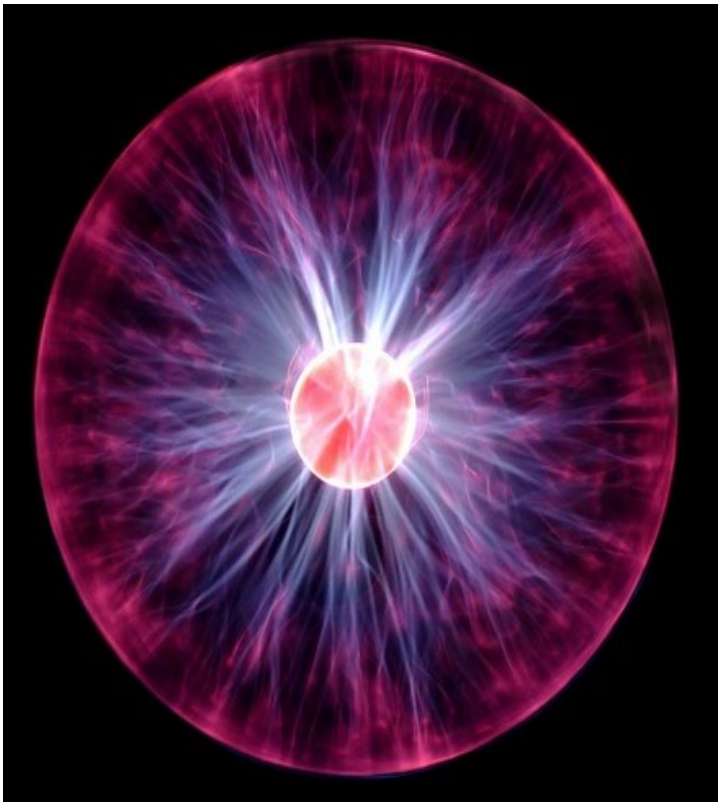
Academic Year :

2023 - 2024



# ELECTROSPHERE

---- A Technical Magazine

Department of Electrical Engineering
AISSMS 's Institute of Information Technology, Pune.

Volume VII

# INDEX

# About Department of Electrical Engineering

The Department of Electrical Engineering was established in 1999 at AISSMS, Institute of Information Technology, Pune. The department offers **B.E. in Electrical** and **M.E. in Power Electronics and Drives**. The department currently has 13 professional faculties, including 02 IEEE, 11 IE(I) and 13 ISTE members. In the department, near about 30 courses are offered, encompassing all areas of electrical engineering. Faculty and students are engaged in courses and research in the fields viz, power systems, control systems, power electronics, electrical machines, renewable systems and power quality. The department focuses on developing its strengths and aligning with the institutional priorities of IOIT.

The vision of the department is to contribute to the society by imparting quality education in the field of electrical engineering and prepares students to succeed in their professional career by inculcating in them high human values.

The department's mission is to develop innovative and socially responsible engineering professionals by delivering in-depth knowledge of electrical engineering.

Several small, medium and large projects have been sanctioned to department faculty in the last five years. This has led to the development of center of excellence in power quality.

Department faculty has been traditionally contributing to administrative activities both within and outside the Institute. Currently, 10 faculties are serving as chairman/paper setter/examiner at University. Several faculties from the department are currently serving as coordinators within the Institute.

The department endeavors to produce confident professionals tuned to real time working environment. Department Alumni have made excellent contributions in various fields like entrepreneurship, industry, and academics. A few illustrious who have distinguished themselves are Kalyani Abhyankar (Sr. Operations Engineer, Sacramento, California Area), Ruchi Muku Das (Infrastructure and Network Procurement, Unilever Asia Pvt. Ltd), Amol Manal (Controls Specialist at Lorik Tool & Automation Kitchener, Ontario, Canada) , Vishakha Chandhere (Founder, OrjaBox Pune, Maharashtra) , Lalit Ghatpande (Relay Setting Engineer, Synchro Grid Limited LLC ).

The infrastructure and lab facilities are upgraded from time to time and provide a good practical learning and innovative environment for the students and researchers. There are about 07 laboratories just for the exclusive benefit of students of department of EE.
The department strives to provide a conductive environment for the students to develop analytical and practical skills and apply them to real world problems. To motivate the students, the department organizes regular training workshop.

A competitive environment is fostered, and development of leadership skills and team skills are also encouraged by means of the department professional body societies such as IEI, IEEE, ISTE, ISLE, REC, EESA which holds various co-curricular and extracurricular events, contests from time to time to bring out hidden talents.

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|  |  |  |  |
| Mr. P.P. Mahajan | Mr. S. D. Raste | Mr. Y. D. Rashinkar | Mrs. P. P. Mane |

**Electrical Department Faculty Members**

# Technical Articles

# Energy Storage System

**Prisha Jagdale**
**Student, T. E. Electrical Engineering**

## Introduction

Electrical power infrastructures are changing dramatically around the globe due to smart grid initiatives, the establishment of renewable and the resulting distributed nature of creating electricity, the need for independent micro grids to ensure grid reliability, new demands from end users, the need to reduce greenhouse gas emissions, as well as the capability to accommodate mixed energy resources. As a result, the power network faces great challenges in generation, transmission and distribution to meet new and many times unpredictable demands of providing coherent electricity supply. Electrical Energy Storage (EES) has been considered a game- changer with a number of technologies that have great potential in meeting these challenges. The suitability of a storage technology is determined primarily by its power and energy capacity and the rate at which these can be stored and delivered. Other characteristics to consider are round- trip efficiency, cycle life, calendar life, safety, reliability, effect on the environment and ramp rate (how fast the technology can respond to a command). Other energy storage technologies such as compressed air fly wheel, and pump storage do exist, but recent generation focuses on battery energy storage systems (BESS) and its related applications.

## Overview of the Energy Storage Technologies

Today, most common battery chemistries are based on lead, nickel, sodium and lithium electro chemistries. Emerging technologies like flow batteries utilize various transition metals like vanadium, chromium and iron as the electro active element. Carbon electrodes are a critical part of several of these battery systems. Each storage type has distinct characteristics, namely, capacity, energy and power output, charging/discharging rates, efficiency, life cycle and cost that need to be taken into consideration for possible applications. Understanding their chemical characteristics and related regulations are critical steps for possible use. This includes the application, sitting, installation, operation and maintenance, as well as shipping and disposing of used batteries. This topic presents a survey of available and emerging battery technologies and their design and performance characteristics. Electric Double Layer Capacitors (often referred to as ultra capacitors or super capacitors) are also addressed in this topic.

## Lead acid batteries:

The lead-acid battery was invented in 1859 by French physicist Gaston Planet and it is the oldest and most mature rechargeable battery technology. There are several types of lead-acid batteries that share the same fundamental configuration. The battery consists of a lead (Pb) cathode, a lead-dioxide ($PbO_2$) anode and sulphuric acid electrolyte ($H_2SO_4$). The deep cycle/traction and the traditional stationary battery types are the most used in Smart Grid applications. The deep cycle battery is composed of very thin plates and has a low energy density; however, its relatively high-power density makes it attractive for use in motor vehicles to provide the high current required for power engine starters.

The larger format and thicker plate stationary battery is used in several applications where interruption to the load cannot be tolerated. Common use in the energy space includes standby backup power for switchgear, turbine motors, data centers and any other application where reliability of the load is critical. Lead-acid batteries are widely used because they are less expensive compared to many of the newer technologies and have a proven track record for reliability and performance.

**Nickel–Cadmium batteries**

The nickel–cadmium battery (NiCd) is a rechargeable battery using nickel oxide hydroxide and metallic cadmium as electrodes. Wet-cell nickel-cadmium batteries were invented in 1899. A NiCd cell delivers around 1.2 volts output voltage until nearly the end of discharge. Compared with other types of rechargeable batteries, NiCd batteries offer satisfactory life-cycle characteristics and improved performance at low temperatures with a good capacity retention at high rates. However, the material costs are higher than that of the lead acid batteries. Moreover, NiCd cells experience the so called “memory effect” and high self-discharge rates which have a great impact to their performance characteristics. In addition, environmental concerns on the disposal of the toxic metal cadmium has dramatically reduced the use of NiCd batteries.

**Nickel–metal hydride batteries**

A nickel–metal hydride battery (NiMH) is also a type of rechargeable battery. Similarly to NiCd batteries, NiMH cells use nickel oxide hydroxide (NiOOH), which is formed in the positive electrode. The use of Cd in the negative electrode is replaced by a hydrogen-absorbing alloy. A NiMH battery can have two to three times the capacity of an equivalent size NiCd, and its specific energy of 80Wh/kg is about 50% of a lithium-ion battery. Main applications of the NiMH batteries are found in consumer electronics and plug-in electric vehicles and hybrid vehicles due to the technology maturity and their competitive cost to Li-ion batteries. However, Li-ion batteries are considered the most promising for the EV industry mainly due to their continuously falling cost and improved performance.

**Lithium-ion batteries**

In 1991, Sony and Asahi Kasei released the first commercial lithium-ion battery. A lithium-ion battery (Li-ion) is a type of rechargeable battery where lithium ions move from the negative electrode to the positive electrode during discharge. The process is reversed during charging. With a high energy density, negligible memory effect and low self-discharge, Li-ion batteries are one of the most popular types of rechargeable batteries for portable electronics. In recent years, they are also growing in popularity for military, Plug-in electric vehicle (PEV), and aerospace applications. Different types of Li-ion battery chemistries present different performance, cost and safety features that can suit a variety of applications. For example, lithium cobalt oxide (LiCoO2) batteries are used in most handheld electronics due to their high energy density and low weight. Other types such as Lithium iron phosphate (LiFePO4), lithium-ion manganese oxide batteries (LiMn2O4, Li2MnO3, or LMO) and lithium nickel manganese cobalt oxide (LiNiMnCoO2 or NMC) offer lower energy density but can provide longer lifetime and inherent safety. These types are widely used for electric tools and medical equipment. The newer emerging types of lithium–Sulphur batteries promise the highest performance-to-weight ratio. Li- ion batteries present a high efficiency and a long lifespan.

**Sodium–Sulphur batteries**

A sodium–Sulphur (NaS) battery is a molten-salt battery constructed from liquid sodium (Na) and Sulphur (S). NaS batteries are fabricated from inexpensive materials, which form one of the main advantages of this technology type. NaS batteries have high energy density, high efficiency of charging/discharging (89–92%) and long cycle life. The main drawbacks of the NaS battery are the operating temperatures of 3000C to 3500C and the highly corrosive nature of the sodium poly sulfides. Battery cells become more economical with increasing size, therefore NaS batteries are considered more suitable for stationary energy storage applications. Typical applications of NaS batteries are distribution network support and grid services and renewable energy integration. The technology has great potential for grid services since it has a long discharge time and can respond precisely to improve power quality issues in the grid.

**Sodium-nickel-chloride batteries**

Sodium-nickel-chloride ($NaNiCl_2$) is a high-temperature batteries similar to NaS batteries. Their operating temperature lies within the 2700 C-3500 C range. During the charging process, salt (NaCl) and nickel (Ni) are transformed into nickel-chloride ($NiCl_2$) and molten sodium (Na). The process is reversed during discharge. Typical applications of $NaNiCl_2$ batteries are grid support services and renewable energy integration.

**Electric Double layer Capacitors**

Electric Double Layer Capacitors (EDLCs), also known as “ultra capacitors” or “super capacitors” store electrical charge in an electric double layer (non-Faradic) at the interface between a high-surface-area carbon electrode and a liquid electrolyte. This mechanism is highly reversible and therefore just as with ECs, conventional capacitors, can be charged and discharged at high power rates with low capacitance fades for hundreds of thousands of cycles. The electrode surface area in capacitors determines the capacitance and thus, the energy storage capability of the device. The amount of energy stored by EDLCs is very large compared to conventional capacitors because of the use of a porous carbon-based electrode material of high surface area. While ultra capacitors have very high specific power (10-20 kW/kg), and longer lifetime relative to batteries, they have a low specific and volumetric energy density (<8Wh/kg).

Ultra capacitors exhibit significantly less sensitivity to temperature than Li-ion batteries. Ultra capacitors are well-suited for high power applications in a variety of areas, with applicability at Transmission, sub-transmission, as well as distribution voltage levels. The key features of ultra capacitors are extremely appealing in electricity grids: fast response time in milliseconds, high- energy efficiency (> 95%), high power density and long calendar and cycle life. Deployment of EDLCs has accelerated greatly over the last 15 years; they are now widely commercialized in hybrid bus, rail, and automotive applications, as well as back-up power applications such as wind pitch control systems and uninterrupted power supplies. Moreover, there are several trials and pilot projects that study the utilization of super capacitors for grid energy storage systems. They can be a stand-alone technology or hybridized with a second, low-cost high-energy density technology such as flow batteries or high energy Li-ion batteries.

**Comparison of battery storage technologies**

A summary of the energy storage technologies discussed above is presented at table. Different types are compared by their main technical characteristics, such as cycle life performance and efficiency.

| Storage technology | Cycle life at 80% DOD | Efficiency | Advantage | Disadvantage |
|---|---|---|---|---|
| Lead Acid | 300-3000 | 70-90% | Inexpensive<br>Mature technology | Limited cycling capability for most standard types<br>Low energy density<br>Environmental hazard |
| NiCd | 3000 | 80% | -Good cycle life<br>-Good performance at low temperatures<br>-More tolerant to hostile environments or conditions. | Memory effect<br>High self-discharge rate<br>Environmental hazard |
| NiMH | 2000 | 50-80% | - High energy density<br>-Good abuse tolerance<br>-Good performance at low temperatures | Damage may occur with complete discharge<br>High costs |
| Li-ion | 3000 | 75-90 % | -High energy density<br>-Low self-discharge rate<br>- No memory effect | - Expensive although costs are decreasing<br>- Not safe depending on type |
| Flow batteries | 2,000-20,000 | 65-85 % | - Scalability<br>-Lifespan not dependent on DOD | - Need for electrolyte tanks<br>- High maintenance<br>-Complex monitoring and control mechanisms. |
| NaS | 4500 | 89 % | High efficiency and cycle life<br>Low-cost battery materials<br>High energy density | - High operating temperatures<br>Temperature is to be maintained close to 300C which might affect battery performance<br>Corrosive materials |
| NaNiCl2 | 1,500-3,000 | 85-95 % | - Long cycle life<br>- High energy density | - High operating temperatures<br>Thermal management requirement |

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# Artificial Intelligence in Electrical Engineering

**Mr. Prashant P. Mahajan**

Artificial intelligence is not new and has been in existence for about 80 years and is an important part of industry 4.0 revolution. What is interesting is the in recent times the field of AI and Data science has seen unprecedented growth and probably humans are finding it a challenge to adapt to the speed with which technology is changing the way we do the work.

**All tasks which do not involve human emotions and psychology and are repetitive in nature will be replaced by Artificial Intelligence.**

Now people should use technology to do tasks effectively. For this constant adaptability to new technology is a must to professionally sustain in this era. Artificial intelligence is changing each sector and its impact on Electrical Engineering (EE) is profound. Here's a concise look at its applications, benefits, challenges, and how students and professionals can adapt and upskill in this evolving field.

