difference of distance among two nodes is used to compute the nodes relative mobility. This approach measures the prospect of nodes mobility in the MANET. The movement of every node is estimated ultimately through changes in the neighborhood of the mobile node above time [12]. **Mobility prediction-based clustering algorithm** evaluates regarding mobility informa- tion. This approach contains two stages, such as clustering, as well as maintenance. It improved the lifespan and minimised the time of re-association [13]. **Link-Prediction approach is used** to forecast the failure of the link. This approach is used to enhance the network function, but it increases the energy utilisation [14].

2) Topography Based Clustering:

This type of clustering, form the Cluster is established by network topology and connectivity metric is used for choosing the CH [15].

Clustering-based new link-state routing approach main- tains which size of the routing table as well as minimised the routing overhead. The excess information on dissimilar control packet cases is rejected through this technique [16]. **Associatively based cluster** formation approach conducts the Spatio-temporal Stability also the optimal position of a CH. Here, the CH selection through Highest Connectivity. Highest connectivity represents the maximum amount of neighbors. However, this approach increases the network delay [17].

3) Identity Based Clustering:

In this type, each node is allotted a unique ID. Here, each node is awake of neighboring node Identity. **Least Cluster Change approach** is used to optimise their clustering expenditure. Here, rebuild of Cluster is prepared via two terms: initially, two CHs are neighbor nodes, the node with the greatest id will be picked out as a CH. Next, if a member node acts into another cluster next to the node departure, the Cluster will be a CH [18]. **Adaptive Clustering approach** is the idea of CH should be resolved as well as whole nodes in the Cluster should act an equal role. The smallest Cluster should act equal roles. The smallest Id metric is utilised for CH choice. For cluster protection, every node has to be alert of its

neighbors able to two-node to be awake of its neighbors till two-hop [19].

A vote-count (VC) based clustering technique that applies node position, identity as well as remaining energy. Every node regards Hello message obtained from neighbors. The highest hello message node is selected as a CH from neighbors. This approach forms the network is strong but, create extra overhead because a large amount of data is interchanged in the procedure [20].

4) Energy Based Clustering:

Node energy has a straight cause on the lifespan of a network. The restriction of energy builds a cruel network function dispute. **Multicast Power Greedy Clustering** approach builds the energy-efficient clustering. This approach reduces both energy consumption and bandwidth utilisation. A **multicasting Power-aware scheme**

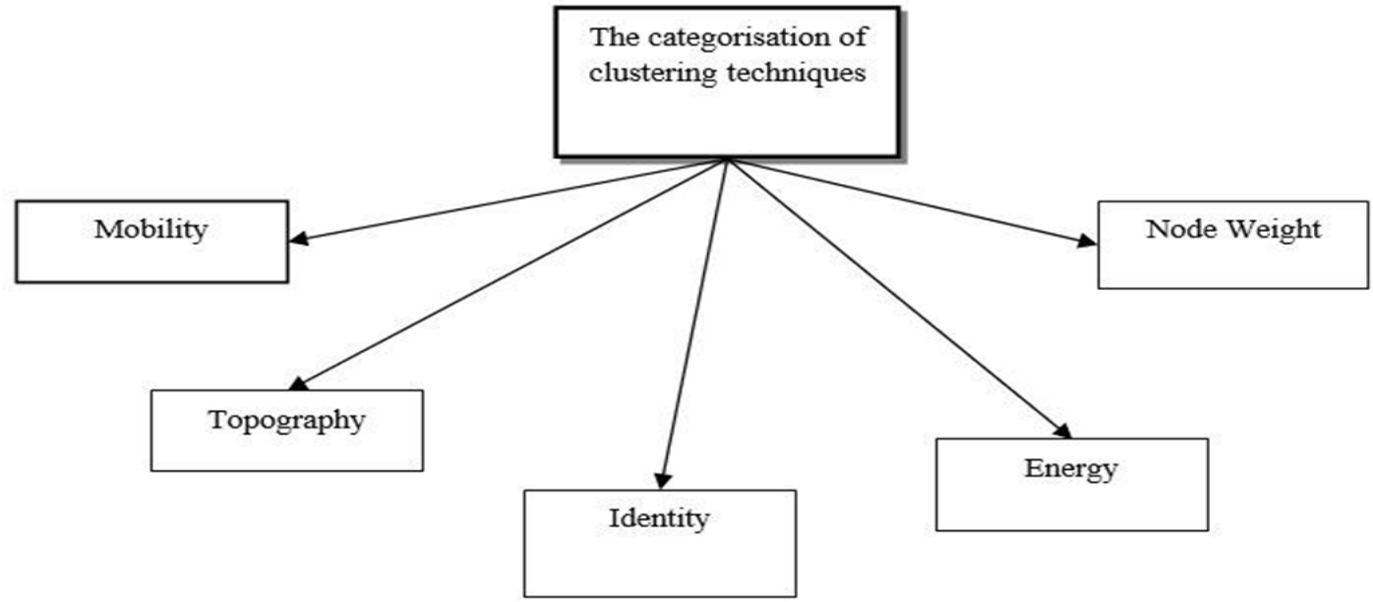

Fig. 1. Categorisation of clustering techniques in MANET

in which selects the CH based on node energy. It offers well function and enhances the network lifespan [21].

Flexible weighted Clustering scheme establishes the route by node energy. In this approach, node weights are attributed to a node through energy value. **Enhanced Sectorised Clus- tering** is used to select the CH based communication range and energy. Enhance Cluster Based Energy Conservation con- centrate on energy saving, thus improving the lifespan of the network.

5) Clustering based on Node Weight:

Combining dissim- ilar arguments is efficiently executed in weight, for example, Energy, node degree, mobility, distance, etc. The weighting factors of each metric will be acclimatised according to the scenario.

Enhancement on weighted clustering approach is used for balancing the load through node stability. This approach minimises the control. However, this approach increases the energy consumption [22].

A robust weighted clustering approach is computing the weight through energy, node movement, as well as a load of Work. In this, every node weight is calculated using three parameters such as power, mobility and workload. It minimises the re-clustering overhead also enhances the network lifespan [23].

This approach computes the weight by stability factor. It is established on several elements, for example, the distance among nodes, CH energy, velocity, also the count of nodes. Here, fuzzy logic is applied for formed the optimal through node energy,

and velocity of the nodes. However, this approach increases the overhead of route [24].

Efficient Weight Based Clustering approach is used to reduce the overhead of the route, improving the throughput, also evade the unwanted resource utilisation like energy and bandwidth. **Density-based clustering approach** is used to enhance the route stability as well as efficiency. Here, the CH is selected via node communication range, energy and distance. This approach minimises both the overheads as well as delay.

Score Based Clustering approach is used for increasing the network lifetime also enhances the nodes lifetime. Here, the node score is computed through the node degree, residual energy, as well as node stability. The highest score is selected as a CH.

Weight Based Distributed Clustering algorithm approach updates itself since modifying in topography. This approach minimises the routing overhead.

Forecast Weighted clustering approach preserves the cluster connections details also cluster rank. This approach minimises the overhead of routing. Flexible Weight Based

TABLE I

COMPARATIVE ANALYSIS OF CLUSTERING APPROACHES

Approach	CH Selection Technique	CH Overhead	Energy
Cluster-Based Routing Protocol	CH selected by based on Lowest Identity Clustering	Routing overhead extremely	High energy utilisation
Weighted Clustering Approach	CH is selected by node weight. This weight is calculated through mobility, connectivity, residual energy, utilized communication factors are calculated.	Routing overhead extremely	High energy utilisation
low control overhead cluster maintenance Approach	CH selected by based on Lowest Identity Clustering	Routing overhead extremely	High energy utilisation
Improved Cluster Maintenance Strategy	Select the CH by Node Degree as well as Residual energy	Routing overhead is low	less energy utilisation
Weight Based Clustering Approach	It contains three phases that is Pre clustering, Cluster configuration and Protection.		Energy utilisation is very less.
Optimised Stable Clustering Approach	Initial CH election based on priority factor.	Overhead is very less.	Energy utilisation is very less
Priority Based Weighted Clustering Approach	CH selection procedure is conveyed out applying the priority factor	Overhead is very less	Energy utilisation is very less

Clustering introduced a relatively stable 2-hop clustering that also provides Stability against updating topography [25].

Trust-based cluster routing approach decides the trust value of every node. Here, the trust value modifying the technique to assure the trust value in a given time interval also modify the friend list because the continuously updates the network. However, this approach increases the routing overhead [26].

C. Artificial Intelligence Machine Learning:

Traditional clustering approaches have several drawbacks in MANET. Artificial Intelligence Machine Learning (AIML) is based on solving these problems in the network [27].

ML is a method in which repeatedly learns from the ex- perience also plays lacking unambiguously programmed. ML computing procedure is a well-organised, dependable as well as cost-effective. ML makes an example through examining still extent composite data repeatedly, speedily also correctly. ML concerns to prototype recognition, data mining, numerical learning, speech identification, language working, computer revelation, also intrusion detection ML mostly categorised into supervised, unsupervised learning, semi-supervised as well as reinforcement [28].

Along with the growth of Internet technology and multi- media proficiency, AI investigation has egress many recent problems. AI has invoked rising the inclining in several fields that are a border of fields applied to suggest human consideration. AI is an intelligence which is a great deal fresher than the greatest human brain in basically each area, admitting computer science as well as linguistic logic. It is new procedures of machines that will do strength work also exemplify complex questions. AI acts an extremely significant function to reveal intellectual behaviour, study, and display and provide suggestion to the user [29].

AI specialist system for sub-as a subdivision of AI has enrolled a practical application in several departments, several views of social life, and extend acting in the direction of in- depth growth. AI contains two types, for example, Weak AI also Strong AI.

1) **Weak AI.**

Weak AI's opinion in which the machines act as if they are well-informed and establish that effective capabilities like speaking, acting, believing, can be complete through the machine if they are programmed. For example, in- game of chess, the computer can act as well as shift players robotically. The computer can't present guessing capability, but in reality, it is programmed so that the computer ever accepts the right step.

2) **Strong AI:**

Strong AI's opinion in which the machines will per- form computations; assume itself also it will forecast the response in future. Therefore in future, it will be absolutely this machines otherwise can be humanoids that will perform it possesses Work also believe more efficient than human beings.

1) Working Function of AIML:

Whether machine capability can exceed the human's or not, the major dispute that several people agree with denial estimation is: The machine is human- made, its function also the society are wholly predetermined through the designer. Thus its capability cannot exceed de- signer in several cases. Since this type of machine's capability can be enhanced continuously in the application, after that, yet the exclusive would not recognise the stage of its capability [30].

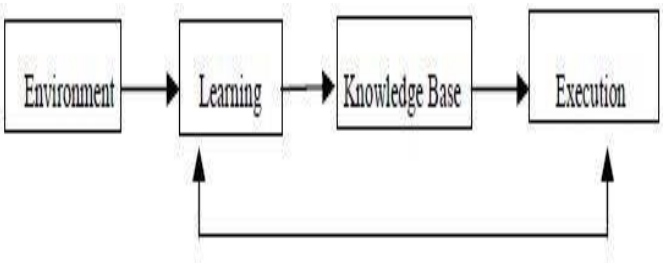

Fig. 2. Working Function of AIML

The ML has a particularly significant condition in the AI investigation. The intelligent system that does not have the learning capability is hard to know a true one, but the past intelligent system usually restricts the study. Its application has been during the several subdivisions of AI, for example, automated analysis, expert systems, intelligent robots, usual language understanding, computer vision, pattern identification also other areas. For example, particular applications include medical diagnosis, handwriting recognition and voice, search engines, recognition of credit card dissembling, stock market examination, DNA sequences, games strategy, and robots. Figure. 2 shows the fundamental formation of ML.

The environment offers sure details to the learning division system. Also, the learning division revises knowledge library through applying these details. In the environment of the actual application, the knowledge library, as well as the execution division, have determined the actual effort content the learning division that necessitated to resolve the difficulty to be decided wholly through the above three divisions [31].

The significant component that involves learning system pattern is the detail that is offered to the scheme through the surroundings, otherwise the information quality. Though, the surroundings also the learning system is offered with a diversity of information. If the quality of information greater also the variation of the general standard of equality is lesser, the learning division is relatively simple to an arrangement with. Next, the role of learning several of is higher; the design is extra hard.

Since the information received from the learning system is repeatedly imperfect, concluding is not completely dependable that is contained out through reasoning. The acceptable rules build the system competence, and the mistaken rules should be erased from the database [32]. The knowledge was carried via several classes, such as the rule of production pattern, semantic network, feature vector, step logic sentence, the frame, etc.

A question, at last, necessitates describing that concerning the knowledge library is analyses the system not to capable not to wholly have in any knowledge condition the baseless knowledge attainment, every learning process all requests to have convinced knowledge to understand the environment offers the information, the analysis comparison, builds the supposition, examines as well as revisions these suppositions. As a result, the learning division is to the existent knowledge development as well as the enhancement.

2) Classification of AIML:

Out of all the approaches, it has been mentioned that AI is the forthcoming conceptions implanted in dissimilar technologies as well as the transaction system. Fundamentally, AI is a method of convincing several devices linked an extremely elegant also intelligence. The necessary involvement of AI is to build the system accepts the autonomous decision. The AI's backbone is fabricated based on several discipline examples, mathematics, computer, linguistic, biology, and engineering [33]. The major idea of the AI is to do an association of the data as well as the system to make sure that i) there should be maximum physical property also offers data, ii) the information otherwise system subjected to alteration to correct the errors, also iii) it should provide greater usage regardless of the detail which it could provide some error- prostrate information.

AIML Clustering Approaches:

Fuzzy based Approaches: The Fuzzy C-Means (FCM) clustering algorithm is suitable for resulting clusters of intensive data and clear distinction among clusters. And it is relatively scalable and highly effi- cient. A Fuzzy method with the weight modification approach is executed to choose the best CH for the MANET [34]. Here, Weight amendment method is established on super- vised learning. Generally, the fusion of fuzzy model also supervised learning represents the checking behavior with the feed-

forward supervised learning. Here, every node develops its score applying factors by fuzzy score computation, for example, neighbor nodes count, residual energy, Stability.

Swarm intelligence (SI):

SI addresses the management of collective behaviors of highly dynamic and distributed ele- ments in decentralised and self-deployed systems. Propagation from one node to another along the transmission path depends on calculating the neighbor node's energy function and the amount of pheromone trail present on the connections between the nodes. However, it still suffers the problem of generating too much additional traffic [35].

K Means Clustering:

This type of clustering is regularly applied for resolving clustering technique. It is a type of unsupervised learning. It is computationally extra competent than hierarchical clustering while variables are great. With global Cluster as well small kit makes closer clusters than hierarchical clustering. Simple in execution and rendering of the clustering results are the magnet of this technique. The disadvantage of this type of clustering is anticipation of K value is hard. Operations endure when clusters are global. Degrade the function while increases the node size as well as density of clusters [36].

SVM based Clustering:

To have mobile nodes separated as well as clustered through Support Vector Machine (SVM). Here, divide the CHs as well as member nodes to receive the training sample set..The SVM clustering procedure is as follow [37]. Categorise as well as Cluster the mobile nodes through the training SVM. Make uncategorised nodes CHs. Give up features information to each other random time. The input of such node to SVM also estimate the output, the value-1 represented as a CH as well as+1 represents the member node. Locate the neighbor nodes to the picked out CHs also appreciate clustering. Since the nonstop moving, also entering node departure, the feature information of the sorted nodes updates else. Thus each other time separate also re-cluster all nodes.

III.CONCLUSION

In this study, Review of Clustering Strategies with Artificial Intelligence Machine Learning Algorithm in MANET is intro- duced. Their characteristics and targets classify the clustering approaches as Identity, Mobility, Topology, Weight, as well as Energy. These types of clustering contain several drawbacks. But, AIML based formed the clusters present more number of advantages in MANET. Furthermore, describe the concept of AIML, importance of AIML, Classification of AIML, and many AIML clustering approaches in MANET. AIML approaches attain the node lifetime improvement, minimising count of clusters, diminishing re-clustering process, managing resources, as well as improving the route stability.

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Revolution of IoT in Energy Efficient Smart Building

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ABSTRACT

Internet of Things (IoT) is endeavoring to improve current structures into energy productive, brilliant, and associated structures, by giving abilities like constant observing, situational mindfulness and knowledge, and shrewd control. Digitizing the in vogue day building climate utilizing IoT improves resource perceivability and creates energy reserve funds. This paper gives a study of the job, effect, and challenges and suggested arrangements of IoT for brilliant structures. It likewise presents an IoT-based answer for beat the test of wasteful energy the executives during a shrewd structure climate. Web of Things (IoT) arrangements offer a way higher incentive if these can work inside the setting of brilliant structures. Such progressed data and correspondence innovation (ICT) applications in business structures, schools, libraries, malls, and so forth offer ease yet profoundly compelling checking and control openings. Sensors conveyed in key areas can screen the structure climate continuously, gather data for wise dynamic, and encourage different administrations. An IoT sensor stage has been created which has given a bound together correspondence stage which will coordinate data from divergent sources and supply one control order. It is an amazing, minimal effort, open-design programming stage that can screen and control major electrical burdens (e.g., HVAC, lighting and attachment loads), just as sunlight based PV frameworks, energy stockpiling units and different IoT sensors in business structures.

Keywords : Energy Efficient, Building Automation, Smart Building.

I. INTRODUCTION

For longer than a century, progresses in inexhaustible force advances (e.G., PV boards), battery stockpiling, shrewd gadgets, notwithstanding financing models have given upward push to power clients – who can deliver power from roof PV while also ingesting from the network [1]. Yet, there are no comprehensively to be had and incredible hardware to encourage buyer cooperation in the strength commercial center. Particularly, the focal point is on these issues: (I) joining with energy the executives structures; (ii)

adaptability of the innovation; and (iii) digital protection gifts [2].

II. IOT FOR ENERGY EFFICIENT BUILDINGS

There are some of energy green homes round the world. Every one of those structures have consolidated certain inventive advances for improving force execution. With IoT, current homes can be changed over into energy effective, keen, and related homes. A brilliant building climate is created from IoT sensors and actuators for discussion, control, and perceptions. IoT gives ongoing remarks abilties to the astute structure chiefs, what capacity to all the more likely serve developing inhabitants through more invaluable following and control functionalities. The IoT system gives an innovation pushed structure for coordination of developing foundation and assets, and consequently give instruments to enhance their utilization and give a green, educated, and evenhanded dispersion of administrations, which benefits the structure inhabitants two or three strategies. Three of the prevalent advantages comprise of improved force effectiveness of a keen structure environmental factors, enthusiastic observing of the building climate, and more reasonable social appropriately being of the tenants. IoT gives various freedoms in cunning homes having a sizable monetary, natural and cultural effect [3].

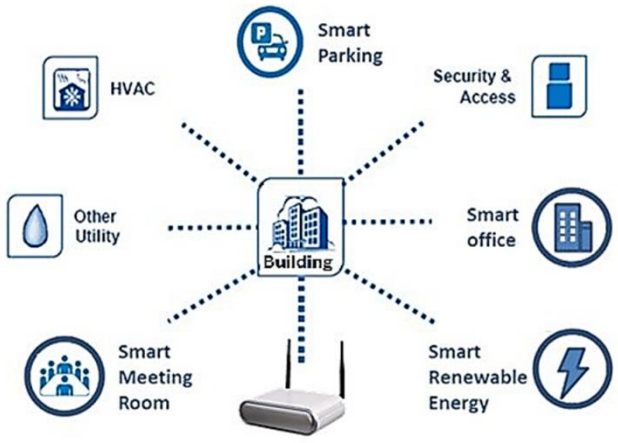

Figure 1: IoT gateway in a smart building.

2.1 IoT Sensors

IoT sensors play an essential situation in improving the strength execution of shrewd structures. With IoT sensors, the structure chiefs can effectively improve energy components depending on the situation to avoid strength squander. Rodriguez-Diaz, Enrique, Juan C. Vasquez, and Joseph M. Guerrero [4]. IoT sensors furthermore make a commitment to developing environmental factors observing via effectively distinguishing the presence of contaminations or distinctive hurtful gases inside the building climate and making the developing inhabitants aware of take remedial measures in a convenient way. In addition, IoT sensors enhance the social appropriately being of keen structure tenants with the guide of bringing additional solace and accommodation of their lives.

2.2 IoT Smart Building Occupancy Sensors

With IoT brilliant structure inhabitance sensors, the developing chiefs can uncover all developments in and around the structure, accordingly helping to shield the structure from hoodlums and miscreants. These sensors also reduce power squander by methods for controlling lighting in a region relying upon its inhabitance [5]. Development sensors show activities inside the structure. With movement sensors, the developing chiefs can hit after astonishing moves in the structure and recognize the presence or nonappearance of individuals in a particular zone and control the lights to show on/off accordingly. Coordinated sensor innovation gives uncommon information and framework usefulness. Remote advances and cloud-contributions empower a shiny new arrangement of data extraction .Irrespective of the application, we incorporate locally available encoded security usefulness to guarantee your data and transmission is comfortable [6]. Open/close sensors show the opening or extreme of racks, entryways, and windows. Open/close to sensors can likewise naturally initiate the lighting when an entryway is opened. Instances of open/close sensors

incorporate glass crush sensors, detached infrared sensors, and entryway and window sensors. Border sensors give the more layer of insurance by methods for recognizing any cars or individuals drawing close to the developing [7].

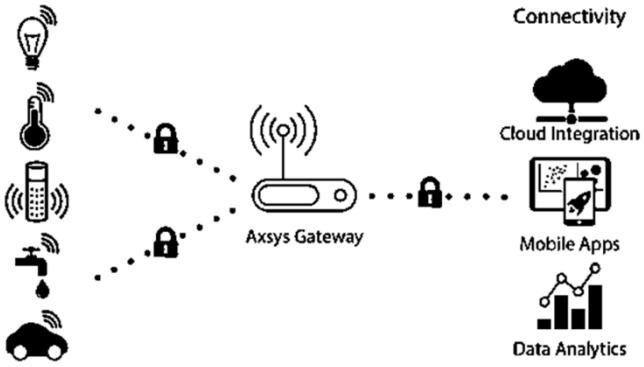

Figure 2: Smart Sensors & Connectivity.

2.3 IoT Smart Building Environmental Sensors

The developing chairmen can make a comfortable dwelling environmental factors for the tenants in the building with IoT keen building environmental factors sensors. IoT cunning building natural sensors incorporate temperature and dampness sensors, break and water sensors, smoke and air sensors, and light sensors. Temperature and moistness sensors show startling changes in warming, cooling, and the amount of water fume inside the building. Temperature and stickiness sensors moreover diminish power squander by methods for killing the cooling or warming in where there is no individual present [8].

2.4 IoT smart building energy video display units

IoT cunning structure energy video show units keep up melody of the measure of force utilized by every machine or another gadget inside the developing. Utilizing these force screens, the building tenants might be extra mindful of their solidarity utilization, direct their power use practices to decrease power wastage, and ensure that each one home gear and various gadgets perform successfully and now not

2.5 Other IoT clever constructing Sensors

Some of the inverse IoT savvy developing sensors which can be at present on market and have not, at this point been listed above incorporate dry touch sensors to find contact between focused on contact focuses; sharp fittings to permit developing chairmen to show on/off the machines or other electronic gadgets distantly utilizing their cell phones; advanced transformers to screen the energy float in the structure;

IoT is propelling structure mechanization past simple improvements. It's uniting frameworks and adding new worth, through developments like interest control and the manner in which it improves air quality. Yet, we should recall that IoT-based investigation stages work simply because they associate individuals with innovation—without people in charge, they're of little worth. The measurements gathered about different designs is hard to coordinate. That makes it a dare to get a full photo of the presentation of your building activities. The absence of an investigation component way the action of realities assessment falls on people. These constructions had been intended to gather realities most straightforward for motivations behind mechanizing tasks, no longer for by and large execution enhancement. Leading such an assessment requires some investment and data—matters greatest focuses bunches plainly don't have. Accordingly, a significant part of the information will squander.

IoT for structures, on the other hand, makes measurements assortment and assessment basic and worth successful, and most designs are developed for the lone explanation of upgrading in general execution. These apparatuses permit far off checking of records, pass on records from divergent resources on the whole, and list and look at the information for significant bits of knowledge. That grants building administrators to be more liquid and lithe in their capacity to react to specific circumstances and oversee costs [10]. Conversely with BMS structures that flip HVAC frameworks on and smelly essentially

dependent on predefined temperature runs, an IoT building device can use request control wind current to work HVAC extra astutely. In light of the idea that CO2 might be utilized as an intermediary for deciding genuine inhabitance of a room or developing, indoor air decent sensors measure CO2 degrees continuously. On the off chance that CO2 levels are in accordance with building proposals, the machine precisely lessens the out of entryways air admission. On the off chance that CO2 ranges are moving toward the confine, it acquires extra external air. Having more oversee over your designs is a more shrewd way of adapting to developing robotization.

IoT-based revealing and examination stages guarantee to be problematic, anyway not inside the manner in which you would potentially assume. Those prevalent designs will not supplant focuses work force—they'll genuinely give more discernment into approaches to upgrade strength execution. One evident qualification is the assortment of endpoints with the aim to must be overseen. Inside the future, there will perhaps be a plenitude of IoT sensors amassing records on temperature, dampness, static pressing factor, and the sky is the limit from there, conferring greater perceivability into building generally execution [13]. Anyway the extra huge exchange might be in how distant of more endpoints can empower criticism circles to figure out what systems give additional energy effectiveness. Having the ability to see the general presentation of individual device segments in setting of the bigger structure activities strategy there can be more prominent opportunities for offices directors to give cost.

With the more proactive control technique that IoT permits, supervisors can better plan about approaches to lessen charges and make a meaningful impact on the most reduced line. They will also be well-prepared to make a commitment impressively in expressions of accomplishing supportability objectives. Labor force members can respond extra rapidly to expected operational inconveniences, being equipped for pinpoint the wellspring of a difficulty immediately.

They'll also have the insights they need to adapt to approaching gadget disappointments sooner than sumptuous, awkward breakdowns happen. Redesign costs are considerably less extravagant than crisis fixes. Furthermore, accept what it may seem, by all accounts, to be when crises happen: a pleasantly learned offices chief could transfer the specific area of a structure hearth or a perilous air excellent area, for instance, to people on call before they even show up on site page.

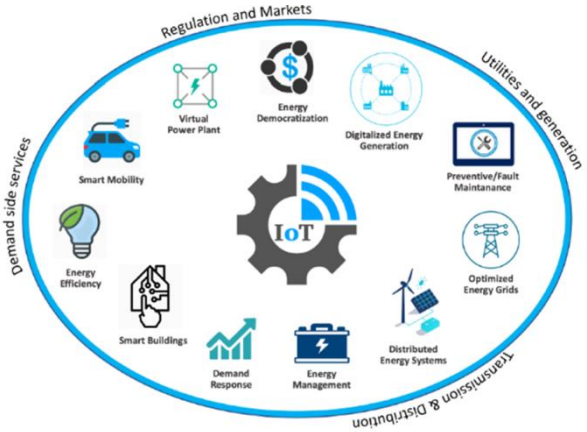

Figure 3: Facilities Management.

IoT-principally based examination stages artistic creations best because of the reality they associate individuals with time—without individuals in charge they're of little worth. Focuses administrators who embrace the chance will improve choices and, accordingly, help their homes (and themselves) stay serious [14]. Connected IoT gadgets (or shrewd articles) can take an interest in another sort of computerized environmental factors, wherein they can be overseen keenly to save power inside a structure or even inside a city. As an occurrence, inside an energy framework, related devices might be figured out how to suit the variable burdens produced with the guide of renewables [15]. IoT gadgets might be coordinated inside a wide range of gadgets that eat up force, like lights, switches, TVs, or force retailers. IoT gadgets can be utilized for talking with utility

stockpile companies to accurately solidness power usage and energy age.

Clients likewise are able to do distantly control IoT contraptions and to halfway control them with the assistance of a cloud-based interface. Further, and a decent method to encourage partner commitment and the other of extraordinary practices, the overall force office (IEA) has dispatched into a cross-association activity to find the ability impacts of digitalization on strength effectiveness and the ramifications for strategy producers. Inside this activity a grouping of online courses handling digitalization and power execution have been coordinated, among which one is devoted to the situation for associated contraptions in savvy strength execution [16].

3. Smart buildings

Digitalization offers people with quickened freedoms to imagine, format, implement, screen and check a wide scope of human games. IoT addresses some other advance since it opens the way to new administrations which are more noteworthy shopper driven and extra centered around improving the purchaser climate, with the capacity to connect with an ever increasing number of components of this environmental factors in an always less confounded manner. The limit of IoT in structures lies inside the improvement of the structure individual appreciate and inside the advancement of the developing activity on account of confounded homes [17]. IoT plays out a significant part in saving force as strength in homes will turn out to be more confounded, as an illustration while a structure has a huge force utilization on account of electric engines, power innovation limit by means of photovoltaic boards at the rooftop, warming capacity through a warmth siphon, or carport limit through a warm water tank or batteries. IoT contributes considerably to improve the blended exhibition of muddled homes by utilizing upgrading them [18].

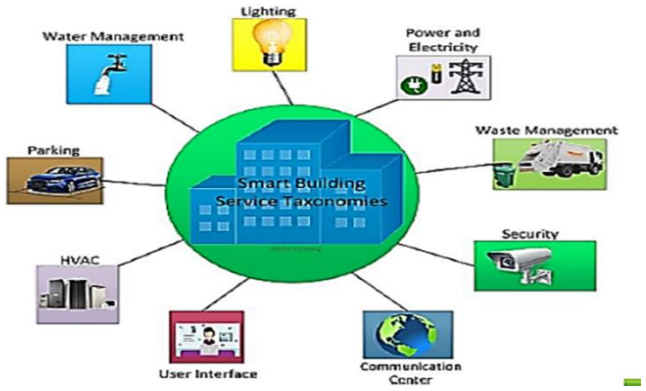

Figure 4: Smart building.

IoT makes a strength of things, allowing higher activity of machines, comprising of the distant, power use metering, diagnosing, by and large execution following, and numerous others. While structures are identified with the power matrix and outfitted to draw in with it, building apparatuses can be utilized to adjust the framework that is deprived for more adjusting because of the convergence of variable sustainable power [19].

3.1 Smart Home Management

Shrewd homegrown administration answers give a stage to uncover and control other customer IoT devices, including indoor regulators, lighting installations, security constructions, and home equipment.By permitting keen home gadgets to convey, buyers can robotize techniques and exercises a few contraptions – as an example, putting the lighting to diminish while the television is turned on or turning on the lights and decreasing the indoor regulator while the front entryway is opened [23].

Figure 5: Applications of IoT in an Integrated Smart Energy System.

Key advantages of brilliant home administration permit savvy home contraptions to talk, exchange measurements, and trigger activities dependent on each extraordinary, disregarding various makers and brands. Brilliant homegrown security utilizes an assortment of IoT-empowered items that permits you to allow clients to distantly screen and control the security in their homes. These situation can control the reconnaissance in and around the home notwithstanding who has get right of section to the entryways on the off chance that they're prepared with keen locks[24]-[28].

Shrewd homegrown security structures grant clients to distantly uncover and deal with their homes in genuine time, cautioning house proprietors of strange lead or amazing attempts to get right of section to the entryways or windows. As opposed to conventional homegrown security frameworks, sharp wellbeing structures safeguard to screen and send markers, in any event, when incapacitated. Cunning homegrown assurance designs can incorporate keen doorbells, which now not best inform clients while somebody is at the entryway, yet can permit them to see and talk with outsiders prior to opening the entryway, and sharp security cameras, which are actuated by methods for movement and can be gotten to distantly.

3.2 Smart constructing IoT great Practices

Organizations that need to make more noteworthy estimated strides sooner than redoing their structure constructions should begin little. For example, they may utilize a pilot project that shines on lights or something else of building wants. Comprehend that this and different frameworks need to have stop-to-surrender configurability [25]-[29].The entire thing that goes on inside a structure can meet up in "developing control structures" (BMS), PC based absolutely frameworks to screen and oversee contributions like lighting, warming, and ventilation. Such constructions in themselves are nothing new and were round for a long time. And yet as they had been quite divided and freely worked sooner than, a current BMS makes all the building's tasks obvious in a solitary region [29]-[31].

Challenge	Issue	Example Solution	Benefit
Architecture design	Providing a reliable end-to-end connection	Using heterogeneous reference architectures	Interconnecting things and people
	Diverse technologies	Applying open standard	Scalability
Integration of IoT with subsystems	IoT data management	Designing co-simulation models	Real-time data among devices and subsystems
	Merging IoT with existing systems	Modelling integrated energy systems	Reduction in cost of maintenance
Standardization	Massive deployment of IoT devices	Defining a system of systems	Consistency among various IoT devices
	Inconsistency among IoT devices	Open information models and protocols	Covering various technologies
Energy consumption	Transmission of high data rate	Designing efficient communication protocols	Saving energy
	Efficient energy consumption	distributed computing techniques	Saving energy
IoT Security	Threats and cyber-attacks	Encryption schemes, distributed control systems	Improved security
User privacy	Maintaining users' personal information	Asking for users' permission	Enables better decision-making

Table 1: Challenges and solutions of IoT

This sort of framework constantly gathers to be had building measurements, strategies it through an investigation layer and empowers office directors decide. Age is disturbing the genuine property endeavor in the making arrangements and creation level as well. In the BIM procedure, modelers, organizers, and subcontractors all work together to fabricate a total virtual rendition of the building, which makes the arranging more noteworthy green and straightforward and later saves time and slip-ups.

III.CONCLUSION

All those improvements are identified with each other in a couple of way. Natural concentration and the craving for a superior tomorrow are utilizing this improvement of shrewd structures and towns. There is parcels happening now in particular areas, anyway we have a similar basic bearing: a green, low-discharge world, with building computerization being one of the components of this development. It is profoundly obvious that with the consideration of Internet of Things we can establish a green climate with zero discharges which is a thing to address and in this way we can be a model of utilizing the energy proficiently with the innovative headways.

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Speed Control and Torque Ripple Reduction of SRM Using Fuzzy Gain Scheduling PI Controller

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ABSTRACT

The controlling of SRM is difficult due to high nonlinear nature with high torque ripple and Acoustic noise. In this work the dynamic behavior of SRM is examined using Fuzzy Gain Scheduling PI Controller (FGS-PI) to mitigate torque ripples and to control the speed of the motor. The PI controller parameters are tuned to achieve better performance of the speed using fuzzy gain scheduling technique. Fuzzy gain scheduling method fine tunes the torque reference value to reduce torque ripple at low speeds. The proposed system is designed and implemented in MATLAB/Simulink environment and performance analysis at various torque and speed is investigated. The simulation results verify that the proposed novel control method, DTC using FGSPI improves the speed control effectively and suppresses the torque ripple.

Keywords - Speed control, Torque ripple, Switched Reluctance Motor, Fuzzy Gain Scheduling (FGS), PI controller

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I. INTRODUCTION

In recent years, many research works have been carried out in Switched Reluctance Motor (SRM) due to its simplest construction, low inertia, and less cost. However, controlling of SRM is difficult due to high nonlinear nature with high torque ripple and Acoustic noise. Without the enhancement in the development of the power converters, the electric drive would have not been attracted by the Industry. The construction of SRM is very simple and robust. SRM is a salient pole machine with the stator winding

and rotor contains no PM or conductors and is a laminated steel core which carries no windings. Hence cost and weight of SRM is slightly low compared to BLDC, PMSM and IM. The motor exhibits high torque per volume ratio, control capability, fault tolerance and can be operated at very high speed. The phases of SRM work independent to each other and run at variable speed. But that apart SRM highly exhibits nonlinear magnetic characteristics. Hence analysis of SRM is highly complicated. Since torque ripple and noise are very dominating, the control of SRM is challenging to the researcher. Though SRM exhibits highly nonlinear behavior, many research works have been taken up using SRM in the field of SRM drives [1-6]

The DTC technique is applied to regulate the torque output of the SRM and hence to reduce the torque ripple in motor within a hysteresis band [10-16]. DITC technique is used by taking torque as a direct control variable to minimize the torque ripple. The torque is controlled using hysteresis controller and Dynamic performance of machine is discussed in terms of torque ripple [17]

The self-tuning Fuzzy PID controller is used to maintain system dynamic preference which improves controller adaptability and performance. The classical controllers may not perform well for changes of operating conditions and for nonlinear systems [18-19]. To improve the speed performance of the motor the self-tuning FLC (STFLC) technique and FLCPI has been used and observed the significant ripple of the electromagnetic torque [20-22].

The fuzzy Sliding mode controller is adopted and the speed variation of the motor under loaded condition is reduced [23]. In speed controller (PI) is designed with two converter topologies to minimize the torque ripples with closed loop configuration in the motor [24]. Many research works have been carried out using conventional PI, PD and PID with FLC to address speed and torque ripple issues associated with the motor. Using a Torque sharing Function (TSF)[2], torque ripple and noise are reduced by implementing online compensation technique [25-27].Many fuzzy control strategies dealt with flux linkage and rotor clamping method are proposed to suppress the torque ripple and to achieve a control over a wide range of load and base speed [28].

The designed controller with fuzzy gain scheduling technique will significantly mitigates the ripple present in the torque and associated noise. The speed variation of switched reluctance motor is attenuated as subjected to change in loads and achieved better speed performance. This controller is tested for various loads and simulation results have been observed. The results are explaining that the overall system performance is improved with reduced speed variation.

II. OPEARTION OF SRM

The SRM is a doubly salient structure with stator having excitation winding and rotor with a permanent magnet. The SRM used in the proposed system is 8/6 and all the phases are excited independently. The mathematical model of the SRM explains the electrical equation is described.

The stator phase voltage is given by

$$v = ir + \frac{d\psi}{dt} \qquad (1)$$

$$\frac{d\psi}{dt} = L\frac{di}{dt} + i\frac{dL}{dt}$$

$$L\frac{di}{dt} + i\frac{dL}{d\theta}\frac{d\theta}{dt}$$

$$L\frac{di}{dt} + i\omega\frac{dL}{d\theta}$$

Therefore, $v = ir + L\frac{di}{dt} + i\omega\frac{dL}{d\theta}$ (2)

Where $= \frac{1}{2}i^2\frac{dL}{d\theta}$ = Rotor angular velocity

The instantaneous input power/phase is given by

$$p = vi = i^2r + Li\frac{di}{dt} + i^2\omega\frac{dL}{d\theta} \qquad (3)$$

The electromagnetic torque equation is express in terms of machine co energy $\omega(i,\theta)$

Then, $T(i,\theta)=\frac{\partial\omega(i,\theta)}{\partial\theta}=\frac{1}{2}i^2\frac{dL}{d\theta}$ where i=constant

Assuming inductance and flux are the functions of rotor position

The mechanical equation of SRM is expressed as

$$T_e = J\frac{d\omega}{dt}+B\omega+T_L \qquad (4)$$

A. Block Diagram of the Proposed Controller

The block diagram of 8/6 SRM control system is shown in the Figure 1. The speed feedback with DTS FGS-PI is implemented to reduce the ripple present in the torque to make the torque smooth and to improve the performance of the overall systems.

In the system, the reference speed command is compared with the actual measured speed and the error signal is passed to the speed controller. The speed controller is implemented using FGS-PI controller which produces an estimated torque. The look up table takes the estimated torque and the flux linkages as the input parameters. The flux is estimated by measuring the current and the corresponding torque produced depends mainly on the flux linkages, current and rotor position. The estimated flux and torque are compared with the reference values.

The rotor angle is measured through encoder and is compared with turn and turn off angle to generate on and off A symmetrical bridge converter is used in the proposed system. The advantages of using asymmetrical converter is that all the phases can be excited independently with soft switching converter.

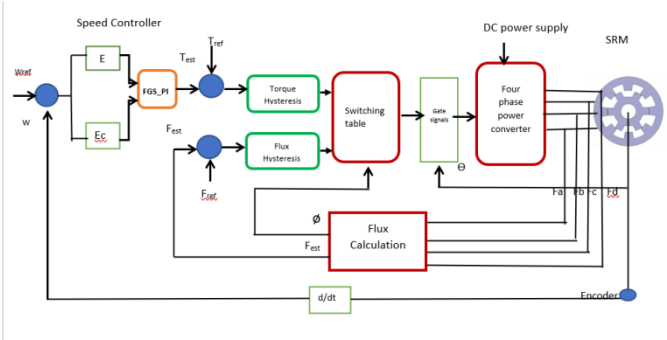

Fig. 1. Block diagram of SRM with proposed controller

III. FUZZY GAIN SCHEDULING CONTROLLER

SRM explicitly known for its highly nonlinear behaviour and analytical modelling of the motor is complex. Fuzzy Logic Controller is robust and most suited to address the non linear system accurately. FLC is used here as it does not demand the model of the system controller.

In this paper the Fuzzy Gain Scheduling of PI Controller is proposed to control the system. Thegain scheduling controller changes the parameter of the controller as the operating point changes and also changes the process gain. FGS controller is ideal to compensate nonlinearities and parameter variations of SRM. The methodology used is fuzzy rule based scheme , to determine the controller parameters and hence the better performance is expected from the proposed method.

The FGS-PI is implemented with a Mamdani type. In designing the controller selection of gain plays a vital role and has been achieved through trial and error method. The Speed of the motor and hence the torque is controlled by Proposed controller. The controller has two inputs,one is speed error and other is change in speed error.

- Input1: Speed error E= Reference speed – Actual speed
- Input2: Change in speed error $E_c = E_k - E_{k-1}$

Output: Torque

The input and output parameters of the fuzzy controller are measured based on the three fuzzy subsets.The fuzzy sets are designated as NB (negative big), ZO (zero), and PB (positive big). Smooth changes in the output power is achieved by choosing less number of member functions and hence to avoid

	Change in error E_c						
Error E		NB		ZO		PB	
		K_P	K_I	K_P	K_I	K_P	K_I
	NB	B	Z	B	Z	M	Z
	ZO	M	B	Z	Z	B	B
	PB	M	Z	B	B	B	B

delay in the process. As speed changes, ripple in the torque increases which leads to the performance reduction in the system. To avoid these adverse effects and to get the desired output, only three member functions are selected.

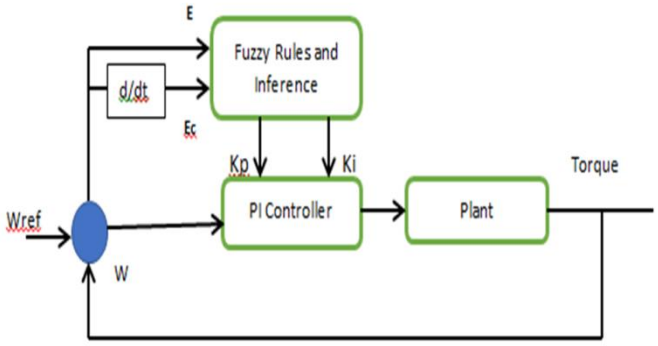

Fig.2. PI control system with a Fuzzy gain Scheduler

A typical PI controller equation given by

$$x(k) = K_p e(k) + K_I \int e(i)$$

Where e(k) is the error which is the difference between the reference and actual speed of the SRM. The fuzzy controller detects the error and change of the error rate to tune the PI parameters by the FGSPI control technique. The fuzzy regulating coefficient are K_P and K_I are adjusted as the error (E) and change in error (E_C) are regulated in PI controller

The membership functions used in the proposed control are trapezoidal and triangular and for defuzzification, centroid method is used. The block diagram of fuzzy gain scheduling controller scheme to reduce the torque ripple is illustrated in the Figure 2. The speed error (E) and change in speed error (E_C) are the input membership function of the controller and are shown in Figure 3 and Figure 4, respectively. The output membership functions K_P and K_i are controlled by the speed error.

Table 1- Rule base Fuzzy gain Scheduler

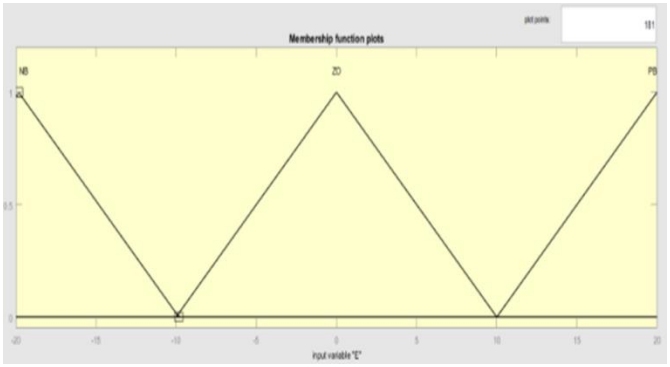

Fig. 3. Membership functions for input error E

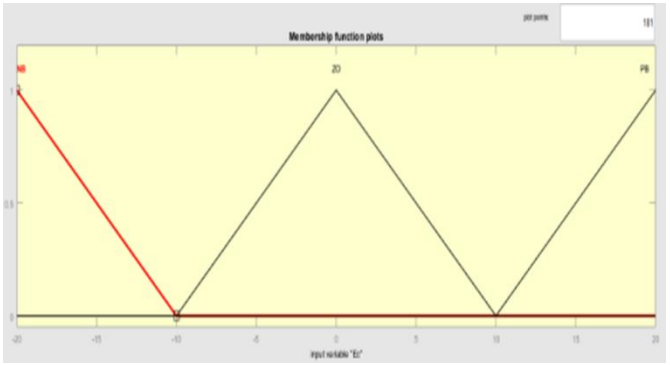

Fig. 4. Membership functions for input change in error

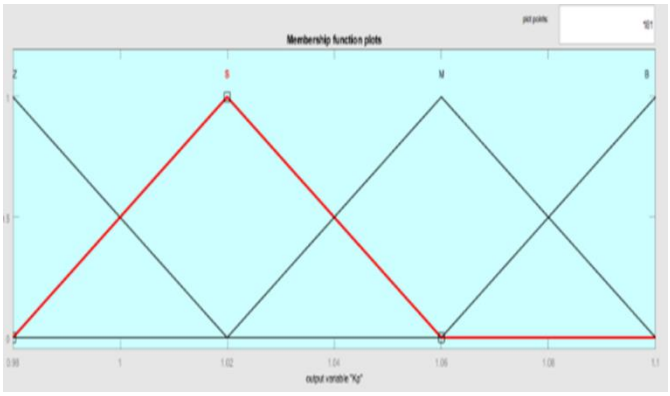

Fig 5. Membership function for kp

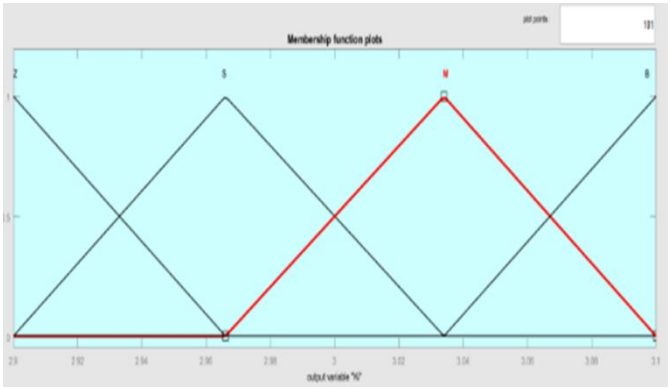

Figure 6. Membership function for K_i

IV. RESULTS AND DISCUSSION

The performance of the proposed system with four phases 8/6 SRM is investigated using MATLAB environment. The SRM under test has the following parameters and is shown in Table 2 below

The simulation is carried out for various loads. A load toque is applied to the SRM drive and increased from 0 to 15 Nm at 750rpm. It has been observed that there is an increase in the speed from 750 to 772rpm and Torque oscillates between 16.1Nm-15.2Nm and produces reduced torque ripple of 5.75%. The Figure 8 to Figure 11 shows responses of speed, torque, current and flux linkages at 750rpm, respectively.

Table 2- Test Parameters

Sl. No	Parameters	Values
1	Stator resistance	0.0 Ω
2	Inertia	0.0082kg-m2
3	Friction	0.01N ms
4	Stator poles	8
5	Rotor poles	6

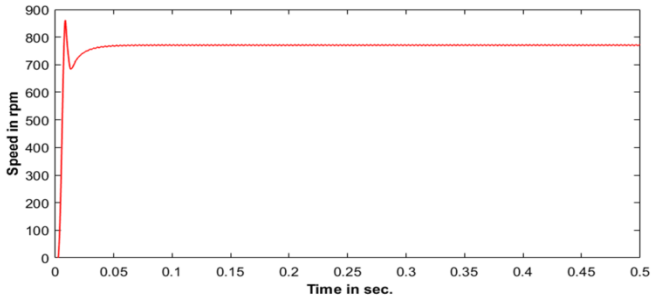

Fig.8. a) Speed response

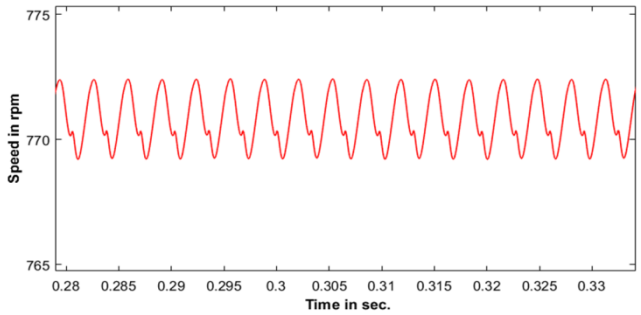

Fig. 8. b) Stretched Speed response

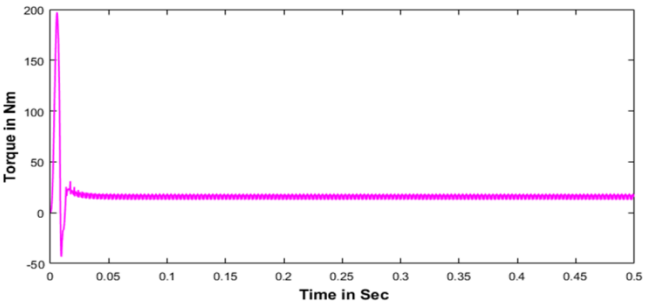

Fig.9. a) Torque response

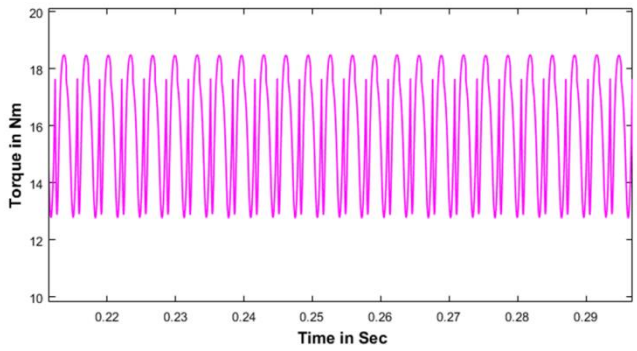

Fig. 9. b) Stretched Torque response

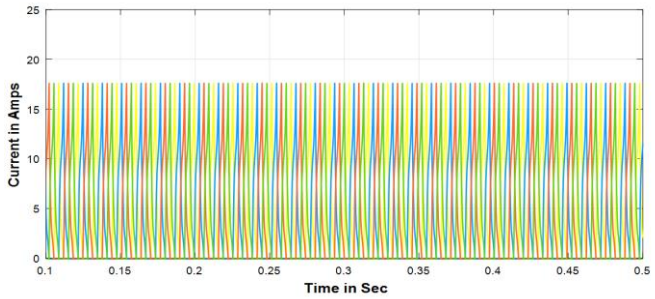

Fig. 10. a) Current response

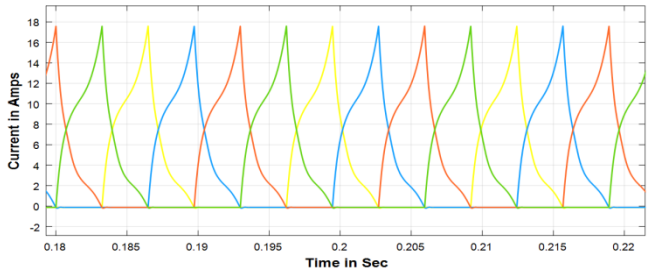

Fig.10. b) Stretched Current response

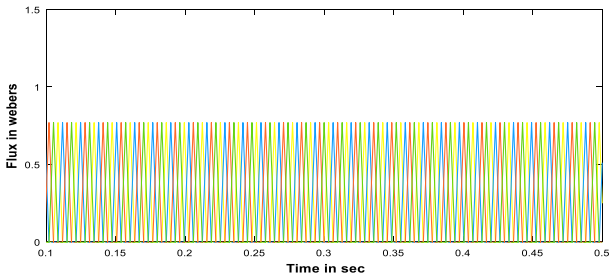

Fig.11. a) Flux response

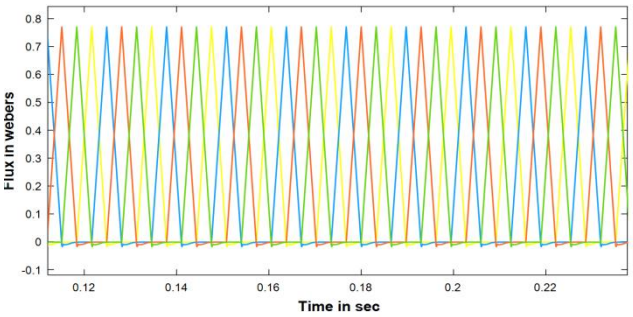

Fig.11. b) Stretched Flux response

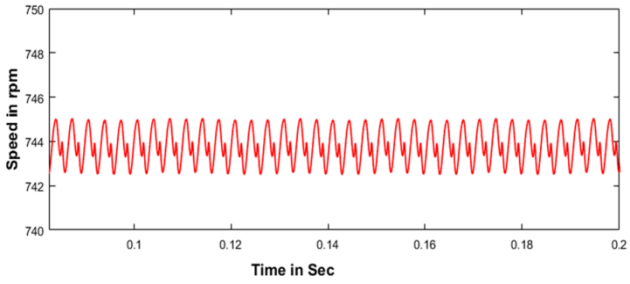

Fig. 12. Speed response

When simulation results are tested for reference torque of 17Nm and speed of 750rpm, the torque oscillates between 17.1Nm -18.5Nm and produces reduced torque ripple of 6.87% but speed is reduced to 745rpm. The Figure 12 and Figure 13 shows the responses of speed, torque, current and flux linkage at 750rpm, respectively.

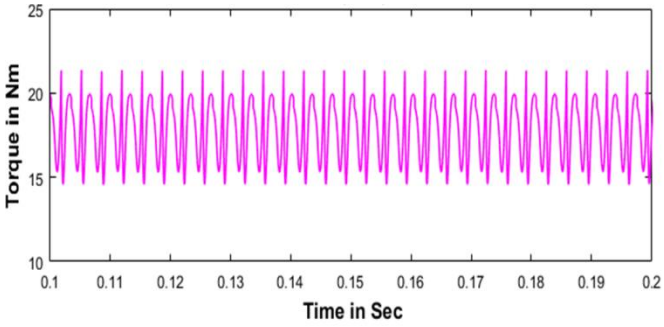

Fig. 13. Torque response

Further the simulation results are observed for 800rpm for the reference torque of 15Nm and 17Nm. With the reference torque of 15Nm, torque oscillates between 17.1Nm -18.2Nm and produces reduced torque ripple of 6.87% but the speed is reduced to 772rpm. The Figure 14 and Figure 15 shows the responses of speed, torque, current and flux linkage at 800rpm, respectively.

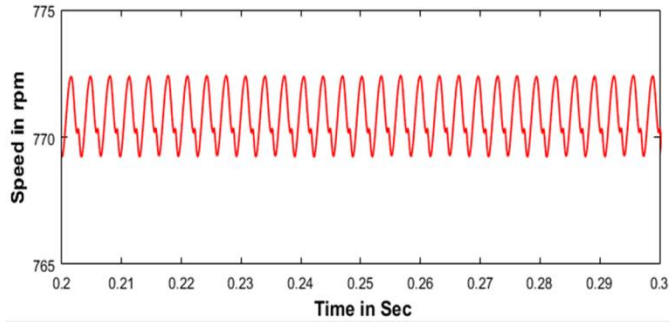

Fig.14. Speed response at 800rpm

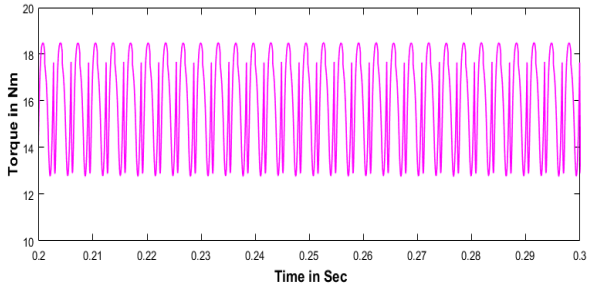

Fig.15. Torque response at 800rpm

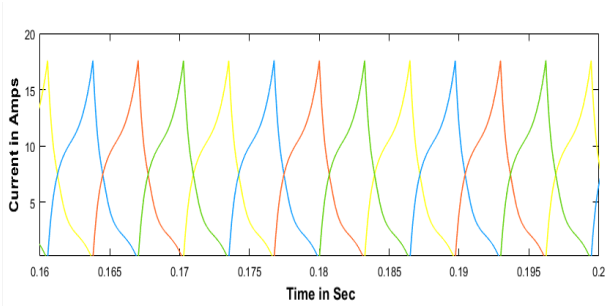

Fig.16. Current response at 800rpm

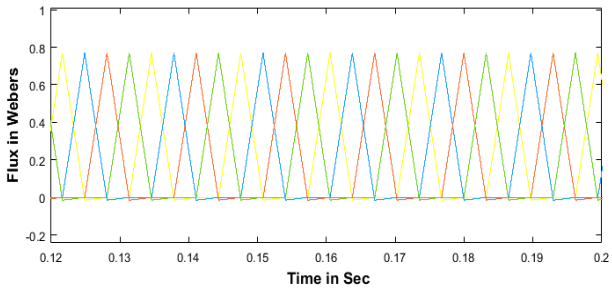

Fig.17. Flux response at 800rpm

In continuation to 17Nm reference torque, torque oscillates between 20Nm -21.2Nm and produces reduced torque ripple of 6.87% but speed is reduced to 745rpm. The Figure 18 and Figure 19 shows the responses of speed and torque at 800rpm.

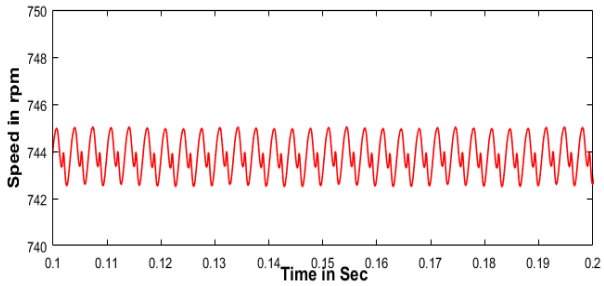

Fig.18. Speed response

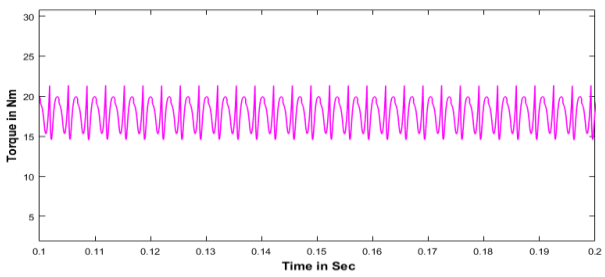

Fig. 19. Torque response

V. CONCLUSION

In this paper a Fuzzy Gain Scheduling technique with DTC is designed and implemented. The proposed FGS PI is an intelligent controller which suppresses the ripple present in the torque and reduces the unwanted noise and vibrations. The implemented controller improves the overall system performance by reducing speed variation with less transient time of 0.01Sec. From the results obtained it is proved that the proposed novel control method, DTC using FGSPI improves the speed control effectively and mitigates the torque ripple.

ACKNOWLEDGEMENT

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Design and Implementation of COBOTS to Assist with Healthcare Workers

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ABSTRACT

The pandemic situation such as ongoing corona virus outbreak (COVID-19) has increased the demand for PPE (personal protective equipment) globally. To reduce both the demand for PPE and severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) exposures, we have developed a COBOTs system which will be able to perform the tasks of healthcare workers inside an intensive health care unit (ICU) room, which will reduce both the PPE use and exposure. The aim of the project is to assist the healthcare workers with a robotic assistant in monitoring and serving the patients during pandemic in a quick and secure way.

Keyword - Cobot, Health worker, Automation, AutoCAD, Simulation, Simu-link.

I. INTRODUCTION

During the pandemic, many industries have faced their challenges, the highly affected being the healthcare industry. Major challenge for healthcare workers is wearing the PPE (personal protective suits) while treating the patients in intensive care unit (ICU). The corona virus pandemic has also increased the need for PPE suits worldwide. To minimize the physical contact between patients and healthcare workers in the isolation ward and to collect infectious wastage inside the isolation ward, collaborative robots can be used to assist with healthcare workers in monitoring the patients and in reducing the exposure to severe acute respiratory syndrome corona virus.

Collaborative robots or cobots can monitor patient statistic and alert nurses when there's a requirement for human presence, allowing a nurse to watch multiple patients simultaneously, allowing a nurse to monitor multiple patients simultaneously. Cobots may be seen moving through hospital corridors carrying supplies. Cobots have also started assisting surgeons, which permit the surgeons greater precision and a better success rate with their operations.

II. LITERATURE SURVEY

A. Robots to deliver food, medicines to patients in isolation wards in regular interval of time, [1].

We use two robots in the proposed model to serve two purposes. One is to deliver food and the other is to collect the medicinal waste that comes in the way. This can be customized as per the needs of the user in the hospital. Secondly the other robots is specified just to collect toxic and contagious waste from isolation ward. The model in this paper uses a humanoid robot, that requires huge investment and more time to design. There is also an alternative application that uses a combination of line follower and pick place robot designed to serve the same purpose as mentioned above

B. Android based Phone controlled Bluetooth Robotic arm in the year of - April 2016.[2].

The connection medium used here to communicate with the robot is Bluetooth. An effective two- way communication has been done between the android phone and robot. This allows a non -expert who is not familiar with the interface can also interact with the robot and adjust the functionality of this system. This makes the application more interactive and accessible.

C. Control of a servo-pneumatic gripper with an individually movable jaws in the robotic arm.[3]

This model has been proposed by W. Gauchel. It uses an individually movable two jawed pneumatic gripper coupled with closed loop position controller of jaws. The drawback is this approach consumes more energy and costs more.

D. A health care robot for patients [4]

Here, a health care robot to help patients is used in hospitals. It is principle in health care to picturise, recognise and identify the conditions of the patients. The robot developed here has a feature of audio announcement system and a vision system. Whenever the patient has an emergency, the robot will call the doctor or nurse. This is how the function of robot contributes to help the patients.

E. GUI Based Pick and Place Robotic Arm for MultipurposeIndustrial Application [5].

As the technology is growing day by day the world is adapting robotic for their comfort in daily life. So we have developed a GUI based, trainable robotic arm which is being automated for multipurpose industrial applications. The special feature which we are highlighting in our work is that, the arm is easily manipulated and has all in one solution for the certain range of pick and place application. The basic aim is to achieve the ability of commanding and controlling the arm through MATLAB Graphical User Interface (GUI) and to make the system more efficient. The designed system has been divided into 2 parts: (1) The AVR micro controller has been programmed for the central controlling station which has GUI access and the arm control, and (2) to program the GUI for making the robot trainable and user-friendly. As it is a time-saving controlling method, we can use it for picking and placing the material over the conveyor assembly.

F. Design and development of 6-DOF robotic arm controlled by Man Machine Interface [6].

This paper presents the design and development of a low cost and user-friendly interface for the control of a 6-DOF slave tele-operated anthropomorphic robotic arm. Articulation of the robotic arm is achieved about six single-axis revolute joints: one for each shoulder abduction-adduction (abd-add), shoulder flexion-extension (flx-ext), elbow flx-ext, wrist flx-ext, wrist radial-ulnar (rad-uln), and gripper open-close. Tele-operator, master, uses the Man Machine Interface (MMI) to operate in real-time the robotic arm. The MMI has simple motion capture devices that translate motion into analog voltages which bring about the corresponding actuating signals in the robotic arm.

III. THEORY

A. Scope / Objectives of the project:

To develop a movable collaborative robot to serve the basic needs of patients inside isolation ward. To minimize the physical contact between patients and healthcare workers in the isolation ward. To collect infectious wastage inside the isolation ward with the aid of collaborative robots.

The stated objective requires to serve isolated patients with minimal physical contact between health care workers and patients. COBOT with an arm which is a

replica of a human hand is designed to satisfy the objectives. The designed arm of COBOT is capable of a 360° rotation. The partially designed COBOT is shown in Fig.1.1. The COBOT in Fig 1.1 is programmed to pick and place the objects to satisfy the objective of collecting infectious wastage inside the isolation ward.

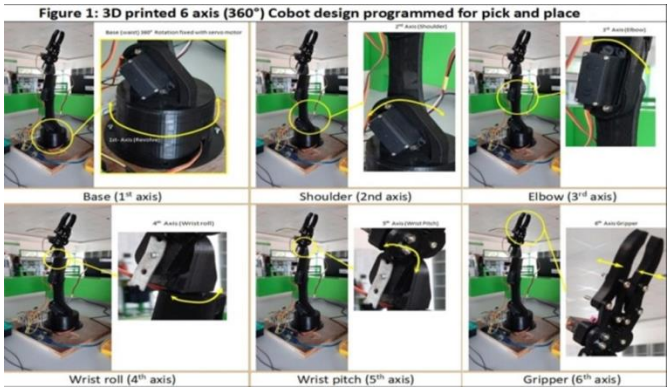

Fig.1 Partially designed COBOT

The team members propose to install a wheel at the base of COBOT to navigate the COBOT inside the isolation ward. Further, a wireless controller is implemented to regulate the movement of the COBOT arm and wheel.The movement of the COBOT arm is controlled by operating the servomotors and the movement of the wheel is controlled by operating the DC motor. The objectives of this project can be accomplished by implementing the above-mentioned methodology.

IV. ILLUSTRATION OF MEDICAL ARENA

The cobots are in an intensive care unit (showed in figure 2). The cobot must remain inside of its own area,and cannot leave it. It is imperative to collect the medical waste in order to keep the environment clean. The medical garbage was previously stored in each bedroom, and now it may be collected in the discarding hole of each bedroom. The medical waste (represented by table tennis balls) is expelled from the discharge holes when cobot engage an appropriate system. Cobot must put all four medical trashes in an appropriate medical tray, carry it to the medical trash bin and dump the medical waste inside it. Cobot cannot touch the medical trash, and medical trash cannot touch any other surface, except the tray. The tray can only be touched in appropriate handles. Additionally, the cobot must cooperate in order to manage the tray, which is very large.

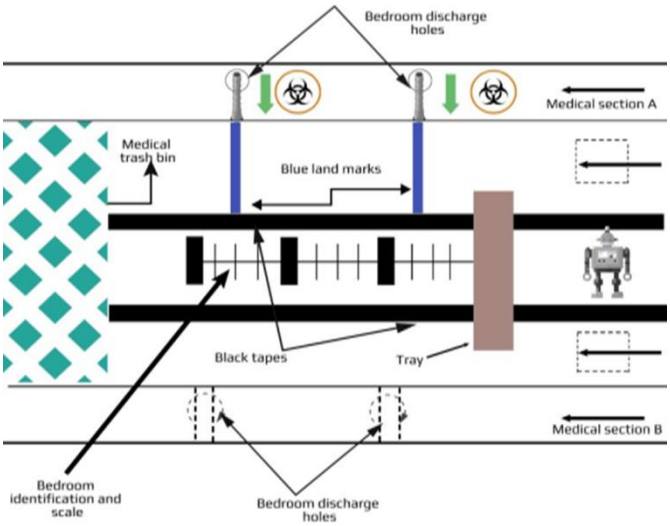

Fig.2. Blueprint of isolation ward for the movement of cobot

V. SIMULATION TOOLS

A. Autodesk Fusion 360 [19]:

Fusion 360 helps students and educators prepare for the future of design. It's the first 3D CAD, CAM, and CAE tool of its kind, connecting your entire product development process into one cloud-based platform. Download the software today, then turn your ideas into reality.

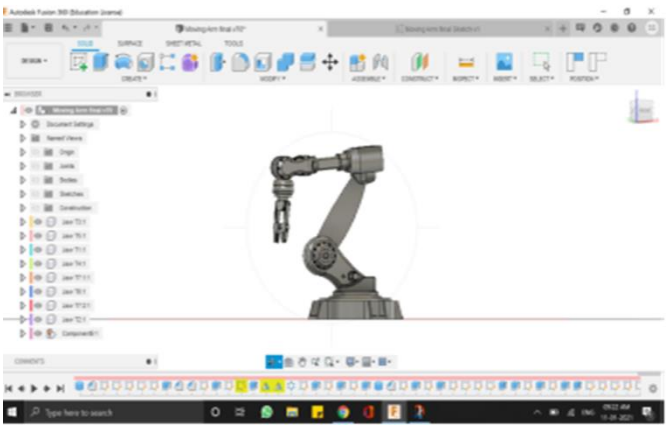

Fig.3: Designed Robotic Arm.

In this robotic arm we have designed it using AutoCAD Fusion 360. We have used a basic tool to build it. We have used different tools like Extrude, Chamfer, Mirror, Fillet, Circular pattern, Revolve, Assemble. There various tools available in the AutoCAD. According to the rough design we have developed the design. The robotic Arm is viewable in 360 degree. Using assemble tool we can join all the parts. We have added step by step pictures for detailed explanation.

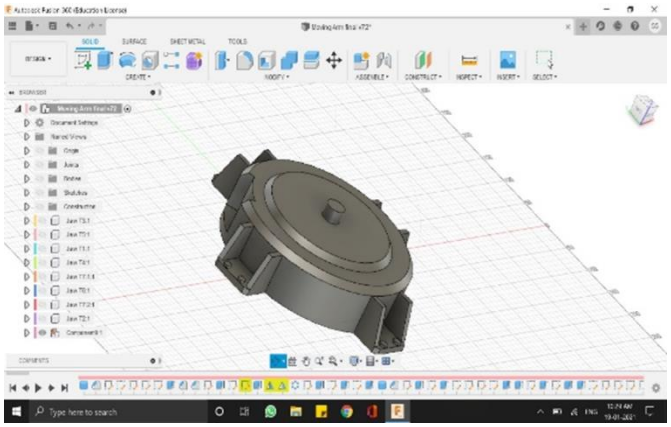

Fig.4: Base of the Robotic ARM

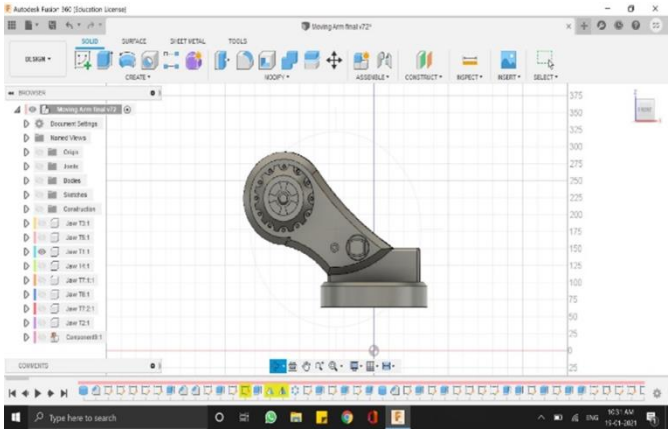

Fig.5: Jaw 1 of the Robotic ARM

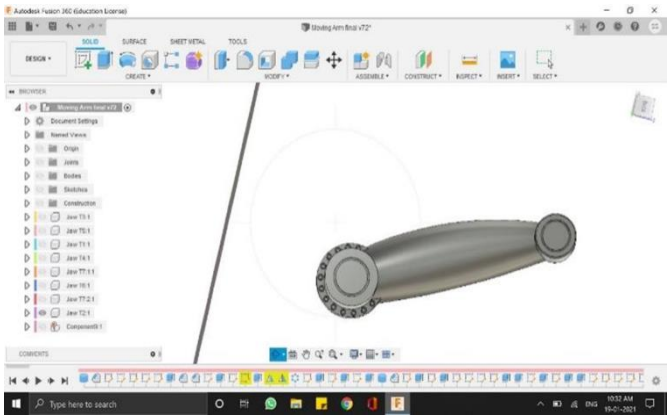

Fig.6: Jaw 2 of the Robotic ARM

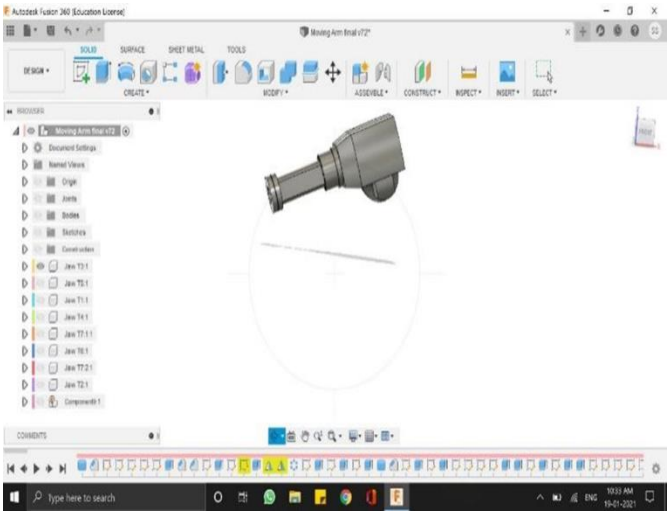

Fig.7: Jaw 3 of the Robotic ARM

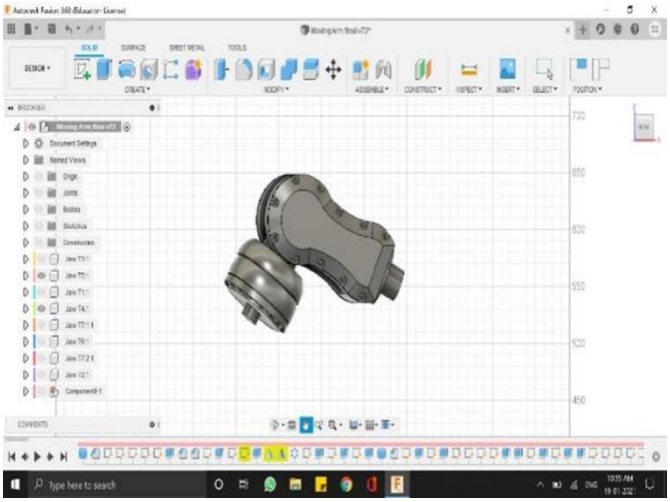

Fig.8: Jaw 4 of the Robotic ARM

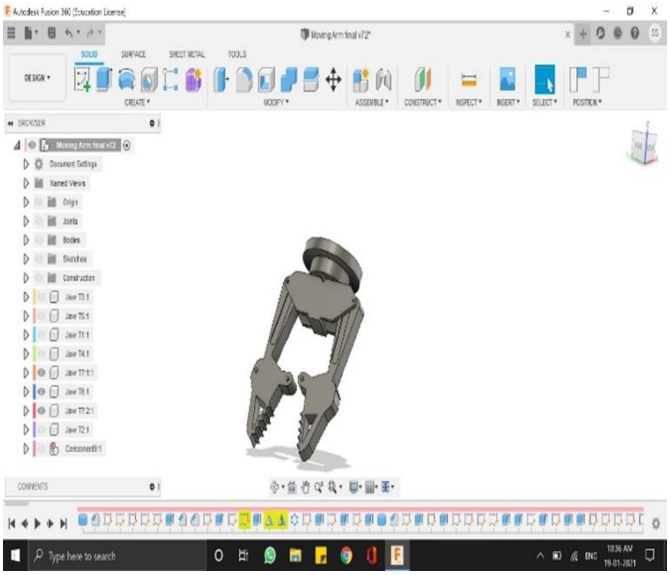

Fig.9: Gripper of the Robotic ARM

B. Steps for the Design in Autodesk

Step 1 : Open Autodesk Fusion 360.
Step 2 : Select the origin where you have to design.
Step 3 : From the rough diagram you have to make the sketch.
Step 4 : In our design we have used a circle component to create a circle for the diameter 40mm.
Step 5 : Then we have to select the circle.
Step 6 : We have to select extrude tool and enter the size to make a sketch to 3D model.
Step 7 : We have to use chamfer tool to smoothen the edges.
Step 8 : We to develop a connecting rod in the top of the base.
Step 9 : Select top view, then create a circle of 10mm. Then repeat step 6.
Step 10 : Now we have to create a nut for the base. By using the line tool, we have to draw the sketch and then cut the particular part.
Step 11 : After creating the single part of the nut we have to use mirror tool to copy it on a parallel side.
Step 12 : Now we have to use circular pattern tool to create it on all the side of the base.
Step 13 : The entire base has been created.
Step 14 : We have to design a second part of the robotic arm.
Step 15 : Make the base disappears using visible tool.
Step 16 : Click on top view.
Step 17 : Create another circular sketch of 25mm.
Step 18 : Then select the circle and extrude it for the required size.
Step 19 : Use the chamfer to smoothen the edges.
Step 20 : Then create a rectangle from the top view and extrude it according to the size required.
Step 21 : Use the 3-point arch tool and create an arch in the rectangle.
Step 22 : Now using extrude tool cut the entire arch.
Step 23 : Create a circle sketch parallel to the rectangle.
Step 24 : Then use the 3-point arch tool to join the circle.
Step 25 : Then extrude the particular part.
Step 26 : Create a circle of 20mm in the top.
Step 27 : Then use the fillet tool and make it as a cone.
Step 28 : Create a design on the cone. Extrude and cut the particular part.
Step 29 : Use the Circular pattern adjust the design.
Step 30 : Then click on the front view and create the rectangular area and extrude it.
Step 31 : Click on back view and create a attaching rod.
Step 32 : Draw a circle of 10mm and extrude it.
Step 33 : The second part of the robotic arm has been designed.
Step 34 : We have to create a 3rd part make the 1st and 2nd part invisible using the tool.
Step 35 : Create a two circular sketch size of 25mm and 15mm at the distance of 150mm.
Step 36 : Extrude both the sketches for the required size.
Step 37 : Use 3-point arch and create it on the both side of sketches.
Step 38 : Then join the 3-point arch present in both the arch.
Step 39 : Select the area and we have to extrude it and using fillet tool and make it as a design.
Step 40 : Then we have to create the particular nut in one side by adding the circular sketch and extruding it.
Step 41 : We have to use a circular pattern and make the nuts on available in the entire circle.
Step 42 : From the top view, select both sides and use revolve tool to create a design.
Step 43 : Now the part 3 has been completed.
Step 44 : Make the part 3 invisible.
Step 45 : For part 4 create a rectangular sketch and extrude the part use the chamfer and fillet tool, make the edges smoothen.
Step 46 : Then create a circular sketch upon the rectangular shape.

Step 47 : Extrude the circular sketch and make another circle and extrude it for the attaching the rod.
Step 48 : Now the part 4 has been completed, now make it invisible.
Step 49 : Select a sketch tool and create a line and then create a part.
Step 50 : Extrude the part, and create a nut design using the sketch.
Step 51 : Now use the circular pattern and make the nut visible in the entire shape.
Step 52 : Use the mirror tool and create the same component on the parallel side.
Step 53 : Create a circular sketch and use the extrude & revolve tool and make it has a cylindrical shape.
Step 54 : Then attach it with the part 4 design.
Step 55 : Now make the part invisible and create a new part.
Step 56 : Create a new part 5 using.
Step 57 : Design of a gripper.
Step 58 : Make a rectangular sketch and extrude it.
Step 59 : We should use the 3-point arch and design it according to the rough diagram.
Step 60 : After this step we have to add the path.
Step 61 : According to the part we have to create a grip.
Step 62 : Use the chamfer tool to modify the edges.
Step 63 : We have made a hole on top corner for attaching.
Step 64 : Now we have to create the shape and cut it for -5mm in the top of the design.
Step 65 : Now we have to use the mirror tool.
Step 66 : And create the same design into another and turn its direction.
Step 67 : Now the design of the gripper is completed.
Step 68 : Make all the parts visible in the sketch.
Step 69 : Use the joint tool and add all the parts
Step 70 : In joint tool we have to give revolute option in the motion so that all the parts of the robotic arm will be moving.
Step 71 : Now the movement of the robotic arm can be moved through the mouse.
Step 72 : The entire design of the Robotic arm is completed using Autodesk fusion 360.