## Applications of AI in Electrical Engineering

1. **Smart Grids and Energy Management:** AI predicts energy demands, optimizes distribution, and enhances grid stability.
2. **Predictive Maintenance:** AI monitors equipment to detect faults early, minimizing downtime and maintenance costs.
3. **Renewable Energy Integration:** AI manages fluctuations in renewable energy supply for efficient grid operation.
4. **Power System Optimization:** AI optimizes generation, transmission, and distribution to reduce costs and improve reliability.
5. **Intelligent Control Systems:** AI-driven controls enhance device performance and responsiveness in various applications.

## Benefits

- **Efficiency:** AI optimizes energy use, reducing costs and environmental impact.
- **Reliability:** Predictive maintenance improves system uptime and reliability.
- **Cost Savings:** Optimization lowers operational expenses and maintenance costs.
- **Scalability:** AI scales to handle large datasets and complex systems effectively.

**Challenges and Considerations**

- **Data Quality:** Ensuring accurate and reliable data is crucial for effective AI applications.
- **Interpretability:** Understanding AI decisions is vital, especially in safety-critical contexts.
- **Ethical Concerns:** Addressing privacy, bias, and socio-economic impacts of AI adoption.

**Upskilling Recommendation**

**For Students:**

- **Curriculum Enhancement:** Seek courses focusing on AI, machine learning, and data analytics within EE programs.
- **Hands-on Projects:** Engage in projects involving AI applications in energy systems or control systems.
- **Internships:** Gain practical experience in companies using AI for electrical engineering applications.

**For Professionals:**

- **Continuing Education:** Attend workshops, webinars, and conferences on AI in EE to stay updated with latest developments.
- **Certifications:** Obtain certifications in AI or machine learning to validate skills and knowledge.
- **Collaboration:** Join professional networks or research groups focused on AI applications in EE for networking and learning opportunities.

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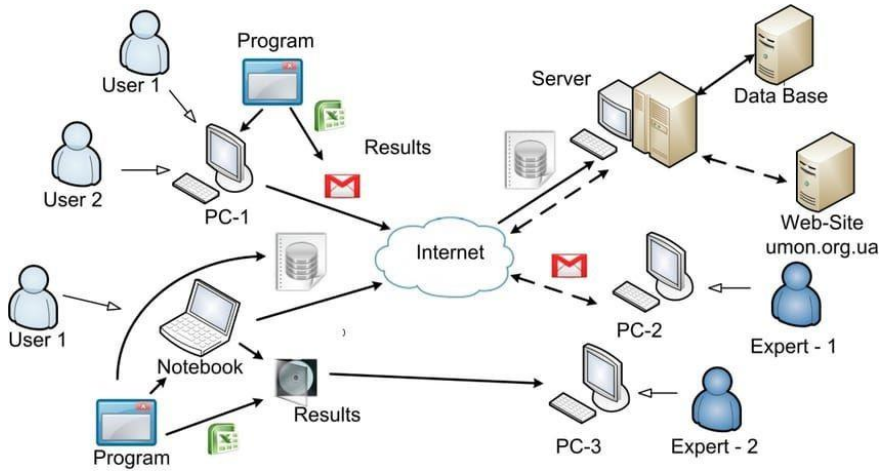
# M-Voting – An alternative of e-voting

**Mr. Sandip D. Raste**

Mobile technology has attained heights, and the market trend is that every citizen of India will possess a mobile handset by the year 2010 (at cheaper rates of service.) When such a PDA is available why not use it for a time saving, cost-effective, secure method of voting.

The concept is as follows:

- Every citizen above the age of 18 years has got the right to vote and hence obtaining their fingerprints and storing in the database along with their birth/death record becomes necessary.
- User sends his fingerprint (secured print is encrypted and sent as sequence of data in encoded form) to the service provider.
- Service provider verifies the fingerprint and checks for the validity of voting and sends voter list (a mobile ballot paper) through SMS.
- User casts his vote and sends 2nd message.
- Since mobile phones have connectivity with computer systems it is easy to store and access the service provider and results are published instantly.



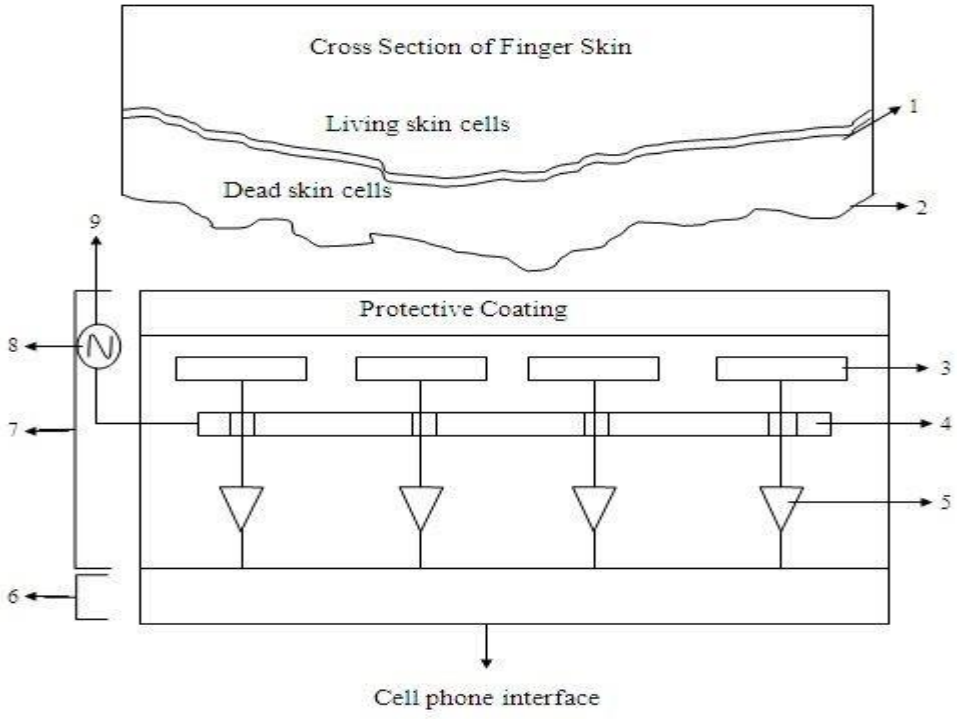

**Fingerprint sensor:**

- The Finger Loc sensor is a mono lithic silicon chip comprising a sensing array and its associated circuitry, all covered by a thick (75 micrometer) proprietary coating. It can be easily embedded in the surface of a cell phone, where the robust coating will protect it from the rigors of normal usage. Finger Loc' key advantage over other (optical) fingerprint sensors, is that it ignores the external fingerprint in a buried layer of living cells, where fingerprints are created, and where they are found in pristine condition
- What it does is apply a low-voltage ac signal to the fingertip and then measure how the resulting electric field varies in amplitude over the fingertip surface. The signal is applied by means of a conductive epoxy ring surrounding the sensor area. It is defined and measured with respect to a reference plane within the chip. The electric field is set up between the reference plane and a thin layer of highly conductive saline liquid that resides at the interface of the living skin tissue and the dead skin. The saline layer has the same shape as the living tissue- the shape of the fingerprint.

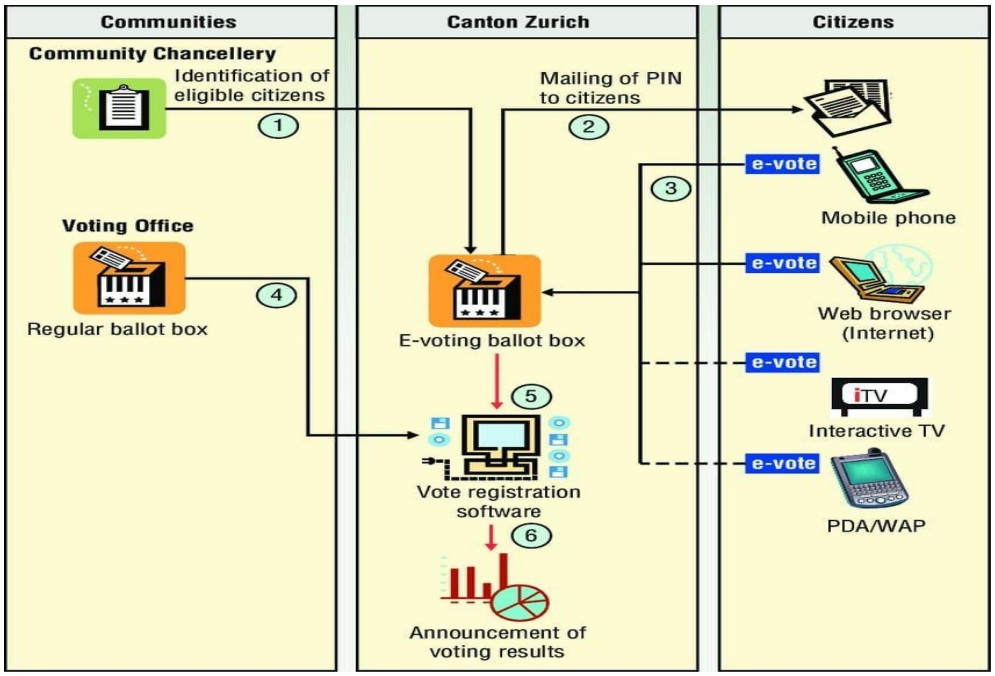
Being highly conductive, it imposes its shape as a boundary condition on the field, thereby spatially modulating the field into an analog of the fingerprint.

- An array of tiny antenna arranged in a square matrix of 96 rows and columns does the actual sensing. Located above the reference plane, the array measures about 6.5mm on a side, giving the sensor a linear resolution of about 15 pixels per millimeter. The sensed analog electric field values are scanned from the sensor matrix a row at a time, digitized, and sent from the Finger Loc chip to the cell phone's microprocessor for further processing. In the cell phone, a module from a special software suite analyzes the fingerprint pattern and extracts information from it, which it converts into a unique representation of the fingerprint owners. To register a voter, that representation, called a template, is stored in nonvolatile memory and in storage of Service Provider for instance VSNL for future use.
- What happens next depends on how the cell phone manufacturer and service provider have set things up. If the handset does not recognize the applicant, service will be denied. It gets more interesting when the system does recognize the fingerprint, because each user can have a stored profile, which personalizes the phone for him or her.

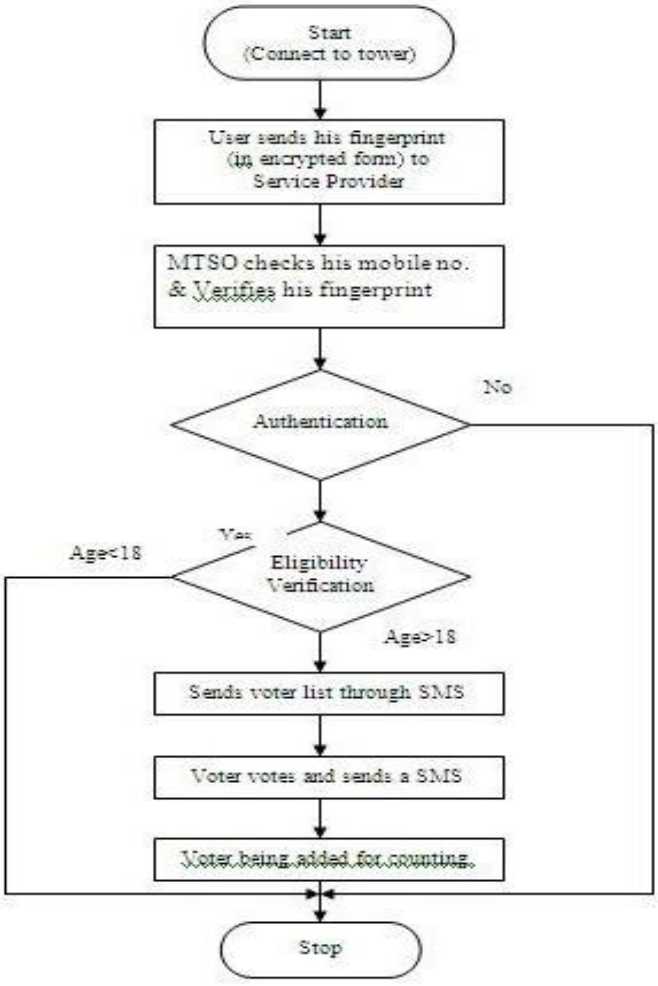
**Finger Loc Sensor**



## M-Voting SMS MESSAGE




## PROCESS FLOW CHART:

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# Ensuring the safety of workers in underground electrical installations - professional risk assessment

**Mrs. Poonam P. Mane**

## 1. Introduction:

In the last years in the urban areas, the aim was to replace the overhead electric power distribution lines with the underground power lines (UPL). This objective of environmental and safety and health at work management eliminates the “aesthetic pollution” and some risk of accidents such as falling from heights, reduce the emission of electromagnetic fields, noise, and “aesthetic pollution” and “psychological pollution” generated by fear of proximity from electrical systems and physical effects, but involves difficult and costly mounting and maintenance.

From the analysis of national statistical data regarding the events and accidents at work at is noticed although the feeling of fear caused by electrical installations on the human factor is reduced for underground electric lines, at the national level are registered and publicizes serious accidents resulting in fatalities due to unauthorized work near these lines, access and interventions of unauthorized persons and theft of electricity and electrical equipment components.
The diagnosis of the activity carried out by the operating and maintenance personnel in the electrical installations, respectively the UPL, the analysis and the evaluation of the professional risks was carried out within the works of evaluation of the level of risk of accident and occupational disease that took place during the years 2000 -2018, realized at a part of the national energy companies and following the studies carried out in order to evaluate the working conditions of the installations during the last 50 years.

## 2. Minimum technical and safety requirements related the workplaces in underground power cables

The diagnosis of activity performed by operating and maintenance personnel was made by analyzing the components of the work system and the technical-economic demands, in conjunction with the provisions of the legislation on safety and health at work and the technical regulations issued by the national authorities in the energy field.
According to GD no.1091/2006, workplaces that use electrical installations and implicitly UPL must be arranged so that there is no danger of fire; explosion and workers are protected against electric shock by direct contact, indirect contact and step voltage. The technical and economical requirements provide that cable routes should be chosen so that to avoid possible areas of fire or areas where the integrity of the cable is jeopardized by mechanical damage by corrosive agents, laying in water, vibration, overheating or arcing caused by other cables.
However, technical regulations provide requirements for including them in the environment and requirements to ensure access for assemble maintenance and intervention in case of fire.

## 3. Study of activities carried out by operating & maintenance for underground power lines

In carrying out these duties, the workers are permanently mentally stressed determined by the compulsory execution under conditions (moisture, extreme temperatures, and airflows) of some activities in a predetermined time (permanent pressure of time to be put into service the power line).

Digging and emptying the pits implies an increased level of physical demand, reaching up to overburden, in relation to the actual conditions from the respective work. The manual support of the cables also requires large physical efforts, with extended static components. On the other hand, to correct the defects on the cables, it is necessary professional gesture that requires precision, motor coordination and loco motor.
Digging and emptying the pits implies an increased level of physical demand, reaching up to overburden, about the actual conditions from their work. The manual support of the cables also requires significant physical effort, with extended static components.
On the other hand, to correct the defects on the cables, it is a necessary professional gesture that requires precision and motor coordination.
From the analysis of job descriptions and the results of studies, was found that professional requirements, involving an increased professional effort and physical and mental stress, lead to psychosocial risk factors that may influence in time the weakening of worker's body.

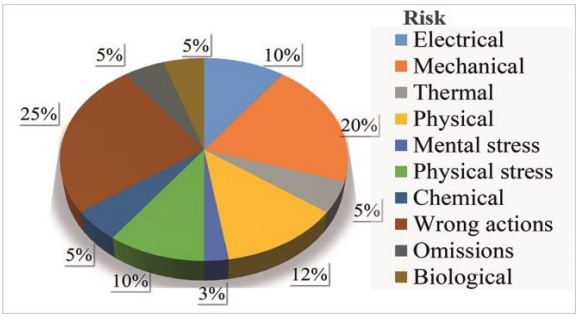


Fig 1. Share of the identified risk factors in electrical installations (UGL - 0.4,-110 kV)

Fig.1 presented the share of risk factors identified for UPL and stated that the electrical risk factors have the highest percentage of 22%, followed by the mechanical risk factors with a percentage of 19%. Fig. 3 shows the weight of the risk factors identified for fault detection.

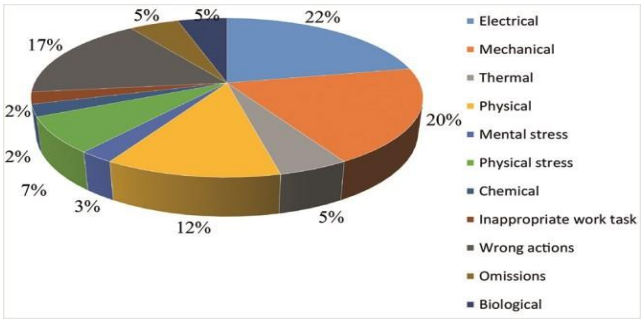


Fig. 2. Share of identified risk factors – fault detection

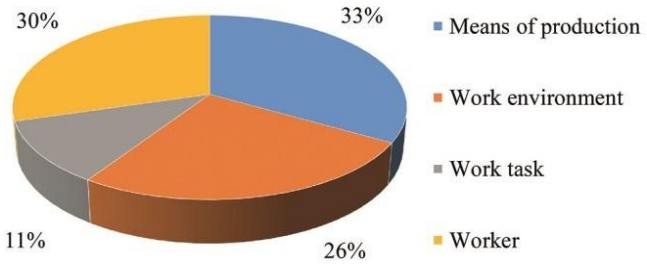


Fig. 3. The distribution of risk factors based on components of work components

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# Journal Paper

# ANN Based Approach for Electricity Theft Detection in Single Phase Energy Meters

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***Abstract*- The major challenges being faced by Power Distribution Utility today are high Aggregate Technical (AT&C) Losses, bad debts, financial liabilities and aging infrastructures. Electricity theft remains a significant challenge in power sector resulting substantial financial losses for utilities and adverse social consequences. Although the AT&C losses have been reduced significantly over past two years, there is a need to further minimize these losses. Due to large database, the utilities find it difficult to implement conventional methods of theft detection. It is therefore essential to develop Artificial Intelligence and Machine Learning based algorithms to tackle this situation. This research paper presents an innovative solution utilizing Artificial Neural Networks (ANN) to detect theft of electricity in case of a single phase meter. The real world data taken from the regions of Maharashtra state in India and consumer profiles are employed to validate the effectiveness of the approach. The proposed methods are novice, simple, cost effective and feasible.**

***Keywords- Aggregate Technical and commercial (AT&C) losses, Electrical theft, Artificial Neural Networks (ANN), One input ANN***

## I. INTRODUCTION

The major problems being faced by the power distribution utility today in India are high Aggregate Technical & Commercial (AT&C) losses, theft of electricity, non-payment of bills by consumers and aging infrastructure. AT&C losses represent percent difference between total energy supplied to the distribution network and the revenue realized from the consumers. These losses can be classified into two categories - technical losses and commercial losses [1]. The technical losses occur because of the reasons such as copper loss, iron loss, equipment inefficiencies and overloading of lines and equipments. The copper losses are $I^2R$ losses taking place mainly in transmission & distribution lines and transformer windings. It is observed that in a normal practice the copper losses are about 4%. The examples of iron loss are core loss, hysteresis loss and eddy current loss. The iron losses mainly occur in transformer cores. In a normal practice the core losses are about 1%. Thus the total technical losses are not expected to be more then. 5%[2]. The technical losses can be further brought down by using good quality material and undergoing proper maintenance.

The other component of AT&C losses is commercial loss. The commercial losses occur because of commercial reasons such as theft of electricity, incorrect electricity bills, billing and collection inefficiencies [3].

As per the report on 'Performance of the Power Utilities' published annually by the Power Finance Corporation Limited (PFC), the national AT&C losses for the year 2020-21 and 2021-22 were 22.32% and 16.44% respectively. For the Maharashtra state the AT&C losses for the year 2020-21 and 2021-22 were 25.54% and 15.25% respectively. These facts are referred by the Ministry of Power, Govt. of India in their notification by PBI, Delhi dated 11-8-2023 [2]. As seen from the report, there has been significant reduction in AT&C losses at National level as well as Maharashtra state level. However, it is essential to further decrease these losses.

Compared to technical losses, the commercial losses are much higher. Therefore, the AT&C losses can be reduced by bringing down commercial losses. The commercial losses are mainly attributed to the theft of electricity. Reducing theft of electricity is a significant challenge for power distribution utilities as it not only leads to financial losses but also affects reliability and quality of service to the legitimate consumers.

Conventionally, the following technological, operational and regulatory measures have been taken by the state distribution utilities to reduce the losses.

1. Replacement of conventional electromechanical meters by electronic meters in case of single phase residential and commercial consumers.
2. Providing Time of the Day (ToD) meters in case of High Tension (HT) and Low Tension (LT) three phase consumers. The data is retrieved from ToD meters and reports are generated such as instantaneous data, billing data, Tamper data and load survey data.
3. Providing metering cubicles in case of HT consumers and some important three phase LT consumers. .
4. Providing check meters in case of main consumers.
5. Providing tamper evident seals to the billing meters. Lead seals, paper seals and plastic seals are the commonly used seals.
6. Improving billing efficiency and collection efficiency of distribution utility.

The collective efforts taken by the distribution utilities mentioned above have been resulted into reducing AT&C losses. For instance, in Maharashtra state in India, the losses have been reduced from 25.54% to 15.25%[2]. However, lot of scope is there to further bring down losses and increase revenue of distribution utility. HT losses, in particular can be controlled. However there are number of challenges in controlling LT losses. Therefore single phase LT meters are selected in this paper for theft detection.

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The literature review is based on books and technical papers mentioned in references. Number of manufacturing manuals were referred from meter manufacturers. Number of testing laboratories were visited.

## II. Need for Implementation of AI ML Methodologies

Artificial Neural Networks can be used to detect theft of electrical energy by analyzing patterns and anomalies in electricity consumption data [4]. For this purpose, the ANN can be used in a following manner

1. Data Collection - the data is collected from the databases including legal as well as illegal electric connections. This data in case of single phase consumers mainly includes kWh consumption, date and time.
2. Data Preprocessing - the outliers and missing values are removed. The data is normalized to bring on normal scale [5].
3. Feature Engineering - the relevant features from the data are extracted that may help in the identification of electricity theft. For example kWh energy is the most import parameter from the available data for single phase.
4. Labeling - the data is labeled as legitimate or potentially fraudulent based on known cases of electricity theft or meter tampering. This labeled dataset is crucial for training ANN [6].
5. ANN Architecture - the ANN model is developed specifying number and type of inputs, number of layers, synoptic weights and bias.
    1. Platforms. The fast convergence depends on the selection of initial values of weights.
    2. The Sigmoid function is found to be a proper choice out of the available activation functions so far this topic is concerned.

It is proposed to deploy one input ANN for theft detection. One input is the basic neural Network Architecture. It takes a single input value and processes it.

A one-input artificial neural network (ANN) is a simple type of neural network architecture designed to process and learn from data with a single input variable. The single input ANN is suitable for single phase meters. ANNs are inspired by the structure and function of biological neural networks, and they are used for various machine learning and pattern recognition tasks [7].

Here is a basic explanation of a one-input ANN:

Input Layer: A one-input ANN consists of only one input neuron or node. This neuron takes a single value as input, representing the feature or data point we want to process. The input neuron can be thought of as a processing unit that receives and forwards the input data.

Weight: Each input neuron is associated with a weight. They are also called as synoptic weights. The weight determines the significance or importance of the input. During training, the ANN learns to adjust these weights to make accurate predictions or classifications.

Activation Function: After multiplying the input value by its corresponding weight, the ANN applies an activation function to the result. The activation function introduces non-linearity to the model, allowing it to capture complex patterns and relationships in the data. Common activation functions include Sigmoid, ReLU (Rectified Linear Unit), and Tanh (hyperbolic tangent) [8].

Output: The output of the activation function is the final output of the one-input ANN. This output can represent a variety of things, depending on the specific task. For example:

- In a regression task, the output might represent a continuous numerical value.
- In a binary classification task, the output might represent the probability of belonging to one of two classes.
- In a multi-class classification task, the output might represent the probabilities of belonging to multiple classes, typically obtained using a softmax activation function [9].

**Training:** To make accurate predictions or classifications, the ANN needs to be trained on a labeled dataset. During training, the ANN adjusts its weights through optimization algorithms like gradient descent to minimize a loss function. The loss function quantifies the difference between the ANN's predictions and the actual target values in the training data.

**Bias:** In addition to weights, a bias term can also be associated with the input neuron. The bias allows the ANN to shift the activation function's output, helping the network better fit the data.

In summary, a one-input ANN is a basic neural network architecture that takes a single input value, processes it through a weighted connection, applies an activation function and produces an output. While one-input ANNs are simple, they can be part of more complex networks and are useful for tasks where there is only one feature or input variable to consider. For more complex tasks, multi-input ANNs are used to handle multiple input variables simultaneously [9].

## III. ANN Based Theft Detection Model

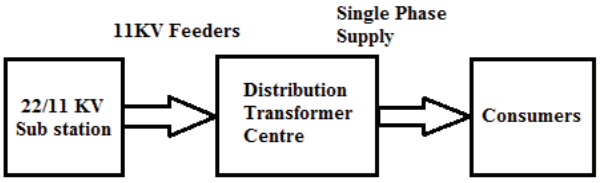


Fig. 1. Schematic of theft detection model

Figure 1 shows the schematic of the theft detection model. The working of the model takes pace in three steps as follows.

1. Computation of feeder loss

The AT&C loss of feeders emanating from substation to Distribution Transformer Center (DTC) is computed. The feeders having abnormal losses are pin-pointed. The AT&C loss is computed as a percent difference between units sent out and units received. Ideally, the loss should be zero.

However, the feeder loss should not be more than 5%. As shown in Table I, feeder no 4 is showing abnormal loss of 30.5%.

TABLE I. COMPUTATION OF FEEDER LOSS

| Month | Feeder No | I. M WH Sent | MWH Received | AT&C Loss in % |
|---|---|---|---|---|
| July 2023 | 1 | II. 220 | 210 | 4.54 |
| July 2023 | 2 | III. 213 | 210 | 1.48 |
| July 2023 | 3 | IV. 213 | 205 | 3.75 |
| July 2023 | 4 | V. 200 | 139 | 30.5 |
| July 2023 | 5 | 220 | 217 | 1.36 |

2. Computation of DTC loss

TABLE II. COMPUTATION OF DTC LOSS

| Month | DTC No | MWH sent out | MWH received | AT&C Loss in % |
|---|---|---|---|---|
| July 2023 | DTC1 | 52 | 48 | 7.69 |
| July 2023 | DTC2 | 55 | 45 | 18.18 |
| July 2023 | DTC3 | 60 | 35 | 41.66 |
| July 2023 | DTC4 | 75 | 65 | 13.33 |
| July 2023 | DTC5 | 81 | 69 | 14.81 |

From substation end, the feeder 4 (bearing abnormal losses) goes to its metering point. Thereafter, the supply is given to different DTCs. The AT&C losses are computed between feeder 4 metering points to the respective DTCs. The sample results are shown in Table II. The losses in respect of DTC3 are found to be abnormally high of the order of 41.66%.

3. Development of ANN Model

The working of ANN model is described in Flowchart furnished in Fig 2.

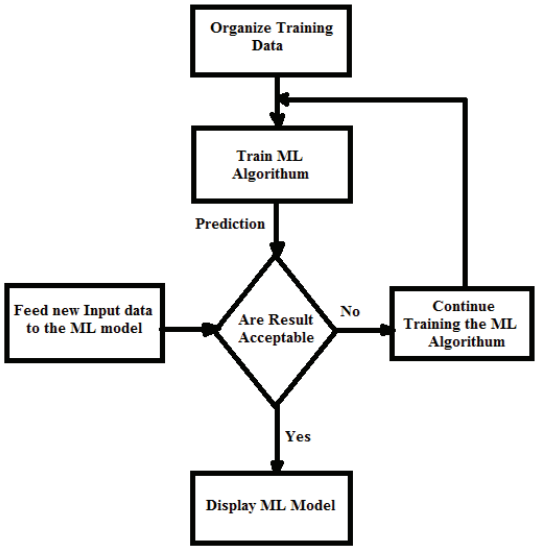


Fig. 2. Working of ANN model

The flowchart execution takes place in a following manner.

1. Data Collection - The training data is collected from various sources. This includes historical data from files, real time data from websites, data downloaded from Meter Reading Instruments ( MRI), SCADA systems etc. wherever available. The ANN is required to undergo training cycles using this training data. The success of ANN depends on use of exhaustive and varying type of data.
2. Training Cycles- the ANN is trained by giving number of training cycles. The Python language has a capacity to executive thousands and even lakes of training cycles.
3. Input data- The ANN is trained using other type of data obtained from specific situations called input data. In this way, the ANN is trained using training data and input data.
4. The output of ANN obtained from training data, input data, synoptic weights etc. is compared with the targeted output. If the results are not acceptable, the training cycles are continued, otherwise the training ANN model is deployed.

Next step is to develop an ANN model. The following steps are taken to develop an ANN model.

1. The neural network is created from input parameters and number of hidden layers. In this case, the input is selected as one (i.e. kWh consumption) and one hidden layer is selected.
2. The input datasets are formed based on training data and input data.
3. The error is found out using predicted value and targeted output. Ideally, the error should be zero or within the permissible limit. The error is minimized using back propagation through number of iterations.

For this purpose, one input or two input ANN models can be developed.

In case of one input ANN, kWh consumption can be selected as an input parameter. In case of two input models the input parameters are kWh consumption and time [10].