Each part of the robotic arm has been added in the above figures for a detailed view

C. ABB Robot Studio [20]:

Robot Studio is ABB's simulation and offline programming software, offering a complete digital replica (digital twin) of physical assets or systems so you can see what's going on in your production line remotely. It allows robot programming to be done on a PC in the office without shutting down production. ABB's Robot Studio offline programming tool enables users to create, simulate and test a complete robot installation in a virtual 3D environment without having to visit or disturb their actual production line.

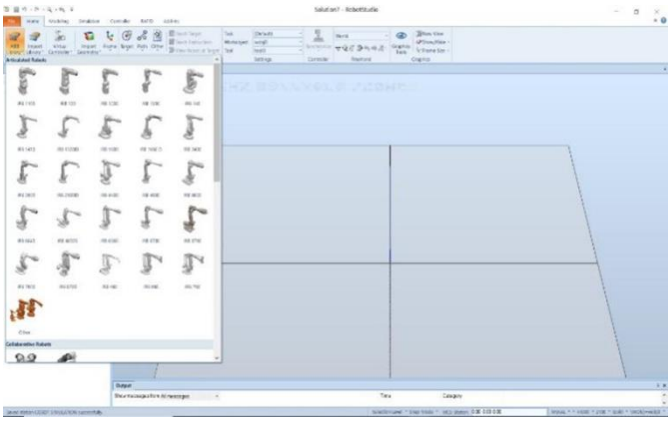

Fig.10: Choosing the robotic arm from abb library in robot studio.

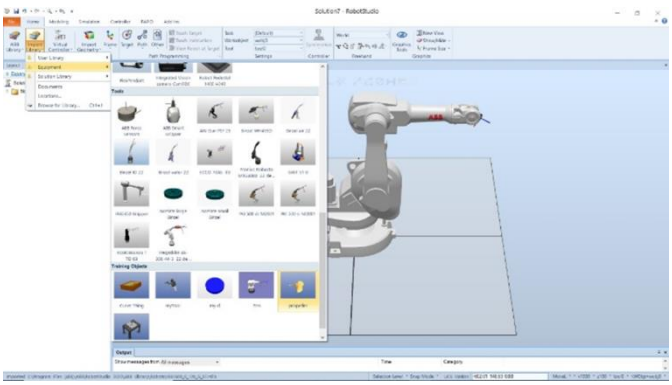

Fig.11: Choosing the tool or gripper from ABB library.

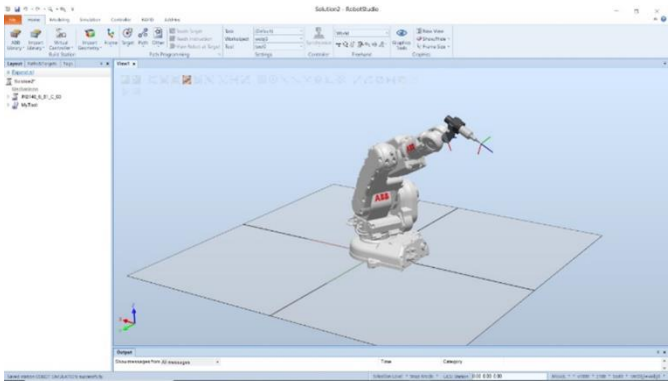

Fig.12: Joining the tool and robotic arm.

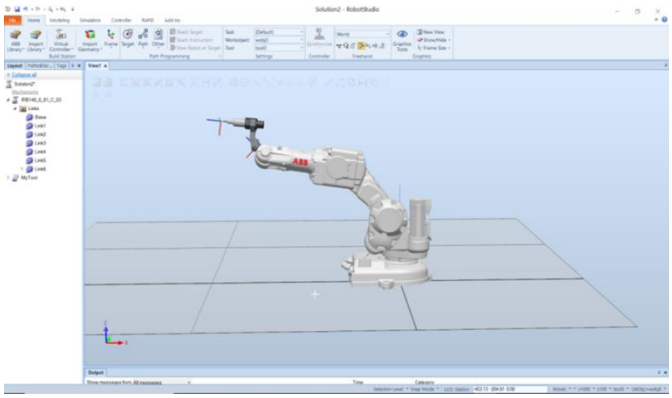

Fig.13: Robotic Arm Simulation using Robot Studio.

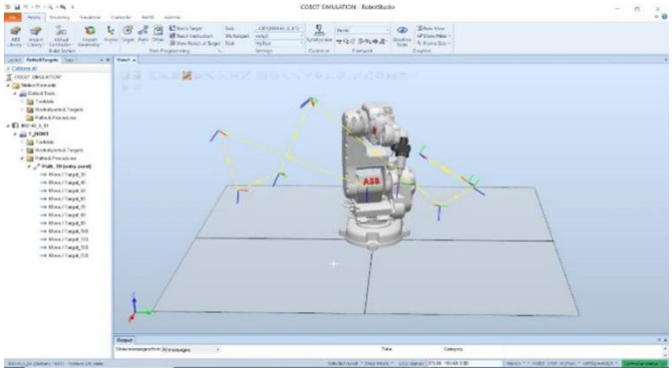

Fig.14: Giving the paths procedures acc. to user (the yellow line in image is path).

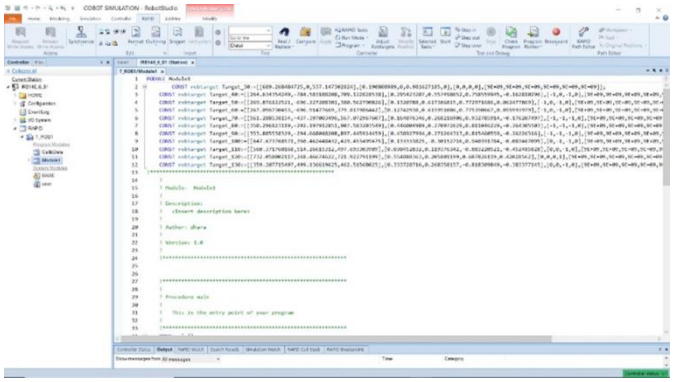

Fig.15: Code to simulate the model based on coordinates or paths assigned.

D. Electrical Simulation [21]:

Tinker cad could be used in numerous ways, from creating designs based on a scientific concept to being featured in a unit or class on 3D design and printing. For example, students could design a solution to an authentic problem from their community. Alternatively, students who are engaged with Minecraft in schools can extend their play-create experience by importing Tinker cad objects. Imagine the possibilities of students bringing literature, math, and even foreign language concepts to life by designing and printing objects around class content. Options to share and improve upon others' designs bring a high level of collaboration with one another and the wider community of creators. And the rich resources available on the site give students a chance to experience the design process in meaningful and relevant ways.

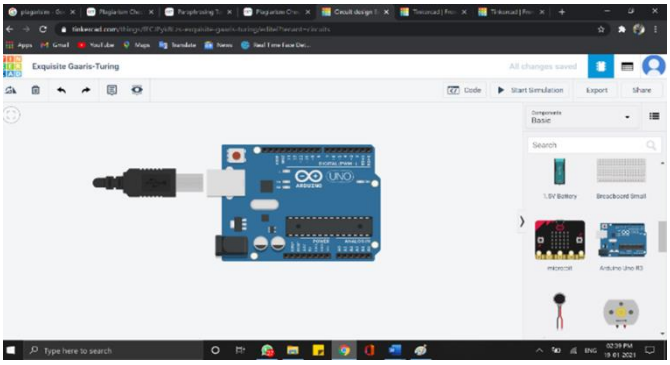

Fig.16: Assembling Arduino

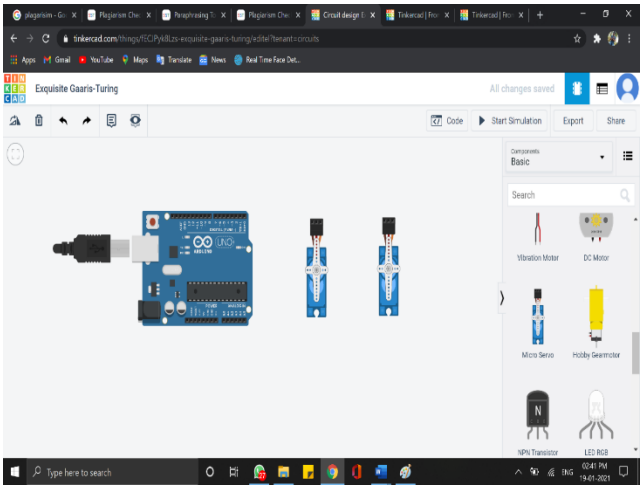

Fig.17: Assembling stepper motors

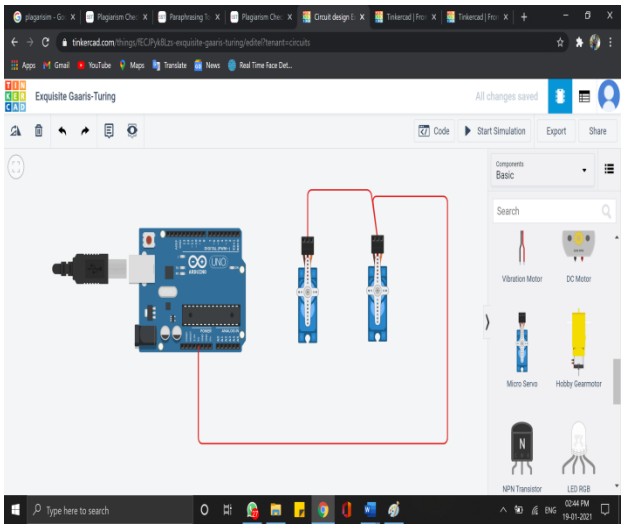

Fig.18: Power supply connection

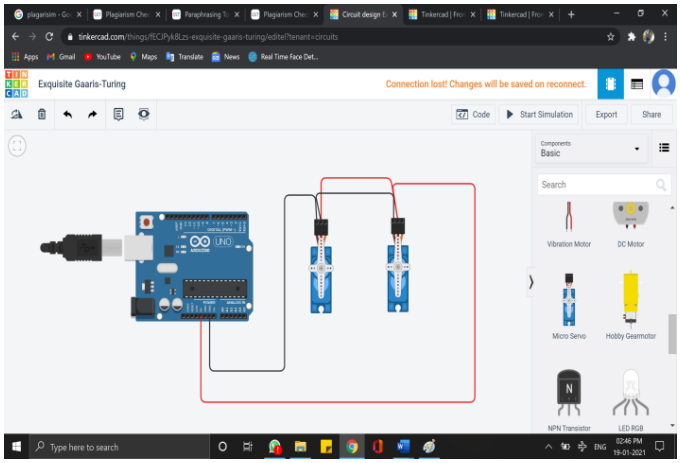

Fig.19: Ground connection

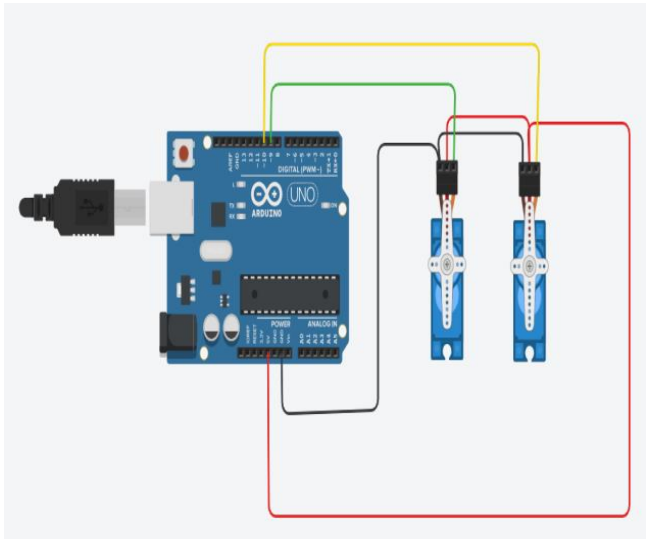

Fig.20: Final Electrical Simulation using 2 servo motors in Tinkercad Software.

VI. BLOCK DIAGRAM AND WORKING

A. BLOCK DIAGRAM:

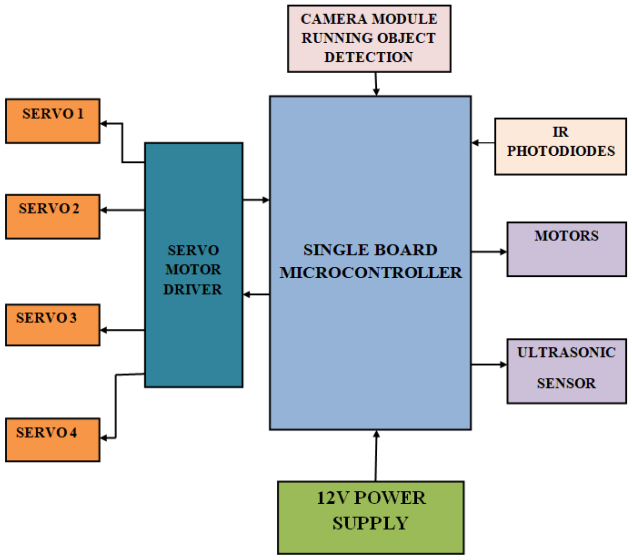

Fig.21 BLOCK DIAGRAM

B. WORKING

The stated objective requires serving isolated patients with minimal physical contact between health care workers and patients. COBOT with an arm which is a replica of a human hand is designed to satisfy the objectives. The designed arm of COBOT is capable of a 360° rotation. The COBOT is programmed to pick and place the objects to satisfy the objective of collecting infectious wastage inside the isolation ward. The team members propose to install a wheel at the base of COBOT to navigate the COBOT inside the isolation ward. Further, a wireless controller is implemented to control the movement of the COBOT arm and wheel.

The movement of the COBOT arm is controlled by operating the servomotors and the movement of the wheel is controlled by operating the DC motor.

An IR photo diode is used for the purpose of implementing the movement of cobot using line follower technology.

A camera module is attached and is controlled using the micro controller by the operator to view the isolation ward from his cabin.

An Ultrasonic sensor is used for the purpose of object/obstacle detection in the path of the cobot during its motion.
The objectives of this project can be accomplished by implementing the above-mentioned methodology.

VII. ADVANTAGES AND DISADVANTAGES

A. Advantages

Cobots are easy to install, easy to move and also flexible to program and run. It is even small and user friendly compared to that of robots. Its size factor contributes to its assembly, disassembly and also to reposition to a desired place. The production design can be flexible and programmed as per the user's wish.

It is also harmless that is most important in the work space. Since the cobots work with humans, safety factor should be given utmost priority. For this safety they are equipped with special care sensors that will detect any obstacle or tool that comes by its way and protect the user.

When it comes to cost factor, it costs less than the price of industrial robots at the time of purchase. Since as mentioned, installation is quite easier in turn reducing the cost. These cobots are self-taught, hence there is no requirement of any specialist to load the programs into our cobots.

Cobots are sophisticated machines that will not only increase the efficiency of the work to be done but also take the aid of human beings. They are mainly designed to work in places that might be hazardous environment for the humans. They give life heavy weights and also handle toxic substances whenever required.

Cobots do not require a separate work cell. They have high quality sensors that are embedded in them and can detect any uncertain objects that mix up with the regular, programmed task.

Shifting the cobot to an entirely new process is faster, simpler and provides the option to automate any kind of manual task. This applies in case of small batches production as well as fast changes in the system. It can reuse the previous programs for performing recurrent task unlike the other industrial robots.

Unlike human beings, the cobots are super accurate in completing the assigned work. It will never digress from its given action and will perform the programmed tasks with the same efficiency and power.

Main purpose of a cobot is not to replace it with humans, but to work with them. It is popularly termed as 'people-focused robots'. It helps humans in refining their work easily. Monotonous tasks can be assigned to the cobots. It makes the production process coherent.
Optimization of a particular process takes highest priority in any field. This can be achieved using cobots. Since they are accurate, the errors get minimized to a great extent. The cost of production is also reduced. The long run provides more profit eventually.

In areas where the human work may lead to slight errors and hinder further processes, the cobots can be put into practise. Most of the surgeries that happen today is with the aid of cobots. Hence being safer, accurate and effective.

B. Disadvantages

Cobots always require a restricted workspace to perform their duties to ensure full safety of the workers. Every time there is a hindrance to its working it automatically gets the work to a halt.

It cannot be operated without proper human supervision because it is programmed in a such a way that it has to work with humans.

The payload capacity is quite lesser when compared to that of an industrial robot. The speed is also less and can be put into use where high speed is not an important factor.

It can be used in applications where the payload capacity is less and where the power limit is low.

VIII. CONCLUSION

The proposed collaborative robot can serve the basic needs of isolated patients like food, water, and oral medicine. The robot can be controlled by the health worker through a smart phone or by a wireless controller. This wireless controller will ensure the minimization of physical contact between isolated patients and the health care worker. The proposed robot can collect infectious wastage inside the isolation ward.

There is no limitation of the servo motor, the movement range of the robotic arm is not restricted within 180 degrees. The robotic arm is designed with four degrees of freedom because it is suitable for most of the application included lifting. Therefore, it can be cost-effective and simple construction by using only 4 actuators. The robotic arm parts are joined together by fastener: screws and nuts[22]. For the robotic arm control, the system mainly consisted of components which are microcontroller, motor driver, servo motor and sensors. It allows the user to control the movement without any training needed so the robotic arm is user-friendly. Experiment is set up to test the performance of the robotic arm by varying the load to be lifted; the lifting mechanism of a robotic arm is validated supported by the results obtained in the experiment.

A. Future Development

In the further development, the robotic arm can be situated on a mobile platform with 4 wheels to allow portability and navigation using line follower robot. We have planned to design a gripper to lift different shapes of objects. Robotic arm has sensors to detect the position of the objects and therefore the whole process can be automated and it also can communicate with user through networking.

B. RESULT

The proposed model can monitor and serve the affected patients isolation ward by collecting the pharmaceutical wastes, thus reducing the direct physical interaction with the patients. The current trend of cobot is to provide a flexible system in which humans and robots can safely interact and cooperate to carry out the assigned tasks. This will encourage to easily integrating cobot systems. Nevertheless, even though the great progress of these systems, effective performance in this field is still far away.

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Urban Flood Management Using RS & GIS - A Case Study of Vrishabhavathi Sub -Watershed, Bangaluru, Karnataka, India

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ABSTRACT

Natural disaster like flooding is the commonest hazard that impacts the Vrishabhavathi River catchment (spread over a surface of 38 km2) on the upstream side of Gali Anjaneya Temple. To help and rescue the flood affected people to mitigate the matter of flood and to require necessary preventive measures in study area, flood management planning is a really important. To reduce the flood risk in the catchment, present study aims to examine and propose the structural and non-structural mitigatory measures. For finding suitable sites for structural and non-structural measures, in the present study attempts has been to reduce the peaking of floods by identifying the areas to delay the flood concentration time and develop a conclusive pattern for finding suitable sites.

Keywords : GIS, Remote Sensing, Flood management

I. INTRODUCTION

Using Remote Sensing (RS) and Geographical Information System (GIS) and data on socio economic characteristics, a planned and integrated management approach has been made to render right suggestions to the people. The study describes an efficient & scientific approach with suitable illustrations of map and real time flood inundations. The areas, which are highly flood affected, are delineated. So that, the flood affected people are often rescued from inundation and may be evacuated to different safe places.

II. GOAL AND OBJECTIVES, METHODOLOGY AND AREA OF STUDY

2.1 Aim and Objectives

Aim:

To manage flood vulnerability and mitigate it, land-use based strategies have been adopted in the Vrishabhavathi Sub – Watershed (study area), Bengaluru.

Objectives:

Following objectives have been set to achieve the said aim.:

1. To identify the flood zone and flood intensity, periodicity, irregularity and its spatial-temporal varieties.

2. To delineate the major flood risk prone areas through vulnerability analysis.
3. Flood harm appraisal to find an outline on the size of impact of the flood.

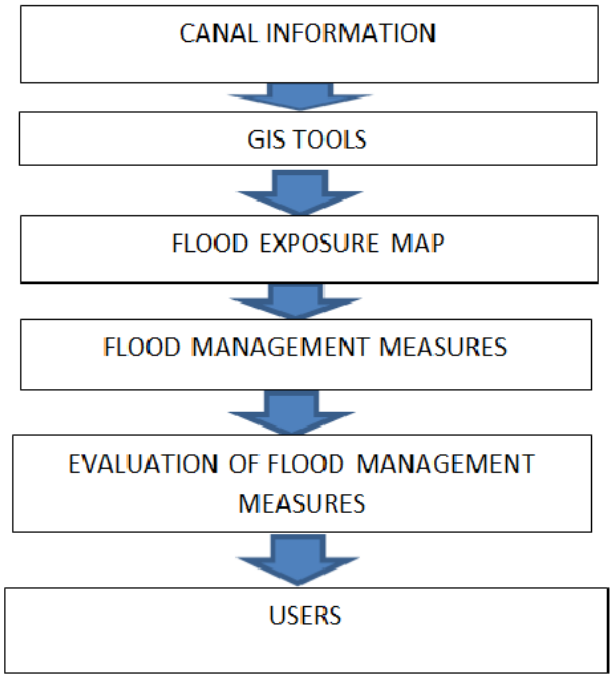
4. To propose an appropriate real time action plan to mitigate and control the calamity.

5. The goal of flood peril examination and its administration is to feature the over a wide span of time situation.

6. The preparedness condition, flood loss prevention & determine current status of evacuation routes.

2.2 Methodology

To mitigate the flood and flood management measures, the GIS based flood data gives detailed information to various users. The flow chart shows the methodology adopted in the study area for the development of flood management measures.



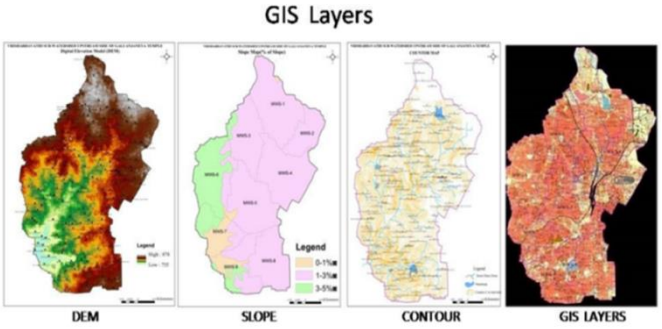


Figure 1: GIS Layers Used in the Model

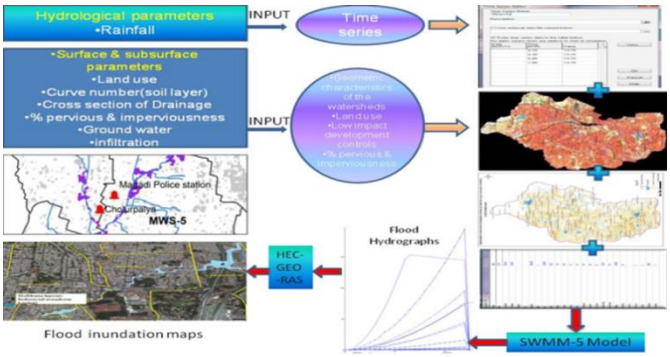


Figure 2: Flow Chart Showing Detailed Methodology Adopted for the Study

2.2.1. Flood disaster management – Conceptual and theoretical frame work characterized by undulating topography with plains and shallow valleys. The study area is located at south of Bengaluru. Bengaluru is the capital of Karnataka state however the district does not have any major river flowing, the district falls in Cauvery River basin. The study area attains maximum elevation of 940 m and a minimum of 880 m above mean sea level. The study area shows that the average depth of annual rainfall for the study area is 812 mm. Finally, the study area was divided total 09 micro watersheds, certain limitations were followed in vectorization of micro-watershed to maintain the physical area 5-10 Sq. Kms. The location map of the study area is shown in Figure 3.

2.3 Study Area

In the Southern part of the Bengaluru city, Karnataka, India, the study area Gali Anjaneya Temple sub

watershed lies in Vrishabhavathi valley. Topographically, the territory is situated at latitude 13°1'11" N and 70°32'6" E longitude, covering a complete zone of around 36 Km^2 (Figure 3) and contains nine micro watersheds draining into Vrishabhavathi valley. Physiographicaly the zone is characterized by undulating topography with plain and shallow valleys. No major river is flowing in the valley and falls in Cauvery River basin. The study area attains maximum elevation of 940 m and a minimum of 880 m above mean sea level. The region is very much associated by parkways and other fundamental streets. The examination zone shows that the normal profundity of yearly precipitation for the investigation zone is 812 mm. At last, the investigation region was partitioned complete 09 miniature watersheds, certain constraints were continued in vectorization of miniature watershed to keep up the actual region 5-10 Sq. Kms. The area guide of the investigation region is appeared in Figure 3.

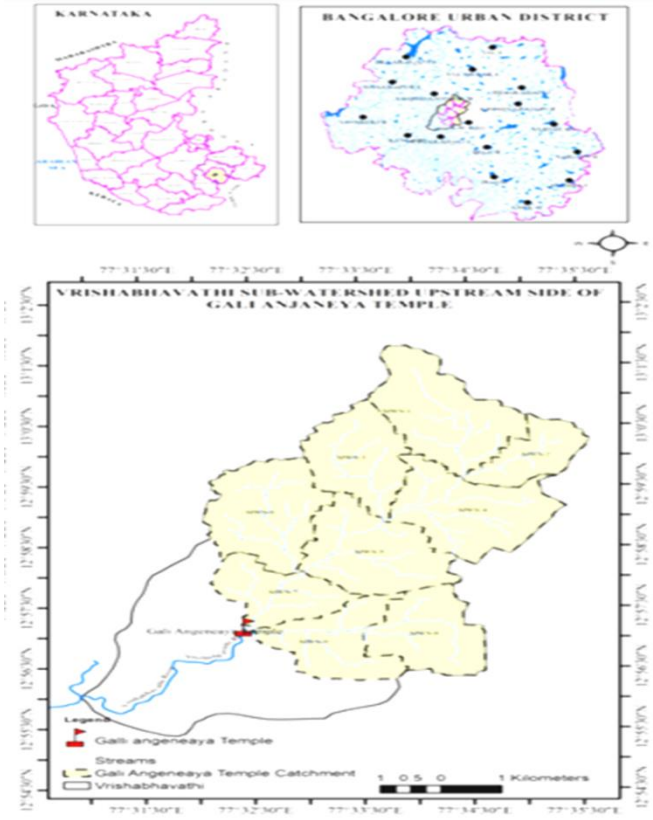


Figure 3: Study Area & prominent features include the 9 sub basins

III. REASONS FOR FLOOD

3.1 Reasons for flood in the examination region

Data analysis of the study indicates that weather variations in Bengaluru are, rise in temperature (during last few decades) is mainly due to urbanization. The increased heat waves, high levels in the carbon dioxide concentrations, change in micro climate, heat Island effects, change in Rainfall pattern its intensity has led to health disorders. Flooding occurs faster & quicker and huge loss to life and property with secondary effects of epidemics and infections. Therefore, management of urban flooding has to be tackled on top priority based on scientific approach and analysis.

3.2 Recognizable proof of flood related issues and issues

A few flood related issues and issues which add to either to agonies of flooding in the region are recognized. These are.

3.2.1 Inconsistent land utilizes, poor land use development, and Lack of zooning.

Due to rapid urbanization, Bengaluru is vulnerable to floods owed to lack of infrastructure planning and drastic land use changes. The lakes and tanks are converting into public and private layouts this has increased the runoff coefficients from existing 30%-40% to 80%-90% and has reduced the ground water storage capacity.

3.2.2 Ill-advised administration of metropolitan exercises, helpless advancement rules and control

Incomplete expansion of drainage system, unplanned drainages in new areas and reduction in the carrying capacity of the existing drains due to silting and

blockage. Recent Urbanization has over exploited the groundwater resources and has resulted in depletion of groundwater levels in Bengaluru. This has led to failure of bore wells and also deteriorated the ground water quality.

3.2.3 Issues identified with flood harms

Various issues and issues have been recognized identified with the job they play in impacting flood harms, and misfortunes in the town and its encompassing territories. These are:

- Poor seepage frameworks
- Narrow channels
- Low level establishment of houses/structures at the town community
- Lack of regular clearance of channels

Channels in investigation are exceptionally arrow and shallow and this makes their conveying limit low. During heavy

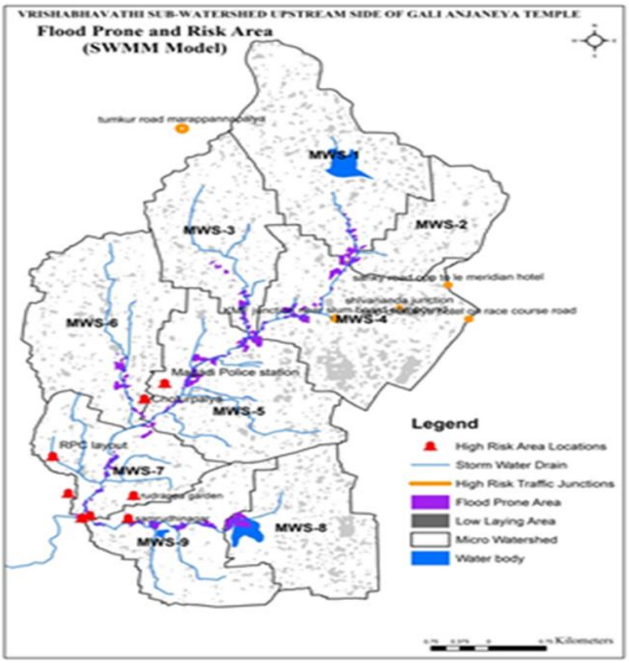


Figure 4: Flood Hazard Ranking Map of the Study Area

downpours, waters flood and run over dry land surfaces causing flooding and traffic issues. The abundance waters either from substantial downpour can't be contained by the shallow wastes in the study region and its encompassing regions.

During rains in the study area, flood water run into shops and houses situated in the low laying areas. Reports and interviews with some of the locals in the study area shows all the settlements in the catchment area were affected during floods during all set of floods in the study area at large.

So, Settlements of the town are directly adjusted along the fundamental street which is raised to be more secure from surface waters during typical downpours in the study area.

3.2.4 Impact of surrounding land uses on the flood ability of the study area.

Due to indiscriminate changes of the land uses in the surrounding areas, flood vulnerability of the area has been intensified. Runoff in the region increases as the surface pavement reduces the rain precipitation which leads to flood ability of the area.

3.2.5 Flood vulnerability and risk map

Flood Vulnerability as per the UNESCO-IHE establishment for water instruction is the investigation of flood vulnerability index (FVI) as the degree of damage, which can be considered typical under specific states of openness, powerlessness and versatility. This is as demonstrated in Fig 4.

IV.CONCLUSION

By using spatial technology, the development of flood inundation map and flood risk quantification maps are prepared for the study area (Figure 2). This study used flood depth in inundated areas, land use, population density and road networks for the evolution of flood hazards. For the effective flood management strategy, this study helps in giving information to planners and decision makers.

The spatial examination (Figure 4) showed that eight sites of occurrences lay in the high-risk zone, which has the highest vulnerability and a high probability of incurring damages. About 25 sites are situated along the main stream in low lying flood-prone areas, which shows a high vulnerability to floods. About 15 sites were located in low-risk zones and 12 sites were located in safe zones.

Rapid urbanization and the subsequent increase in floods have urged environmental researchers to think about absolute flood security along with being aware that flood risks cannot be avoided completely, but can only be reduced to a desired level. Hence, the flood risk mitigation does not strive to completely eliminate the flood risks from urban areas, but attempts to conceptualize measures to control them. This can be done by integrating structural and non-structural measures with community involvement. Additionally, the systematic and gradual conversion of urban land use to its natural stage would also contribute to the sustainable approach. In India, the flood protection program focuses on structural and non-structural measures, where structural measures deal with the hazards and non-structural measures deal with the elements of exposure and vulnerability.

Structural Measures:

Storage and detention reservoirs:

Detention ponds, also called holding ponds and storage reservoirs are suggested in all the micro-watersheds from MWS-1 to MWS-9. These ponds are useful in reducing peak flows and the subsequent frequency of overflow.

Flood embankment or Levees:

Flood embankments are suggested in MWS-5, MWS-6, and MWS-7. The most popular flood protection method is the construction of embankments that includes ring bunds and town protection works. The confinement of a river's flood banks by levees to a narrower space leads to higher flood levels for a given discharge. In the present study area, levees or flood embankments are suggested to reduce the flood peak in MWS-5, MWS-6 and MWS-7.

Retention tank:

Retention tanks are used for detaining excess water to prevent flooding of low-lying areas, roads and streets. The Mungeshpur drain, the NG Drain and the SD Drain are also used as retention basins at their outfall.

Channel improvement:

Channel improvement is suggested in MWS-3 and MWS-8. The frequency of flooding can be reduced by increasing the flow and maintaining the same water level, which can be achieved by either increasing the velocity or increasing the cross section. Deepening the channel helps to avoid the floods as the water level is lowered, but this results in a comparatively higher cost.

Diversion:

It is recommended to build diversion channels or floodways to mitigate the effects of flooding and to restore rivers to their natural water level. Diversions are man-made channels that render a different route for excess water from the main storm water drain.

In the present study area, diversion or floodways were suggested to reduce flood peak in MWS-7 to be diverted towards the downstream side of the Vrishabhavathi valley. Typically, diversion channels are built around communities or economic centers to prevent extensive flood damages.

Roof top Rainwater Harvesting:

Rainwater harvesting is a form of control by which water can be converted into a resource. In the present research work, the precipitation runoff of the study area was found to be reduced by 0.30 m^3/sec, due to roof top rainwater harvesting (RRH). The outcomes of the flood litigation measures suggested that 32% of the total runoff volume can be diverted to rainwater harvesting.

Non-structural Measures:

Flood plain management:

In order to demarcate the flood-prone areas according to various flood frequencies, flood plain management is recommended for preparing the flood risk maps.

Flood Proofing:

Flood proofing program is proposed for the flood-prone areas, more particularly for high-risk areas.

Disaster Preparedness and Response Planning:

Planning and preparing in advance is recommended for warning, disaster mitigation, emergency operations, rehabilitation and recovery.

Flood Forecasting and Warning:

Flood forecasting and warning is recommended for covering most of the flood-prone areas of watersheds. An ideal coordinated waste bowl the executives model has been advanced looking at of 30 and odd destinations situated for capacity and detainment repositories, 7 reasonable locales for flood dikes in MWS-5, 6, 7 and 9, one area for divert improvement in MWS-3, 3 destinations of New flood channels proposed for MWS-5, 6 and 8, one redirection direct situated in MWS-7, 3 appropriate locales are situated for flood protection in MWS-1, 2 and 4 and one existing tank in MWS-8 is suggested for desiltation for better water assets the board.

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Design of ARM based Data Acquisition from Underwater Sensor

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ABSTRACT
In today generation the importance of underwater vehicles are increasingly high as it can collect the data that is difficult for human beings to gather. This paper deals with acquiring the data from the underwater using specified sensors. Data Acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values. Acquiring the data from the underwater using specified sensors and arm controller and analyzing it using MATLAB in system and also feeding it to cloud.

I. INTRODUCTION

About 3/4th of the Earth's surface is covered by water, with the oceans holding over 96% of that water. This paper deals with acquiring the datafrom the underwater using specified sensors. So the requirement of underwater vehicle is more. The existing technologies are

- Unmanned Ground Vehicle (UGV)
- Autonomous Underwater Vehicle (AUV)
- Remotely Operated Underwater Vehicle (ROV)

Data Acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values. Data acquisition begins with the phenomena or physical to be measured. Examples of this include temperature, pH , pressure, distance and force. The Controlling of the system is based on underwater sensors and ARM Controller, which is located near the system. Underwater sensors as a DAS and control hardware in these system increased its reliability and robustness.

The components of DAS includes sensors to convert physical parameters to electrical signals, signal conditioning circuitry to convert sensor signals into a form that can be converted to digital values, Analog to Digital converters, to convert conditioned sensor signals to digital values.

II. LITERATURE SURVEY

[1] Model of Embedded Bluetooth Data Acquisition system which was designed using the ARM processor (S3C2440) as an embedded target and Bluetooth device which is connected to the ARM processor through a RS-232 serial port. In our implementation the ARM processor which acts as the Central Data Acquisition System is used as the controlling system that controls the Bluetooth device connected to it and acquires the data from the different subsystems of a UUV.

[2] under water communication system using the Zigbee protocol stack. This is very useful to find out any problem in caves and mines. An embedded system is a special purpose system in which the compute is completely encapsulated by or dedicated to the device or system. It controls personal digital assistant (PDAs) or handheld computers are generally considered embedded devices because of the nature of their hardware design, even though they are more expandable in software terms.

[3] Model of Embedded Bluetooth Data Acquisition system which was designed using the ARM processor (S3C2440) as an embedded target and Bluetooth device which is connected to the ARM processor through a RS-232 serial port. In our implementation the ARM processor which acts as the Central Data Acquisition System is used as the controlling system that controls the Bluetooth device connected to it and acquires the data from the different subsystems of a UUV.

III. ARM DATA ACQUISITION SYSTEM

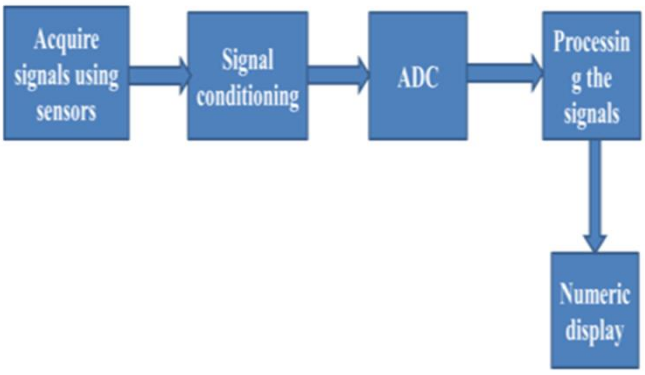

Fig 1: Block of data acquisition system

Acquiring the Real time physical parameters from underwater using specified sensors and ARM controller and feeding it to the signal conditioning circuitry which converts the Real time signals into the digital form using analog to digital converter.

DAS must acquire the necessary data, at correct speed and at correct time. To provide reliable, easy to operate and must be user friendly. Signal conditioning make quality measurements on transducers, additional circuitry is often needed between the transducer and the Analog to Digital converter.

The circuitry is generally referred to as signal conditioning and can include amplification/attenuation, filtering, Wheatstone bridge completion, excitation, linearization, calibration, and cold- junction-compensation (CJC). Different sensors have different signal conditioning needs. Thermocouples, which output signals in the mV range, need to be amplified as well as filtered before going through the ADC. Circuitry is contained within a data acquisition device, but signal conditioning may also be part of the transducer. ADC at the core of all data acquisition systems is an Analog to Digital Converter (ADC). The resolution of an ADC is essentially analogous to the ticks on a measuring stick.

Data acquisition applications are usually controlled by software programs developed using various general purpose programming languages such as Keil micro version4 and MATLAB. Stand- alone data acquisition systems are often called data loggers.

ARM Board for PH measurement was Tm4c123gh6pm Launch pad. Its features related to data acquisition is shown below

Table 1 : ARM cortex features for data Acquisition

SI NO	Parameters	Features
1	CPU	ARM Cortex M4
2	Frequency	80 MHz
3	ADC	12-bit SAR
4	GPIO	43
5	UART	8
6	I2C	4
7	Operating Temperature (C)	-40 to 85

IV. PROCEDURE OF DATA ACQUISITION

A. Transmitter

Acquiring the data from underwater using specified sensors namely

1. pH sensor

pH describes acidic or basic in an aqueous solution. pH scale is used to represent the hydrogen ion activity in solution.

2. Ultrasonic sensor

Ultra-sonic sensors are used for recognition and object detection. By ultra- sonic transducer the distance of any object can measured. The distance ranges from minimum of 19cm to maximum of 500m.

3. Vibration sensor

Vibration sensors are sensors for measuring, displaying, and analyzing linear velocity, displacement and proximity or acceleration..

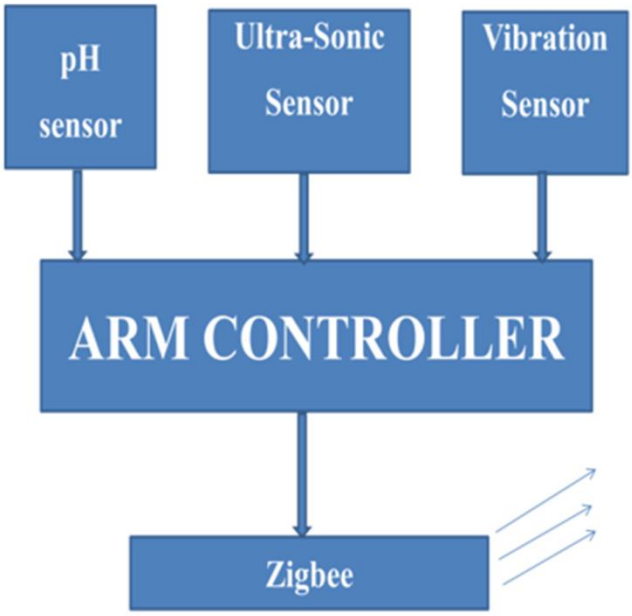

Fig 2: Transmitter section

B. RECEIVER

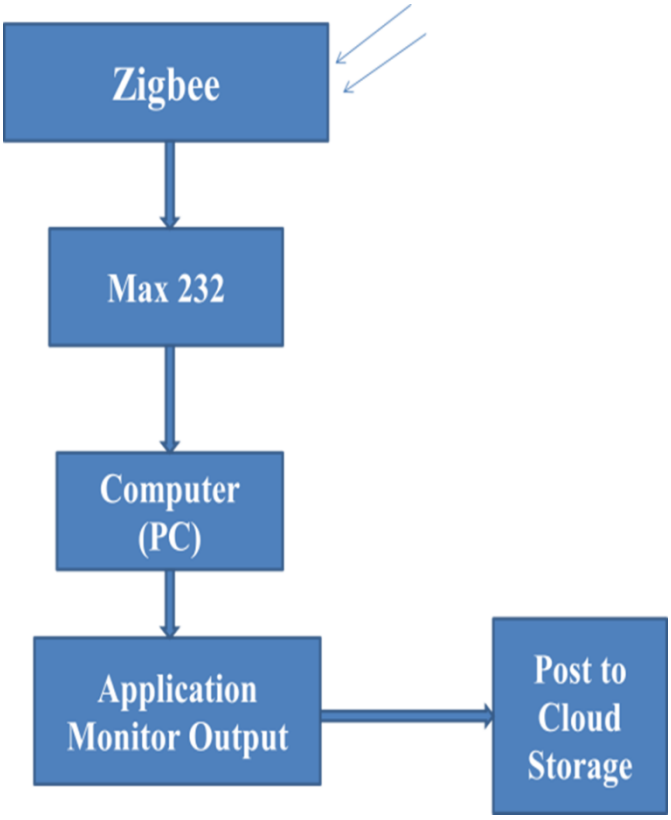

Fig 3: Receiver section

The collected data from the above specified sensor is been interfaced to the ARM controller and fed to the Zigbee Transreciever

Max 232 is a dual driver/receiver that includes a capacitive voltage generator to supply voltage levels from a single 5V supply.
We are feeding it to the PC in order to analyze the data which is coming from the underwater and later it is fed to the cloud.

V. RESULTS AND DISCUSSIONS

The programs are executed in MATLAB R2012a, PC is connected to microcontroller using UART. The system is used to measure pH value of different water samples using pH Sensors consisting of two electrodes. The results is as show below.

Table 2 : pH values of different water samples

SI NO	Sample	pH value
1	Normal water	9
2	Cold Water	8
3	Hot Water	7
4	Salt Water	5
5	Acidic Water	3

Figure below shows simulation output on LCD screen A 16 by 2 LCD is used to display the output. It is alpha numeric and shows the output in alphabets and numeric characters.

Fig 4 : LCD display of pH value for water sample

By using Ultrasonic sensor system is tested for different object recognition. It is observed system was recognizing under water objects in the range of 200m by blinking LED

VI. CONCLUSION

Data Acquisition is the sampling of the real world data. The features makes the data acquisition system from the underwater sensors of a choice and a system of feature having unlimited scope for development and expansion. The data acquisition designed here, DAQ integrated with ARM controller and processed it by MATLAB application. The combination of these two has proven beneficial in analysis. The MATLAB application interface the ARM based DAQ. The system is tested for measuring different pH values and also for different object recognition. The system implementation was easier since ARM launch pad with built-in features was used and system was working was faster with high accuracy

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Microwave Assisted Synthesis of Activated Carbon from Parthenium Hysterophorous for Electrical Double Layer Supercapacitors

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ABSTRACT

Microwave assisted method has been developed for the synthesis of activated carbon (AC) from a waste plant: Parthenium hysterophorous. Synthesized carbon material has been characterized by X-ray diffraction studies, Fourier-Transform Infrared spectroscopy, Scanning electron microscopic techniques. This characterization confirms the formation of carbon materials from the plant. AC has been evaluated for its electrochemical performance in supercapacitor applications using cyclic voltammetry, impedence spectroscopic techniques using three electrode systems. The specific capacitance obtained was found to be 182 Fg-1 at 2 Ag-1 current density. These results confirm the suitability of the activated material for supercapacitor applications and could serve as a alternate for energy storage systems.

Keywords - Activated carbon; Microwave synthesis; supercapacitors; Characterization.

I. INTRODUCTION

Global growth, lifestyle upgraation and ecological factors depend mainly on the utilization of the available energy. Every day, the issues pertaining to energy are keep on rising across the universe due to the excess use of fossil fuels and resulted in socio-economic and environmental issues. Thus, the researchers, scientists, technologists across the globe are paying much attention to solve the issues related to energy by finding the alternate sources of energy. In consequence, batteries, fuel cells, supercapacitors and hydrogen storage cells etc. Supercapacitors are considered as the alternatives in automobile industry due to its enhanced power density, fast charge-discharge profile, cost-effective and gaining attention in the field of energy harvest and storage systems [1-5]. Based on the mechanism of energy storage, supercapacitors are broadly classified in to 1) Electrical double layer capacitors (EDLC) and ii) Redox-capacitors. The materials used in EDLCs include carbon materials, carbon aerogels, activated carbon, graphite, graphene, graphitic carbo nitrides etc.

Parthenium hysterophorous (PH) popularly also called as wild carrot weed is considered as the dangerous weeds that causes huge damage to the health of living beings. [6]. This plant contains ambrosinect, Parthenon and hymenin and causes allergies like black spots, blisters around eyes, hay fever etc. Therefore, its neither decontamination nor complete eradication is practically impossible without

the effort put on by the public and governing bodies. Activated carbons have been prepared by many sources, like nut shells, coconut shells, rice husks etc [7-9]. Reports on the use of flowers of PH for supercapacitor application is not found in the literature, so authors planned and successfully synthesized the activated carbon using microwave method and used as electrode material for supercapacitor applications.

II. EXPERIMENTAL

Materials and Methods

Analytical grade reagents were purchased from Fisher Scientific India Pvt. Ltd. Mumbai, India, further used as received without any purification.

Synthesis of Activated carbon (AC) from PH flowers

Parthenium hysterophorous flowers (white) were collected from a place near the NHCE college premises, Bangalore. These flowers are dried under sun first later in hot air oven for one day. Later, collected and ground in to fine powder, added required amount of sulphuric acid and using china dish kept inside the microwave synthesizer. The microwave power was fixed to 400 w and the radiation time was 60 min. After the microwave activation, the samples were collected, cooled and washed several times using distilled water. The resultant was dried under vacuum overnight and used for characterizations.

Electrochemical measurements

The activated carbon (AC) has been used as electrode material for supercapacitor applications using the electrochemical work station CHI660E using three electrode system. AC electrode was fabricated using Ketjen black-EC 600JD and PVDF (binder) dissolved in NMP (N-Methyl-2-pyrrolidone) solution in 85:10:5 weight ratios and coated on 1 cm^2 area carbon paper, later dried under vacuum and used as working electrode. The other two electrodes used are platinum wire (counter electrode) and Ag/AgCl (reference electrode). The electrochemical performance of the AC material was carried out in 1M H_2SO_4 solution. The specific capacitance of supercapacitors was calculated based on CV analysis using equation (1):

$$C_{sp} = \frac{\int IdV}{m\,\Delta V\,s} \longrightarrow (1)$$

where C_{sp} is the specific capacitance measured in Fg^{-1}, I is the specific current in A, m is mass of the active electrode material in g, ΔV is the potential window in V, s is the voltage scan sweep rate in mVs^{-1} and $\int Idv$ is the total voltammetric charge obtained by the integration of positive and negative scan sweep.

III. RESULTS AND DISCUSSION

The crystallinity of the synthesized AC has been evaluated using X-ray diffraction studies (Bruker D2 Phaser XRD). As seen in the figure 1, the AC carbon possesses its characteristic broad peak at 2θ 24.8° and a 42.5° with the (002) and (101) planes, respectively. These results, suggests the activated carbon extracted from flowers of PH are somewhat amorphous in nature.

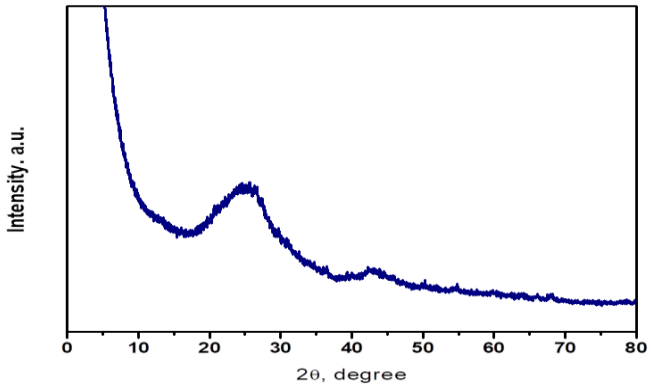

Figure 1. XRD pattern of synthesized AC.

The morphology of the synthesized AC has been evaluated using scanning electron microscope (SEM, using JEOL JSM 840A) technique. The figure 2 clearly depicts the SEM monograph of the AC and suggests

the uniform distribution of the carbon atoms, porosity of the materials is not clearly found in image. A slight spherical nature of the particles could be observed in the image.

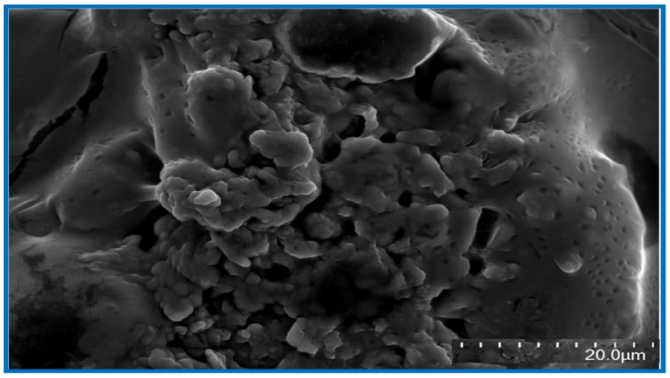

Figure 2. SEM Monograph of synthesized AC.

The cyclic voltammetry (CV) technique has been used to evaluate the electrochemical performance of the synthesized AC using three electrode system. CV curves of the AC at varied scan rate has been given in figure 3, and clearly indicates the current density of the AC increases upon raise in the scan rate from 20-150 mv. The shape of the curve are perfectly rectangular in nature without any oxidation and reduction peaks, indicated the property of the electrical double layer supercapacitors. These characteristic natures of the curves spell about the faster ion diffusion, enhanced charge propagation, low contact resistance and swift re-organizing properties of the synthesized AC material. The specific capacitance obtained for AC at different scan rate is depicted in table 1.

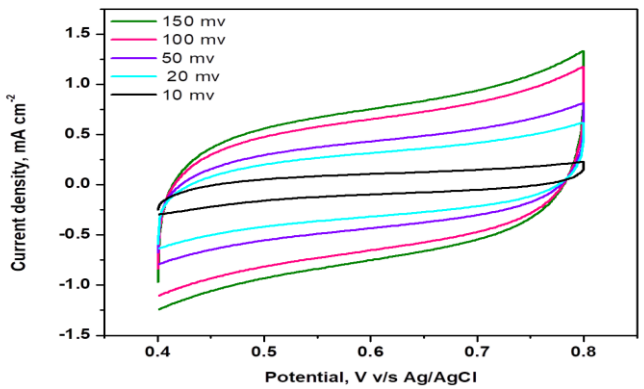

Figure 3. Cyclic voltammetric curves of AC

Table 1: Specific capacitance of the AC at different scan rate		
Sl No.	**Scan rate**	**Specific capacitance (CSp) Fg^{-1}**
1	10	187
2	20	156
3	50	98
4	100	86
5	150	62

The Galvanostatic charge discharge (GCD) curves of the AC electrode have been evaluated at the potential window between 0-0.8 V and are given in figure 4. AC curves in the figure are falling under similar trend of two stage voltage drop one at the upper part of the curve suggesting the specific capacitance and a typical symmetrical shape of the curves suggesting the EDLC behavior of the AC electrode material.

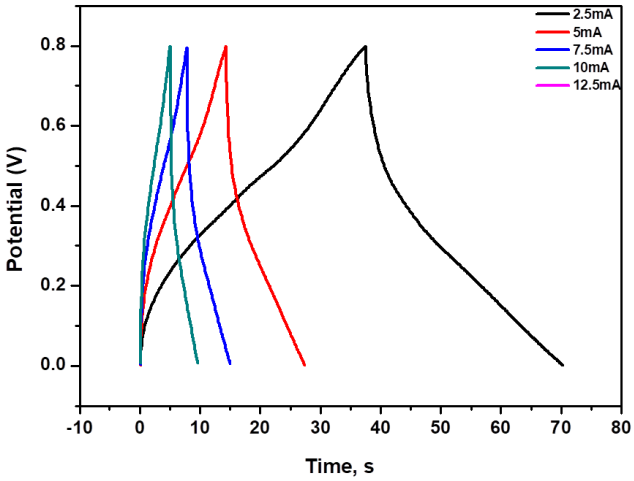

Figure 4. Galvanostatic charge discharge profile of AC.

Electrochemical impedance spectroscopy (EIS; figure 5) a useful technique and gives the characteristics on the electrochemical frequency and its behavior in supercapacitor electrodes. EIS evaluation has been done at a dc bias on 0.2 V at a 0.01 HZ -100 HZ frequency range. The specific capacitance was estimated using equation 2 and found to be 109 Fg^{-1}.

$$C_{sp} = \frac{I\,t}{m\,\Delta V} - - - - \rightarrow (2)$$

Where, C_{sp} is specific capacitance measured in Fg^{-1}, I is the specific current density in Ag^{-1}, t discharge time in s, m is the active electrode mass in g and ΔV is the potential window in V.

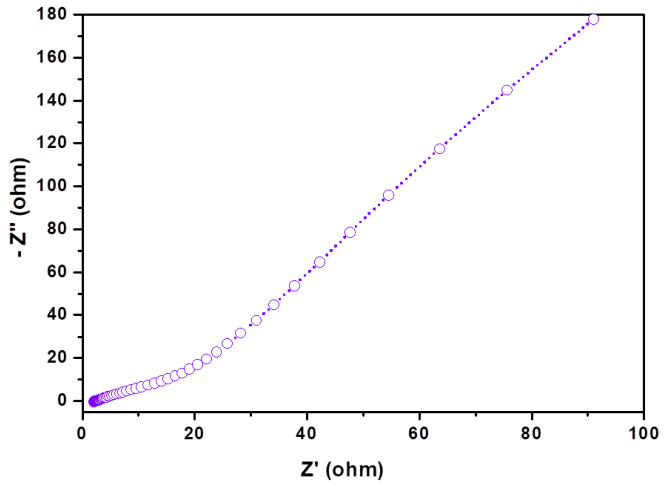

Figure 5. The Nyquist plots of synthesized AC

IV.CONCLUSION

Activated carbon has been synthesized using flowers of the *Parthenium hysterophorous* using microwave assisted method. Characterization confirmed the amorphous nature of the AC and perfectly gives the EDLC behavior in supercapacitor applications under three electrode system. The results shows AC could serve as a good material for the energy storage systems in the future generation.

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Parameter Space of a PWM Chopper Controlled DC Series Drive System

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ABSTRACT
In this paper a study is made on the bifurcation behavior for speed response of a chopper fed dc motor drive system. The key idea is to identify the operating conditions over the allowable range of load torque for stable operation of the motor drive system. With only speed loop operative investigation is made by numerically simulating the drive system and also performing laboratory experiment on a 0.5 hp, 220V and 1800 rpm dc series motor.

Keywords : Chopper, Pwm, Bifurcation, Chaos, Chopper, Period One.

I. INTRODUCTION

Since last few decades investigations on bifurcation behavior in nonlinear systems [1-6] have taken a lead almost in every sector of research activities. The reason behind this enhanced research activity is to explore wide diversion in dynamic behavior that ranges from periodic to sub harmonic and even chaotic responses. Advances in the field of power electronics and the unique advantage of high starting torque have made the dc series motors widely acceptable in traction, hoisting and different variable speed applications. All power electronic systems are inherently nonlinear in nature. It is therefore highly desirable to investigate dynamic behavior of this high torque dc motor drive system for identifying the optimum range of operating conditions to avoid occurrence of undesirable chaotic oscillation. However, although chaos is unwanted in a practical dc series motor drive system, but there are also different promising applications of chaos [7]. These include compaction, mixing and grinding, washing etc.

In the existing literature for power electronics and drives, several investigations are present exploring bifurcation behavior of dc drive systems [8-19]. Most of these publications have considered brushless dc motor, PMDC or shunt motor as the electromechanical equipment. For example, Chau et al in [20] had described bifurcation and chaos in a chopper fed PMDC motor–load system. Responses of a dc drive system operated from buck converter [21-22] against variations in input voltage, controller gain, and load torque are also present. These investigations are pre requisite for designing a motor drive system in order to avoid chaos or enforce chaos. Interestingly very few studies [22-24] are available in the literature for dc series motor drives which are largely used in traction and different modern industrial and domestic appliances.

This paper therefore presents a detailed study on a pwm controlled buck converter fed dc series motor drive system. This investigation with source side ac

bus voltage is important for domestic and small scale industrial applications of dc series motor where the cost for installing a dc bus is not economical. Behavior of the drive system is mainly described with low and high speed operation against variation of load torque and controller gain. These observations are necessary for selecting the most suitable operating conditions to ensure stable operation of the drive system in different sections of the load characteristic, like low speed-high torque or vice versa or low speed low torque etc.

Organization of the paper is as follows: section 2 describes the operating modes of a buck converter fed dc series motor drive system with source side ac bus voltage. Section 3 is presented a short note on the different nonlinear behaviors of the drive system and their identication for proper design of the drive system. Section 4 explores bifurcation phenomena of the drive system for variation in load torque and controller gain with low speed and high speed operation. In section 5 results for laboratory experiment showing performance of the control circuit for period-1,period-2 and chaotic response of drive system are presented.

II. SYSTEM DESCRIPTION

Fig. 1 shows schematic of the pwm buck converter fed dc series motor drive system. It is observed from Fig.1, that device switching pulse is generated by comparing the actuating signal $v_{con}(t)$ with an externally applied sawtooth waveform $v_{tr}(t)$. The $v_{con}(t)$ is produced by a PI controller to which is fed the speed error signal. If $v_{con}(t)$ be more than sawtooth waveform, switch SW becomes on and D_F remains in off state. Otherwise SW remains off and D_F starts conducting to free wheel the energy of capacitance and motor inductance. Thus the drive system has two switching modes. These are STATE-1, when SW is on and D_F is off and STATE-2 when SW is off and D_F becomes turned on. Interestingly each switching state has two operating modes depending on the state of charging or discharging of the filter capacitor C.

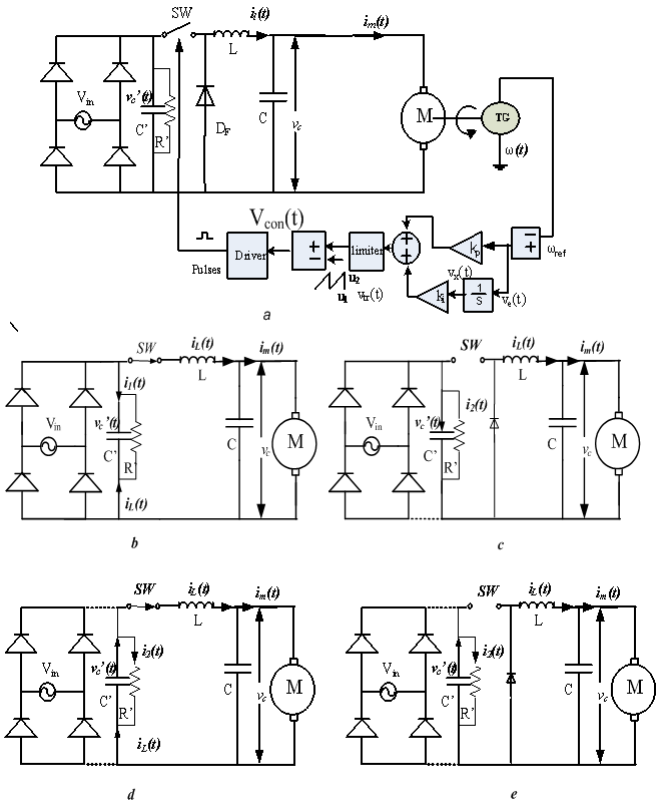


Fig.1: Schematic of PWM buck converter fed dc series motor drive system.

a,b: state of charging and discharging of C' during state1 respectively.

c,d: state of charging and discharging of C' during state2 respectively

Systems of differential equations governing the two operating modes during each switching state are stated in 1.1-1.4 with state vector as in 1.0

$$x=[i_L(t) \quad i_m(t) \quad \omega(t) \quad v_c'(t) \quad v_c(t) \quad v_e(t)] \qquad 1.0$$

In 1.0, the phase variables are chosen as the inductor current $i_L(t)$, motor current $i_m(t)$, speed $\omega(t)$, voltage of filter capacitor (C') or $v_c'(t)$,voltage input to motor armature $v_c(t)$ and input to the integral controller $v_e(t)$. The operating modes are briefly described in the following section.

Mode 1(State-1): $V_{in}(t) > v_c^{'}(t)$. During this mode capacitor $C^{'}$ takes charging current $i_1(t)$ from the ac supply and simultaneously also discharges by causing $i_L(t)$ to flow through the LC section as shown in Fig. 1(b). So, $i_L(t)$ continues to charge the capacitor C with upper plate positive. 'C' however discharges through motor armature by sending current $i_m(t)$, provided back emf of motor will remain always less than $v_C(t)$. This condition is also necessary to ensure motoring mode of the drive system, which demands careful selection of C.

$$\begin{bmatrix} \frac{di_L(t)}{dt} \\ \frac{di_m(t)}{dt} \\ \frac{d\omega(t)}{dt} \\ \frac{dv_{C'}(t)}{dt} \\ \frac{dv_C(t)}{dt} \\ \frac{dv_e(t)}{dt} \end{bmatrix} = \begin{bmatrix} -\frac{R}{L} & 0 & 0 & \frac{1}{L} & 0 & 0 \\ 0 & -\frac{r}{l} & -\frac{k_e * i_m(t)}{l} & 0 & \frac{1}{l} & 0 \\ 0 & \frac{k_e}{J} i_m(t) & -\frac{B}{J} & 0 & 0 & 0 \\ -\frac{1}{C'} & 0 & 0 & 0 & 0 & 0 \\ \frac{1}{C} & -\frac{1}{C} & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} i_L(t) \\ i_m(t) \\ \omega(t) \\ v_c^{'}(t) \\ v_c(t) \\ v_e(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ -\frac{T_L}{J} \\ \frac{V_{in}(t) * (2 * \Pi * 50 * C^{'})}{C^{'}} \\ 0 \\ \omega_{ref}(t) \end{bmatrix}$$

1.1

Mode2 (state-1): $V_{in}(t) < v_c^{'}(t)$. In this mode capacitor $C^{'}$ stops charging from the supply and starts discharging either through the LC section and resistor $R^{'}$ or only through $R^{'}$. However $C^{'}$ can continue discharge through LC section if $v_{C'}(t)$ remains more than $v_C(t)$. Otherwise SW becomes reverse biased and hence turned off, although gate pulse still exists .Therefore while selecting circuit components value of the capacitors must be properly selected so that never $v_{C'}(t)$ becomes less than $v_C(t)$. The situations are shown in Fig.1. (c)

$$\begin{bmatrix} \frac{di_L(t)}{dt} \\ \frac{di_m(t)}{dt} \\ \frac{d\omega(t)}{dt} \\ \frac{dv_{C'}(t)}{dt} \\ \frac{dv_C(t)}{dt} \\ \frac{dv_e(t)}{dt} \end{bmatrix} = \begin{bmatrix} -\frac{R}{L} & 0 & 0 & \frac{1}{L} & 0 & 0 \\ 0 & -\frac{r}{l} & -\frac{k_e * i_m(t)}{l} & 0 & \frac{1}{l} & 0 \\ 0 & \frac{k_e}{J} i_m(t) & -\frac{B}{J} & 0 & 0 & 0 \\ -\frac{1}{C'} & 0 & 0 & e^{-\left(\frac{t}{R^{'}C^{'}}\right)} & 0 & 0 \\ \frac{1}{C} & -\frac{1}{C} & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} i_L(t) \\ i_m(t) \\ \omega(t) \\ v_c^{'}(t) \\ v_c(t) \\ v_e(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ -\frac{T_L}{J} \\ 0 \\ 0 \\ \omega_{ref}(t) \end{bmatrix}$$

1.2

State 2 (mode-1): $V_{in}(t) > v_c^{'}(t)$ As the switch remains in off state, so $C^{'}$ can't discharge through LC section and only continues to charge from the supply. The inductor discharges through the freewheeling diode D_F and C simultaneously continues to charge by $i_L(t)$ and discharge through the motor armature.

$$\begin{bmatrix} \frac{di_L(t)}{dt} \\ \frac{di_m(t)}{dt} \\ \frac{d\omega(t)}{dt} \\ \frac{dv_{C'}(t)}{dt} \\ \frac{dv_C(t)}{dt} \\ \frac{dv_e(t)}{dt} \end{bmatrix} = \begin{bmatrix} -\frac{R}{L} & 0 & 0 & 0 & 0 & 0 \\ 0 & -\frac{r}{l} & -\frac{k_e * i_m(t)}{l} & 0 & \frac{1}{l} & 0 \\ 0 & \frac{k_e}{J} i_m(t) & -\frac{B}{J} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ \frac{1}{C} & -\frac{1}{C} & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} i_L(t) \\ i_m(t) \\ \omega(t) \\ v_{C'}(t) \\ v_C(t) \\ v_e(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ -\frac{T_L}{J} \\ \frac{V_{in}(t) * (2 * \Pi * 50 * C^{'})}{C^{'}} \\ 0 \\ \omega_{ref}(t) \end{bmatrix}$$

1.3

State 2(mode-2): $V_{in}(t) < v_c^{'}(t)$ .During this switching state $C^{'}$ simply discharges through $R^{'}$ and rest of the circuit operation is same as in mode-1 of state 2.

$$\begin{bmatrix} \frac{di_L(t)}{dt} \\ \frac{di_m(t)}{dt} \\ \frac{d\omega(t)}{dt} \\ \frac{dv_{C'}(t)}{dt} \\ \frac{dv_C(t)}{dt} \\ \frac{dv_e(t)}{dt} \end{bmatrix} = \begin{bmatrix} -\frac{R}{L} & 0 & 0 & \frac{1}{L} & 0 & 0 \\ 0 & -\frac{r}{l} & -\frac{k_e * i_m(t)}{l} & 0 & \frac{1}{l} & 0 \\ 0 & \frac{k_e}{J} i_m(t) & -\frac{B}{J} & 0 & 0 & 0 \\ 0 & 0 & 0 & e^{-\left(\frac{t}{R^{'}C^{'}}\right)} & 0 & 0 \\ \frac{1}{C} & -\frac{1}{C} & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} i_L(t) \\ i_m(t) \\ \omega(t) \\ v_{C'}(t) \\ v_C(t) \\ v_e(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ -\frac{T_L}{J} \\ 0 \\ 0 \\ \omega_{ref}(t) \end{bmatrix}$$

1.4

Thus, order of the drive system is higher than the previous and therefore complexity in system behaviour will be more.

III. BRIEF NOTE ON SYSTEM BEHAVIOR

For the motor drive system as considered in this paper, gate pulses for the switch SW are generated by comparing the actuating signal with an externally applied sawtooth waveform. Therefore, different dynamic behaviours are described by scaling the ripple frequency in response of motor speed or the switching frequency with that of sawtooth waveform,

$v_{tr}(t)$. When switching frequency is same as that of $v_{tr}(t)$, the drive operates in period-1 mode and values of motor current or speed sampled at starting instant of every ramp cycle will have same value. In the bifurcation diagram, the sampled values plotted along y-axis show a single point or very close distributed points at the corresponding parameter value plotted along the x-axis. This is basically the stroboscopic sampling technique and samples should be taken only after steady state has reached. Similarly higher periodic behaviour means values of stroboscopic samples will be repeated after two (period-2) or three (period-3) or some higher number of consecutive ramp cycles. But chaotic or quasiperiodic evolution implies aperiodic switching or switching frequency is incommensurable from the sawtooth frequency. Stroboscopic samples in either case will be a collection of different values of the samples and such behaviours in bifurcation diagram will be presented as dense collection of points spreaded over a length along the y-axis. No measure in this investigation is taken to differentiate whether the response is chaotic or quasiperiodic, as it aims only to locate the area of load characteristic, where the desired period-1 behaviour is possible.

Bifurcation Behavior

A dc series motor drive system is nonlinear in nature and therefore very much sensitive to changes in operating conditions .So variations in the user defined parameters, like

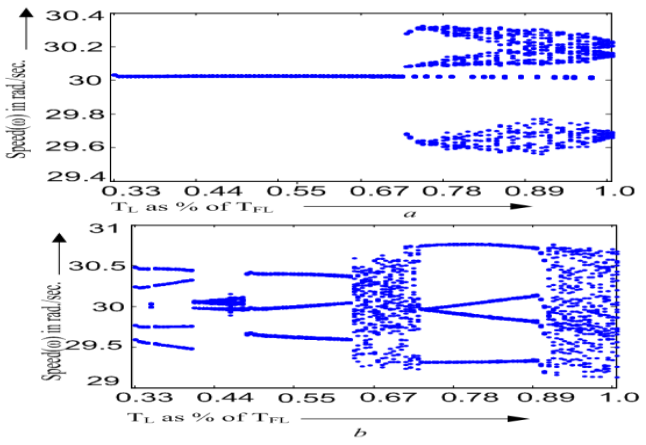
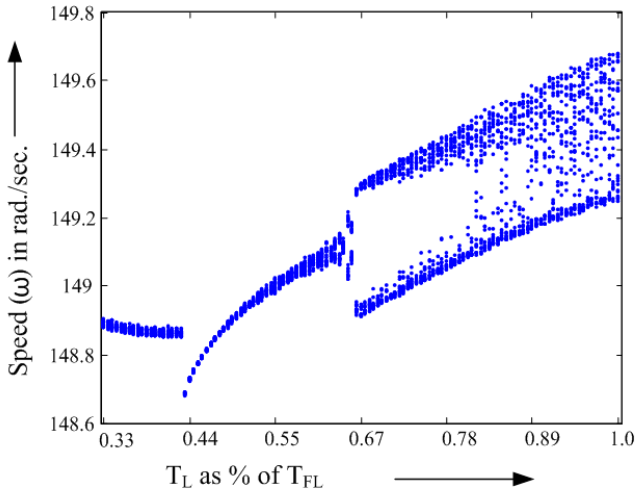


Fig.2: bifurcation in speed response of the drive systems against variations in load torque with $\omega_{ref} = 30$ rad./sec and $k_p = 2.1$ (a), $k_p = 4.1$ (b)

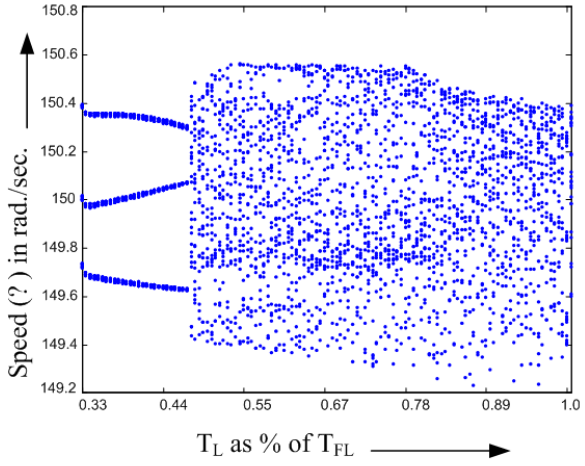
load torque, controller gain, input voltage or speed command results a change in qualitative behaviour of drive system along with average value of motor speed or current. Thus for presenting a study on the load characteristics of the dc series motor drive system, bifurcation behaviours for motor speed are reported with low speed and high speed operation against variations in load torque and controller gain with parameter values as listed in table 1. Numerical simulation is performed on the drive system and bifurcation diagrams are prepared by using stroboscopic sampling method. This investigation aims to find the zones in load characteristics where the desired nominal period-1 behaviour is possible.

Table1: Different parameters of the motor drive system

Parameters of the drive system		
Symbol	Quantity	Value
R_m	Total resistance of dc series motor	29.2 Ω
L_m	Total inductance of dc series motor	0.0736 H
k_e	Back-emf constant	0.039 V/rad./s
k_t	Torque constant	0.039 N-m/A
J	Moment of inertia	0.015 kg-m^2
B	Viscous friction coefficient	0.001 N-m/rad/s
C'	Capacitor filter	0.0022 F
R	Resistor for discharging of C'	220Ω
C	Power circuit capacitance	0.0001 F
L	Power circuit inductance	370mH



a



b

Fig.3: Bifurcation in motor speed with high speed operation

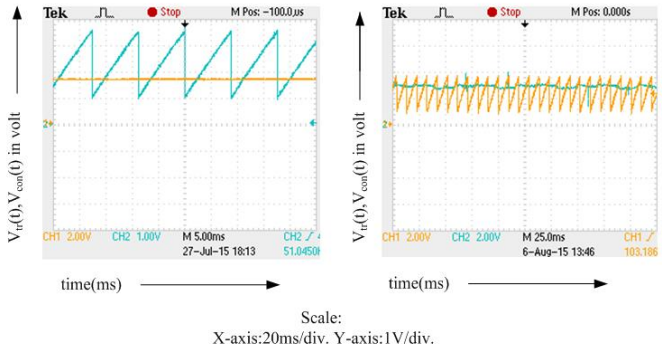
A. Low Speed Operation

It is observed from Fig. 2, that no period-1 behaviour is found to occur when the gain value for the proportional controller is increased from 2.1 to 4.1 with $\omega_{ref} = 30 rad./\sec.$ and $k_i = 1.1$ .In fact intermittent chaotic windows and higher periodic behaviours are observed with $k_p = 4.1$ as present in Fig. 2(b) .However, Fig. 2(a) shows that, with $k_p = 2.1$ period 1 response occurs when load torque is increased from 33% to 70% of full load torque, T_{FL}. Also with further increase in load torque period-1 response is found to occur only at some values of T_L and at other values the drive system has two band chaotic response

B. High Speed Operation

With $k_p = 2.1$ it is observed from Fig. 3(a) ,that speed response is period-1 for almost the same range of load torque variation as noted with low speed operatoin. With further increase in load torque motor speed bifurcates to period-2 behavior and finally at higher values of load torque behaves chaotically. of load tBut the period-1 behaviour has ripples and the speed is observed to decrease with T_L . However in SYSTEM 2 when k_p is increased from 2.1 to 4.1 ,the desired period-1 behaviour doesn't occur as shown in Fig. 7(d).

IV.CONCLUSION



Scale:
X-axis:20ms/div. Y-axis:1V/div.

Fig.4:

In this investigation a report is presented on comparative study of the speed response in a dc series motor drive system when operated from two different configurations of dc/dc converters, named as SYSTEM-1 and SYSTEM-2. From the results of numerical simulation and laboratory experiment it has been observed that, over the entire range of operating speed, the speed response in both drive systems are very much sensitive with the gain value of proportional controller. SYSTEM-1 gives period-1 behaviour with very low gain value of proportional controller for a lower range of load torque. However, to have period-1 response in SYSTEM-2 the upper

limit for gain value of proportional controller is relatively wide as compared to SYSTEM-1.Similar to SYSTEM-1, the period1 behaviour in SYSTEM-2 becomes unstable with high values of load torque. This paper also presents an expression for load characteristic in both the drive systems and shows that with increase in loadtorque, decrease in speed is comparatively more in SYSTEM-2 than in SYSTEM-1.

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Development of a Residential Microgrid Using Home Energy Management Systems for Effective Energy Conservation

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ABSTRACT
Now a day's there is a shift from conventional to non-conventional sources of energy for power production because of less pollution and eco-friendly. Depending on such single source of energy results in unstable operation caused due to inaccessibility and climatic variations. The proposed system allows two or more sources to supply the load depending on the availability of the energy sources and priority. This paper presents a new system configuration of solar and wind integration for automatic energy management system of renewable energy source. Microcontroller based control ensures the optimum utilization of resources and it also increases the efficiency of the combined system as compared to the individual mode of generation.

Keywords : Hybrid System, Energy Management System

I. INTRODUCTION

One of the major attribute of the smart grid is to integrate renewable and storage energy resources at the consumption premises [1]. In today's technology driven world electricity is one of the foremost things for our day-to-day life activities. As we all are oblivious of the fact that the renewable sources of energy are depleting at a lightning fast rate. So, it's time for us to shift the focus from conventional to non-conventional sources of energy to produce electricity.

With increase in population and advancement of technology, consumption of electricity is also increasing exponentially. Simultaneously, we have to increase the production of electricity also in order to meet the demands of growing population. The biggest disadvantage with the usage of conventional resources is that their usage causes pollution due to the production of various pollutants like ash in case of a coal power plant, smoke in case of diesel power plant, radioactive material in case of nuclear power plant. Maintaining these pollutants is not an easy task and it also requires a lot of money. So, we have to find some other methods to produce electricity. The best possible way is by using non-conventional sources of energy. Out of all the possible options available in nonconventional sources of energy, solar and wind are the best methods.

However, due to the dynamics of renewable resources, use of any particular renewable energy resource system as a standalone may lead to in operation during some time of the day and seasons and unnecessary operational and lifecycle costs, as well as components oversizing. These limitations can be overcome by combining two or more renewable energy resources in the form of a hybrid system, such as a photovoltaic system and a wind turbine.

A hybrid system has the advantage of improved reliability and gives better energy service when compared to a standalone supply system.

II. HYBRID SYSTEM

A. Solar Energy

Solar energy is that energy which we get from the sun in form of radiation. It does not cause any kind of pollution, it is inexhaustible. It is available free of cost. Specially, in a country like India where sun shines for almost 300 days in a year, it is therefore a convenient mode of electricity production. Meager amount of investment is involved in setting up a solar power plant and also it is quite easy to maintain. The efficiency of the system is also quite good. Long life span and less emission of pollutants are its major advantages [2].

B. Wind Energy

When air flows then it is having some kinetic energy with it which is known as wind energy. This kinetic energy is converted into mechanical energy by the wind turbine, which is used to rotate the shaft of the generator and then electricity is produced. The cost of generation of electricity is quite less. The initial investment of the system varies depending on the type of turbine used. The best part about producing electricity with the help of wind energy is that wind is available for almost 24 hours in day, so there will not be any discontinuous production of electricity. The output varies with the speed of the wind.The combination of renewable energy sources, wind & solar are used for generating power called as wind solar hybrid system. This system is designed using the solar panels and small wind turbines generators for generating electricity[2].

C. Integrated Solar and Wind System

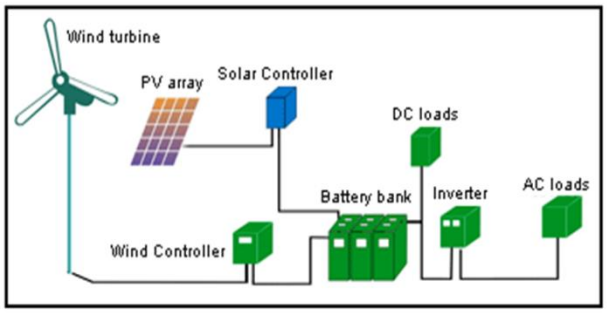


Fig 1. Hybrid System

Wind and solar energy are complementary to each other, which makes the system to generate electricity almost throughout the year. The main components of the Wind Solar Hybrid System are wind aero generator and tower, solar photovoltaic panels, batteries, cables, charge controller and inverter. The Wind - Solar Hybrid System generates electricity that can be used for charging batteries and with the use of inverter we can run AC appliances. Wind aero-generator is installed on a tower having a minimum height of 18 mtrs from the ground level. Because of the height, the aero-generator gets wind at higher speed and thereby generates more power.

The primary objective of the paper is to utilize the available renewable energy in the nature without causing any harmful effects to the human lives and environment. The main objectives of the project include:

- Generate power from wind and solar system and make automatic energy management system of renewable energy source.
- Automatic switching between different source and provide continues power

It has three alternate sources, which are automatically switched as per the priority of available source. The operation of this system can be explained in different cases. In this case when solar power and wind power are both available then, we preferably go with solar power, since it is higher than wind power. And the power from Solar is delivered to battery. If solar not available than wind will transfer the power from battery. In this case when both solar power and

wind power is less, or not available then automatically power will be drawn from main supply and delivered to battery. Each time when renewable sources are opted then the energy is stored in battery, which can be later used for specific applications. Inverter section is for convert DC power to AC.

Automatic energy management system with solar and wind energy is applicable for power generation in both rural and urban areas. The automatic energy management system of renewable energy source system maintains a continuous supply of power. This system utilizing energy from nature can overcome the drawbacks caused due to unfavourable climatic conditions in the environment. Energy management in microgrids is defined as an information and control system that provides the necessary functionality, which ensures that both the generation and distribution systems supply energy at minimal operational costs.

III. SIMULATION

The structure and methodology of the hybrid system key parameters are choosing of proposed guaranteed power supply system of responsible consumers with use of emergency power supply sources and uninterruptable power supply is developed.

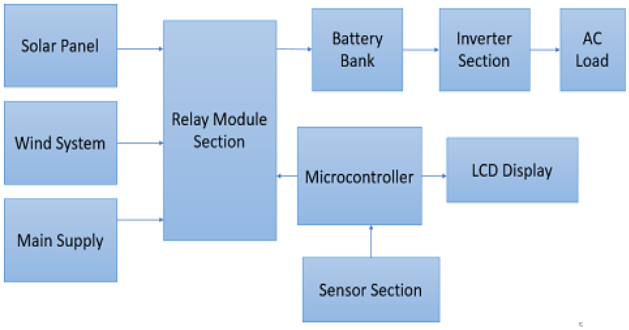


Fig 3.Block Diagram

The implantation of functions on the bottom of the choice and renewed energy sources, like windmill, solar array and main power supply. Each of those sources allows avoiding occurrence of emergencies and infringement of technological process continuity. The main stages of selecting power source of obtainable with help of control section and sensor section. The relay switch is employed for automatic switching from one source to a different source.

A. Circuit Diagram

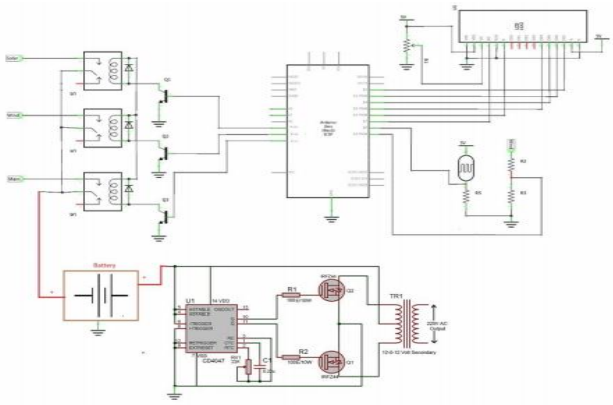


Fig 2: Circuit Diagram

This system is implemented with atmega328 Arduino microcontroller. All available source connected with relay switch. These relay s are successfully ready to switch from one source to a different source. DC to DC converter is increasing the availability quality. During this system we are changing the source supported source availability and also as supported priority. That we design it's supported for solar First priority and 2nd priority for wind and last priority for main power supply

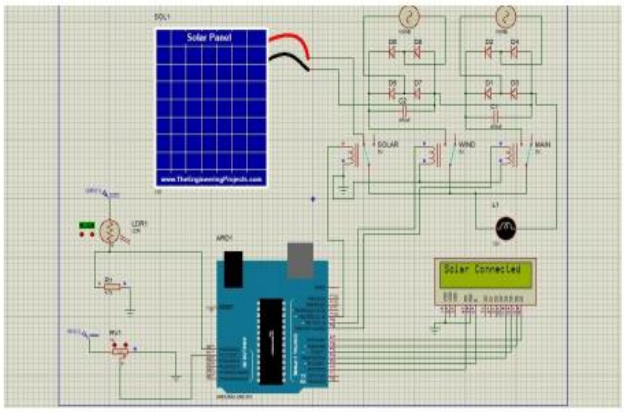
TABLE I. OPERATION CASES OF THE PROPOSED HPG

Operation Cases	PV Panel	Wind Turbine & Battery	Inverter Operation State	Active Power Source
1	+	+	Yes	PV Panel
2	+	-	Yes	PV Panel
3	-	+	Yes	Wind Turbine
4	+	+	No	Grid
5	-	-	No	Grid

+:Sufficient Energy Source
-:Insufficient Energy Source

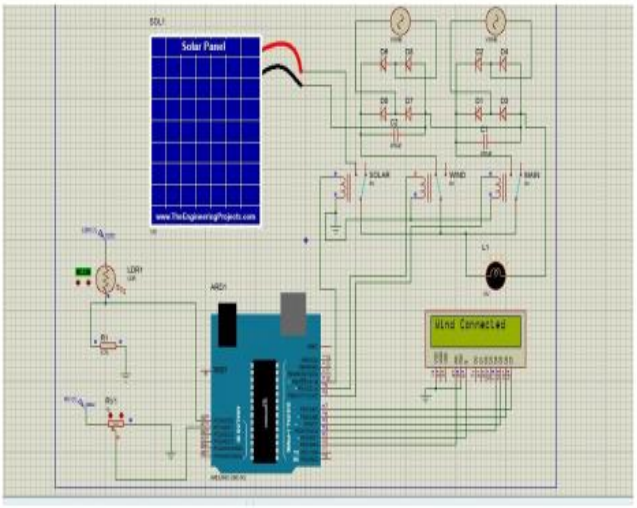
Case 1: Solar Connected

Simulation Output Case 1



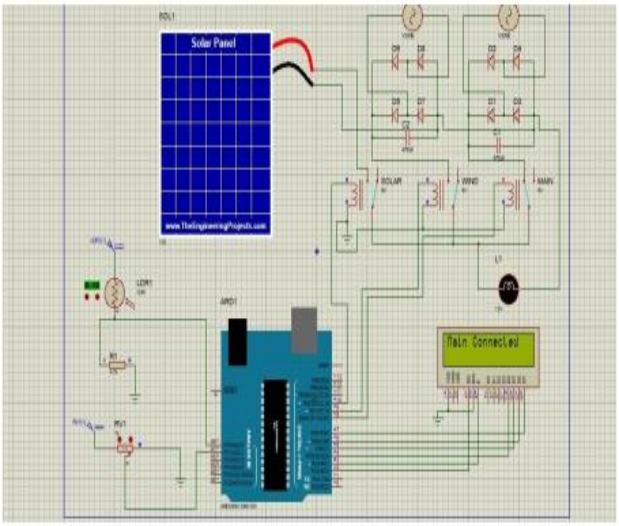
Case 2: Wind Connected

Simulation Output Case 2



Case 3: Mains Connected

Simulation Output Case 3



IV.CONCLUSION

The necessity of proposed guaranteed power supply system creation for responsible consumers is proved. During this case under responsible consumers is taken into account the electrical installations, which define the robustness and continuity of various technological processes .

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Real Time Safety Monitoring System for COVID-19

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ABSTRACT
In this paper, a cost-effective microcontroller-based system is proposed to reduce and control the COVID-19 virus spread. The proposed system is used to identify the mask through image recognition, to measure the temperature of human and can be used as an automatic hand sanitizing dispenser. All these functions can be performed without any human contact. This eliminates the need of a human and ensures all safety protocol checks as an individual enters a closed premise.

Keywords - Cobot, Image-Recognition, Health Care, Contact-Less Temperature Sensing.

I. INTRODUCTION

The impact caused by Covid-19 to the world has dramatically changed people's lifestyle. Use of masks, sanitizers and extra care of personal hygiene is mandatory. Restaurants, malls, schools, colleges and any other closed premises opened for public have it mandate to record temperatures of individuals before entering. A person is instructed to carry out these tasks at those places with an IR temperature sensor for measuring temperature and sanitizer dispenser is used to provide sanitizer.

Wearing masks reduces the probability of contacting corona virus but does not eliminate it completely. Since the temperature measurement and hand sanitizer dispensing requires a person to come close to another, it increases the risk of either one of them contracting the virus if one is affected. The risk increases more if one of the two are not wearing their mask in a proper manner.

COVID-19 virus spreads easily from person to person, mainly by the following routes:

- Between the people who are in close contact with one another i.e. within 6 feet.
- By respiratory droplets produced when an infected person coughs, sneezes, breathes or talks to another.
- Respiratory droplet can cause infection when inhaled or deposited on mucous membranes like those that line the inside of the nose and mouth.

Studies and surveys indicate that the spike in the number of cases arises within a short interval when protective measures are not followed properly [1]. This causes an overflow of patients and shortage of medical facilities required to treat them [2]. Hence, wearing masks, using hand-sanitizers and doing regular temperature checks can reduce the spike of cases and reduce the number of cases over a period of time.

Constant measuring of temperature and ensuring masks are being worn by people entering public places can reduce the spread of the virus[3]. But if the people who do the checks are infected with the virus and/or not wearing their masks might spread or get infected by the virus while doing the temperature checks or handing hand-sanitizers. This would result in significant increase in the number of cases [4]. Hence, this paper proposes a solution to replace the traditional methods with the use of microcontroller-based systems to provide with contactless real-time monitoring and functioning.

II. PROPOSED METHODOLOGY

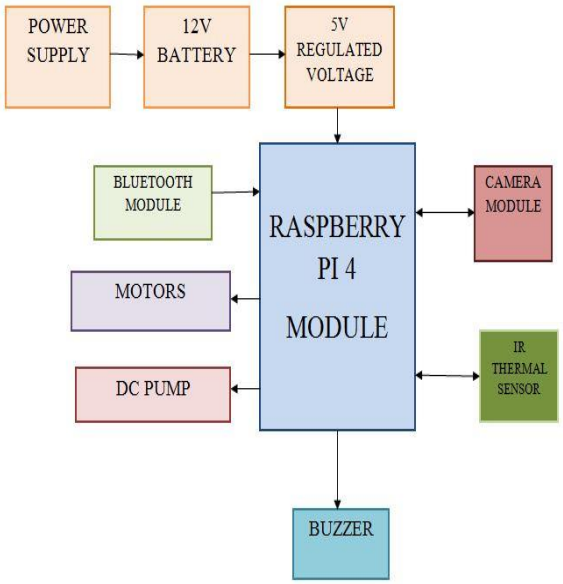

Fig.-1 Block diagram

This paper suggests to design a cost-effective system which focuses on most common precautionary measuresto identify the people with high body temperature, not wearing masks and to design a hands-free dispensing of sanitizer.

It utilizes separate module to connect and to coordinate the system automatically by a programmable single board microcontroller such as a Raspberry Pi module and Arduino UNO microcontroller. All the components are fixed on a metal frame. The hand-sanitizer is placed in a container with a DC submersible pump which is placed inside the container.

The face detection of masks can be obtained using a camera mounted on top of the module. The entire apparatus is powered by a 12V battery and controlled by a programmed Raspberry Pimodule all fitted on back of the base. The base is fitted with wheels connected to motors for easy mobility of the apparatus. The movement scan be controlled over Bluetooth through a Bluetooth module and smart phone.

The camera identifies that the individual infront of it has a facemask through Machine Learning (ML) basedfacerecognitionprogram.Ifthemaskisnotdetected abuzzersounds.For the mask identification algorithm, OpenCV and python programming is used. OpenCV is a free library of Python which is used for computer vision programming. It consists of Classifiers which can be implemented with pre –trained models along with tensor flow models trained using Teachable Machines. The output of the ML model yields an output based on if the person in front is wearing a mask or not. Tensor flow Lite models are being used for the low computational devices like Raspberry Pi modules and Android devices. Tensorflow.js models can also be created which can be utilized for JavaScript files and p5.js models.

The temperature of the wrist is recorded using the MLX90614 IR temperature sensor connected to the Raspberry Pimodule. IR sensitive thermopile detector chip and signal conditioning ASIC are integrated in the same canister. Integrated into the MLX90614 is a low noise amplifier, 17-bit ADC and powerful DSP unit providing high accuracy and resolution of 0.02° C. If the temperature is within the suitable limits, the DC submersible motoris turned on to dispense the hand sanitizer else buzzer sounds and the system waits for the next person.

III. ANALYSIS OF TEMPERATURE SENSING TECHNIQUE

The output of the temperature sensor is in the form of bits (0-1023), which is fed to the input analog pins of the microcontroller, the sensor uses a 3.3V as source and the output is divided by 1023. This gives the proportional analog output voltage for the sensor output. This is converted to temperature with 500mV offset and 10mV per degree. The output temperature is now referenced with a constant temperature.

Voltage at pin in mV=(reading from ADC)*(3300/1024)

Centigrade temperature = {(Analog voltage in mV)–500}/10

IV. SIMULATION RESULTS

A. Mask identification simulation:

Fig.-2 Simulation output with mask

The output of the program when the person infront is wearing a mask, the output is generated and displayed at the bottom in real-time as “MASK”.

Fig.-3 Simulation output without mask

The output of the program when the person infront is not wearing a mask, the output is generated and displayed at the bottom in real-time as “NO MASK”.

B. Design simulation:

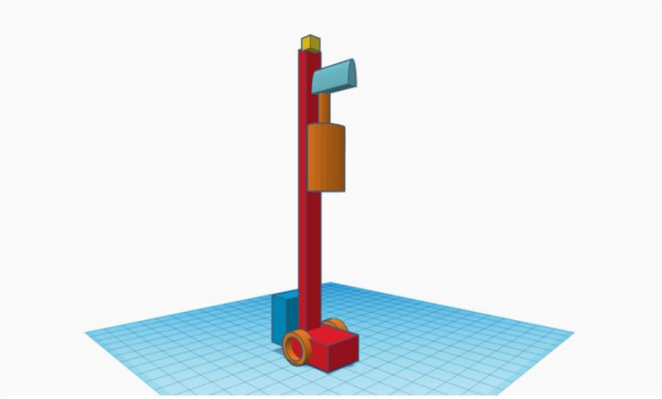

Fig.-4 Design model developed in Tinkercad software

The metallic frame/base (red coloured part in fig.4). The hand- sanitizer is placed in a container (orange coloured part in fig.4)

A 12V battery and controlled by a programmed Raspberry Pi module all fitted near the back of the base (Blue colour part in fig.4). The Face detection for masks is done using a camera mounted on top of the module (yellow color part in fig.4)

C. Scilab simulation output:

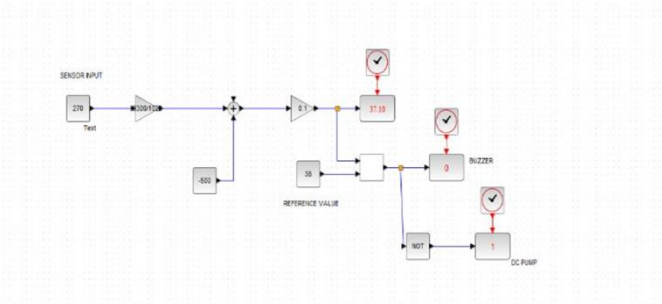

Fig.-5 Scilab simulation when temperature input is 270

The sensor input is 270 in bits which is the digital input that is being transmitted in I2Bus. This is converted to centigrade temperature using the formulas and the output is obtained as 37.09 degree centigrade. This is within the limits of the normal

temperature. Hence the buzzer is in OFF condition and the DC pump is in ON state.

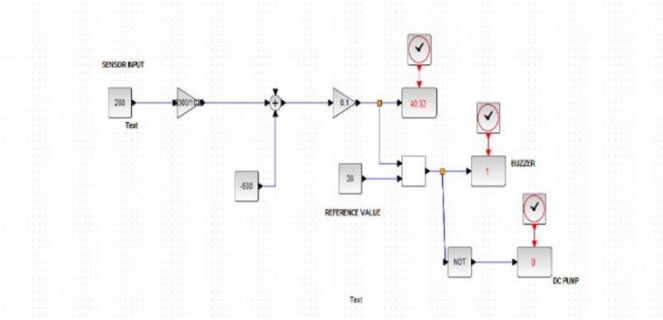

Fig.-6 Scilab simulation when temperature input is 280

The sensor input is 280 in bits which is the digital input that is being transmitted in I2Bus. This is converted to centigrade temperature using the formulas and the output is obtained as 40.32 degree centigrade. This is within the limits of the normal temperature. Hence the buzzer is in ON condition and the DC pump is in OFF state.

V. ADVANTAGES

- It is a simple and low cost mechanism
- Performs multiple functions
- Uses cost effective components
- Replacement for a person, thus reducing the risk of virus transmission
- Easily mobile to move around

VI.CONCLUSION

The proposed model can be used to perform temperature sensing, mask identification and hand sanitizer dispensing, replacing the need of human and hence reduces the risk of virus transmission. This non-contact temperature and sanitizer dispenser device is best way to avoid the use of traditional contact thermometer and handheld device for preventingthespreadofCOVID19 infections.

It avoids the risk of contracting the virus while measuring the temperature or using hand-sanitizer dispenser in public places. Since the model is small and low-cost it can be utilized in all medium-sized shopping centers, malls, offices, colleges, schools, etc.

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RFID Based Attendance System using PHP and MySQL

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ABSTRACT
The main aim of this paper is to design a RFID based attendance system using MySQL and PHP which helps in replacing the old and tedious way of marking the attendance using register and pen. The new system is cost effective, error free and capable of handling large storage database precisely. This paper analyses the recent development and implementation of IoT attendance system using the concept of Radio Frequency Identification (RFID)for automatic attendance system and it provide very higher accuracy and performance than conventional paper-based system.

Keywords : RFID, MySQL, PHP & Arduino

I. INTRODUCTION

In this modern era the conventional method of taking the attendance is a paper-based system which facing difficulties in keeping the attendance list over a significant piece of time, fair amount of time wastage amid composing and marking, forged documentation, students are neglecting as well as ignorance to sign the attendance paper, lecturers overlooking the attendance list in the study hall, students signing or marking unlawfully for a truant among others. It is necessary to move away from this conventional system and need to provide better solution for the problems which are being faced.

Eventually all the systems discussed in this analysis has its own advantages and disadvantages. Some certain characteristics are good for some systems and some are not. To overcome this, a hybrid model is necessary and which must confirm higher security, reliability, low cost and better performance of the system. In that respect, "RFID four tire system with biometrics" could be used along with adequate number of RFID tag readers and finger print devices in order to confirm the security and the reliability of the system. Web server could be replaced by PHP and MYSQL result cheaper, better accuracy and high performance.

The paper that we will be working on is RFID Based Attendance System which is already started as an application in many schools around the globe. It is used as an alternative to Manual attendance system or Bar code application used in most of the college and schools around the globe. As manual attendance was very tedious task and involved much costs for registers, pens and most importantly time taken to make an entry was much more so RFID attendance system was portrayed as a solution to all these problems and was able to store much larger memory compared to the previous ones.

By using Arduino Mega to take the information from RFID reader via serial communication for which we need a RFID tag and RFID reader respectively which will send 8 - digit no. to the database using Arduino. The attendance is recorded in database using MySQL and is uploaded using XAMPP server and can be viewed on the webpage that is been created using HTML and PHP.

When the RFID tag comes in close proximity with the reader the data is decoded then sent to the MySQL Server where the saved value in the database is compared with data in the tag, if the data is found then the SQL script checks the entry time limit then the student is marked present if the entry time is in the specified time limit. The student will be marked absent if the tag was scanned after the given time limit.

The advantage of using MAMP server is that it saves the cost for hosting the website live, in this case the website and the php script can be hosted on the local machine at a specified port like PORT 80 and all the data can be transferred over the TCP/IP or UDP protocol. For back up the data can be saved on the SD card as well, then the data can be retrieved from the database tables in csv, pdf, text format which can be shared to students and parents at the end of the day.

II. COMPONENTS REQUIRED

1. Arduino MEGA
2. RFID Reader
3. RFID Tags
4. Real Time CLK Module
5. SD Card Module
6. LCD (16x4) Display
7. Windows PC with MySQL Database
8. Windows PC with XAMPP Server

Arduino Uno is a microcontroller board that is based on the ATmega328P datasheet. It has totally 14 digital input/output pin of which 6 can be used as the PWM output and 6 analog inputs. A 16 MHz ceramic resonator can be used which is: CSTCE16M0V53-R0 and a USB connection also with a power jack and an ICSP header and also provided with a reset button. It stores everything that will be needed to support a microcontroller. It can easily be connected to the computer and with the help of the USB cable or power on/off with it an AC/DC adapter and battery to start.

"Uno" means Unitary or One in Italian and it was chosen as to mark the release of Arduino Software (IDE) 1.0. The Uno board and the version of 1 of the Arduino Software were made for the basic reference versions for the Arduino; they have now evolved to the newer releases. The Uno board was the first in the series of the USB Arduino boards, and was the perfect reference model for the Arduino platform, for an extensive list of current, past or for the outdated boards sees the list.

RFID tags are the type of tracking system in which it uses smart barcodes in order to scan and realize the items. RFID is the short form of “radio frequency identification” and as such, RFID tags utilizes the radio frequency identification technology. These radio waves can from tag and giving it to the RFID reader, transmit the information to the RFID computer program. They can also be used in attendance systems, finding pets patients with Alzheimer’s disease. An RFID tag can also be called an RFID chip.

MySQL and PHP Myadmin are the tools we are implementing to build our database where the details of the students such as USN, Name, Date and Time will be saved once the RFID tag is scanned by the scanner. Web data-based server for RFID Attendance Record System may be used in the different places in schools in registering the attendance of the students or in private companies and similarly, automatically

record the time of arrival in the office and many other similar kinds of applications. In this paper, the student's attendance record can be stored in the MySQL database by using the MFRC522 RFID readers and any other RFID tag card.

Each student in the organization is provided with the RFID tag card for authorized entrance to the school by the reading of RFID reader and record their attendance data simultaneously. This system can solve the problem such as the students cheating on their attendance or loss of the attendance sheet and many students by asking their friends to help them to put proxy if they are absent.

III. DESIGN OF THE DATABASE

In this paper implemented a new system where a person is provided with a RFID Tag which contains a 8 digit no. when a person with a tag comes near to the RFID reader it reads the 8 digit no. and sends this data to Arduino via Serial communication and the data is stored in the Database using MySQL and is uploaded on the webpage using XAMPP server and can be accessed on a webpage which is build using PHP and HTML as shown in figure 1 &2.

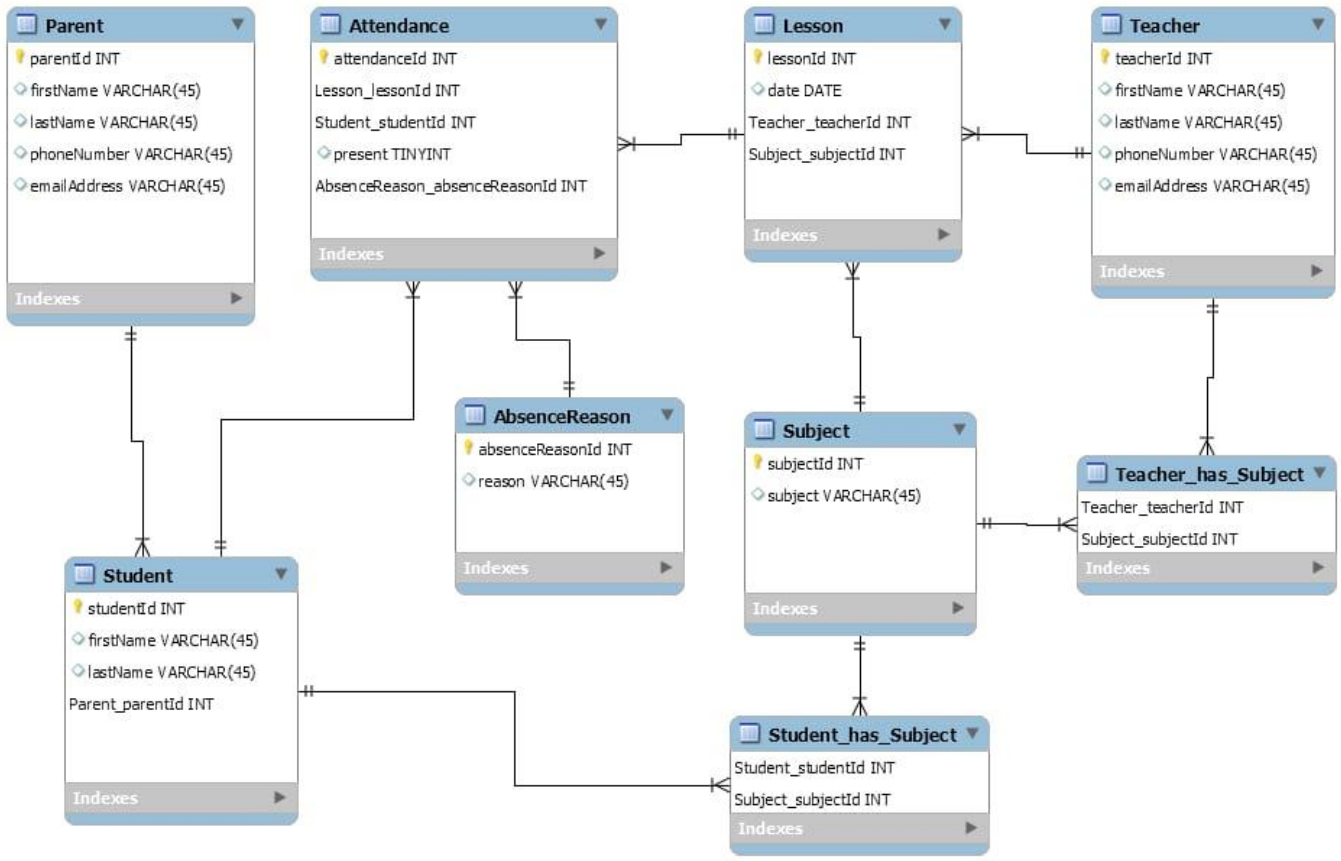

Figure 1: Design Database Schema

Therefore, use of RFID based attendance system will increase efficiency as it minimizes the errors made by humans and it will work precisely according to the data read by its own RFID tag and it will also be cost effective and also reduce the time and effort put into the manual way of taking attendance, it also provides a general security to all sorts of schools and universities and is safe to use.

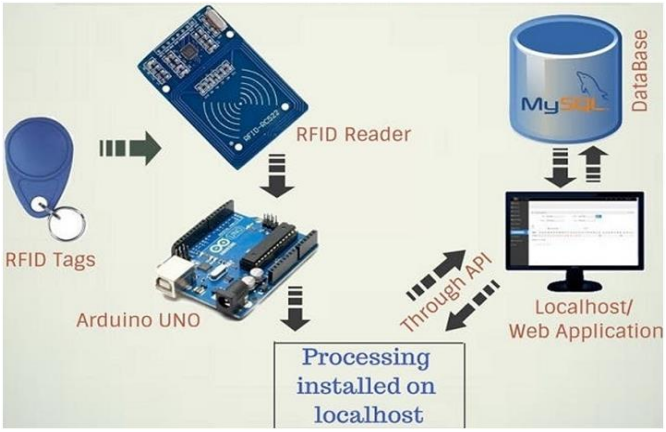

Figure 2: Student Database Schema

IV. CIRCUIT DIAGRAM:

MAMP will include MySQL and PHP. These two components are simple technologies used for creating of the dynamic websites. MySQL could be a popular DBMS and PHP could be a web scripting language as shown in figure 3. Webpages that include PHP code can access data from a MySQL database and cargo dynamic content on-the-fly. Installing PHP and MySQL software locally, a developer can easily build and test the dynamic on the web site on his Mac before publishing it on the net as shown in figure 4.

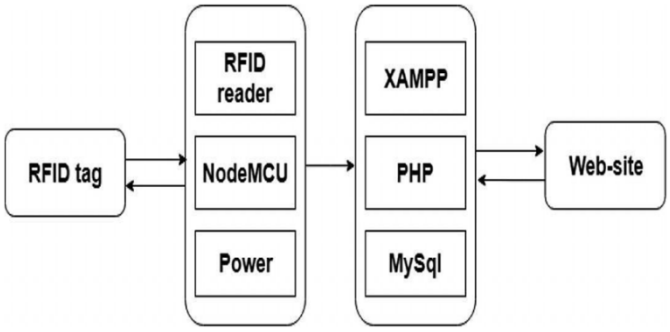

Figure 3: Block diagram of the System

V. FLOWCHART

You firstly need the card or the tag to access mainly attendance system record. When approaching the card or the RFID tag for a sensor, the 8 digit no. number on this card or the tag will be detected and will be compared to the 8 digit no. numbers listed in to the database. If it is of the registered 8 digit no. number, the system will forward the card no. to the database. LCD will display the result, and authorized messages will appear on the LCD display as shown in figure 5. If not, the system will not authorize the user access and the data transmission on the LCD will show the warning message card the card not authorized.

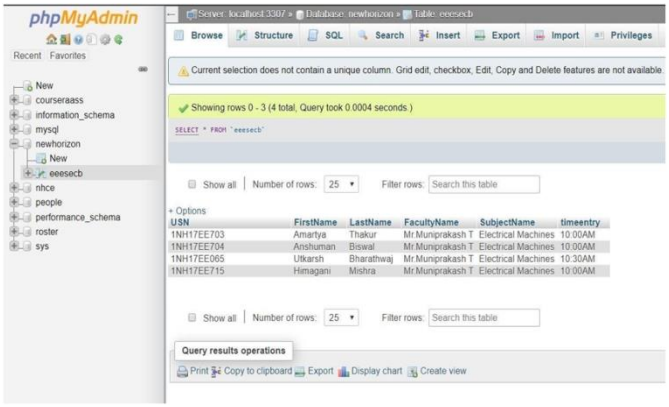

Figure 4: MYPHP Software Interface

Due to the interaction with the tag and reader 8 no. from the tag will be sent to the controller. These 8 digit no. will be sent to the Arduino via serial communication. Here, processing software is for the communication between Arduino and PHP/HTML based Web Application. This software can read the 8-digit no. at serial communication and match it with the data stored in Database (MySQL). Run the XAMPP Server save the real time data to webpage.

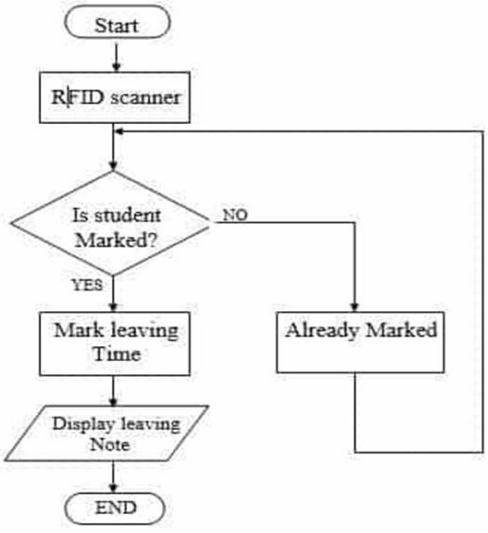

Figure 5: Flow chart of the System

VI. RESULTS

Here, we are using the Passive RFID Tags which can contain up to 8 digit number tags inbuilt in it. RFID reader always contains a copper winding in it. This winding can act as an antenna. When a person with RFID tag enters in the range (depends on the manufacturer) of the RFID reader, the RF field induces a particular voltage in the coils of the tag. The range of the RFID reader can be set by using the appropriate reader of appropriate frequency.

AttendanceDetailID	CollegeID	Status	SubjectID	TeacherID	BatchID	SemesterID	AttendanceID	Date
1	6621	present	23	102	6	3	19	2016-04-10
2	6622	present	23	102	6	3	19	2016-04-10
3	6624	present	23	102	6	3	19	2016-04-10
4	6621	absent	23	102	6	3	20	2016-04-10
5	6622	absent	23	102	6	3	20	2016-04-10
6	6624	absent	23	102	6	3	20	2016-04-10
7	1212	present	41	102	2	7	21	2016-04-10
8	1213	present	41	102	2	7	21	2016-04-10
9	1214	present	41	102	2	7	21	2016-04-10
10	1215	present	41	102	2	7	21	2016-04-10
11	1216	present	41	102	2	7	21	2016-04-10
12	1217	present	41	102	2	7	21	2016-04-10
13	1218	present	41	102	2	7	21	2016-04-10
14	1219	present	41	102	2	7	21	2016-04-10
15	1220	present	41	102	2	7	21	2016-04-10
16	1221	present	41	102	2	7	21	2016-04-10
17	8997	present	41	102	2	7	21	2016-04-10
18	8998	present	41	102	2	7	21	2016-04-10
19	34342	present	41	102	2	7	21	2016-04-10
20	1212343	present	41	102	2	7	21	2016-04-10
21	11111111	present	41	102	2	7	21	2016-04-10
22	877777	present	41	102	2	7	21	2016-04-10
23	122211	present	41	102	2	7	21	2016-04-10
24	1212	present	41	102	2	7	22	2016-04-13

Figure 6: UI Output

This induced field can supply the voltage in case of passive tags and will act as a battery in that case. Due to the interaction between tag with the reader 8-digit no. from tag are sentto the controller. These 8-digit no. are sent to Arduino via the serial communication. Here, processing software is used for the communication between the Arduino and PHP/HTML -5 based Web Application.

This software can read the 8-digitno. At serial communication and match it with the data stored in Database (MySQL). Run the XAMPP Server save the real time data to webpage. If it is matching then it replies with valid user message and attendance is marked otherwise it replies with not valid message and no attendance is marked. On serial you can view the results in the Processing output window.

VII. CONCLUSION

This paper on RFID based attendance system can be used by colleges and schools or may be offices in the near future. This paper can help any of the above-mentioned institutions to manage their data and security, this can be made better by adding more features to it like GSM and Sending SMS as soon as the student's card is being scanned by the system or his/her attendance is marked. I can also Track the student location till the time he/she is in the premises as it will increase security level in the institution.

We can also use it for the result display in an LCD outside the classroom as it will read the card and will fetch result of a particular from the databases and many more such examples. Thus, for future Work, we recommend incorporating a facial recognition application that would serve to further increase the biometric security of the system against impersonation by hearing students. Also, we recommend including a timing circuit in orders to specify the exact time date each student enters the classroom so that erring students That use the card twice at the same time without the consent of the lecturers can be dictated.RFID based attendance system or any other projects will reduce human errors, will be cost effective and will provide a general type security to any place and will serve as a multipurpose project.

VIII. FUTURE SCOPE:

RFID based attendance system was basically built to replace the bar code/bar code scanner. After seeing the vast advantages of the RFIDs, many institutions have started to install the good projects of RFIDs. One of the great advantages of the RFID system over the manual attendance is its high capacity to store more information.The tags in the system have been developed to allow the system to accommodate more information. This makes the RFID system for taking attendance very useful in schools or colleges as it can store large amount of information. One more

advantage of the attendance using RFID system is that unlike any system available RFID tags can easily locate or track the candidate throughout his/her stay in the particular arena. Another advantage that the system holds is that it can store the information of a particular till many years and can be useful in some cases.

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A Short Range under Water Data Transmission Using Li-Fi and PWM Techniques

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ABSTRACT
In recent days, the under-water vehicles are implemented for various applications like military application, ocean mapping etc. In this regards, the data communication between Vehicle to Vehicle or Vehicle to Infra-structure is very essential for critical informative wirelessly. In this proposed research article data transmission from one vehicle to another vehicle is obtain using Li-Fi and PWM Techniques for under water application. The Li-Fi Technology is constructed to build the wireless data transmission for the various application proposed in this research article. The PWM Technique is additionally programmed in the proposed model to decode the various numerical values. These techniques are framed to communicate wirelessly between two devices through the water medium.

Keywords - under-water vehicles, data communication, Li-Fi, PWM Techniques, wirelessly

I. INTRODUCTION

In future, the underwater communication system is going to play a vital role in the various applications highlighted in this research paper.

The outline of [1], reveals the review on the propagation up to certain MHz frequency range in under sea water. In [2] proposed system utilizes the ultra-low power MSP430F449 MCU and an infrared wireless communication, to obtain a simple underwater communication in the wireless form. In [3] research article proposes 433MHz bow-tie antenna is suitable for use in Underwater. The research article [4] presents existing UWC techniques for the future directions on the next generation underwater wireless communication systems. The research paper [5] reveals a study on UWA communication corresponding to the multicarrier communication particularly Orthogonal Frequency Division Multiplexing -OFDM.

In [6] paper, a new OFDM-based scheme is proposed for underwater transmission in order reduces the combat with asynchronous problem in cooperative UWA systems without adding a long CP at the transmitter antenna. The research articles [7], [8], [9], [10], propose an acoustic modelling of underwater communication. The foresaid research articles propose underwater communications with different techniques are highlighted with suitable contents. In this research article executes with more suitable Li-Fi and PWM techniques to provide accurate data communication for the underwater applications.

II. SOFTWARE

The proposed methodology is programmed using Arduino software. The two section coding, one for transmitter section and another for receiver section is programmed uniquely and dumped into the microcontrollers in both transmitter and receiver sections.

III. HARDWARE IMPLEMENTATION

In this research proposes underwater wireless data transmission enlisting two sections namely, transmitter section and receiver section.

A. Functional Block Diagram

In the transmission section, the list of components like LED, Arduino Uno, Keypad are interfaced to communicate a data to receiving section. In the receiver section, the list of components like LDR, Arduino Uno, LCD are interfaced to receive a data from transmitter section. The complete architecture of underwater data communication wirelessly is shown in Figure 1 combining with both sections.

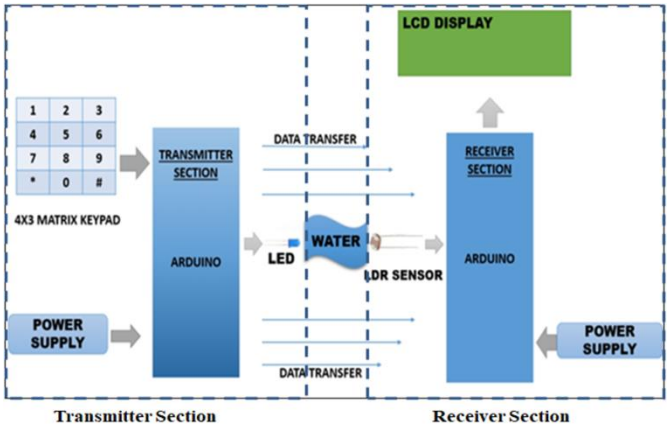

Fig 1. Function Block Diagram of underwater communication system

1) Transmitter Section

In this section, the list of hardware components like LED, Arduino Uno and Keypad are interfaced to transfer the valid data to the receiver section. In this research paper, the keypad acts as input device in the transmitter section, the character on the keypad is received to Arduino Uno upon the specific key press. Arduino Uno is a microcontroller board, which has lot of peripherals likes PWM, ADC, Serial communication peripherals (UART, SPI, I2C), etc. Arduino Uno fetches a character from keypad and converts equivalent electrical signal in the form of the pulse using PWM techniques. The equivalent converted electrical pulse signal is applied to the LED to glow for certain period in the transmitter section. The emitted light from the LED is transmitted to the receiving section through the medium called water.

2) Receiver Section

In this section, the list of hardware components like LDR (Light Dependent Resistor, Arduino Uno and LCD are interfaced to receive the valid data from the transmitter section. In the receiver section, LDR acts a receiver to fetch a light signal and convert into the equivalent electrical pulse signal. The converted electrical pulse signal is given to Arduino Uno microcontroller board to converted electrical pulse into equivalent character using the suitable control logic algorithm. The converted character is observed on the LCD by sequence programming of character to display. Here, LDR plays a vital role in sensing the character in the form of electric signal. On the whole, the data is communicated wirelessly through the water medium.

B. Working Principle

In the lab setup, the transmitter and receiver sensors i.e. LED and LDR are dipped into the water. The working operation is carried out to obtain an efficient data transmission from transmitter section to receiver section. In the transmission section, character is encoded and converted into equivalent electrical signal, thus generated electrical signal is applied to LED were electrical signal is converted into light and transfer into the water medium.

Dissimilarly, the light applied on the LDR in the receiving section converts light energy into electric signal in the form of pulse. Thus generated electrical pulse into convert equivalent character by using time logic coded in the Arduino Uno microcontroller. Finally, generated character is visualized on the display unit using LCD.

The complete hardware interfacing with both transmitter and receiver sections is shown in Figure 2.

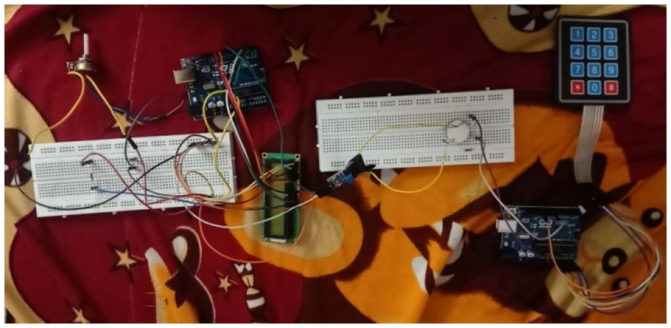

Fig 2. The complete Harware Setup with transmitter and receiver sections

The design of simple hardware prototype as complete model for underwater testing is shown in Figure 3. The sensors LED and LDR are dipped into the water to test the accurate data transmission shown in Figure 4.

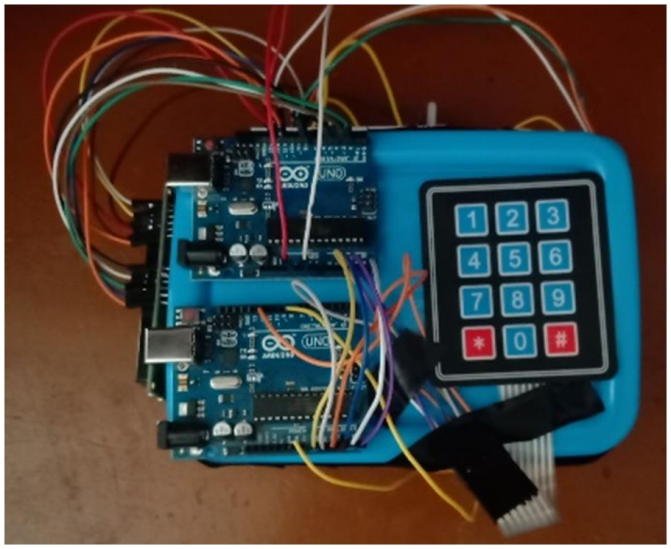

Fig 3. Compact Hardware testing module

After the complete hardware setup, the control algorithms are dumped into the transmitter and receiver microcontrollers to transmit and receive the data upon the key press on the keypad. The user presses key 4, corresponding data is displayed on the display unit in the receiver section as shown in Figure 5.

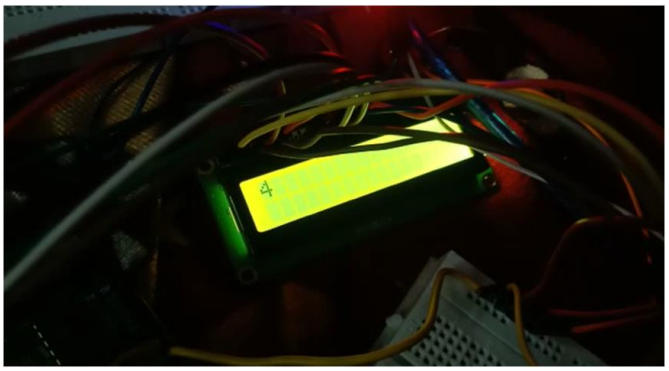

Fig 4. Data communication result on the receiver upon keypress.

IV.CONCLUSION

In this proposed research article, the underwater data communication is tested and verified with suitable hardware modules. The sensor modules are dipped into the water to identify whether there is accurate data transmission using Li-Fi technology. In future, the data communication between two vehicles or devices inside the River, ocean, etc, is easily obtained by using Li-Fi technology.

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A Studies on Static Analysis of Link Chain - A Case Study

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ABSTRACT
Industrial companies, manufacturing factories use chains as the basic equipment to carry the raw material, move equipment one location to another for process. Ships use theses chains link or slings for lifting loads. Bigger link chains are as anchor chains. In this study, 3D modelling and FE analysis were performed taking the two models of a link chain, one non-welded model and another welded model. The static study on these models is done at different load conditions. The stress- strain concentrations and the deflection of the models on loading is observed. This study gives the stress-strain concentration patterns on the model on different loads and observe the locations where the minimum and maximum concentration occurs and where the maximum and minimum deformations take are observed on applying different load conditions. In this paper, we study the stress- strain concentrations, deflection on different load conditions on both non-welded and welded models of a link chain specimen.

Keywords : Chain Link, FE Analysis, Welded, Non-Welded, Lifting Load.

I. INTRODUCTION

Industrial or manufacturing units use chain link for the moving, lifting heavy equipment, loads to different locations for different processes. In ships these chain links are used for carrying containers, using anchor chain to hold the ships from moving. We need to study the effects of chains links when they carry load or when the loads are acting on them. Thus we need study effects of loads, at what loads the maximum yielding it takes etc. A chain consisting of consecutively connected metal rings, is usually used to crane heavy weight materials and hot parts in industry, due to its rigidity and strong resistance to heat and corrosion. In this study, 3D modelling and FE analysis were performed taking the two models of a link chain, one non-welded model and other welded model. Comparison between the two models considering the conditions of different load applications and observing the change in the stress-strain concentrations happening in the models and the deformation on load applications are observed on different load conditions. or this study, model is done using the solid works 3D modelling software and static load analysis is done using solid works simulation software. A chain is a serial assembly of connected pieces, called links, typically made of metal, with an overall character similar to that of a rope in that it is flexible and curved in compression but linear, rigid, and load-bearing in tension. A chain may consist of two or more links. Chain, series of links, usually of metal, joined together to form a flexible connector for various purposes, such as holding, pulling, hoisting, hauling, conveying, and transmitting power.

Fig 1. Chain Link

II. SELECTION OF THE MATERIAL

The chain link is a part of a series of connected links to make sling chain that are used for the lifting the heavy equipment, concrete blocks, containers etc. Chain link in series is connected to form slings of chain, having capability of lifting loads that can be measured in terms of tons. Chain link since used for lifting heavy load, it comprises of material having high strength, resistance to heat and corrosion effects, able to withstand sudden impact variations, long life etc.

For this project, AISI 8622 Steel is used for the study. The purpose of using this material is that it gives high strength, it has resistance to heat property, resistance to corrosion effects. These link chains are used in production factories for lifting heavy goods, since there will be application lifting hot product during the manufacturing products. In shipping industries where there will contact with water, thus corrosion effect might take action. To encounter these effects, the material AISI 8622 steel which is a Grade 80 steel is used in this study.

III. AISI 8622 STEEL SPECIFICATIONS

A. Chemical composition

Compartment	Composition of chemical (%)									
	C	Si	Mn	P	S	Ni	Cr	Mo	Cu	Fe
SPEC (AISI 8622)	0.20-0.25	0.15-0.35	0.70-0.90	Less than 0.035	Less than 0.040	0.40-0.70	0.40-0.60	0.15-0.25	-	Rest
Crane chain	0.244	0.160	0.758	0.011	0.007	0.537	0.332	0.174	0.081	Rest

Table 1. chemical Combination of material

AISI 8622 STEEL (GRADE80) has the above chemical composition, due to addition of the nickel, chromium metal with this, the material gives high strength to the link chain.

B. Mechanical properties of material

PROPERTIES	VALUE	UNIT
Young's Modulus (E)	1.9E+011	Mpa
Poisson's Ratio	0.29	-
Tensile Ultimate Strength	1598.79	Mpa
Tensile Yield Strength	800	Mpa
Density	7800	$\frac{kg}{m^3}$
Thermal Expansion	1.1×10^{-5}	k^{-1}

Table 2. Mechanical properties of material

IV. DESIGN PROCESS

DESIGN and model is done on the solid works modelling software using the standard data for 10mm diameter link chain specifications.

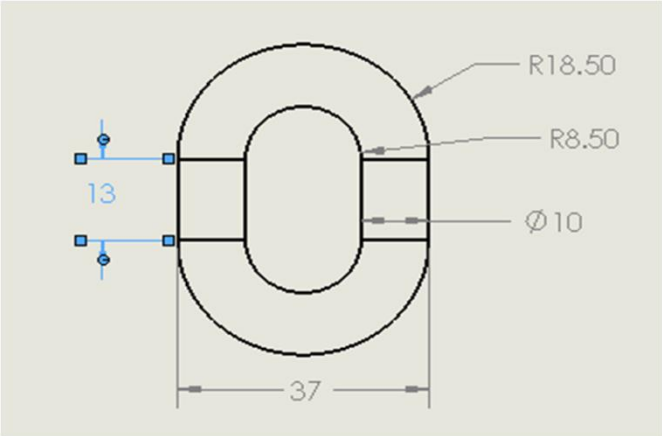

Fig 4. dimension of the model

V. SOLIDWORKS MODEL

The design is done, and the 3D model is created using Solidworks Modelling software. The model is made into equal half sections by cutting the original full

link. This cutting section is made to ease the study process of this project.

One half sections is considered and cut into equal quarter sections and assembling is done and made a weld bead between the two sections to make a welded half chain link. Another half section is considered as non-welded model. Then the two model, are used in the static study process for the comparison of welded and non-welded part for minimum load conditions and observing the difference between values of the two sections of the model.

Fig 6. Non-weld model Fig 5. Link chain solid works model

VI. FEM ANALYSIS

The model of chain link is taken for analysis process using the solid works simulation. The two sections of models are taken and material is applied to the model in the study process. The model is fixed at the top face of the half section of the both welded and non-welded link chains. The meshing is done the models to done on the models using fine meshing property, this meshing gives an effective simulation patterns during the analysis giving accurate load concentrations acting on the models.

The static study gives the stress, strain and displacement plots showing the concentrations of the stress, strain and where the displacement is more are found using this study simulation. The plots help in observing the regions or locations where the concentration is acting maximum and minimum.

The main analysis in this study is on the chain link where the load at safety working limit is taken from the standard loading data for the taken dimension of the chain link and observe the stress acting on the chain link. Chain considered is taken as two section A-A in vertical direction and section B-B in horizontal direction and observing the stress concentration acting the model at safety working load of 31392 N. The FEA stress value at maximum and minimum locations are compared with the numerical calculated values and the error percentage is noted.

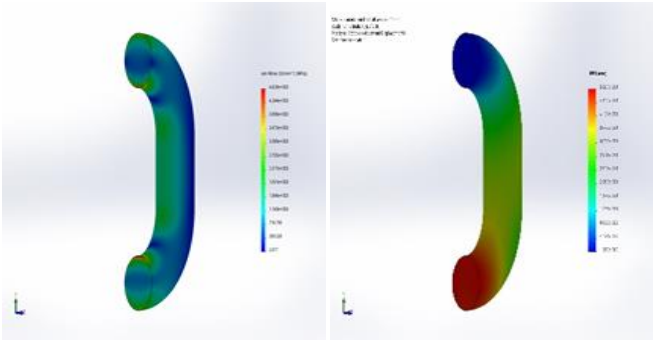

Fig 8. Stress analysis plot Fig. 7 Displacement analysis plot

VII. RESULT & DISCUSSIONS

- The stress concentration acting on the model is maximum along the vertical section A-A where the forces acting vertically downwards.
- The Stress concentration acting on the model is minimum along the section B-B.
- The below results give the theoretical and FEA stress readings at safety working load of force=31392 N.
- The below table 1 shows the comparison between numerical and FEA values and its error percentage.
- Table 2 shows comparison of welded and non-welded models.

Parameter		Welded model		Non-welded model	
	Forces	Minimum stress Mpa	Maximum stress Mpa	Minimum stress Mpa	Maximum stress Mpa
	3000	0.762	586.8	0.8327	580.6
Stress	4000	1.154	779.4	1.397	771.1
	5000	1.312	970.5	2.267	960.1
	3000	1*10^-30	0.457	1*10^-30	0.457
Displacement	4000	1*10^-30	0.604	1*10^-30	0.604
	5000	1*10^-30	0.749	1*10^-30	0.749
	3000	2.454*10^-6	2.439*10^-3	6.56*10^-6	2.46*10^-3
Strain	4000	5.411*10^-6	3.24*10^-3	1.056*10^-5	3.267*10^-3
	5000	9.712*10^-6	4.035*10^-3	1.566*10^-5	4.069*10^-3

Table 4. Comparison of welded and non-welded model

Node	Numerical stress in MPa	FEA values in MPa	Error in %
Node A inner fibre	2134.03	2232	4.3893
Node A outer fibre	1190.16	1471	19.0917
Node B inner fibre	1027.17	1037	0.9479
Node B outer fibre	461.41	522.67	11.7205

VIII. CONCLUSION

This research deals with a stress analysis for a chain link plate. The stress analysis was performed by Finite element method, and some methods were considered with the suppression of the stress distribution. The main conclusions are as follows.

1) The design proposal for the use of a chain link symmetrically constrained at center will yields a desired stress. Although welded and non-welded comparison was made to understand the residual stress effect on the chain link
2) residual stress is algebraically added to which causes maximum stress at inner fiber in A-A cross section which is corelated in finite element method
3) the non-welded chain link will exhibit better results in terms of stress distribution across the curved beam compared to welded section due to influence of residual stresses during temperature rise in welding process.

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SiO_2@ $CaTiO_3$:HO^{3+}, Li^+ Core Shell Nanostructure: Enhanced Photoluminescence for Optoelectronic Applications

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ABSTRACT

This work involves the systematic analysis of Core-shell (C-S) $CaTiO_3$:Ho^{3+} (3 mol%), Li+ (0.25-1 mol%)/SiO_2 nanoparticles (NPs). C-S NPs were prepared using combustion method. Photoluminescence (PL) properties of NPs and C-S NPs were studied and enhancement was observed in C-S NPs which indicate that, by creating C-S structure with SiO2 as core, PL intensity can be increased. The CIE (Commission International de l'Eclairage) chromaticity co-ordinates were calculated from emission spectra. These analysis shows that the synthesized material is suitable for optoelectronic devices.

Keywords - $CaTiO_3$:Ho^{3+}, Li^+ co-doping, SiO_2 core shell, CIE

I. INTRODUCTION

In recent years, core-shell (C-S) structured nano composites are gaining growing interest due to their unique structures and properties. These nano composites bear core properties and also shell properties and sometimes new properties depending on the interaction between the core and the shell. This exceptional property makes it a very significant promising nano material which is extensively used in different fields such as electroluminescence devices, bio-nanotechnology, bio-imaging, optics, energy storage materials, etc.[1-5]. Also the formation of C-S is one of the efficient strategies to improve luminescence efficiency. The growth of a crystalline shell of a suitable material around each NPs reduces surface defects. When lanthanide ions are doped into these C-S nanostructures, quantum yield increases and non-radiative transitions decreases [6, 7].

Silica is generally used as core and shell material in C-S structured nano composites due to its low cost, high mechanical stability, high surface area, biocompatibility, low cytotoxicity, high scattering power, optically transparent, higher packing density, chemically stable, easy control of thickness and ease of preparation [8, 9]. This C-S structured nano material with silica coating has weak luminescent properties which limit their application in many fields. But, the rare earth complexes have excellent luminescence properties and these have strong and narrow emission bands which makes them efficient in optical fields [10]. Hence the nano composites with silica as the core and rare earth complexes as the shell

have good luminous properties, which make them more advantageous.

The synthesis of C-S NPs is a two-step procedure, first the synthesis of the core and later the synthesis of the shell which is formed by surface modification. The properties of C-S NPs depend on the nature of the shell [11-13].

The coating of SiO_2 controls the dimensions, increases the efficiency of Luminescence and plays a vital role in photonics. Silica (SiO_2) is used as both core and shell materials [14, 15] but silica as shell is deposited around the core microspheres and their properties can be improved.

Titanates possesses excellent properties because they are chemically and thermally stable, hence they are of current research interest [16, 17]. Especially, Calcium titanate ($CaTiO_3$) has stable crystal structure [18] but its nanoparticles face problems such as agglomeration, transformation of phase, etc., [19]. These problems can be solved by coating SiO_2 on $CaTiO_3$. Therefore, preparation of SiO_2C-SNPs has been studied vigorously in the last few years due to its several advantages over the single oxide phosphors [20]. When SiO_2 coated to synthesized nanoparticles, it controls the particles size and hence luminescence efficiency. The C-SNPs are used as important product in photonics for luminescence enhancement, energy transfer, etc. [21].

II. EXPERIMENTAL

All chemicals were obtained from Sigma–Aldrich and used as received. All chemicals were of analytical grade or of the highest purity available. Chemicals used are calcium nitrate ($Ca(NO_3)_2$),Titanyl nitrate ($TiO(NO_3)_2$), Holmium nitrate ($Ho(NO_3)_3$), lithium nitrate ($LiNO_3$), urea (NH_2CONH_2), Ethanol, aqueous Ammonia tetraethyl orthosilicate (TEOS). SiO_2 coated $CaTiO_3:Ho^{3+},Li^+$heterostructures were prepared using a two-step synthesis process. In step 1, $CaTiO_3:Ho^{3+},Li^+$ (0.25- 1 mol%) nanophosphors were prepared by solution combustion method by taking stoichiometric amounts of analar grade (99.99%) $Ca(NO_3)_2$, $TiO(NO_3)_2$, $Ho(NO_3)_3$ and $LiNO_3$ chemicals in petridish along with double distilled water. The solution was stirred well on magnetic stirrer for 30 min and it was transferred it to pre heated muffle furnace whose temperature was maintained at 500 °C. Combustion took place after the solution transformed into gel and then as foam. Finally, the product obtained as powder was used for further characterizations and for the preparation of heterostructure. In step 2, $CaTiO_3:Ho^{3+},Li^+$heterostructures were synthesized as follows: Firstly, SiO_2 was prepared by mixing Ethanol (88 ml) and aqueous ammonia (12 ml), further 3.7 ml of tetraethyl orthosilicate (TEOS) was added drop wise and stirred continuously for 24 h on a stirrer. The end product was centrifuged at 3500 rpm and dried at 80 °C. Then, equal amounts of $CaTiO_3:Ho^{3+},Li^+$ (1 gm) and SiO_2 (1 gm) were finely diffused in minimum amount of double distilled water (25 ml) and kept for sonication in bath sonicator. The finally obtained solution was dried at 80 °C [22].

III. RESULTS AND DISCUSSIONS

Fig. 1 show emission spectra of $CaTiO_3:Tb^{3+}$, Li^+ NPs excited at 375 nm. All the characteristic green emission peaks were observed in visible region. It was observed that, PL intensity is high due to codoping of Li^+ and 0. 5 mol % doped NPs show highest intensity and act as a optimum concentration which is mainly because of improved radiative transition rate from the Li^+ codoping. Here, Ho^{3+} concentration is kept as 3 mol% which was analysed experimentally. Addition of Li^+ leads to charge compensation, balances the state of the system, higher efficiency of energy transfer by creating the oxygen vacancies [23]. Also, addition of Li^+ modifies the symmetry of the Ho^{3+} ions and due to

all these reasons, PL enhancement takes place. Above the optimum concentration of Li^+ of 0.5 mol %, defects created by oxygen vacancies cause PL emission suppression by allowing non radiative transitions. It is understood that, PL enhancement upto 0.5% indicates the better control over the defects [24-25].

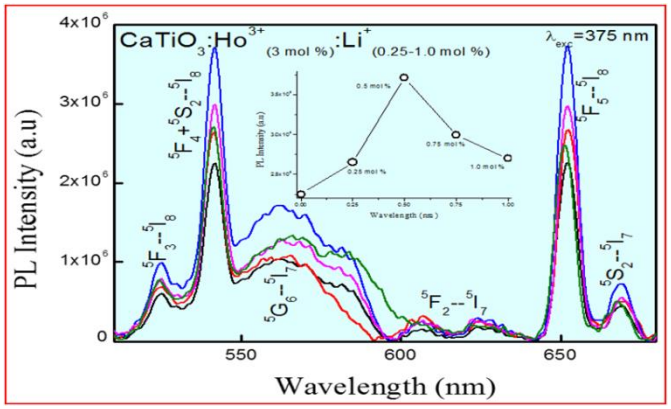

Fig. 1 emission spectra of $CaTiO_3:Tb^{3+}$, Li+ NPs excited at 375 nm

Fig. 2 Shows the $CaTiO_3:Ho^{3+}$,Li^+ NPs@SiO_2 excited at 375 nm. All the characteristic Ho^{3+} peaks are observed and are transitioned as shown in figure. It was observed mainly that due to SiO_2 coating, PL intensity was enhanced for 0.5 mol% sample. According to the experimental results above, proposed luminescence enhancement mechanism is as follows: SiO_2 coating will provide a suitable surface modified phosphor with reduced lattice distortion, surface defects and surface adsorption. It inhibits the energy transfer losses at the surface. The core always improves the crystal field environment of the rare earth ions and shell protects the core for any interference by outer environment. The perturbation effect of the crystal field doped rare earth ions get stimulated to produce luminescence. Some ions will be on the surface layer in the dormant state and cannot produce luminescence due to surface degradation. But after SiO_2 coating the interface between phosphor and SiO_2 will produce the ligand field Ca-O-Si bond and this result in repair of unsaturated bonds at the surface which also reduces selection rules which results in conversion of the dormant state to activated state [26].

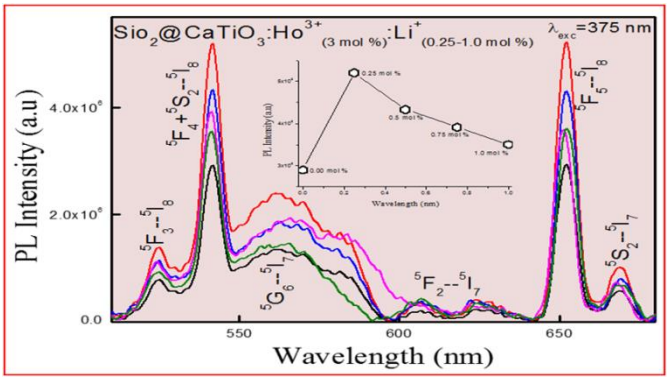

Fig. 2emission spectra of SiO_2@$CaTiO_3:Tb^{3+}$, Li+ NPs excited at 375 nm

Further, to confirm the Green emission of the prepared $CaTiO_3:Ho^{3+}$, Li^+ NPs and SiO_2 @ $CaTiO_3:Ho^{3+}$, Li^+ NPs, CIE chromaticity coordinates were found out from the PL spectra and the corresponding coordinate values are given in Fig 3 [27]. It was evident that chromaticity coordinates of $CaTiO_3:Ho^{3+}$, Li^+ and SiO_2 @$CaTiO_3:Ho^{3+}$, Li^+ phosphors are situated in the green region in CIE diagram, also noticed that chromaticity coordinates of $CaTiO_3:Ho^{3+}$, Li^+ and SiO_2 @ $CaTiO_3:Ho^{3+}$, Li^+ phosphors is closer to the chromaticity coordinate of the standard green light. The CIE chromaticity coordinates of SiO_2 @$CaTiO_3:Ho^{3+}$, Li^+ NPs fall more specific in green region than $CaTiO_3:Ho^{3+}$, Li^+ . To make out the applicability of the green emission, the CCT was calculated from CIE coordinates by transforming the (x, y) co-ordinates of the light source to (U', V') by using the eqn. (1) and (2) and the estimated values are presented in the Fig 4.

$$U' = \frac{4x}{-2x + 12y + 3} \quad -----(1)$$

$$V' = \frac{9y}{-2x + 12y + 3} \quad -----(2)$$

Calculated CCT values of uncoated and coated phosphor are 4475 K. CCT of coated NPs is less than 5000 K represents that prepared material can be useful for the warm green light used for commercial lighting purpose.

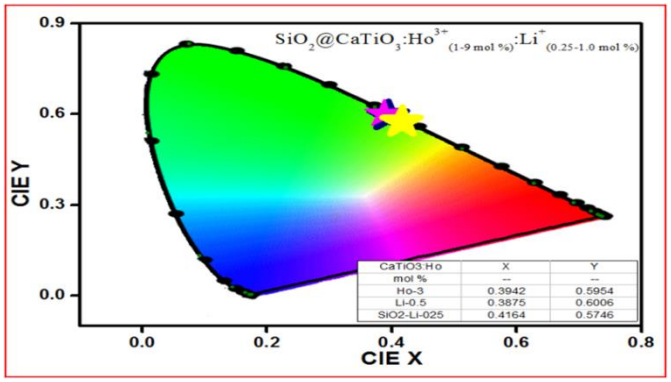

Fig.3 CIE diagram of the prepared phosphors

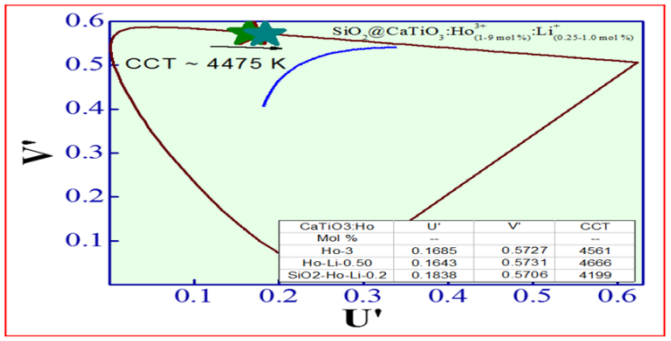

Fig.4 CCT diagram of the prepared phosphors

IV.CONCLUSION

This work presents photoluminescence enhancement of $CaTiO_3:Ho^{3+}$, Li^+ NPs after silica coating at low concentration of Li^+. No phase change was observed at any doping codoping and silica coating stages and all the samples were crystalline in nature. Due to coating PL intensity was enhanced for the concentration i.e. 0.5 mol %. Color coordinates were found to be green shifted due to silica coating which shows that coated samples are better materials for optoelectronic applications.

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Comparison of Multi and Taper Leaf Spring, Variable thickness optimization of Taper Leaf Spring

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ABSTRACT

Design of lightweight trucks is of importance to enhance the load capacity and reduce the production cost. All trucks industries are knee interest in leaf spring to reduce mass and friction in leaf spring to achieve good handling stability without degrading its functionality. In this study, consider the light duty truck: class 2 segments vehicle suspension. Aim of this study is to comparison between the multi and taper Leaf spring for jounce loading condition and understand sensitivity of variable thickness in taper leaf spring using application of DOE (Design of experiment) method. Design parameter like variable thickness and number of leaf spring are considered in optimization of variable thickness for taper leaf spring for application jounce loading condition.

Keywords - Leaf Spring, Taper Leaf Spring, DOE, Thickness Optimization

I. INTRODUCTION

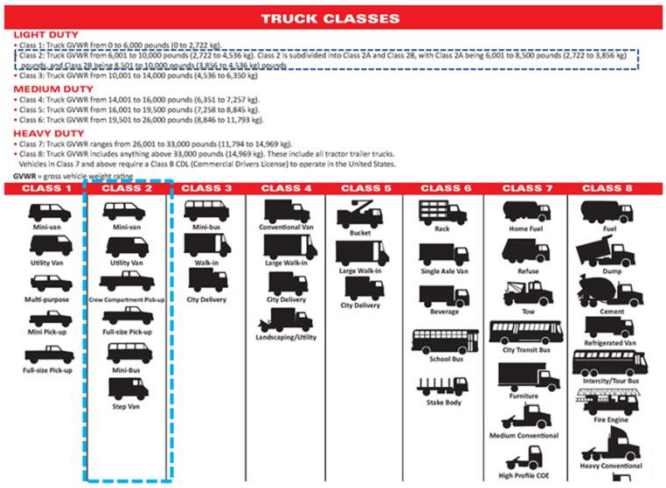
All wheeled vehicles are commonly use suspension with a simple type of spring it may be helical or simple leaf spring. Engineering effort has applied to improve vehicle handling, stability and safety of vehicle engineering effort has applied constantly in improvement of suspension.

Leaf springs consist of one or more flat strips of material loaded as cantilevers or simple beams. They can be designed to provide a compressive or tensile force as they are deflected from their free condition. Leaf springs are capable of exerting large forces within comparably small spaces. Particular force-deflection characteristics can be achieved for a spring by careful dimensioning of the strips and nesting of a number of components

Gross vehicle weight rating(GVWR) is a weight rating that applies to vehicles that fit into a range of different categories, from light, everyday pick-up trucks to trucks towing large tractor trailers. GVWR is an important safety element for personal to commercial trucks. At its essence, GVWR can be broken down into one rating classification compiled of two separate elements: 1.The base curb weight of the vehicle. 2. The weight of optional truck accessories, the weight of the cargo, and the weight of the driver and passenger(s).

The classes range from 1–8. Trucks are also classified more broadly by the Federal Highway. Administration (FHWA), which classifies groups by light duty (1–2), medium duty (3–6), and heavy duty (7–8). As shown in fig(1a)

In our study, Light Duty: Class 2 segments with GAWR are 10000lbs or 4500kg is considered. In this study, CAD model is created/edit in CATIA. Assumption are considered to model Taper leaf spring are (1).Spring arch span(2L) is kept constant. (2). Width of leaf in both multi and taper leaf spring remain constant. (3). Taper leaf spring stiffness is symmetric on both sides. (4). Shackle/Bushing stiffness is considered remain constant in both case. 5. Material is assume to be Steel with mechanical properties E=210000MPa, Density = 7.785e-9 kg/mm^3



Fig(1a) : Classification of Truck classes based on GVWR

Simulation of Multi and Taper leaf spring is performed for jounce condition. The value of displacement and stiffness curve is determined. Obtained results assistance to understand stiffness and displacement in both cases. Many parameters affect stiffness/deflection of leaf spring functionalities like Process parameter: Quenching, tempering, Method: Stretch and compress, Design parameters: thickness, width and length of leaf spring. In this study is limit to number of leaf spring and thickness of leaf spring

Sensitivity study is executed to understand effect of thickness displacement/stiffness of taper leaf spring. Thus help to assign initial thickness for taper leaf spring for further iterations. Calculate optimize variable thickness using optimization method (Adaptive Response Surface Method) for taper leaf spring, without degradation of its functionality for same application of load

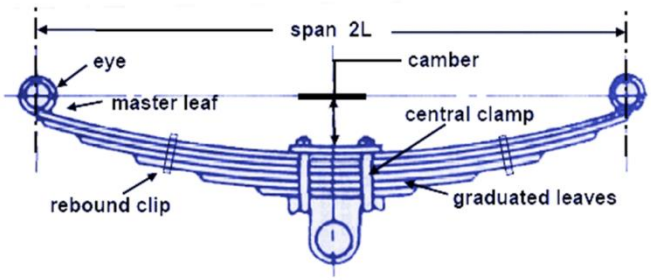


Fig1b : Schematic representation of Multi leaf spring

II. OBJECTIVE

a. Compare between Multi and Taper Leaf Spring for jounce load , Observe the displacement and stiffness of both case (refered as baseline for compare results)
b. Initially, base thickness from multi leaf spring has considered for taper leaf spring and executed the analysis. Observed displacement and stiffness curve(plot)
c. Sensitivity study of variable thickness in taper leaf spring. It aid to understand stiffness and deflection for variable thickness for different iteration
d. Evaluate an optimize variable thickness for taper leaf spring for jounce load condition without degrade its functionality (stiffness and displacement)

III. TAPER LEAF SPRING PARAMETER

A. Cause-and-Effect diagram

A Cause-and-Effect diagram is also known as Ishikawa diagram or fishbone diagram as shown in Fig. 2 is used in the brainstorming session to identify the cause-effect between factors related to cause. The main purpose of the Cause-and-Effect diagram is to generate a comprehensive list of possible causes at the first step in problem solving

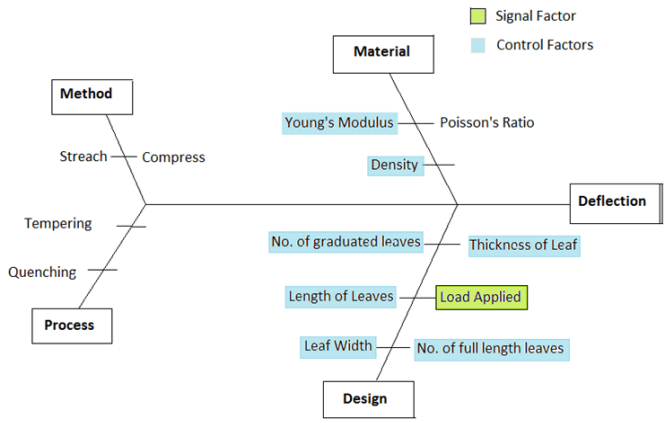


Fig 2: Cause and effect diagram of leaf spring

In this study mainly concentrate on design parameter which affects deflection of leaf spring and material as steel.

B. Finite Element Setup

1. CAD Data

To study and perform analysis, multi leaf spring CAD shown in Fig (3) data is considered. 4 Leaf spring is considered with span length 760mm. One end (left) having bushing and bracket attached to frame. Other end is having shackle bracket having provision to move and bracket connected to chassis frame

Fig 3: CAD data considered for analysis

2. FE Setup

Finite element modeling of multi and taper leaf spring is modeled using 1D,2D shell element as shown in Fig (4&5). Leaf spring and brackets are modeled with 2D element, Axles model as 1D element and bushes are model with 1D with necessary stiffness value in direction

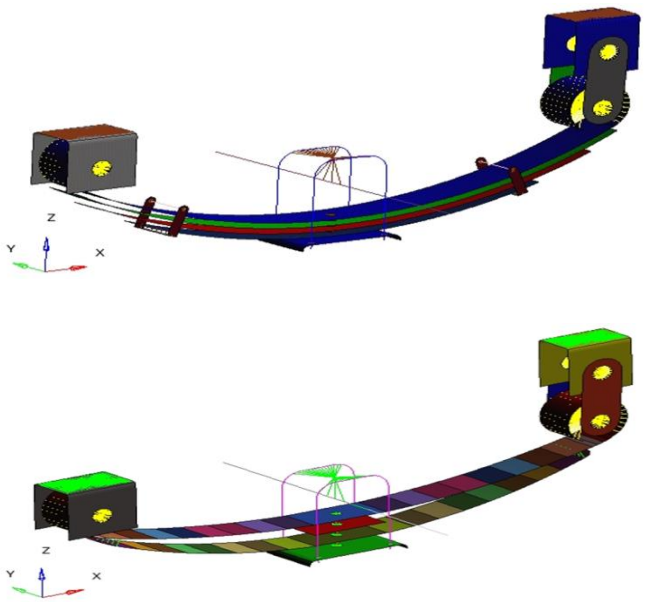


Fig 4& 5: Model setup of Multi and Taper leaf Spring

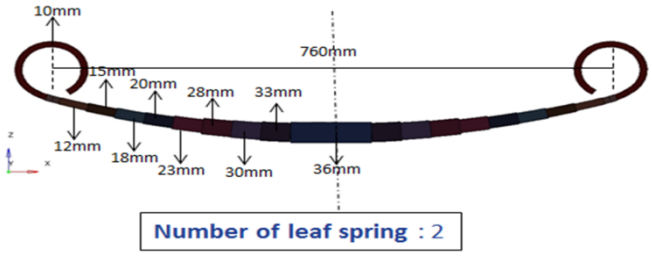
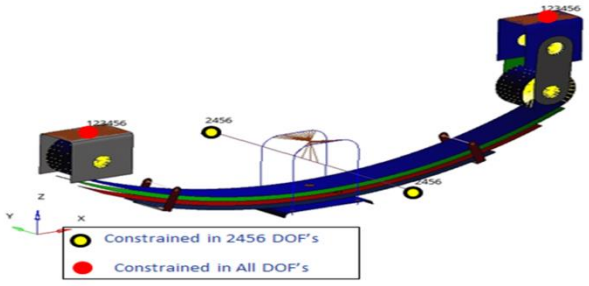


Fig 6: Modeling of Taper leaf Spring

3. Boundary and Loading condition

Boundary conditions are maintained as shown below Fig(7) and remain same in both cases. The bracket which is attaching to chassis frame are constrain all DOF 123456. Axial end point has provision to move in x and z direction, constrain with DOF 2456



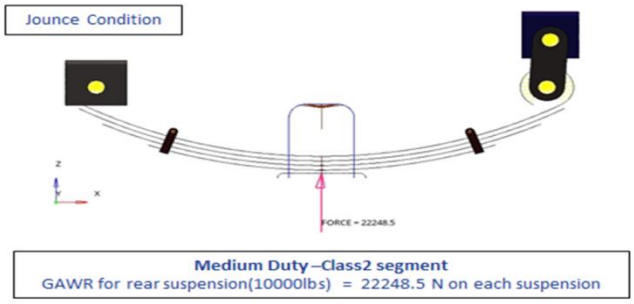


Fig 7 & 8: Boundary and Loading condition

In this study, Medium Duty – Class2 segment is considered with GAWR rating for rear suspension is 10000lbs. Consider loading type will be jounce condition. The lbs has converted as force(22248.5N) and applied in +z direction as shown in Fig(8)

4. Comparision between Multi and Taper leaf spring

Static analysis is carried out in opti-struct to find out the maximum deflection for multi leaf spring thickness(each 10mm thickness) when max load of 22248.5N acts at center of leaf spring as mention in loading condition.

The spring behaves like a simply supported beam. The obtained displacement contour for multi leaf spring of material (steel) is shown in Fig(9)

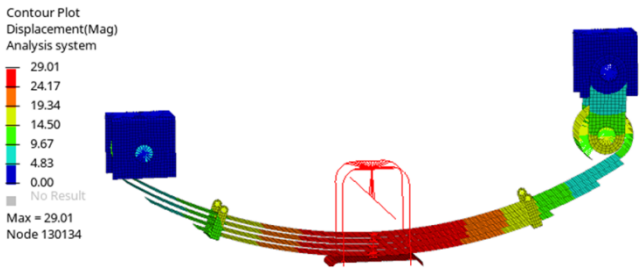


Fig 9:Displacement contour for Multi leaf spring

Determine the maximum deflection for Taper leaf spring thickness (as mention in Fig 6) and number for leaf spring of 2. When applied load of 22248.5N at center of leaf spring as mention in loading condition. Obtain result helps to understand stiffness curve is deviate as compared to multi leaf spring. The obtained displacement contour for multi leaf spring of material (steel) is shown in Fig(10)

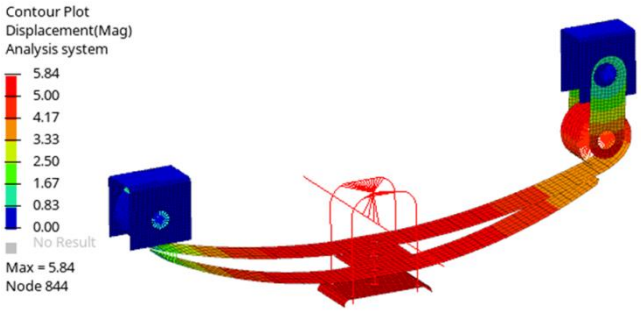


Fig 10:Displacement contour for Taper Leaf spring

Curve shown below fig 11 show force verse deflection i.e., stiffness curve. Result shows for given configuration Taper leaf spring provide much stiffer than Multi leaf spring

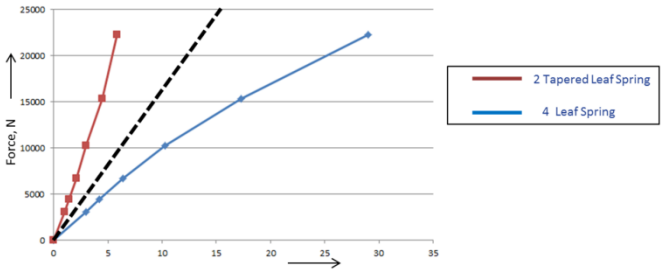


Fig 11: comparison of Force v/s Displacement curve for multi and taper leaf spring

Initial taper leaf spring thickness is assumed as shown in Fig6. It is observed that taper leaf spring initial assigned thickness has high stiffness.

Our aim of this study to find optimum thickness to match the curve without degrading functionality.