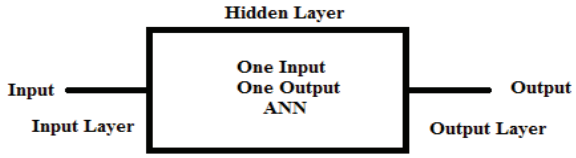


Fig. 3. Single input ANN model for single phase meter

Figure 3 illustrates single input ANN model for a single phase meter. In this paper, it is proposed to use a single input ANN model as it is quite suitable for single phase consumers. Secondly, there is one hidden layer and one output. The synoptic wight w is initialized as 0.001 and the bias is initialized as 0.0002. Sigmoid function is used as an activation function. The target output or threshold is chosen as 0.5004. If the output of ANN model is less than or equal to the target output, the ANN model would indicate the possibility of theft. The path from input layer to output layer

is called feed forward path. Small part of the Python code is furnished below in Fig. 4[11].

```
import numpy as np
x=1;w=0.001;b=0.0002;alpha=0.1;T=0.5004
for i in range(6):
 y=x*w+b;print('x=',x)
 print('y=',y)
 Y=1/(1+np.math.exp(-y))
 print ('Y=',Y);e=Y-T;dedY=1
 dYdy= Y*(1-Y);dydw=x;dedw=dedY*dYdy*dydw
 print('dedw=',dedw);w=w-alpha*(1-dedw)
 print('w=',w)
if Y<=T:
  print('Status doubtful')
else:
 print('Status Normal, No Theft')
```

Fig. 4. Sample code

The output obtained from feed forward path is compared with the targeted or threshold value [12]. If the error is not zero, then the control will come back from output to input layer. This process is called back propagation [13]. The back propagation aims to adjust the value of synoptic weight, w. This is mostly done by Chaining Rule and Gradient Descent methods. In Chaining Rule method, the multiplication of derivatives of variables e, Y,y and w is performed as shown in Fig 4[14]. The value obtained from Chaining Rule is substituted in the updated formula of w. The formula is mentioned in Fig. 4. The updated value of w is substituted in a feed forward path. The iterations are executed to check whether there is any possibility of theft. The sample output of the code is shown. Gradient Descent is an optimization algorithm used in machine learning and deep learning to minimize error by iteratively adjusting its parameters - error and weight. It works by calculating gradient (derivative) of loss function updating to reach optimal value. This iterative process continues until convergence thereby improving the performance of the model.

```
x= 1
y= -0.2992828748954913
Y= 0.4257327997323501
dedw= 0.24448438296440478
w= -0.37503443659905084
x= 1
y= -0.37483443659905086
Y= 0.40737336980002725
dedw= 0.2414203073777975
w= -0.4508924058612711
Status doubtful
```

Fig. 5. Output of sample code

Thus the ANN model gives verdict in terms of ‘status normal’ and ‘status doubtful’ [15].Figure 5 illustrates output of a sample code. It executes value of w from input parameter x. The output of linear function is y. The output of activation function is Y. dedw is rate of change of error with respect to weight w. Only sample output is shown in figure. In fact, large number of loops are executed.

The site engineers of the distribution utility are expected to maintain the code in their smart mobile phones so that whenever they visit consumer installations, they would check the probability of theft [16]. If the case is doubtful, they would verify other parameters given below-

1. Whether the consumer is out of house for some months?
2. Whether consumer has applied for load reduction?
3. Whether the consumer has sold his property to others?

On basis of ANN output and above parameters the site engineers would take decision whether there is a theft of energy [17].

## IV. Conclusion

In conclusion, this research paper has explored the application of Artificial Neural Networks (ANNs) for the detection of electricity theft in the power sector. Electricity theft poses a significant challenge for utilities, leading to revenue losses and operational inefficiencies. Detecting and preventing electricity theft is crucial for ensuring the sustainability and reliability of the power supply.

By leveraging the power of ANNs, utilities can enhance their capabilities in detecting electricity theft patterns that might go unnoticed through the traditional methods.

Furthermore, this research emphasizes the importance of data quality and quantity in training accurate and robust models. It underscores the need for utilities to invest in advanced metering infrastructure and data collection techniques to improve the effectiveness of theft detection systems.

In summary, this research has contributed valuable insights into the application of artificial neural networks for electricity theft detection. By embracing such innovative techniques and continuously refining them, the power sector can better protect its revenue streams, enhance its operational efficiency, and ultimately provide a more reliable and sustainable electricity supply to consumers.

A Single Input Artificial Neural Network can be beneficial in the case of electricity theft detection in the power sector, especially when dealing with specific and straightforward data inputs or when simplicity and interpretability are essential. This is found suitable for single phase meters.

The above mentioned proposed methods are novice, feasible, cost effective and simple.

As we move forward, it is essential to mention that the power sector is evolving rapidly, with the integration of renewable energy sources, smart grids, and advanced technologies. Therefore, future research should focus on adapting and enhancing ANN based approaches to address emerging challenges in electricity theft detection within this changing landscape.

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# Hand Gesture-Controlled Robot Using Arduino with Integrated Cleaning System

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**ABSTRACT**

The motivation behind the Gesture-Controlled Robot with an integrated brush paper is to simplify household cleaning tasks. Traditional cleaning often requires users to physically move and hold the device, making the cleaning process labor-intensive and time-consuming. This innovation allows users to effortlessly control the robot's movement and cleaning operations through predefined gestures, making the interaction easier. This Gesture-Controlled Robot with an integrated brush not only aligns with the increasing demand for smart home technologies but also promotes energy efficiency and automation in domestic chores.

**Keywords:** Robot, Gesture-Controlled, Arduino Uno, Integration, Brush.

## INTRODUCTION

The traditional methods for controlling robots typically involve remote controllers and complex programming. However, these methods can create barriers for user friendly interaction. Addressing this need, the paper aims to bridge the gap between humans and robots through the natural language of gestures. The paper's main objective is to develop a hand gesture-controlled robot that responds to specific user gestures. The paper seeks to provide a user- friendly and engaging method for controlling robots in real- time. It uses Arduino, an open-source electronics platform and integrating sensors capable of recognizing hand gestures. It also provides an integrated brush which is fixed on the robot which makes household chores more interactive and engaging.

In addition to introducing the paper's purpose and goals, this paper provides an overview of its key components and methodology. It includes a review of relevant literature to explain the paper's approach. Method details, such as how the transmission and receiving systems work, along with the cleaning mechanism, are also covered. Furthermore, a detailed list of components is included, explaining what they are and how they function. The paper wraps up with a discussion on how the paper can be applied practically.

**Components:**

Arduino UNO, ADXL335 Triple Axis Accelerometer, 2WD Two Wheel Drive Robot Car Chassis, 170 Points Mini Breadboard, Jumper wires, RF433 MHz Transmitter Receiver Wireless Module, L293D Motor Drive Module, 9V Battery, Battery Snap Connector to DC Barrel Jack Adapter, brush.

**Methods:**

The paper is divided into 3 sections in order to make it simple and prevent complexity.

**A) Transmitter Unit**

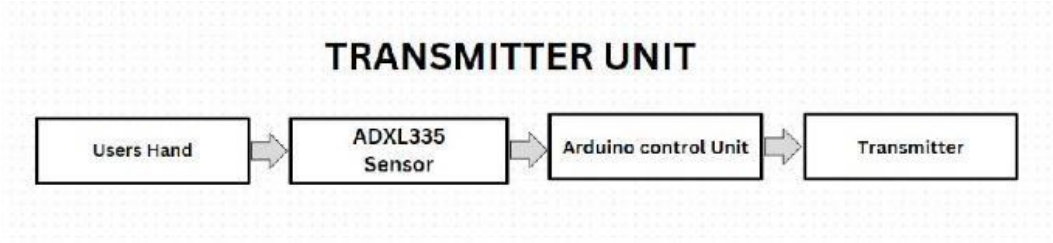


Figure 1:Block Diagram of Transmitting Section

Refer Figure 1 for transmission unit. Accelerometer ADXL335, Arduino Uno Atmega328, RF transmitter TX (433MHz). The ADXL335 is a compact and energy- efficient 3-axis accelerometer sensor, perfectly suited for applications such as hand gesture-controlled robots. It possesses the capability to detect acceleration across the X, Y and Z axes. The Arduino Uno based on the ATmega328P chip, interfaces with the ADXL335 accelerometer, which provides three-axis analog outputs corresponding to hand gestures. An RF pair module is a wireless communication device that consists of a transmitter and a receiver module. RF pair modules typically operate in the 433 MHz or 2.4 GHz bands. They are ideal for wireless communication because they are relatively free from interference from other devices.

**B) Receiver Unit**

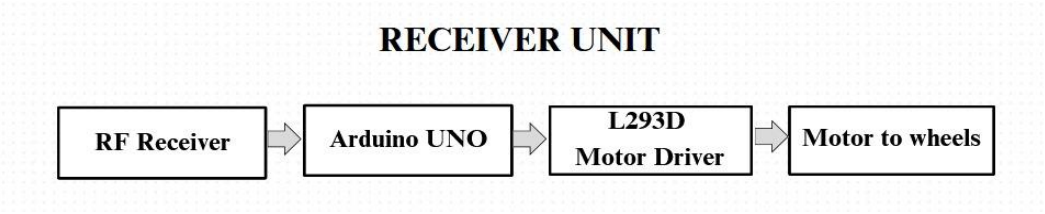


Figure 2:Block Diagram of Receiving Section

Refer Figure 2 for receiving unit. RF Receiver Module, L293D Motor Driver, DC motors, Arduino Uno Atmega328.

The L293D serves as a dual-channel H-bridge motor driver IC, enabling the management of either two DC motors independently or a single stepper motor [4].

**C) Cleaning Unit**

This will include the integration of a soft bristled brush which is ideal for removing dust, hair, and other light debris without scratching or damaging the surface for cleaning purposes [5].

**Brief Description of Components**

**Arduino Uno Atmega328p for Transmitter Receiver Unit**

The Arduino UNO is a microcontroller board based on the ATmega328P. It is equipped with a 16 MHz ceramic resonator, 6 analog inputs, 14 digital input/output pins (with 6 of them configurable as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes fully equipped to support the microcontroller, requiring only a USB cable to connect to a computer or an AC-to-DC adapter or battery for power. In this paper it is responsible for interpreting the hand gestures and translating them into motor commands for the robot to follow. It serves as the central processing unit for our hand gesture-controlled robot, interpreting commands from the ADXL335 accelerometer and controlling the robot's movements via the L293D motor driver. Communication with the robot is facilitated through the RF pair module.

**ADXL Sensor For Transmitter Unit**

The ADXL335 represents a compact, energy-efficient 3 axis accelerometer sensor, well-suited for integration into hand gesture-controlled robots. It possesses the capability to detect acceleration across all 3 axes - X, Y, and Z, within a range of ±3 g. This means that it can measure acceleration up to 3 times the acceleration of gravity. The ADXL335 sensor is connected to the Arduino board, which reads the sensor data and processes it to identify the desired robot movement. Subsequently, the Arduino board produces PWM signals to manage both the direction and speed of the motors in the robot [6].
Features of ADXL Sensor for transmitter unit are as follows: -

- It offers 3-axis sensing capabilities. Housed in a compact, low-profile 4 mm × 4 mm × 1.45 mm LFCSP package.
- It operates at low power, typically consuming 350 μA.
- Compatible with single-supply operation ranging from 1.8 V to 3.6 V.
- It withstands shock of up to 10,000 g.
- Demonstrates excellent temperature stability.
- Allows bandwidth adjustment with a single capacitor per axis.
- Compliant with RoHS/WEEE standards, ensuring lead-free composition.

**L293D Motor Driver for Receiver Unit**

The L293D functions as a dual-channel H-bridge motor driver IC, facilitating the control of two DC motors. For each motor channel, the L293D provides two inputs, labeled as IN1 and IN2. These inputs dictate the motor's rotational direction. When IN1 is set to a high signal and IN2 to a low signal, the motor rotates in one direction. Conversely, if IN2 is high and IN1 is low, the motor rotates in the opposite direction. When both IN1 and IN2 are low, the motor ceases operation. The L293D also has two outputs for each motor channel: OUT1 and OUT2. These outputs are connected to the motor itself. The L293D uses a variety of internal circuits to control the current flow to the motor, which enables the regulation of both motor speed and torque.

**RF Pair Module for Transmitter and Receiver Unit**

A wireless communication device made up of a transmitter and a receiver module is called an RF pair module.

The frequency ranges in which RF pair modules normally function are 433 MHz and 2.4 GHz. These frequency ranges are comparatively free from other device interference, making them perfect for wireless communication.

Utilizing RF pair modules is quite simple. By connecting the Arduino to the transmitting module, it may communicate the appropriate orders to the transmitter. The commands are then broadcast over the air to the receiving module via the transmitting module. The receiver module is attached to the robot, through which it receives and processes commands. The Arduino controller oversees sending and receiving commands. The intended orders are sent by the Arduino board to the transmitter module, which subsequently sends them to the receiver module via radio transmission. The robot then carries out the instructions that it receives from the receiving module.

When it comes to hand gesture-controlled robots, RF pair modules offer a flexible and dependable method for wireless communication between the Arduino and the robot. They have a broad communication range and are comparatively simple to use [7].
Specifications of RF pair modules are as below: -

- It provides a range of 100 meters in open space under standard condition.
- The RX receiver operates at a frequency of 433 MHz with a typical sensitivity of 105 dBm.
- The RX receiver requires a supply current of 3.5 mA and operates at an IF frequency of 1 MHz.
- It operates at an operating voltage of 5V.
- The TX frequency range is 433.92 MHz, with a supply voltage requirement of 3V to 6V.
- The TX module offers an output power range of 4 to 12 dBm.

Features of RF pair modules are as below: -

- It exhibits low power consumption.
- Designed for ease of use in Radio Frequency-based applications.
- It functions as a complete radio transmitter.
- Ensures a highly stable operating frequency.
- Consumes low current, typically around 11mA.
- Compatible with a wide range of operating voltages. Utilizes ASK modulation for signal transmission.

**Robot Chassis for Hand Gesture Robots**

Robot chassis is lightweight and durable for the robot to move easily. The chassis is flexible enough to allow the robot to move freely in all directions. The chassis is stable enough to prevent the robot from tipping over. The wheels allow the robot to move in any direction, including sideways and backwards. The rubber wheels have good traction to prevent them from slipping on smooth surfaces.

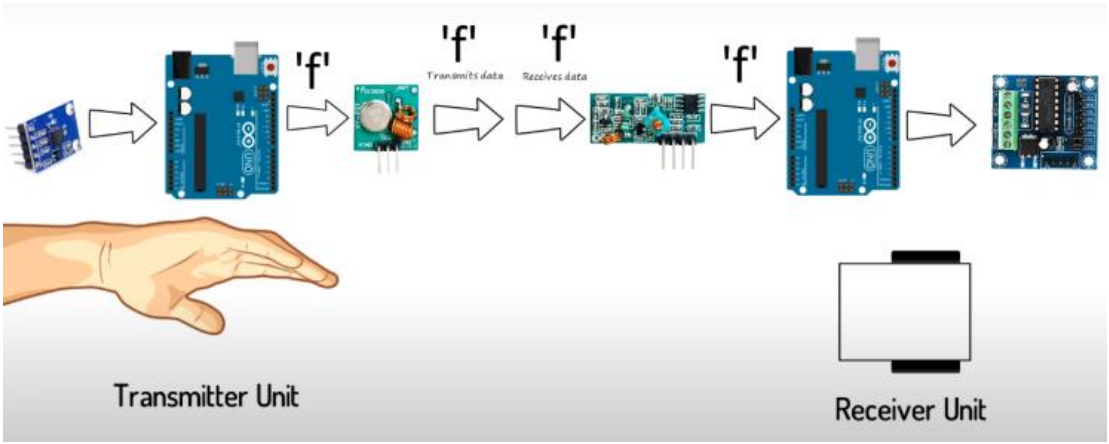


Figure 3: Image of Hand-Gesture Communication

As shown in Figure 4, after connecting Arduino along with the ADXL335 and RF transmitter, to the gloves worn on the hand. When the ADXL335 detects a tilt, it will transmit its data to the Arduino. The Arduino, in turn, will send the information via RF transmitter. For instance, if there is a forward tilt, the Arduino will read 'f' (forward), and the RF transmitter will send this to the receiver unit fixed on the robot chassis. The receiver unit as shown in Figure 5, comprises an RF receiver, Arduino, and motor driver. Upon receiving the 'f' signal, the RF receiver will pass it to the Arduino, which will then instruct the motor driver to move the robot forward. This programming logic will be replicated for backward, right, and left directions.

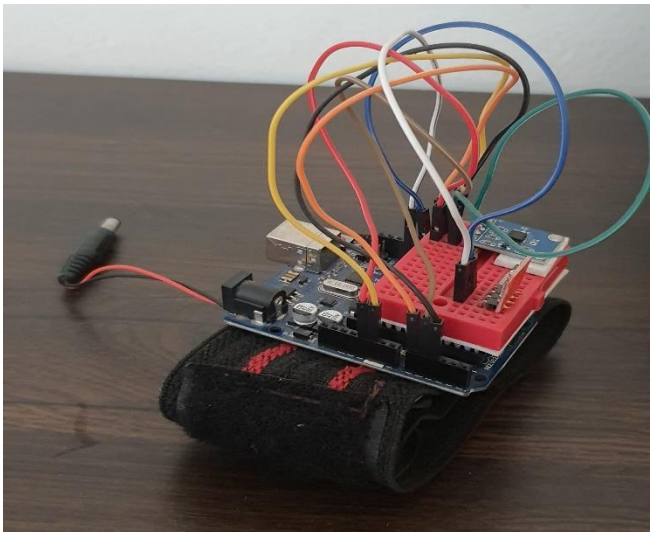

Figure 4: Transmitter Unit Image

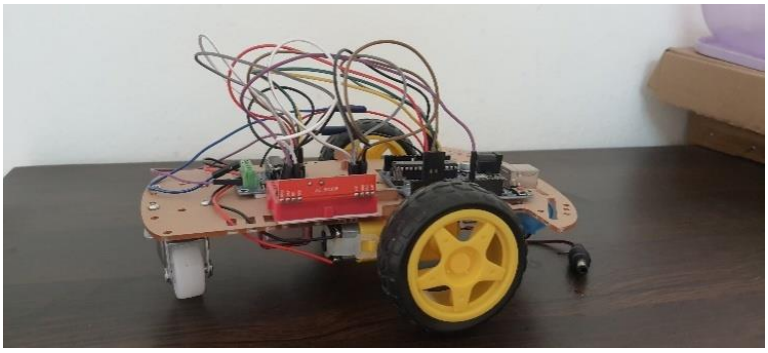

Figure 5: Model Image

**Basic Application**

In addition to hand gestures, the robot features a physical manual on/off button. A soft bristled brush is installed for removing dust, hair, and other light debris without scratching or damaging the surface. Users can quickly and hygienically dispose of collected debris. The user interface is designed for simplicity and accessibility. The primary application of this robot is for home cleaning.

## CONCLUSION

In conclusion, the Gesture-Controlled Robot with an integrated cleaning system is a significant step forward. By using simple hand gestures, it offers a hassle-free experience for users. With sensors like ADXL, L293D motor driver, and transmitter and receiver units, along with two Arduino boards for controlling hand gestures and the robot, the paper shows a comprehensive approach to robotics. While it's mainly for home cleaning, its potential goes beyond that, promising to make tasks simpler and more efficient in various areas like hospitals, industries etc. The user-friendly design and smart technology will make everyday life easier and more fulfilling.

## ACKNOWLEDGMENT

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Finally, we acknowledge the unwavering commitment and dedication of our project team members, whose collaborative efforts and enthusiasm have culminated in the creation of this innovative and user-friendly technology.

This project was made possible by the collective efforts of all those mentioned above, and we are immensely grateful for their contributions

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# Solar Wireless Electric Vehicle Charging System

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***Abstract*-- The Solar Wireless Electric Vehicle Charging System (SWEVCS) represents an innovative solution for electric vehicle charging, utilizing solar power for wireless charging. Powered by an Atmega microcontroller, this system incorporates coils, an LCD display, a rechargeable battery, and a boost converter. By harnessing solar energy, it charges the battery and wirelessly transfers power to the vehicle's battery. The LCD display offers clear indications of the charging status, facilitating user monitoring. SWEVCS enables electric vehicle owners to charge their cars independently of the grid, presenting a sustainable and environmentally friendly alternative.**

***Index Terms*—Wireless Charging, Solar Panels, Rechargeable Battery, Inductive Power Transfer**

## 1. Principle of Electric Vehicle Charging System

WIRELESS EV charging systems utilize the inductive power transfer (IPT) concept to convey electricity from the charging station to the vehicle's onboard receiver. Consisting of a charging pad on the ground and a receiving pad on the EV, this system operates by generating an electromagnetic field from the charging pad, inducing a current in the receiving pad, thereby charging the EV's battery. The efficiency of the system hinges on the proximity of the charging and receiving pads, with effectiveness increasing as the pads draw closer. To ensure both effectiveness and security, most wireless EV charging systems operate at a frequency of 85 kHz.

## 2. Literature

Reviewing recent literature regarding research and advancements in solar-powered and wireless charging stations for electric vehicles.

Bugatha Ram Vara Prasad and colleagues (2021) introduced a solar charging station designed for electric vehicles, incorporating a solar panel array and a power conditioning unit to transform solar energy into electrical

power. Their system integrates an energy management system to oversee the charging procedure and maximize the utilization of renewable energy resources.

T.D. Nguyen and co-authors (2020) carried out a feasibility analysis on bipolar pads intended for wireless power chargers. Their study assessed the effectiveness and efficiency of these pads for wireless charging, emphasizing the promising advantages of this technology in diminishing dependence on physical connections.

Bugatha Ram Vara Prasad and K. Aswini (2021) developed a two-way battery charger for electric vehicles, facilitating both efficient charging and discharging of the vehicle's battery. This system incorporates a battery management system responsible for overseeing the charging procedure and maintaining peak performance.

M. Singh (2019) introduced a real-time coordination system tailored for electric vehicles, aiming to bolster grid support at the distribution substation level. This system leverages a communication network and intelligent algorithms to oversee the vehicles' charging and discharging activities, thereby enhancing the utilization of renewable energy sources and lessening dependence on the power grid. The review of literature underscores the significance of renewable energy sources and wireless charging technologies in fostering sustainable and effective charging options for electric vehicles. These studies underscore the necessity of sophisticated energy management systems and intelligent algorithms to oversee the charging procedure and maximize the utilization of renewable energy sources.

## 3. Introduction

The ongoing climate crisis has spurred significant research and development efforts in the field of electric vehicles over the past decade. Heightened awareness of global warming has prompted individuals to consider transitioning to electric vehicles. One notable

advancement is the potential reduction in charging time experienced at charging stations, as charging while driving on the road could significantly decrease waiting times. However, to establish electric vehicles as the primary mode of transportation, further development of their charging systems is imperative. Dynamic charging systems offer enhanced reliability, user-friendliness, and time efficiency. Additionally, they pave the way for reductions in battery size and improvements in range. Implementation of such charging systems can extend beyond traditional charging stations to encompass travel routes, traffic signals, and bus stations, fostering a more widespread adoption of electric vehicles.

### 3.1 Merits

Environment-Friendly - The foremost and most compelling reason to opt for an electric vehicle is its eco-friendliness. Unlike fossil fuel-powered cars, electric vehicles do not emit harmful gases into the air, thereby significantly reducing air pollution.

No Fuel or Gas Cost - Given that electric vehicles do not rely on traditional fuels such as gas or diesel, users are insulated from fluctuations in fuel prices. Additionally, with the convenience of simply plugging in and being ready to go for another 100 miles, the dependency on fossil fuels is further diminished.

Convenient – Charging a wireless electric vehicle is a breeze, eliminating the need to visit fuel stations for refueling. Additionally, the convenience extends to using standard electric sockets for charging, providing even more flexibility and accessibility.

### 3.2 Challenges

Despite their advantages, wireless EV charging systems still face several challenges that need addressing. One significant obstacle is the high installation cost, which surpasses that of conventional charging systems, potentially hindering widespread adoption. Another issue is interoperability, as the absence of global standards for wireless EV charging could make it challenging for EV owners to find compatible charging stations. The alignment and distance between the charging and receiving pads also influence the effectiveness of wireless charging systems. Lastly, further research is necessary to address concerns regarding the potential impact of electromagnetic fields on human health.

### 3.3 Applications

Wireless EV charging systems find application across multiple sectors of the economy. Primarily, they are utilized in the automotive sector, enabling EV charging at public stations, residential settings, and workplaces. Moreover, to enhance charging efficiency and convenience, wireless charging is also employed in transit vehicles such as buses, trams, and trains. This technology extends to the aviation industry, facilitating the refueling of electric planes. Additionally, in the industrial sector, electric forklifts and various other forms of industrial equipment can be charged using wireless charging systems.

## 4. Hardware

### 4.1 Atmega Controller

The Arduino Uno utilizes the Atmel manufacturer company's Atmega328p model microcontroller chip. The "32" in its name denotes the maximum program size it can store (32K), while the "8" signifies its processing speed (8 bits), and the "p" indicates its pico Power feature, which ensures very low power consumption. The ATmega328p is widely employed in numerous projects and autonomous systems requiring a simple, low-powered, and cost-effective microcontroller. Its most prevalent application is in the Arduino development platform, notably in models such as the Arduino Uno, Arduino Pro Mini, and Arduino Nano.

### 4.2 Transmitting and Receiving Coil

Wireless power transmission, also referred to as wireless charging, involves transmitting electrical energy from a power source to an electrical load without the use of wires or cables. This process relies on two coils positioned closely to each other: a transmitting coil (primary coil) and a receiving coil (secondary coil). The transmitting coil, typically connected to a power source, generates an oscillating magnetic field when supplied with alternating current. Positioned nearby, the receiving coil picks up this magnetic field, inducing an electrical current within it. This current can power an electrical load directly or charge a battery.

The transmitting coil is usually a flat, circular coil constructed from copper wire or a printed circuit board (PCB) trace. Its design, including the number of turns, size, and shape, aims to produce a robust magnetic field. Similarly, the receiving coil, also typically flat and circular, is designed to efficiently capture the magnetic field generated by the transmitting coil and convert it into electrical current. Both coils' configurations may vary depending on the specific application, but the objective remains consistent: to enable effective transmission of electrical energy wirelessly.

### 4.3 Rechargeable Battery

A rechargeable battery, also known as a secondary cell, is an energy storage device designed to be recharged and reused multiple times, unlike primary cells which are non-rechargeable and disposable after a single use. Rechargeable batteries are available in various chemistries, including lead-acid, nickel-cadmium (Ni-Cd), nickel-metal-hydride (Ni-MH), and lithium-ion (Li-ion). Among these, lithium-ion batteries are particularly favored for portable electronic devices and electric

vehicles due to their high energy density, low self-discharge rate, and extended cycle life.

Comprising one or more electrochemical cells, rechargeable batteries convert chemical energy into electrical energy. During discharge, chemical reactions within the battery generate electrons that flow through an external circuit to power a device. When recharging, this flow of electrons is reversed, restoring the battery's chemical composition for subsequent use. The capacity of a rechargeable battery is typically measured in ampere-hours (Ah) or milliampere-hours (mAh), indicating the energy it can deliver over a specified period. Voltage levels vary depending on battery chemistry, ranging from 1.2V for Ni-Cd and Ni-MH batteries to 3.7V for Li-ion batteries.

Rechargeable batteries can be charged using different methods, such as constant current, constant voltage, and pulse charging. However, caution is necessary during charging to avoid overcharging, which can shorten battery life or cause damage.

4.4 16*2 LCD Display

A 16x2 LCD (Liquid Crystal Display) is an alphanumeric display capable of showing up to 16 characters per line across two lines, totaling 32 characters. Comprising a grid of pixels, each pixel can be activated or deactivated to form characters, symbols, and numbers. Operation involves sending commands and data to the LCD controller, which then renders the desired content on the screen. Typically equipped with a standard HD44780 controller, a 16x2 LCD can exhibit a wide range of characters and symbols, encompassing uppercase and lowercase letters, numerals, and special characters. Often featuring backlighting, these displays offer enhanced visibility in low-light environments. LCD displays find widespread use across industrial control systems, consumer electronics, and embedded systems. Their affordability, energy efficiency, and compatibility with microcontrollers make them a preferred choice for showcasing information in various electronic projects.

4.5 Solar Panels

A solar panel is a device designed to convert sunlight into electrical energy through photovoltaic (PV) cells. These cells, typically composed of semiconductor materials like silicon, generate an electric current when exposed to sunlight. Solar panels typically comprise multiple PV cells arranged in a grid-like pattern within a frame. The most common type is the flat-plate PV module, which includes layers of PV cells, glass or plastic, and protective materials.

When sunlight strikes a solar panel, the photons interact with the electrons in the PV cells, prompting them to move and generate an electrical current. This current is then directed to an inverter, which converts it from DC to AC current suitable for powering homes or businesses. The electricity output depends on factors like PV cell efficiency, sunlight intensity, and temperature. For optimal performance, solar panels are often installed on rooftops or in sun-rich areas.

Solar panels offer a renewable energy solution with zero greenhouse gas emissions during operation, making them an environmentally friendly alternative to fossil fuels. Their popularity has surged due to declining costs, enhanced efficiency, and supportive government policies and incentives.

4.6 Boost Converter

A boost converter, also referred to as a step-up converter, is an electronic circuit frequently employed in charging systems to elevate the voltage of a power source. In EV charging systems, boost converters play a crucial role in augmenting the voltage from the DC output of the battery to the necessary level for charging the EV's battery.

The boost converter functions by taking a DC voltage input and amplifying it to a higher DC output voltage. The circuit typically comprises an inductor, a switching element, a diode, and a capacitor. During operation, the inductor is charged by the input voltage when the switching element is activated, and subsequently discharged when the switching element is deactivated. This process induces a current flow through the diode, charging the output capacitor, which then delivers an elevated voltage to the load.

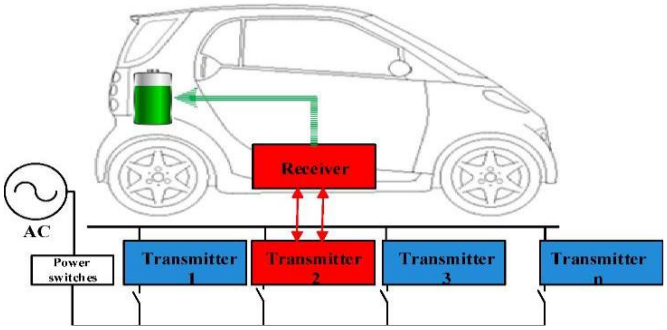
Within the context of an EV charging system, the boost converter serves to elevate the voltage of the DC output from the solar panel or the battery to the requisite level for charging the EV's battery. Additionally, the boost converter can regulate the output voltage to maintain stability and ensure it does not surpass the maximum voltage threshold of the EV's battery.