IV. SENSITIVITY STUDY OF TAPER LEAF SPRING

First, understand how the variable thickness along taper leaf spring will affect the deflection/stiffness of model.

To achieve, the variable thickness is subdivide as shown in figure 11. Similar way thickness has assign symmetric side also. Thickness assignment been done for tapered leaf spring with Label 1 to 9

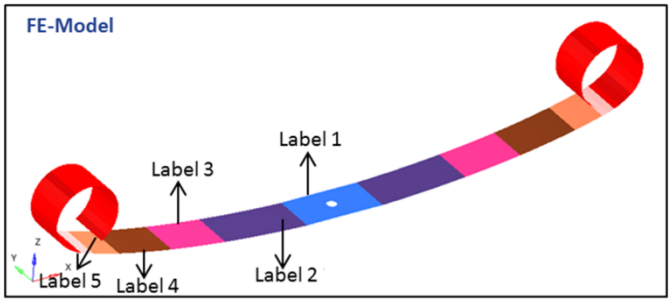


Fig 12: Thickness assignment

Number of Label assignment will get more accuracy result. For time constrain and run time, it has constrained to 9 sub divisions

DOE(Design of Experiment)is tool for determining the significance of thickness factor affecting deflection and stiffness. DOE study has performed in HYPESTUDY tool.

On multiple iteration, consider nominal thickness 15 and lower and upper bound condition value are input as shown in figure 12. Fractional factorial method is used to solve the equation as show below.

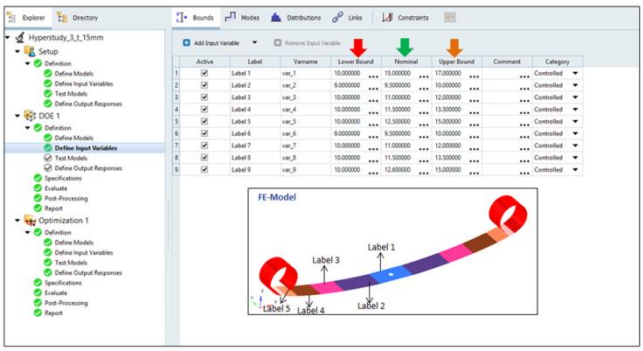


Fig 13:Setup of DOE study in Hyperstudy

Fractional factorial method has used to optimize and understand effect of variable factors. Number of runs considers is 36. Increase in number of runs will increase the accuracy as well run time. Below shown fig13 shows run matrix summary for thickness value assigned for Label for iteration

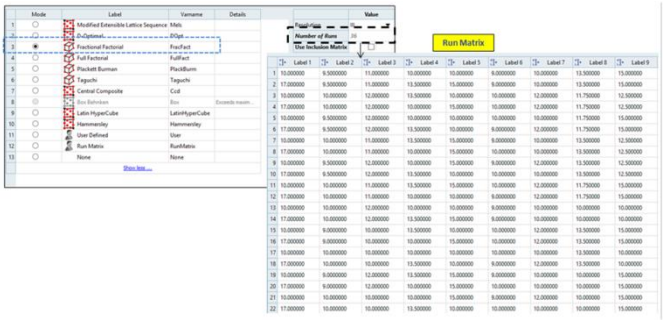


Fig 14:Mode: Fractional Factorial and run matrix

Different iteration has run and plotted sensitivity thickness linear curve. As from result Label-1,Label-2, Label-5 and lable9 are more sensitivity towards deflection. Variation of thickness at these Labels will yield desire result.

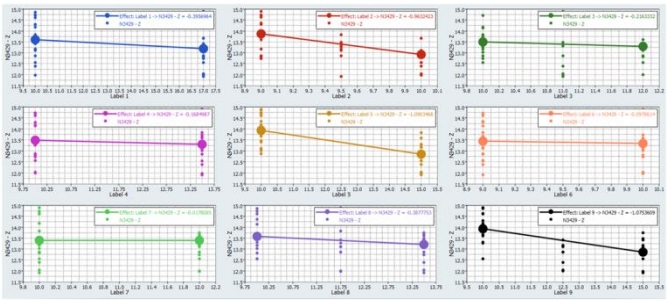


Fig 15: Sensitivity curve for variable thickness and iterations

Optimization of variable thickness of taper leaf spring

Similar thickness assignement is followed as mentioned in sensitivity study(as Fig11). Optimziation study is perform in Hyperstudy and setup as shown in Fig 15

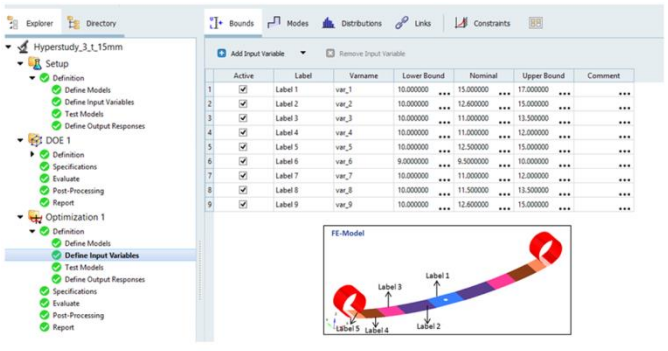


Fig 16: Optimization model setup in hyperstudy

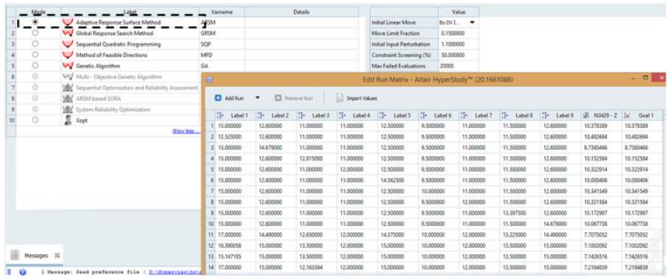


Fig 17: Adaptive Response Surface method and run matrix

In this Adaptive response surface method is consider. And run matrix for iteration is shown in Fig(16)
Based on simulation, below mentioned iteration has feasible condition for assign variable thickness for Label 1 to 9

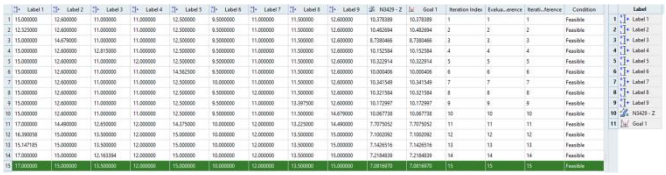


Fig 18: Iteration for different variable thickness details

Each label parameter assigned thickness, iteration numbers and displacement details are shown in below fig18

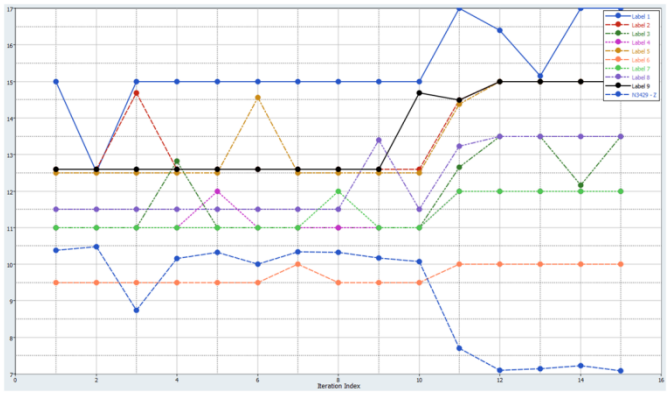


Fig 19:Iteration : Label details

V. RESULT SUMMARY

Each iteration has run with variable thickness as discussed earlier. Force v/s displacement curve is plot as shown in fig(19)

- Based on Optimization results : Iteration 3 and 6 curves are near towards the target stiffness curve
- For future fine tuning on material, arc length, span length and number of leafs, Iteration 3and 6 variable thickness values can be consider

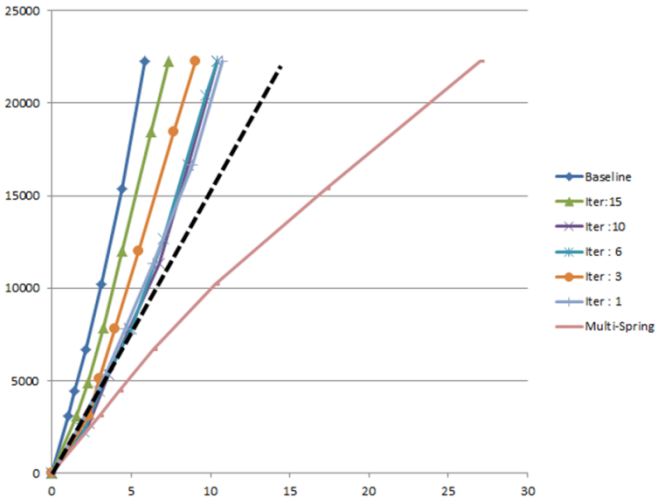


Fig 20:Force v/s deflection curve

VI.CONCLUSION

After performing static analysis, sensitivity and optimization of variable thickness analysis following observation has made:

a) Increase in taper leaf spring thickness increase stiffness
b) Variable thickness along taper leaf spring affects deflection and stiffness value
c) Iteration 3 and 6 of variable thickness has considered for furthur study

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Review of Clamped Type Based Single-Phase Single-Stage Transformerless Current Source Inverters for Residential Grid Connected Solar PV Systems

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ABSTRACT
Current source inverters are presently gaining more attention over their counterpart i.e., Voltage source inverters due to several advantages like inherent voltage boosting ability, better reliability and single- stage power conversion ability etc. Also, the development in the field of semiconductor devices like that of with reverse voltage blocking capability and the wide band gap devices has also triggered to relook at CSIs in several applications including solar PV systems. These inverters can be built transformerless which will further enhance their popularity. However, there are few challenges with transformerless CSIs and flow of leakage current is one of them. In this paper clamped based transformerless CSI is reviewed and an improved topology is suggested for its use in grid connected PV systems. The proposed topology is examined through simulations using MATLAB/SIMULINK tool.

Keywords - Single-Phase, Single-Stage, Current Source Inverter, Grid Connected, Transformerless

I. INTRODUCTION

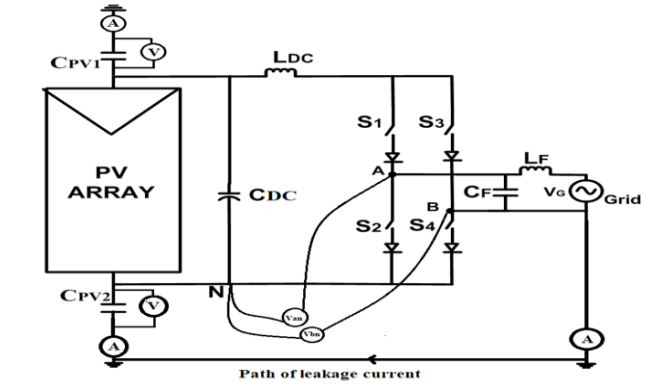
Recently, due to development of reverse blocking IGBTs and the wide band gap devices (WBG), CSIs have got new life and are being considered for their applications in medium and low power drives. Due to their advantages, they are also being considered for application in for a grid connected PV system [1],[2]. Firstly, as PV is basically a current source a CSI will be able to deliver a sinusoidal current into the grid. Secondly, it has an inherent voltage boosting capability. This would allow a lower voltage PV string to be connected at the input side of the CSI as compared to a Voltage Source Inverter(VSI) where a high input voltage PV string is needed resulting in losses due to the partial shading effect in a PV panel. Alternatively, if low voltage PV string is used, an additional DC-DC stage is required for boosting the voltage when a VSI is used. Thirdly, an inductor is used as a DC link in a CSI, and it is more reliable than a DC link capacitor in a VSI, thereby improving overall PV system reliability. Lastly but not the least, use of CSI in PV systems could result in a single-stage transformerless system. Recently there has been a growing interest in transformerless inverters.

Transformerless(TL) inverters are popular due to advantages like increased efficiency, reduced weight, and lower cost[3]. Regulations of few countries including India, allow the use of TL inverters and some more are considering changing their regulations in the same direction. Due to above advantages, research on transformerless inverters gained traction[4]. TL inverters are already commercialized

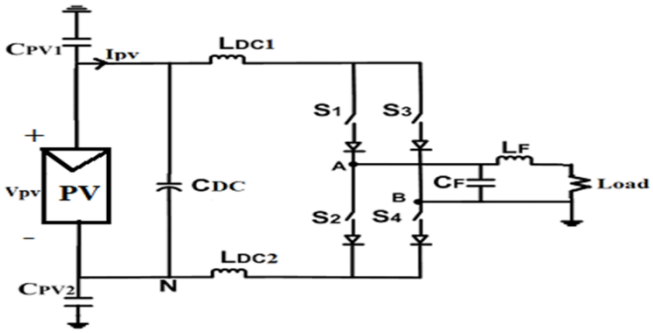
using a VSI. However, to afore-mentioned advantages of a CSI, research in PV inverters using CSI started since 1990s[5] for residential applications by use of a Thyristor. Alternatively, a series connected IGBT, and diode are used as a switch. But few drawbacks like high conduction losses, DC inductor losses etc. has resulted in less research. Though TL systems have advantages, there lies an issue of flow of earth leakage currents causing safety concerns. Last decade, research work is carried out in eliminating leakage current using a CSI. However, the focus was on three phase topologies that are suitable for medium power to high power applications. Present work is carried with use of single–phase topology for transformerless grid connected PV systems. Use of these topologies are first reviewed and an improved topology is also suggested for residential PV grid connected applications.

II. LITERATUE REVIEW

A transformerless conventional CSI with a bulky inductor is shown in Fig.1(a) and with a modified inductor is shown in Fig.1(b). Parasitic capacitance C_{PV1}, C_{PV2} of the solar PV panel is formed due to different conditions and its value lies between 50-150nF/kW for crystalline silicon and 1μF/kW for thin film module [6],[7]. This causes varying Common Mode(CM) voltage and is calculated as shown in (1) by measuring V_{an} and V_{bn} and this results in flow of leakage current $I_{leakage}$ given by (2)[8] and is also measured as shown in Fig. 1(a). The circuit analysis indicating the leakage current path is as shown in Fig 2(a) for the charging mode and in Fig.2(b) for discharging mode respectively only for positive half cycle. Unipolar switching pattern is adopted and is shown in Fig. 1(c). Upper switches are operated at grid frequency and the lower ones at high frequency alternatively for each half cycle. For a typical rating of 1000W(230V,50Hz), the leakage current flowing through the parasitic capacitance is observed with simulation using MATLAB/Simulink tool. In a conventional TL CSI shown in Fig. 1(a), leakage current is not within the standards specified by the standards in VDE0126-1-1[9]. A comparison of the magnitude of leakage current flowing in the conventional CSI with a bulky inductor and a conventional CSI with a split inductor is made as shown in Fig.3. It is observed from the simulated output that leakage



(a)



(b)

Fig. 1 A conventional CSI with (a) bulky inductor and (b) split inductor

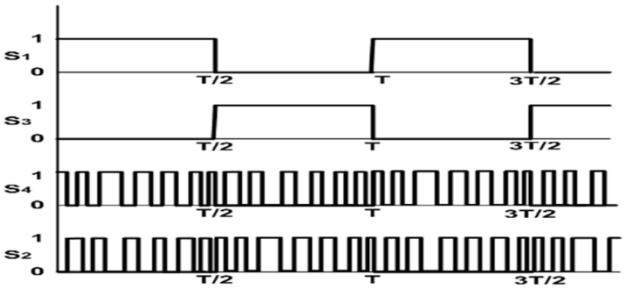


Fig.1(c) Switching Pattern of a conventional CSI.

current for a CSI using a bulky inductor and split inductor is very high and do not conform to the standards[9]. Though with a split inductor, the leakage current reduced significantly but it is not

within the limits. Therefore, conventional transformerless CSI with a split inductor is still not suitable for grid connected PV systems and needs to be modified suitably for the application.

$$V_{CM} = \frac{V_{AN}+V_{BN}}{2} \quad (1)$$

$$I_{leakage} = \frac{dV_{CM}}{dt} \quad (2)$$

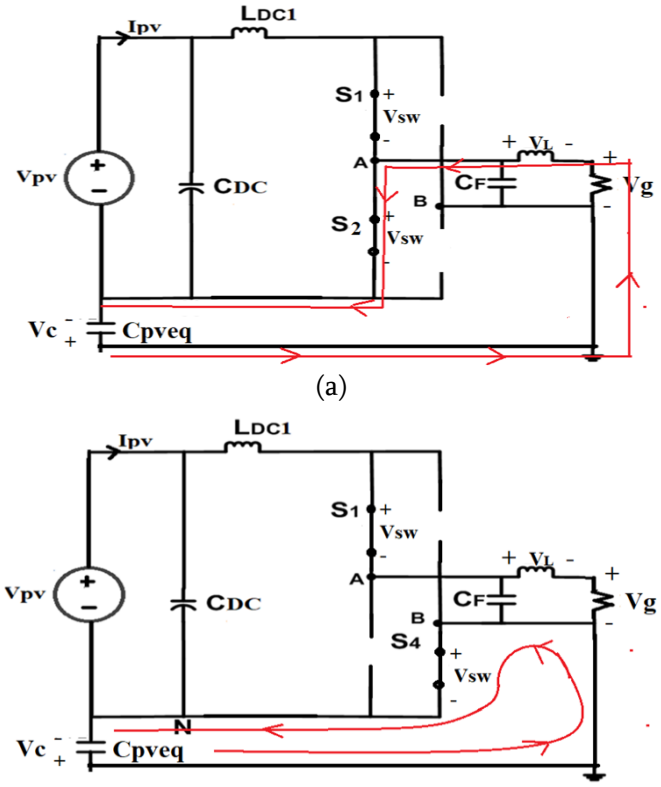
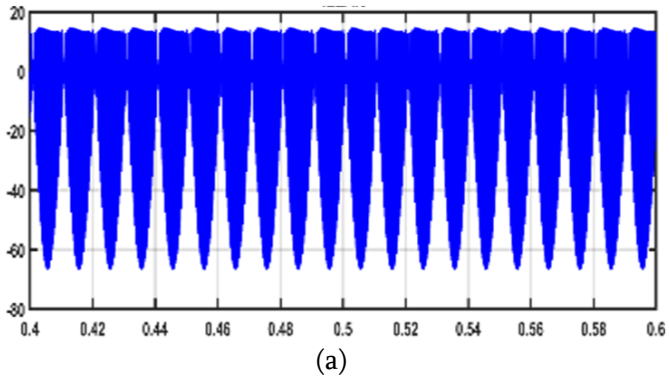
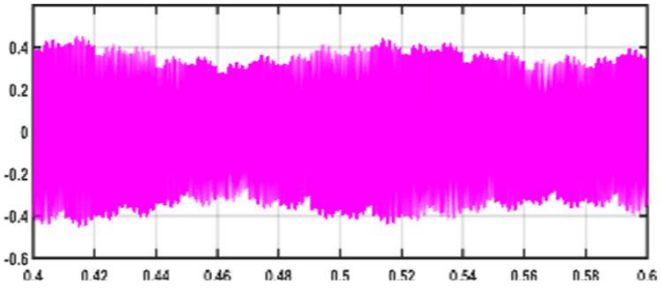


Fig.2(a) Power Charging mode and (b) Power Discharging Mode



(a)



(b)

Fig 3 Leakage Current with (a) Bulky Inductor (b) Split DC Link Inductor

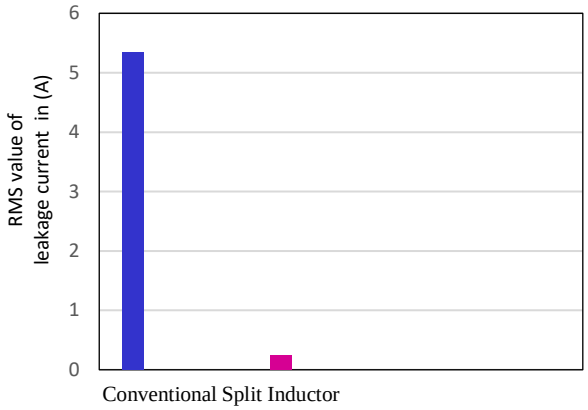


Fig 3.4(c) RMS current magnitude

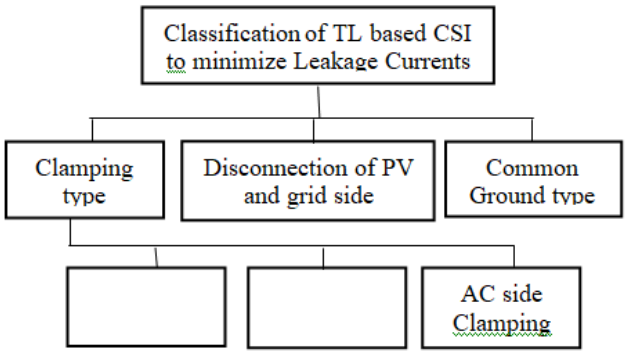


Fig.4 Classification of Topologies based on leakage current elimination.

Many CSI topologies are suggested in literature to eliminate the problem of leakage current flow. These topologies are classified broadly as shown in Fig. 4. In this paper only the clamping type of topologies are considered. In these topologies, the negative side of the PV array is clamped to a low frequency potential source such that the voltage variation across the parasitic capacitance is minimized and, therefore, the leakage current is minimized. The value of leakage current lies well within the standards. Very less

research work is carried in this area and is explained as follows.

a) Neutral clamped topology

The topology shown in Fig. 5(a) is proposed in [10]. This inverter with a split capacitor arrangement is proposed whose mid-point is connected to the grid neutral. A common mode choke is used as split inductor to attenuate the ground leakage current. With the proposed control method, reduced value of dc link inductor is used and the CMV varies according the grid frequency and the leakage current is very small. This topology has a disadvantage that during the freewheeling period, the PV still remains connected to the grid and may still provide a path for leakage current into the grid.

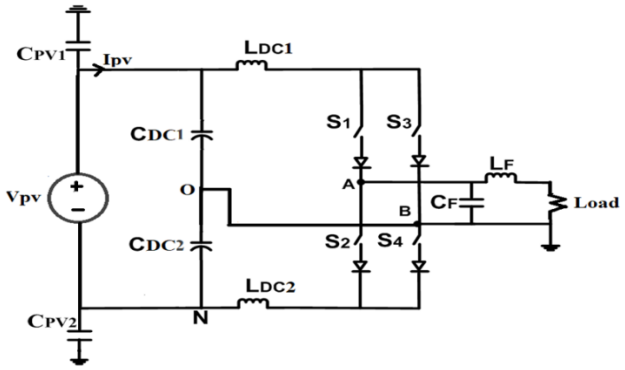


Fig. 5(a) Topology in Ref[10]

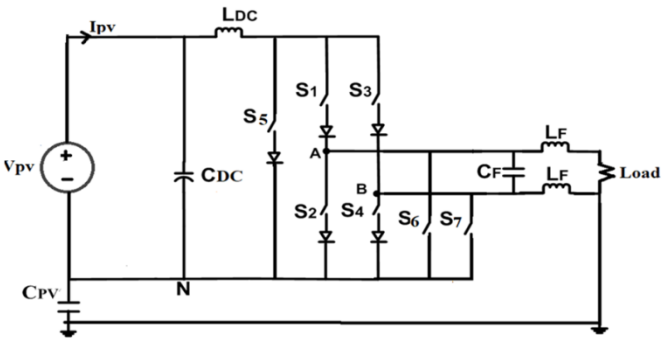


Fig. 5(b)Topology in Ref [11]

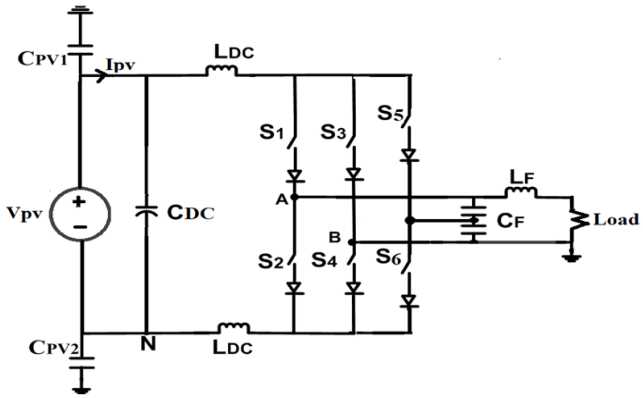


Fig. 5(c) Topology in Ref[12]

b) Clamping negative DC bus:

In [11] a microinverter topology is proposed that can minimize ground leakage current. As seen in Fig.5(b), the objective is achieved by placing two switches on AC grid side to clamp the negative DC bus to the grid voltage during the free-wheeling mode. This allows the parasitic capacitance to vary according to grid voltage and reduces leakage currents. Though seven switches are used for the purpose.

c) AC clamped topology:

In [12], a novel current source inverter with AC-side clamping is proposed to mitigate the switching-frequency common-mode voltage. This is depicted in Fig. 5(c). The main switches are operated at low-frequency to bring down switching losses. An additional leg with two switches is connected whose midpoint is connected to midpoint of AC filter capacitor. During the freewheeling mode, the midpoint of the switches is clamped to the split AC side capacitors. This allows the voltage across the parasitic capacitance to vary as half the grid voltage and also minimizes leakage current. However, the AC side filter capacitor still results in a connection between PV and the grid during freewheeling.

III. PROPOSED TOPOLOGY

Based on the literature review of clamping type topologies, an improved topology is proposed by combining the advantages of two topologies proposed

in [10] and [12] which is shown in Fig. 6(a). On the DC side a split capacitance is connected whose midpoint is connected to the grid neutral as shown in [10]. As mentioned in [12], two additional switches are connected in series and whose mid-point is also connected to the split capacitor midpoint. By doing so, during the freewheeling mode, the PV and the grid get completely disconnected thereby no leakage current flows through the grid which was the case in [10] and [12]. As the midpoint of the additional switches S5 and S6 is connected to the grid neutral, now no leakage path exists between PV panel and grid.

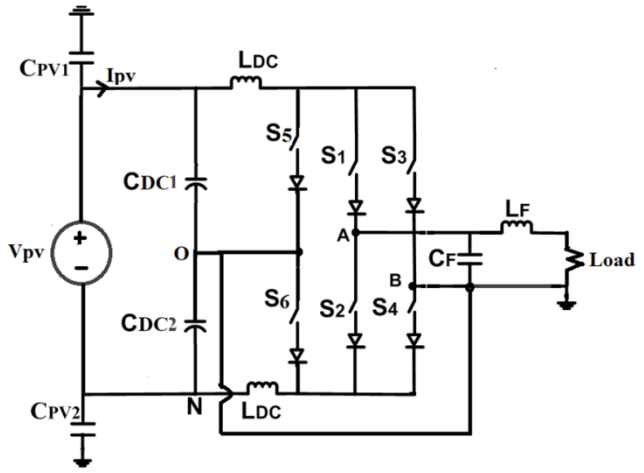


Fig. 6(a) Proposed Topology

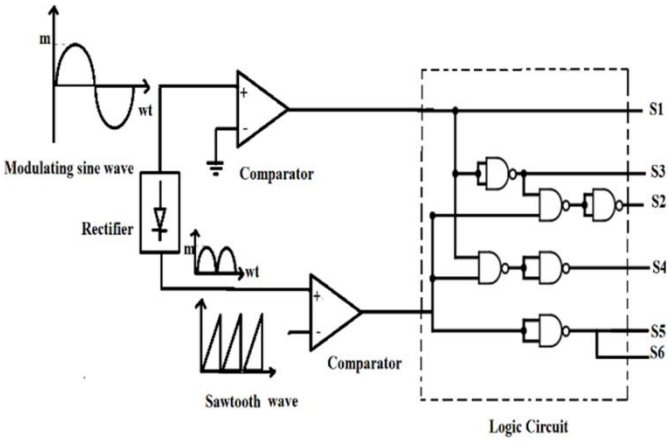


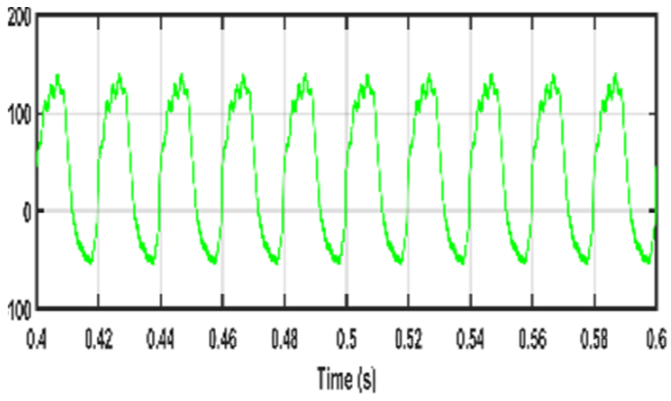
Fig.6(b) Switch Logic for the proposed inverter

This gives better safety to the PV system. Common Mode Voltage (CMV) V_{CMV} is given by

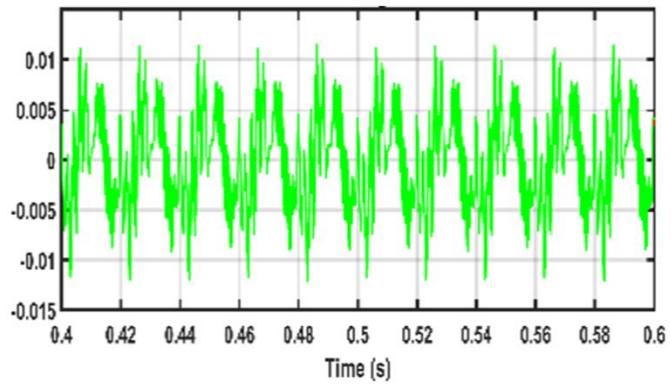
$$V_{CMV}=\frac{Vg}{2}+V_{DC2} \quad (3)$$

IV. SIMULATION RESULTS AND DISCUSSIONS

Simulation is carried out for the inverter topologies of clamped type and also for the proposed topology at a standard rating of 1kW, 230V, 50Hz with DC input of 80V. A resistive load is considered for the leakage current study. Sinusoidal PWM method is modified, and the switching signals are obtained as shown in Fig. 6(b) for the proposed inverter. Fig. 7(a) and (b) indicate the CMV variation while Fig. 7(c) gives a comparison of leakage current through different topologies. It is observed that for the proposed topology the leakage current obtained is well within the standards as specified in [9]. When compared to other topologies, this gives a lower value of the leakage current.



(a)



(b)

Fig. 7 (a) CMV of proposed topology (b) Its Leakage Current

Table 1: Comparison of different TL CSI topologies based on neutral clamping from available literature

Ref	Rating			Device		Passive element				Gain	Switching Frequency	I_{leak}	CMV	Switching pattern
	P	V_{dc}	V_{acpk}	D	S	L_{dc}	L_f	C_{dc}	C_f	---	fsw			
	W	V/A	V	No of devices		mH	mH	mF	µF		kHz	mA	V	
Rajeev etal. [10]	250	40 V	100	4	0	16	3	0.22	6	>1	15	---	(Vg+ Vdc)/2	SPWM
Migliazza etal. [11]	100	60 V	325	7	5	0.5	0.5	2200	2.2	>1	30	27	--	SPWM
Li X. etal[12]	1600	200V	155	6	6	10	--	--	18.8	<1	10	144	Vg/2	SVPWM
Proposed	1000	80	325	5	5	300	4	---	10	>1	10	5	Vg/2+ Vdc2	SPWM

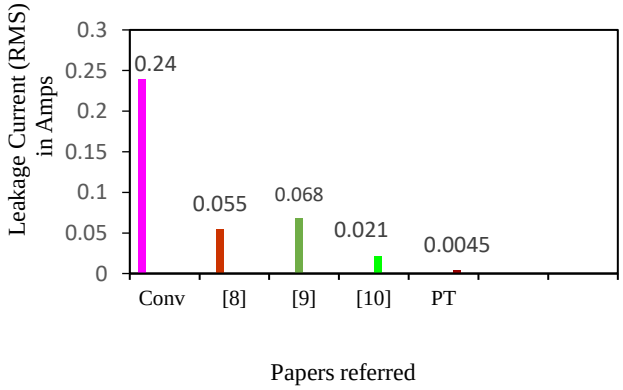


Fig.7(c) Comparison of proposed topology with the existing ones in the literature

V. CONCLUSION

Current Source Inverters are again becoming popular in many applications due to several advantages like single stage power processing, high reliability etc. due to new developments taking place in semiconductor devices like wide band gap devices. In Residential PV systems, solar PV using CSI is seen to have lot of potential as they can reduce partial shading losses and

improve the reliability of the overall system. Transformerless Inverters are becoming popular in the field of PV systems however using a CSI not much research work is reported. In this paper, the existing transformerless CSI with leakage current elimination feature is reviewed and an improved topology is also proposed. Though the proposed topology can eliminate leakage current, further work will be carried out for its application in PV systems.

ACKNOWLEDGMENT

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A Review of Multi-Legged Bio-Inspired Robot Designs

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ABSTRACT

Over the past decades, the research in the field of legged robots has increased. This is because they take inspiration from the bio-organisms. As compared to them wheeled robots are much less maneuverable and cannot be used in a complex environment. This paper presents the state of art in the field of legged robots and presents the design features and the task performed by such robots.

Keywords - Legged Robot, Bio-Inspired Robotics, Actuators, Sensors, Locomotion, Animal-Inspired Robots

I. INTRODUCTION

Legged animals because of their unique bone and muscle functions can survive in a wide variety of environments. The robots inspired by such animals can imbibe such features and can become useful in applications where the human presence can be fatal, for example, detection of bombs, exploration, disasters, terrorist action, exploration of deep canyons, etc. The task of muti-legged robots in such situations can be to autonomously detect any possible threats in the given situations and plan its path in between obstacles and further gain and transmit the information as and when required [1]. Hence, in this paper, we present the state-of-art in the field of design of legged animals-inspired robots.

This information can further be useful for the other roboticists in developing new robots based on their requirements. One of the earliest legged robots was a six- legged robot vehicle having eighteen independently powered joints developed at Ohio State University [2]. This led to the development of various legged robots.

In this review paper, an extensive survey of legged robots has been carried out based on the design features of the robot which includes, types of sensor and actuators used. Based on the above information a comparison has been made between the different types of legged robots.

As the literature in the field of legged robots is vast it is difficult to include all the papers which have been published till date. The scope of our paper is as follows:

1. We have considered the development in the field of legged robots from 2011 to 2020.
2. We have only included terrestrial robots in this paper due to space constraints.
3. The robots have been classified based on the number of limbs.
4. We have not includes two-legged robots in our survey as they are humanoid robots.

5. We have also not included three-legged robots as they are not usually bio-inspired robots.

II. ROBOTS BASED ON NUMBER OF LIMBS

Bio-inspired legged robots can be classified based on the number of limbs mostly into

1) One-Legged,
2) Four-Legged
3) Six-Legged, and
4) Eight legged.

In this section, we have presented a review of all the different robots developed in each of the categories except two-legged robots.

A. One-Legged Robot

One-legged robot has the simplest topology and depends only on hopping mechanisms to move forward. Due to their simplistic features, they are usually used to test the control algorithms used for locomotion [3]. These robots usually require high force and speed actuation to land perfectly on any surface and as a result subject the actuators to high mechanical stress [4].

One-legged robot ETHOP developed at ETH by Guenther et al. in 2019 was made up of a two-segmented leg which was composed of multiple elastic actuators using a modified Linear Multi-Modal Actuator (LMMA) [5] connected in series along with discrete couplings used to actuate the knee joint and an electrically driven hip joint. The foot of the robot also had a horizontal wheel for sideways movement. The sensors used in the robot include a pitch potentiometer for measuring the hopping height by measuring spring deflection. A switch to detect the foot tip [6].

Azhar et al. in 2013 developed a simple hopping robot which was made up of a stand wherein the leg was modeled based on 'passive dynamic' using a mass-spring-damper model and was controlled using Central Pattern Generator (CPG) [7].

Andrew et al. in 2013 developed a one-legged planar robot wherein the leg was attached to a boom and was capable to rotate about the same. The point of rotation was offset from the center of mass. The crank was placed at a 3 o'clock position directly above the point of rotation and was in turn attached to a coupler which was again connected to the leg shaft. A spring was also placed around the shaft between the coupler attachment and the foot. The toe of the leg which was placed at the bottom of the foot was the point of contact to the ground [8].

Shill et al. in 2014 developed a robot skin is called Pressure Sensitive Robot Skin (PreSRS) which was made up of individual piezoelectric based pressure sensors arranged evenly on the surface of the skin to develop a sense of touch as soon as the robot's leg touches the ground surface [9].

Yamamoto et al. in 2016 developed a one-legged jumping robot which comprised of a waist, a thigh, a shin, a foot, and a toe. The robot in total had 5 DOFs which included 1 DOF in the toe, 2 DOFs in the ankle, 1 DOF in the knee, and 1 DOF in the hip. Artificial pneumatic actuators were used to drive the robot along with encoders attached to each of the joints, an air pressure sensor placed at the waist, an acceleration sensor, and gyro sensors [10].

Jumping using a single leg usually comes up with various challenges. One of them is the robot should be capable of balancing its stance while accelerating the body during the next jump and then land accurately. Hence in the case of a single-legged robot, it is important to accurately estimate and control the jumping pattern of the robot. This becomes more complex in the cluttered environment [1].

B. Four-Legged Robot

Four-legged robots, also known as quadruped robots, because their even number of legs have high stability and can perform efficient gait [11]. A lot of work has been done in the field of Quadruped robots and has been presented in the paragraphs below.

Filho et al. developed a four-legged robot Guará with sixteen degrees of freedom wherein each of the legs contained 4 DOFs. The actuators were positioned on the leg of the robot and the joints were driven with the help of timing belt transmissions. The leg design was inspired by a human leg with the knees facing forward [12].

Nguyen et al. developed a miniature four-legged robot having two degrees of freedom each and was actuated by means of a biomimetic actuation system wherein a dielectric elastomer (DE) material was used as an actuator. The robot design resulted in mechanical simplicity, fast motion, and compliance [13].

The robot developed by Semini et al. was made up of aerospace-grade aluminum alloy (type 7075) and was actuated using hydraulic actuators [14]. All the electronic components were covered with a tubular torso-like structure and the hydraulic actuator was covered by Kevlar reinforced fiber. The robot was capable of self-righting and trotting experiments without failing.

In 2015 Seba et al. developed a prototype that was capable of reconfiguring its design which was performed using Klann linkage and thus was capable of performing five different gaits. The developed prototype was tested physically and was able to perform all the different gaits successfully [15].
Quadruped robots can usually perform four different types of gaits which include trot gait, creeping gait, bounce gait, and wave gait. Among these gaits, trot gait results in one of the highest speeds. They have low static stability and hence dynamic stability is used to maintain the balance of the robot [16].

C. Six-Legged Robot

Six-legged robots are the ones that are inspired by insects. These robots have the most stable gaits as they make use of tripod gaits. In such robots minimum of three legs are always in contact with the ground thus reducing the complexity of control, however, the coordination between the limbs is required to be high as the leg configuration increases with an increase in the number of legs of the robot [17].

Bartsch et al. developed a SpaceClimber which was made up of six legs along with foot [18]. The body of the robot was broken down into two parts. The front part was connected to two legs and the back body was connected to four legs. The two parts were further connected via a body joint. Among the six limbs, two were connected to one of the mountings and the next four were connected to the next housing. The front body contained the electronic components and two force/torque sensors and the rear compartment contained a central control board, IMU, and four force/torque sensors, power supply, and other electronic components. The robot was used for mobility on steep gradients.

Robot Octopus III was developed by Xu et al., which was designed to carry a high payload on uneven terrain [19]. The robot was based on parallel mechanisms wherein each of the legs consisted of three degrees of freedom. Each of the legs was actuated by servomotors which were installed on the leg. The robot was controlled by an industrial Linux operating system. Force sensors were used to determine the pressure applied by the legs. Also, batteries were used to supply power to the robot.

AntBot developed by Dupeyroux et al. was also composed of six legs with each leg containing three

degrees of freedom and was actuated using servomotors [20]. These robots consisted of a bio-inspired OF sensor and a celestial compass and were controlled by means of Raspberry Pi. As the robot was inspired by ants, it was capable of moving in a hostile environment.

Yang et al. developed a rescue robot that also made use of parallel mechanisms using three-link parallel mechanisms which were actuated by motors. The robot was capable of carrying a payload of up to 500 kg at a low power rate and hence was also energy efficient. The legs were also capable of being used as a manipulator [21]

Zhuang et al. developed a large load ratio six-legged robot, driven electrically and was capable of walking over obstacles and hence was capable of application in rough and uneven terrain without applying much force on the ground surface. To reduce the impact on the ground a buffer device was added at the end of the shin of the robot [22].

Six-legged robot because of their large degree of freedom is capable of surviving and moving in a complex environment. Also because of their high stability can be used for situations that require the robot to carry a high payload and hence can be used for the rescue operation.

D. Eight Legged Robot

These robots are usually inspired by spiders and have one of the highest stability but one of major problem associated with these robots are the number of control parameters. These robots have a large number of control parameters because of the increased number of legs and as a result the computation cost as well as the physical cost of the robot increases. Hence these robots are one of the least used robots.

Though these robots can find a large number of applications due to the higher degrees of freedom the trajectory planning of such robots also becomes computationally expensive.

Eight-Legged Mobile Walking developed by Andreev et al. consisted of two frames, a top frame and a bottom frame which were connected via a rotary mechanism to each other. Each of the legs of these robots was actuated by a guide block which consisted of a splined shaft and consisted horizontal displacement drive to make the robot move. The drive was further actuated via a servomotor and consisted of a brake as well as a position sensor [23].

Soyguder and Alli developed a spider-like robot ROBOTURK SA-2, in which four legs lie on one side of the robot and the other four lies on the other side of the robot body. Each of the legs was further actuated by means of a single DC motor and using Geneva mechanism and CAM. This resulted in a reduction in the energy consumption and number of control parameters and thereby reduced the complexity of the robot [24].

Ribuan et al. developed an eight-legged soft mobile robot that was made up of silicone rubber and was actuated pneumatically. The locomotion speed of the robot ranged between 5 mm/s to 6.9 mm/s [25].
Though research in the field of the eight-legged robot is particularly scant, the development of new algorithms to control this robot can result in improved efficiency.

III. DESIGN ASPECTS

To develop a robot, it is important to understand the types of actuators and sensors which can be used in the robots. So, this section provides the information regarding these design aspects which can be taken into consideration while developing the robot.

A. Sensors

Since the bio-organisms have evolved over the years they can perform locomotion very easily because of their capability to sense the surrounding very easily. The main sensory functions which can be found in the legged organisms are (i) vision, (ii) pressure/force detection, and (iii) hearing.

Roboticists have taken inspiration from all these sensory features of the bio-organisms and have incorporated the same in their robot via means of different sensors. In this section, we will present how each of these features has been incorporated into the robots to make them mimic bio- organisms.

To provide a sense of vision in the robots, different types of cameras have been incorporated. These cameras are either fitted on the robot or are placed overhead above the robot to detect their motion. This helps the robot to carry on operations such as navigation [26], obstacle avoidance [27], and detecting threats [28] around them.

To incorporate the sense of hearing in the robot the robots make use of sensors that are based on ultrasonic or infrared radiations. These radiations are sent out from the robot body and then are received after they have reflected from the surrounding obstacles [29], hence also helps in navigation [30] and obstacle detection [29]. Also, in some cases, these sensors can be used to measure the speed of the robot [31].

Just like how the legged animals are required to feel the surface on which they need to land similarly in the case of robots, pressure and force detection is required in the robot when they travel on uneven terrain or on such surface which is soft thus neither damaging the surface on which they are landing nor damaging the body of the robot [19].

B. Actuators

Actuators are the components that connect the technical or nontechnical components with the electronic control system. They help in regulating the flow of volume, mass, and energy. They are usually referred to as components that are used to convert one form of energy into another. In the case of legged robots usually, electrical energy is converted into mechanical energy [32].

Legged robots make use of servomotors [33], elastic actuators [34], Shape Memory Allow (SMA) [35], hydraulic [14], and pneumatic actuators [10], and magnetic actuators [33].

The choice of actuators usually depends on the type of applications. The applications which require the robot to have very high maneuverability and to be of low weight usually make use of soft robotics-based actuators such as SMA and elastic actuators. The applications which require the robot to move in a complex environment and the robot need to carry high load servomotors are usually used as the actuating elements. The energy required in the case of servomotors is much high as compared to soft actuators, but the force generated by servomotors is much higher as compared to the soft robots.

IV. APPLICATIONS OF LEGGED ROBOTS FOR VARIOUS TASKS

This section presents the various tasks performed by legged robots. This information will be useful for roboticists to select the type of algorithms to be used based on the task performed while carrying out any applications.

- The first and foremost application of legged robots is the detection and avoidance of obstacles while navigating in a cluttered environment. To do so many algorithms have been developed and used which include the Taguchi method [36], fuzzy logic (FL) controller [37], a combination of FL and ANN (Artificial neural network) [38].

- Localization is another important task for legged robots. Various methods such as 3D factor-graph LiDAR-SLAM [39], Observability Constrained Extended Kalman Filter [40], using stereo visual odometry and LIDAR registration [41], and Markovian Localization Framework [42] have been used. These methods are usually based on vision to determine the location of the robot in the environment.
- Legged robots can also be used for waypoint following wherein the robot needs to traverse through predetermined waypoints autonomously. For such tasks, various path following algorithms can be used which include state estimation using visual-inertial odometry [43], nonlinear Lyapunov- based control law [44], generalized path following method [45], and wave propagation path planning algorithm [46].
- Another important task wherein the legged robots can be used autonomously is to perform any given task in cooperative fashion wherein multiple robots can communicate with each other and can perform tasks as a team. Cooperative mobile robots can be classified based on two approaches: intentional cooperation and swarm-type cooperation [47]. In the case of the swarm-type approach, all the robots are unaware of the action of the other robot while in the case of intentional cooperation, all the robots are aware of each other and perform together to achieve a common goal.

All the aforementioned tasks can be used either in different combinations or separately for different applications such as inspection, rescue missions, locomotion in rough terrain, autonomous navigation, and payload delivery [48].

V. CONCLUSION

Research and interests in the field of robotic systems which take inspiration from bio-organisms have increased in the last decade. In particular, the use of legged robots for various purposes which are unattainable by humans has increased. This is because of their capabilities to perform similar to real bio-organisms. They are able to move much more easily when compared to robots that make use of wheels, as they can move in areas inaccessible to wheeled robots. This paper presented a detailed review of different types of legged robots based on the number of limbs and it was found that with the increase in the number of legs the stability of the robot increases, however, it comes at the cost of an increase in the complexity of such robots.

We also presented different types of sensors and actuators used by legged robots. It was seen that soft actuators could provide more maneuverability but also resulted in less thrust generation. The servomotors provided more thrust as well as better speed as compared to soft actuators. However, it also resulted in an increase in the weight of the robot and caused more energy loss. We also showed how different tasks can be performed by legged robots using different algorithms. These algorithms can either be used separately or in combinations to perform different tasks at a time.

Some of the major limitations of such robots are the speed generated by them, and the requirement for complex algorithms to control such robots. Also, such robots are usually very heavy because of the number of actuators used to move such robots.

To improve the performance of such robots it is essential to optimize the locomotion of such robots so that they can move with much ease without losing much energy. The locomotion efficiency of such man-made robots is still much less as compared to

their biological counterparts. To improve the performance of the robot it is important to develop better actuators that can easily mimic the structure of the muscles of the bio-organisms.

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Effect of MIMO Scaling on Energy Efficiency of Beamforming Systems

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ABSTRACT

The inclusion of MIMO antennas in relay assisted wireless communication has intensified the diversity but leads to severe interference issues. To mitigate the effect of interference, beamforming systems enabled with Conditional Time-split Energy Extraction is extensively used in modern wireless generation networks. Relay selection, Energy Extraction and Beamforming phases are successively implemented to ensure maximum energy efficiency for a predefined transmit power constraint. This paper focuses on the effect of MIMO scaling. Generally, increasing the antennas decreases the energy efficiency of the system but the proposed architecture yield better results compared to conventional techniques with and without energy extraction and power constraints.

Keywords : Beamforming, Conditional Time Split Energy Extraction, Energy Efficiency, Minimum Mean Square Error Algorithm, Modified Cuckoo Search optimization Algorithm, Power Constraints

I. INTRODUCTION

Modern wireless generation networks rely on high data rate, coverage range and energy efficiency to accomplish the transmission of multimedia messages over a wireless channel. Quality of the signal transmitted towards the end user is another major concern. Many diverse schemes have been employed at transmitter and receiver level to achieve effective utilization of available spectrum. To achieve the space diversity, MIMO modeled relay units and communication nodes are used. The use of MIMO networks in wireless communication results in increased data rate but leads to severe interference issues. To mitigate the effects of interference, advance signal processing algorithms are employed in the antenna systems. The smart antenna system associated with the MIMO networks creates beams in desirable directions and restricts in unwanted directions. Relay assisted wireless communication enhances the coverage range of the system. Relay nodes in Full-Duplex MIMO systems results in loop back propagation and self interference, which can be suppressed using beamforming algorithms jointly implemented over the source nodes and relay nodes. Traditional Beamforming (BF) architecture can nullify the back-propagated self interferences but leads to excessive power wastage, time delay and error in data transmission. There is a large scope to design a novel BF architecture to optimize all the performance metrics relevant for future generation networks.

Connectivity between the end users needs to be sustained without causing abrupt termination. Demand of bulky data transmission with uninterrupted connectivity brings the scope of selecting the most feasible set of relay units and

development of enhanced energy extraction architecture over the selected relays. The proposed architecture in this investigation gives solution to the issues related to the dynamic behavior of user nodes and relay nodes. Without compromising the conventional optimization targets, Energy Efficiency (EE) of the beamforming system has been maximized by using optimal power wastage scheduling algorithms. Multi objective optimization algorithms are developed for maximizing the Energy Efficiency and minimizing the Mean Square Error (MSE). Complexity in BF vector calculation becomes tedious for high speed user nodes and proposed algorithm finds the most optimum time at which beams can be steered with minimum MSE.

This work utilizes the combined optimization in relay selection, energy and power wastage schedules as well as BF vector update so as to enable the system to perform well in a highly dynamic environment. Proposed relay selection algorithm selects the best combination of relays to transmit the signal to the destination so as to maximize the fitness function. To ensure sustained connectivity and avoid communication failure, the power level of battery is monitored and accordingly energy is extracted if required. If the intended relay is most critical and has a deep role in contributing the maximization of fitness function, then the proposed architecture permits the usage of the same until the communication terminates by the end-user. In this scenario, the system requires switching between information decoding phase and energy extraction particularly if the data is bulky and consumes more time for the communication. This situation is evident in static cases, where the same set of relay nodes is continuously used by the user nodes for establishing the communication throughout. This is equally applicable for low speed pedestrians. Whenever highly mobile and dynamic nodes are considered, frequent relay switching is required. This means relays selected at the current time slot for maximizing the fitness function may not be relevant for the next time slot. Here is the importance of fast relay switching so as to address the connectivity problems with dynamic nodes.

Fixed pre-assigned scheduling of energy extraction degrades the processing speed and leads to undesired overflow of energy. As energy resources are limited and it is important to preserve the energy, proper energy scheduling is incorporated in the proposed architecture. Imposing power constraints at relay nodes in beam formation leads to minimize the power wastage problems. Whenever the information is much bulky and communication is prolonged, the BF vector calculation and update becomes quite complex. It is necessary to have the beam formation with minimum time slot and at the same time the data is transmitted error free. The frequent relay switching between information decoding and energy extraction phase leads to increased time delay. Hence, critical scenarios are analyzed in which relay switching and energy extractions are mandatory and therefore executed. For uncritical cases relay switching and energy extraction are bypassed and hence time delays are properly planned by instantaneous scheduling mechanism. This paper focuses on the effect of MIMO scaling. Generally, increasing the antennas decreases the energy efficiency of the system but the proposed architecture yield better results compared to conventional techniques with and without energy extraction and power constraints. Future wireless generation networks are expected to make use of the smart antenna technology in millimeter wave frequency band and if worked on this proposed architecture, it brings ultimate solution for connectivity problems in dynamic communication scenario.

II. LITERATURE REVIEW

EE in modern wireless networks are accomplished with the aid of time splitting and power splitting

methods to ensure simultaneous EE and information decoding. The relay systems are wirelessly powered by extracting energy from radio frequency. Energy inefficiency in traditional networks may be a threat to the life of relay assisted wireless networks. A hybrid analog/digital BF for the purpose of simultaneous information decoding and EE are promising approaches in MIMO networks. Optimal energy scheduling algorithms are mandatory to maximize the channel sum-rate with available CSI. On the downlink, base station transmits energy and information simultaneously to all the available receiver nodes. A power split device is used in Power split EE method to divide the power of the received signal between the information decoder and energy extractor. A fraction of the energy harvested by energy extractor is used for uplink pilot signal and data transmission in the current frame. An optimization problem and solution is developed into maximize the sum throughput of a wireless powered communication network. A non-linear Energy extraction model is well suitable for MIMO networks rather than the idealistic linear EH model. Authors in [1] focused on imposing energy constraints while the current energy always is ensured to be greater than a predefined threshold. Here both minimum mean square error (MMSE) and mutual information are taken as the performance metrics for the BF designs. A dynamic power allocation solution was developed for MIMO systems and by integrating Simultaneous Wireless Information and Power Transfer (SWIPT), researchers were able to maximize the energy efficiency [2].

The energy efficiency of the two-way relay networks in the MIMO system is determined by the robust optimization in algorithms used for beam steering. At the source and relay nodes, low complex transmit power constraints are imposed and BF is executed based on generalized singular value decomposition algorithm [3]. To optimize the power loss both total and individual power constraints are considered for solving the sub-optimal BF and relay selection problems. Eigen value decomposition is used for achieving the optimum solution and system complexity does not increase as semi-definite programming problems are not dealt with. Highly-mobile millimeter wave applications requiring deep learning methods that predict precise BF coefficients at relay nodes is presented in [4]. For enhanced achievable sum rate, authors designed balance architecture to deal with useful signal to noise ratio improvement and SI suppression. Behavior of time split architecture is analyzed for different transmission modes in [5]. Optimum time split architecture certainly improves the throughput of the system for a full duplex network compared to half duplex systems. The success (or failure) to select the best available path depends on the statistics of the wireless channel. A promising methodology to evaluate performance of any kind of wireless channel statistics is provided in [6]. A semi definite relaxation algorithm is proposed in [7] for the combined source-relay BF design and offers guaranteed power-optimization.

Adaptive BF algorithms in smart antennas for modern wireless networks are presented in [1]. Both transmit and receive BF systems are jointly implemented at relay nodes to maximize the signal to noise interference plus leakage ratio [2]. A novel BF design problem is formulated with energy extraction at the relay nodes, while MSE is minimized under precise power constraints [21]. Total network transmission power is minimized with QoS constraints for a two-way MIMO relay network with novel transceiver design [22]. A new BF approach is presented in [23] to suppress the inter-stream interference at the sources caused by multiple antennas in MIMO networks [24]. Friendly jammers and useful relays for signal transmission are identified and classified in [25]. The nodes which failed to decode the source signal properly are

considered as jamming nodes and the remaining nodes are considered for relaying the message signal with the aid of cooperative BF.

There are few promising robust beamforming technology, the power splitting and SWIPT technology over relay systems. To achieve energy harvesting fairness, the minimum harvested energy among users subject to secrecy rate constraint and total transmit power constraint are accomplished in [1]. To design robust transmit BF vectors and the power splitting factors in the presence of CSI errors [2], the average worst-case signal-to-interference-plus-noise ratio (SINR) is maximized while achieving an individual energy harvesting constraint for each mobile station. To reduce the computational complexity of the semi-definite programming problem, a successive convex approximation (SCA) iterative algorithm is proposed in the perfect channel state information (CSI) case to obtain a near-optimal rank-one solution [3]. Authors in [4] investigated the robust weighted sum secrecy rate maximization design, subject to multiple signal-to-interference-and-noise ratio and harvested energy constraints. A secrecy rate maximization (SRM) problem is formulated in [5], which can be decomposed into a twin-level optimization problem and solved by a one-dimensional (1D) search and semi-definite relaxation (SDR) technique. It is observed that the Time Split scheme outperforms the Power split scheme [6] in terms of achieving a higher covert rate when the transmit power at the source is relatively low. Unlike the approaches discussed in the literature, in this paper a novel design is proposed to execute energy extraction and beamforming hand in hand in a conditional-split manner so as to maximize the energy efficiency, minimize the error and computational complexity.

The existing systems compromises in performance constraints like Achievable Sum Rate (ASR), Mean Square Error (MSE) and particularly in signal latency considerable time is devoted for the energy extraction process to maximize the energy efficiency. Relay failure or power drain off in traditional BF architecture is our main concern. Power loss minimization and achieving error free data transmission per unit amount of energy are great challenges for the modern communication systems. Frequent energy extraction process without boundary conditions leads to transmission delay. Motivated by these earlier works, our paper is based on a time split scheme that would maximize the energy efficiency without compromising the conventional metrics. To achieve the desired spatial diversity it is necessary to increase the number of antennas but this leads to self interference thereby decreasing the Energy Efficiency. Though this is applicable to our proposed system for higher order MIMO, but is found to be much appreciable than state-of-art architectures. In this proposed work we are able to balance this trade-off.

The key highlights of proposed architecture include the Fixed and Switched Relay selection, Conditional Time- Split Energy Extraction and Joint beamforming. Figure 1 depicts the overall flow diagram of the system architecture including relay selection, relay switching, CT-EE and beamforming. Both single user and multi user communication are considered in this work. Consider that the user nodes are geographically far apart from each other. They may not be able to establish a direct radio link with the help of a base station and mobile switching centre. Hence direct transmission of information is not possible between the end-users. To tackle this, numerous relay nodes are deployed in the communication scenario that works in an Amplify-Forward (AF) methodology. Relay nodes can be static or mobile as well as the user nodes are also expected to be static or mobile. In this relay-assisted wireless communication, relay nodes are intended to form beams in desired directions so as to enable the reception of messages from the neighboring relay

nodes or user nodes. They are also responsible in forming beams in specific direction so as to enable the forwarding of the intended message towards the destination user or relay node. All relay nodes are modeled as MIMO unit equipped with multiple antennas at its input and output and hence spatial diversity is explored.

PROPOSED BEAMFORMING SYSTEM WITH CT-EE AND RELAY SWITCHING ARCHITECTURE

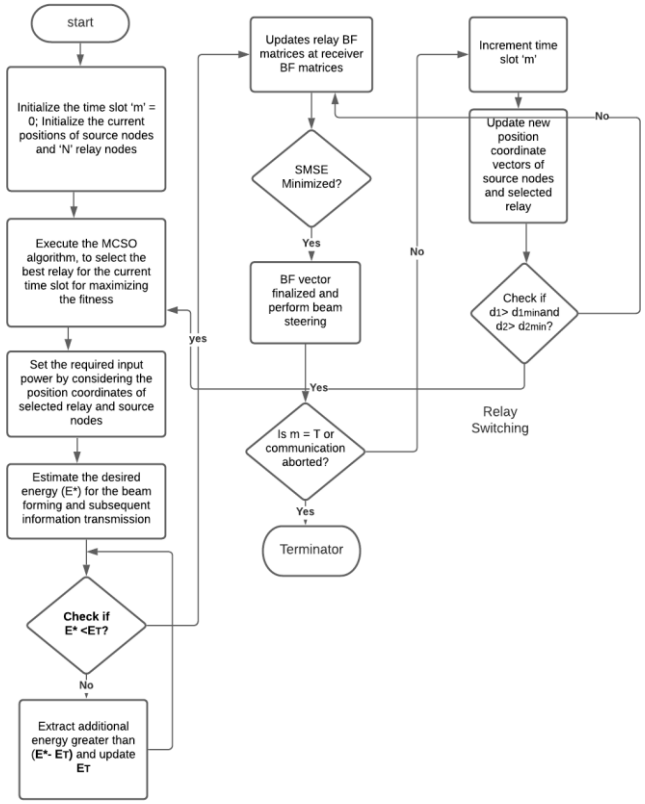

Figure 1: Overall System Architecture of proposed CT-EE enabled beamforming system

Each relay node is equipped with a smart antenna system that executes an algorithm to form beams after collecting the real time data. Hence, the system works with a distributed beamforming system instead of a centralized system. The use of distributed system helps in achieving quality and precise BF vectors without errors in an instantaneous basis. To facilitate long distance communication, 'N' relays are deployed with MIMO antennas. It is not necessary that all 'N' antennas works simultaneously for the information transfer for a specific time slot. The relay participation is solicited if it contributes to enhance the fitness function. Fitness function is to maximize the power efficiency which is equal to channel capacity to power transmitter ratio. Single relay or multiple relay selection is done for a specific user pair. If the end-user nodes are very close to each other, it would be sufficient to select a single relay that can maximize the fitness function in the best way. On the other hand, if the end-user nodes are geographically far apart from each other, it is mandatory to select a combination of multiple relay units that can maximize the fitness function. The best relays are ranked and then selected together for the beam formation. As one relay is not enough to make the information available at the destination, all the selected relays are cooperated together in beam formation.

Modified Cuckoo Search Optimization (MCSO) Algorithm is used for the relay selection scheme. If the user nodes are static, the selected relay set will be fixed for the entire conversation period. The selected relay(s) will be active in forming beams in the desired directions throughout the period of conversation. This positive scenario happens only if the relay batteries are equipped with sufficient power or the conversation period is too short. In the worst case, both the possibilities are discarded. It is required to expect zero battery power in the selected relay node, or the other way, the communication period is too long such that the available power in the battery is not sufficient to set up connectivity for prolong duration. In such cases, replacement of relay units in the selected set is also not possible as it may affect the fitness function. To achieve full connectivity, required amount of energy is to be extracted and the battery power is to be made sufficiently more than the required estimated power.

In this context of distinct modes of relay's behavior it is mandatory to have proper energy scheduling mechanism. It is noted that the pre-assigned fixed schedule of energy extraction will not work in all contexts. As it encounters with fully drained off relays some times and fully charged relays during other circumstances, conditional scheduling is necessary. This resulted in the design of CT-EE architecture which allows splitting the beamforming phase to energy extraction phase for a considerable amount of time. This happens in critical cases, where power drain off issue is severe and the available low battery power level may lead to connectivity termination. Power fed to the antenna terminals of any transmitter node depends on the separation between transmitter and receiver node. With the development of communications applications, system designers are in a position to consider the placement and performance of an antenna system. The first step in establishing antenna requirements is to determine the desired communication range and terminal characteristics of the radio system (i.e., transmit power, minimum receiver sensitivity level). Given those parameters, one can ascertain the amount of gain or loss required to maintain the communication range by using the Friis Transmission formula. With the help of GPS technology, distance towards the destination/ adjacent relay node is obtained. Frequency of transmission is in mm-wave band and 35GHz RF signals are radiated from the antenna terminals. For simulation purpose antenna gain is set as unity. Received power at the end-user or relay terminals is maintained at a minimum value so as to maintain the required sensitivity for information decoding.

Depending on the current position coordinate of destination node (or the adjacent relay node), each relay and source node estimate the average power required to transmit the signal without error. An approximate energy estimation E^* is done and thereafter the available energy E_T is compared with the estimated energy to decide whether additional energy, E_H is to be extracted. It is to be noted that pre-assigned fixed time slot for energy extraction may lead to overflow of battery power and results in power wastage issues. This is not acceptable as the energy resources are scarce and it is high-time that engineering designs need to follow measures to preserve the resources. The proposed CT-EE architecture permits the bypassing of energy extraction phase for un-critical cases as the present battery power level is sufficiently high to permit the connectivity for desirable period of time. This saves the processing time and beamforming phase is directly executed.

In this work, joint beamforming using Minimum Mean Square Error (MMSE) Algorithm is performed over selected relays with sufficient power level. The term "joint" in the sense that beamforming is jointly performed with all the selected relay nodes and source nodes. The BF vectors are updated at each time slot to steer beams in desired directions and nulls in the unwanted directions. MMSE algorithm converges once sum of mean square (SMSE) is minimized and beams are steered. When user nodes are continuously moving, the cooperating relay nodes will not be the same set throughout the communication period. In this scenario, Switched Relay selection scheme (SRS) is accomplished to replace the selected relay(s) with new set of cooperating relays. Hence the rate of replacement depends on how dynamic the mobile nodes are. It depends on the relative movement of user nodes with respect to the previously selected relay nodes in the past time slot.

Fixed Relay Selection (FRS) permits the usage of same set of relay(s) until the communication is terminated by the subscriber. FRS scheme bypass relay switching and avoids unnecessary switching time wasted in a static end-user case. The additional time T' elapsed for EE process can be compensated in

BF process by finding an optimum time at which iteration can be concluded and subsequently BF vector can be updated. Allocation of T' for EE is acceptable as it enables uninterrupted connectivity and the duration is not constant, whereas it depends on the current battery level of the particular relay node under consideration. The proposed architecture always recommends continuing with FRS scheme as it avoids relay switching and replacement. FRS scheme also permits the usage of partially selected relays in the set to be active in a current time slot without replacement the entire set. In that case, if other relays are not cooperating in the beamforming because of the mobility nature of user nodes, they will enter in to the sleep mode so as to restrain from power wastage and unnecessary beam spill-out. At later instant the few relays in the selected set might turn ON to fulfill the fitness function constraint. FRS is replaced by SRS in highly dynamic environment, in which the entire selected relay ranked set are replaced with new ones at the next time slot. Hence, joint BF over the energy extracted feasible relay enhances the system efficiency in terms of energy, time, sum rate achievement, error free transmission etc.

Full connectivity between communication nodes can be achieved by ensuring the sustained life of relay nodes, without allowing power drain off. The proposed CT-EE system compares the power level of the storage batteries with the estimated power for beam formation after every BF vector update. Whenever it finds the current power level goes below the estimated power, information decoding and BF phase are switched towards EE phase. CT-EE is done in a distributed manner at all relays separately making use of the input RF signal. More time the relay works in BF phase, more will be the power drain off and so EE phase takes more time for the battery to charge to the desired level.

The life time of relay nodes can be extended and achieve universal connectivity by making use of RF signal to simultaneously extract energy and decode information. The existing time split and power split architectures yields unnecessary power wastage and signal latency issues due to the use of a power split device and fixed time split switch. These issues can be mitigated by a conditional time splitting scheme with boundary conditions that ensures minimum power loss and leads to useful power transmission thereby maximizes the energy efficiency. The proposed CT-EE architecture works over all wireless links with an assumption that CSI is static for a given frame duration. Before the cross over from one frame to another, CSI varies and it can be estimated by pilot signal transmission procedure as discussed in system model.

III. RESULTS AND DISCUSSSION

The proposed CT-EE architecture brings significant performance improvement in the energy extraction enabled beamforming. To validate its achievement, energy efficiency is computed for various beamforming schemes with and without energy extraction, power constraints and boundary conditions. Following sub-sections highlights the major observations in energy efficiency for various beamforming architectures. Energy Efficiency is computed as a ratio of average Achievable Sum Rate to average power dissipation. Maximum Energy Efficiency corresponds to decrease in overall power used by the system that carries enhanced results, and it can be accomplished by dropping the static power consumption of the system. The EE for the proposed system model can be evaluated by applying the proposed power wastage schedule during CT-EE and the fitness maximization relay selection. The proposed CT-EE enabled beamforming is compared against beamforming with conventional EE without boundary conditions. This architecture has mandatory energy extraction without checking the

current battery level. This leads to battery overflow and considerable power wastage at relay terminals. The overall consequence is energy efficiency decreases. The next scheme of comparison is with respect to beamforming without EE but imposed with power constraints. In this scheme the selected relays are carried towards beamforming phase. Neither battery power level is monitored nor is energy extraction involved. This creates abrupt relay failure and termination of service. Achievable sum rate decreases and hence Energy Efficiency decreases. However, during beamforming phase as long as relay is available power constraints imposed over the relay nodes permits optimum usage of power for beam steering. This maintains more Energy Efficiency than conventional BF without energy extraction and power constraints. This scheme as discussed in [33]-[34] implements beamforming without energy extraction and power constraints. The objective is to form precise beamforming matrix at the end of time slot by compromising in the convergence rate, energy efficiency and ASR. Due to inadequate battery level, abrupt relay failure occurs and service is terminated. As a result, ASR decreases and Energy Efficiency falls down.

Energy efficiency is measured in terms of amount of useful energy in message transmission through relay networks. A greedy policy resulted in optimal wastage of power at the transmission nodes. In addition, the CT-EE process will not allow the relay batteries to drain-off below a critical value. This performance metric is closely associated with number of bits transmitted without error per unit amount of useful energy throughout from source to destination via relay nodes. Figure 2 depicts the comparison of four different architectures-conventional BF without EE and power constraints, BF without EE and with power, BF with EE but without boundary conditions and finally proposed BF with CT-EE. Energy efficiency changes with respect to maximum allowable transmitter power at the relay node. It is observed from the Figure 2 that energy efficiency increases with the power and is maximum for the proposed CT-EE enabled BF for a given transmitter power value. Table 1 summarizes the numerical values for the specified power constraint with respect to all the BF and EE schemes for 2x2 MIMO and 4x4 modeled relays.

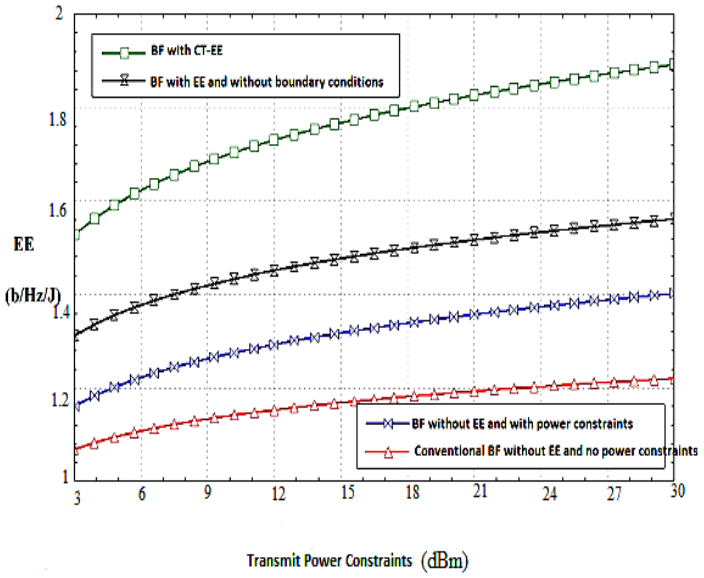

Figure 2: Performance Comparison in terms of Energy Efficiency for 2x2 MIMO

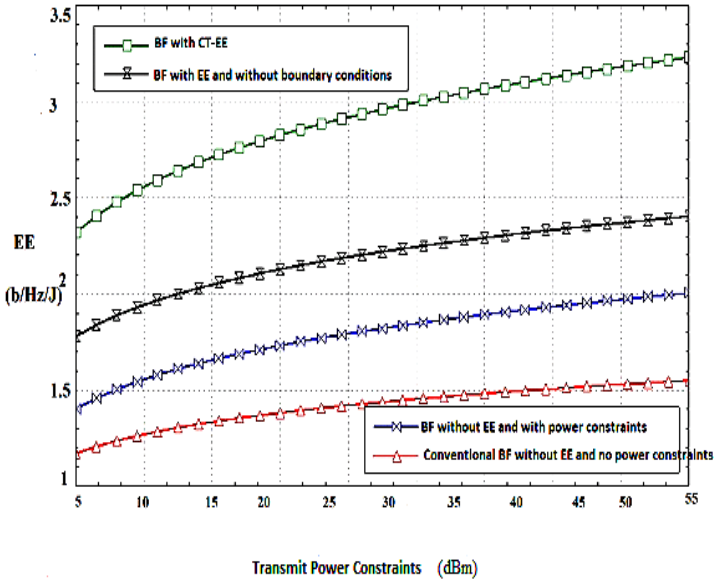

Figure 3: Performance Comparison in terms of Energy Efficiency for 4x4 MIMO

Proposed architecture is also evaluated for 4x4 MIMO in terms of energy efficiency as shown in Figure 3. For same transmit power constraints, energy efficiency decreases as it contributes more interference and terminal outages. But, performance is achieved with respect to the conventional BF without EE, while maintaining appreciable MSE and ASR. For 4x4 MIMO modeled relays, 52% of enhancement of BF with CT-EE is remarkable when compared to other three techniques. Curves of Figure 2 and 3 maintain almost same slope and uniformity. Thus it is proved that proposed architecture is scalable for NxN MIMO antennas in relay and user nodes. For 2x2 MIMO modeled relays, 120% of improvement in energy efficiency improvement in energy efficiency is achieved in the proposed architecture.

Table 1 : Performance comparison of BF architectures in terms of Energy Efficiency in 2x2 MIM

Parameter Analyzed	Conventional BF (2x2 MIMO)	Conventional BF (4x4 MIMO)	BF without EE and with power optimization (2x2 MIMO)	BF without EE and with power optimization Conventional BF (4x4 MIMO)	BF with EE but no boundary conditions (2x2 MIMO)	BF with EE but no boundary conditions Conventional BF (4x4 MIMO)	Proposed BF with CT-EE (2x2 MIMO)	Proposed BF with CT-EE Conventional BF (4x4 MIMO)
Energy efficiency (bits/Hz/Joule) for dBm power constraint	1.5	1.21	2	1.4	2.4	1.58	3.3	1.84
Relative performance improvement in %	Reference Work [33]	Reference Work [33]	33%	15%	60%	31%	120%	52%

IV. CONCLUSION

Conditional Time-Split Energy Extraction allows bypassing the energy extraction phase at uncritical nodes. On the other hand, energy extraction phase is mandatory for critical nodes. Time scheduling of energy extraction phase depends on the residual battery level and estimated transmitter power. Greedy policy adopted in proposed CT-EE architecture manages the optimum power wastage schedules. MMSE based beamforming algorithm is executed over the selected relays and source nodes. Beamforming vectors are updated at an optimum time slot at which

Mean Square error is minimum. At this optimum time slot, Achievable Sum Rate is maximized. The time elapsed for Energy Extraction at critical nodes are compensated during BF phase with aid of iterative algorithm converged at optimum time. Overall, a robust optimization is achieved in terms of time and power with the maximization of energy efficiency. The investigation results are scalable for higher order MIMO networks. To achieve the desired spatial diversity it is necessary to increase the number of antennas but this leads to self interference thereby decreasing the Energy Efficiency. Though this is applicable to our proposed system for higher order MIMO, but is found to be much appreciable than state-of-art architectures. In this proposed work we are able to balance this trade-off.

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A Study on Free Space Optical Communication - Opportunities and Challenges

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ABSTRACT

In today's communication scenario where it has become increasingly important to meet the high data rate requirement, we have to look for alternative ways of communicating rather than depending fully on the prevalent mainstream communication systems. Free space optical (FSO) communication proves to be one of the best candidates to meet these requirements. It resolves the last mile bottleneck connectivity issues especially in local area access networks and acts as an addition to conventional RF/microwave links. This is because of its inherent advantages of license free long range communication, high bandwidth, high data rates, low cost implementation, relatively low power requirement and security compared to existing RF technologies. This paper reviews all the possible opportunities and attached challenges with FSO implementation.

Keywords : FSO, MIMO, Atmospheric Turbulence, Space Time Coding.

I. INTRODUCTION

Free space optical communication (FSO) is a technology in which data is transmitted wirelessly at high rates with the help of optical signals. In contrast to the conventional method of transmitting optical signal through fiber, FSO makes use of free space as the medium to transfer information. It proves to be an excellent candidate for last mile access compared to the traditional last mile delivery systems such as wired LAN, mobile CDN etc. Implementation of a FSO system is quite simple as the working principle resembles that of Infrared TV remote control and wireless keyboard.

Optical wireless communications was first exhibited by an experiment conducted by Alexander Graham Bell in the late nineteenth century. He named it as "photophone", which converted voice sounds into telephone signals and transmitted via wireless medium along a light beam over a distance of around 700 ft. It could not be realized commercially even though his experimentation clearly proved the basic principle of wireless optical communications. Lasers when introduced in 1960s transformed the wireless optical communication scenario. Many military bodies showed their curiosity and enhanced their growth by addressing the principal engineering challenges of FSO. In spite of that the technology failed to meet the requirements when there was a market surge in optical fiber network installation. Early commercial applications of FSO were to provide CCTV video connections and remote LAN-extension services. Over the past two decades, FSO has come up from a niche to deliver mainstream network infrastructure services for free space carrier and telecommunication.

II. WHY FSO?

The last mile bottleneck issue is a major challenge in today's communication era. With the relentless and increasing demand for high bandwidth applications, the last mile access has become a concern. Not only has this been a larger problem, connectivity bottleneck too exists almost everywhere in metro networks. Even though there are several alternatives to address this connectivity bottleneck issue but most of them do not make sense economically. The first and most reliable option is optical fiber communication but the associated cost to lay fiber systems often makes it economically prohibitive. The second option is the radio frequency technology which is a much more mature technology that offers longer ranges but RF based networks require large investments to acquire licensed spectrum. Moreover scaling is a problem with RF networks. The third option is wire and copper based technologies i.e. cable modem, DSL etc. Although copper infrastructure is available almost everywhere and the percentage of buildings connected to copper is much higher than fiber, it is still not an appreciable alternative for solving the connectivity bottleneck as the biggest hurdle is bandwidth scalability. Copper technologies may ease some short-term pain, but the bandwidth limitations of 2 to 3 megabits make them a marginal solution [11].

The most viable alternative is FSO. This technology facilitates an optimal solution, bandwidth scalability, speed of deployment, re-deployment and portability, and cost-effectiveness on an average of one-fifth of the cost required for installing fiber optic system.

III. HOW FSO WORKS?

FSO system consists of optical transceivers with full duplex capability at both ends of a transmission system. It transmits invisible, eye-safe light beams from one transceiver to the other using low power infrared lasers in the terahertz spectrum. The light beams are transmitted by laser light focused on highly sensitive photon detector receivers. These receivers are telescopic lenses that are able to collect the photon stream and reproduce the digital data. Commercially available systems offer capacities in the range of 100 Mbps to 2.5 Gbps, and demonstration systems report data rates as high as 10 Gbps. FSO systems perform communication over distances of several kilometres as long as there is a clear line of sight between the source and the destination with ample transmitter power [11].

IV. ADVANTAGES

Unlike RF and microwave systems, FSO is an optical technology and no spectrum licensing or frequency coordination with other users is required. Interference from or to other systems or equipment is not a concern at all. Electromagnetic interference does not affect FSO link transmission, hence provides immunity to RF interference. The point-to-point laser signal is extremely difficult to intercept, and therefore it is one of the most secured communication. Data rates comparable to optical fibre transmission can be carried by FSO systems with very low error rates. The extremely narrow laser beam widths ensure that there is almost no practical limit to the number of separate FSO links that can be installed in a given location. Since FSO transceivers can transmit and receive through windows, it is possible to mount FSO systems inside buildings, reducing the need to compete for roof space, simplifying wiring and cabling and permitting FSO equipment to operate in a very favourable environment. The most indispensable requirement for optical wireless transmission is line of sight between the two ends of the link. It is undoubtedly a more flexible technology that provides high speed communication. Installation is easy as deployment is quite straight forward and has very low initial investment. FSO facilitates dense spatial reuse. Low power usage per transmitted bit is the advantage

of FSO system as it is based on simple on-off keying technique [8].

V. APPLICATIONS

Inter-satellite communication: FSO can be used in deep space for communication between satellites.

Disaster recovery: It works well during disaster situations where mainframe network fails to provide service.

Fibre communication back-up: FSO is used in providing a backup link in case of failure of transmission through optical fiber link.
Storage area network: SAN is built on FSO links to provide access for consolidated block level data storage.

Last-mile access: Laying cables to the end user premises (last mile) is an expensive affair for service providers as the cost of installation in terms of digging to lay fibers etc. FSO can be used to solve such problem.

Enterprise connectivity: The easy installation feature of FSO makes it applicable for interconnecting LAN segments to connect two buildings or enterprise.

Metro-network extensions: It can be used for extending the fiber rings of an existing metropolitan area as FSO system can be deployed in lesser time and connection of new network and core infrastructure is easily done. It can also be used to complete SONET rings.

Links in difficult terrains: It can be used for unapproachable regions and difficult terrains where much intervention is not possible. One time installation of a FSO system in such cases would prove useful.

Mobile wireless backhaul: It can be helpful in carrying the traffic of cellular telephone from antenna towers back to the PSTN with high speed and high data rates.

High-speed low-interference WiFi /802.11 backbones: FSO is beneficial in LAN by supporting high speed data services for mobile users and small satellite terminals. It acts as a backbone for high speed trunking network.