## 5. Methodology

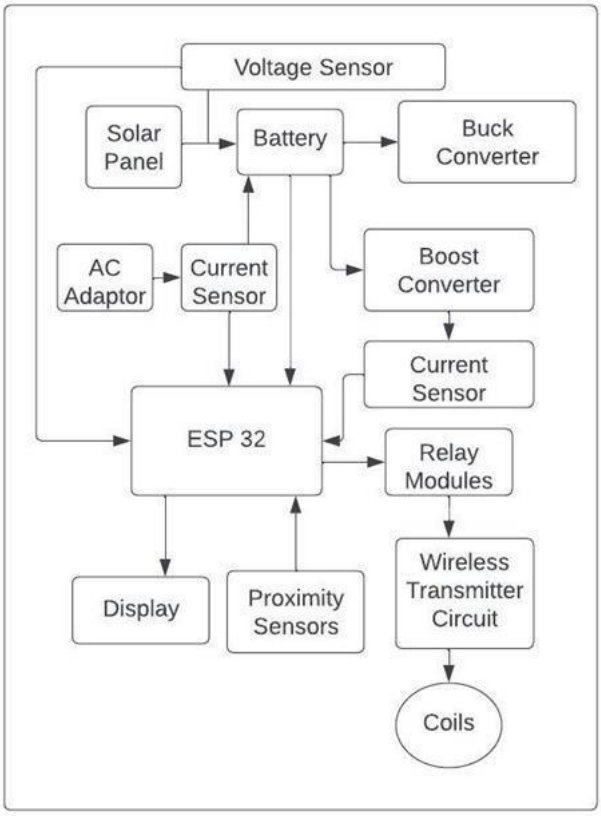
The primary principle employed in solar wireless charging systems is Inductive Power Transfer (IPT). IPT operates on the concept that when an alternating current passes through a coil, it generates a magnetic field. A second coil placed in close proximity to the first coil induces a current as a result of this magnetic field. The device connected to this second coil can then be powered by the induced current.

In an electric vehicle charging system utilizing IPT, the receiving coil is typically positioned beneath the car, while the charging pad is installed on the ground. When the vehicle is parked directly over the charging pad, the two coils align, initiating the charging process. The IPT system is designed to be reliable, efficient, and practical,

automatically recognizing the presence of a vehicle and commencing charging accordingly.




5.1 Working of Transmitter Part



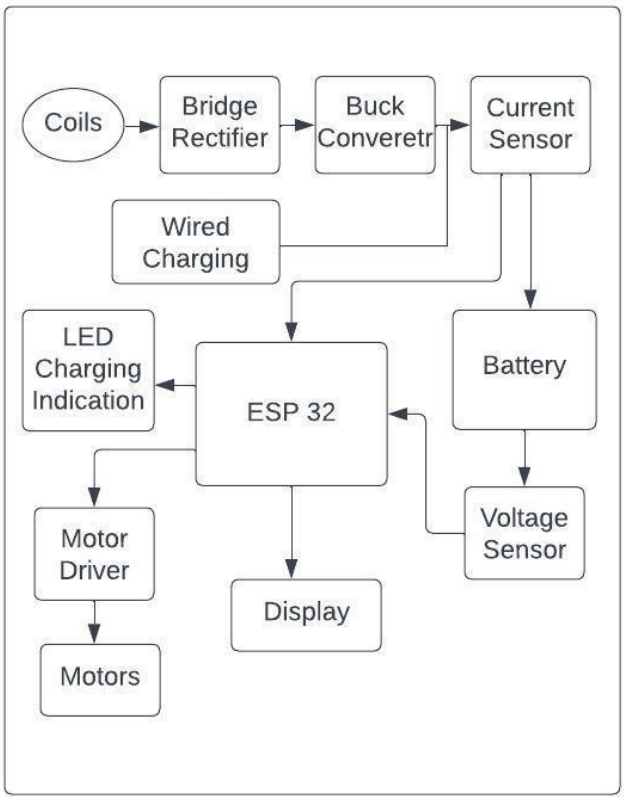

The solar panel captures solar energy and converts it into electrical energy. It's linked to a charge controller, which regulates the current and voltage supplied to the battery. The battery stores the electrical energy and is connected to a Battery Management System (BMS) for monitoring and regulating its charging and discharging.

The buck converter is a DC-DC converter that lowers the voltage from the battery for efficient power transfer, while the boost converter raises the voltage for the same purpose. A current sensor measures the system's current flow to monitor and control power transfer.

The ESP32 microcontroller manages the system's operation, overseeing power transfer processes. A proximity sensor detects the receiver vehicle's presence and initiates charging. A relay module controls power supply to the transmitter coil and manages power transfer.

The copper coil generates a magnetic field for wireless power transmission to the receiver. The wireless transmitter circuit regulates power transfer and communicates with the receiver for efficient, safe charging.

5.2 Working of Receiver Part




The receiving coil captures the magnetic field produced by the transmitting coil and converts it into an electrical signal. This signal is then fed into the full bridge rectifier, which transforms the alternating current (AC) signal into direct current (DC). The DC signal is subsequently directed to the buck converter, which regulates the voltage and current to levels suitable for charging the battery. Additionally, the buck converter ensures a stable output voltage despite fluctuations in the input voltage caused by changes in the magnetic field.

A current sensor monitors the battery's current consumption and relays this data to the Atmega microcontroller. Simultaneously, a voltage sensor measures the battery's voltage and communicates it to the Atmega. The Atmega processes information from these sensors to manage the buck converter's operation, ensuring safe and efficient battery charging. It also interacts with the display to present charging status and

with the LED charging indicator to visually indicate the charging process.

Moreover, the motor driver controls the motor responsible for positioning the receiving coil optimally for efficient charging. Instructions from the Atmega prompt the motor driver to adjust the receiving coil's position accordingly. Ultimately, the battery undergoes wireless charging via this system, with the charging status visible on both the display and the LED charging indicator.

## 6. Conclusion

The solar wireless electric vehicle charging system represents a promising advancement with numerous advantages over traditional cable charging methods. It reduces reliance on fossil fuels and offers convenient, cable-free charging for electric vehicles. Harnessing clean, renewable solar energy, the system's solar panel on the charging pad generates electricity efficiently from sunlight.

Wireless power transfer between the charging pad and vehicle eliminates the need for physical contact, reducing the risk of electrical hazards and damage to charging cables. The battery charging process is managed securely and effectively through the use of an ESP32 microcontroller and other electronic components, ensuring efficient and intelligent charging management.

Drivers can easily monitor their charging sessions with LED charging indicators and a display, providing clear feedback on the vehicle's charging status throughout the process. Overall, the solar wireless electric vehicle charging system presents a sustainable and user-friendly solution for electric vehicle charging needs.

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# IoT-Based Battery Management System for Enhanced Performance and Sustainability

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***Abstract –***

**Batteries have long been employed as a means of power storage by individuals. They are utilized in various devices including flashlights, radios, and smaller electronics. In the realm of automotive vehicles, batteries are utilized for starting the engine, operating the air conditioner, activating turn signal lamps, and more. Recently, renewable energy sources have emerged as substitutes for fossil fuels. These energy sources, such as solar, wind, and other forms of green energy, store their energy in batteries for use during periods of low alternative energy availability, such as at night. As the demand for batteries continues to surge, the quality and quantity of batteries produced have increased accordingly. Among the alternative energy sources developed, electric vehicles rely on batteries to power their motors and propel them. Lithium-ion batteries have emerged as the most favored choice for electric vehicles due to their high energy density and low maintenance requirements. Nevertheless, these batteries necessitate precise charging methods, as even slight errors during the charging process can lead to explosive incidents or diminished battery performance. Therefore, it is crucial to exercise strict control over batteries' charging and discharging methods to uphold their performance levels.**

***Keywords- Arduino UNO, ThingSpeak, R.C.P, Solar Panel, Cooling Fan.***

## I. Introduction

The development of an IoT-based battery management system aims to improve the performance and sustainability of lithium battery packs. By utilizing IoT technology, the system can monitor and optimize factors such as battery temperature, charge-discharge cycles, and overall battery health.

This IoT-based battery management system utilizes smart devices and communication techniques to extend the battery life of devices. Additionally, it incorporates energy-efficient medium access control protocols to minimize energy consumption during wireless transmissions by IoT sensors. By implementing this system, manufacturers and users can ensure that the batteries operate within the optimal temperature range, enhancing their performance and prolonging their lifespan.

Furthermore, the IoT-based battery management system also enables real-time data monitoring and analysis. This allows for proactive maintenance and troubleshooting, leading to improved safety and reliability of the battery packs.

## II. Literature Review

Traditionally, BMS monitors the state and health of the battery and ensures the battery is used within its safe operating conditions. The crucial job of the battery management system is to protect the battery from damage and maintain the battery in its optimal condition. This is done by controlling the parameters like state of charge (SOC), state of health (SOH), and depth of discharge (DOD) of the battery. Typically, BMS has its proprietary dashboard software to monitor the battery parameters, which can be monitored only by the user. With IoT-based BMS,

implementing these traditional jobs are just basic ones.

Overall, previous efforts in IoT-based battery management systems have focused on leveraging IoT technologies to optimize battery performance, improve reliability, and maximize the value of battery assets in various applications ranging from renewable energy integration to electric vehicles and grid storage. Ongoing research and development continue to refine these systems and explore new opportunities for innovation in battery management and energy optimization.

## III. Objectives

1. Enable remote monitoring of battery parameters such as voltage, current, temperature, state of charge (SOC), and state of health (SOH).

2. Optimize energy consumption in IoT devices and systems by intelligently managing battery usage based on demand and usage patterns.

## IV. Block Diagram

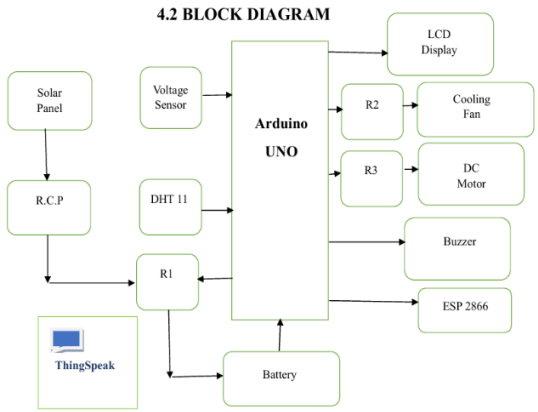


Fig.1 Block diagram of IoT Based Battery Management System

The Block diagram is divided into three parts or sections. 1. Supervision section 2. Output section 3. Charging section.

The supervision section consists of a Voltage sensor, Current sensor, and Temperature sensor which supervises or measures the Voltage, Current, and Temperature of the Battery pack connected to all microcontrollers. The output of these sensors is supervised by Arduino UNO and sends data over IOT. These sensors have Analog data which converts into Digital data using Arduino UNO.

The output section includes a DC motor, Buzzer, Cooling fan, and LCD. Before these outputs are connected to the Relay for secure operation.

The charging section is important for the battery pack. It consists of a Solar panel, R.C.P (Reverse Charging Protection) battery, and an external charger.

The list of Components is following-

| Sr.no | Components | Quantities |
|---|---|---|
| 1. | Solar Panel | 1 |
| 2. | DHT 11(Temp Sensor | 1 |
| 3. | Voltage Sensor | 1 |
| 4. | Battery Pack | 1 |
| 5. | Microcontroller | 1 |
| 6. | Relays | 3 |
| 7. | Buzzer | 1 |
| 8. | Motor | 1 |
| 9. | Cooling Fan | 1 |
| 10. | LCD Display | 1 |

## V. Working Model

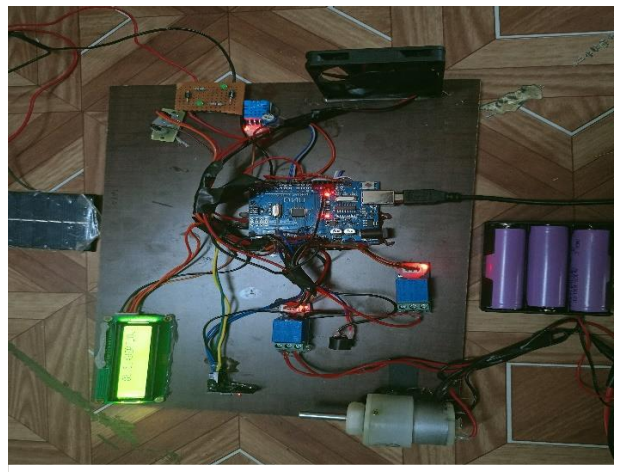

Fig.2 Working Model of IoT-Based Battery Management System

The working model is shown in Fig. 2. In this model we added a battery pack of 12V and an external supply. The external supply is connected to the Arduino UNO and the Battery is connected to all other sensors or devices. But we can't

connect a direct battery supply to the Controller because the controller needs a continuous current supply of 500-600 mA. That's why external supply is given.

For charging purposes, the solar panel is connected to a battery. The battery connection is given to the voltage divider circuit and DHT 11 temp sensor. These sensors are connected to the controller and the LCD shows and monitors the continued working parameter of the battery.

For battery discharging DC motor is connected. When the motor starts running the controller monitors voltage and temperature continuously. When the battery discharge rate goes down to 10%, the automatic solar starts charging without disconnecting disconnect motor. Then, when the charging rate reaches 90% relay disconnects the solar charging circuit.

While charging and discharging of battery Temperature is also monitored by the controller. If the temperature exceeds $35^0$C then the buzzer is blown and cooling fan is started and heat exertion is started from the battery. This real-time data is continuously shown on LCD and over IoT. The IoT is connected to the controller via WIFI. In this model, we use the ThingSpeak IoT platform for monitoring. If any situation occurs then, the suggestion also shows on the IoT platform and the buzzer is blowing.

## VI. Source Code development

The Arduino Integrated Development Environment (IDE) serves as the primary software platform for programming Arduino microcontroller-based devices. It provides a user-friendly interface for writing, compiling, and uploading code to Arduino boards. The Arduino IDE abstracts much of the complexity of microcontroller programming, making it accessible to beginners and experienced developers alike. the Arduino IDE is a powerful yet accessible tool for programming Arduino boards. It provides a user-friendly interface, extensive library support, and a vibrant community, making it an ideal platform for learning, prototyping, and developing embedded systems and Internet of Things (IoT) applications.

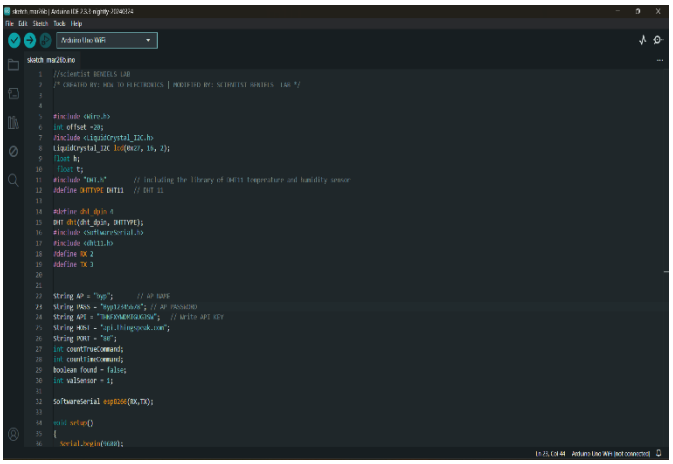

Fig.3 Interface of Arduino IDE

Arduino UNO WIFI device to this IDE. For programming, we use C++ language with the **WIRE.H** library. Using the API address, IDE is connected to the ThingSpeak IoT platform for parameter monitoring.