Medical imaging: It can be used in medical domain for viewing the human body to diagnose, monitor or treat medical conditions.

Military access: as it is a secure and undetectable system it can connect large areas safely with minimal planning and deployment time and is hence suitable for military applications.

VI. CHALLENGES

The advantages of FSO do not come so easily without paying anything for it. When light is transmitted through optical fiber, transmission integrity is quite predictable barring some unforeseen events but when light is transmitted through the air it must survive with the complex and not always quantifiable subject – the atmosphere. Few of the factors that greatly affect signal propagation in FSO systems are discussed below:

Atmospheric Attenuation:

Absoption- Absorption is caused due to the presence of water molecules that are suspended in the terrestrial atmosphere. These particles are responsible for absorbing the optical energy as a result of which there is a decrease in the power density of the optical beam. Transmission in a FSO system is directly affected by absorption. Carbon dioxide also causes absorption of the signal.

Scattering- Scattering takes place when the optical beam hits the scatterer. It is a wavelength dependent phenomenon in which energy of the optical beam is not altered. It results in directional redistribution of optical energy which leads to the reduction in beam intensity while transmission over longer distance.

Atmospheric Turbulence:

It is caused due to atmospheric in-homogeneity or random temperature variation along the beam path. The atmosphere behaves like a prism of different sizes and refractive indices leading to phase and irradiance fluctuation. This result in deep signal fades. The size of turbulence cell leads to different types of effects that would be dominant. If size of turbulence cell is of larger diameter than optical beam then beam wander is experienced. Beam wander is defined as the rapid displacement of the optical beam spot. If size of turbulence cell is of smaller diameter than optical beam then the intensity fluctuation or scintillation of the optical beam takes place. Turbulence leads to fading of optical signal power, at times results in complete loss of the signal [10].

Atmospheric Weather Conditions:

Weather conditions are one of the main causes of attenuation in FSO transmission. Some of the weather conditions are discussed below:

Fog: It is one of the major weather conditions that affect FSO propagation. Fog greatly attenuates the visible radiation and has a similar affect on the near-infrared wavelengths employed in FSO systems. The effect of fog on optical wireless radiation is entirely analogous to the attenuation and fades suffered by RF wireless systems due to rainfall. Similar to the case of rain attenuation with RF wireless, fog attenuation is not a show-stopper for FSO because the optical link can be engineered such that, for a large fraction of the time, an acceptable power will be received even in the presence of heavy fog. Optical wireless based communication systems can be enhanced to yield even greater availabilities [9].

Rain: Rain drop sizes are larger than fog and wavelength of light. Extremely heavy rain conditions where one can't see through it results in link failure. Even water sheeting on windows also affects signal propagation. Rain attenuation is because of rainfall which is a non-selective scattering phenomenon. This form of scattering is independent of wavelength. Rain gives rise to fluctuation effects in laser transmission. Visibility of FSO signal relies on the amount of rain. During heavy rain conditions, water droplets are solid compositions that either change the characteristics of optical beam or limits the beam transit as it may undergo absorption, scattering and reflection.

Haze: Haze particles stays for long time in air thereby leading to atmospheric attenuation. As a result, the attenuation value is dependent on the visibility level at a given time.

Smoke: It is produced by the combustion of various substances like carbon, glycerol, and household emission and affects the visibility of transmission medium.

Sandstorms: Sandstorm is a common issue in outdoor communication. This is likely only in desert areas and rare in urban core. Wind particles size that depends on the soil texture and the wind speed needed to blow up the particles during a minimum time period are the major reasons of sandstorms occurrence.

Clouds: Cloud layers are a part of earth's atmosphere. Clouds are formed by the condensation or deposition of water above earth's surface. It can entirely obstruct the portion of optical beam transmitted from earth to space. The attenuation resulting due to clouds is hard to compute because of the diverse and in-homogeneous nature of the cloud particles. Presence

of low clouds is same as fog and may accompany rain and snow.

Snow: Snow has larger particles that cause geometric scattering. The snow particles affect in a similar manner as that of Rayleigh scattering. Heavy snow may result in ice build-up on windows and lead to whiteout conditions also.

Pointing Stability – Building Sway, Tower Movement: Only wide beam width fixed pointed FSO systems are able to handle majority of the movement observed in deployments on buildings. Narrow beam systems are unpredictable and seek manual intervention for re-alignment regularly, caused due to building movement. 'Wide beam' corresponds to more than 5milliradians. Narrow systems (1-2mRad) are not dependable without a tracking system.

Effective beam divergence and a suitably matched receive Field-of-View combined together results for an immensely robust fixed pointed FSO system applicable for multiple deployments. Fixed-pointed FSO systems are mostly favoured compared to actively-tracked FSO systems because of less cost.

Scintillation:
Performance of many FSO optical wireless systems is adversely affected by scintillation on bright sunny days; the effects of which are typically reflected in BER statistics. Few FSO products come up with a unique combination of large aperture receiver, widely spaced transmitters, finely tuned receive filtering, and automatic gain control characteristics. Additionally, specific optical wireless systems also incorporate a clock recovery PLL time constant which help in eliminating the atmospheric effects such as scintillation and jitter interference.

Solar Interference:
Solar interference in FSO systems can be tackled in two ways. Optical narrowband filter preceding the receiver detector responsible for filtering all components except the wavelength actually used for intersystem communication. To control off-axis solar energy, sophisticated spatial filters needs to be implemented in Cable Free systems, enabling them to operate without getting affected by solar interference that is greater than 1 degree off-axis.

Physical Obstructions:
FSO products with distantly spaced redundant transmitters and wide receiver optics will be able to eliminate interference from objects such as birds. In a day, an object covering 98% of the receive aperture and all but 1 transmitter; will not cause a FSO link to fail. Hence birds are not likely to affect FSO transmission.

VII. SOLUTIONS TO COMBAT CHALLENGES

Implementation of an adaptive laser power Automatic Transmit Power Control (ATPC) scheme to dynamically control the laser power in response to varied weather conditions will increase FSO reliability. In clear weather conditions the transmit power is significantly reduced, thereby increasing the laser lifetime when laser is operated at very low-stress conditions. In severe weather conditions, the laser power is increased required to maintain the optical link continuity and decreased again as the weather clears. A TEC controller that maintains the laser transmitter diodes temperature in the optimum region maximizes lifetime and reliability with consistent output power making FSO system operates efficiently at higher power levels.

Spatial Diversity (MIMO): Diversity at transmitter and diversity combining at receiver end can successfully combat the degradation caused by atmospheric turbulence in free space optical links. Alamouti space time coding is considered at the transmitter while the receiver employs switch-and-examine combining (SEC) [1]. Numerical results for

on-off keying (OOK) modulation are provided and are compared with Monte Carlo simulations. BER expression for FSO link experiencing gamma-gamma fading is derived when Alamouti coding is applied on the transmitter side and switch-and-examine combining is employed on the receiver side.

Suitable STC: A space time code construction with a symbol rate of two for free FSO-MIMO communication systems is proposed [2]. Unlike the radio-frequency space time coding design that deals with complex symbols containing phase and magnitude information, the phase detection in wireless optical communications is very challenging. This restricts optical MIMO codes to carry positive magnitude information belonging to a finite range. To meet these requirements, the authors proposed to design the FSO-MIMO codes considering first the whole real space R, followed by a bipolar to unipolar conversion to fit in the intensity margin. MIMO configurations with two or four transmitters (lasers) are considered. The base is of shape-preserving construction on quadratic extension fields that linearly combine the real symbols to form a full diversity space time code with a symbol rate equal to two. Authors have shown how to optimize the choice of the algebraic field numbers for different configurations to jointly optimize the non-vanishing code determinant and the bipolar to unipolar attenuation factor.

Robust Modulation Techniques: In this paper, authors have designed Q-ary (Q arbitrary) intensity modulation schemes for free-space optical OSTBC communications with arbitrary code dimensions by introducing a modulation mapping function f(·) in the transmitter and a linear post receiving function g(·) in the receiver[3]. Necessary and sufficient condition for the intensity-modulated OSTBC to maintain orthogonality is derived. Finally, the f (·) and g (·) functions that satisfy the necessary and sufficient condition for Q-ary intensity modulation schemes such as PPM, PWM and ASK are formulated. BER performance is verified by simulation in an asynchronous FSO MISO channel setting.

VIII. CONCLUSION

This study depicts the importance of FSO systems and attached challenges.FSO systems transmit data wirelessly using visible to near infrared (NIR) light propagating through the atmosphere as carrier in contrast to optical fiber communication where a dedicated channel exists between transmitter and receiver. It is evident that this form of communication is used in situations where it is impractical to establish physical connections. Signal propagation in FSO is quite challenging and is greatly affected by various atmospheric conditions such as dust, rain, and fog and atmosphere turbulence. These atmospheric attenuation factors are the reason for degradation of FSO link performance. Nevertheless researchers have shown that FSO outperforms conventional RF communication at very high frequencies.

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Efficient Energy Management using IoT for Industrial Applications

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ABSTRACT

The rising cost and demand for energy forced us to find smart ways to save electricity and energy. To meet the demand for energy and at the same time reduce costs, energy consumption should be monitored and controlled. In 2020s Internet is there at every corner, and also the high computational power. These two factors can be used to build the Internet of Things (IoT), With the help of IoT, world can be made better place. The IoT device will be placed at any corner of world and can control any sort of appliances and data can be collected with IoT devices by using sensor and can be used for feature prediction.

Keywords : IoT, Wind Energy, SEMS, Hydroelectric Energy

I. INTRODUCTION

Energy is the fuel for everything happening in the universe. Humans and animals need energy for doing chores which is fulfilled by the consumption of food and liquids. Humans have built appliances which need energy or in other words, fuel, to run. Humans have also developed the kind of fuels required to run those appliances.

For example, petroleum fuels like petrol and diesel are used to run vehicles. Fossil fuels and coal are used to generate electricity which is used for various purposes. When the threat of losing these forms of electricity generation was looming a lot, renewables sources of energy were identified to fulfil the energy (electricity) requirements of various sectors. Renewable sources of energy provide means by which the source which helps in generating electricity never dries out.

In other words, it is recurring in nature. Few examples of renewable sources of energy include:

❖ **Wind Energy:**

This is the kind of energy or electricity which is generated by harnessing the winds blown in the atmosphere by the help of a device named Windmill. The windmills are installed at places where the wind is blowing at faster speeds. When the wind blows, the blades of the windmill rotate, which results in rotation of the turbine, and concludes in the generation of electricity.

❖ **Water Energy (Hydroelectric Energy):**

Here, energy (electricity) is generated by harnessing the power or speed of the flow of water. At the bottom of the stream, a reservoir (dam) is built. So, when the stream flows with huge force from higher areas to the lower areas where the dam is situated, it enters the dam and with the force of its flow, it

rotates the turbine present in the dam which is then used to generate electricity.

❖ **Solar Energy:**

Here, a panel made of silicon and a few other substances is used to absorb the rays of sunlight and then convert them into electrons, i.e. generating electricity. We have used a solar panel in our project as well which will be discussed later.

II. MOTIVATION AND BACKGROUND

There can be two major reasons for these many ways of generation of electricity to be used in the world. Those two reasons are:

- Depletion of naturally occurring resources like fossil fuels, coal and petroleum.
- Increase in the demand for electricity in the post industrialization and globalization era.

This paper mainly deals with an underlying issue with the increase in demand for electricity. With the advancements in science and technology at an unforeseen pace, demand also increased substantially as electricity was required for every hour of the day.

Whilst the companies generating electricity were trying hard to meet this growing demand, there was also a lot of energy being wasted. We all have heard phrases like “Switch off the TV”, “Turn off the fans and lights while coming out of your room kiddo”, etc. Likewise, even if we are aware of such things, still almost a third of electricity generated turns out be wasted in the offices and other commercial complexes, and in few cases, our homes as well.

In other words, the appliances keep on running and consuming electricity but there is no end user who is either using or controlling that particular appliance in concern in real time. This, in turn, led to increased electricity bills and consumption as well with no desired output or result achieved.

Home Energy Management System (HEMS) are the most effective energy management systems which receive information of electricity pricing from the utility and go for automation functions at home. The system may be costly but it increases efficiencies [1]. The techniques for controlling the devices based on the motion, the temperature, the time and the voice are also implemented to monitor and save energy [2]. The energy-efficient communication faces many challenges such as providing a continuous energy supply to objects in loop and supporting energy-efficient communication protocols that enable peers to communicate in a reliable manner [3]. The IoT-based energy management framework for a smart city is surveyed and studied [4]. The proposed work is set to open new avenues for smart energy management on IoT and Big Data platform. The system design uses data analytics and scalable storage for building a Smart Energy Management System (SEMS) to aid different stakeholders with their respective privileges. The system empowers users to remotely monitor and control devices, and online bill generation via a friendly user interface mobile application [5]. In this article, an overview of energy management in smart cities given, and then a unifying framework for IoT in smart cities is presented. Energy management has been classified into two levels: energy-efficient solutions and energy harvesting operations [6]. the scientific structure of IoT-based energy management is demonstrated, including sensor actuator layers, organizational layers, and application layers. The energy issues related to exclusively considering the supply and demand side of IoT energy management, demand side, and energy balance is also considered [7]. In this the hardware prototype of SEMS is designed and developed in the laboratory environment, and experiments are carried out to demonstrate the effectiveness and working of the power optimization algorithms deployed in the controller [8].

To counter such excessive and unwanted wastage of electricity in today's digitized world, a need for is inevitable. A system which can monitor the consumption of electricity as well as the usage of the particular appliance and provide the data to the user on their smartphone so that they can be controlled and used in an optimal manner in order to make it cost effective as well as a well-informed consumption of electricity. It will help the consumers be well informed about the usage as well as know where the energy is being wasted and how they can reduce it.

III. PROPOSED METHODOLOGY

This paper proposes a system which aligns solar panel perpendicular to sun rays at a given time and place, the system can be visualized for energy production and control electric appliances with web interface. The proposed system has single axis solar tracking system. This system aligns solar panels, lenses other equipment's using solar energy or record solar signals. The suns position will be changing every day and time, in order to get the maximum energy, the solar tracking system has been used. It increases the energy production per day, fig. 1 shows the block diagram of energy management system using IoT

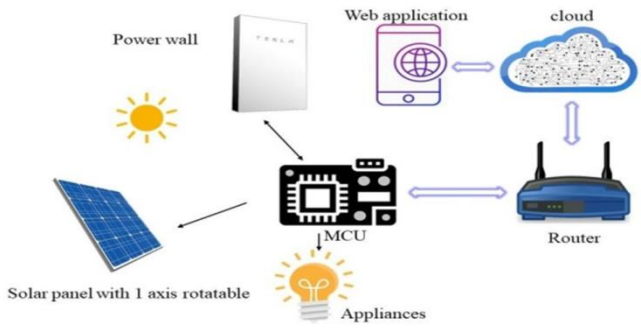

Fig. 1. Block diagram for energy management system

- Solar tracking system we the sun position will be calculated in the cloud.
- With the web application we can control the electric appliances and we can visualize the plots of incoming energy and outgoing energy.
- The router will be used to connect the MCU to cloud.
- MCU will used to control the servo motor to align in position with data computed in cloud and MCU will monitor the incoming energy and outgoing energy. From the solar panel we get the electrical energy and we will charge the battery (Power wall).

Cloud (server):

Solar tracking- We chose a webhosting server where we will create the files that written in PHP which is server scripting language. The sun position is calculated with the nonlinear equations.

The declination angle(δ) for the sun is defined using the following equation:

$$\delta=23.45\sin((N+284)/365) *360° \quad (1)$$

In the above equation N defined as day no. of the year with Jan 1as 1.

The apparent solar time, AST (or local solar time) in western longitudes is calculated from

$$AST = LST + (4min/deg) (LSTM - Long) + ET \quad (2)$$

In above equation LST denotes as Local Standard Time,

Long denotes as Local longitude at the position of interest and LSTM denotes as Local longitude of standard time meridian.

$$LSTM= 15° * (long/15°)\text{round to integer} \quad (3)$$

The hour angle (H) is the azimuthal angle of the sun's rays caused by the earth's rotation, and H can be computed from

$$H =(P-720mins)/(4min/deg) \quad (4)$$

In the above equation the P denotes No. of minutes past midnight, AST.

The solar altitude angle (β1) is the apparent angular height of the sun in the sky if you are facing it. The

zenith angle (θz) and its complement the altitude angle (β1) are given by

$$\cos(\theta z) = \sin(\beta 1) = \cos(L)\cos(\delta)\cos(H)+\sin(L)\sin(\delta) \quad (5)$$

In the above equation L denotes as latitude and
δ denotes as declination angle. H defined as hour angle

The solar azimuth, (α1) is the angle away from south (north in the Southern Hemisphere) and given by

$$\cos(\alpha 1) = \sin(\beta 1)\sin(L)-\sin(\delta)/(\cos(\beta 1)\cos(L)) \quad (6)$$

With this angle we can locate the sun in spherical coordinates, fig.2 shows sun angles, with this servo angle can be calculated. The servo angle will be read by the MCU for aligning Solar panel.

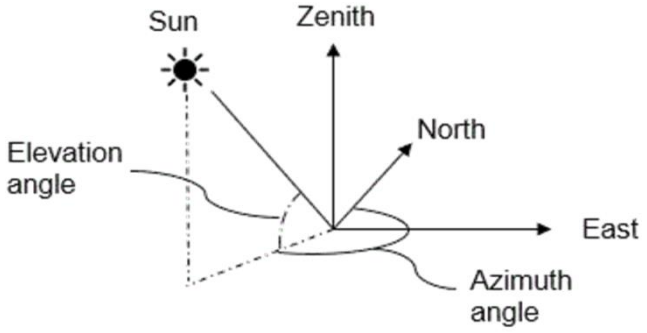

Fig. 2. Sun angles

Web Interface:

The web interface helps to control the electric appliances and also to visualize the data of the Electrical parameters like voltage, current, power and energy.

The web interface program is written for front end are HTML, CSS and Java Script and for back end is PHP.

MCU:

Microcontroller unit which is a bridge between the cloud(server) and motor which will control the solar panel. MCU will request the data from the server, the server serves the data which is requested by the client (MCU). The data requested is the servo angle of the particular location and particulate time where we will maximum energy form the sun. The MCU will receive the data requested and sends the appropriate signal to the servo motor. Then the MCU will measures the voltage, current and power and send to the server. With the values sent the server stores in the database for the user visualization. Overall, the energy production from solar panel was increased and using IoT we can manage energy by controlling appliances.

IV. RESULT AND DISCUSSION

The prototype designed by us will monitor the input, output and the power consumed. It will give us the data analyzed in the cloud so that the energy can be managed in the most efficient manner. The data analyzed in the cloud and by the graph obtained due the power consumption of various appliances at any given place will show us the amount of energy wasted. By this data one can understand the Wastage of energy and use every appliance in the most efficient manner. With each data that is analyzed, a learning model can be created which tells us how much energy is consumed by each appliance and we can limit that much of energy to that particular appliance which saves energy. Fig 3 shows the power consumed by the load.

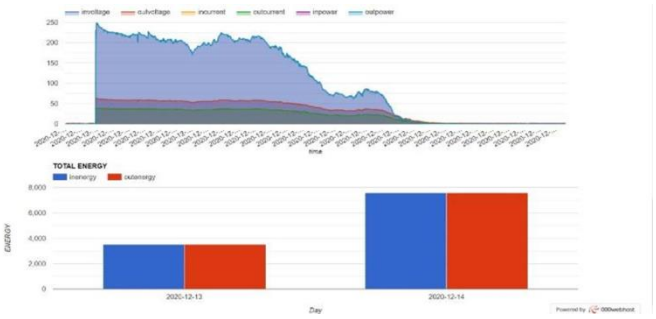

Fig. 3. The power consumed electric load

Fig. 4 shows the web application which is displaying the voltage that the appliance gets or consumes whilst

working or in ON mode as well as the current it draws in order to function properly. Then, power consumed by the appliance cab be calculated by the voltage and current. The data is stored in the manner that the most recent record figures are showed at the end and they just keep getting stacked to the database of the web application.

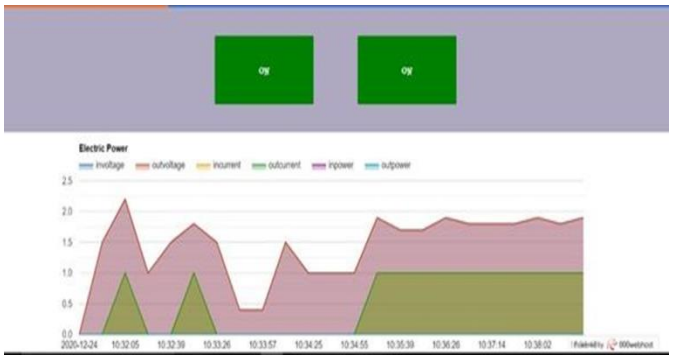

Fig. 4. Web application indicating the current of power consumption

Here, the web application that showing the user the current status of the appliances being monitored by this prototype – two LEDs in this prototype. Also, the power consumed by the appliances is shown in an easy-to-read graph for the user at regular intervals of time which can be altered by the user according to his or her convenience. Hence, the letting the user control the device with ease of his/her fingertips. Fig 5 shows the total energy consumed by the electric appliances.

Fig. 5. Total energy consumed by the appliances

Here, the web application is showing the energy consumed by both the appliances so that the user can understand the current usage pattern in more detail and use the same to analyze and control the consumption of energy as well as make sure that it is cost effective.

This prototype has a bi-directional data flow between the NodeMCU and the web application. The microcontroller is connected to the appliances as well as to the web application. It will analyze the usage pattern of the appliances and send it to the web application. Here, the suer will be able to see the data and control the appliances by passing instructions to the NodeMCU. The data analyzed in the cloud (web application) and by the graph obtained due to the power consumption of various appliances at any given place and time will show the user the amount of energy wasted. By this data one can understand the wastage of energy and use every appliance in the most efficient manner.

With each data that is analyzed, a learning model can also be created which tells us how much energy is consumed by each appliance can we also limit that much of energy to that particular appliance which saves energy.

Few advantages of Efficient energy Management System are listed below:

- Reduce amount spent on energy
- Minimize carbon emission, hence, eco-friendly
- Abides by the Government restrictions on harm to the environment
- Integrates greener sources of energy
- Optimizes asset maintenance
- Involves automation as well
- Cuts operational expenses
- Gives proper understanding of energy use
- Identifies the malfunctions in time and prevents them
- Effectively combats power outages, accidents as well as blackouts
- Facilitates prediction of consumption and helps in planning the spending

V. CONCLUSION

In this study, an IoT based Energy management system has been designed by in order to reduce energy consumption and unit energy cost. Thanks to the IoT-based energy management system, the user is immediately provided with information such as current values, electrical power, power, usability, humidity, temperature and light intensity. With this system, energy costs can be reduced by using devices such as a washing machine and a dishwasher that will be used at any time of the day, within hours when energy costs are low. In addition, power consumption reports can be tailored to each device such as daily, weekly, monthly and yearly. In this way, it will be easier to take the required amount of energy savings by doing research on energy consumption, where devices operate in a wide range of design applications, it turns off the appropriate device, thus ensuring security. The Energy management system directs users to use flexible devices to use at any time throughout the day, in Period I. The management system extends using data via the user interface and helps the users for taking energy saving measures.

- We here have developed a better IoT system for Energy Management which takes the Humidity, Temperature and light intensity into consideration and accordingly interfaced with Arduino microcontrollers for controlling the usage of appliance like speed of fan, positioning of solar panels, light intensity rather than just switches on or off.
- In this context, the proposed IoT based system facilitates energy end-users to know how much energy is consumed in total and what is the contribution of the specific end-user and other peers to that, as well as get personalized recommendations of actions for energy conservation and load shifting, along with an estimation of their impact on energy use and user comfort.
- The system uses data sensors embedded in the structure and measures real-time data in terms of application of equipment, residential data, behavior data, se points, system settings etc.
- Thus, it is concluded that IoT plays a major role in energy management and contribute much for green initiatives. Our future work is to explore various energy efficient techniques to reduce energy consumption in the campus environment thereby making it green by utilizing IoT.

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Google Assistant Controlled Scrolling Display

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ABSTRACT

In this rapidly growing and developing world, the foremost aim of technology is to increase the efficiency and to decrease the effort. In this trending world, Internet of Things is given so much of importance. Hence by using IoT, we are successful in controlling various devices or appliances in this present world. And one such device is a matrix display, which is controlled using a NodeMCU. Various other modes such as raspberry pi or beagle board can used to do the same. The idea behind Google assistant-controlled scrolling display is to a matrix display with voice. In this project, the Google assistant requires voice commands. Adafruit account which is a cloud based free IoT web server is used to create virtual switches, that links to IFTTT website abbreviated as "If This Than That" which is used to create if else conditional statements. The voice commands for Google assistant have been added through IFTTT website. In this project, as the user gives commands to the Google assistant, the display, can be controlled or updated accordingly. The commands given through the Google assistant are decoded and then sent to the NodeMCU, the microcontroller in turn control the display unit connected to it. The disply unit updates as per the users request to the Google Assistant. The microcontroller used is NodeMCU (ESP8266) and the communication between the microcontroller and the application is established via Wi-Fi (Internet).

Keywords - IFTTT, Adafruit IO, Google Assistant, Node MCU.

I. INTRODUCTION

Day by day there is a rapid evolution in human communication with the machines. This human-machine interaction process which basically started with the buttons has now evolved into touch-pads and further now humans can give commands to intelligent and sophisticated machines by just talking to them. One of the main objective or goals of Artificial intelligence (AI) is the realization of natural dialogue between humans and machines. In recent years, the voice systems, also known as interactive conversational systems are the fastest growing area in AI. These are known as Voice Assistant or Virtual Personal Assistant (VPA) system that can be used in different areas of applications which include education assistance, medical assistance, robotics and vehicles, disabilities systems, home automation, and security access control. Nowadays, Google Assistant is becoming more popular personal assistant and people frequently use it's features in the applications on their,

smart devices such as smartphones, smart digital television receivers, smart watches etc.

In the present technology, majority of the work is done through communication, so the effective way of communication can be done through voice. The idea behind using Google Assistant is to control the scrolling display through voice. These voice commands are added through IFTTT website which is linked to a cloud based free IoT web server Adafruit MQTT. So hereby in this project we make use of two web services IFTTT and Adafruit MQTT for updating the output of the matrix display using another IOT platform Google Assistant , and the former being interfaced using a NodeMCU which is internet operated Wi-Fi module.

II. LITERATURE REVIEW

A. Design and Implementation of IoT based Smart Controlling Application.

The above mention paper reviews about the design and implementation of Iot based Smart Controlling Application for LED Scrolling Text Display with Integration of Google Assistant describes the complete circulatory of our project. Doesn't give much information about future scope.

B. Google Assistant controlled Home Automation

Provides details on how to use NodeMCU and connect to IFTTT servers for doing certain tasks. Creation of IFTTT applets is not described in detail.

C. International Conference on Advanced Computing & Communication Systems

How to use Google Assistant and Clap Switch Circuit in house amenities. Doesn't give much information Integration of Google Assistant in Android Application for Voice Cntrol.

III. PROPOSED WORK

The Existing systems in the consumer market, IoT technology is closely related to products related to the concept of "smart home", including devices and electrical appliances such as lighting, thermostats, home security, and various household products that sustain many common ecosystems, and can be controlled by similar devices. Ecosystem, such as Smartphones and smart speakers. Home automation creates an independent home system also called smart home. Features of IoT may include sensors that can monitor medical emergencies such as falls or fainting. IoT is also used in health care systems which include GPS tracking belts, fitness bands etc.

A. Problem Statements

Google assistant is an artificial intelligence based voice command service used to control a device with ease. In our project we make use of Adafruit MQTT (IoT platform) and IFTTT web services for updating the matrix display through Google Assistant.

B. Objective of the Paper:

- To assign voice command over the mobile headset to control a device (matrix display)..
- Converts voice command to text and reverts back in both voice and text.
- A local hotspot has to be used to establish the connectivity. Hardware prototype has validated the work.

IV. SYSTEM DESIGN

The main purpose of this project is to control the display unit through voice. This project uses two services i.e. Adafruit MQTT and IFTTT, to make it control through Google Assistant from anywhere in the world. Adafruit MQTT broker allows us to change the message globally over any internet connected device. NodeMCU is a WIFI module that connects to the internet using the WIFI Network provided. Here

NodeMCU is acting as a MQTT client and hence it constantly listens to the MQTT broker. So if any changes that is observed on the server side is thereby reflected on the client side i.e. on the NodeMCU Inorder to change the message on the MQTT broker side via Google Assistant we are using IFTTT. In IFTTT, we make use of an applet through which we can connect the Google Assistant and Adafruit MQTT. So by making proper applet , we can successful update the message on the broker with the Google Assistant on our phone and thereby control the output of the display unit.

A. NodeMCU ESP8266:

NodeMCU is an open source IoT platform which is based on Lua firmware, that runs on ESP8266 WIFI SoC module from Espressif System and based on ESP-12 module hardware. It was developed to replace AT commands with Lau scripting to make it easier for the developers. The NodeMCU is a Low cost WIFI chip with full TCP/IP stack and complete microcontroller features to help the developers to use it in IoT applications.

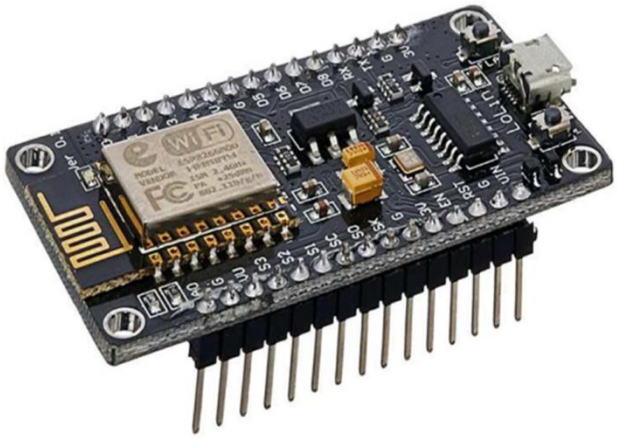

Fig 1. NodeMCU ESP8266

B. ADAFRUIT MQTT

MQTT (Message Queue Telemetry Transport) is a device protocol supported by Adafruit IO that is used for communication. Using MQTT broker and client we can publish and subscribe to send and receive data. In our project adafruit acts as MQTT broker and NodeMCU acts as MQTT client.

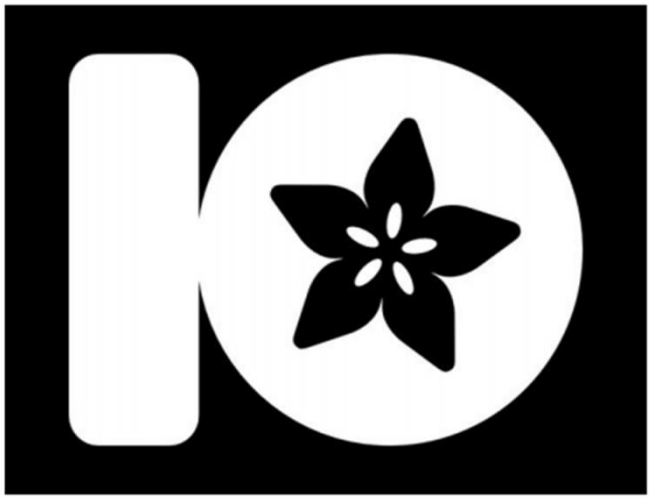

Fig 2. Adafruit IO

C. IFTTT (If This Than That):

It is a free we-based service, where we can create chain of simple conditional statements, called Applets. An appletis triggered by changes which occur within other web-services such as Facebook, Gmail, Pinterest, etc. We have used IFTTT to create an applet which can connect two services i.e. Google Assistant and Adafruit MQTT.

Fig 3. IFTTT (If This Than That)

D. AURDINO IDE

The Arduino IDE (Integrated Development Environment) is a Board development application that is written in function of C or C++. It is used to write, compile and upload programs to Arduino board and other third party microcontrollers which support the Arduino software. Version 1.8.13 is used.

V. PROJECT DESCRIPTION

In this project we are using the concept of IoT (Internet of Things) for implementing Google Assistant controlled scrolling display. We also make use of IoT based cloud platform Adafruit MQTT and a web server application IFTTT. In this project whenever the status of the MQTT broker is triggered by Google Assistant through IFTTT the status of its client (NodeMCU) is updated which is reflected on the matrix display. We have built this project mainly on two hardware components i.e. NodeMCU (ESP2866 WiFi module) and LED Matrix Display.

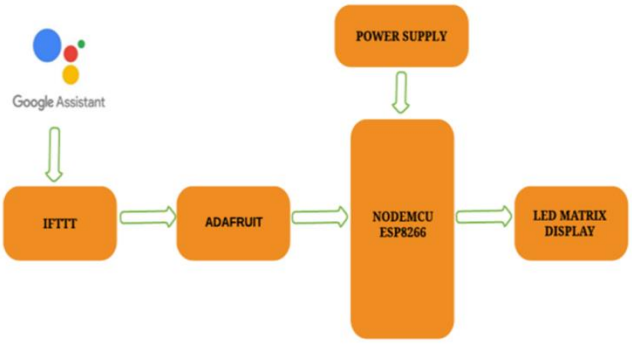

Fig 4.1 Block diagram

The above block diagram explains the working of the project in a brief manner. The block diagram has mainly 4 important blocks- Google Assistant, IFTTT server, Adafruit MQTT, NodeMCU (ESP2866).

A. The steps followed in the project are as follows:

- Connect to given Wi-Fi network and in turn establish a connection with the IFTTT server/app.
- Check the status of MQTT broker triggered by Google Assistant.
- Check the updated status of the client i.e. NodeMCU.
- Finally the response is seen on the matrix display and also on Google Assistant in both voice and text.

B. The schematic circuit diagram of the project:

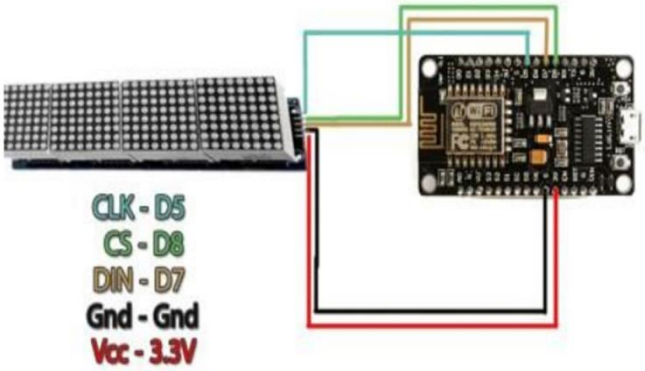

Fig 4.2 Schematic circuit diagram

The components used in the circuit are:

- NodeMCU
- Matrix display
- Power Supply

VI. IMPLEMENTATION OF PROPOSED SYSTEM

A. Algorithm used in the project:

Step 1 : Switch ON the NodeMCU.
Step 2 : To get response, connect to Wi-Fi and also IFTTT server.
Step 3 : Check the status of MQTT broker when it is triggered by Google Assistant.
Step 4 : Status of the client (NodeMCU) is updated.
Step 5 : Display unit is updated and the user gets response in both text and voice.

B. Flowchart of the project:

Description of the below Flowchart

- When the device is powered ON using a power supply, NodeMCU gets connected to the given Wi-Fi network.
- Adafruit MQTT and IFTTT are the two services used to control the display unit through Google Assistant. Here NodeMCU is acting as a MQTT client and hence constantly listens to Adafruit MQTT broker.

- Inorder to change the status of MQTT broker via Google Assistant we are using IFTTT server.

- So if any changes occurs on the broker side will be reflected on the client side.

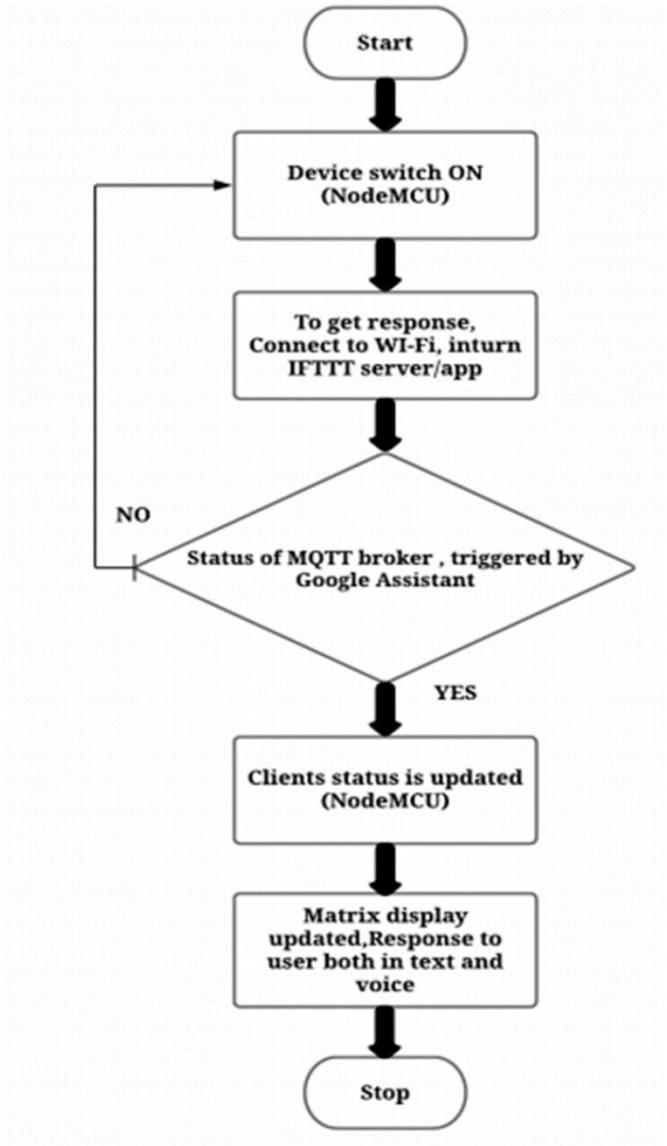

Fig 5. Flowchart of the project

VII. RESULT AND CONCLUSION

The project was successfully completed before the due date. The main purpose of this project is to control the display unit i.e. matrix display using Google Assistant. Whenever the status of the broker gets updated the status of the client and display unit gets updated.

A. Hardware setup of the project:

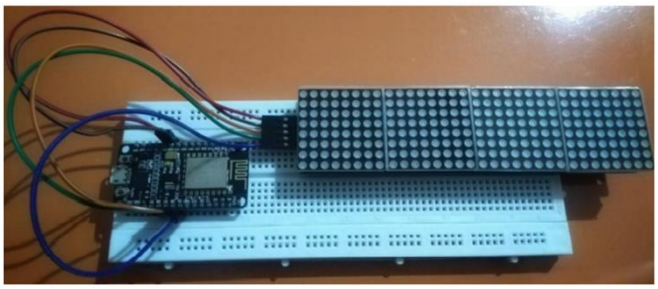

Fig 6.1 Hardware Setup

B. Output Screenshots:

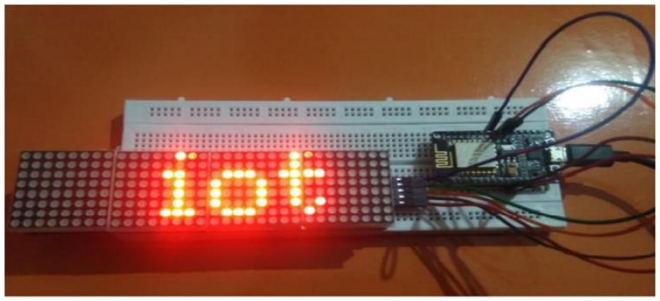

Fig 6.2 Updated display

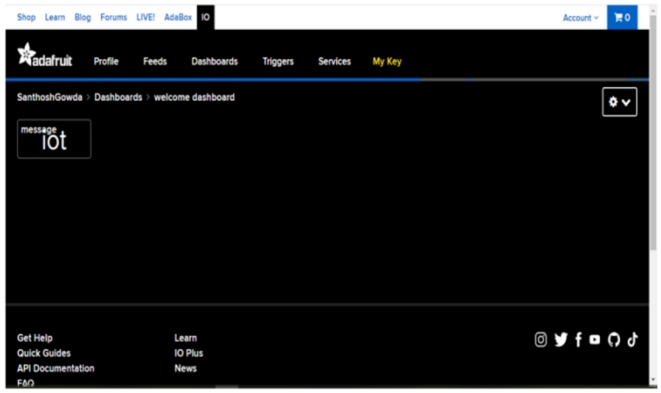

Fig 6.3 Status of MQTT broker

Fig.6.4 Response on smartphone

C. Applications of the project:

- Lighting control system
- Appliance control with a smart grid
- Indoor positioning systems
- Home automation for elderly and disabled people.

VIII. CONCLUSION

An application has been implemented using technologies like Artificial Intelligence based Voice Personal Assistant (VPA) i.e. Google Assistant, by transferring data over an IoT based cloud platform and hardware system using Wi-Fi protocol for establishing communication. In short it was an IoT based application that utilizes another AI powered platform for controlling it. So Google Assistant controlled LED scrolling message display was successfully implemented in this project. Since it is an AI powered system it is completely user friendly and could accept commands from different users. This system provided user the liberty to use either a voice based command or a text command. The developed system was highly responsive and performance wise much more efficient than the conventional systems available. Updating a message on the display has become very quick now by adopting this technique. Atlast we can confirm it to be a worthy system.

Future Scope:

This project can be further improvised to new levels as adoption rate of AI is increasi ng at a high pace in this developing world. To add on, IoT has already made a huge impact in the present market. The combination of these two would lead to the development and implementation of much more sophisticated systems. These systems would restrict human interventions as most of the tasks would be effectively and efficiently performed by these smart systems only. Google Assistant based controlling of different parameters and devices could be quite useful for disabled patients or elderly people. One can integrate or combine multiple sensors and home appliances with the help of IoT platforms and their controlling could be made easy using these AI powered VPAs like Google Assistant over the phone.

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Bit Error Rate Analysis of Passband Digital Transmission Techniques over AWGN Channel

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ABSTRACT
Modulation plays a significant role in the field of electrical communication where different techniques are employed to achieve better performance and focusing in meeting the standards of various parameters such as BER, SNR, MSE etc. In this paper we have analyzed BER for passband digital communication techniques on AWGN channel and results are verified using MATLAB.

Keywords - Binary Phase Shift Keying (BPSK), Quaternary Phase Shift Keying (QPSK), Quadrature Amplitude Modulation (QAM), Bit Error Rate (BER), Signal to Noise Ratio (SNR), Additive White Gaussian Noise (AWGN), Mean Square Error (MSE)

I. INTRODUCTION

The history of communication focuses the way it influenced the development of civilization and its impact on modern societies. Communication stands in simple words as 'sending and receiving messages', or 'the transmission of messages from one person to another'. Effective communication happens only when the receiver understands the exact message sent by the transmitter.

The communication systems may be basically categorized into three groups based on the nature of the input signal as well as the behaviour of the system. The system may be unidirectional or bidirectional, whether it uses as analog or digital signal, which type of transmission technique the system is going to opt. The above discussed classification is also shown in figure 1.

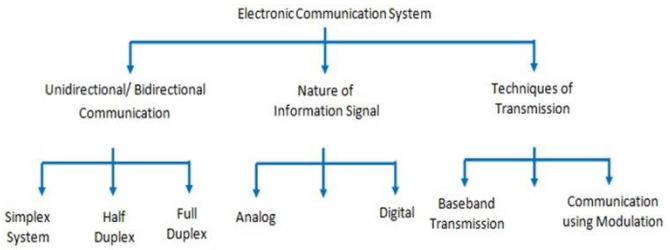

Figure 1 : Classification of Electronic Communication System

The current research majorly focusing on last classification based on the technique of transmission. We can categorize the transmission techniques in further two types namely baseband transmission and passband transmission (Communication system using modulation).

In baseband transmission systems, the baseband signals are directly transmitted. Example of these type of systems are telephone networks where the sound signal converted into the electrical signal is placed

directly on the telephone lines for transmission. Thus, the baseband transmission is the transmission of the original information signal as it is.

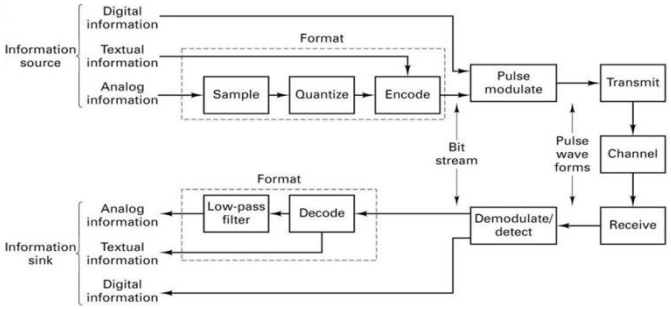

Figure 2 : Functional model of baseband data transmission system

In passband transmission systems, digital modulation methods are employed so that only a limited frequency range is used in some bandpass filtered channel. Passband transmission is typically utilized in wireless communication and in bandpass filtered channels such as POTS lines. It also allows for frequency-division multiplexing.

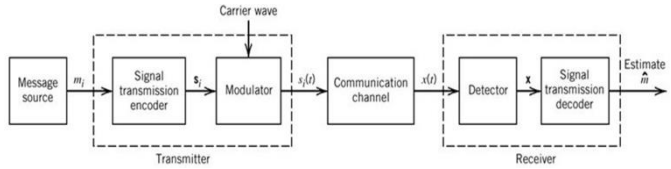

Figure 3 : Functional model of passband data transmission system

A. Literature Survey

Reference [1] presents performance evaluation of the different Modulation Schemes (BPSK, QPSK, GMSK) in of BER in cellular mobile environment with GSM standard parameters. The main objective of this paper is to investigate the factors that go into selection of the particular modulation scheme in the wireless environment.

Reference [2] describes the performance of OFDM-BPSK,-QPSK and -QAM system by using forward error correcting codes (convolution, reed Solomon as well as concatenated coding) schemes in wireless communications AWGN channel. Various simulations performed to find out the best BER performance among each code and used these best outcomes to model the RS-CC concatenated codes.

Reference [3] discusses the basic criteria for best modulation scheme depends on BER, SNR, Available Bandwidth, Power efficiency, better Quality of Service, cost effectiveness. The performance of each modulation scheme is measured by estimating its probability of error produced by noise and interference induced in the channel. The research has been performed by evaluation of BER and SNR for OFDM system models using MATLAB SIMULINK Tool.

Reference [4] analyses the BER, for different modulation techniques known to be BPSK, QPSK. After performing various simulations it is observed that by choosing a reliable modulation scheme and better coding technique can enhance the performance of transmitter and receiver system. Simulated result is analyzed and compared the performance of these systems through Lab VIEW software.

B. Organization of the paper

The paper has been organized into six sections. Section I gives the brief introduction about the digital communication and some of the previous works related to this paper. Section II gives an idea about each scheme in digital communication. Section III focuses on details about the types of communication channel and its characteristics. Section IV is a more complex one deal with parameters to analyse various digital modulation techniques. Section V elaborates about the input signal specification. Section VI shown the simulated results in the form of graph and table. In section VII, based on the above observations, what can be inferred is described and conclusions drawn based on them.

II. DIGITAL TRANSMISSION SCHEMES

A. Introduction

Data transmission is a way of transmitting digital or analog data over a communication medium to one or more devices in different environments: point-to-point, point-to-multipoint or multipoint-to-multipoint. Data transmission can either be analog or digital but is mostly earmarked for sending and receiving digital data. Thus, data transmission is also referred to as digital transmission or digital communications.

B. Classification

The digital transmission is classified in into two major categories namely Baseband Transmission and Passband Transmission (communication using modulation). The layman classification of digital signals transmission is clearly depicted in below figure 4

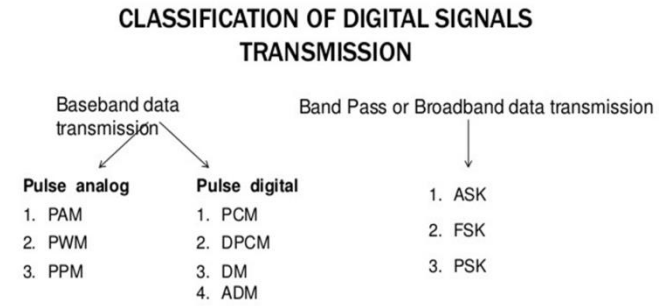

Figure 4 : Digital Modulation Classification Model

C. Passband digital modulation techniques

The main objective of digital passband modulation is to transfer a digital bit stream through the process of varying one or more properties of a periodic waveform known as carrier signal, over an analog communication channel. There are 3 basic modulation techniques and based on parameters like amplitude, phase or frequency variations in the transmitted signals, the modulation is referred to as Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), and Phase Shift Keying (PSK).

D. Binary Phase Shift Keying (BPSK)

Binary Phase Shift Keying (BPSK) is a two phase modulation scheme in which the 0's and 1's in a binary message are represented by two different phase states in the carrier signal: θ=0° for binary 1 and θ=180° for binary 0 or vice-versa.

The transmitted BPSK signal can also be represented mathematically shown in equation 1

$$s_n(t) = \sqrt{\frac{2E_b}{T_b}} \cos(2\pi ft + \pi(1-n)), \quad n = 0, 1$$

Equation 1 : Transmitted Signal Expression for BPSK

The bit error rate of BPSK under additive white gaussian noise can be calculated from expression present in equation 2

$$P_b = Q\left(\sqrt{\frac{2E_b}{N_0}}\right) \text{ or } P_e = \frac{1}{2}\operatorname{erfc}\left(\sqrt{\frac{E_b}{N_0}}\right)$$

Equation 2 : BER Expression for BPSK

The output waveform representation of BPSK modulation corresponding to the input binary sequence is depicted in figure 5.

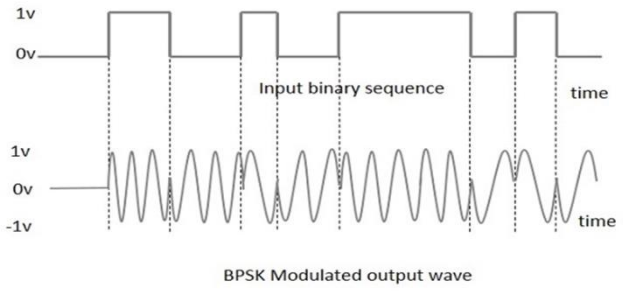

Figure 5 : Waveform Diagram of BPSK Modulation

E. Quaternary Phase Shift Keying (QPSK)

A four-level (4-ary) PSK is called Quaternary Phase Shift Keying (QPSK), and constellation points also chosen as four. As per the theoretical analysis, it is found that QPSK system and BPSK system having the

same BER. The QPSK system can also be utilized to double the data rate compared with a BPSK system for some special applications.

The implementation of QPSK is more general than that of BPSK and also indicates the implementation of higher-order PSK

$$s_n(t) = \sqrt{\frac{2E_s}{T_s}} \cos\left(2\pi f_c t + (2n-1)\frac{\pi}{4}\right), \quad n = 1, 2, 3, 4$$

Equation 3 : Transmitted Signal Expression for QPSK

The qpsk using two independently modulated quadrature carriers known as in-phase component and quadrature-phase component. The BPSK is used on both carriers as they can be independently demodulated and therefore resulting BER for QPSK is similar to BPSK.

$$P_b = Q\left(\sqrt{\frac{2E_b}{N_0}}\right) \text{ or } P_e = \frac{1}{2}\,\text{erfc}\left(\sqrt{\frac{E_b}{N_0}}\right)$$

Equation 4 : BER Expression for QPSK

The QPSK can transmit 2 bits/symbol and shifts the phase of the signal to one of four states as clearly mentioned in figure 3.

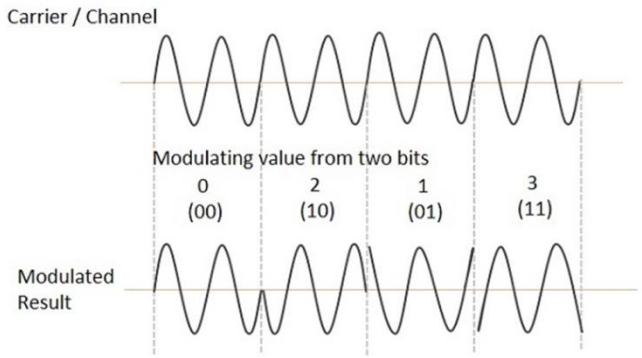

Figure 6 : Waveform Diagram of QPSK Modulation

F. Quadrature Amplitude Modulation (QAM)

QAM (Quadrature Amplitude Modulation) utilises both amplitude and phase components of a carrier signal in order to achieve high levels of spectrum usage efficiency. This technique includes pulse amplitude modulation (PAM) in high speed data communication systems.

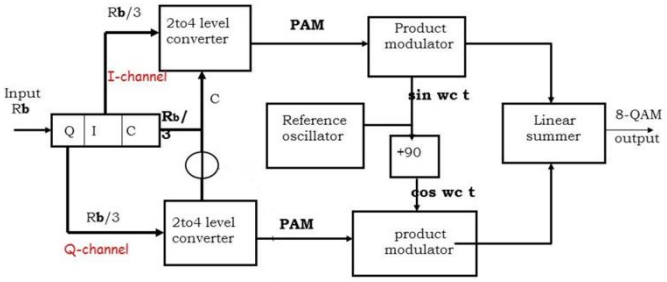

Figure 7 : Block Diagram of 8-QAM Modulator

M-QAM constellations involve two orthonormal basis functions and are two-dimensional. The transmitted QAM signal waveform can also be represented as

$$s_i(t) = \sqrt{E_i}\sqrt{\frac{2}{T_s}}\cos(2\pi f_c t - \theta_i)$$

$$\text{where: } E_i = \sqrt{A_{I,i}^2 + A_{Q,i}^2} \text{ and } \theta_i = tan^{-1}\frac{A_{Q,i}}{A_{I,i}}$$

Equation 5 : Transmitted Signal Expression for M-QAM

M-QAM constellations involve two orthonormal basis functions and are two-dimensional. An important configuration of signal points is rectangular QAM, in each direction the signal points are spaced equally in amplitude and placed on a rectangular grid as clearly understood from the signal constellations diagram depicted in figure 8 for different values of M.

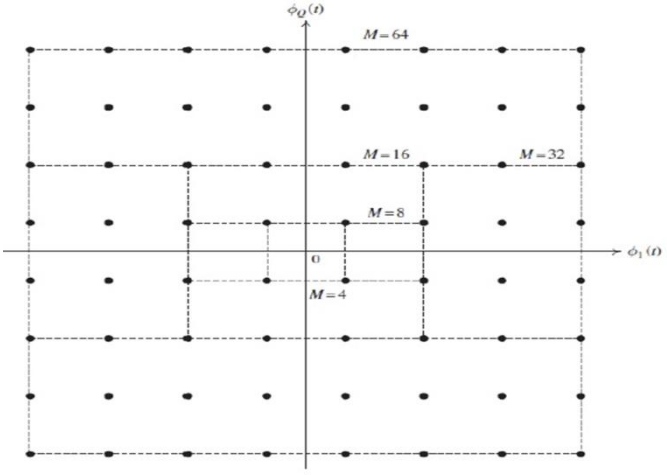

Figure 8 : Constellation Diagram of M-QAM Modulation

III. COMMUNICATION CHANNEL

Communication channels are basically of three types based on the classifications in terms of their characteristics as Additive White Gaussian Noise Channel (AWGN), Bandlimited Channel and Fading channel. These characteristics play a vital role in the design and selection of the schemes. A detailed explanation about the AWGN channel is given below based on the analysis.

A. Additive White Gaussian Noise Channel (AWGN)

This is one of the important channel model for analyzing modulation schemes. The AWGN channel is mathematically represented by an output series *Yi* at different time index *i*. *Yi* is the summation of the input *Xi* and noise, *Zi*, where *Zi* is identically distributed and drawn independent from a zero-mean normal distribution with variance *N*.

$$Z_i \sim \mathcal{N}(0, N)$$
$$Y_i = X_i + Z_i$$

Equation 6 : Mathematical representation for AWGN Channel

In this model, the channel adds a white Gaussian noise to the signal passing through it which shows that the channel's amplitude frequency response is flat and phase frequency response is linear for all frequencies. This results if any modulated signals pass through it is without any amplitude loss and phase distortion of frequency components.

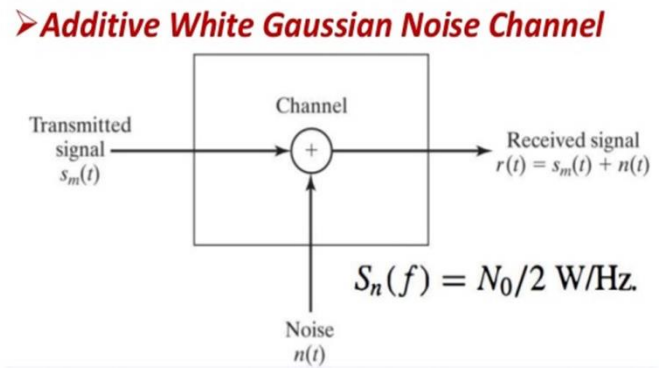

Figure 9 : AWGN Channel Model

IV. PERFORMANCE MEASURES

A. Bit Error Rate – BER

It is the number of bits corrupted or destroyed during the transmission of data from the source to destination. When transmitting data from one point to another, either over a radio/ wireless link or a wired telecommunications link, the key parameter is how many errors will appear in the data that appears at the remote end. Therefore, a system with low BER is required for efficient communication.

$$\text{BER} = \frac{\text{Number of bits in error (at receiver)}}{\text{Total number of bits (transmitted)}}$$

Equation 7 : BER Formula

B. Signal To Noise Ratio - SNR

Signal-to-noise ratio compares a level of signal power to a level of noise power expressed in decibels. If the ratio is higher than 1:1, it shows that more signal than noise. So as long as the incoming signal is strong and well above the noise floor, then the audio will be able to maintain a higher quality. Hence it's kind of good signal-to-noise ratio people prefer for a clear and accurate sound.

$$\text{SNR} = \frac{P_{\text{signal}}}{P_{\text{noise}}}$$

Equation 8 : SNR Formula

C. Mean Square Error – MSE

The mean squared deviation of an estimator measures the average squared difference between the estimated values and what is estimated. The MSE can be written as the sum of the variance of the estimator and the squared bias of the estimator, providing a useful way to calculate the MSE and implying that in the case of unbiased estimators, the MSE and variance are equivalent.

$$MSE = \frac{1}{N}\sum_{i=0}^{N}(\hat{y}_i - y_i)^2$$

Equation 9 : MSE Formula

V. IMPLEMENTATION DETAILS

An audio signal of file size 673 KB in the .wav format is fed as a common input to various modulation schemes and the same is analyzed by simulation through MATLAB. The resulted spectrum waveform of input audio is shown in Figure 10.

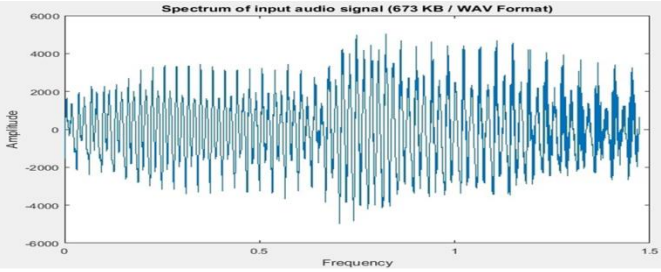

Figure 10 : Spectrum of input audio signal

Before processing to modulation, the real-time audio signal is converted to digital form and sampled at a rate of 44,100 Hz through MATLAB functions. In order to compare the digital modulation schemes performance, this digitize sequence is carrying through AWGN channel at different levels of SNR.

VI. EXPERIMENTAL EVALUATION

An audio signal whose spectrum as shown in figure 10 is fed as an input to obtain the results as mentioned below.

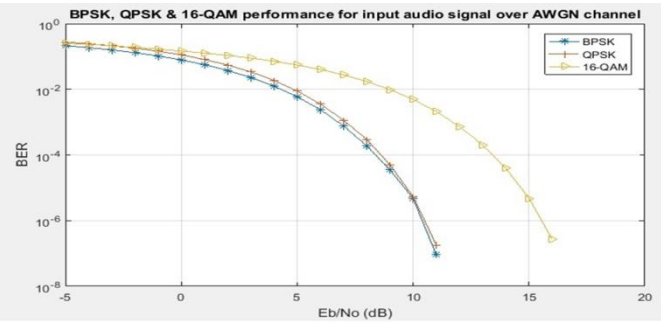

Figure 11 : BER curve for BPSK, QPSK & 16-QAM

From the obtained BER curve it is clear that the relation between SNR and BER quantities are inversely proportional. It is observed as SNR value increases the BER decreases.

In the table tabulated below, the observation made for different SNR levels on various techniques is mentioned.

MODULATION TECHNIQUES	BIT ERROR RATE
BPSK	0.0562
QPSK	0.1795
16-QAM	0.2557

Table 1 : BER value at SNR = 1dB

It is inferred that from the table 1 and table 2, at the lower SNR level say 1 dB the larger is amount of noise and at the medium SNR level say 5dB the amount of signal power is increased respectively.

MODULATION TECHNIQUES	BIT ERROR RATE
BPSK	0.0060
QPSK	0.0551
16-QAM	0.1678

Table 2 : BER value at SNR = 5dB

Considering the table 3 which says the SNR at 10dB there is a vast increase in the signal power and huge decrease in the BER values.

MODULATION TECHNIQUES	BIT ERROR RATE
BPSK	0.0000
QPSK	0.0012
16-QAM	0.0720

Table 3 : BER value at SNR = 10dB

From the above experimentation results we infer that when SNR is of high value the data rate techniques like 16-QAM shows better performance when compared to the lower data rate techniques.

VII. CONCLUSION

The respective conventional passband modulation schemes have been simulated in MATLAB software in terms of BER values as well as BER curve corresponding to different levels of SNR. The conclusion made from the above observation and discussions are as follows:

- Experimentally it is found that the minute difference of 1 dB (approx) will occur among the BER curves of BPSK and QPSK as clearly shown in figure 11. Ideally the BER result of BPSK and QPSK are equal over AWGN channel.
- At low level SNR it is efficient to use low order modulation schemes such as BPSK or QPSK and at high level SNR it is better to use high order modulation schemes like 16-QAM as respective modulation schemes offer less amount of BER in respective levels of SNR.
- In feature the research can also be proceed further while implementing these single carrier modulation schemes namely BPSK, QPSK & 16-QAM with multicarrier modulation schemes such as OFDM, FBMC, SEFDM etc in order to enhance the productivity of present communication system.

VIII. ACKNOWLEDGMENT

Our sincere thanks to all the associates & technical staff at Truba Institute of Engineering & Information Technology, Bhopal for rendering their valuable time & support in bringing this paper and also provided technical support for analyzing the results outcome. We would appreciate for more guidance and continuous support for all our future endeavours.

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Stress -The Major Obstacle in Experiencing Euphoria

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ABSTRACT
The term "stress", as it is currently used was coined by Hans Selye in 1936, who defined it as "the non-specific response of the body to any demand for change". Speaking of origin, we must noticeably talk about its evolution through the centuries. If we have lived in early 14th century, we would most probably use the term stress but it had very little to do with our psychological state. As most people know, the 18th and 19th centuries are associated with a period of intense scientific and industrial progress. The physical sciences, most notably engineering, began to use terms like stress, strain, resilience, pressure, and elasticity to describe the effects of materials anyways the stress related with ourselves, the one which consumes us and eats up our mental stability is been experienced by half of our people which is really disturbing. So in this paper we will be knowing more about this phenomenon and learn about things which help us to cope up with this condition.
Keywords : Stress, Emotion Regulation, Cognitive Behavioral Therapy

I. INTRODUCTION

Stress is defined as any type of change that causes physical, mental, or emotional or the overall psychological strain. It is our body's response to anything that requires attention or action as this condition demands it.

How is it really caused?

Stress is a normal part of life that can either help us learn and grow or can cause us significant problems. So, there are so many factors that cause stress and may also increase the degree of harm and adversity. Stress is mainly caused because of being under lots and lots of pressure. Speaking about stress in modern era, it is also caused by the inferiority we feel and the lack of confidence. The following factors are stress causing agents

- Facing big and massive changes all of a sudden.
- Worrying too much about the future.
- Overthinking.
- Boredom and eventually feeling irresponsible.
- Uncertainty or waiting for an important outcome.
- Job issues and problems in workplace.
- Money bereavement
- Family problems
- Marriage and divorce.

Is there types? Indeed!

There are so many other different causes for stress. Teenage stress is one important condition where every teenager goes through it. Teenage stress is caused mainly by feeling incompetent, comparison

with fellow mates, bullying, indiscrimination, gender differences, racism, love and romantic life, the overwhelming feeling of heightened responsibilities etc [1-5].

a. Acute Stress

It is a minor form of stress, for example if we are facing an entrance exam to a particular university, we mandatorily fear about the outcome or the end result, and eventually after the results are out, we will be at ease and the stress automatically vanishes.

b. Chronic Stress

Chronic stress is not for a short period of time, it is definitely prolonged for a long period of time. It is applicable in a life of an individual from below poverty line of this society.

c. Stress and its Biology

- Stressful experiences are associated with various physiological changes in the body:
- Flight and fight response (acute stress), It refers to physiological reaction of the body.
- it prepares the body either to flight(runaway) or fight(stand)when confronted by a threat.

d. General Adaptive Syndrome

- PHASE (1)-ALARM REACTION
  When threat is recognized the physiological arousal occurs (seeing a snake)
- PHASE (2)-STAGE OF RESISTANCE
  If stress continues body tries to adapt and changes in the body to reduce the stressor.
- PHASE (3)-STAGE OF EXHAUSTION
  If stress is not resolved in second phase the body collapses quickly, particularly the immune function (cardio diseases, ulcer)

e. Some of the Effective Coping Strategies

So basically, coping refers to the ways in which we came overcome stress. Coping strategies include thoughts and behavior which we use to manage the demand of stressful situation.

PROBLEM FOCUSED COPING

It involves tackling or dealing with the problem that is causing stress and finding a resolve.

EMOTIONAL FOCUSED COPING

It is managing the stress causing feeling (agent) and self-controlling.

ENGAGEMENT COPING

It is actively dealing with the stressor or emotions related with that stress. It includes emotions such as support seeking, emotion regulation, acceptance and cognitive restructuring.

DISENGAGEMENT COPING

It is the response such as avoidance, denial and wishful thinking. It involves an attempt to escape the feeling of distress.

ADAPTIVE COPING

It is an effective means of coping that allows an individual to adequately address stressor.

MALADAPTIVE COPING

It is a temporary and has only limited value and provide temporary relief

a) Avoidance/giving up:
   It is running away or distancing ourselves from stressful events.

b) Learned helplessness:
   It occurs when an individual repeatedly experience negative or uncontrollable situation and become passive and unmotivated and stay the way even after the incident (but on the brighter side, control is possible).

II. DEFENSE MECHANISMS WHEN PEOPLE FACE STRESS

REPRESSION

It is unconscious and removing/blocking/forgetting impulses or memory.

SUPPRESSION

It is more conscious, It removes unpleasant thoughts / memories out of their awareness.

DENIAL

It is refusing to admit or accept a particular aspect of reality.

REGRESSION

When confronted with stress and anxiety sometimes people display immature behavior that have relieved anxiety in past.

RATIONALISATION

An Individual gives logical / rational/socially acceptable reason for their unacceptable behavior.

INTELLECTUALISATION

Individual reduce anxiety by reacting to an event or situation in a detached cold way.

SUBLIMATION

It is a healthy defense mechanism when an individual coverts unacceptable impulse by converting them into more acceptable form.

DISPLACEMENT

Taking out aggression on other people that are less threatening.

REACTION FORMATION

Deal with opposite emotions with own feeling / emotion (hiding true feeling)

COMPENSATION

Developing talent in one area to compensate the failure in other area.

III. OVERCOMING STRESS

Stress has always been a hindrance to the happy routine of our life and our mental state. Recent researches and psychologists have been proposing new techniques and methods to handle stress. One of the major techniques is CBT, lets know more about this particular yet important method[5-9].

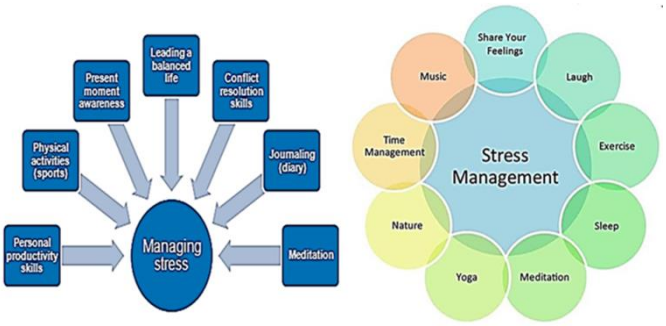

Fig.1. Stress Management

IV. EUPHORIA

Euphoria denotes to an emotional state categorized by feelings of deep pleasure, happiness, cheerfulness, and excitement. A state of euphoria can be naturally induced, chemically induced or the outcome of a neurological condition. There are numerous types of euphoria, each induced by diverse mechanisms and involve several neurological pathways. Euphoria can be induced by persistent aerobic exercise, like running, cycling, and further aerobic activities is recommended as an additional treatment for addiction, neurodegenerative disorders and major depressive disorder. Studies have shown that the euphoric properties of exercise can aid in the recovery of drug addictions, function as an antidepressant, as well as improve overall cognition and brain health[10-15].

V. CBT-AN IMPORTANT PERSPECTIVE

First of all, CBT stands for cognitive behavioral therapy As the abbreviation speaks for itself it is basically a psychotherapeutic treatment helping so many individuals to identify and modify destructive or disturbing thought patterns that have a negative influence on behavior and emotions. Cognitive behavioral therapy focusses on changing the negative thoughts which can worsen emotional difficulties, depression, stress, and anxiety. These continuous

negative thoughts have a dangerous influence on mood. CBT can provide you with a new perspective on your situation, enabling you to regain control, reduce the physiological and emotional symptoms and learn effective strategies that will help us to deal with stressful situation with some confidence and ease[1-15].

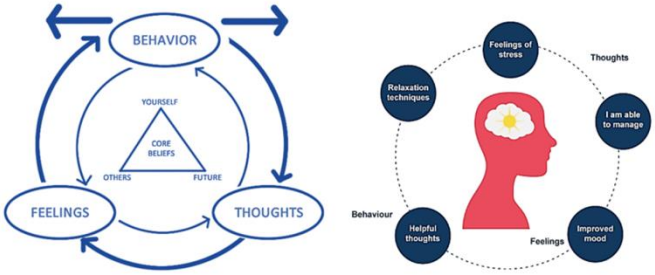

Fig.2. Cognitive Behavioural Therapy

CBT also helps in treating the following conditions:

- Addictions
- Anger issues
- Anxiety
- Bipolar disorder
- Depression
- Eating disorders
- Panic attacks
- Personality disorders
- Phobias
- Problems with stress

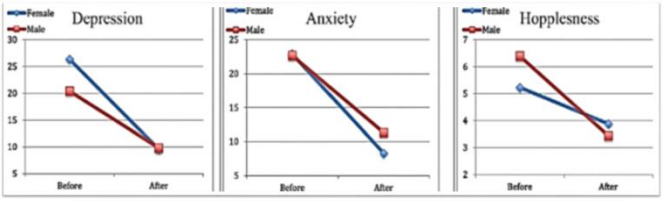

Fig.3. Scale of depression, anxiety and hopelessness

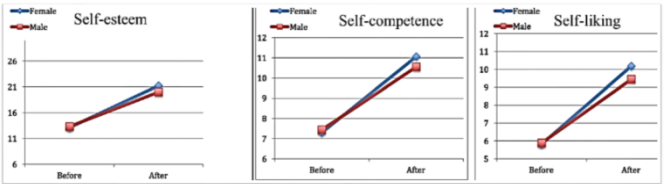

Fig.4. Scale of self-esteem scale and its dimensions, self-competence and self-liking

Fig.5. scale of hope as well as its subscales agency and pathway

VI. PRACTISING CBT AT HOME

❖ CHANGE YOUR PERSPECTIVE:

Cognitive restructuring can help in modifying problematic thoughts, which in helps us change our behavior. For example, making a list helps a lot. The overall fact is that the thoughts are interlinked, so by changing a perspective from negative to a positive one might really help.

❖ BALANCING THE THOUGHTS:

If we are facing a crowd which we are really nervous about, we should try to be overcome the fear by embracing the things you really love about the crowd, like in the crowd of unknown people there might still be your friends or the people who could potentially enjoy your talent. make your thoughts more balanced, your emotions and behaviors are likely to follow.

❖ BE PATIENT WITH YOURSELF

Change is inevitable but that doesn't mean it can happen in a fraction of second, so being consistent and being true to oneself in the overall process might lead to the best outcome ever even if it is late. Remember, the longest walks make you the strongest one.

❖ BE KIND TO YOURSELF

When things get harder and darker we tend to be rude on ourselves, but that is abruptly wrong, At the end of the day, we only have ourselves to pat our and say, "it's going to get better".so it is vital to take care

of our own self and embrace the beautiful mess which we are .so it's important to stay kind.

Other simple ways in which we can overcome stress

1) Talking and sharing the problems with your significant one
2) Meditation
3) Better sleep patters
4) Eat right
5) Exercise for a bit
6) Laugh it off.

VII. PRACTISING MINDFULNESS

Mindfulness involves breathing methods, other practices to relax the body and mind and help reduce stress[7-20].

HOW TO PRACTICE MINDFULNESS:

1) Take a seat or find a place and sit where you can literally feel the calmness caressing your mind.
2) Set a time for like 5 to 10 minutes and stay there.
3) Sit in a position which is comfortable for you and observe yourself.
4) Feel your breath.
5) Notice where your mind has wandered
6) And finally, be kind to your wandered mind instead of judging or obsessing yourselves [20-25].

VIII. CONCLUSION

Stress is a feeling of emotion or physical tension. It can come from any event, thought or situation. Stress is a common reaction, however when it becomes constant it can turn into a problem. We experience stress when are overwhelmed by any responsibility. Issues that causes stress cannot always be resolved but, changing our perspective can help us reduce the stress. A balanced lifestyle and coping strategies can help you in managing stress. How an individual reacts to a difficult situation will determine the effect of stress on overall health. Half of the individuals experience hardships and stress but, both the quantity and quality of the stressor varies from one person to other .Stress is a key for survival, but too much stress can be destructive .Stress is a natural phenomenon which everyone has to go through at least once in their lifetime, the thing is how we perceive it and apply righteous mechanisms to overcome this condition and not let our life go south. Finally, stress is common and what matters the most is that we have ourselves and each other's back at the end of the day.

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A Study of Energy of Graphs Using Multiple Regression Technique

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ABSTRACT

Energy of a graph is an important aspect of a graph and its applications are growing in a fast pace over the years. Results regarding energy of a graph and its components are one of the happening areas in research. This paper is about one such result using the established and stabilized line of statistical regression. It considers a dataset of five compact graphs K2, K3, K4, K5, and their line graphs, collecting a few components of them and regressing their energy using the components.

Keywords : Energy of graph, Line graph, Multiple regression

I. INTRODUCTION

The energy of a graph is the sum of modulus values of the eigen values of its Adjacency matrix. Study of the energy of a graph is an important one in application domains.

It is one of the most referred articles in energy of graphs as it gives you a nice and good discussion about the topic.

A complete graph is a graph in which every possible combination of vertices has an edge connecting them.

The line graph L(G) of a graph G is a graph such that there is a one to one correspondence between edges in G and vertices in L(G) and two vertices in L(G) are adjacent if and only if their respective edges share a vertex in G.

It also discusses about energy of graphs. It studies energies of Laplacian graphs and line graphs. It has many results regarding the energy of graphs. It has discussions about hyper energetic and equi-energetic graphs. This is a master of science thesis of a IIT, Bhubaneshwar student which has nice discussions about energy of different types of transformed complete graphs.

There are many lines of discussions in literature regarding the energy of a graph but not much yet using a statistical regression one. This paper is addressing that line of discussion. For simplicity sake, we consider complete graphs K2, K3, K4, K5 and their line graphs, obtain data from them like number of vertices, number of edges and their degrees, the order of its Adjacency matrix, positive inertia, negative and its energy, Fig1.

Table 1 -Components of a graph

	vertices	Edges	Degree of edges	nu+	nu-	o(A(G))	Energy
K2	2	1	1	1	1	2	2
L(K2)	1	0	0	0	0	1	0
K3	3	3	2	3	0	3	4
L(K3)	3	3	2	3	0	3	4
K4	4	6	3	1	3	4	6
L(K4)	6	12	4	1	2	6	8
K5	5	10	4	1	4	5	8
L(K5)	10	30	6	5	5	10	20.1065

Fig 1

Then , use multiple regression technique to first find out which of the selected variables are significant ones to explain the energy of a graph and once it is found out, use multiple regression techniques once again to obtain a relation between the energy of a graph and the significant variables which can explain that better than others.

II. METHODOLOGY

Prepare a dataset consisting of details of a graph like, number of vertices, number of edges and their degrees, the order of its Adjacency matrix, positive inertia, negative and its energy

Run a multiple regression with energy as dependent variable and all other variables as independent ones and identify the significant variables.

Run a regression or multiple regressions for energy with one or more significant variables from step2 to obtain a relation for energy.

III. RESULT AND ANALYSIS:

The regression run with energy as dependent variable and all others as independent ones yields the result,

Table 2 - Multiple Regression 1 for Energy of graphs

Regression Statistics	
Multiple R	0.999899
R Square	0.999798
Adjusted R Square	0.499293
Standard Error	0.163547
Observations	8

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	6	264.8319	44.13865	1980.223	0.0171999
Residual	2	0.053495	0.026748		
Total	8	264.8854			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.811868995	0.591209202	-1.37323	0.303364	-3.355636888	1.73189889	-3.35563688	1.73189889
vertices	0	0	65535	#NUM!	0	0	0	0
Edges	0.254430834	0.096124826	2.64688	0.117999	-0.159160912	0.66802258	-0.15916091	0.66802258
Degree of edges	-0.195749098	0.399651084	-0.4898	0.672732	-1.915308924	1.523810728	-1.91530892	1.523810728
nu+	0.724797924	0.069360038	10.44979	0.009034	0.426365768	1.023230081	0.42636576	1.023230081
nu-	0.660915254	0.126527607	5.223487	0.034751	0.116510899	1.205319609	0.11651089	1.205319609
o(A(G))	0.752477359	0.512098086	1.469401	0.279492	-1.450902866	2.955857585	-1.45090286	2.955857585

Fig 2

From the Fig2 it is clear that only Positive inertia and negative inertia are found as significant independent variables (bolded P values in the table) for understanding the energy of a graph.

The other notable thing from the Fig-2 is that the number of vertices and the number of edges turn out to be insignificant variables for predicting the energy of a graph which was not in the expected lines.

Then, using the two significant independent variables, again run a multiple regression for the energy to obtain,

Table 3 - Multiple Regression 2 for Energy of graphs

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.969961182
R Square	0.940824695
Adjusted R Square	0.917154574
Standard Error	1.770574803
Observations	8

ANOVA					
	Df	SS	MS	F	Significance F
Regression	2	249.2107488	124.6054	39.74735	0.000851827
Residual	5	15.67467566	3.134935		
Total	7	264.8854245			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-1.095315217	1.076365636	-1.01761	0.35555	-3.86220117	1.671570735	-3.86220117	1.671570735
nu+	1.911209239	0.427966328	4.465793	0.006605	0.811086772	3.011331707	0.811086772	3.011331707
nu-	2.146725543	0.358656614	5.985462	0.001866	1.224769367	3.06868172	1.224769367	3.06868172

Fig 3

From Fig-3, we obtain the regression equation for the energy of a graph in terms of the most significant predictors, the positive inertia and the negative inertia as,

Energy of graph =-1.09532+1.9112*Positive inertia+2.1467*Negative inertia

IV. DISCUSSION:

The study has resulted in a concrete mathematical equation connecting the energy of a graph and its inertial values. But, the immediate reaction possibly could be ,

- Is it applicable for a random graph as the graphs employed are complete graphs and their line graphs.
- Can it be used to obtain a much easier way of obtaining energy of a graph using other variables.