## VII. Introduction of IOT Platform

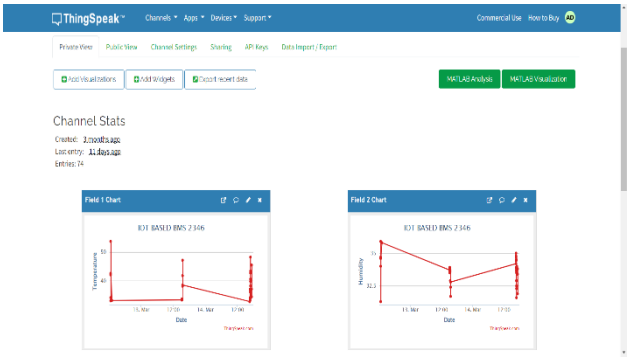


Fig.4 Interface of ThingSpeak IoT

The Internet of Things has revolutionized the way objects in the physical world are interconnected and communicate through the existing Internet infrastructure. This has given rise to platforms like ThingSpeak, which provides a robust and scalable solution for managing and analyzing data from connected devices. ThingSpeak is an IoT platform that allows users to easily collect, analyze, and visualize data from connected devices. By signing up and creating a channel, users can send data to the channel using a Write API Key, which ThingSpeak processes and allows for retrieval.

Here is some information about, how Temperature, Voltage, and Humidity parameters are continuously monitored by the ThingSpeak IoT platform.

1. The DHT 11 sensor continuously checks the temperature of the Battery pack and IoT monitors and saves this real-time data for audit purposes.

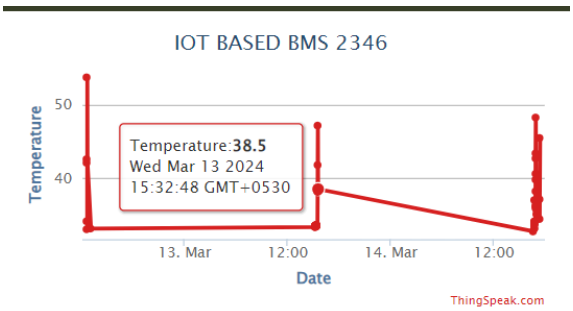


Fig.5 Temperature monitoring

2. The voltage sensor continuously checks the Voltage of the Battery pack and IoT monitors and saves this real-time data for audit purposes.

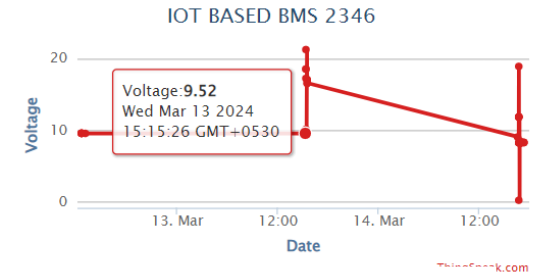


Fig.6 Voltage Monitoring

## VIII. Final Result

This paper presents an overview of recent approaches and intelligent control schemes for developing a robust battery management system. Efficient Battery Usage: The system should optimize the use of batteries, ensuring they are utilized effectively without overcharging or discharging, thus prolonging their lifespan.1. **Real-Time Monitoring:** IoT enables real-time monitoring of battery parameters such as voltage, current, temperature, and state of charge. This allows for proactive maintenance and timely interventions if any issues arise. 2. **Predictive Maintenance:** By analyzing data trends, the system can predict when maintenance or replacement of batteries might be needed, reducing downtime and minimizing unexpected failures

## IX. Applications

1. in electric vehicles, IoT-based BMS can monitor the health and performance of individual battery cells, manage charging and discharging cycles efficiently, and provide real-time data to optimize driving range and battery lifespan.

2. IoT-based BMS can be employed in solar energy storage systems and wind farms to manage battery charging and discharging based on energy demand and supply fluctuations.

3. large-scale battery systems as backup power sources. IoT-based BMS can optimize the charging and discharging of these batteries, monitor temperature and other environmental factors, and detect potential failures to prevent downtime.

4. Medical devices such as implantable medical devices, portable medical monitors, and electric wheelchairs often use batteries. IoT-based BMS can monitor the health of these batteries, alerting patients or healthcare providers when replacement or maintenance is needed.

## X. Conclusion

In conclusion, the implementation of an IoT-based battery management system offers a comprehensive solution for efficient, proactive, and cost-effective management of batteries in various applications, ranging from consumer electronics to industrial energy storage systems. Its ability to provide real-time insights, optimize performance, and facilitate remote management positions it as a key technology in the advancement of battery-powered devices and renewable energy systems. Additionally, incorporating information technology and artificial intelligence in battery management systems can lead to more sustainable batteries with ultra-high performance.

## XI. Future scope

The future of IoT-based battery management systems holds great potential for revolutionizing energy management, improving sustainability, and driving innovation across various industries. Continued advancements in technology, coupled with increased investment and collaboration, will further accelerate the adoption and evolution of these systems in the years to come.

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# Human-Following and Mobile-Controlled Robot Car using Arduino Uno

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**Abstract:** *Humanoid robotics is an emerging research field that has received significant attention during the past years and will continue to play an important role in robotics research and many applications of the 21st century and beyond. In this rapid moving world, there is a need for robot such as "A Human Following Robot" that can interact and co-exist with them. Because of their human following capability, these robots can work as assistants for humans in various situations and it can also acquire or monitor certain information associated with the human subject. In this paper we present a prototype that uses Arduino Uno along with basic sensors such as IR and IR sensor. All the processing is carried out by the microprocessor while the control of the motors is carried out by the controller. This robot can further be modified by using many technologies such as Bluetooth, PixyCamera etc.*

**Keywords:** Artificial Intelligence, Human following, Human tracking, IR Sensor, Arduino Micro Controller.

## I. INTRODUCTION

Robotic technology has increased appreciably in the past couple of years. Such innovations were only a dream for some people a couple of years back. But in this rapidly moving world, now there is a need for robots such as "A Human Following Robot" that can interact and co-exist with them. The development of robot technology has increased significantly due to industrial, medical and military applications. In various fields with harsh environments such as underground mining, war zones, medicine, construction, space exploration etc. the work done by one is extremely dangerous. The lives of individuals assisting are also put at risk. Tasks performed by humans have their own limitations in many ways. To perceive beyond the human limitation in vision, speed, consistency, flexibility, quality e.tc we should make use of robots. A key requirement for these robots is the ability to detect humans and to interact with the main non-technical way. The main objective of this dissertation is to make a robot that can help humans with various tasks. In this paper, we present a prototype of a human following robot that uses Arduino Uno and different sensors for detection and following an object. The Robot must follow the following objectives:

- The robot must be capable of accurately following a person.
- It should be capable of taking various degrees of turns.
- The robot must be insensitive to environmental factors such as noise.
- The robot must be capable of avoiding collision.


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## II. System Circuit Diagram and Components

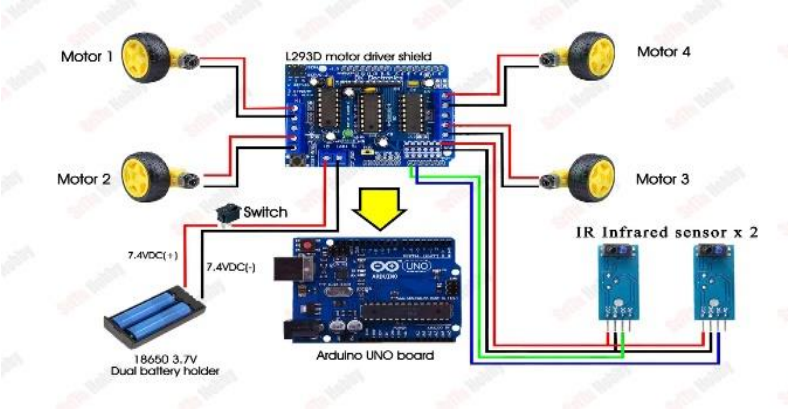


**Figure 1:** Human Following Robot Circuit

### 2.1 System Components

#### 2.1.1. Arduino Uno

It is the brain of our project. It can give all the commands to their subordinate components which should by operated by the human behavior. And it also gives feedback to the other components and humans. So that it can be used as a medium of communication between humans and robots & vice versa. It has specification of 8-bit CPU, 16 MHZ clock speed, 2 KB SRAM 32 KB flash Memory, 1 KB EEPROM.

#### 2.1.2. DC Motors

DC Motor is a device that converts any form of energy into mechanical energy or imparts motion. In constructing a robot, motor usually plays an important role by giving movement to the robot. Here 4 DC motors are used to drive the robot.

#### 2.1.3. Motor Shield

The Motor Shield is a driver module for motors that allows you to use Arduino to control the working speed and direction of the motor. The Motor Shield can either be powered by Arduino directly or by an external 6V~15V power supply via the terminal input. Here Motor Driver Board is designed to Work with L293D IC.

#### 2.1.4. IR Sensor

IR sensor is an electronic device, that emits light to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detecting the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiation are invisible to our eyes, but infrared sensors can detect these radiations. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode


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## III. Working and Design

Our system consists of a four-wheel robotic vehicle mounted with a separate microprocessor and control unit along with different sensors and modules i.e. IR sensor, infrared sensors which helps them to move with respect to people and objects in their surroundings. The above sensors work in unison with each other and help the robot in its operation and to navigate its path by avoiding obstacles and maintaining a specific distance from the object. We used IR sensor for obstacle avoidance and to maintain a specific distance for the object. The IR sensor works accurately works accurately within a range of 4 meters.

### 3.1 IR Sensor Principle

This IR sensor is placed at the top of robot and a pair of IR sensors are attached on either side of the IR sensor. We used IR sensor for obstacle avoidance and to maintain a specific distance for the object. The IR sensor works accurately works accurately within a range of 4 meters. IR sensors operate by calculating the times differences. Infrared sensors detect the object's distance with infrared radiations when the beam from transmitter detects an object it returns to the receiver with an angle after reflection also known as method of triangulation this also helps in calculation of distance travelled by robot and eliminate any further error in the robotic movement due to displacement.IR sensor controls the movement of motors and IR sensor detects the obstacle and stops the motors

## Results

Different experiments were conducted and the performance of the human following robot was tested. Test was performed on the IR and infrared sensor. It was noted that the sensor was working accurately within a range of 4 meters. Then we performed the test to check whether the robot maintains a specific distance with the target object. Then we checked the serial communication between Arduino, motor shield and various motors. Based on results obtained from these tests and experiments, we made the necessary changes in the processing and control algorithm. After the completion, we observed that the results produced were very satisfying. The robot was perfectly following the person wherever it went. Hence the objective of implementing a good Human-Robot interaction was achieved.


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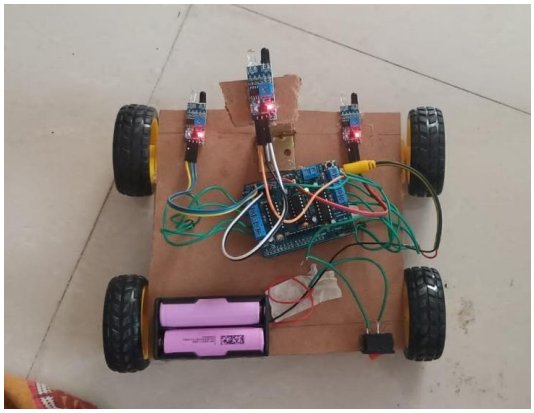

**Figure 3:** Human Following Robot

## IV. APPLICATIONS

Looking deeply into environment or our surroundings, we were able interpret that there is a need for such robot that can assist humans and can serve them. Such a robot can be used for many purposes. With a few modifications, the robot can act as a human companion as well. The tasks these kinds of robots can perform are limitless, including assisting in carrying loads for people working in hospitals, libraries, airports etc.

## V. FUTURE WORK

There are many interesting applications of this research in different fields whether military or medical. Wireless communication functionality can be added in the robot to make it more versatile and control it from a large distance. This capability of a robot could also be used for military purposes. By mounting a real time video recorder on top of the camera, we can monitor the surroundings by just sitting in our rooms. We can also add some modifications to the algorithm and the structure as well to fit it for any other purpose. Similarly, it can assist the public in shopping malls. So, there it can act as a luggage carrier, hence no need to carry up the weights or to pull that. Similarly, an ample number of modifications could be made to this prototype for far and wide applications.


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## VI. CONCLUSION

The successful implementation of a prototype of human following robot is illustrated in this paper. This robot does not only have the detection capability but also the following ability as well. While making this prototype it was also kept in mind that the functioning of the robot should be as efficient as possible. Tests were performed on different conditions to pinpoint the mistakes in the algorithm and to correct them. The different sensors that were integrated with the robot provided an additional advantage. The human following robot is an automobile system that can recognize obstacles, move and change the robot's position toward the subject in the best way to remain on track. This project uses arduino, motors different types of sensors to achieve its goal. This project challenged the group to co- operate, communicate, and expand their understanding of electronics, mechanical systems, and their integration with programming.

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# Green Technology in Agriculture

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**Abstract - Technology is being utilised on a greater scale each day. Everyone depends on technology, and we all make use of different kinds of technology for various tasks during our daily lives. The way we live has changed as a result of numerous new technologies present today. We use technology in almost every part of our daily lives. Technology will benefit you in some way regardless of your industry. The needs of the market and of people will continue to drive the evolution of this technology. It is hence your responsibility to keep updated of advancements in technology. Green technologies are modern technology that have the capacity to not only stay the world's agriculture towards sustainable development but also to support the development of efficient and cost-effective approaches to producing safe, high-quality food; to support the income of Asian small-scale farmers through the production of marketable, high-value agricultural goods and successful agricultural enterprises; and to support sustainable production methods that protect the environment and public health.**

**Keywords – Green Technology types; Sustainable development; Innovative idea'**

## INTRODUCTION

Green technology in agriculture is the use of sustainable practices and cutting-edge technologies to improve agricultural efficiency while reducing environmental impact. Green technologies are designed to address pressing issues such as climate change and resource depletion, as well as biodiversity loss.

For example, precision farming uses data-driven methods to optimize inputs such as water, fertilizer, and pesticides, thereby reducing waste and increasing crop yields.

Organic farming reduces the use of synthetic chemicals, improving soil health and biodiversity.

Solar-powered irrigation systems reduce dependency on fossil fuels while simultaneously decreasing greenhouse gas emissions. Water-saving technologies such as drip irrigation or soil moisture sensors help to conserve water resources, which is essential for sustainable agriculture in regions with limited water resources.

Conservation tillage techniques help to reduce soil erosion, improving soil health by reducing soil disturbance.

Integrated pest management tactics decrease relying on chemical pesticides and promote natural pest control methods, while also reducing plastic pollution.

Green technology in agriculture supports a holistic approach that balances economic profitability and environmental sustainability, while also increasing food security and long-term resilience.

### *A. Green Technology for Sustainable Development*

Sustainability should not only mean saving resources, but also not just using resources. Genetically modified crops can help farmers in a variety of ways. Sustainable growth and development of the Indian agriculture sector with the integration of education, research, and extension programmes along with effective and efficient institutional, facilities and policy support for achieving livelihood security. As a result, the growth of the agriculture sector, defined as growing output at lower average expenses, becomes an essential requirement for the entire development of an impoverished country's economy, such as India. The sustainability element refers to an agricultural land's ability to sustain a suitable level of output over time without resulting in adverse effects on the environment while generating safe and nutritious food. Green technology has an impact on many elements of agriculture.