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Distributed Generation Impact on Voltage Profile Improvement in Agriculture Feeder - A Case Study

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ABSTRACT

In this paper, analysis regarding agriculture feeder network with integration of DG fo voltage profile improvement and loss reduction , DG with solar energy resources on integration with optimal locations on distribution feeders, which reduces loss reduction and improve in voltage profile. deciding the appropriate location for DG integration in agriculture feeder simulations are performed in power world simulators and verfired with MIpower which quantify the loss reduction and system improvement by having distributed generation. Finally The analysis reveals the improvement in voltage profile, significant energy loss reduction in distribution network and an increase in network capacity.

Keywords - Distributed Generation ,Agriculture Feeder Network, Voltage Profile

I. INTRODUCTION

Power system are becoming complex in structure the demand for electrical energy is increasing, the demand and supply gap is currently in peak and average load load electricity consumed in India is generated by thermal power plants, 21.73%–by hydroelectric power plants, 2.78% by nuclear power plants and 10.73% by Renewable Energy Sources. More than 50% of India's commercial energy demand is met through the country's vast coal reserves. The DG integrations has also invested heavily in recent years in renewable energy technology the agriculture feeder network with poor integration and voltage support , The rural networks with less access to reliable power supply, the rural areas suffers from frequent power cuts , voltage regulation problems, high energy losses with large number interruptions etc. . The necessity for reliability of power supply with loss reduction and less environmental throughout a power system, to provide the electric power needed by electrical customer. Such locally distributed generation, has several merits from the viewpoint of environmental restriction and location limitations, as well as transient and voltage stability in the power system. The integrating techniques of the DG allocation can be obtained by a complete enumeration of all feasible combinations of sites and sizes of DGs in the network. The number of alternatives could be very large, however load flow should be performed for each feasible combination and selection of the optimized solution among these alternatives is an important task. The problem is to determine optimal placement of DG that minimizes

the distribution power losses under the condition that number of DGs and total capacity of DGs are known.

II. PROBLEM FORMATION

The case study is based on a agriculture feeder network of , with peak load of 0.9 MW has a total line length of 20 km which supplying power to agricultural & irrigational pump- set motors, The details of the connected load to the agriculture feeder DG integration with power quality improvement in the rural areas where grid connected is difficult. The study reveals about DG integration in rural network for rural electrification during peak loading for voltage profile improvement agriculture feeder system have limited or no reserve capacity with peak loading conditions . This case study, provides solution for real time improvement of distribution feeder and improve in voltage magnitude and reactive power compensation and integration of DGs with RES with solar resources avai;ab;ity for voltage magnitude improvement . This analysis improves in the distribution feeder with DG integration in agriculture feeder power network and techniques to exact the DG locations for determining real power and reactive power with voltage profile improvement for with and without DG Integration . The relabity of agriculture feeder network is improved.

The distributed generation and integrating techniques are considering with optimum allocation of DG in distribution network for providing peak loading conditions and considering the agricultural pump sets for solar pumps for providing the peak loading conditions DG plays a very important role for remote and rural to setup rural micro grids ,nanogrids , and alternative supply of rural areas ,with DG integration in rural areas tariff rtes depending upon the wheeling charges and providing continues power supply and improving the agriculture feeder feeder

the study of existing agriculture feeder network revels that the major problem faced by the consumers voltage magnitude with real and reactive power loss and less peak loading capacity, and during peak load condition the voltage magnitude of rural feeder reduces up to lower voltage level and with DG integration voltage has to be improved

with rural feeder loading conditions graphs with increase in the peak loading conditions for same voltage profile during the peak loading conditions the load varies in which voltage magnitude is reduced across the buses for peak loading condition

III. FEATURES OF POWER WORLD SIMULATOR (PWS)

Simulation software with PWS planning and operational stages of power system. The application of software used for for power system research with different configurations and techniques used for the power system planning techniques.

- Load flow analysis techniques
- Distribution network and analysis
- Optimal operation of generation
- Power system audits and analysis
- Voltage profile improvement techniques
- Feeder loss analysis

The average monthly load characteristic curves of the rural area in 2017 were selected for modeling analysis. The loads in the multi-energy system can be classified into three kinds, the AC power load, the DC power load, and the thermal load. The yearly values of the three different loads are displayed from Fig.2 to Fig.4, we can see thatMonthly Average AC the AC load curve characteristics can be described as "three peaks and three valleys". Firstly, the first peak is the winter heating load of residents, which last for a long time and generally occur from November to January. Next, the second peak is due to the agricultural irrigation demand in spring, which is slightly higher than the first peak, appearing in April. Besides, the third peak, because of agricultural irrigation and summer cooling load, appearing in July and August, is the highest. On the other hand, because the demand for heating load falls and agricultural production does not start

officially, the first valley appears in February and march. In addition, the second valley appears in May and June, after spring tillage and before summer irrigation. Finally, the third valley comes after the autumn harvest, before winter heating.

IV. CASE STUDY : BEFORE DG

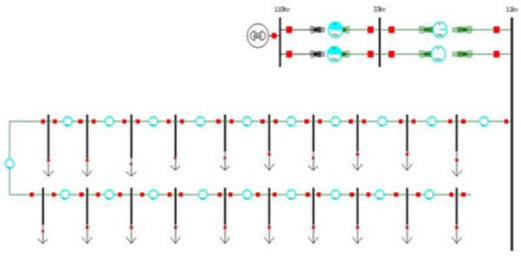

Fig.3 Agriculture feeder network before DG

rural feeder of agriculture feeder network with peak load of 0.9 MW and transmission line length of 28km the feeder loading with rural areas primary distribution system drawing power with 66kv substation and the power transferred secondary transmission level with transformer capacity 5MVA with magnitude of each voltages of 11kv buses and power transferred to feeders in which rural feeder integration with DG allocation

The distribution feeder has the following problem associated .

- High energy losses.
- Voltage regulation problems.
- Large number of interruptions and interrupted power supply.
- Overloading in the sections.

TABLE 1 DETAILA OF TRANSFORMER CONNECTED

Serial no	Details	Transformer rating HV/LV	Type of connection HV/LV	Impedance(%) rating (z)
T-1	5MVA	66/33KV	Delta/Star	6.15
T-2	3MVA	33/11KV	Delta/Star	4.35

V. PROPOSED METHODOLOGY

The case study regarding the methodology of multiple DG integration in agriculture feeder network for loss reduction and improvement of voltage magnitude of the system. The different algorithm techniques and available of DG integration techniques and improving reactive power In a distribution feeder there may be some optimum locations and sizes for a DG unit but one of them is the best location and size between them. The proposed algorithm of this paper gives the most optimum location and size of a DG unit in a distribution system. is based on iterative approach

- Mathematical analysis with calculation of voltage profile, loss reduction with load flow
- Integrating the DG limits strategic location for voltage magnitude
- Integrating the min real power and reactive power limits of a DG
- Different DG values in steps. on V in PU improvements
- Compare the losses of each for multiple DGs with loss reduction
- find the DG value with improve in V pu
- Compare the voltage profile improvement in each unit of buses. With multiple DGs
- Select the best size of DG integration for min losses & voltage magnitude with location. In Integrating multiple DGs

The power flow analysis in a agriculture feeder and the distribution network considered for alternative PV power generation capacity improvement in rural feeder and Optimal allotting the solar PV as size of DGs practically algorithm for locations for the real distribution networking in rural feeder and also . Maintaining coordination of multiple DGs with simulation approach with existing constraints.. with invest ting the solar resources availability the proposed methodology for wide range of operating

condition considering of seasonal solar radiation and short-term fluctuation Energy is essential for the survival and development of human beings. All world countries focus on ensuring adequate energy supply and reducing environmental pollution. Since coal, oil and other fossil energy is non-renewable, only by improving energy efficiency and exploiting new energy can we relieve the pressure of providing energy supply. By developing new energy and changing the existing mode of energy supply systems which operated independently, the research of multi-energy system can effectively solve the current energy problems [1]. Paper [2] proposed a multi-energy cooperative optimization of an integrated energy system in plant considering stepped utilization of energy. Paper [3] built up the randomness model of output of renewable power supply through scenario analysis, and on this basis, a model of multi-energy system operation optimization based on CCHP and energy storage was proposed. In [4], an optimal day-ahead scheduling method for hybrid energy park based on energy hub model was proposed. Paper [5] showed a day-ahead economic dispatch strategy of regional electricity-heating integrated energy system based on multiple energy station. Paper [6] presented a two-layer optimal allocation model of Energy Stations in large-scale park integrated energy system, including power supply

VI. CASE STUDY : AFTER DG

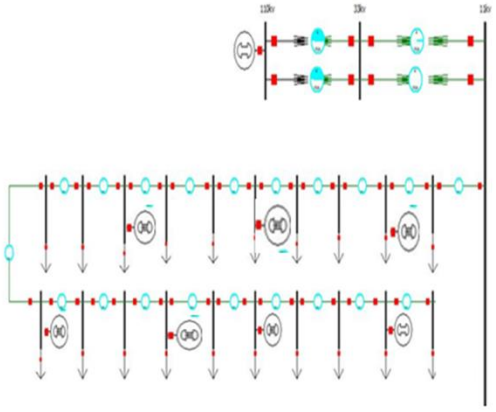

Fig.4 Agriculture feeder network After DG

Therefore, appropriate sizing and locating a decentralized generator improves the quality of power supplied to the feeder and also reduces the distribution losses. With PV technology as DG integration as multiple DGs

The integration methods and techniques suggests that DG as PV in which solar resources availability in rural areas benefits both the local consumers with improve in reliability of feeders and also for creating local grids in remote areas with increasing peak load penetration also supply with continues availability with backup power or spinning reserve

VII. DG : SOLAR ENERGY

PV generation in which solar resources availability converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect. PV with integration techniques for multiple DG allocations and rural reliable power supply networking PV techniques are commonly used in alternative supply for rural areas demand for renewable energy sources, the reliability of power supply and improve in quality of power in rural areas the solar irradiance level is to with peak hours of rural areas with location of distribution network with an average of five hrs of peak matching the demand with solar resources availability and rural feeder

Solar resources availability in rural area assessment and implementation of PV integration techniques also studying the assessments and metrological conditions and it also upon solar radiation availability with average earth temperature, The common findings of resources availability was obtained through.

- Latitude and longitudes of solar resources
- Solar irradiance level in rural areas.
- Max and min azimuth angle
- Peak Sunshine aviablity hrs

- Optimum tilt angle for MPPT tracking

VIII.SIMULATION RESULTS

Above Fig. 5 Reveals the voltage magnitude in pu values of rural network It reveals that before DG integration the voltage magnitude under lower limits with DG integration techniques the voltage magnitude is raised above the high penetration level of voltage magnitude considering before and after the DG permissible limit (the best practice as per IEC standard is 0.95pu) , after DG the voltage magnitude raises up to 0.95pu which is under permissible limit

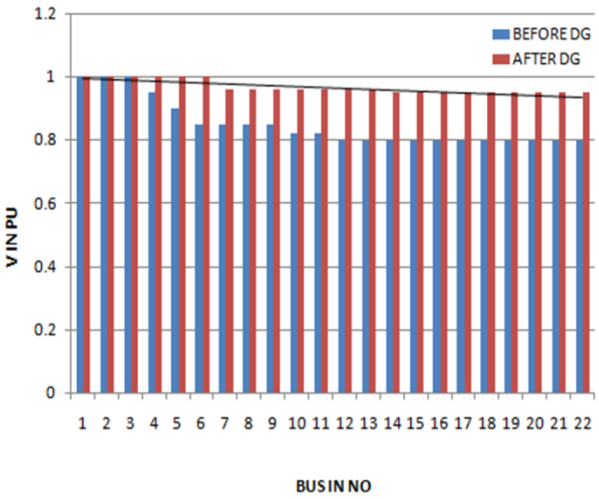

Fig.6 Voltage Profile with different sizes of DG units

The optimal allocation of DG installation with different sizes of DG units shows in Fig.6, voltage profile in PU at different sizing of the DG units of agriculture feeder network. It reveals that from size DG 1-DG3 there is no changes in voltage magnitude, at size DG 3 voltage raises which is under the permissible limits, The DG-3 which is considered as best optimum size of DG for voltage profile improvement Since the control of voltage regulation is usually based on radial power flows, the inappropriate sitting and sizing can cause voltage disturbance in the network. With system model and available resources for the solar PV

Rural feeder which locates in a remote areas (buses) are considered to be available agricultural pumps . Through 30 buses at the current network, the rural sites as rural agricultural land or rooftop photovoltaic solar panel and can be integrated utility grid at LV power distribution level. Allocation of DG location and size without any methodology will cause the system technically and economically to be inefficient and costly, even worse than the case with no DG installation. The technical issues mostly rise with voltage deviation

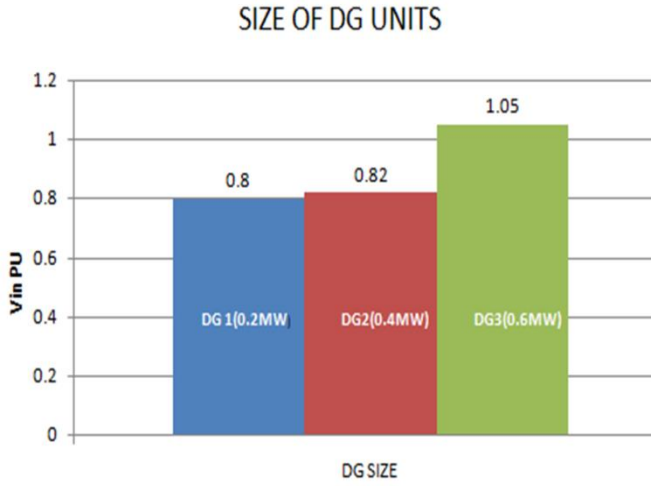

Fig. 7 Loss Reduction with different sizes of DG units

Above figure shows line loss reduction in MW at different sizing of the DG units of agriculture feeder network. It reveals that from size DG(0.2MW-DG0.6MW)there is no changes in line loss reduction of active & reactive power, At size DG(0.6MW) line losses slightly reduces, but at DG(0.6MW) the line losses of active &reactive power reduce It is approached at this reveals technique for obtaining the optimal locations and sizes of DGs at the system. Simultaneously, the most accurate power flow analysis method, NR is selected to conduct the loadflow.The connection of DG integration in rural grids , with considering the permissible limits of IEEE pu systems during normal operations The distribution losses in the system is which will be affected by increase or reduction based on the configuration of renewable energy mainly as DG. Meanwhile, power flow techniques provide the exact location of DG and exhibit the impact of DGs on the network parameters.

Voltage improvement techniques and algorithm uses system analysis and design that shows real and reactive power flows, currents, and voltages on every bus in the system. Load flow mathematical calculation

The planning of power system network in rural areas power system operation and planning in which the system is with operating conditions, the rural distribution network is considered as a rural proposed model, operating underbalanced condition Commonly, there are four parameters tackling in the power-flow analysis as voltage peak loading , voltage profile reactive power support,The rural feeder bus is taken as reference bus where magnitude and phase angle of the voltage are specified. The role of this bus is to make up the difference between the scheduled loads and generated power. Another one is the load bus where active and reactive powers are specified. The magnitude and the phase angle of the bus voltages are unknown. Finally, the regulated bus with the Specified real power and voltage magnitude is known as voltage controlled bus. The voltage phase angle and the reactive power are

IX.CONCLUSION

In this paper, I have examined the opportunities for Multiple DG integration in agriculture feeder network with . PV integrating technologies in agricultural feeder of agriculture feeder network with increasing in peak loading and improvement in voltage profile improvement . I undertook a case study of a rural feeder to study the impact of a decentralized power generator located in the feeder. There is a significant improvement in the voltage profiles and reduction of distribution losses. This creates a possibility of setting up of rural micro-grids generation

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Design and Optimization of Intake Manifold in Automotive

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ABSTRACT

Intake manifold is a crucial part in an engine that acts as a medium for airflow to mix with the fuel before entering the combustion chamber. The primary function of the intake manifold was to deliver the air/air-fuel mixture to the engine cylinder through the intake port with least losses. In addition, based on the engine cylinder firing order, the flow must be evenly split among the cylinder. Intake manifolds affect the volumetric efficiency which ultimately makes impact up on the engine power and torque. Conventional intake manifolds have fixed geometry and thus does not cater for the demand of wide range of engine speed. Gas dynamics of intake system plays a key role deciding the performance of an engine. This dynamics are different for fuel injected and carbureted engine and vary according to type of engine, number of cylinders, temperature of inlet, valve timing, valve angle and other factors. This paper investigates the effect of intake runner length on the performance characteristics of a four cylinder compression ignition engine with electronically controlled fuel injector.

Keywords : Intake Manifold, Fuel Injector, Four Cylinder Compression Ignition, Short Runner, Plenum, Runner.

I. INTRODUCTION

The word manifold comes from the Old English word 'manigfeald'. The word manigfeald which means 'manig' as many and 'feald' as repeatedly. Intake manifold refers to the multiplying of one (pipe) into many. The primary function of the intake manifold is to evenly distribute the combustion mixture or just air in a direct injection engine to each intake port in the cylinder heads. Even distribution is important to optimize the efficiency and performance of the engine.

The more air and fuel you feed your engine, the more power the engine is going to produce. This reduces weight significantly and production costs generally are reduced. Performance improves with the precise control of the interior surface finish and reduces air induction temperature.

There are three types of fuel injection system in the intake manifold:

1. Single Point
2. Multi Point
3. Direct Point

The proper entry of air to fuel mixture provides the greater swirl and increases in the efficiency of the engine.

1. Single Point Injection
2. Multi Point Injection
3. Direct Injection

Parts of fuel Injection Process:

1. Fuel supply
2. Air intake
3. Throttle
4. Intake manifold
5. Fuel Injector (or Injector)

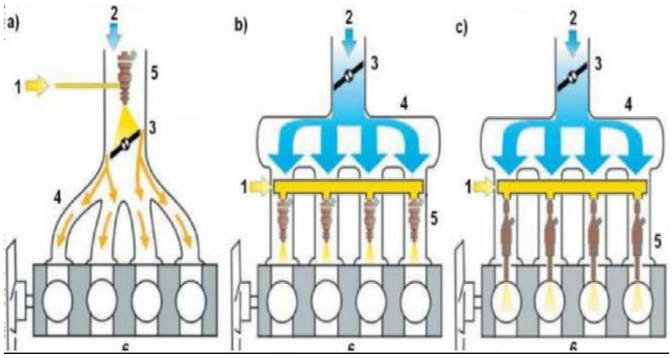

Fig 1: Systems of fuel injection

1.1 Scope:

The breathing capacity of the intake manifold should maximum for higher volumetric efficiency. The main aim or objective of any manufacturer is to create an efficient model by varying the dimensions of plenum or runner.

Intake manifold is the breathing system of any engine. Design of intake manifold for light duty locomotive engine by adopting different approaches and various analytical calculations also analyze fluid flow characteristics of intake manifold by using CAE and CFD.

Recent development in the computer simulation-based methods for designing automotive components had been gaining popularity even though the results obtained from numerical simulation (CFD) were comparable with the experimental studies; there's been continuous research to improve the simulation accuracy.

1.2 OBJECTIVES

1. Generate the mathematical model by referring analytical calculations.
2. Perform vibrational analysis to minimize the vibrations in manifold.
3. Find out localization of thermal Stresses and minimize their effects.
4. Determine the flow of air and fuel mixture and their effect in intake manifold by CFD analysis.

II. METHODOLOGY

❖ **Steps in Methodology**

1. Analytical calculations for Runner diameter and plenum length
2. Generating the model using CAD software
3. CAE Analysis for determination of vibrations and localization of thermal stresses
4. Perform CFD analysis to study the flow of mixtureand its through intake manifold
5. Verification and comparison of results
6. Optimization and reconstructing the model

III. LITERATURE REVIEW

Shrinath Potul, Rohan Nachnolkar, Sagar Bhave [1] described in Analysis of Change In Intake Manifold Length And Development Of Variable Intake System that Gas dynamics of intake system plays a key role in deciding the performance of an engine. This dynamic is different for fuel injected and carbureted engine and vary according to type of engine, number of cylinders, temperature at inlet, valve timing, valve angle and other factors. Careful design of the manifolds enables the engineer (designer) to manipulate the characteristics to the desired level. This paper investigates the effects of intake runner length on the performance characteristics of a four-stroke, single cylinder spark-ignited engine with electronically controlled fuel injector. In this paper basic intake tuning mechanisms were described.

Engine performance characteristics such as brake torque, brake power, brake mean effective pressure and specific fuel consumption were taken into consideration and virtual simulation software LOTUS ENGINE SIMULATION was used to evaluate the effects of the variation in the length of intake plenum on these parameters. It was found that change in runner length had a considerable effect on the rpm at which peak value of torque was obtained (occurred). Accordingly, a system to adjust the manifold length (tuned adjustable intake pipe) was designed and developed. According to the simulation graphs, in order to increase the torque performance, plenum length must be extended for low engine speeds and shortened as the engine speed increases.

Arvindkumar K, Adhithiyan N Darsak & V S Dinesh c [4] described in Optimization of Intake Manifold Design Using Fiber Reinforced Plastic that In this paper we discuss the design and manufacture of an intake system for a 600cc YAMAHA ZF engine.

Intake system have a major effect on a vehicle's engine performance, noise and pollutants. Differences in engine outputs and applications require different designs of intake-air manifolds in order to achieve the best volumetric efficiency and thus the best engine performance. As a result, the geometry of the intake system has been redesigned to result in reduced weight by using FIBER REINFORCED POLYMERS (due to lower material density and lack of welds, thermal, heat aging, fatigue, impact, creep, stress and chemical resistance), improved charge distribution, and increased torque through a wide RPM range when compared to its traditionally-manufactured aluminum counterpart.

This lead to incorrect air/fuel ratios were some cylinders ran too lean at times, while others were running too rich. Incorrect air fuel ratios can lead to excessive exhaust gas temperatures, pre-ignition detonation, causing components such as head gaskets and pistons to fail. The new manifold is aimed at tackling these issues by supplying uniform amount of air to all four cylinders. 3D modeling is done using Solid-Works and the internal flow distribution will be calculated.

A Jason D'Mello, B Omkar S. Siras [3] described in Performance Analysis for 4-Cylinder Intake Manifold: An Experimental and Numerical Approach that the primary function of the intake manifold was to deliver the air / air- fuel mixture to the engine cylinder through the intake port with least flow losses. Also, based on the engine cylinder firing order, the flow must be evenly split among the cylinders. This had been investigated in this work for a 4- Cylinder IC engine intake manifold for five flow rates – 4 kg/min, 4.5 kg/min, 5.0 kg/min, 5.5 kg/min and 6.0 kg/min. CFD simulations, using STAR CCM+, were carried out for estimating the flow losses, mass flow distribution between the engine cylinders, swirls inside the intake manifold. The Realizable k-epsilon turbulence model with All Y+ Two Layer Model was applied for these simulations. An experimental validation was also carried out. An innovative boundary condition method for the CFD simulations was suggested for improving the CFD simulation accuracy. The flow path for the cylinders 2 and 4 provide high flow losses. Also, un-even distribution of the mass flow between the ports had been observed.

IV. INTAKE MANIFOLD

The intake manifold connects the throttle body to the intake ports on the cylinder head. A manifold has a plenum or an air chamber where air is stored and a set of runners connected to the intake ports of the engine on the engine head. With port fuel injection, only air flows through the manifold and the top half of the runner. Fuel is injected into the air as it flows through the intake ports. When the throttle valve opens, air flows into the plenum. During the intake

stroke, the intake valve opens and air-fuel mixture flows through the runners into the cylinder where combustion takes place. This auto part is not just a passageway for the mixture to flow into but it also contributes to a better distribution of the fuel and air.

4.1 Design Theory

Various design theories have been suggested throughout the history of intake, manifold development. The basic layout of the fuel injection manifold will be determined by its application. A racing application will generally, tend toward a design with one throttle plate per cylinder. Typically, a street manifold will employ just one throttle plate or one multi-plate progressive throttle body attached to a plenum that that will feed all cylinders. Because we are dealing with everyday user motorcycle engine, we opt for the single throttle body design because it generates a considerably crisper intake manifold vacuum signal. This greatly increases the accuracy with which low speed fuel and ignition can be calibrated and is this thus better suited to a street driven engine. Of the single plate throttle two plenum design theories have been prominent in the Racing team. The dual plenum and single plenum design. Though both design theories have their own benefits and disadvantages, the main deciding factor to select one of these plenums is based on a concept called resonance charging.

This pressure wave bounces back and forth in the runner and if it arrives back at the intake valve when the valve opens, it is drawn into the engine. This combination of synchronized events is known as 'resonant conditions'.

The following parameters affect resonance charging: -

1. Engine speed
2. The number of crank rotation degrees the intakevalve is closed
3. Length of the intake runner tube
4. Volume of the plenum
5. Diameter of the intake runner

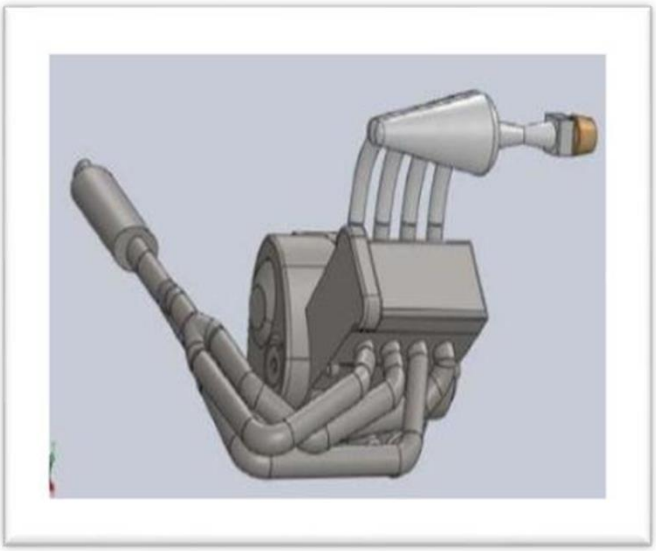

Fig 2: Assembled View of Manifold

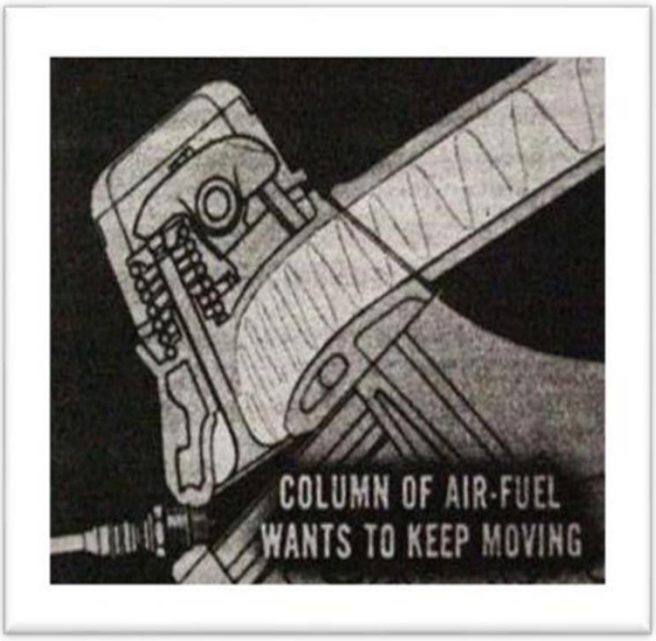

Fig 3: Column of Air-Fuel Wants To Keep Moving

4.2 ANALYSIS OF INTAKE MANIFOLD

❖ **CAE Analysis Static Structural**

The Pressure Loss Coefficients for individual runners canbe determined.

3D CFD allows the designer to see what the flow structureis like inside the manifold

The Boundary Conditions in Steady State simulation can beMass Flow

Rate, Constant Static or Total Pressure Can be used tomake the design ready for unsteady state simulation

➢ **Transient State Analysis**

1. Steady State study can be fast and can provide the loss coefficients but this cannot provide any information about an Intake Manifold performance in the operating
2. Conditions.
3. Transient simulation can predict how an Intake Manifold works under real world conditions.
4. The Boundary Conditions are no longer constant but time variant
5. These Boundary Conditions are obtained from the 1-D gas dynamics analysis by using the Wave Code.

➢ **CFD Analysis**

▪ **Steps in CFD analysis**

1. Simplifying the geometry
2. Setting up the model
3. Meshing of the model which includes reduction ingeometry complexity
4. Defining boundary conditions
5. CFD-Post for results

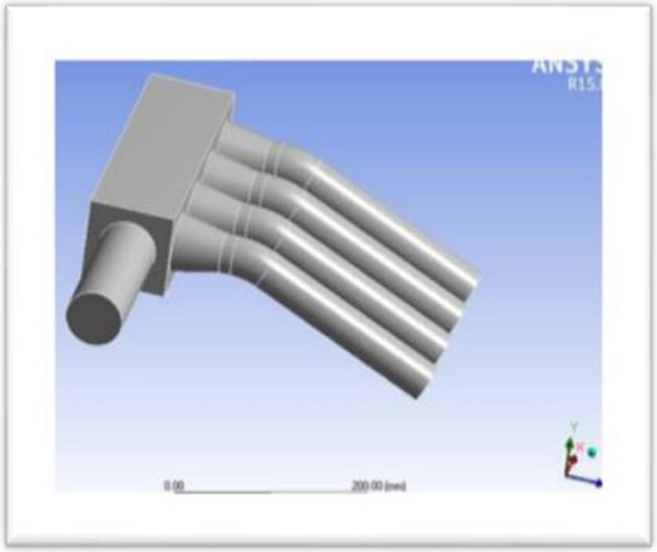

Fig 5: Manifold Geometry side view

V. STANDARD & OPTIMIZED PARAMETERS

Sr. no.	Parameters	standard value	optimized value
1	Total pressure	5.31 Pascal	5.78 Pascal
2	Overall velocity	0.130 m/s	0.193 m/s to 0.214 m/s
3	velocity in runner	0.269 m/s to 0.401 m/s	0.326 m/s to 0.6 m/s
4	velocity at outlet of runner	0.906m/s to 0.969 m/s	1.28 m/s to 1.30 m/s
5	velocity at outlet	2.69 m/s	3.261 m/s
6	pressure at outlet	-	1.178 Pascal

Table 1: Comparison between standard and optimized parameter

VI.CONCLUSION

Based on this extensive research work, the following were the conclusion.

A new CFD simulation methodology in terms of boundary conditions – For the intake manifold was proposed. The result from this approach was in close agreement with experimental data.

High flow swirl had been noted for all the operating conditions which could enhance the engine combustion characteristics.

It can be easily concluded that intake geometry made a conside5rable impact of outlet velocity. The main impact is on the volumetric efficiency of the engine which ultimately affects the torque and power produced a different engine speed.

The intake manifold design with less curvature at the runner. This is shown in results there is a percentage increase in outlet velocity as compared to conventional manifold model of INDICA VISTA.

Based on the computational fluid dynamics theory, three dimensional numerical simulation of the engine's intake manifold system is carried out, which is an effective and feasible method of analysis.

The results shows that the pressure loss and flow uniformity of intake manifold are two major evolution indicators.

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Electrochemical Studies of $GdAlO_3 : Eu_{3+}$

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ABSTRACT

Evaluation of the electrochemical performance of $GdAlO_3:Eu^{3+}$ electrodes, in neutral KOH electrolytes. The electrical conductivity of $GdAlO_3:Eu^{3+}$ was measured using cyclic voltammetry. The cyclic voltammetry measurements indicate that the reversibility of the electrode reaction increases. Cyclic voltammograms (CVs) analysis used for understand the electrochemical performance of the Eu^{3+} doped $GdAlO_3$ electrode for super capacitor during charging and discharging processes.

Keywords : GAG, electrical conductivity, cyclic voltammetry (CV)

I. INTRODUCTION

Presently energy is a fundamental worldwide issue for the human society, what we needed energy is provided by the fossil fuels. But it is not renewable and it emits pollutants while burning which degrade the environment and greenhouse gases, which lead to a global warming problem [1-2]. Such frameworks require the advantages of compactness and energy effectiveness while being environmental friendly [3]. The technology and systems of an external thermal interface or that of an external electrical interface embrace by Energy conversion and storage systems [4]. Based on amount of energy and power available for the load they are categorised into groups which includes batteries, fuel cells, capacitors and supercapacitors [5-6].

Complex oxides like ABO_3 are a class of chemically and thermally stable materials, which are suitable for a wide range of applications, such as magnetic, optical, ceramics, and catalysis [7]. Among these Rare earth ortho aluminates $REAlO_3$ materials are better candidates, because of their excellent properties like high thermal stability, high mechanical resistance, hydrophobicity, and low surface acidity [8]. In previous studies it is found that gadolinium aluminate ($GdAlO_3$) is a potential host system for materials with oxygen ion conductivity [9]. In order to study the structure, Cyclic Voltammetry of perovskite $GdAlO_3$ due to the effect of cation dopant

II. RESULT AND DISCUSSION

❖ PREPARATION OF THE MODIFIED CARBON PASTE ELECTRODE

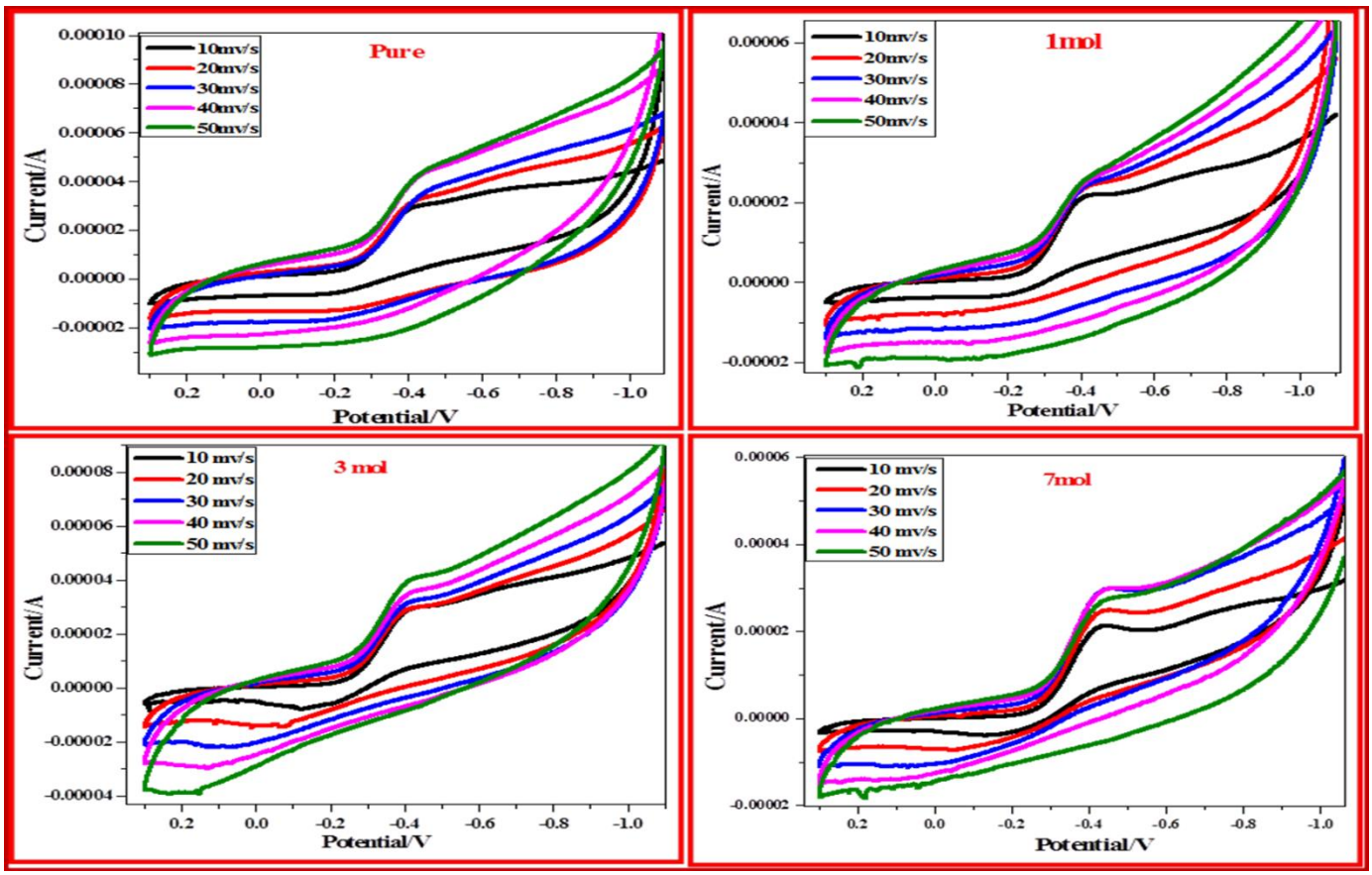
The sample, graphite powder and silicone oil ratio was 15:70:15 % by weight and were mixed in an agate mortar for about 40 min. the carbon paste was packed in to the of homemade carbon paste electrode and then smoothened on a tissue paper till the surface become uniform.

The choice of an electrolyte is particularly important because the amount of energy stored in the cell and

how quickly this energy can be released are determined by the thermodynamic stability of the electrolyte employed [10]. In aqueous electrolyte, concentrated electrolytes such as H_2SO_4 and KOH are able to minimize internal resistance and maximize power capability due to excellent ionic conductivity (~ 10^{-2} s/cm). The great number of proton (H^+) and hydroxide (OH^-) involved in the proton transport explains the higher ionic conductivity in strong acid and alkali, respectively [11]. However, the use of concentrated electrolyte limits the cycle life of electrochemical capacitor and restricts the range of possible electrode materials because of most of the metal oxides degrade dramatically in concentrated solutions. As a result, neutral and mild aqueous electrolytes including KCl, Na_2SO_4, Na_2SO_3 and Li_2SO_4 have therefore been considered for use with metal oxides [12].

❖ CYCLIC VOLTAMMETRY

The first studies on faradaic pseudocapacitive behaviour of nano MnO_2 by Lee and Good- enough in 1998 have shown that mild KCl aqueous solution can replace strong acid such as H_2SO_4 as the electrolyte of electrochemical capacitor [13]. We undertake evaluation of the electrochemical performance of $GdAlO_3:Eu^{3+}$ electrodes, in neutral KOH electrolytes. Electrochemical tests, including cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) were performed, in this study; all of the electrodes were tested in aqueous 1M KOH electrolyte using a three electrode system. Fig. 1exhibits cyclic voltammetry curves obtained at different scan rate (10, 20, 30, 40 & 50 mV s^{-1}) in 1M KOH electrolytes.



Cyclic voltammograms (CVs) analysis used for understand the electrochemical performance of the Eu3+ doped GdAlO3 electrode for super capacitor during charging and discharging processes. In order to understand the effect of various mol concentrations on the electrochemical performance of GdAlO3:Eu3+ nanophosphors carbon paste electrodes, the CV experiments were conducted for the electrodes with different mol concentration. Fig1 (a-c). It was observed that the response of each analyte was specific, exhibiting different electron transfer activities at different electrodes. Here, the capacitance was mainly based on the redox reaction because the shapes of the CVs were distinguished from the shape of the electric double-layer capacitance, which is normally close to an ideal rectangle [14-15].

The quantification of charge efficiency, charge-discharge of The quantification of charge efficiency, charge-discharge of electrodes and the reversibility of the electrode reaction were carried out using cyclic voltammetry. The reversibility of the electrode reaction was measured by taking into account the difference between the oxidation potential (EO) and the reduction potential (ER) [16] at 10 mV/s scan rate. Smaller the value of EO-ER, more reversible was the electrode reaction. Hence, with the addition of Eu3+ a phenomenal increase in the reversibility of the electrode

Eu^{3+} Concentration (mol %)	E_O (V)	E_R (V)	E_O-E_R (V)
1	-0.196	-0.414	0.218
3	-0.188	-0.389	0.201
9	-0.198	-0.417	0.219

III.CONCLUSION

The behaviour of electrochemical reactions at the GdAlO3:Eu3+ electrodes electrode was investigated. All of the presented voltammograms share a similar shape, but the influences of different diffusion coefficients are significant. The reversibility of the electrode reaction was measured by taking into account the difference between the oxidation potential (EO) and the reduction potential (ER) at 10 mV/s scan rate. , the capacitance was mainly based on the redox reaction because the shapes of the CVs were distinguished from the shape of the electric double-layer capacitance. the addition of Eu3+ a phenomenal increase in the reversibility of the electrode reaction was noted at 3 mol % of Eu3+.

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An Efficient and Robust Audio Steganography Using MATLAB

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ABSTRACT

In present day to day life, effective data hiding methods are needed due to attack made on data communication. This paper presents the technique for the above requirement. In this proposed method, secret message is embedded within carrier audio file (.wav) . In the transmitter end the output will be similar to the carrier with secret message embedded inside. The hacker will be blinded by the transmitted signal. At the receiver end the original message can be retrieved without any loss. The entire proposed system is simulated and their corresponding waveforms proved the effectiveness of this method.

Keywords - Image Steganography, Echo hiding, Feature coding, Audio Steganography,Video Steganography

I. INTRODUCTION

Now-a-days the steganography technique deals with many electronic media rather than physical objects the Medias are used for digitally embedding message such as plain text hypertext audio or video still images and network traffic. There are many steganography techniques which are used for hiding the data in a cover file. Broadband communication networks and multimedia data available in a digital format opened many challenges and opportunities for innovation. Multimedia information hiding is widely used to protect personal privacy and many effective methods have made progresses over the recently years. The word Steganography comes from the Greek and it means covered or secret writing [2]. Nowadays, embedding techniques are used for hiding information into something else for the sole purpose of hiding that information from the casual spectator.

Audio Steganography describe methods to embed information into a carrier signal. In this technique audio file is sampled and then an appropriate bit of each alternate sample is altered to embed the textual information.

The phenomenal growth in e-commerce applications through the Internet in the past few years has led to a genuine need, as well as a sense of urgency, for both small office and home office (SOHO) and corporate users to protect their data transactions through the Internet. These data transactions may include sensitive document transfer, digital signature authentication, digital watermarking for copyright protection, and digital data storage and linkage.

II. STAGNOGRAPHY TECHNIQUES

Hiding of an image, data, audio or video differs from application to applications and user to user. Hence, there are various ways in hiding a data is prohibited to others.

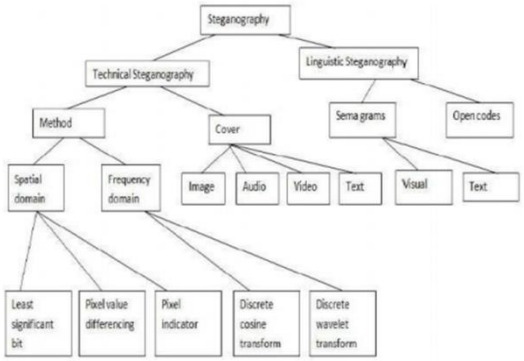

Figure-1 Classification of Steganography Techniques

The various Steganography techniques are listed below:

1) Echo Hiding:

Encodes and echoes the secret message in the form of the binary forms in audio signal with minimal degradation at the data. In this, the information is embedded in a sound file by introducing an echo into the discrete signal, Echo Hiding places embedded message in cover audio by introducing an echo.

2) Linguistic Hiding:

Linguistic technique is used to hide the message within the cover text in non-obvious way such that the presence of message is imperceptible to an outsider. It is divided into two types:

a) Semagrams:

It uses only symbols and signs to hide the information. It is further categorized into two ways:

i. Visual Semagrams:

A visual semagrams uses physical objects used every day to convey a message. For example: the positioning of items on a particular website. Spread spectrum makes use of the fact that small changes are more difficult for the human eye or ear to detect at high energy levels (loud audio or bright video). The message is hidden in those areas of the carrier file with the greatest energy.

ii. Text Semagrams:

This type is used to hides a message by modify the appearance of the carrier text, or by changing font size and type, or by adding extra space between words and by using different flourished in letters or handwritten text.

b) Open Code:

In this approach the message is embedded in legitimate paraphrases of cover textin the way such that it appears not obvious to an unsuspecting observer. It can be achieved by two ways viz., Jargon which is understood only by a group of peoples and Cipher which uses some concealed ciphers to hide a message openly in the carrier medium. A subset of jargon codes are cue codes, where certain prearranged phrases convey meaning.

III. IMAGE STEGANOGRAPHY

This Steganography technique is more popular in recent year than other steganography possibly because of the flood of electronic image information available with the advent of digital cameras and high-speed internet distribution. It can involve hiding information in the naturally occurred noise within the image. Most kinds of information contain some kind of noise. Noise refers to the imperfections inherent in the process of rendering an analog picture as a digital image. In Image steganography we can hide message in pixels of an image. An image steganographic scheme is one kind of steganographic systems, where the secret message is hidden in a digital image with some hiding method. Someone can

then use a proper decoding procedure to recover the hidden message from the image. The original image is called a cover image in steganography, and the message- embedded image is called a stego image. Various methods of image steganography are:

a) Data Hiding Method:

hiding the data, a username and password are required prior to use the system. Once the user has been login into the system, the user can use the information (data) together with the secret key to hide the data inside the chosen image. This method is used to hiding the existence of a message by hiding information into various carriers. This prevents the detection of hidden information.

b) Data Embedding Method:

For retrieving the data, a secret key is required to retrieving back the data that have been embedded inside the image. Without the secret key, the data cannot be retrieved from the image. This is to ensure the integrity and confidentiality of the data. The process of embedding the message inside the image, a secret key is needed for retrieving the message back from the image, the secret message that is extracted from the system is transfer into text file and then the text file is compressed into the zip file and zip text file is converting it into the binary codes.

c) Data Extracting Method:

It is used to retrieve an original message from the image; a secret key is needed for the verification. And for extracting method, a secret key is needed to check the key is correct with the decodes from the series of binary code. If key is matched, the process continues by forming the binary code to a zipped text file, the unzip the text file and transfer the secret message from the text file to retrieve the original secret message.

IV. AUDIO STEGANOGRAPHY

The technique that provided secured message transfer between two parties commonly in Internet is audio Steganography. Secret information is hidden in digital sound of an audio file in audio Steganography system. The secret information is hidden by marginally changing the binary sequence of a audio file. Hiding secret information in audio file is normally a higher difficult method than hiding information in other media. A variety of techniques for hiding secret message in audio file have been developed in order to conceal secret messages successfully. Types of audio steganography:

a) Least significant bit
b) Parity Coding
c) Echo Coding
d) Phase Coding

V. VIDEO STEGANOGRAPHY

Most of the methods on audio and image can be used to video which are generally a collection of sound and image. Hence, video steganography is nothing but a combination of audio and image steganography. The evaluations for audio and image steganography can be taken together for the evaluation of video steganography. Important benefit of video steganography is the huge quantity of information that can be embedded inside of sounds and images. Thus, any small perceptible distortions might go by secret by people due to the uninterrupted flow of message. A video stream consists of collection of frames and the secret information is embedded in these frames as payload.

VI. TEXT STEGANOGRAPHY

Text steganography can be achieved by altering the text formatting, or by altering certain characteristics of textual elements (e.g., characters). The goal in the

design of coding methods is to develop alterations that are reliably decodable (even in the presence of noise) yet largely indiscernible to the reader. These criteria, reliable decoding and minimum visible change, are somewhat conflicting; herein lies the challenge in designing document marking techniques.

VII. PROPOSED METHODOLOGY

The proposed technique tries to minimize the data lost at the receiver side by solving disadvantage of overlapping during extraction problem. Here secret text is embedded as target data within a cover audio. During embedding first the data is pre-processed then inserted using modulo operator.

A. Embedding :

1) Pre-processing:

The target string length should be multiple of four otherwise some less used special character is concatenated at the end to make string length as multiple of four.

2) Embedding using modulo operator:

Now these hexadecimal digits are embedded into the cover audio .The amplitudes of cover audio are divided by 16.

B. Creation of GUI and steps executed :

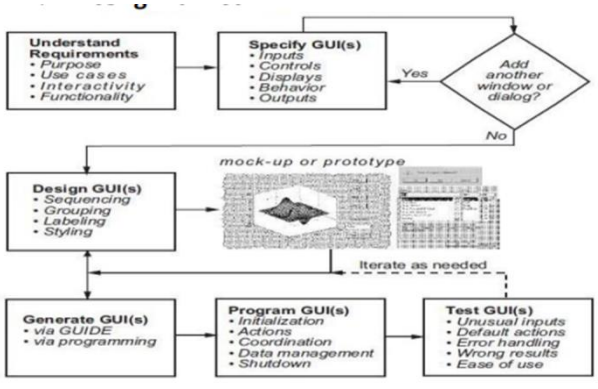

Figure-2 : Creation of MATLAB GUI

Steps involved in the proposed method:

Step 1 : By typing the keyword "GUIDE" at the MATLAB prompt and selecting the GUI template(blank or existing), a template was created.

Step 2 : By selecting components from the component palette, aligning them accordingly, preferences were selected.

Step 3 : Customization of Layout was done.

Step 4 : Once the front end is generated it is saved as a (.fig) file. Corresponding to the front end, a back end is generated which is a (.m) extension file.

Step 5 : The cover audio was obtained by selecting appropriate file name and path using the inbuilt function UIGETFILE.

Step 6 : The pitch values are converted into sample values using the inbuilt function WAVREAD.

Step 7 : Graph was plotted for the cover audio sample values using MATLAB axes.

Step 8 : Using the GET function, secret keys and secret messages were accepted.

Step 9 : Both keys and message values are embedded into one entity for comparison during decryption.

Step 10 : Both the values were fed into the user-defined EMBEDBP function.

Step 11 : A random function was generated to keep track of the user inputs.

Step 12 : A message was displayed saying "Data has been embedded in the cover audio successfully".

Step 13 : The embedbp function takes three arguments : the cover audio, secret data and the position to be hidden.

Step 14 : The number of unoccupied voice samples were computed.

Step 15 : The number of secret data samples from the total number of voice samples were extracted.

VIII. RESULTS AND DISCUSSION:

A. Encryption:

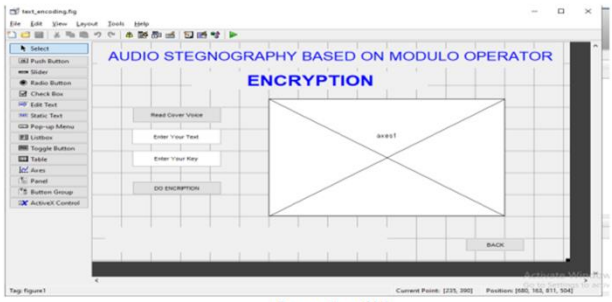

Figure-3: Encryption GUI

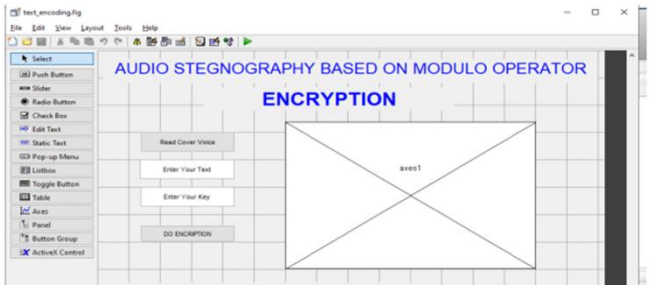

Figure-4: Encryption using Modulo operator

B. Decryption:

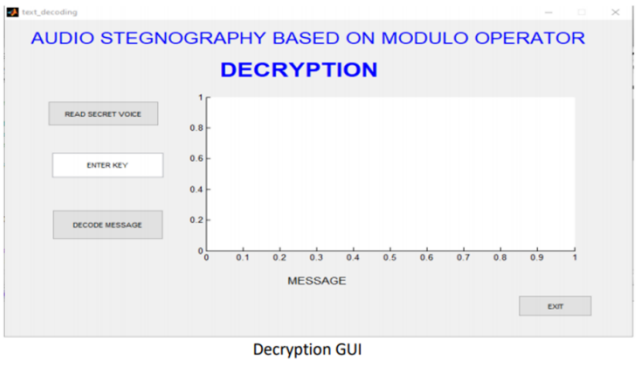

Figure-5: Decryption GUI

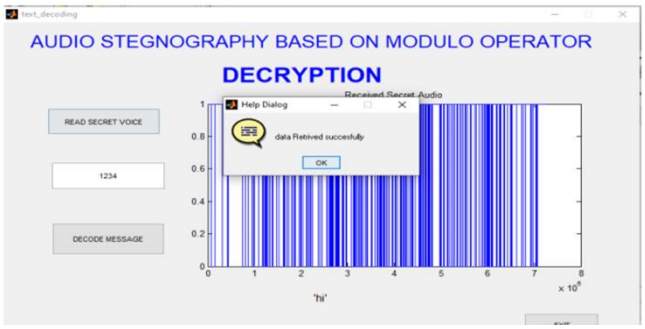

Figure-6: Decryption using Modulo Operator

This research paper has extended the conventional LSB modification technique for audio steganography to make it more secure against steganography analysis. An intelligent algorithm used to embed the message bits in the deeper layers of samples and alter other bits to decrease the error. Objective tests showed the algorithm succeeds in increasing capacity, while keeping SNR value close to the level of SNR obtained by standard LSB embedding with lower capacity. The stego message formed on the basis of proposed methodology cannot be differentiated from host message. The secret message on the receiver side can be extracted from the stego message as well.

IX. CONCLUSION

Described algorithm incorporated in not only increasing the depth of the embedding layer but also sample was chosen randomly without affecting the perceptual transparency of the audio signal. That is, two-way of robustness, first, the selected frame was randomly chosen, Second, Additive noise has less effect on the hidden message as higher order bits were modified.The proposed algorithm had significantly lower bit error rate than the standard algorithm. In addition, tests showed that the algorithm resulted in increasing capacity, while keeping SNR value close to the level of SNR obtained by standard LSB embedding with lower capacity.

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Network–On–Chip Router Microarchitecture for Future Communication : A Comprehensive Review

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ABSTRACT

Network-on-Chip (NoC) is fast emerging as an on-chip communication alternative for many-core System-on-Chips (SoCs). NoC architecture is a preferable communication backbone for today's multiprocessor platforms. NoCs utilize routers at each node to direct traffic. However, designing a high performance, low latency NoC with low area overhead has remained a challenge. Conventional NoC router micro-architecture has main drawbacks in terms of circuit complexity, high critical path delay, resource utilization, timing, and power efficiency. The growing reliance on intellectual properties exposes SoCs to many security vulnerabilities and is raising more and more concerns. At the same time, with the quick increase in chip density and deep scaling of feature size, current billion-transistor chip designs introduce more challenges to manufacturing fault-free chips. The research presented in this paper has investigated these issues in detail and wants to develop a low latency, low-power and high-performance NoC router architecture that is applicable to a wide range of FPGA families.

Keywords - NoC router, VC allocator, Switch allocator, Switch traversal.

I. INTRODUCTION

As the quantity of cores on a single chip keep increasing, the network-on-chips (NoCs) technology is getting to be key to interconnect these cores. . NoC has turned out to be an essential piece of chip multiprocessors (CMPs) and interconnect hundreds even thousand cores [1]. Network-on-chip (NOC) solves the lack of scalability issue in bus-based interconnection system-on-chip (SOC) [2].Network-on-Chip (NoC) gives an adaptable and extensible inter-core-communication infrastructure for many-core system-on-chips. NoCs utilize routers at each node to direct traffic A typical, baseline router pipeline consists of two stages [3]. However, because of numerous numbers of routers a packet needs to navigate between a source and destination cores, as well as each individual router buffering, NoC-based frameworks can suffer from high inter-core communication latency. Reducing NoC communication latency while maintaining good throughput, a router needs to perform several stages such as route computation, VC allocation, and switch allocation in parallel. However, designing a low latency NoC router is still a challenge for on-chip systems [4].

Current NoC routers apply several virtual channels (VCs) on a solitary physical channel, for multiple

proposes for example, expanding system throughput, avoiding deadlock in fully adaptive routing [5], isolating resources for different message classes to prevent application-level deadlock [6], and enhancing Quality-of-service (QoS) by generating virtual networks [7]. VC makes the router architecture to become more complex that requires additional VC allocation stage to the existing router pipeline stages. In order to reduce on-chip memory usage, worm-hole flow control algorithm is widely applied in NoC routers [8-10]. Due to limited area and power budgets in a SoC, wormhole flow control is commonly used in NoC routers. Wormhole lowers the buffer requirement by storing different flits of the same packet in several routers along the path. Apart from that, NoC routers typically employ several VCs on a single physical channel as it offers several benefits such as increasing throughput by functioning as escape channels for active packets to bypass head-of-line (HoL) blocking, preventing deadlock condition in both network-level and protocol level as well as generating VNs to support QoS for different applications. A worm hole router divides a packet into several smaller flow control digits and allows flits to be buffered in a flit serial fashion order through several routers along the path. To provide low latency, there have been significant efforts on the design of routers [11], and network topologies. However, due to the stringent power and area budgets in a chip, simple routers and network topologies are more desirable.

In order to reduce the power utilization and increase the performance, various optimizations in the area of on-chip network design have been proposed. Different methods have been proposed for various on-chip network problems for example, layout designs, router microarchitecture design, mapping methods, and switching and flow control mechanism issues. Considering the aforementioned optimizations, flow control and buffering issues play a crucial role in power reduction [12].

II. LITERATURE REVIEW

RoB-Router: A Reorder Buffer Enabled LowLatency Network-on-Chip Router, IEEE Transactions on Parallel and Distributed Systems,2018 by Cunlu Li et al. [13] have developed a method to schedule packets in input buffers utilizing reorder buffer (RoB) techniques. The virtual channels VCs was designed as RoBsto allow packets located not at the head of a VC to be allocated before the head packets. RoBs reduce the conflicts in switch allocation and mitigate the HoL blocking and thus improve the NoC performance. However, it is hard to reorder all the units in a VC due to circuit complexity and power overhead. Then the RoB-Router was proposed, which leverages elastic RoBs in VCs to only allow a part of a VC to act as RoB. RoB-Router automatically determines the length of RoB in a VC based on the number of buffered flits. The design minimizes the resource while achieving excellent efficiency. Furthermore, two independent methods was proposed to improve the performance of RoB-Router. One was to optimize the packet order in input buffers by redesigning VC allocation strategy. The other combines RoB-Router with current most efficient switch allocator TS-Router. The method achieves 46% and 15.7% performance improvement in packet latency under synthetic traffic and traces from PARSEC than TS-Router, and the cost of energy and area was moderate.

ATAR: An Adaptive Thermal-Aware Routing Algorithm for 3-D Network-on-Chip Systems, IEEE Transactions on Components, Packaging and Manufacturing Technology, 2018 by Dash et al. [14] have developed an adaptive thermal-aware routing (ATAR) algorithm to distribute the traffic more uniformly across the chip for uniform thermal distribution in the chip. ATAR makes the decision based on the weighted sum approach by taking input parameters such as path length, next router

temperature, next router queue length, and link workload into account. Distributed ATAR units are coupled using a dynamic network to regulate the routing workload and results in minimization of thermal hotspots. In ATAR, cost computation and direction selection take place in accordance with a deadlock-free turn model. ATAR performs better in terms of thermal management and average packet delay.

Multicast-Aware High-Performance Wireless Network-on-Chip Architectures", IEEE Transactions on Very Large Scale Integration (VLSI) systems, 2017 by Duraisamy et al. [15] have presented a multicast-aware WiNoC architecture which can efficiently handle multicast-heavy cache coherence communications. Incorporated with a congestion-aware multicast routing and NC, WiNoC eliminates the initial and intermediate queuing latencies seen in conventional wire-line mesh NoCs. Moreover, using wireless shortcuts, the WiNoC achieves significant reductions in network latencies leading to improved system performances. The multicast aware WiNoC achieves an average of 47% reduction in message latency compared with the XY-tree-based multicast-aware mesh NoC.

OrthoNoC: A Broadcast-Oriented Dual-Plane Wireless Network-on-Chip Architecture", **IEEE Transactions on Parallel and Distributed Systems**, 2018 by SergiAbadal et al. [16] have presented ORTHONOC, a hybrid wired-wireless architecture composed of two independent network planes driven by a hybrid controller that can be agnostic or aware of the architecture. With the architecture-agnostic approach, ORTHONOC achieves significant speedups over other hybrid NoCs by offloading the wired plane from traffic for which it was inefficient. The method achieves 30 percent latency improvement, 25 percent throughput improvement, and higher energy efficiency with a similar number of wireless interfaces than other wired-wireless designs. With the architecture-aware approach, ORTHONOC's consistent order of delivery enables the design of faster and simpler multiprocessor architectures.

Randomly prioritized buffer-less routing architecture for 3D Network on Chip, Computers & Electrical Engineering, 2017 by Karthikeyan et al. [17] have presented a 3D lottery routing algorithm which was based on arbitral mechanism like randomly prioritized buffer. Communication among the IPs in NoC can be customized by users through the lottery router. The lottery routing algorithm distinguishes the different priorities of the input port and makes sure that it responses to the higher priority port. The efficient hardware implementation of 3D NoC was proposed using Xilinx Spartan 3E FPGA, the architecture consumes 1644 slices out of 4656 slices and operates at the maximum frequency of about 103.602MHz. The power consumption of 3D NoC was reduced by 9% compared to a single layer.

An Efficient Network-on-Chip Router for Dataflow Architecture", Journal of Computer Science and Technology, 2017 by Shen et al. [18] have proposed an efficient NoC router for dataflow architecture. The router supports multiple destination; thus, it can transfer data with multiple destinations in a single transfer. Moreover, the router adopts output buffer to maximize throughput and adopts non-flit packets to minimize transfer delay. The method improves the performance of dataflow architecture by 3.6 x over a state-of-the-art router.

A highly efficient dynamic router for application-oriented network on chip, The Journal of Supercomputing, 2018 by Su et al. [19] have proposed an effective router architecture including intra-port and inter-port allocation mechanism to improve network performance. By modifying the virtual channel unit of NoC's routers, the new router architecture can improve the buffer utilization

without affecting network performance. By using the idea of virtual output queue (VOQ), the router can solve the problem of head of line blocking. It can also balance the traffic load flexibly between different ports on the application-oriented NoC.

ProNoC: A Low Latency Network-on-Chip based Many-Core System-on-Chip Prototyping Platform, Microprocessors and Microsystems, October 2017 by Monemi et al. [20] have proposed a prototype NoC (ProNoC) method, Prototype NoC functionally represent an actual low latency ASIC-style NoC on field-programmable gate arrays (FPGA) platform. The method was developed in Register Transfer Level (RTL) and can support different features of a modern NoC such as VC, VN, different routing algorithms, non-atomic VC relocation, LRC, different VC and SW combined-allocator types as well as single clock cycle latency acceleration on packets traversing long distances. The proposed router was resource optimized to satisfy the limited hardware area of FPGA device while running at acceptable operating frequency. Pro NoC was also equipped with an EDA tool aided with GUI to facilitate NoC emulation and automated system integration of a complete NoC-based MC SoC in RTL level.

Low Latency Network-on-Chip Router Micro-architecture Using Request Masking Technique by Monemi et al. [21] have presented a two-clock-cycle latency router micro-architecture with parallel VC and switch allocator. The architecture eliminates the need of setting higher priority to any IVC requests. The NoC router architecture, any request which has been granted service by the switch allocator is able to pass a flit to the output port successfully. An efficient masking technique is proposed to filter all switch allocation requests that are not able to pass flits to the output port, either due to the lack of free space in assigned VC or due to the lack of free VC in the output port for no assigned VC requests. The masking technique also provides an efficient usage of VC memory buffers. The proposed technique has minimal impact in timing and area overhead of a NoC router.

III. CONVENTIONAL NoC ROUTER ARCHITECTURE

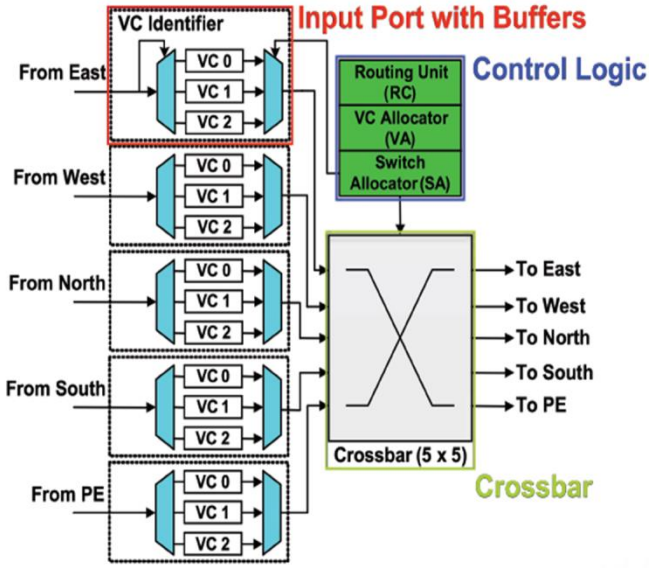
A conventional NoC router has four consecutive pipeline stages.

(1) Route computation: this stage determines the output port that a packet must be sent to.
(2) VC allocation: this stage assigns an empty VC in the neighboring router connected to the output port. Since several header flits may send requests for the same VC, arbitration is required. The routing computation as well as the VC allocation only requires the header flit. The body and tail flits will follow their respective header flit.
(3) Switch allocation: if VC allocation is successful, the third stage sends request to the switch allocator to allocate the output port.
(4) Switch traversal: if the switch allocation is successful, the flit will be passed to the crossbar and be delivered to the output port.

A conventional virtual channel NoC router block diagram is illustrated in Figure 1. The NoC router consists of input ports, VC/SW allocators, routing computation module, and a crossbar. The input ports buffer input flits and send requests to the allocators. The routing computation module determines the output port based on the routing algorithm. After the route computation, a free output VC (OVC) in the next router is assigned to the input VC (IVC) by sending request to the VC allocator. If an OVC is successfully assigned, then another allocation request will be sent to the switch allocator. The crossbar is then configured to send the desired flit to the output port if the switch allocation request is granted. In

order to send requests to the switch allocator, the available space in the next router buffer must be known. Hence, output port modules maintain a set of credit counters to keep track of available buffer space for each OVC.

Figure 1: Conventional NoC Router architecture



The allocator is the most challenging module to design since the overall NoC router performance and area overhead will be dominated by this module. Moreover, allocators are located in the NoC critical path. An allocation is required when several agents (IVCs) require access to several resources (OVCs or output ports) simultaneously. Generally, three types of allocators are widely used in NoC router microarchitecture design, namely, wavefront, separable input-first, and separable output-first allocators.

A comprehensive analysis on the allocators shows that separable input-first allocators have the advantage of lower communication delay, area overhead, and power consumption compared to other schemes. Hence, the separable input-first allocator has been chosen to be implemented in our low latency NoC router. A separable input-first allocator consists of two levels of arbitrations. In the first arbitration stage, for each input port, only one request of all IVC requests is granted. Since several input ports may request the same output resource, another arbitration stage is required to resolve this limitation. The number of arbiters and the arbiters' size required for the VC and switch allocations. VC allocator consumes a large number of resources compared to SW allocator. In this work, we assume that no input port sends a packet.

IV. ANALYSIS OF RESULTS

In order to compare network performance results, we generate cycle-accurate behavioral model of the one-clock-cycle latency CONNECT and our proposed architecture using Verilator. Both NoC are configured in a 5 × 5 mesh topology having 4 VCs on each port with the size of 4 flits per each VC and the flit payload width of 32 bits. As CONNECT [12] only supports dimension order routing (DoR), we use DoR for both routers. All NoC endpoints are connected to the custom traffic generator modules. The traffic generators are responsible for injecting network packets into the NoC routers and collecting performance statistics as the packets are received by destination cores. . The hardware utilization summary and the maximum operating frequency obtained for Altera Cyclone IV EP4CE115 are shown in Table 1.

Table 1: Hardware Utilization summary

4VCs/4 flits per VC	Two clock cycle latency Router	CONNECT Two - Clock	CONNECT One - Clock
Logic cells (LCs)	2,890 (2.5%)	5,934 (5.2%)	5,690 (5.0%)
Memory blocks (M9K)	5(1.2%)	-	-
Maximum frequency	88MHz	65MHz	41MHz

V. CONCLUSION

The paper has given survey of different NoC router designs in terms of hardware utilization such as logic cells, memory blocks and maximum frequency.

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Random Number Generator Using Sound

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ABSTRACT
True random number generators can significantly contribute to the development of high security cryptographic schemes, such as those required for use in military applications. This article presents some the results of an innovative method for the generation of truly random number sequences, based on environmental noise measurements.
The statistical properties of different noise types have been studied. Based on this study, an efficient random number generator has been developed that uses signals from the built-in microphone that is ubiquitous most current personal computers and other personal information processing systems. Statistical measures have been determined that measure the randomness qualities of the output sequence. These measures have been studied for different input noise properties.
Key-Words: - True Random Number Generation, Cryptography, Sound

I. INTRODUCTION

From simple gambling thousands of years ago, to modern statistical sampling, humans have created random number generators. Methods ranging from a simple coin flip to complex deterministic equations have been employed for amusement, statistics, and science. However, the use of random number generators, even today, is still not completely understood. Our foray into random number generation barely scrapes the surface of the subject. Thus, much of this work is a compilation of previous research. Our aim has been to condense the wealth of information on random number generation into a simple overview and further, execute several established generators. Through original computer applets, we attempted to test the degree of randomness of the generators, using several traditional statistical tests. Computer systems and telecommunications play an important role in modern world technology.
The communication and data transfer through computers touch almost every aspect of life, i.e., transferring data, tracking personal data, trading over the internet, online banking and sending emails. As more vital information is transferred through wire or wireless means, the need to safeguard all this data from hackers is growing. All these security concerns emphasize the importance of developing methods and technology for the transformation of data to hide its information content, prevent its modification, and prevent unauthorized use.
Random number generation is a fundamental process for protecting the privacy of electronic communications. It is a key component of the encryption process that protects information

from attackers by making it unreadable without the proper decryption processes. Since the strength of an encryption mechanism is directly related to the randomness of the binary numbers used in it, there has been an enormous need to design and develop an efficient random number generator that can produce true random numbers to implement a safe and secure cryptographic system

II. RANDOM NUMBER GENERATORS

As one can imagine, random number generation is quite a broad topic. Involves producing a series of numbers with no recognizable patterns or regularities, that is, appearing random." Thus, computers do not hold a monopoly on random number generation. Dice rolls, coin flips, drawing lots, and other forms of physical means can indeed produce

streams of numbers that one could not predict.

These were the earliest random number generators. As larger and larger streams of numbers were required for scientific procedures, physical random number generators lost value; scientists required the streams within a reasonable time-frame, with little effort. With the advent of computing, random number generation received a needed modern boost.

A computer is capable of two distinct types of random number generation. The first is comparable to a physical random number generator. What is known as a hardware random generator can extract information from a "weakly" random physical process, and convert the information into a stream of numbers. Processes used include thermal noise, nuclear decay, or "quantum" processes, such as the agitation of electrons.

Computers also excel at iterating deterministic equations. Generators based on a deterministic, iterated function are called pseudorandom number genera- tors. These generators are the primary ones used in scientific research in our modern world. These three distinct genres of generators offer unique ways of random number generation. In studying these generators, one can learn much about randomness, and its applications in science.

III. WHAT IS RANDOM?

To see the value in random number generation, one needs to know what is meant by a random number. For accuracy, we refer to Edwin Lindauer, in his "Methods of Random Number Generation," [5] to define the term. "A random number is defined to be a series of digits (a) where each digit has the same probability of occurring and (b) adjacent digits are completely independent of one another (if we know one digit, we still have no way of predicting the next one)." That is, given any number of digits in a stream of digits, we could not predict the following, or previous numbers, for example.

This definition is, of course, not all-encompassing. Many degrees of randomness in streams of "random" numbers exist. In any deterministic generator, the streams of numbers created cannot be called "random" since they are created through an algorithm. Thus, they are known as "pseudo-random" numbers. Up to the discretion of the tester, a random number generator may be designated "statistically random" if it passes certain chosen tests. For many purposes, "statistical randomness" is acceptable, though such "random" streams are not truly random, and may even fail to "appear" random if further testing is employed. However, one can estimate the degree of statistical randomness of a generator.

IV. MODERN USES OF RANDOM NUMBERS

One of the most famous uses for random numbers are those in statistical sampling.

Many facets of statistics require random numbers, such as choosing a representative sample and randomization of steps of an experiment to hide the protocol from the subject. It is also useful in creating the design itself. Certain types of statistical analysis require random number generators. In any of these uses, a faulty random number generator can nullify any results. Simulation of statistical events such as a coin toss, or computer simulation of physical phenomenon also requires random number generators.

Cryptography is another interesting application of random number generation. For the utmost security, the streams of numbers used must not only be random, but also from an unknown, that is, new source. For example, the digits of π can provide random streams. According to Weinstein [6], the decimal digits of π, are thought to be normal, that is, the distribution of its decimal digits (0–9) has a uniform probability of 1/10 for each digit. There has been as of yet no widely accepted proof that any non-artificially constructed numbers are normal. However, the first 30, 000, 000 decimal digits of π have been shown to be uniformly distributed (Bailey, [1]). One might think that drawing from a possibly uniform distribution, like the digits of π, would be an efficient method of generation. However, well known streams like that of π, or commonly used deterministic generators are not very secure options.

Finally, Monte Carlo methods of simulation are yet another remarkable application of random numbers. This is a broad heading under which fall many algorithms which, instead of using a deterministic function, use random sampling to compute results. Weisstein [7] defines a Monte Carlo method as "any method which solves a problem by generating suitable random numbers and observing that fraction of the numbers obeying some property or properties". A common use of the Monte Carlo method is known as Monte Carlo integration. To simplify integration of a function with a complex domain, D, Monte Carlo integration randomly plots "many" points over a larger, simpler domain; each point can then be categorized: it is either inside the bounds of D, or outside. An estimation of area can then be made using the ratio of points in D to those outside of D but within the much simpler domain ([7]). Before this method came about, simulations were tested against already solved deterministic problems to test their success. In turn, Monte Carlo methods solve deterministic problems using a simulation. They are usually applied to problems with many variables and parameters, that is, a system too complex to solve deterministically. They could therefore be applied to dynamical systems; though not necessarily arising from complex multivariate equations, these systems are often difficult to examine deterministically. Monte Carlo methods have, in fact, been applied to fluid flow.

V. PHYSICAL METHODS HISTORICAL METHODS

In a sense, the earliest methods of random number generation were highly successful. Physical processes are not entirely random, but are usually so complex that they are unpredictable to the casual observer.

In the ancient world, chance was linked to fate. Those interested in their fate could throw dice in the hopes of divining their future. Primitive "generators" included the scattering of rice and the interpretation of the cracks of a turtle's shell, once heated. These methods were not number generators, as they did not produce numbers; they required interpretation before recording. Actual random number generators

were used as well. Specifically, in the I Ching, an ancient Chinese text, there are many methods discussed in depth of random number generation. These include coin-flipping and the counting of yarrow stalks. The random data produced by these methods was then used to divine fate.

These methods of divination morphed into games of chance, the first being simple bets on the rolls of a die. Games of chance date back to 2000 B.C.

VI. GENERATING NUMBERS FROM THE ENVIRONMENT

In our modern world, using physical processes to generate random streams may seem outdated. A deterministic random number generator, like those discussed in the next section, can speed one's work along substantially. However, there are instances in which such a generator is not useful. This is true in certain facets of cryptography. In cryptography, random numbers are used to generate keys for secure communication. If the numbers used are not random enough, security may be compromised.

In cryptography and other areas, ultra-secure options include generators called hardware random number generators [5].

These are based on physical processes like the historical generators mentioned. However, the processes used for the hardware generator are favored to be those with quantum quality, that is, quantum mechanics predicts these phenomena are fundamentally random. These include shot noise, which is "noise" created when photons from a lamp are directed to a photodiode. Noise occurs when the photons affect the circuit. Other phenomena are used which are not predicted random by quantum mechanics; these include thermal noise: the agitation of electrons inside a conductor. Quantum processes are hard to detect, as they are so small, thus other sources of noise are used, though these are more easily attacked. From the physical noise, a transducer converts the physical phenomenon into an electrical signal. Then, an amplifier is usually required to increase the amplitude of the signal to the macroscopic level, so it can be read by an analog to digital converter that finally yields a number. While generally very hard to predict, there are often issues of statistical randomness in the final data. One example is called bias. The data will often have a mean not equal to the expected 0.5 of a uniform distribution on the interval [0, 1]. Thus, most hardware generators have what is called a corrector

to bring the mean to the desired value. Another problem can arise if data is sampled too quickly. In such a scenario, short-term dependencies of physical phenomenon may cause the data to be correlated. Finally, hardware generators are sensitive to outside noise. This can effectually ruin a data set. Roger Davies, in his Hardware Random Number Generators, presents two spectral analyses of hardware random number generators, one that passes the significance test, and one that is badly contaminated by an outside frequency, and thus fails miserably (See Figure 1 and Figure 2 below). Note the difference between the distribution of the data between the horizontal lines in each graph.

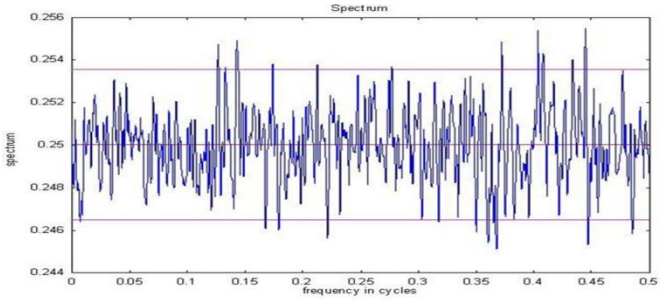

Figure 1 Spectral analyses of hardware random number generators within the frequency

Though these generators are often slow, the field is still expanding. A recent development is

the use of lasers as a source of random numbers. Especially exciting in the new study, multiple sources were used, thus multiple streams of data were generated concurrently. Setups like this one could help speed hardware generators considerably in the future (Wu, [4]).

VII. SOFTWARE RANDOM NUMBER GENERATORS

Casting lots or using environmental white noise to generate random numbers is not always possible, or feasible. In many modern scenarios, casting lots or cracking turtle shells simply takes too much time. In a database where user information is encrypted with random prime numbers, rolling dice to determine numbers are impractical, to say the least, when dealing with thousands of users. Generating the numbers from the environment often takes time as well as dedicated computer hardware

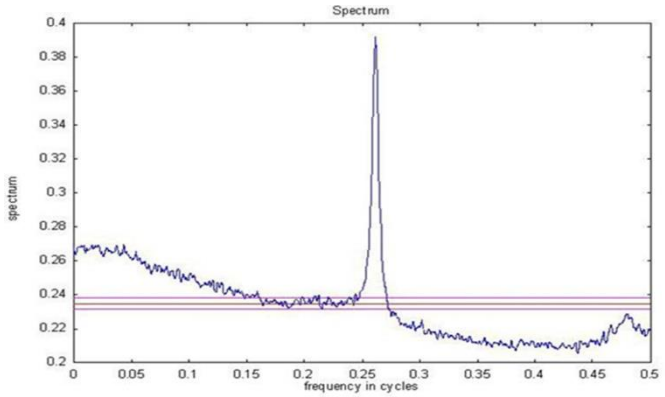

Figure 2 Spectral analyses of hardware random number generators outside the frequency

The specialized computer hardware makes these generators impractical for most users. Software random number generators allow for the creation of high-quality random number sequences quickly and without any specialized computer hardware.

The algorithms used in software random number generators are easily implemented on computers for use in cell phones, laptops, servers, and data centers. These algorithms have multiple parameters that dictate how the generator will perform. In most cases, these parameters are preset values except for a seed value. The seed value is typically time based and is used as a starting place for the production of the sequence. Unfortunately, these algorithms all have a cyclic period after which they will repeat. There are guidelines available for each generator to maximize its period. Sometimes the restrictions make selecting the proper initialization for a generator a difficult process. However, modern programming languages come with these random number generators built-in so that software engineers always have access to good random number sequences. There are many different algorithms for generating a sequence of pseudorandom numbers.

VIII. LINEAR CONGRUENTIAL GENERATOR

The most common category of software random number generators is the Linear Congruential Generators (LCG). An LCG is defined as the recurrence relation of the form:

$X_{n+1} = (aX_n + c) \pmod m$, $n \geq 0$ m, the modulus; $m > 0$

a, the multiplier; $0 \leq a < m$ c, the increment; $0 \leq c < m$ X0, the seed value; $0 \leq X0 < m$.

According to Knuth [2][3], LCG's are known to have a period of length m if three conditions are met. First, c and m must be relatively prime. Second, a should be divisible by all prime factors of m. Third, a should be a multiple of 4 if m is a multiple of 4. In addition, the choice of m is typically the word size of the computer (usually 232 or 264) because that makes the binary modular operation very fast. Generator's whose parameters do not meet these requirements have significantly shorter periods and are therefore not suitable for many scenarios. LCG's excel in

applications where a small memory footprint is crucial, such as in embedded systems like an internet router or car computer, because they need very little memory in order to execute.

IX. TRUE RANDOM NUMBER GENERATOR (TRNG)

A hardware true random number generator is an electronic device that generates truly random and unpredictable binary numbers. The output pattern of a TRNG is arbitrary and non-deterministic in nature, meaning that the output binary numbers cannot be reproduced even if internal design and seed of the generator is known. As complete unpredictability is the key aspect of the true random number generator, a seed given to the TRNG must be random. Fortunately, it is not so difficult to collect true unpredictable randomness by tapping a chaotic world. Some of the examples of physical random sources are, thermal noise, shot noise, atmospheric noise, radioactive decay and clock jitter. A TRNG can be fed a seed from such a physical random process to get true random outputs. Another characteristic of TRNGs is that they are non-periodic in nature (as opposed to PRNGs), meaning that output binary pattern of a TRNGs is never repeated even if the same seed is applied to the generator.

Chip manufacturing companies such as Intel are including random number generators in their chips. This paper illustrates a hardware-based Intel Random Number Generator for use in cryptographic applications.

The Intel hardware random number generators are based on unpredictable analog property such as junction or thermal noise. In this design, Intel RNG samples the thermal noise of

undriven resistors by amplifying the voltage across it. One significant problem associated with this noise amplification technique is that random components are associated with local pseudorandom noise sources such as temperature and power supply fluctuations. The effects of these sources are minimized by subtracting the signals sampled from two adjacent resistors.

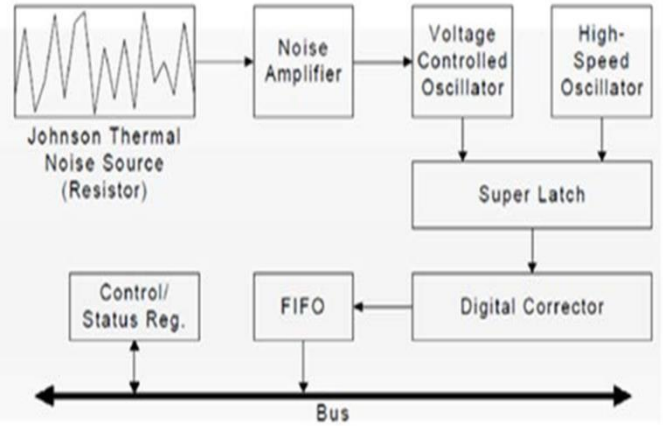

Figure 3 Thermal noise voltage amplifier for TRNG

X. SUMMARY OF CHARACTERISTICS OF RANDOM NUMBER GENERATORS

Below is the summary of the properties of a pseudo random and a true number generator.

Characteristic	PRNG	TRNG
Non-deterministic	No	Yes
Unpredictable	No	Yes
Reproducible	Yes	No
Periodic	Yes	No

Table 1 Properties of PRNG and TRNG

XI. CONCLUSION

Random number generation is a veiled subject; often used in mathematical settings, but not much studied. Our foray into number generators yielded an implementation of several software generators that seem to work well given certain

seed values and parameters. Other choices of these values failed spectacularly. Given our limited knowledge on the barrage of tests available to test these generators, we cannot say definitively whether any of these generators would continue to perform, under more extensive testing. What we can report is the complexity of random number generation. A deeper understanding of such methods is required as we rely increasingly on random number generation globally.

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Development of a Home Security Robot with FacialRecognition using Deep Learning and IoT

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ABSTRACT

The major problem in any society is the lack of security to residential areas. The number of thefts, electricity and food wastage at homes in urban areas increase every year due to human error. As per the National Crime Records Bureau (NCRB), 2,44,119 cases of robbery, theft, and burglary took place in residential premises in 2019. Also, electricity consumption in Indian homes has tripled since 2010. In 2019, an urban Indian household consumed about 90 units (kWh) of electricity as a monthly average which is one- third of the monthly world average. To solve these issues, we have proposed an idea of a “Home Security Robot” for a smart city using AI. The Home Security Robot will help in eliminating the reliance on security guards and will effectively monitor everything in the house (if there are any gas leakage, fridge malfunctions, unnecessary electricity wastage, indoor air quality and any unknown movements inside the house). If the owner is under attack, he/she can shout out “HELP” or “SAVE ME "so that the robot can take in the voice command to automatically call the police

Keywords : Component, Formatting, Style, Styling, Insert

I. INTRODUCTION

- To solve these issues, we have proposed an idea of a “Home Security Robot” for a smart city using AI. The Home Security Robot will help in eliminating the reliance on security guards and will effectively monitor everything in the house (if there are any gas leakage, fridge malfunctions, unnecessary electricity wastage, indoor air quality and any unknown movements inside the house). If the owner is under attack, he/she can shout out “HELP” or “SAVE ME "so that the robot can take in the voice command to automatically call the police.
- We have three python programs used for facial detection and recognition using OpenCV and Haarcascade Classifier. The first program (Face Dataset) consists of codes that are used in collection of images of known users and storing it in an database for example a folder using HAAR CASCADE CLASSIFIER. The second program (Face Training) is used to train the stored database images and then these trained images are stored in the trainer.yml file. The third program (Face Recognition) is used to read the trained images stored in the trainer.yml file and using HAAR cascade classifier to classify the faces of users and obtain their accuracies.
- The accuracy of facial recognition depends on the number of images of the owner stored in the database using the Face Dataset Program. The time required to run the programs depend on the

version of Raspberry Pi. The accuracy in Raspberry Pi 3 is 72% and version 4 has 85% with same number of images.

II. OBJECTIVES

- To apply deep learning with python programming on Raspberry Pi using Open CV algorithm for image classification and facial detection and recognition.
- TO DEVELOP AN IOT SYSTEM CONSISTING OF RASPBERRY PI, BOLT IOT MODULE, SENSORS (LM35, LDR, PI CAMERA, MQ135) CONNECTED WITH BOLT CLOUD FOR EFFECTIVE SECURITY AND SAFETY OF HOMES AND FAMILIES.

III.LITERATURE REVIEW

A. Comparison of open CV's feature detectors and feature matchers(FRAZER.K.NOBLE):
There exists a range of feature detecting and feature matching algorithms; many of which have been included in the Open Computer Vision (OpenCV) library. This paper discusses the implementation and comparison of a range of the library's feature detectors and feature matchers. It shows that the Speeded-Up Robust Features (SURF) detector found the greatest number of features in an image, and that the Brute

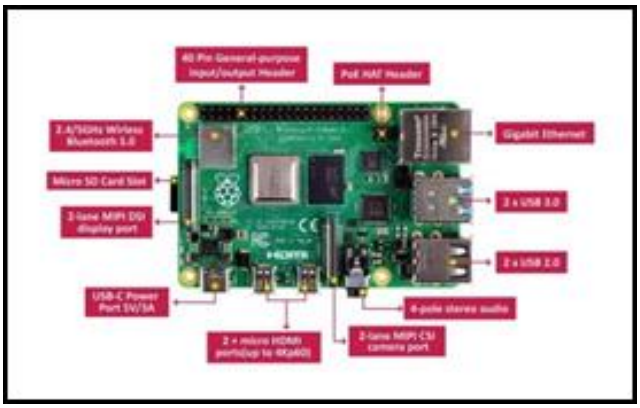
Force (BF) matcher matched the greatest number of detected features in an image pair. Given a benchmark image set, OpenCV's SURF detector found, on average, 1907.20 features in 1538.61 ms, and OpenCV's BF matcher, on average, matched features in 160.24 Mrs. The combination of the Binary Robust Invariant Scalable Key-points (BRISK) detector and BF matcher was found to be the highest ranked combination of OpenCV's feature detectors and feature matchers; on average, detecting and matching 1132.00 and 80.20 features, respectively, in 265.67ms. It was concluded that if the number of features detected is important, the SURF detector should be used; else, if the number of features matched is important, the BF matcher should be used; otherwise, the combination of the OpenCV's BRISK feature detector and BF Feature matcher should be used.

B. Vehicle Theft tracking, detecting and locking using open CV System(MOHANASUNDARAM.S):
In recent days GPS and GSM module used to theft detection and vehicle tracking system. We added technology like; face recognition based on vehicle theft tracking and detection system.Its provides an ultimate solution for this all problems. The face recognition technology is used here. In this paper, face recognition and detection in real time by using Open CV Python Module. Face recognition may solve many problems. Vehicle locking & detection system (or) device is installed in the vehicle. By using mobile application to recognize the face and compares face within their data to checked whether, that user is an automated owner (or) not. If the condition is true, unlock the vehicle. Otherwise the vehicle has been locked If any automatically sending the message and call to the responsible person. This system secures vehicle from theft as well as allowing users to view the theft details thereby highlight the theft details and saving the data in a USB drive. Parameter includes such as position, pose, lightening, background, camera quality and gender.

IV. EXPERIMENTAL EQUIMENT AND INSTRUMENTATION:

a. System specification:
Raspberry PI: Raspberry Pi is a series of small single-board computers developed in the kingdom united by raspberry pi association with Broadcom. Early on, the Raspberry Pi project leaned towards the promotion of teaching basic computer science in schools and in developing countries Later, the original model became far more popular than anticipated, selling outside its target market for uses such as robotics. It is

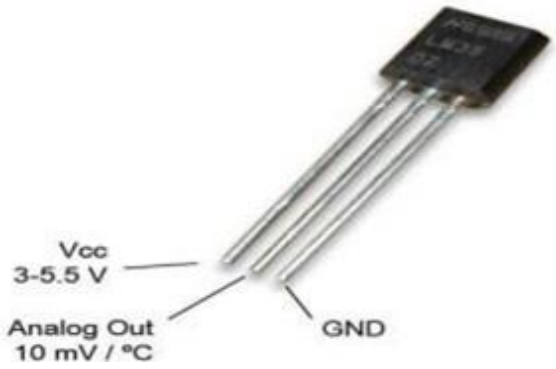
now widely used in many areas, such as for weather monitoring, because of its low cost, modularity, and open design.



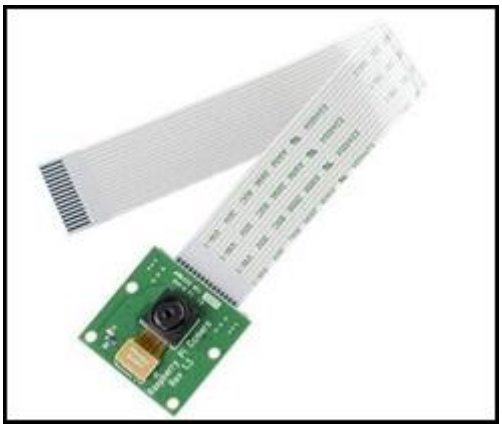
b. BOLT IoT: BOLT is an Internet of Things platform (Hardware + Cloud) that enables user to build Iot products and projects. Using BOLT, users can control and monitor devices from any part of the world. It provides the ability to embed Wi-Fi/GSM capabilities within other systems, or to function as a standalone application.

The manufacturers can embed the Bolt hardware in their product, develop a custom UI and then their users can control their products using the Bolt Iot app. Bolt works on pay as you go basis, which means the manufacturers have no capital investments to get their products Iot enabled. This lets even small-scale players to build Iot enabled products and services.

C. LM35 Sensor: The LM35 series square measure exactness integrated-circuit temperature devices with associate output voltage linearly- proportional to the Centigrade temperature.The LM35 device is rated to work over a −55°C to 150°C temperature vary, whereas the LM35C device is rated for a −40°C to 110°C vary (−10° with improved accuracy).



D. Raspberry PI Camera Module: Raspberry Pi at present sell two sorts of camera board: a 8MP gadget and a 12MP High Quality (HQ) camera. The 8MP gadget is additionally accessible in NoIR structure without an IR channel. The first 5MP gadget is not, at this point accessible from Raspberry Pi. The particulars of the multitude of gadgets can be found here. All Raspberry Pi cameras are equipped for taking high-goal photos, alongside full HD 1080p video, and can be completely controlled automatically. This documentation depicts how to utilize the camera in different situations, and how to utilize the different programming apparatuses.



V. Robot Parts Description:

A. Robot Chassis: The robot chassis bares of all the components required to run the robot and also

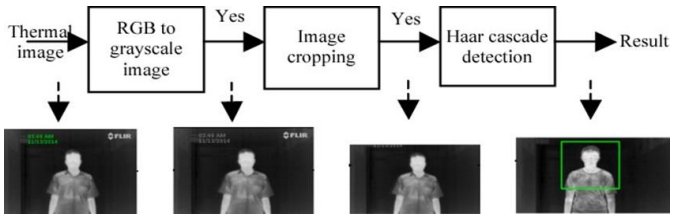
provides structural support to the robot. We designed the chassis using CATIA software and tested the load bearing capacity using ANSYS software.

B. L298D Motor Driver: L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC).

C. LIPO Battery: A lithium polymer battery, or more correctly lithium-ion polymer Battery is a rechargeable battery of lithium-ion using a polymer electrolyte instead of a liquid electrolyte. High conductivity semisolid (gel) polymers form this electrolyte. These batteries provide higher specific energy than other lithium battery types and are used in applications where weight is a critical feature, such as mobile devices, radio- controlled aircraft and some electric vehicles.

VI. Working of Prototype

To solve the problem of theft and accidents that occur at home using a smart security robot. The robot works on raspberry PI operating system which is loaded with thony python IDE. Our python program consists of facial detection program using Open CV package which works on haar cascade classifier for facial detection and recognition.



PROGRAM 1: FACE DATASET

This program consists of codes that are used in collection of images of known users and storing it in an database for example a folder or a cloud storage using HAAR CASCADE CLASSIFIER. When the program runs it takes

specified amount of pictures. The output of this program is to store the users faces in database.

PROGRAM2: FACE TRAINING

We train the stored database images and then these trained images are stored in the trainer.yml file. The output of this program is to trainer the images of the users stored in the database.

PROGRAM3: FACE RECOGNITION

We are reading the trained images stored in the trainer.yml file and using HAAR cascade classifier to classify the faces of users and obtain the accuracies. If there is no set of images in the database then the program shows an error. The output of this program is to recognize multiple faces stored in the database and give their accuracies and if there is a strangers face it shows negative accuracy and shows unknown.

VII. RESULTS AND CONCLUSION

The accuracy is around 60-75% due to less images stored in the database because of less memory space available in Raspberry Pi 3. The time required to store these images in database is close to 18-20 seconds.

The sensors (LM35, LDR, MQ135) data is sent to the BOLT cloud using BOLT Iot Module. The safe ranges for sensor values were specified in python program run on Ubuntu server. The data is collected and compared to these ranges. If the data falls outside the specified range, a Telegram alert message is sent using a telegram bot on a telegram channel.

The accuracy can be increased by adding more images in the database or by upgrading Raspberry Pi version. The time required to run the Python programs and store images In database depends on the Raspberry Pi model.

OUTPUT CHARACTERISTICS	RASPBERRY PI 3	RASPBERRY PI 4
FACIAL RECOGNITION ACCURACY	70-75%	82-85%
TIME TAKEN FOR IMAGE CAPTURING	18 SECONDS	10-12 SECONDS
IMAGES STORED IN DATABASE	70-90 IMAGES	300-400 IMAGES

Table 1. Comparison between raspberry pi 3 and raspberry pi 4

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IoT in Hybrid Grid Integrated Management System

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ABSTRACT
The control and monitor of system with advanced technology gives the qualitative and quantitative analysis in any field of engineering. It reduces the time of operation to solve any issue in a system. The necessity of these technologies is very high in integrated electrical system which gives the fast response. Internet of things (IoT) is a new environment helps us in hybrid integrated renewable energy source management system. This is the new era in electrical engineering to improve the smart grid operation over the cloud with remote access using internet. In this paper, the IoT approach to evaluate the smart grid management system is described. The potential of IoT in the grid integration from the basics are also covered in this paper.

Keywords : - Hybrid Integrated grid, IoT (Internet of Things), smart grid

I. INTRODUCTION

The increase in load demand and depleting of fossil fuels leads to depend on alternate energy resources like solar, wind, fuel cell to replace the conventional energy sources. In last three decades many researchers have been working on the integration of power plants using traditional energy sources and non-conventional energy resources. The IoT based devices makes the smart grid integration, so that the monitor and control process can be perform effectively. This leads to economical distribution energy integrated system for the load [1].

The main objective of this integration to minimize the energy loss and renewable energy generation cost. But some of the power generation capacities and energy storage charge management conditions enforced by the boundary conditions. The main focus here is to develop the optimized model for the micro grid which comprises of solar power generation, wind power, ultra-capacitors and a centralized distribution system. The present central power stations which control power grid by the estimation of power to meet the load demand. The problem with renewable energy sources is a variable power output over the time period. Due to the variable output power of these sources are not suited for integration with conventional power grid systems. To integrate them, the possible solution is battery storage. The main focus of this paper is to cover issues and challenges of the conventional systems and IoT based devices applications.

The problems in an electrical network are increasing due to load demand and lack of advanced monitor and control over the system. The smart grid can give reliable and secure electricity to the customers.

Integration of renewable sources into utility grids faces the challenge of controlling mechanism with storage facility [2]. The economic development of a country is based on the per capita consumption, so the generation of power and its consumption is an important consideration for the development of a country. The implementation of new technologies plays a vital role for efficient and reliable smart grid [3]. Now a day, in all most all sectors the usage of IoT based devices are increased rapidly as a part of smart network. The IoT can be used in sectors like smart grid architecture, weather forecasting, military applications, and smart automation of industry. Basically, the IoT refers to the Internet-based architecture that facilitates the exchange of services, information, and data among the billions of smart objects. By contrast, a smart grid can provide two-way communication between a grid and energy management system and monitors and controls energy-generating units [4]. The fig.1. Shows the smart grid network with renewable energy resources.

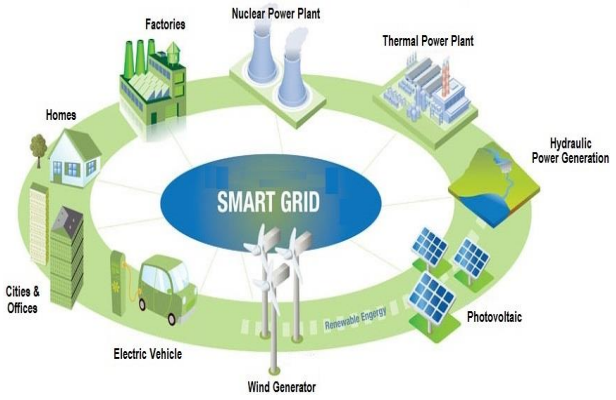

Fig.1.Smart Grid Network with renewable energy resources

ARCHITECTURE of HYBRID MICRO GRID

The basic hybrid micro grid system consists of solar panels along with battery storage system as shown in Fig.2. The main purpose of this system is to maintain the desired battery charge state.

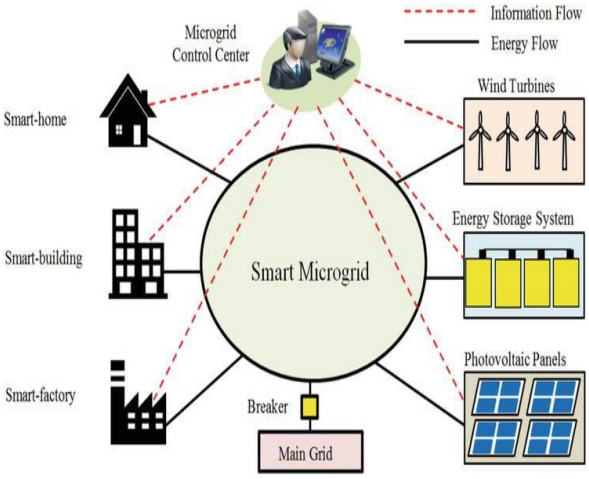

Fig.2.Architecture of Smart Hybrid Micro grid

An IoT based network for integration of energy storage and renewable energy resources in distribution system was introduced in [5]. The distribution renewable energy resources are developed based on the system operation using IoT architecture. The paper evaluates the IoT-based devices integration in distribution system with quantitative analysis. The optimal power flow is achieved by a forward-backward algorithm development. The effect of distribution energy resource management is analyzed under several IoT-based load conditions. The traditional system without any energy resources case and the renewable energy with energy storage case are explained in this paper.

The energy storage systems in the IoT can significantly improve the grid efficiency, stability, and reliability. A storage device can reduce the stress of a grid and store energy for later use, thus ensuring the smooth supply of electricity. The ESS can improve power quality and solve the problem of voltage fluctuations [6]. Commonly used storage devices are batteries, super capacitors, fuel cells, flywheel, compressed air, and pumped hydro. The smart grid benefits in hybrid micro grid system are focused in fig.3. The benefits like energy management, smart meter infra, security, bi-directional power flow. By

this, the power generation from fossil fuel is reduced, so that we can achieve greenhouse gas emissions.

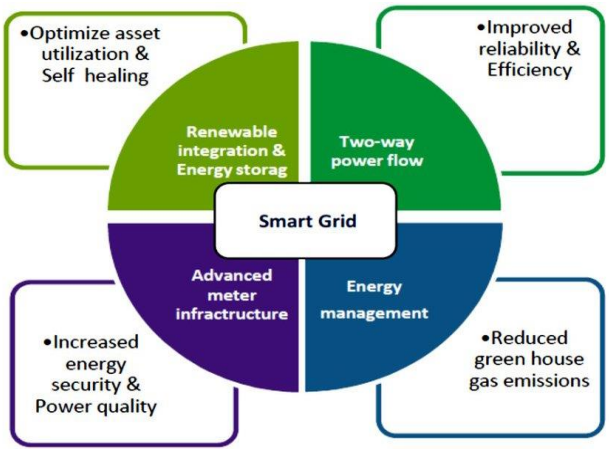

Fig.3. Smart grid benefits

PROPOSED IoT BASED ARCHITECTURE

The smart infra is the new concept of world to upgrade the industry and domestic systems. Every country is showing interest on smart grid in the field of renewable energy generation to improve the reliability of the system. The proposed model consists of solar panels, battery bank, charge controller, bidirectional converter, load and IoT based devices as shown in fig.4.

A DC-bus, or AC-bus, or in a hybrid DC/AC buses are connected together as shown in figure. The type of output power for most generation and loads is deciding the choice of configuration. Therefore, it is better to use DC-bus coupling if most generation and some loads are DC and to use AC-bus coupling in the case of mainly AC generation and loads. If the major power sources of the HRES generate a mixture of AC and DC power, then a hybrid-coupled integration scheme is preferable.

To meet the demand at low cost, the intelligent algorithm is evolved to obtain the optimum size of integrated grid. The load is divided into two varieties of fractions, low priority load (LPL) and high priority load (HPL). Demand profile improvement is carried out by shifting the LPL from low generation to high generation time. The logic used in this algorithm is designed to follow the value of the loss of load probability (LOLP) and the dummy energy (E_{dummy}) to satisfy the aggregate load demand with a minimum value of levelized energy cost (LEC). Particle swarm optimization (PSO) algorithm is employed for seeking optimum size of HRES at a minimum cost of energy of the system under study. Furthermore, parallel implementation of PSO (PIPSO) is a new proposed method to distribute the evaluation of the fitness function and constraints among the ready-made processors or cores and to speed up the optimization process [7].

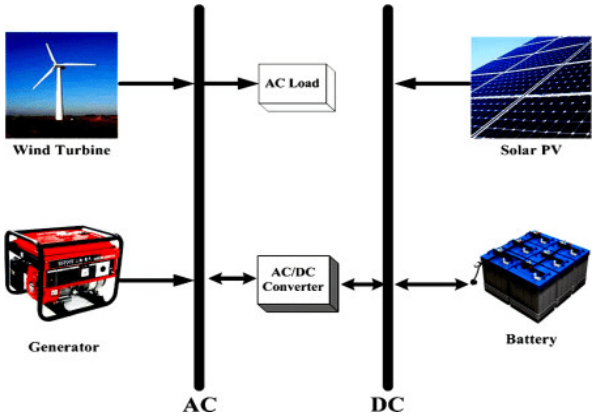

Fig.4. Schematic diagram of the hybrid PV/wind/diesel/battery energy system

The conventional distribution system is subjected to various illegal usage of electricity. The losses are about 20% in distribution and transmission system. In a hybrid micro grid system the solar energy output is monitored separately with real time analytics and theft is nearly as difficult as stealing the sunlight. There exists a system of observers and identifies to contact each node user and operator immediately as and when an intrusive behavior is detected within the grid.

The illegal node is removed from the grid in the process. In the event of doing so, user can also consume his own solar power output but cannot do any transaction of power with others in the grid [8].

The simplified IoT based architecture is shown in fig.5.

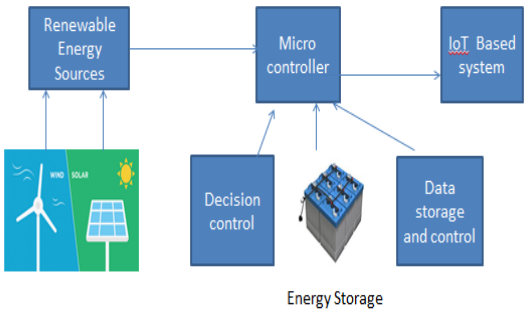

Fig.5. IoT based architecture

The following hardware components as shown in fig.6to 9 constitute a hybrid micro grid system to collect the data from system. The basic circuit requires major component like ACS758LCB-100B high current bi-directional current sensor, LM358-Single Supply Dual Operational Amplifiers, ESP8266 -12e Wifi module and CY8CKIT-044 PSoC® 4 M-Series Pioneer Kit.

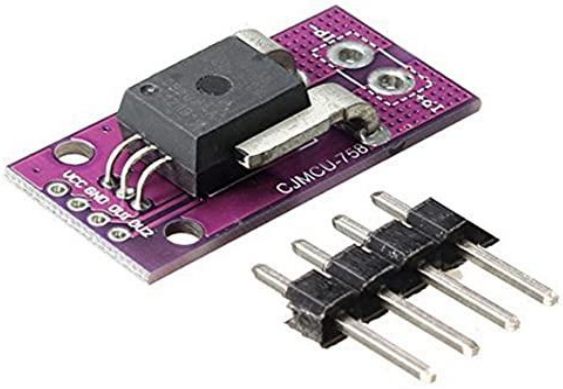

Fig.6. ACS758LCB-100B high current bi-directional current sensor

Fig.7.LM358-Single Supply Dual Operational Amplifiers

Fig.8. IoT with ESP8266 -12e Wifi module

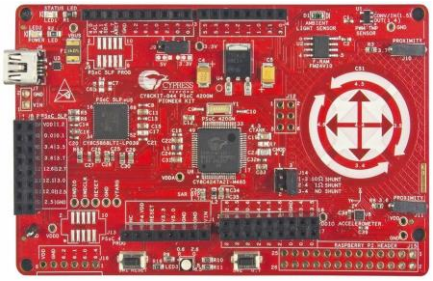

Fig.9. CY8CKIT-044 PSoC® 4 M-Series Pioneer Kit

PROPOSED OPTIMIZATION ALGORITHM

The process of local exploitation and global exploration method is discussed. The mesh adaptive direct search (MADS) algorithm as a local optimization and particle swarm optimization (PSO) algorithm as global exploration method are to be used to obtain solution with high accuracy. Both of these algorithms don't require any gradient information of fitness function. Program start with PSO and the best solution of each iteration is sent to MADS for local search. If any improvement is achieved, the new MADS solution is updated and replaced with the old PSO solution. Otherwise, no changed is made on PSO solution. Detailed procedure of MADS is reported in [10] to achieve efficient solution.

One of the most important issues in the recent studies is to optimally size the HRES components to meet all load requirements with possible minimum cost and highest reliability. In view of the complexity of optimization of the HRES, it was imperative to discover effective optimization methods ready to get good optimization results especially, for the complex optimization problems.

Particle Swarm Optimization (PSO) is recommended as a standout amongst the most valuable and promising methods for optimizing the HRES because of using the global optimum to locate the best solution. PSO algorithm is designed based on swarm intelligence and used to handle the complex optimization problems. A novel intelligent PSO algorithm based on smart grid applications is introduced to determine the optimum size of the hybrid system. The main objective of this algorithm is to optimize the system size so as to meet the load requirements with the minimum cost and the highest reliability. The flowchart of the PSO is shown in fig.11.

Load shifting-based load priority is presented in this chapter as one of smart grid applications by shifting the LPL from deficit generation time to surplus generation time of HRES.

A comparison between the results obtained from PSO algorithm and those from the iterative optimization techniques (IOT) is introduced. Moreover, parallel implementation of PSO (PIPSO) is a new proposed method is effective to distribute the evaluation of the fitness function and constraints among the readymade processors or cores, and to speed up the optimization process. Furthermore, a comparison between utilizing PIPSO and utilizing a serial implementation of PSO (SIPSO) is presented.

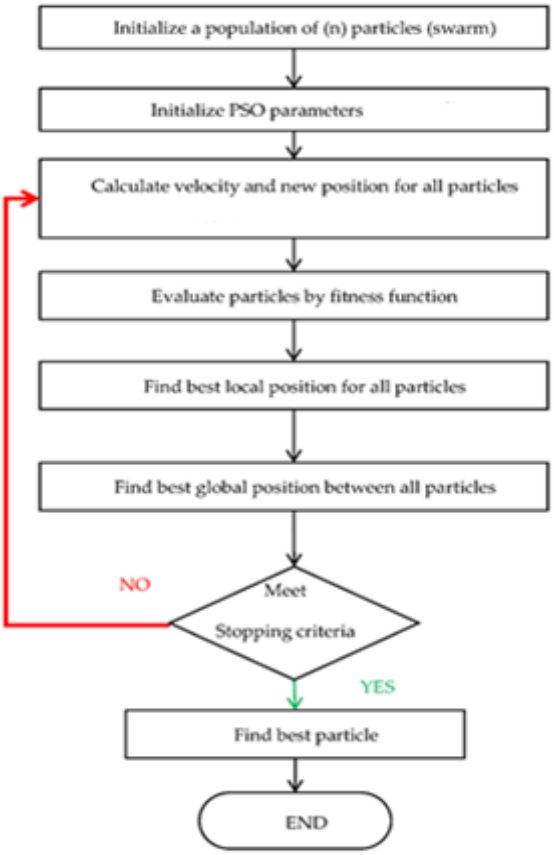

Fig.10. Flowchart of particle Swarm Optimization (PSO) algorithm

Considering distribution system operation criteria, model of multi-objective fitness function can be written as the total summation of loss cost, cost of purchasing electricity from the grid, renewable energy unit cost, and encouragement for end users who modify their energy consumption patterns. The objective function is given as equation:

$$\text{Min}f_{\text{Total}} = f_{\text{loss}} + f_{\text{grid}} + f_{\text{renewable}} + f_{\text{prize}} \quad \text{-------- (i)}$$

Energy management of distribution system must respect some of technical constraints. In this paper, it is assumed that all home appliances are categorized in flexible IoT smart devices and inflexible device. For more simplification we don't consider the role of human in changing inflexible devices manually. Therefore, just flexible device would be modified by third party offers and end user preferences.

Furthermore, all renewable energy resources consumed inflexible and with no dispatch ability. So, in this paper, we manly investigate the role of IoT based loads on distribution system management. Here, two IoT smart devices are covered: time flexible and power flexible devices [7].

The following operational algorithm is proposed for power management of the HRES. The HPL is supplied primarily from WT and afterward PV array, respectively. In the case of the generated power from the RES surpasses the required power for the HPL (PLHP), the excess power will be used to charge the batteries up to its maximum level, EB,max. The abundance power above EB,max will be used to supply the LPL (PLLP). If the power exceeds the LPL demand; the surplus power will be used to supply the dummy load, Pdummy. If there is an unmet LPL demand; it will be shifted to the time of surplus generation.

II. CONCLUSION

This paper concludes an optimized solution for renewable energy utilization via smart hybrid integrated grids to achieve efficient, reliable and secured system. The hybrid micro grids integrated with other renewable energy resources should be installed to generate the energy locally and share with other utilities in a grid. It will control and monitor the entire system over the internet using IoT based devices. The smart grid system can provide the data sharing effectively. IoT based sensors along with data loggers will transfer the data over a cloud in real time for qualitative and quantitative analysis.

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Airport Automation using GSM

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ABSTRACT

Automation refers to "The Automatic controlling of a Task". Airport Automation deals with the Automatic controlling of tasks of the Airport like check in, security check , announcements , aircraft arrival and departure information , baggage control,.etc. This reduces the risk of manual errors during task execution , which may lead to accidents and delays at the Airport.

Keywords : - Automation, Airport, GSM, Control systems

I. INTRODUCTION

Aircraft is the best means for traveling far off distances by many passengers to other countries or continents. Airport is the base station for the passengers from where they will travel to their respective destinations. Till now the Airport tasks was controlled manually by humans [1]. That is, one section of Airport would be set to control the landing and take off of the Aircraft's, one section for security check, one more section for weather checking, other section for controlling the check-in and check-out of the passenger's at the Airport. Due to such manual controlling many error occur, resulting in delay, which could cause the runway unsafe for landing [2]. Their would be lot of delay in security checking counter's as well.This is all about manual controlling of different tasks of airport separately, which may lead to several accidents , insecurity of passengers at the airport [3].

II. OUR CONTRIBUTION

As a major step to prevent the confusions, and accident at the Airport , we are introducing a prototype model, which tells about automatic controlling of tasks. Here we use 89c51 microcontroller , member of intel 8051 family. The special feature of microcontroller is that , it can perform 'n' number of tasks at a time simultaneously with out much delay.

We use GSM technology, for communicating with the pilot's of aircraft. Before take off of aircraft to its destination's base station, a message is send to destination's base station by pilot regarding flight details [4]. Immediately after receiving message, the weather sensor would be made ON for checking weather and checks the runway for clearance , if every thing

is good, a message is sent automatically to pilot to take off and reach to its destination. When the aircraft approaches near airport, with the help FM receiver the aircraft is detected and automatically announcement is made at the airport regarding arrival of flight. When aircraft lands at the runway , another announcement is made automatically regarding the flights arrival at respective terminal number when it has arrived. Automatically with the help of conveyer, the baggage's of all passengers are directly are sent to the security checking centre from Aircraft itself. Passengers need not have to bother about their luggages because after checking it in the entrance, the baggages will be taken care of till the destination [5].This is a prototype model describes an integrated system room where baggage handling, apron handling, security, ground handling, take off and landing controlling and immigration will operate together.

III. BLOCK DIAGRAM AND FUNCTIONAL DESCRIPTION

GSM stands for Global System for Mobile Communication. This is a worldwide standard for digital cellular telephony, or as most people know them Digital Mobile Telephones [6]. In addition to digital transmission, GSM incorporates many advanced services and features, including ISDN compatibility and worldwide roaming in other GSM networks. The advanced services and architecture of GSM have made it a model for future third-generation cellular systems, such as UMTS. GSM was designed having interoperability with ISDN in mind, and the services provided by GSM are a subset of the standard ISDN services. Speech is the most basic, and most important teleservice provided by GSM [7]. In addition, various data services are supported, with user bit rates up to 9600 bps. Specially equipped GSM terminals can connect with PSTN, ISDN, Packet Switched and Circuit Switched Public Data Net-works, through several possible methods, using synchronous or asynchronous transmission. Also supported are Group 3 facsimile services, videotex, and teletex. Other GSM services include a cell broadcast service, where messages such as traffic

reports, are broadcast to users in particular cells. A service unique to GSM, the Short Message Service, allows users to send and receive point-to-point alphanumeric messages up to a few tens of bytes. It is similar to paging services, but much more comprehensive, allowing bi-directional messages, store-and-forward delivery, and acknowledgement of successful delivery [8].

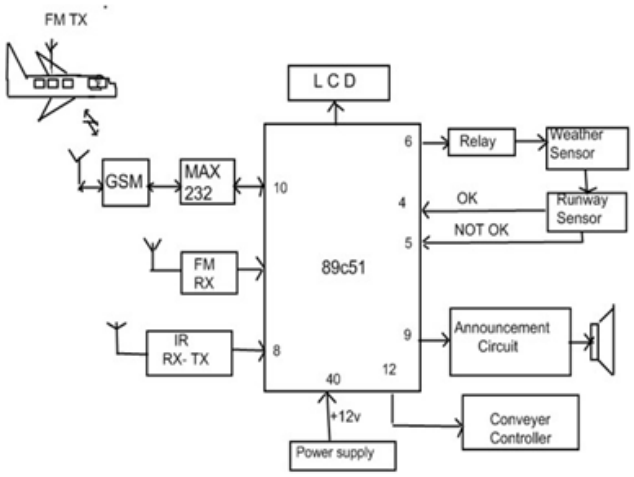

Fig. 1. Block Diagram of Airport Automation

B. GSM Frequencies

In principle the GSM system can be implemented in any frequency Band. GSM frequency bands are the radio frequen-cies designated by the ITU for the operation of the GSM for phones. However there are several Bands as shown in table I. Where the GSM terminals are or will shortly be available. GSM terminals may incorporate one or more of the GSM technology bands listed below to facilitate roaming on a global basis. There are fourteen bands defined in 3GPP TS 45.005, which succeeded 3GPP TS 05.05 [11].

TABLE I. STANDARD GSM FREQUENCIES [12]

System	Band	Uplink(MHz)	Downlink (MHz)	Channel Number
GSM-450	450	450.4–457.6	460.4–467.6	259–293
GSM-480	480	478.8–486.0	488.8–496.0	306–340
GSM-750	750	747.0–762.0	777.0–792.0	438–511
GSM-850	850	824.0–849.0	869.0–894.0	128–251
GSM-900	900	880.0–915.0	925.0–960.0	975–1023, 0-124

C. GSM Modem

GSM MODEM provides full functions capability to serial devices to send SMS and data over GSM network . The most familiar modem is the one that we use for browsing Internet. The conventional modem has two connection ends and both the connections are wired. One end is connected to the com-puter and the other end is connected to the telephone line. The serial port of the computer (of RS-232 standards) is connected to the modem while the other end of the modem is connected to the telephone line and the modem effects the two-way data communication. The GSM modem is slightly different from the conventional modem. This utilizes the GSM standard for cellular technology. The GSM modem acts like a cellular phone and transmits text and voice data. It communicates with the GSM network via the SIM (Subscriber's Identity Module) card. We use the Nokia 1110 mobile phone in place of this modem for interfacing with the microcontroller via the data cable.

The AT commands are used to control the operation of the modem. They are called AT commands because the characters AT must precede each command to get the ATtention of the modem. AT commands can be issued only when the modem is in command mode or online command mode [13]. The modem is in command mode whenever it is not connected to another modem. The modem is in data mode whenever it is connected to another modem and ready to exchange data. Online command mode is a temporary state in which one can issue commands to the modem while connected to another modem. To put the modem into online command mode from data mode, we must issue an escape sequence (+++) followed immediately by the AT characters and the command, e.g., +++ to hang up the modem. To return to data mode from online command mode, we must issue the command ATO. To send AT commands to the modem we must use a communications program, such as the HyperTerminal applet in Windows 98/95 and NT 4.0, or some other available terminal program. We can issue commands to the modem either directly, by typing them in the terminal window of the communications program, or indirectly, by configuring the operating system or com-munications program to send the commands automatically. Fortunately, communications programs make daily operation of modems effortless by hiding the commands from the user. Most users, therefore, need to use AT commands only when reconfiguring the modem, e.g., to turn auto answer on or off. The format for entering an AT command is ATXn, where X is the command and n is the specific value for the command, sometimes called the command parameter. The value is always a number. If the value is zero, it can be omitted from the command. Most commands have a default value, which is the value that is set at the factory. One must press ENTER (depending on the terminal program it could be some other key) to send the command to the modem. Any time the modem receives a command it sends a response known as a result code. The most common result codes are OK, ERROR, and the CONNECT messages that the modem sends to the computer when it is connecting to another modem. Several commands can be issued in one line, in what is called a command string. The command string begins with AT and ends when ENTER is pressed. Spaces to separate the commands are optional; the command interpreter ignores them. The most familiar command string is the initialization string, which is used to configure the modem when it is turned on or reset, or when the communications software calls another modem. The AT commands used by us for the purpose of sending messages through the GSM modem, are AT+CMGF

and AT+CMGS. Issuing the AT+CMGF helps in setting its mode (PDU or text). Its syntax is AT+CMGF = [¡mode¿] Issuing the AT+CMGS command, the GSM modem will send an SMS to the mobile number that is sent as a parameter in the AT command. Its syntax is AT+CMGS = ¡phone number¿¡CR¿ message ¡Ctrl+Z¿.

D. AT89C51 Microcontroller

The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pinout. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications [14].

The AT89C51 provides the following standard features: 4K bytes of Flash, 128 bytes of RAM, 32 I/O lines, two 16-bit timer/counters, a five vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator and clock circuitry. In addition, the AT89C51 is designed with static logic for

operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port and interrupt system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator disabling all other chip functions until the next hardware reset.

E. FM Receiver and Transmitter

The FM transmitter is working on 27 Mhz is used to control the relay .It based on DTMF (dual tone multi frequency). The DTMF generate IC no 91214 various types of 16 tones the tones are modulated in modulator section after amplification by the RF section is radiated by the antenna Transistor BC 494 are used for RF amp and modulator .Rod antenna is used to transmit the FM modulated signal because the impedance of the circuit and the antenna are same 75 ohm.

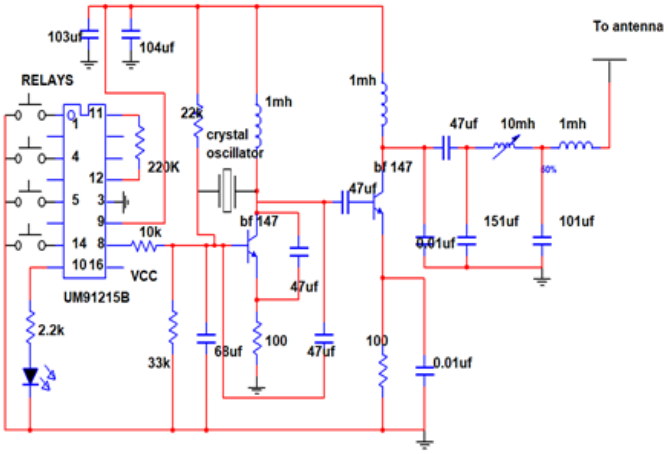

Fig. 2. FM Transmitter

The signal transmitted is received by the Receiver an-ntena.The length of the anntena is reduced by the connecting the inductor in series with the antenna.Its then fed to the RF amplifier to amplify the received signal since received signal strenght is low. An inductor is connected at the collector and tuned to the carier frequency used to the transmitter for synchronization the receiver and tranmsitter frequency .Frequency modulated signal is obtained at the collector. The signal is then demodulated by passing it through diode, which removes the carier signal and hence signal obtained at the output of the diode is a DTMF signal.Which is then passed to the DTMF decoder to Deocode the signal sent and hence run the relay and inturn controlls in which direction should the 12V DC motor rotate depending on the signal transmiited from the receiver section.

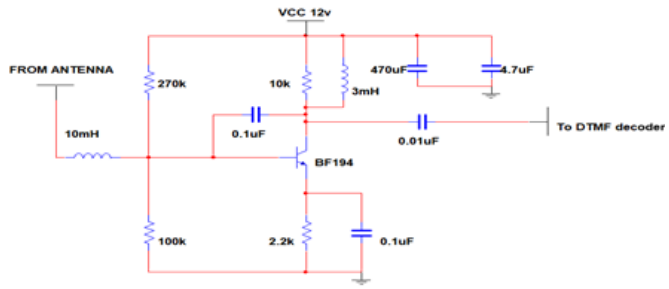

Fig. 3. FM Receiver

F. Announcement Circuit

The APR9600 device offers true single-chip voice record-ing, non-volatile storage, and playback capability for 40 to 60 seconds. The device supports both random and sequential access of multiple messages. Sample rates are user-selectable, allowing designers to customize their design for unique quality and storage time needs. Integrated output amplifier, micro-phone amplifier, and AGC circuits greatly simplify system design [15].

The device is ideal for use in portable voice recorders, toys, and many other consumer and industrial applications.APLUS integrated achieves these high levels of storage capability by using its proprietary analog/multilevel storage technology implemented in an advanced Flash non-volatile memory pro-cess, where each memory cell can store 256 voltage levels. This technology enables the APR9600 device to reproduce voice signals in their natural form. It eliminates the need for encoding and compression, which often introduce distortion. The APR9600 device incorporates several features designed to help simplify microprocessor controlled message management. When controlling messages the microprocessor essentially toggles pins as described in the message management sections describe previously. The Busy,Strobe, and M7END pins are included to simplify handshaking between the microprocessor and the APR9600 The /Busy pin when low indicates to the host processor that the device is busy and that no commands can be currently accepted. When this pin is high the device is ready to accept and execute commands from the host.

The APR9600 samples incoming voice signals and stores the instantaneous voltage samples in non-volatile FLASH memory cells. Each memory cell can support voltage ranges from 0 to 256 levels. These 256 discrete voltage levels are the equivalent of 8-bit (28=256) binary encoded values. During playback the stored signals are retrieved from memory, smoothed to form a continuous signal, and then amplified before being fed to an external speaker.

According to the Shannon's sampling theorem, the highest possible frequency component introduced to the input of a sampling system must be equal to or less than half the sampling frequency if aliasing errors are to be eliminated. The APR9600 automatically filters its input, based on the selected sampling frequency, to meet this requirement. Higher sampling rates increase the bandwidth and hence the voice quality, but they also use more memory cells for the same length of recording time. Lower sampling rates use fewer memory cells and effectively increase the duration capabilities of the device, but they also reduce incoming signal bandwidth. The APR9600 accommodates sampling rates as high as 8 kHz and as low a 4 kHz. You can control the quality/duration trade off by controlling the sampling frequency. An internal oscillator provides the APR 9600 sampling clock. Oscillator frequency can be changed by changing the resistance from the OscR pin to GND. Table 2 summarizes resistance values and the corresponding sampling frequencies, as well as the resulting input bandwidth and duration.

TABLE II. STANDARD GSM FREQUENCIES

Ref Rosc	Sampling Frequency	input Bandwidth	Duration
84K	4.2 KHz	2.1 KHz	60 sec
38K	6.4 KHz	3.2 KHz	40 sec
24K	8 KHz	4.0 KHz	32 sec

G. Firmware Development

The firmware for the airport automation system was de-veloped using Keil software. The process flow chart below describes the step by step execution of the automated system. The prototype testing of the system yielded better response.

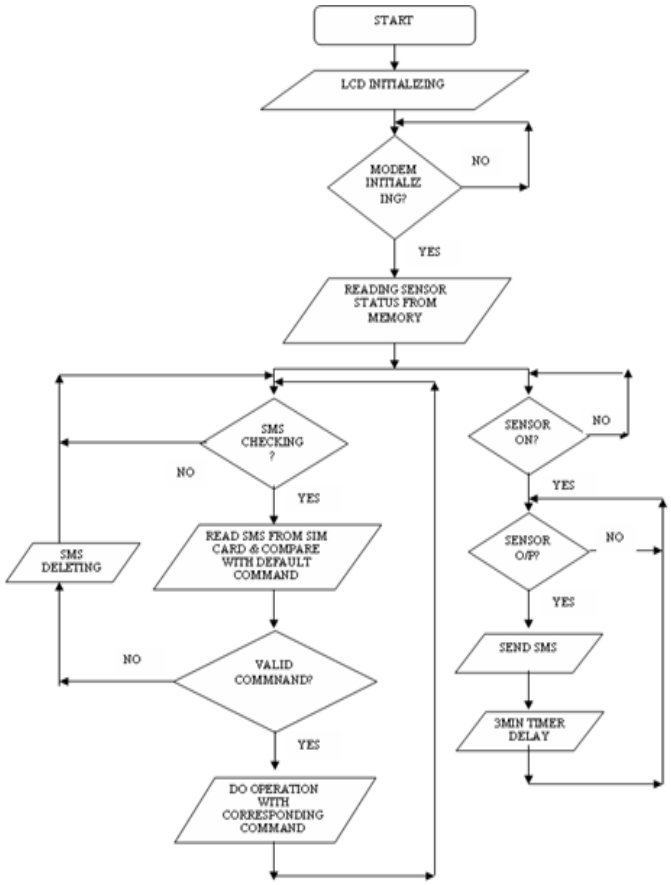

Fig. 4. Firmware Development

IV. CONCLUSION AND FUTURE SCOPE

This project is an attempt to present a prototype model which can operate automatically with minimum human inter-vention. It also capable of collecting the data from the pilot of planes and communicate simultaneously with help of GSM. The GSM will also be able to send the encrypted messages about safe landing of the airplane. The GSM device helps in sending the SMS message via the GSM network.This project also tries to present a prototype model which is cost effective and versatile in its work and function compared to the present airports.

The cost effective objective can be realized by the careful selection of components, which in the project has been suc-cessfully implemented . This prototype model can be used to reduce human risk operations in place of man-machine monitoring for service which is hazardous.

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Fuzzy Elman-Jordan Neural Network Based Space Vector Modulation for VSI Fed Induction Motor Drive

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ABSTRACT

The space vector modulation is one of an optimal pulse width modulation approach employed for variable speed drive application. This Paper develops a fuzzy ELMAN JORDAN neural network model to perform space vector modulation for a voltage source inverter. The developed fuzzy- ELMAN JORDAN neural network (Fuzzy-EJNN) is one of the computational intelligent technique and the proposed method is noted to be independent of the switching frequency and employs gradient descent learning rule for training the network process. The ELMAN JORDAN neural network employs recurrent architecture model and gets hybridized with fuzzy system module and performs space vector modulation (SVM). Using this fuzzy-neural approach, SVM operation becomes much faster and the algorithm trains itself to achieve minimal training and testing error and gets converged within minimum number of iterations. The recurrent architecture of the ELMAN neural model makes it to get converged faster and result in better total harmonic distortion (THD) in comparison with the traditional drive modules. Simulation results of the proposed technique are verified experimentally with Dspace module. Results prove the superiority of the proposed model in comparison with that of the individual other neural network models considered.

Keywords : Space Vector Modulation, Total Harmonic Distortion, Voltage Source Inverter, Random Space Vector Pulse Width Modulation

I. INTRODUCTION

The extensive literature study made in the area of voltage source inverter design for drives. In this Paper, it is well observed that they possess numerous applications for active filter designs, motor drive modules and uninterruptible power supplies. The working efficiency and effectiveness of voltage source inverter highly depends on the switching scheme employed. Due to which, several pulse width modulation techniques were developed over the decades. The paper presents Improved random space vector modulation techniques for effective VSI design as applicable for induction motor drives and intelligent controllers have also been designed for carrying out an effective pulse width modulation approach so as to operate the inverters. This section presents a brief overview on the review made on the applicability of various fuzzy, neural network based intelligent controllers employed to perform effective PWM operation and thereby to operate VSI based motor drives.

The torque ripple is the common notable problem in variable speed drives, Rajasekaran and Senthilkumar (2018) proposed various direct torque and flux based control strategies to accomplish the requirement of torque ripple reduction in induction motors. The proposed neutral point clamped inverter reduces the harmonics than the conventional inverters. The comparative study made with PI, Fuzzy, ANFIS techniques based on the factor of total harmonics distortion (THD) validates the effectiveness of the proposed strategies. Mini et al. (2017) presented a power factor correction method using Cuk converter for inverter fed induction motor drives. The presented converter operating in discontinuous inductor current mode reduces the THD and improves the efficiency. Further the speed control achieved by the presented fuzzy logic controller.

To improve the efficiency of Matrix Converters (MC), Sri Vidhya & Venkatesan (2018) discussed about quasi-Z-source indirect matrix converter (QZSIMC) to control the flow rate of the dye in paper mills. Between the voltage source and indirect matrix converter the proposed QZSIMC is placed. The fuzzy logic controller is used to meet the duty rati0 on variations. Ranga et al. (2016) presented adaptive neuro fuzzy based indirect vector control variable speed drive for doubly fed induction motor. The proposed VSI considerably reduces the torque ripple in induction generator and also the performance of ANFIS controller is compared with PI controller, the obtain results found be better for ANFIS than PI based VSI.

To address the shortcomings of hybrid space vector pulse width modulation (HSVPWM) such as at high switching frequencies the practical implementation is difficult, so Abhiram & Prasad et al. (2016) proposed neuro-fuzzy based HSVPWM method for two level VSI fed induction motor. The presented method is practically implemented in real time processor at switching frequency of 5 kHz for IGBT based VSI. Aruninivas & Themozhi (2016) proposed fuzzy logic controller based Cuk converter fed induction motor. The induction motor is powered through Photo Voltaic system, the PV generated DC power is boosted by the proposed cuk converter and fed to an inverter unit to power the three-phase induction motor. The closed loop response of PID and Fuzzy based driving system is simulated and the comparative study depicts that the fuzzy based driver reduces the torque ripple with better time domain response.

Menghal & Laxmi (2016) discussed about fuzzy logic and PI controller for induction motor drive to improve the performance of the machine. The closed loop response of Fuzzy and PI controllers-based drive of induction motor is simulated through Matlab Simulink model. The current ripples and total harmonics distortion are reduced by introducing fuzzy based SVPWM method in inverter fed induction motors. The work presented by the authors, Aravind et al. (2016) for the provided sampling frequencies, the possible sequences from the proposed three which results in same average switching frequency is identified through the proposed FSVPWM and CSVPWM methods at the condition of variable speed. The simulation studies prove the significant impact of FSVPWM method on ripple and THD reduction than the CSVPWM. Naveena et al. (2015) presented fault monitoring system based on Fuzzy logic approach of VSI fed induction motors. The linguistic variables represent the motor condition and based on the fuzzy rule base framed the fault is diagnosed with knowledge of measured current values. The simulation result demonstrates the performance of the proposed methodology.

II. Review of Space vector Pulse width Modulation

This section presents the details on the duty cycle obtained during the switching states of the voltage source inverter. Figure 1 provides the space vector

diagram for the inverter fed drive. From Figure 1, the reference vector during one sampling period is given by,

$$V_{ref} = (T_1 \cdot V_n + T_2 \cdot V_{n+1})/T_s \quad (1)$$

where T_1, T_2 represents effective times in respect of active vectors $V_1 - V_6$. The duty cycle of α inverter switching states is given as,

$$D_1 = \frac{2\sqrt{3}}{\pi} m \sin\left(\frac{\pi}{3} - \alpha\right) \quad (2)$$

$$D_2 = \frac{2\sqrt{3}}{\pi} m \sin(\alpha)) \quad (3)$$

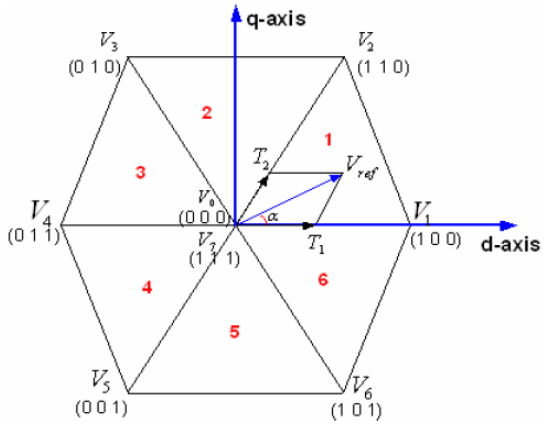


Figure 1. Space vector diagram of a three phase VSI fed inductor drive

III. PROPOSED FUZZY - ELMAN JORDAN NEURAL NETWORK MODEL FOR SVM

In this work, a fuzzy based ELMAN-JORDAN neural network architecture is developed to perform space vector modulation of a VSI fed induction motor drive. ELMAN-JORDAN neural network is a recurrent neural network model which performs its training in a relatively better manner. Even though there exist numerous neural network architectures like back propagation neural network, adaline model, perceptron model and so on, this work focussed on developing ELMAN-JORDAN model due to their recurrent nature and the feedback signal being sent to the hidden layers, which increases its accuracy rate. Fuzzy inference system design operates on assigning membership values to the input parameters and thereby formulating the rules to make inferences. With respect to the output inference made by the fuzzy system module the response of the system is noted. Combining the positive aspects of recurrent ELMAN-JORDAN model and fuzzy system technique, this thesis chapter contributes in developing a fuzzy-ELMAN-JORDAN neural network (Fuzzy-EJNN) model-based space vector modulation operation. The following sub-sections present the development of the proposed technique.

ELMAN-JORDAN neural network are under the class of recurrent neural network models which possess a closed loop in their architectural topological structure. In these types of recurrent neural models, certain group of units receives feedback signals from the earlier time steps and these units are called context units. These context units interact only with that of the hidden layer and not with any other layers. Figure 2 shows a fundamental ELMAN-JORDAN neural network model.

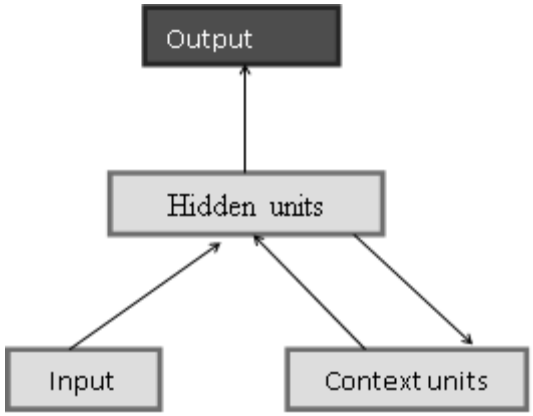
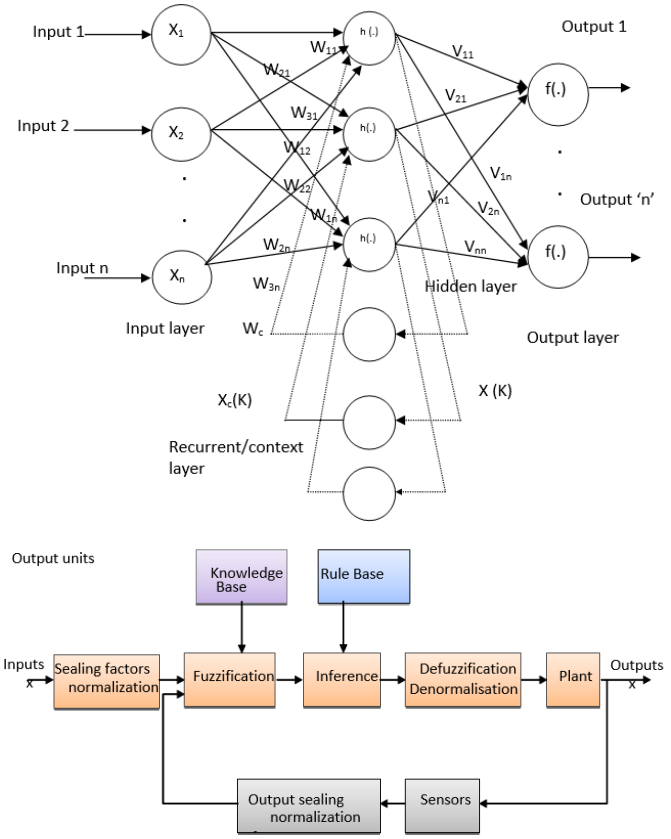


Figure 2. Architecture of the ELMAN-JORDAN model



The fuzzy model is developed so as to give a fuzzy control law which carries out an effective control action for the system under consideration. The fuzzy model operates as given below,

Membership function is determined for each of the fuzzy subsets

Formulate fuzzy associative memory table with the rule base formulated.

Rules are

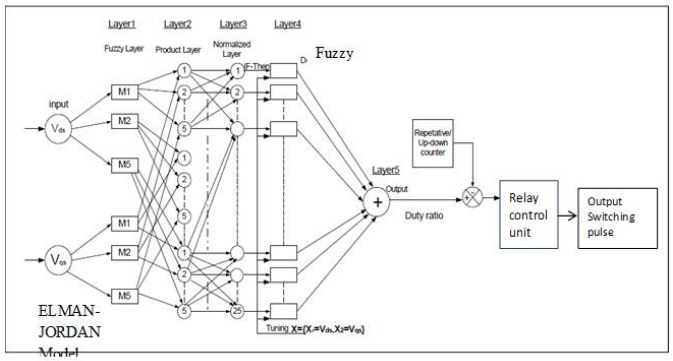


Figure 3. Structure of fuzzy-EJNN model for attaining output switching pulse

IV. SIMULATION RESULTS AND ANALYSIS

The proposed fuzzy-EJNN based space vector modulation as applied for voltage source inverter fed induction motor drive is simulated in this section in MATLAB/SIMULINK environment. Entire simulations are run in MATLAB R2013b environment and are executed in a PC with Intel Core2 Duo Processor with 2.27GHz speed and 2.00 GB RAM. Fuzzy-EJNN model gets trained to generate duty cycles for the switching pulses SWa, SWb and SWc with varied switching frequencies. Table 2 shows the simulation parameters assigned for the developed fuzzy-EJNN model. Input to the proposed model is the d-axis voltage and q-axis voltage and the output from the network is the duty cycle ratio and the switching pulses are as well generated. The training inputs for the developed model are taken from the simulation done for the traditional space vector modulation. The membership function variables assigned for the two

Table 2 shows the simulation parameters assigned for the developed fuzzy-EJNN model. Input to the proposed model is the d-axis voltage and q-axis voltage and the output from the network is the duty cycle ratio and the switching pulses are as well generated. The training inputs for the developed model are taken from the simulation done for the traditional space vector modulation. The membership function variables assigned for the twoinput variables are 5 and their respective linguistics are very low, low, zero, high and very high. The maximum rules that can be generated with 5 membership variables for each input are 25, but in this work the better performance is achieved employing only 16 rules. The system is simulated with 1HP, 400V, 2.5A asynchronous induction motor drive.

Table 1. Simulation parameters of proposed fuzzy-EJNN model

Parameters	Fuzzy-EJNN model
Learning rate	0.2
Momentum factor	0.1
No. of input neurons	2
No. of Hidden Neurons	7
No. of output neuron	1
Maximum iteration	100
Activation function	Sigmoidal Activation Function
Recurrent nodes	Context layer nodes
Membership function	Gaussian function
FIS	Takagi-Sugeno FIS
Defuzzification	Weighted average method

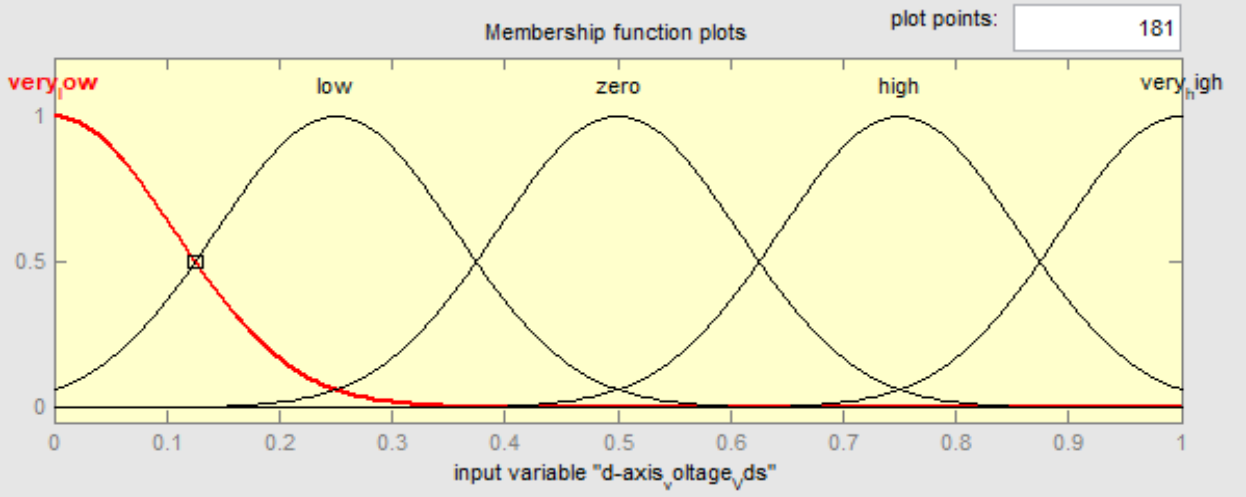


Figure.2 Membership function of V_{ds} with proposed fuzzy-EJNN model

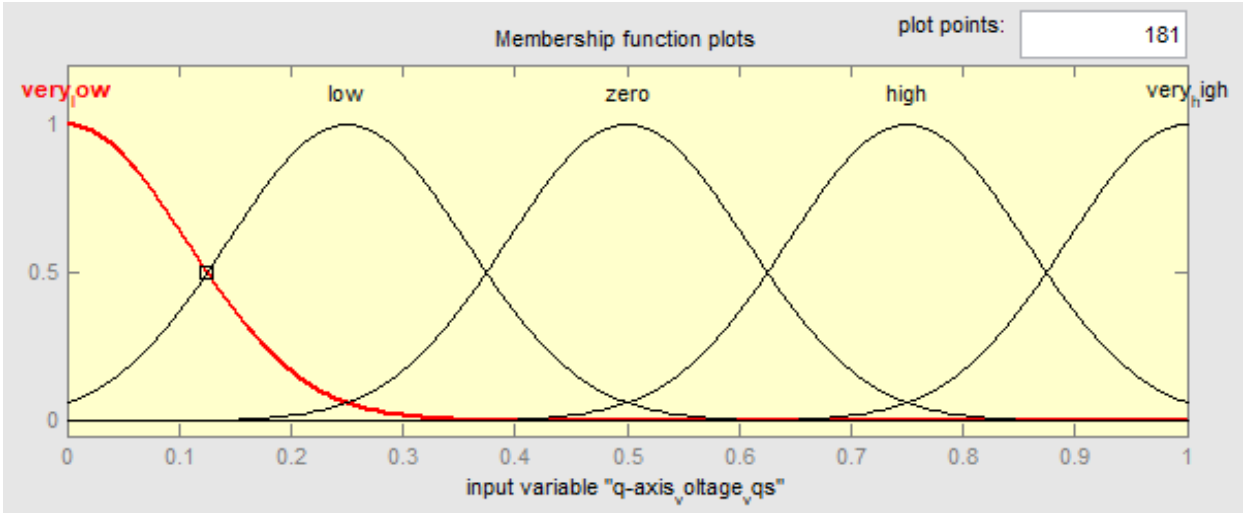


Figure.3 Membership function of V_{qs} with proposed fuzzy-EJNN model

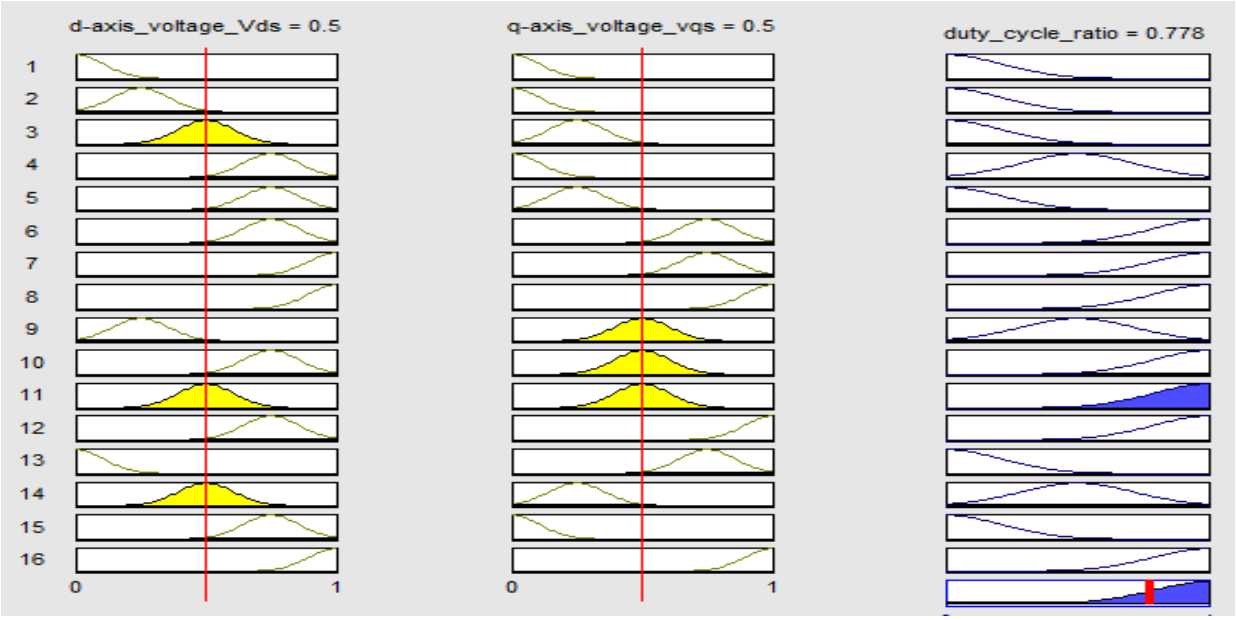


Figure.4 Formulated 16 rules using proposed fuzzy-EJNN model

Figure 6 and Figure 7 shows the Gaussian membership function defined for the input variables d-axis voltage and q-axis voltage. There are 16 rules formed in this model and based on the inferences made from these rules the surface plots obtained are shown in Figure 9, Figure 10 and Figure 11 respectively. The evaluations of the rule process are as presented in Figure 8. The surface plots shows how the output gets varied with the variations in the input signals. The surface viewer shows the dependency of the output variable to that of the defined inputs.

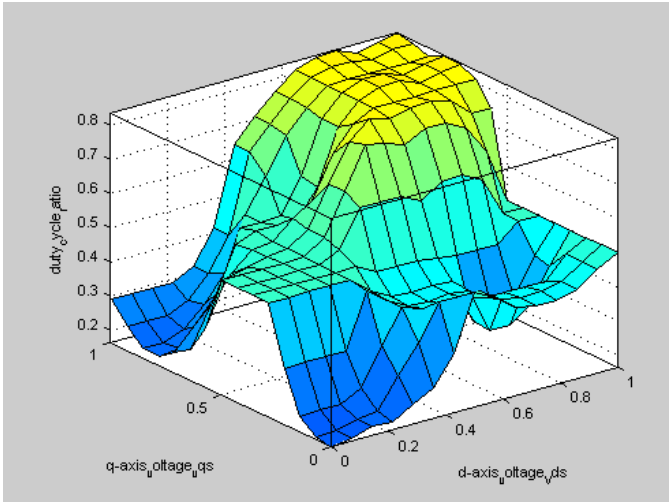


Figure.8 Surface view of SWb

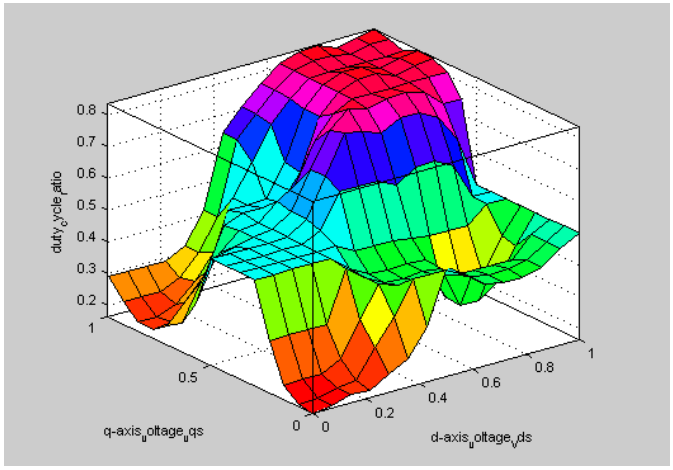


Figure.7 Surface view of SWa

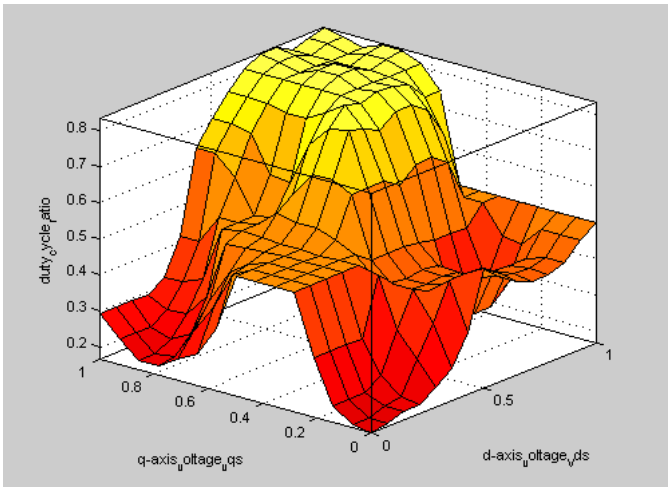


Figure.9 Surface view of SWb

V. CONCLUSION

Fuzzy-ELMAN JORDAN neural network based space vector modulation developed in this thesis chapter is applied for two-level inverter model. The traditional space vector modulation algorithm generates the training data for the proposed fuzzy-EJNN model and the developed hybrid algorithm is employed for training the data. The advantage of fuzzy systems to make better inferences and the advantage of ELMAN-JORDAN neural model to make better training mechanism are hybridized to result in a fuzzy-EJNN model that is highly reliable and effective than the traditional SVM technique based motor control. The developed fuzzy-neural based SVM technique improves the dynamic performance of the induction motor by decreasing the total harmonic distortion of the inverter phase voltage and the phase current. The evaluated total harmonic distortion value in both simulation and hardware model is significantly minimal than the existing traditional SVM method and other methods considered for comparison from literature. Hence, it is well noted that the performance of developed fuzzy-EJNN based SVM technique is superior in comparison with the traditional SVM and other methods as available in the literatures.

VI. REFERENCES

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A Comprehensive Study on Consumer's Behaviour with respect to Electric - Bikes in Bangalore Region

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ABSTRACT

At present, the Bangalore citizens are living each day on an accumulation of excessive traffic and noise. Other aspects that are being seriously harmed by the city traffic are the air quality and the health. The traffic is the main source of many air pollutants such as carbon monoxide and suspended particulates. In addition, addition, the air pollution is the main cause of environmental disease. Because of this air pollution, the citizens have many possibilities to suffer some cardiovascular and respiratory problems. This problem is more and more increasing because of the traffic. Finally, and no less important, the climate change is quickly growing because of the air pollution in the cities. To improve this situation, it is necessary to change the culture and the costumes for urban mobility. Institutions and citizens must make an effort and try to solve this problem as soon as possible. With Increasing in air pollution in urban areas and scarcity of fuels Electric bikes (E-bikes) are in great demand but they are not used by most people because of lack of awareness. India electric scooters and motorcycles market is projected to reach $617.7 million by 2025. Moreover, these electric two-wheelers are virtually silent and do not cause noise pollution. This paper focusses on building the consumers behaviour towards e- bikes. Data was collected through Secondary source of Data.

Keywords : Air pollution, Consumers' behaviour, E- bikes, Lifestyle, Scarcity of fuels

I. INTRODUCTION

India electric scooters and motorcycles market is projected to reach $617.7 million by 2025. Increasing pollution awareness among people and increasing government support in the form of subsidies are the key factors driving the growth of the market. Electric scooters and motorcycles use electric batteries for propulsion and do not produce any emissions. Moreover, these electric two-wheelers are virtually silent and do not cause noise pollution. Electric two-wheelers can manoeuvre through congested streets; can be charged from traditional wall outlets and can have a removable battery, however, the share of electric motorcycles is expected to grow in future. India would follow tough emission norms Bharat Stage (BS)-VI, from the current BS-IV, by 2020, skipping the BS-V. Such policies or initiatives to curb pollution levels in the country promises a positive regulatory environment for the electric two-wheelers industry in coming years. Stringent emission norms would increase the prices of conventional vehicles making the electric vehicles more viable to opt.

With Increasing in air pollution in urban areas and scarcity of fuels Electric bikes (E-bikes) are in great demand but they are not used by most people because of lack of awareness. So, keeping this in mind the purpose of the study is to raise the awareness level of consumers towards the e-bikes and also the perception of the users.

II. LITERATURE REVIEW

1. History of e-bike: It is surprising to know that the experiment done to make bicycle to function on electricity, was done quite a long time ago. The record said that the first electric bikes were already available during 1890s1 .
2. The bicycle ran on 10 volt battery power, in which the motor could draw power up to 100 amperes. The hub motor was used placing in the back wheel. During that time gears was still a mysterious concept for the bicycles. So, it was made without it.
3. In 1989, Michael Kutter, the founder of 'Dolphin E-bikes' done the first initiation in commercially producing e-bikes in the market. After his attempt, a well-known motorbike company from Japan 'Yamaha' took the leap in developing commercial e-bikes, producing a large number of e-bikes in the year 1994, giving the name 'Power Assist'.
4. Hatwar etal. (2013) projected a new approach in the design of e-bike which consists of hybrid system of battery and super capacitor for increasing speed, and avoid the complaints of long charging time and short lifespan of batter.
5. Mukesh Sharma (2002) conducted "A Study on Consumer Awareness and Perception towards Genxt Electric Bikes". The study identifies and evaluates the consumer perception towards various factors about electric bike. The result of this study shows that there is a combination of both positive and negative effect on consumer perception.
6. Weinert, C.T. Ma, and C. Cherry (2006) in their study on "The Transition to Electric Bikes in China: History and Key Reasons for Rapid Growth." Examines how and why e-bikes developed so quickly in China with particular focus on the key technical, economic, and political factors involved.
7. Kumar et al performed experimental studies on Electric Bike which has an alternative source of Battery-operated cycle. They found that the design of E-bike was more efficient than normal Bicycle.
8. Mahadik et al introduced the concept of electric bike. He converted the normal bicycle in to electrical one with an innovative approach. Charging of Battery was provided by three ways i.e. by means of wall charging, solar charging and by mechanical pedal.
9. Evtimov et al they studied consideration of energy efficiency on an experimental bicycle. the bicycle was fitted with board computer to store information about motion and energy consumption
10. Esther et al conducted a survey to promote the use of electric bike as well as the awareness about environment in highly polluted countries like china, USA, India, Germany etc.

Conceptual model

The rise of demand and constantly increasing cost of petrol and diesel has been ruling India for ages; society needed a non-negotiable solution especially in India. Transportation is very important and in order to augment it, people started seeking transportation by different means of energy. Electric vehicles gave a breakthrough solution to satisfy the needs required thereby it started to flourish, by overcoming the hindrance. Electric Bikes are two-wheeler vehicles which use electricity as the source of fuel. Electric motorcycles are noiseless, pollution free, zero-emission, and electrically driven. The operation and speed are controlled by the battery. To extend the variety of e-bikes and improve the production, fuel cells and petrol-electric hybrids could be introduced which are also in the verge of development and thus improving the efficiency of the electric drive system.

The usage of electric bikes has turned out to be a solution for reducing pollution to a larger extent. To burgeon the sale of e-bikes it needs to have customers' awareness towards the e-bike.

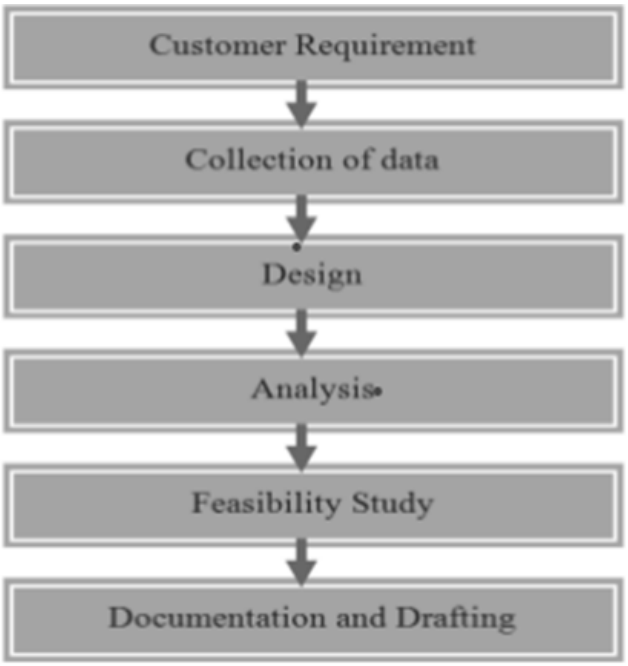


Fig 1 : Conceptual Model of the e- bike survey

III. Research Design & Methodology

Rationale behind choosing the topic: As E. bike is the trend of the economy, reducing air pollution, the market is likely to grow.

Objectives

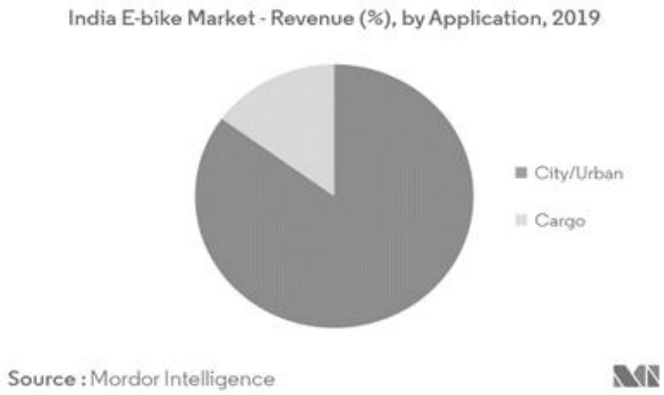
1. To study customer Usage for e-bikes.
2. To study the opinion for using the e-bikes.
3. To suggest using e-bikes to other customers.

Tools for Data Collection

Data collection was done by using secondary source of data.: Secondary Data: Research articles, journals, magazines, books etc.

New Product Development will Provide the Boost in the Market

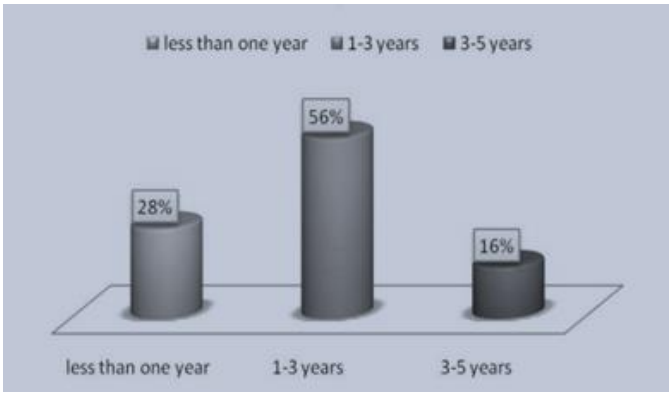
The factor which is likely to fuel the demand of the e-bike market in India is the increasing interest of new startups in e-bike leasing and new e-bike development in the country. For instance, In 2019, the Bangalore-based electric bike rental Yulu entered into a partnership with Bajaj. Both the players will co-design and manufacture upcoming Yulu two-wheelers. Yulu maintains over 3,000 electric bikes on its platform and its plan is to have 100,000 two-wheelers in its fleet by next year. Yulu is also expanding its presence quickly in the country, it has acquired the permission to provide electric bikes at 250 subway stations in Delhi.



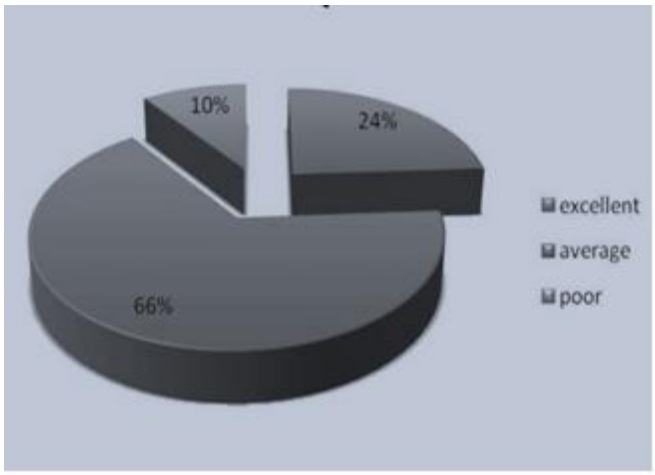
IV. Results and Findings

Based on the secondary sources of data, certain findings are observed.

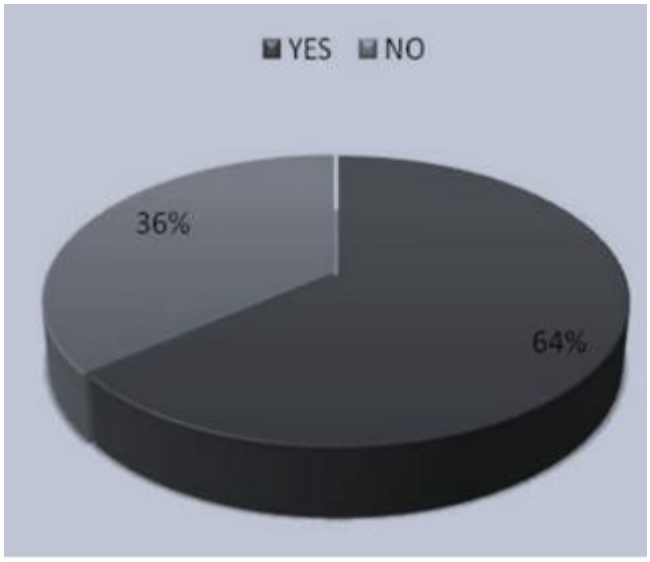
1. Customers using E bike for more than 1 year , nearly 56% consumers are aware of this product and are using this product.



2. Opinion of customers using e-bikes : Research shows around 66% are satisfied while using ebikes.



3. Users of e-bike will recommend to other customers also to use e-bike.: Around 64% will recommend to other customers also for using e-bike.



V. Potential Contribution

The increasing urbanization with climate change, global warming issues and the related need to decarbonize the economy, is forcing urgency for identifying the alternate source for the global adoption and sustainable scalable solutions. The country's demographic and road patterns and its natural resources availability provide enormous scope for the electric bike industry.

It is a frugal innovation strategy which provide safe carbon free environment, and moreover a part of health rehabilitation programmes. It is required that societal, economic and political and infrastructure systems integrate together to balance the energy environment. With this potential, the era of electric bike started its new avenues on the roads of India specifically focusing on Indian women. To develop this viewpoint, the present study focuses on the preference of e-bike among the commuters in Bangalore region.

VI. CONCLUSION

Electric vehicles are the new buzz word when it comes to the world of automotive. With fossil fuel reserves running out and pollution levels increasing to dangerous levels, an alternative to internal combustion engines is the need of the hour. Electric vehicles run clean and produce zero emissions, making them a popular alternative systems The top brands that produce electric bikes & scooters in India are Bajaj, Revolt, Hero Electric, Ather, Okinawa.
Increased e-bike use can potentially support a shift towards more sustainable and active transport.

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An Introduction to Green Communications

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ABSTRACT

Communication is the process of transmitting a message generated at one point called as transmitter or source to another point called as receiver or destination. According to information theory, the extraction of the transmitted message which has passed through the communication channel was considered as the primary accomplishment. The information is broadcasted using electro-magnetic waves as message carriers, and not as a source of energy. This embodiment opened the doors to new paths of thinking about communications. As said by Norbert Wiener, "Information is information not matter or energy".

Keywords : Transmitter, Communication Channel, Electro-Magnetic Waves

I. INTRODUCTION

The act of powering the communication devices for their hassle free operation has taken myriad turns. Due to the unprecedented expansion in wireless data utilities, the stringent requirements for spectrum and power are constantly expanding leading to the issues of battery depletion mostly in wireless nodes. Nikola Tesla was the first researcher who gave the idea of wireless charging and transmission. According to the book titled "The fantastic Inventions of Nikola Tesla The Lost Science Series," JP Morgan backed Tesla with a huge chunk of $150, 000 to build a base-station tower that can utilize the natural frequency/ambient energy of universe to transmit data along with a huge information like images, data, voice and video. These facts proved that the universe is equipped with a lot of abundant free energy that could be harnessed to form a world wide web to connect people throughout the world, now termed as Internet of Things (IoT) as well as to allow people to harvest the energy around them. As a result, the recent developments in wireless technology has persuaded a lot of researchers from academic as well as industrial back-ground. Due to the limited battery life of sensor nodes, the inculcation of power through ambient sources to replenish the power of sensor nodes has been a major development regarded as 'GREEN COMMUNICATION'. Although the life-time of the entire network can be extended by replacing or recharging the batteries, but it proves to be highly cumbersome and hazardous in toxic environments and can incur huge expenditures. There- fore, a modern, convenient and guarded alternative is to garner energy from the ambience that can ascertain virtual energy supplies to wireless devices and networks. Cutting the usages of fossil fuels to power communication devices like base- stations, etc. and adopting new renewable energy sources has been considered a new paradigm in wireless communications.

MOBILE– USER

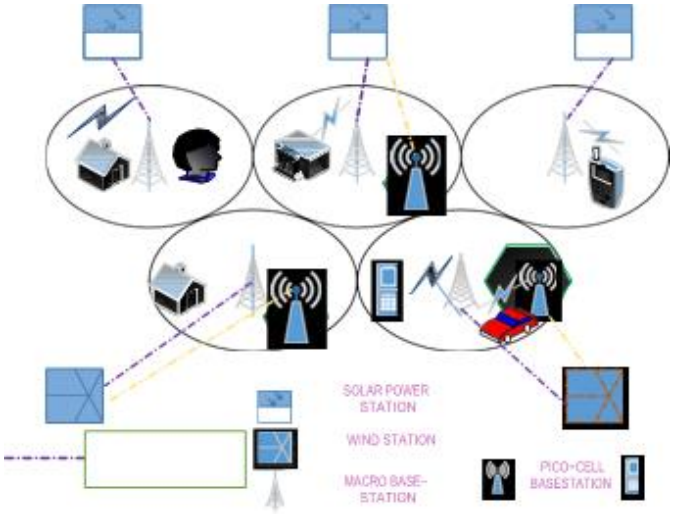


Fig. 1 : Energy Harvesting in Cellular Wireless Networks

II. ENERGY HARVESTING IN GREEN COMMUNICATIONS

To enable the wireless nodes to scavenge energy from natural or man-made phenomena, energy harvesting has been proposed as a workable solution. For instance, the physical effects such as motion, pressure, vibration and even electro- magnetic (EM) radiations can be appertained to capture energy from the surroundings or the human body to obtain electrical energy. Let us mention certain occurrences like: the photo- voltaic effect through which the visible light can be converted into electricity and the heat energy can be converted into electrical energy via the thermo-electric effect.

Numerous advantages of energy harvesting (EH) in wireless sensor networks persist such as reduction of carbon print and increasing battery life has been unveiled. Hence, it is gaining immense popularity in a number of applications like body area networks, consumer electronics and remote environment monitoring. Moreover, it is worth observing that wireless EH can be dynamically and sporadically applied in wireless sensor networks (WSNs). For a node in typical WSN, the power requirement ranges from 100μW to 100mW, which is much less as compared to commercial mobile devices that take power of the range 150mW- 1.5W.

There are four major sources for EH: Solar/Light, mechan- ical motion, thermo-electric effect and radio-frequency (RF) radiations. Generally, ambient energy sources like solar, wind, vibrations and interfering signals are exploited for harnessing energy in wireless communication as shown in Fig. 1. The main advantage of utilizing the surrounding energy sources is that they are environment friendly and economic; but their limitation is that they cannot guarantee quality of service (QoS) in wireless practices due to uncertainty in time, weather conditions as well as location. Dedicated energy supplies like power-stations run by fossil-fuels are used to provide energy on demand in order to attain reliability and predictabil- ity. They ascertain to persistently recharge wireless devices, satisfying their QoS requirements. However, the deployment of these non-renewable power sources can induce additional disbursement that gets enhanced consistently with different performance criteria and requirements. A brief description of the energy scavenging sources is given as follows.

1) Solar/Light Energy Sources

The prominent ubiquitous origin of energy sources is solar energy. The phenomenon of photo-voltaic effect is exploited to convert light radiations into electricity. The power harvested from the sun is considered as a discernible energy source for self-sustainable devices during the day-time for outdoor environments. Typically, the amount of harnessed energy through the ambient solar power is in the order of 150-500 mW/cm2 during the peak time of the day and it disappears at night i.e. no energy can be captured during night-time. This makes it dynamic and uncontrollable in nature. However, for indoor environments and night time, any source of

illumination can be used but its power intensity will be much less as compared to the solar radiation and specifically, its value ranges from 10μW/cm2 to 100μW/cm2. The only impediment of utilizing energy resource is that its energy harvesting level is limited by a number of factors like time, geographic conditions and climatic conditions. Due to this, the energy available to any wireless node may fluctuate over the time.

2) Thermo-electric Energy Sources

The basic idea of thermo-electric effect is to generate potential difference between two conductors made of different materials by heating them at different temperatures. Nowadays, advancements are observed in case of body area networks where thermo- electric sensors attached to human body can sense the temperature deviations between body and the environment leading to generation of electricity by the temperature gradient.

3) Mechanical Motion / Pressure Energy Sources

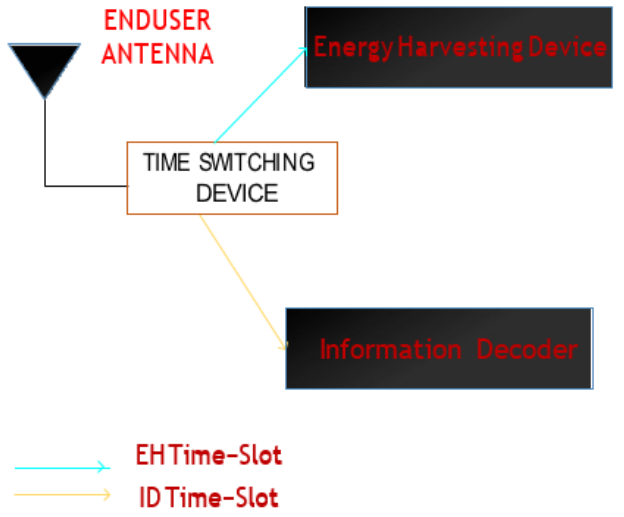
Electric energy is extracted from mechanical motion dynamics inculcating the electrostatic, electromagnetic and piezo-electric effects. In electrostatic method, the mechanical motion can make the distance between the two plates / electrodes of a capacitor to change thereby, producing the current in the circuit. In the electromagnetic technique, relative motion between a magnet and a conductor coil can stimulate an electric current in the coil by virtue of Faraday's law of induction where as pressure is applied on to piezo- electric material and is converted into electricity. The electric power generated through mechanical effects is also random and uncontrollable. Wind energy is a good alternative to solar energy in areas of less sun-light and more rainfall. For instance, a wind station is capable of producing around 100 mW of power if the wind is flowing at the speed of 2m/s to 8m/s.

4) RF or EM Radiation Energy Sources

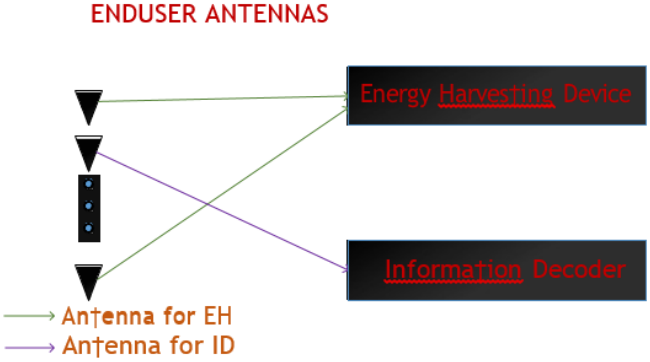
Power harnessing from RF sources has gained popularity in the area of green communications. According to distance parametric (long-distance or short-distance), the EM radiations have been classified into two categories: near-field and far-field. In near-field EH applications, communication devices are recharged wirelessly within the distance of a wavelength. Due to this reason, the energy relaying efficiency in case of near-field appli- cations is 80%. When the distance between the energy source and energy harnessing device is up to certain kilometers, i.e. in far-field applications, the radio waves in the form of RF or microwave energy can be ab- sorbed through receiving antennas and then converted to electrical power by rectifier circuits. The radio energy can be possibly ambient EM radiations or radio signals emitted by a known transmitter. The viable sources of ambient radiations from surroundings may include TV broadcast stations, amplitude-modulation (AM) / frequency-modulation (FM) radio transmitters or Wi-Fi access points. The amount of energy harvested through EM radiations can be of the order of -40 dBm. Here, a point should be noted that surrounding RF energy is readily and freely available and sufficient in urban areas due to large number of cell-towers, radio and TV broadcast stations but it is very scarce in sub-urbs. In the case of dedicated energy harvesting, it has been seen that a power station which is relaying tens of Watts, can power/charge sensors, smart-phones, laptops etc, at a distance less than 15 meters. Simultaneous wireless information and power transfer (SWIPT) has become popular for harvesting energy from RF/EM radiations. It is emerging as a popular solution to increase the active-time of wireless devices. In the next section, some popular SWIPT techniques are discussed.

III. SWIPT TECHNIQUES

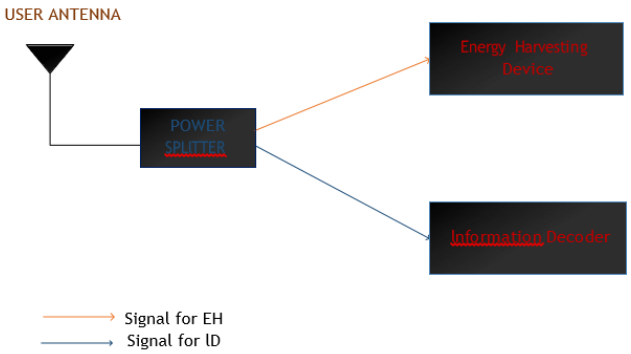
The process of simultaneous transmission of information and energy called as SWIPT technique is possible in certain applications like IoT devices, cellular systems and heteroge- neous sensor networks. In this technique, data-rate can be maximized along with the advantage of increasing the life-time of a wireless network. In order to achieve SWIPT practically, the received signal needs to be split into two different parts, one part is used for energy harvesting where as the other part is used for information decoding. Several SWIPT receiver architectures that have been illustrated in Fig. 2 in order to achieve simultaneous power harvesting and information retrieval by receiver signal splitting are described below.



(a) SWIPT with Time Switching Technique (TST)



(b) SWIPT with Antenna Switching Technique(AST)



(c) SWIPT with Power Switching Technique (PST)

Fig. 2: SWIPT Techniques

1) Time Switching Technique (TST)

In TST, the SWIPT receivers consists of an information decoder (ID) circuit, the energy harvester circuit (EH) and a switch at each receiver antenna. The signal splitting is performed in time-domain and therefore, the signal that is received in each time slot is used either for power transfer or information decoding as shown in Fig. 2(a). At each time-slot, the transmitter can optimize its transmit waveform for either information transmission or energy harvesting. Usually, each receiver antenna switches in time between wireless information transfer and energy harvesting periodically. TST doesnot allow simultaneous transfer of energy and information due to switching limitations. So, varying the length of time-slots, rate-energy trade-off can be achieved. It entails a simple receiver hardware structure. If the time-slot for energy harvesting is increased, then the information transfer rate will go down. Therefore, it requires stringent time-switching patterns and optimal energy/information scheduling algorithms.

2) Antenna Switching Technique (AST)

Another popular scheme is to switch each element of receiver antenna array either for decoding of transmitted information or for the purpose of energy scavenging as shown in Fig. 2(b). The receiving

antennas are segregated into two groups. The function of one group of receiving antennas is to work as ID where as the other group of antennas is meant to gather the ambient energy. Given a total number of NR receiver antennas, a subset of L antennas can be selected for ID, while NR L antennas are used for EH. Diversity combining techniques are also employed to improve the signal to noise ratio. Since in TST structure, the information decoding and energy harvesting cannot be done at the same time. On the other hand, the information decoding and energy harvesting is performed simultaneously in AST. Therefore,the receiver complexity is more in AST as compared to TST. Optimal selection of antennas for EH and ID is the major challenge in the implementation and design of AST.

3) Power Switching Technique (PST)

In PST, a passive device called power splitter is deployed for each receiver antenna to segregate the total received signal power into two streams of different power levels as shown in Fig. 2(c). One stream is sent to base-band circuit for information decoding while the other power stream is sent to energy harvesting circuit. Therefore, in this receiver structure, EH and ID can be done simultaneously. The power splitting is done on the basis of a power-splitting factor ρ and the optimization of this factor balances the rate-energy trade-off. Since PST employs the segregation of total received power into EH power and ID power using power-splitter makes its structure complex as compared to TST receiver. Any hardware imperfections in power-splitter module can lead to performance degradation in terms of information rate-energy tradeoff.

TABLE I : ADVANTAGES AND DISADVANTAGES OF SWIPT TECHNIQUES

SWIPT Tech-niques	Advantages	Disadvantages
Time Switching Technique (TST)	- Entails simple hard-ware implementation at the receiver. - Paging and control signals of other users may be used for EH.	- Requires stringent time-synchronization patterns for switching. - Requires optimal infor-mation/energy schedul-ing algorithms.
Antenna Switching Technique (AST)	- Diversity combining techniques [9] may be used to enhance per-formance. - Uncompromised data rate/throughput in some diversity combining schemes.	- Requires optimal as-signment of antenna el-ements for EH and ID. - High complexity receivers.
Power Switching Technique (PST)	- Suitable for applications with energy/delay constraint. - Simultaneous EH and ID all the time.	- A higher receiver com-plexity as compared to TST. - Performance degrades due to hardware imper-fections.

IV. MODELING OF ENERGY HARVESTING SOURCES IN SWIPT

In SWIPT, the energy harvesting process can be modeled as a deterministic EH model and stochastic EH model. For the case of deterministic EH model, the EH information is non- causal. That means, the energy arrival profile is known prior to the transmitter. On the other hand, in data driven stochastic EH model, the EH information is causal and therefore, the mod- eling parameters are trained using a stochastic model. Hence, depending upon the availability of exact knowledge regarding presence of harvested quanta of energy at the transmitters, the prototypes cultivated for modeling the harvested energy in SWIPT are mainly divided into two classes : deterministic models and theoretic models.

Deterministic Models

The deterministic models consider complete knowledge of the instants as well as amounts of

energy arrivals a priori at the transmitters. The primary benefits of deterministic models is that the non-causal energy state information (ESI) is gathered to generalize the optimal energy scheduling strategies. Hence, these models depend upon the precise energy harvesting profile over a long time period. Therefore, the deterministic models are pre- cisely exploited in the case where intensity of harnessed energy vary very slowly.

Theoretic Models

In theoretic or stochastic energy harvesting models, the energy gathering processes are assumed to be random. The virtue of these models is that they do not require any non-causal information of ESI. Thus, they are needed for those particular applications where ESI is unpredictable. The limitation of this model lies in the fact that model mismatching can happen as it is difficult to fully predict and contemplate the stochastic behavior of surrounding energy sources. Further, stochastic energy models are categorized as time correlated and time uncorrelated models.

In time uncorrelated models, the energy that is harvested in each periodic duration is assumed as statistically inde- pendent. Examples of time uncorrelated models include the models in which energy generation process is illus- trated via Bernoulli process with a constant harvesting rate. Some other energy cultivating prototypes include the uniform process, exponential process and the Poisson process. The major drawback of time uncorrelated models is that they cannot guarantee the temporal correlation for most of the energy sources.

On the other hand, a correlated temporal process incul- cates discrete Markov model for modeling the arrival instants of energy packets. The onset and amount of scavenged energy can be demonstrated as a Poisson counting process in time. Moreover, the energy gathered from ambient energy sources is being reproduced as a two-state Markov model in order to dummy the time correlated energy saving behavior. The energy generation process can be accounted for the two state (ON and OFF) correlated process in which the ambient energy is gathered with a uniform rate in the ON state and no energy is harvested in the OFF state.

V. CONCLUSION

The spirit of energy harnessing and cooperation among nodes has fostered a wide-scale technicality in the development of wireless communications. Nowadays, SWIPT has emerged as a promising solution to guarantee convenient and perpetual energy supplies to wireless nodes as well as data can be transferred between several energy harvesting nodes for better spectral efficiency and power efficiency of the wireless networks.

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Digital Twin in the Automotive Industry

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ABSTRACT

There can be no turning back. Manufacturing processes are becoming increasingly digital. As this trend unfolds, many companies often struggle to determine what they should be doing to drive and deliver real value both operationally and strategically

Keywords : Digital Twin , Automotive Industry, Information Technology, Operations Technology

I. INTRODUCTION

INDEED, digital solutions may promise significant value for an organization—value that could never have been realized prior to the advent of connected, smart technologies. Of particular fascination of late seems to be the notion of a digital twin: a near-real-time digital image of a physical object or process that helps optimize business performance. Until recently, the digital twin—and the massive amounts of data it processes—often remained elusive to enterprises due to limitations in digital technology capabilities as well as prohibitive computing, storage, and bandwidth costs. Such obstacles, however, have diminished dramatically in recent years. Significantly lower costs and improved power and capabilities have led to exponential changes that can enable leaders to combine information technology (IT) and operations technology (OT) to enable the creation and use of a digital twin.

So why is the digital twin so important, and why should organizations consider it? The digital twin can allow companies to have a complete digital footprint of their products from design and development through the end of the product life cycle. This, in turn, may enable them to understand not only the product as designed but also the system that built the product and how the product is used in the field. With the creation of the digital twin, companies may realize significant value in the areas of speed to market with a new product, improved operations, reduced defects, and emerging new business models to drive revenue.

In the past few decades, mass production, lean adoption, and globalization were the key enablers for the automotive industry to drive growth and profitability. However, with data becoming the new oil and Industry 4.0 taking hold, future growth of the industry is expected to be fueled by data-led manufacturing. Under this model, enterprises leverage data across the product life cycle to build faster, cost effective and high quality products.

A key enabler of data-driven manufacturing is the concept of digital twin. It represents a pairing of virtual and physical worlds underpinned by emerging technologies such as IoT, 3D simulation tools, and predictive analytics. The result: enhanced ability to analyze data and monitor systems to solve the problems even before they occur. The paper explores the role of digital twin in addressing the current challenges of the automotive industry, especially with regards to vehicle product design, manufacturing, sales, and service.

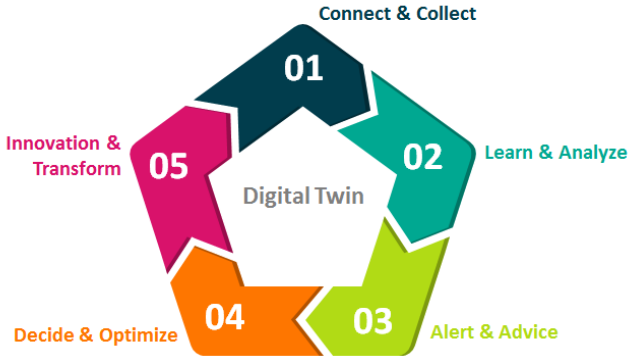
DIGITAL TWIN:

What it is and why it matters!

A digital twin can be defined, fundamentally, as an evolving digital profile of the historical and current behavior of a physical object or process that helps optimize business performance.

INDUSTRY and academia define a digital twin in several different ways. However, perhaps neither group places the required emphasis on the process aspects of a digital twin. For example, according to some, a digital twin is an integrated model of an as-built product that is intended to reflect all manufacturing defects and be continually updated to include the wear and tear sustained while in use.

Other widely circulated definitions describe the digital twin as a sensor-enabled digital model of a physical object that simulates the object in a live setting. A digital twin can be defined, fundamentally, as an evolving digital profile of the historical and current behavior of a physical object or process that helps optimize business performance. The digital twin is based on massive, cumulative, real-time, real-world data measurements across an array of dimensions. These measurements can create an evolving profile of the object or process in the digital world that may provide important insights on system performance, leading to actions in the physical world such as a change in product design or manufacturing process.



A digital twin differs from traditional computer-aided design (CAD), nor does it serve as merely another sensor-enabled Internet of Things (IoT) solution. It could be much more than either. CAD is completely encapsulated in a computer-simulated environment that has demonstrated moderate success in modeling complex environments and more simple IoT systems measure things such as position and diagnostics for an entire component, but not interactions between components and the full life cycle processes. Indeed, the real power of a digital twin—and why it could matter so much—is that it can provide a near-real-time comprehensive linkage between the physical and digital worlds. It is likely because of this interactivity between the real and digital worlds of product or process that digital twins may promise richer models that yield more realistic and holistic measurements of unpredictability. And thanks to cheaper and more powerful computing capabilities, these interactive measurements can be analyzed with modern-day massive processing architectures and advanced algorithms for real-time predictive feedback and offline analysis. These can enable fundamental design and process changes that would almost certainly be unattainable through current methods.

Internet of Things an integral part of digital twin technology:

From the very definition, it's clear that digital twins ought to depend on IoT technologies. Driven by sensors, artificial intelligence, machine learning, data and analytics, IoT acts as the foundation for digital

twins, as it leverages specific data about physical assets to help companies make better decisions.
Digital twin is, therefore, expected to increase IoT deployments given its ability to add value for end-customers. Experts predict that, within the next five years, digital twins will be adopted by 85% of all IoT platforms.

How it works & Why it matters:

Digital Twin, the virtual counterparts of a physical asset is created as the digitalized duplicate of a machine/ equipment or a physical site. These digital assets can be created even before an asset is built physically. To create a digital twin of any physical asset, engineers collect and synthesize data from various sources including physical data, manufacturing data, operational data and insights from analytics software. All this information along with AI algorithms is integrated into a physics-based virtual model and by applying Analytics into these models we get relevant insights regarding the physical asset. The consistent flow of data helps in getting the best possible analysis and insights regarding the asset which helps in optimizing the outcome.

Digital twins are powerful masterminds to drive innovation and performance. Imagine it as your most talented product technicians with the most advanced monitoring, analytical, and predictive capabilities at their fingertips. Companies who invest in digital twin technology will see a 30% improvement in cycle times of critical processes, predicts IDC.
Also, the digital twin technology helps companies improve the customer experience by better understanding customer needs, develop enhancements to existing products, operations, and services, and can even help drive the innovation of new business.

TYPES OF DIGITAL TWIN:

Digital Twins are of two types:

- Digital Twin Prototype (DTP)
- Digital Twin Instance (DTI)

Major Applications-Digital Twin Technology:

Other Applications

Retail, Infrastructure, Oil & Gas Industry and Gas Turbines

Economic value of Digital Twin

The economic value of the digital twins technology will vary widely, depending on the monetization models that drive them. For complex, expensive industrial or business equipment, services or processes, improving utilization by reducing asset downtime and lowering overall maintenance costs will be extremely valuable, making internal software competencies critical to driving value with digital twins.

As such, the costs of developing and maintaining digital twins must be driven by both business and economic models. Digital twins are not developed in a vacuum. Both the business concept and model must be tested against an economic architecture – revenue, profits, return on investment (ROI), cost optimization – and a way to measure progress as the products/services are rolling out.

To obtain the highest value from digital twins, the enterprise must address the digital ethics issues raised by different parties interacting with the data from not just the enterprise, but also its partners and customers. This will require the enterprise to think about the value of the data and its contributions to the business and partners, and also to identify potential areas where its customers or its own data could drive value but also could be at risk.

Future of Digital Twin:

In the future, expect to see the expansion of the IoT, and with it, some version of digital twin technology. According to predictions, by 2022, 85% of all IoT platforms will include some kind of digital twinning.

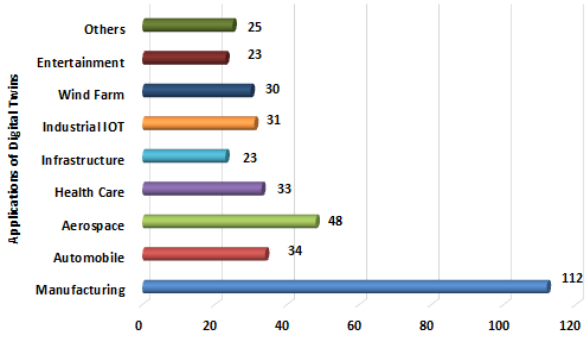
As more and more products in our homes and workplaces evolve into smart devices (i.e., they connect to the Internet, providing remote access and control), we'll also see an increase in the availability of digital twin technology. These digital twins already allow you to remotely adjust the temperature in your smart home, for example. Or to make calls using your business number on a "softphone" that's available on all your personal devices.

Benefits of Digital Twin

Objectives of the Study

- ❑ To understand "Digital Twins" technology and prepare a patent landscape report.
- ❑ To understand major patent holders, geographical distribution of patents, Technologies analysis etc.
- ❑ To analyse patent application filing/publication/grant trends over the years, top assignees, and patent classifications among others.

Digital Twin Application Analysis



Insight:

Digital Twin Application Analysis demonstrates that maximum number of Digital Twin patent applications was filed in Manufacturing Industry followed by Aerospace and Automobile Industries.

Challenges faced by the automotive industry

The challenges are faced throughout the product development cycles in each of the stages. Automotive product development is a complex process. Typically, manufacturing a new car model takes five to six years - from design to launch the product.

Effective design is the key to for long term sustainability of an automotive organization. Even a small mistake in product design can erode the company's brand value and leads to huge losses.

Many examples are heard on these lines, take for instance Mercedes Benz. The company launched it's a Class in early 2000, at a product development cost of USD 1.5 2 billion . After its launch, the vehicle failed a Moose test. As a result of this the company has to recall the sold cars and refit the part. Which incurred a huge cost.

Challenges faced in during the vehicle design stage, and the role of digital twin in addressing those are discussed below

Challenges faced in conceptual design phase

- Designers need to deal with the variety of data which is scattered across the organization.
- Integration of information from previous generation vehicles (customer usage of features, feedback, failures) is traditionally missing at this stage.
- This stage in current context is more centered around designers than the end customers in the industry

Role of digital twin

- Digital twin can potentially integrate all the data between previous generation vehicles and current vehicle concept in its digital model.
- Communication between designers, stakeholders and end customers (product clinics) can be more interactive and faster
- Data led decision making to finalize the vehicle concept

Challenges faced in detailed design phase

- Refinement of product design involves multiple iterations of simulation tests which are time consuming and often lacks comprehensive coverage of scenarios under real environment conditions.
- Any alterations in the design in the later stages impacts multiple tracks of design including (tools, equipment, material sourcing, launch timelines)

Role of digital twin

- Digital twin is expected to hold the complete data of product lifecycle. Leveraging digital twin at this stage can bridge this data gap to improve the performance of simulation tests.
- Reusability of proven models and simulations can enable rapid assessment of change impacts and early discovery of issues

Challenges faced in Design Verification Phase

- Small volume trial production to confirm the feasibility of design extends the timelines of product launch and add burden on company's balance sheet.
- It is too late a stage for the company to work retrospectively, if they need to accommodate any major change in the design.

Role of digital twin

- Digital twin can potentially integrate all the data between previous generation vehicles and current vehicle concept in its digital model.
- Communication between designers, stakeholders and end customers (product clinics) can be more interactive and faster

Challenges faces in Automotive Manufacturing phase

- Deep personalization, autonomous driving and electric cars are adding complexity to the current manufacturing facilities. These facilities are still driven by conventional fixed conveyor belts
- Skilled labor shortage in manufacturing sector (22% skilled manufacturing workers will be retiring in next 10 years)
- Machine down time during production hours (1 minute 5 of downtime costs $22000 due to unexpected stoppages)
- 178 work related accidents every 15 seconds, and 374 million non-fatal injuries every year is recorded in the manufacturing sector. Zero 6 incidents are the goal.

Role of digital twin

- Automakers are considering flexible-cell manufacturing as an alternative; where automated guided vehicles (AGVs) will transport car bodies individually only to those assembly workstations that are relevant to the specific model.

- All equipment (including machines, AGVs, and tools) on the shop floor and in the logistics, area are connected and continuously send status and location data to the factory's digital twin. There the data is processed in near Realtime and used to centrally steer all the operations on the shop floor. These intelligent systems can tell AGVs which workstation to approach and how to react to problems.
- Digital twin is already seeing large deployments in training the workforce by providing real-time, on-site, step-by step visual guidance on tasks such as product assembly, component design, machine operation, etc. Augmented Reality (AR) also referred as the "skin" of the digital twins is catching up the trend to augment the capabilities of the operator to reduce the stress and manage variability on the shop floor. This technology provides a detailed experience of the internal features of the equipment/machine to the operators that would otherwise be difficult to see, thus enhancing the understanding of fundamental principles of operation and design.
- The digital twin can draw on experiences to predict when a certain failure or other unwanted event will occur on the machine, and it can learn how to avoid that event.
- Gathering real time data from the machines (sensors) and overlay this information on the digital version of the machine is the first step to observe the trends in the machine behavior. The more machine performance data is analyzed and interpreted through digital twins, the more IoT enabled maintenance strategies will be enabled and resulting in the overall performance optimization and the avoidance of unplanned downtime.
- Attaching Bluetooth beacons with sensors to assets and employees, organizations can digitally see the manager, the employees, the accidents.

Challenges faces in Automotive sales and service

New vehicle introduction involves innovation in terms of research, engineering finesse, network planning, and marketing campaigns. It is a colossal effort that typically spans five years. Translating investments into revenue for the manufacturer

Challenges faces in Automotive vehicle sales

- Future car ownership model will be servitized, where customers will prefer to pay to the OEM based on the feature usage of the vehicle instead paying upfront for the entire vehicle.
- Number of configurable features in a car has increased and this leads to a vast number of unique combinations and special orders. Building some would result in a negative margin
- Effective Customer data management is missing at the retailer and OEM end. Manufacturer and channel partners stand to loose potential revenue from customer
- New as well as repeat customers visiting a dealership demands retail (B2C) like experiences. They expect an improved and personalized sales experience

Role of digital twin

- OEMs can maintain a vehicle twin of each VIN and software updates over the air (SOTA) can enable/disable features for a period of time when customer requests
- Real time field insights can be captured with the help of a Digital Twin of the vehicle. It will highlight the features that are widely used and rarely used by customers
- OEMs and dealers see boost in revenues by building a 360° view of customer. Digital twin can bring up insights on driver preferences and attributes to build this view to upsell/cross sell

- Sales experience can be enhanced by closely connecting AR (skin of digital twin) with the well evolved digital twin. This can create a more interactive and immersive UX on the sales floor

Challenges faced in vehicle service and parts

- Total cost of ownership (after sales ownership cost i.e. TCO) is a key criteria for customers to decide on automotive brands. Keeping TCO low from OEM standpoint is a constant challenge
- When a customer relocates or vehicle ownership changes, the service history of the vehicle gets lost due to scattered IT landscape of OEMs and their dealers.
- Warranty claim expenses on 7 avg. represents 2.5% of total sales turnover of OEM. Reduction in warranty expenses can significantly improve the bottom line of OEMs
- Residual value of a vehicle slips due to lack of transparency of car usage history and performance. Current mindset of residual value in general is driven by market perceptions rather than actual condition of the vehicle

Role of digital twin

- Every critical part can be monitored by creating its vehicle twin. It can predict and plan for breakdowns by putting the virtual vehicle/component twin into real world environmental conditions
- Vehicle twin can hold the service history of a vehicle and therefore this data can be leveraged by multiple stakeholders (dealers to fix the car 'first time right' and other third parties)
- Warranty data when linked with the vehicle twin will highlight failure patterns. Based on this, field inspections or pro-active recalls can be enabled. OEMs gain on time, money and brand image
- Vehicle twin will hold all the real-time performance data, sensor data, and inspection data along with the service history, configuration changes, parts replacement and warranty data.

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A Study on Employee Turnover and Its Impact on Organization Performance

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ABSTRACT

Success of any business depends on its organizational performance. Performance of organization depends on its employees who are the assets of the business and help in achieving organizational goals. Within the business community, employee turnover is widely assumed to affect organizational performance and the importance of maintaining qualified employees for the success of organizations is not a new idea. It is not very often that the management would be aware of the true reason as to why an employee would be leaving their organization. This would help the organization to an extent to get a clear picture of what is going wrong. The impact of the millennial workforce's working environment on organizational performance is the focus of this conceptual paper. This research highlights on the factors that influence organizational performance by systematically collecting and contextualizing all empirical evidence from literature that fits the study's context.

Keywords : Employee Turnover, Organizational Performance, Millennials

I. INTRODUCTION

Generational demographic shifts have had a significant impact on the current work environment, specifically the millennial workforce. When compared to previous generations, such as the Baby Boomer and X generations, the millennial generation is vastly different. For the first time in history, there are five generations in the workforce today, each with their own communication style and preferences. “Our generation has seen double-digit growth since they gained consciousness and has been continuously on the fast track; now we are realizing there is more to life than growth; we are experiencing the truth behind the old saying...less is more,” said Anuradha Menon, an IT professional, Pune. While they hoped for the best, millennials admitted that they are seriously rethinking and realigning some of life's fundamental needs, such as control, relationship, and satisfaction. Millennials seem to have progressed from infantile interactions to compassionate human connection. Media portrays millennials as selfie-obsessed fitness addicts who change jobs frequently and companies that want to retain millennials must be ready to embrace all aspects of the generation, beginning with technology.

According to a recent Gallup survey on today’s generation, 21% of millennials say they've switched jobs since last year more than three times the number than other generations who say the same. These Millennials are also less likely to stay in their existing career paths. Half of millennials, compared to 60% of

non-millennials, strongly agree that they hope to work at their current company in a year. Thus, Millennials significantly impact on reason for high employee turnover level. Millennials make up a significant percentage of the modern workforce, and their numbers are dwindling. Businesses need to adapt to this generation in terms of attracting and retaining talent.

While attracting Millennials, companies have become better at communicating their organization culture and company values. As the millennial generation continues to dominate the workforce, businesses are becoming largely focused on them. They have started recognizing that Millennials possesses positive ambitions of a potential employer so that they can constantly adapt to technologies that ensures the critical information in an appealing way.

Within organizations turnover establishes a diverse scenario [18]. Human capital theory and social capital theory are two theoretical perspectives that are particularly interesting from a public sector perspective [10]. According to social capital theory, high turnover rates will disrupt social ties and hinder trust among colleagues. Yet on the other hand, job stability and high-quality professional networks have a significant effect on performance [22]. These two theories study the chain of events that occurs when people leave or enter the workplace to understand the impact of turnover on organizational performance.

In any business, Organizational Performance is a vital evaluation metrics that can impact various diverse areas from human resources (HRs) and marketing to operations management, international business, strategy, and information systems. The present perception of the turnover–performance relationship is majorly unidirectional, with the focus on how turnover affects performance of the organization. In their review of turnover research in public administration concluded that "the characteristics of the relationship between turnover and performance remain unknown [15]. Organizations may improve performance management or reduce limited resources or initiatives that do not significantly benefit success, resulting in an increase in employee turnover.

II. REVIEW OF LITERATURE

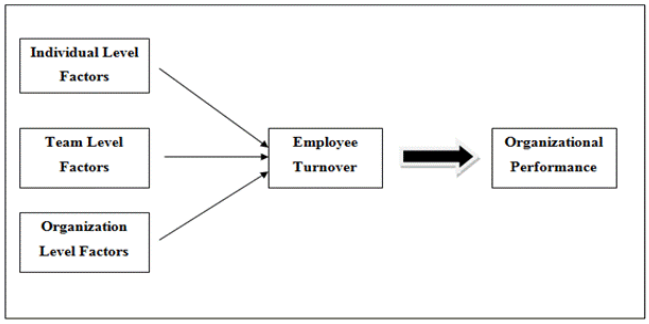
Several theoretical frameworks on the relationship between employee turnover and organizational performance have been developed. Given that employees are significant resources that help to empower, influence, and implement the strategy, any change in human resources has an influence on organizational success [17]. As a result, many managers believe that employee turnover has a negative impact on the business [1] and management continues to be a difficult topic in corporate strategy [17]. The impact of employee turnover on organizational performance is measured by the key indicators are sales growth [3], return on equity [16], customer service efficiency [18][26], and profitability [21][26][27].

Managers regularly evaluate organizational performance to idealistic practices according to the behavioral policy of the company, and make appropriate changes if there is a performance shortfall [14][7]. Employee turnover and organizational performance have a nonlinear relationship (inverse U-shape) that influences the impact of employee turnover,[11] as it leads to innovation, creativity and highly motivated employees [30][13]. Scholars, Mobley and Price and Mueller introduced the pioneering employee turnover model.

First basic model helped to illustrate how employee turnover decisions evolved through various phases varying from analyzing the existing job to having to leave it[24]. Subsequently, in the later stage,

conceptual model included organizational, individual and economic labour market variables that have passed through other intermediate factors that affect employee turnover [25]. In a more recent study highlights The hospitality sector relies significantly on human resources (HR) [9] because staff always play vital roles in forefront that can cause negative side effects, such as turnover social behaviour and poorer customer service [2]. Hence, these contextual factors affect employee turnover decisions.

Conceptual Model of the study



Factors affecting Employee Turnover

Individual Factors affecting employee turnover

Job satisfaction is a reliable indicator of the purpose of turnover [28]. Job satisfaction influences organizational commitment both directly or indirectly. In addition to the impact of job satisfaction on turnover, the factors predicting job satisfaction includes relationship quality, job accuracy, need-to-reward effects on relationship quality [6] to training [5]. According to Kim and Jogaratnam [20], intrinsic motivation along with supervisory leadership is an indicator of turnover intention. Employees who felt they encouraged were less willing to quit their work and were more optimistic on their abilities at work, resulting in lower turnover[12].

Although work–life balance is possibly a non gender issue that affects employee turnover, as Work–family balance is a concern when female staff members change to new jobs. Individual employment characteristics affect the intention to continue in a job, depending on employment level, working hours, number of years at the organization and work shifts. The older generation had lower job satisfaction levels, which led to higher turnover intention levels, particularly for those at non managerial levels. Promotion opportunities affected women more significantly regarding turnover decisions because women frequently had fewer promotional opportunities than men, affecting work–life balance issues. Accordingly, women tend to emphasize promotion in job decisions.

Team Factors affecting employee turnover

Relationship quality has been mentioned studied often in previous studies. Some studies have proved a link between the quality of the relationship between coworkers, supervisors and turnover intentions [5], although the effect was somewhat indirect. Becker and Tews [4] concluded that fun activities improve the relationship quality and bonding between employees, yet they did not eventually lower employee turnover intentions. Tews[4] focused on employee relationships, namely instrumental support and emotional support. The study concluded that more significant instrumental support increased turnover intentions, while more significant emotional support decreased turnover intentions. In addition to the peer-level relationship, the effect of supervisory support on employee turnover received mixed findings[20].

Organizational level factors affecting employee turnover

Salary was mentioned most frequently as a factor causing employee turnover. Chan and Kuok tried to explain why people resign for salary reasons based on the local labor market conditions. Lee and Way determined that different job categories, shifts and levels affect turnover intentions for hotel employees. Yang explained that four different job qualities affected employee turnover: “lack of challenge,” “too

much information processing," "monotony of daily work" and "change in the philosophy of business operation.[35]" Promotion was consistently proven to be a concern affecting employee turnover in previous studies, such as the study by Chan and Kuok explained that promotion is a way to affect a higher level of intrinsic motivation for employees. Accordingly, when the opportunity to attain a higher position was absent, employees were more willing to leave their jobs. Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns.

The term working environment was mentioned in several studies [35] which indicated a correlation between the working environment and employee turnover. Choi [5] confirmed that training positively influenced an organization by decreasing employee turnover and increasing job satisfaction regardless of the type of jobs and roles. In addition to the individual demographical differences, some studies have attempted to explain how organizational background influences employee turnover decisions. In total, two external factors formed by organizations were identified: organizational reputation and the owner's financial capability [35]).

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Four-legged Spider Robot to Walk Over and Clean Vertical Glass Surfaces

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ABSTRACT

In the current era of robotic world, various types of spider robots for various purposes are being developed. The objective of this project is to develop a reliable robot to walk over vertical glass surface. This type of robots can be used very efficiently to clean glasses of big buildings which were build using glass surfaces. In this paper, an algorithm is proposed to make four-legged robot to walk in various directions and also to scan full surface based on the coordinates passed to the robot, in order to clean the full glass surface. This also consist of IoT device to send the single to operator to monitor the movements and radar to detect any object. Since this robot is to walk over the vertical glass surface, integration of vacuum suction holds to the algorithm is a new and challenging part of this project.

Keywords : IoT, Vacuum Suction Hold

I. INTRODUCTION

Now a days, every building either office workspaces or residential apartments are being build using glass as outer surface. To maintain these types of buildings, people are spending lot of money for cleaning these outer surfaces. Spending money is one side of the effort and the main risk factor in this process is, people are cleaning these glasses by hanging through ropes as shown in fig1. There are many incidents where many people are died while doing this process.

Fig-1 People cleaning glass surfaces

So, to avoid these types of incidents and maintain the glass clean, a robot has to be designed to ease this work. With this motivation as primary target, a four-legged spider robot with four legs connected with vacuum suction cups to hold the glass and walk over the glass. The robot should either be driven from the base station or remote location that should send all available data from sensors, which will be displayed on the computer in the user interface program. It is also important to create and program a system into the IoT controller, which would have the capacity to control the servomotors and sensors and pass the information to remote system online.

II. BACKGROUND

Examination of walking machines started in the nineteenth century. One of the first models showed up around the year 1870. For 80-90 years, endeavors were made to build walking machines based on

different kinematic chains that were supposed to generate a desired motion profile during operation. During those years, numerous models were proposed, yet the execution of a large portion of these machines was constrained by general cyclic s walking forms and the inability to adjust a walking pattern to the landscape. In the late 1950s, it turned out to be clear that machines ought to not simply be based on kinematic mechanisms that provide cyclic movements, and that there was a need to integrate planning and control systems. The first robot to move independently with computerized control and electric propulsion was built in 1966 by McGhee and Frank. The main task of the robot's computer was to unravel the kinematic equations involved and to control the electric motors that drove the legs, such that the robot could go forward while maintaining equilibrium constraints. Since then, and following the advance of control technique technologies, computing resources and motion actuators, many different robots with varied abilities have been built.

In 2003, AMIR SHAPIRO in this paper he has developed a spider like robot with two main features as development target 1) stable movement and 2) destination finder to achieve stable locomotion. The control method is based on new results in the fields of grasp theory, and control of asymmetric 2nd-order linear systems. The control method ensures that when a spider-like mechanism bracing against the environment at equilibrium posture the naturally occurring compliance at the contacts stabilizes the mechanism as a single rigid body. Next an algorithm, named PCG (Preconditioned Conjugate Gradients), for selecting sequence of foothold positions along the tunnel has been developed. This robot is developed to use in a situation like, surveillance of collapsed structures for survivors, inspection and testing of complex pipe systems, and maintenance of hazardous structures such as nuclear reactors, all require motion in congested, unstructured, and complex environments.

In 2013, Yam Geva [11] developed, a spider like robot is designed to traverse rough terrain while carrying additional payloads. Such payloads can include both sensors and computational hardware. To develop the forward kinematics equations, we use rotation and translation matrices combined in homogeneous transformation matrices. We chose to use the zero reference point (ZRP) [12] representation method although the Denavit-Hartenberg (DH) [13] method can also be applied.

In 2014, Sachin Oak [14] and Vaibhav Narwane presented a paper on design, analysis and fabrication of a quadruped robot of weight 1.71 Kg incorporates four bar chain leg mechanism as its locomotion element. Mechanical design gait analysis and fabrication of the robot is discussed. Quadruped robot designed and fabricated here involves 8 degrees of freedom which are controlled by servomotors and it walks on flat terrain using symmetrical gaits viz. trot and pace. Its locomotion is controlled by controlling angular rotation of servomotors.

Prof. Atish.B.Mane & Atharva Barje has done research conducted on replacing the wheeled robot with legged robots by using two major mechanisms Joe Klann's Mechanism and Theo Jansen's Mechanism. They majorly taken the Joe Klann's Mechanism for the development of robot. The Joe Klann's Mechanism is a planner mechanism simulates the walking mechanism of the spider. Mechanism consists

of crank, rocker arm, leg, frame all connected with pivot joints.

In 2018, Rozita Teymourzadeh [16] had presented the development of an adaptive intelligent spider robot, with various sensors as feedbacks to the control system to take a decision for the next footstep. In this project, the whole control system was developed using national instruments [NI] controller. The simulations are extracted and monitored using LABVIEW interface. The various sensors used in this project are GH-311 Ultrasonic Sensor to detect any obstacle in front of the robot, GH-312 Smoke Sensor which use to detect smoke in the particular area and LM35 Temperature sensor to get temperature for the surround. The proposed module was designed and implemented using movable wireless Router Module TP Link TL-MR3420 Router transceiver for device communication. The robot was tested and analyzed showing the system efficiency of above 95%, which is competent in robotic applications.

In 2016, Mr.V.Arun & Mr.S.V.S.Prasad [17] had presented an integrated perception and control system for a quadruped robot that allows it to perceive and traverse previously unseen, rugged terrain that includes large, irregular obstacles and also explain the overall structure of the Robot a monolithic mechanical structure and closed- system software architecture.

In 2018, Ritesh G. Waghe [18] had developed a reliable platform that enables the implementation of stable and fast static/dynamic walking on even or uneven terrain. The movement of robot is developed based on the most common way of creating gaits is by manual programming. More sophisticated methods exist and some of them include mimicking stick insects, evolving patterns using genetic algorithms or using artificial neural networks. Some of the most common gaits used are creep and trot gait.

In 2019, S.N. Teli, Rohan Agarwal [19] had presented a paper on how to fabricate mechanical part. In this paper, no prototype is developed, but the main aim is to design and fabricate mechanical multi-legged robot and deformation in the kinematics links by using CADD software. The analysis of the robot is based on the FEM concept integrated into Cad software called ANSYS R16.2. The aim of this project is to create an eight-legged robot to test new walking algorithm

III. CHARACTERISTICS OF LEGGED ROBOT

This part is focuses on several characteristics of walking robots. Some classifications of walking robots and most common walking gaits are described.

A. Classification of Walking Robot

There are many ways to define walking robots

- ✓ By a body shape
- ✓ Number of legs
- ✓ Number of degrees of freedom per leg
- ✓ Locomotion technique.

To achieve many different configurations various options can be combined. By body shape it can be classified into two category Mammal and Spider which is shown in Fig.1.

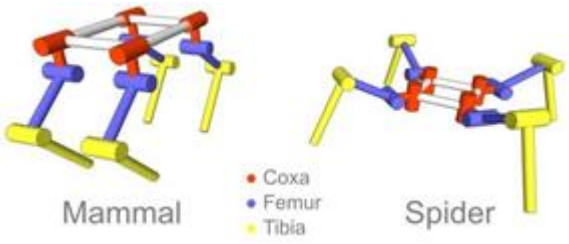

Fig -1: Mammal and Spider robot body shape

At least two degrees of freedom are needed to construct a walking robot – first for lifting the leg, second for rotating it. Nevertheless, for a good functioning robot there should be three degrees of freedom, because the legs move along a circle and the forward movement of the body causes slipping

between the foot and the surface, which can be compensated by third joint..

B. Walking Theory

In order for the four-legged robot to walk, several algorithms need to work together to form a complete controller. The end product at every time interval is the position set-point for each servo. Walking patterns need to be chosen, swing trajectories calculated and leg position constraints updated. Depending on velocity, different gaits are selected by a controller. To execute these gaits each leg will have a stand phase and a swing phase. Whereas the stand phase is when the leg has ground contact at all time. During the swing phase a trajectory between two stand positions must be properly calculated by the controller. Due to size of hardware such as leg length, servo positions and body width, certain constraints will restrict the possible leg positions. The positions of each leg will also affect remaining legs possible position space. Due to resemblance between a quadrapod robot and legged insects a lot of inspiration can be taken from insect locomotion and biometrics.

1) Walking Gaits

To move a quadrapod in any direction the legs has to push it in that way, resulting in legs getting further away from the quadrapod body. In order for this to continue the legs have to be lifted and moved back into the vicinity of the body. This can be done in several different ways and possibilities increases with the amount of degrees of freedom. The most common way of creating gaits is by manual programming. More sophisticated methods exist and some of them include mimicking stick insects, evolving patterns using genetic algorithms or using artificial neural networks. Some of the most common gaits used are creep and trot gait. They are used for slow and medium movement respectively. The basic difference between these gaits are the usage of one or two legs simultaneously in swing phase, Figure 2.

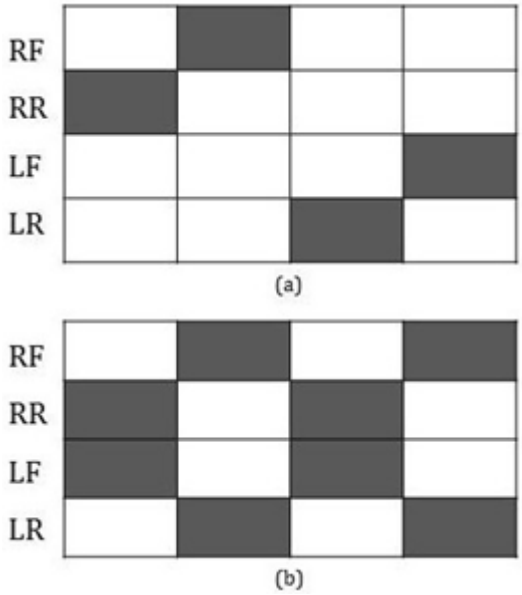

Fig -2: Gait diagram for two common gaits that can be implemented. Black symbolizes swing phase. (a) Creep, (b) Trot.

2) Creep Gait

The basic alternating diagonal walk called the creep, sometimes known as the crawl, it also known as static stable gait. The alternating diagonal walk has dynamic stability (Trot gait), the creep has static stability. Only one leg is ever lifted from the ground at a time, while other three maintain a stable tripod stance. The ground legs are maintained in a geometry that keeps the center of mass of a body inside the triangle formed by the three points of tripod at all times. As the suspended leg moves forward, the tripod leg shit the body forward in synchrony, so that a new stable tripod can be formed when the suspended leg comes down.

The tripod can shift the body forward simultaneously with the suspended leg, giving a nice smooth forward movement. This method should provide good speed on level ground. The tripod can shift the body forward after the suspended leg has touch down, giving a more tentative and secure forward movement this method should be useful when engaging obstacles or moving over broken ground.

The diagram below shows the basic timing for the leg positions when doing a creep gait.

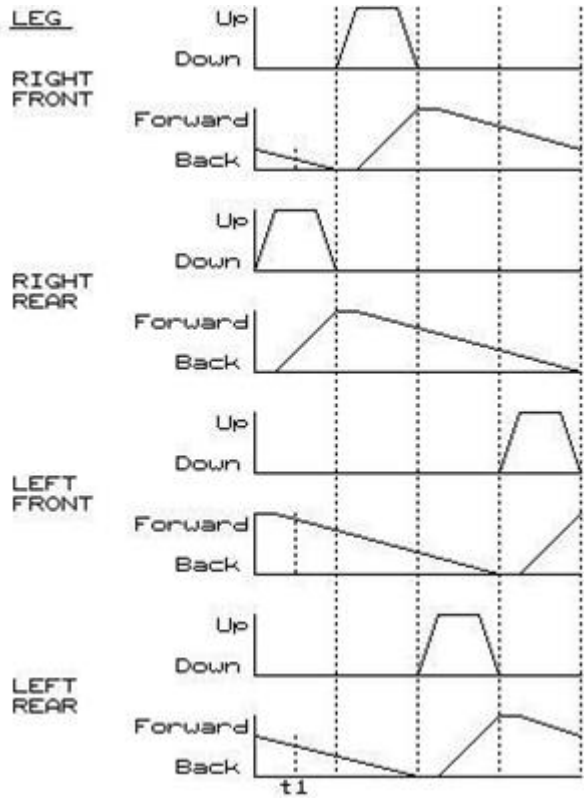

Fig -3 : Timing diagram for leg positions when doing creep gait

The creep gait works with 4-beat timing. One leg at a time, starting with the right rear, picks up and moves forward and down during one beat and then slowly moves backward during the next 3 beats. During the second beat, the front leg on the same side goes through the same motion. During the third beat, the rear leg on the opposite side does the same. Finally, the front leg on the opposite side does similar, during the fourth time beat. The cycle repeats, and forward motion continues. Each leg picks up and moves forward during its own quarter phase, and then moves backward during the other three-quarter phases. The overall action results in very smooth and even forward movement, since all legs are constant motion here. The body remains nice and level.

3) Trot Gait

The alternating diagonal walk has dynamic stability, its sometimes called amble gait. Two diagonal legs swing forward while the others two support the body and moves backward. It's one of the quickest gait because two of its legs are lifted at one time, although it's not very energy efficient.

The stability of the body is related to the frequency of the legs being lifted and placed, the quicker, the less shaky you will find it is. Of course, it's has something to do with the design of the feet as well, if the feet have a large contact are with the ground you will find it stay better while the other two legs are lifted. Since in this project, the robot should be able to walk on vertical glass surface, stability is far important that fast. So, for this project, Trot gait method won't be useful.

d. Inverse Kinematics

Each leg constitutes of three links (Coxa, Femur, Tibia) and three actuators (Body-Coxa, Coxa-Femur, Femur-Tibia). The first actuator connects the leg to the body. It is a shoulder pivot and is referred as γ. This angle controls the rotation of the whole leg in the plane parallel to the [x, y] place of the robot's body. The first link is called Coxa, is usually rather short and connects shoulder pivot with the elbow. Another actuator is placed between Coxa and Femur. The angle is called α and allows vertical movement of the leg. The Femur is connected to the Tibia with another actuator. It allows the set the angle between them. The angle is called β and operates in vertical plane as well. This angle allows to place the foot near or far to the center of gravity (CoG). Both angles α, β operate in the same plane, which is perpendicular to the robot's base plane. All the links in the leg has a fixed length. The actuators connecting the links are standard servos. The output horn of a servo can be set for angle 0–180◦. Therefore a coordinate conversion between [x, y ,z] and angles α,β,γ must be provided

The conversion can be based on standard trigonometric functions and law of cosines.

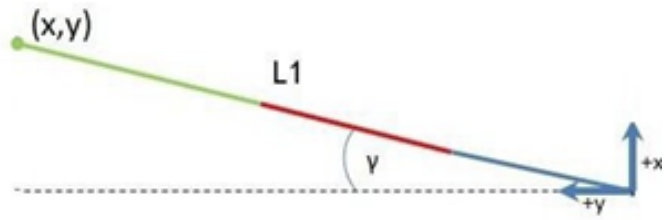

Fig -4: Inverse kinematics top view

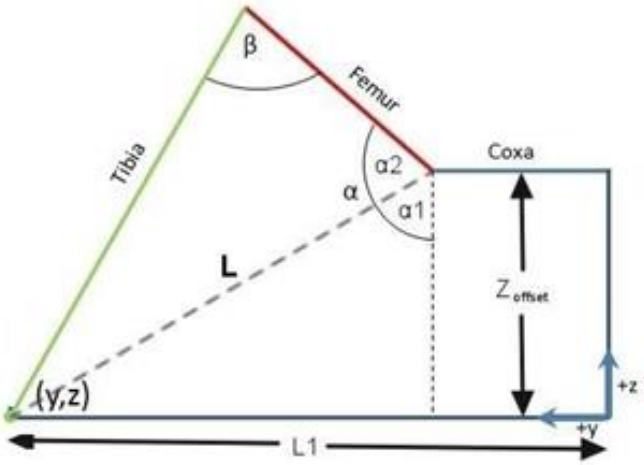

Fig -5: Inverse kinematics side view

$$\frac{x}{y} = \tan(\gamma)$$

$$\rightarrow \gamma = \tan^{-1}\left(\frac{x}{y}\right)$$

$$L = \sqrt[2]{z_{offset}^2 + (L1 - coxa)^2}$$

$$\alpha_1 = \cos^{-1}\left(\frac{Z_{offset}}{L}\right)$$

$$Tibia^2 = Femur^2 + L^2 - 2(Femur)(L)\cos(\alpha_2)$$

$$\rightarrow \alpha_2 = \cos^{-1}\frac{Tibia^2 - Femur^2 - L^2}{-2(Femur)(L)}$$

$$\alpha = \alpha_1 + \alpha_2$$

$$\alpha = \cos^{-1}\left(\frac{Z_{offset}}{L}\right) + \cos^{-1}\frac{Tibia^2 - Femur^2 - L^2}{-2(Femur)(L)}$$

$$L^2 = Tibia^2 + Femur^2 - 2(Tibia)(Femur)\cos(\beta)$$

$$\rightarrow \beta = \cos^{-1}\frac{L^2 - Tibia^2 - Femur^2}{-2(Tibia)(Femur)}$$

IV. INTEGRATING VACUUM SUCTION CUPS [15]

Vacuum switches and pressure gauges are normally selected on the basis of the functions required in the application and on the switching frequency.

Weight Estimations

It is an important to know the mass of the work-piece to be handled. Work-piece weight can be estimated as follows:

1. Suction Pad Mass m [kg]: m = L x B x H x ρ
a. L = length [m]
b. B = width [m]
c. H = height [m]
d. ρ = density [kg/m3]
2. Example: m = 2.5 x 1.25 x 0.0025 x 7850 Workpiece mass, m = 61.33 kg
3. Load case I: horizontal suction pads, vertical force against the workpiece load
a. FTH = Force for theoretical holding [N]
b. m = mass [kg]
c. g = acceleration due to gravitational force [9.81 m/s2]
d. a = system acceleration [m/s2] (remember to include the "emergency off" situation!)
e. S = safety factor (minimum value 1.5; for critical inhomogeneous or porous materials or rough surfaces 2.0 or higher)

The suction pads are placed on a horizontal with work piece which is to be moved sideways. Fig 6: Suction Pads

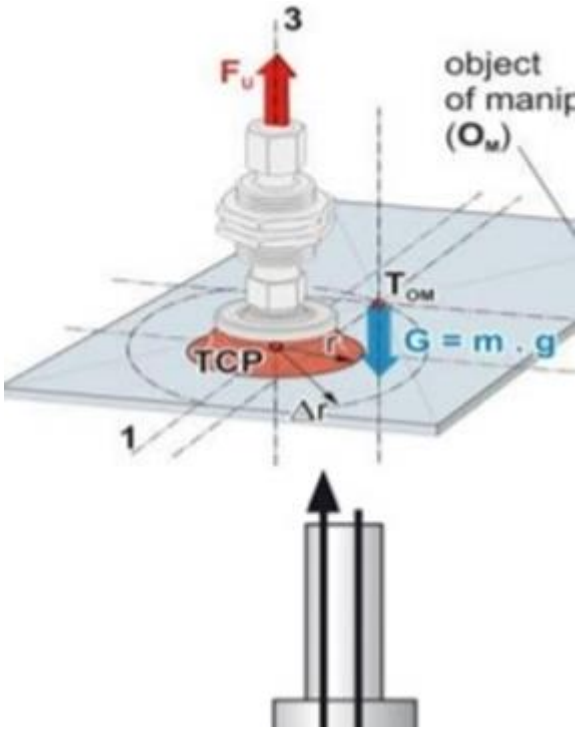

Fig 6 Suction Pads

Fig 7 Sucction pads implementation. ELECTRONIC SYSTEM

In order to control the robot there must be some control unit. Ardiuno Mega was chosen to drive the servomotors and sensors on this robot. All servo motors and sensor are connected to it. The whole scheme is in Figure 10.

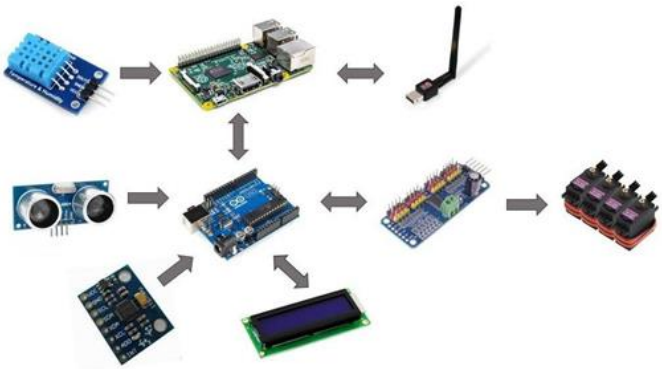

Fig -8: The electronic system of the robot.

Fig – 9 12V DC 8L/m Mini Vacuum Pump

V. RESULTS

The overall body looks like Fig -10 without vacuum integration.

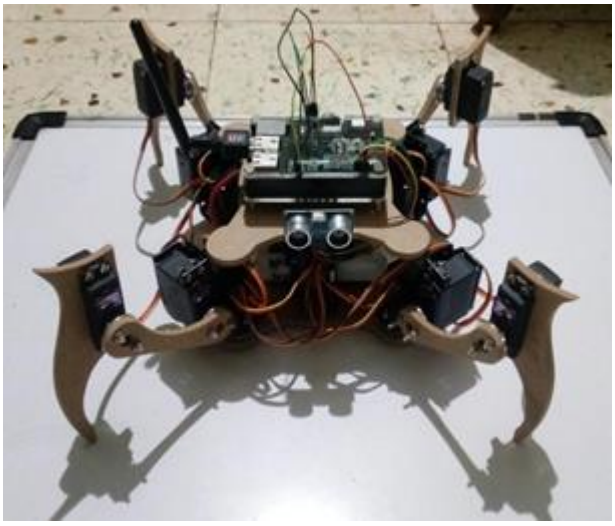

Fig 10 : The Complete robot without vacuum integrated.

VI. CONCLUSION

I would like to conclude this paper with a four-legged spider robot with three degrees of freedom for each leg was designed and capable of walking over the vertical surface of glass using vacuum suction pads. Using this prototype, one can further modify to integrate cleaning system to fulfill the main motivation of this design.

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A Study on Implementation of Design Thinking and Innovation – Contribution Towards Atmanirbhar Bharat

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ABSTRACT

This paper is an attempt to identify and discuss about implementation of design thinking in order to create and innovate product to solve various livelihood problems catering to the pyramid of the society in a developing countries like India. Design thinking a five stage problem solving methodology to cater and assist innovation and the process of adaption of innovation in the life of people to influence the livelihood. Design Thinking process is reiterative, adaptable and centered on coalition between inventor and users, with an emphasis on bringing ideas to life based on how real useer think, feel behave and adopt.

Keywords : Design Thinking , Innovation, Problem solving, creativity, Atmanirbhar Bharat

I. INTRODUCTION

Design Thinking is human centric, nonlinear, iterative process where the ideas generate either from present need or from futuristic requirements. it leads to collaboration of Technology and economics. According to Tim Brown(2008) Design thinking comprises of 3 step process which includes – Inspiration, Ideation and Implementation . Inspiration can be opportunity, Problem that can be identified through close observation. Ideation stage a brainstorming stage to collect relevant information sketch and produce creative formwork. Design thinking has transformational abilities by developing products and services apt to benefit the customer and create more value to the business. Design thinking starts with understanding users, challenge assumptions, redefine problems and create innovative solutions to prototype and test. The five step design thinking process proposed by the Hasso-Plattner Institute of Design at Stanford. Design thinking can be explained Involving five Stages Empathize, Define, Ideate, Prototype and Test it is most useful to solve problems that are poorly defined and unknown by understanding the human needs involved, in brainstorming sessions, and by adopting a hands-on approach in prototyping and testing. Commiserate the first step in design thinking process it includes gaining an empathic understanding of the problem. consulting experts to find out more about the area of concern through observing, engaging and empathizing with people to understand their experiences and motivations, immersing in the physical environment to gain a deeper personal understanding of the issues involved. Empathy is crucial to a human- centred design process and allows design thinkers to set aside their own assumptions about the world in order to gain insight into users and their needs. substantial amount of information is gathered to use during the next stage to develop the

best possible understanding of the users, their needs, and the problems that underlie the development of that particular product. The second stage is Define stage, it put together the information created and gathered during the Empathise stage analysis of the observation and synthesise them in order to define the core problems identified . The problem is defined as a problem statement in a human-centred manner. The Define stage will help to gather great ideas to establish features, functions, and any other elements that will allow them to solve the problems or, at the very least, allow users to resolve issues themselves with the minimum of difficulty.

In the Define stage will lead to the third stage, Ideate, A stage for idea generation of solution . There are many methods available for Ideation such as Brainstorm, Brain write, Worst Possible Idea, and SCAMPER. The ideation stage leads to selecting most feasible solution and developing a working model including all features to it called as prototype . The last

Understanding these five stages of Design Thinking will empower anyone to apply the Design Thinking methods in order to solve complex problems that occur around us — in our companies, in our countries, and even on the scale of our planet. There are various phases in around the spheres of life where design thinking can be applied to solve the problems. This paper is an attempt to identify implementation of design thinking leading to innovation and then diffusion of the innovation by adapting it to solve the problems of life".

II. LITERATURE REVIEW

Innovation means something new, not done before, for any innovation need to incorporate the phases of design thinking process. Design Thinking is a five-step sequential process that initiates with empathise or understanding about pain of any person. the first step in identifying the problem. and hence observation becomes a crucial tool in understanding the same.

Define the problem which refers to demographic profiling of the problem. Develop Idea in and around the problem and look for the innovative solutions to solve . Develop a prototype and check for the feasibility and adaptability of the same. This design thinking approach accordring to Brown consists of three main steps: the motivation, idea generation, and application phase. Brown, T. (2008).

Herbert Simon was the first one to coin the term design thinking as a way of thinking in his major book The Sciences of the Artificial, 1969. Later in 1973 and in 1993, respectively, Robert McKim and Rolf Faste elaborated the term, defining, and commercializing the idea of design thinking and its original benefits on creation. Peter Rowe's 1986 systematic approach in his book Design Thinking became one of the primary literatures on design that explained the design thinking term with problem solving procedures in urban planning and architecture. In these past years, design thinking has been a highly discussed term in the realm of design and also in the realm of business (Davy, 2012). the structure of design thinking creates a natural flow from research to rollout. Immersion in the customer experience produces data, which is transformed into insights, which help teams agree on design criteria they use to brainstorm solutions. Assumptions about what's critical to the success of those solutions are examined and then tested with rough prototypes that help teams further develop innovations and prepare them for real-world experiments. (Jeanne Liedka,2018). Having good design thinking skills can help in solving really complex and ill defined problems as well as adjusting to unexpected changes. The design process involves in-depth cognitive processes—which will,help to build critical thinking skills (e. g. , reasoning and analysis) involving

personality and dispositional traits such as persistence and creativity. (Razzouk,2012). Design Thinking is used to identify the problems and provide solutions . Some examples quoted from rural Indian innovations focuses on the concept of design thinking for inventions & Innovations. Anjan Mukherjee, a former marine chief engineer, has developed the Taraltec Disinfection Reactor, a 'fit and forget' device, which converts contaminated water from borewell andpumps at the source to clean water, by killing 99% of the microbes. From the remote village of Madhya Pradesh born in the family of marginal farmer s, Jitendra mechanical engineer by profession has built Shuddham, a low-cost water filter that can filter 90,000 litres of water in six months and uses no electricity and works on the principle of gravity . Per day, it has the capacity of repurposing 500 litres of dirty water for everything except drinking and cooking. Lack of storage facility and food processing units leads to a loss of post harvest. Three ex-students of IIT- Kharagpur have come up with a product through which farmers can now increase the shelf life of their produce and operate in a wider market. Through their start-up Eco zen, Devendra Gupta, Prateek Singhal, and Vivek Pandey developed Eco frost, a solar-powered cold storage unit. This can be used to preserve produce that tends to spoil quickly, such as spinach, tomatoes, or capsicum, and be stored for up to 21 days. Farmers can control the temperature from their phone by selecting the produce that they want to store. The storage unit then automatically regulates the optimum temperature. On days when there is no sun, the facility is equipped with chemical batteries that maintain temperatures up to 30 hours . Charu Monga, a researcher at the Department of Design, Indian Institute of Technology, Guwahati, announced the development of Jugnu solar bags, that have solar panels integrated into them. During the day, the bag stores enough power for an LED light. For students living in unelectrified parts of India, especially mountains it's a great innovation. There are many grassroots innovators Who took inspiration from everyday circumstances and shortcomings to invent time-saving, energy-efficient devices. Bommai N (41) has always had an eye for innovation. rural innovator from Bukkasandra village in Karnataka has comes a long way. Irked by the manual effort it takes for rural women, to dole out large number of rotis, Bommai decided to innovate a simple machine that makes the whole process easier. Costing Rs 15,000, Bommai's portable, easy-to-operate machine weighs just 6 kg and is the size of a regular induction stove. Forty- seven-year-old V Jayaprakash went door to door, selling clay stoves with his mother in the villages near Koyilandy, Kerala.

Seeing how these biomass stoves emitted huge amounts of smoke, Jayaprakash's inquiring mind thought of various ideas that could mitigate this problem and help women who choked in the kitchen while cooking. This then led him to improvise the portable stove to make it more efficient and energy saving. Made of stainless less and cast iron, Jayaprakash's unique design involves a two-tier system of burning that ensures both the biomass fuel and the smoke created from it are completely burnt creating less pollution. At a time when traditional handlooms are dying a slow death, people like Dipak Bharali refuse bow down to the dictates of modern weaving. Compelled by the everyday challenges involved in weaving Assam's much acclaimed muga silk, this serial innovator has invented a device that has simplified the laborious task of many silk weavers. Hailing from a small village in Gujarat's Junagadh district, Bhanjibhai Mathukiya has been credited with innovating more than many useful agricultural equipment- ranging from low- cost tractors to an airborne agricultural sprayer. Born into an agricultural family, the multi-talented tinkerer has also developed a mechanism to store grains at low cost. Born to a carpenter's family in Rajasthan's Sikar, Madanlal Kumawat had to quit school after fourth grade owing to health issues and an added financial burden. This led him to build a thresher, a machine

used to separate grain from stalks and husks. Though efficient, the initial model was not suitable for multi-grains.

However, further improvisations and persistence paid off and, soon, Madanlal was able to design different models of the thresher that come in different sizes and consume different levels of power. Having simplified a labour-intensive task of threshing that mostly depended on right winds, Madanlal's thresher has helped many farmers obtain cleaner grains without much. Having grown up amidst the rubber plantations surrounding Kottayam, Mathews K Mathews was well acquainted about the mosquito menace that prevailed in Kerala, the state that houses the greatest number of breeds. Soon after his graduation, Mathews started developing a cost-effective device that traps and kills mosquitoes through many trials and errors. Unlike other mosquito catchers and repellents that make use of toxic chemicals, Mathew's eco-friendly version (called Hawker) depends on the smell from septic tanks to attract mosquitos. Eventually, the trapped mosquitos are killed due to the heat built up inside the device because of direct sunlight. Remya Jose, a young teenager from Kerala who was tired of washing dirty clothes with her hands decided to do get solution of the problem . She went ahead and created a washing machine that resembles the exercising cycle in gym. 3-4 minutes of pedalling will help to clean the clothes completely and also to dry by 80%.

The machine washes clothes effectively, saves time and electricity. Daramveer Kamboj cost-effective machines to make the process of converting herbs into gel easily. Leaves and twigs can be easily converted into highly beneficial gel in rural areas for both production purposes as well as self-medication in many cases. M J Joseph ,Tree Climbing Machine. The machine consists of two loops and pedals for each foot, which one can easily use to climb a tree. Primarily used for coconut trees, it can be adjusted and used for various other trees as well. Safe, cheap and convenient, the machine has been a roaring success. Innovations are important as long as they influence and change life of people and make it better . And for all these innovation design thinking empathise understanding the problem from the perspective of people becomes important and solution become easy to escalate to diffusion and more importantly acceptable by the people to adapt the same .

III. RESULT AND DISCUSSION

Innovation, adaptability, and diffusion of innovation depends upon identification of problem and how much the problem is empathised by the innovator. For adaptability of innovation its very important that solution can be affordable by the people facing the problem . In all examples quoted from innovation from rural India it can be referred that design thinking is a key to innovation and creating the solution suitable and affordable makes the innovation popular and worth . In country like India which covers varied geographical regions with huge population it becomes especially important to inculcate the concept of design thinking among the youth as it will help systematise the problem-solving skills through innovation. Atmanirbhar self-dependent need to be started from grass root level identifying micro level problem proving apt solution that is affordable and achievable . The five step process of design thinking is a framework of innovation , where the process is carried out in a more flexible and non-linear fashion. Design Thinking should not be a concrete and inflexible approach to design. To gain the purest and most informative insights for any problem, these stages might be switched, conducted concurrently, and repeated several times for best possible solution .

IV. CONCLUSION

Atmanirbhar comes from identifying and solving problems at micro level with the resources or the capabilities available. Solving the problems ourselves without taking help from any other country. Design thinking is the guiding principle towards innovation we would like a suggest a preliminary step of observation to find the problem and provide suitable solution. Five-stage model can be concluded to seven step that will help in acquiring knowledge at the later stages can provide feedback to earlier stages. Information is continually used both to inform the understanding of the problem and solution spaces, and to redefine the problem(s). This creates a perpetual loop, in which the designers continue to gain new insights, develop new ways of viewing the product and its possible uses, and develop a far more profound understanding of the users and the problems they face. Design thinking a five step process is a framework for innovation and understanding of grassroot level problems and providing solution , and intermediate refining and gaining more insights to the problem and suitability of the solution . The innovation quoted in the paper are some of the examples of identifying problem and providing solution suitable for the people facing the same . Design thinking is a process that can be implemented anywhere and everywhere a mindset to solve problem and zeal to change and influence life of people is the motivation required. Atmanirbhar Bharath is achievable through all these small innovations. Development is not an overnight process but a revolution which can come through solving grass root level problems.

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