*1) Solar Energy* : The primary energy source is solar energy, which comes directly from the sun. Photovoltaic cells convert sunlight directly into electricity. Every year, the sun provides more than 10,000 solar energy sources, which can be used to charge batteries, provide lighting, pump water, and power tiny motor.

Renewable water supply system solves many problem compared to non-renewable fuel. For example, it does not require fuel and service, and it does not pollute the atmosphere. In nations as India, the potential of water supply system is significant as it receives abundant solar radiation.

The development of new techniques will result in rise in solar energy applications. This, in turn, will boost the effectiveness of photovoltaic cells and lower their cost..

This kind of sustainable technology is the most effective technique to enhance rural households' quality of life in terms of food production, lighting, cooking, and natural food production.

*2) Biomass* : Biomass is a cost-effective and efficient technology able to producing high-value industrial products. Biomass, derived from crops, trees, and waste from animals, is excellent for organic farming. Agricultural remainders and trash are turned into electricity and heat energy using techniques like gasification. These are then utilised to produce efficient generation of electricity. When biomass combines the biorefinery with biogas, which is it

creates fresh products and expands the organic agriculture industry. By replacing fossil fuels with biomass, greenhouse gas emissions can be reduced. Biomass can be an effective way to increase organic agricultural revenue and conserve exhaustible resources.

*3) Wind Energy :* Organic agriculture takes use of wind energy since they offer mechanical power for supplying water. It serves with the goal of eliminating the expensive installation of transmission cables as minuscule wind turbines are also helping to generate energy. Wind energy can also be used to emit greenhouse gases in an environmentally friendly way using power production techniques. This kind of technology can be called an appropriate choice for delivering sustainable energy services for the production of organic food.

*4) Biogs* : Methanogenic microbes break down organic materials anaerobically, producing biogas. Biogas qualifies due to it recycles organic agricultural waste to generate fuel and fertilisers. Biogas has immediate effects on fuel wood, agricultural left-overs, livestock manure, and gasoline savings. Improved soil fertility and agricultural yield have also been recorded.

### *B. Integrated pest management (IPM)*

IPM is a knowledge rich technique of test control that is different from the traditional use of chemicals. It is designed to promote healthy crop growth with minimal disruption to the agricultural ecosystem, and to encourage natural pest control mechanisms. According to the University of California Agriculture and Natural Resources, IPM is an effective way to manage pest problems while reducing risks to humans and the environment. It can be used in both urban and rural settings, and is based on knowledge of pest biology and ecology in the agro ecosystem. IPM applications are designed to prevent pest problems from occurring by taking measures that will keep pests away from the farm, such as growing healthier crops, planting disease-resistant crops, and designing human look alike to discourage pests and rodents. The fundamental principles of IPM are as follows :

1. Pest avoidance/ exclusion mechanism- This is an action taken early enough to avoid the entry of any pest into the agro ecosystem to ensure its pest free. This is mainly by employing techniques which exclude and prevent the pest such hand-picking, physical beating, noise creation, burning etc. Burning included here as techniques for eco-friendly managing pest also has negative impact on the environment and man. The effects of Bush burning are harmful to the environment and to human health. Bush burning produces pollutants in the air like carbon monoxide, hydrocarbons, hydrogen sulphide, nitrogen oxide, sulphur , etc. Bush burning should not be treated as an environmentally friendly process because it harms the natural environment as well as human health. Identification of pest and its status: This is management of pest by identifying the pest; its life stages and effect. Identification of pest will help you determine their status, population and effective measures to employ. However, proper identification of pest especially at early stage is expertise that cannot easily be learned and most farmers don't have this neither do they have financial strength to employ the services of the qualified entomologist.
2. Understanding biology and ecology of pest: Sufficient understanding of the biology and ecology of pest such as anatomy, morphology, growth, etc., will enable you choose appropriate method or repellants for the pest than applying whatever that is called pest repellent or adopting any IPM method. This is also quite difficult as an average farmer cannot afford to hire a professional who can do that.

### *C. Vertical Green Farming*

Vertical farming, as opposed to traditional horizontal farming, is the process of growing crops in vertically stacked layers. Farmers will be able to grow significantly more food on the same amount of land as before. Environmental agriculture and techniques such as aquaponics and hydroponics are frequently used. Vertical farming can be a sustainable urban farming method that benefits the environment, the economy, and society. Farmers will see an increase in yield as well as a reduction in water and fertiliser waste. This new technology has been found to reduce water consumption by up to 95%. Because the crops are grown in a controlled climate, pesticides are used less frequently to combat pests and diseases.
Another significant advantage is that vertical farms may be developed anywhere, including in urban and densely populated regions, to meet local food demands.
Local crop cultivation and harvesting reduces the quantity of 'food miles,' which lowers travel expenses and reduces carbon footprint. In metropolitan regions and countries with limited free land, this green technology is preferred.

Fig 1. Vertical Green Farming

### D. *Zero Tillage Farming*

Zero tillage, often known as no-till farming, is a form of farming that does not need ploughing the land or the use of heavy farm machineries as the soil is not disturbed as much as it is with traditional farming practices carried out from the accident time, greenhouse gas emissions are minimized with reducing the erosion and runoff. Zero tillage also promotes soil carbon sequestration (the amount of carbon absorbed and stored by the soil) and makes use of crop residue left on the soil surface from previous crops. Overall, this environmentally friendly farming practise reduces the quantity of greenhouse gases released into the atmosphere while also saving farmers money. This strategy has demonstrated to be beneficial to both the environment and the economy, and it is essential since it can be used anywhere in the world. Zero tillage does not necessitate a large financial investment before seeing returns. Educating farmers about this method could be a huge step toward ensuring the agriculture industry's long-term viability. No-till farming is a sustainable strategy that also considers the enormous global food need. This method was first developed with the goal of conserving water and soil, but the added benefits of lowering greenhouse gas emissions could be beneficial to the globe.

Fig 2. Zero Tillage Farming

### E. *Precision Farming*

Precision agriculture (PA) is the science of improving crop yields and assisting management decisions using high technology sensor and analysis tools. PA is a new concept adopted throughout the world to increase production, reduce labor time, and ensure the effective management of fertilizers and irrigation processes. It makes extensive use of data and information to increase agricultural resource utilisation, yields, and crop quality. PA is an advanced technology and optimum field-level management method used in agriculture with the goal to improve resource production. Thus, PA is a new advanced strategy in which farmers use optimised resources such as water and nutrients to increase quality, productivity, and yield. It requires a large volume of information about crop status or health throughout the growing season at high spatial resolution.

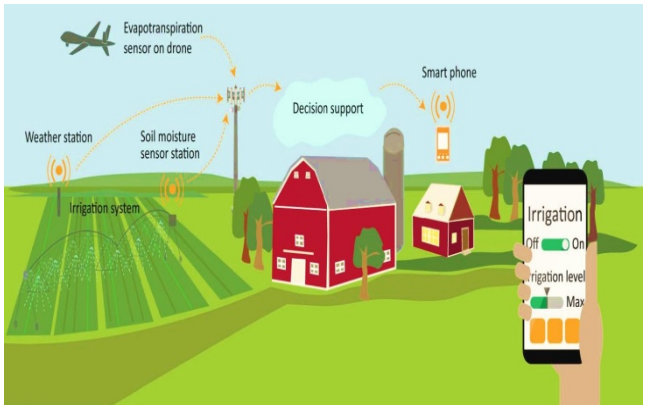


Fig. 3 Precision Farming

Precision agriculture uses data from numerous sources to increase yields for agriculture and lower the cost of crop management procedures like fertiliser additions and irrigation management, and the use of pesticides. Precision agriculture refers to locally suitable technologies and methods at subfield scales (< 5 m), however definitions vary. For decades, satellite mapping has been pushed as an essential source of information for precision agriculture, but acceptance has slowed down due to a number of factors.

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# Designing a Control Unit for Controlling Pressure While Assembling Bearing of Vehicle Shaft

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**Abstract**

In the ever-evolving landscape of automotive engineering and manufacturing, precision and reliability are paramount. The seamless integration of vital components, such as bearings within vehicle shafts, demands a meticulous approach. To ensure the utmost quality and performance, the project focuses on the development of a cutting-edge control unit designed to regulate and maintain optimal pressure during the assembly of bearings onto vehicle shafts.

If the bearing of wheel is not mounted in the limited range of pressure, there is a possibility of wheel separation or vehicle will get imbalance which would lead to major accidents.

The project represents a critical advancement in automotive mounting processes, as it addresses a crucial aspect of vehicle performance and longevity. The precise installation of bearings on shafts is fundamental to the functionality of various vehicle systems, from engines to suspension, and even steering. By developing a specialized control unit, we aim to enhance the efficiency, accuracy, and consistency of this critical assembly step, thereby contributing to the overall quality and durability of automotive products.

The primary objective of the project is to design, develop, and implement an advanced control unit specifically tailored for the precise regulation of pressure during the mounting of bearings in vehicle shafts. The control unit is designed to ensure the proper mounting of bearing in wheel shaft. Thus, by designing a control unit for the operation of a press machine by using AT 328 SMD we ensure that the bearing is assemble with accurate pressure in wheel shaft

The methodology is divided into three parts:

1. Design Analysis
2. Hardware description
3. Hardware programming

All these three parts were assembled together and experiments were then performed to build a system that can control the hydraulic pressure that was carried out.

**Keywords:** Hydraulic Press, Pressure, Automation technology, etc

## 1. Introduction

Accuracy and dependability are critical in the dynamic field of automobile engineering and production. A careful technique is necessary to ensure the smooth integration of essential parts, like bearings inside vehicle shafts. Our research focuses on creating a state-of-the-art control device that will maintain and adjust the ideal pressure while bearings are being assembled onto vehicle shafts, guaranteeing the highest level of quality and accuracy. Major accidents could result from wheel separation or vehicle unbalance if the wheel bearing is not assembled within the specified range. This research targets a vital component of vehicle longevity and performance, which constitutes a critical development in automotive assembly procedures. The correct positioning of bearings on shafts is essential for the operation of several car systems, including the suspension, steering, and engines.

Our goal is to improve the overall quality and longevity of automotive goods by improving the efficiency, accuracy, and consistency of this crucial assembly stage through the development of a specialized control unit.

The goal of this study is to automatically operate the press machine by regulating its force and speed. The field of hydraulics is vital to human existence. Given its status as a component of the industrial muscle and its position in contemporary automation technology, hydraulics is a highly versatile technology with a vast array of applications, demonstrating its significance.

The term "hydraulics" now refers to the use of fluids to transmit and control force and movement. Press working techniques involve cold working mild steel and other ductile materials in less time, with higher accuracy and at a lower cost, by using huge amounts of cost-effective tooling equipment design. The components produced cover a very broad range and are used in the industry to create large numbers of pressing economically; the rate of production and the cost of the press tool to be used must be taken into account. A press is a chipless manufacturing process used to create several types of sheet components.

Press-used components often have thin walls and a predetermined shape. The sheet metal work piece is cut or formed into the appropriate shape by applying a lot of force with press tools in the shortest amount of time during manufacturing. Metal forming presses were first equipped with a basic crank and lever mechanism that used a punch or ram to translate rotating action into linear motion. Punch or ram applied to the work item produces linear motion and the motor produces rotating motion. Arduino controller with an electronic pressure sensor. The relationship between the pressure needed to bend the material and its parameters is performed by it according to its programming. To ensure that the system is operating as intended, a simulation program called Automation Studio was used to mimic the system. In this paper, copper alloys of various thicknesses were examined. To verify the system's functionality and design, a laboratory setup was constructed to demonstrate how the system operates. Consequently, a proportionate connection between the ultrasonic and pressure sensors and the proportional valves has been established. By the end of this process, the force and speed can be adjusted based on the alloy type and thickness of the material. Lastly, a smart press that integrates with an automation system can be designed and put into operation.

## 2. Literature Review

The following literatures are directed to the work with proportional valves in electrohydraulic systems and the different control algorithms used for enhancing their performance.

Willy Lazuli and Bjorn Victor Lund (2010) presented in a study the results of modeling and simulation of a physical hydrostatic transmission with three different modeling tools; Simulink, Sim Hydraulics and

Simulation X. The aim has been to get the simulations from the different models to be as similar as possible to the two measured pressures and the rotational speed of the load. The Simulation X model gave the best results compared with the measurements. The largest challenge has been to simulate the model in Simulink and to find the frictional losses in the hydraulic motor by performing different tests. The solver in Simulink could not solve the equations and it was difficult to find the tests for finding two of the friction parameters

Denishet al., (2019) designed an Automatic Phase Sequence and Overload Protection using PIC Microcontroller. Single phase was taken from three phase supply for voltage and current measurement. Three phase supply was given as input to phase sequence detector module to check the phase sequence. Then the measured voltage, current and checked phase sequence was given to ADC pins of PIC 16F877A. Using the C-program dumped in PIC 16F877A, it compared the measured parameters with the predefined ranges used in the program and displays voltage and current values in the LCD as well as sent the signal to relay according to the results of comparison of the measured parameters.

Eryilmaz and Wilson developed a unified model for proportional control valves and analysed the effect of spool lapping on open-loop hydraulic system properties. The developed nonlinear equations were used to obtain simplified flow rate expressions under generally accepted assumptions. These unified model equations are useful for simulation and nonlinear controller design.

Renn and Tsai built an electro-hydraulic proportional flow control valve with lowest cost by developing a proportional switching solenoid. The fuzzy-logic controller was used to linearize the force/stroke characteristics of the normal switching solenoid valve.

Hamdan and Gao developed a Modified PID (MPID) controller to control and minimize the effect of hysteresis in Pneumatic proportional valves. It consists of four parts: Proportional-Integral-Derivative (PID) controller, a Feedforward term, an Anti-Windup mechanism, and a Bang-Bang controller. The result is a unique Modified PID (MPID) control scheme that demonstrates better command following and disturbance rejection qualities than a conventional PID (PID + Feedforward + Anti-windup) scheme, and also provides better step response, command following, robust control in the presence of significant dynamic variations in the valve, and greater bandwidth than conventional methods.

Kiković developed a mathematical model of filling chamber controlled with proportional spool valve. Use different geometry of valve output port; the aim was defining optional geometry so that pressure response in chamber is sufficiently linear and quick. Valve dynamics, the nonlinearity of the valve effective area with respect to the coil current, and the nonlinear turbulent flow through the valve orifice were also considered. The other construction aspects of proportional valve were analysed. For example, the spool spring constant has huge influence on time of pressure response and it is possible to have this time less than 1 sec what is demand for hydrodynamic brake.

Dobchuk developed a model reference control scheme to provide control of the valve spool displacement for a particular electrohydraulic proportional valve. He presented the conditions by which the linearizing feedforward controller produces excellent velocity tracking characteristics and concluded that the linearizing feedforward approach has the potential for excellent response, disturbance rejection and repeatability when used as a single component pressure compensated flow control device.

Ferreira et al. described a new semi-empirical modelling approach for hydraulic proportional spool valves to be used in hardware-in-the-loop simulation experiments. The model described the behaviour of the whole hydraulic valve package (valve, spool position transducer and electronic controller card). Spool dynamics are modelled by a non-linear second-order system, with limited velocity and accelera-

tion, the parameters being adjusted using optimization techniques. The developed models use either data sheet or experimental values to fit the model parameters in order to reproduce both static (pressure gain, leakage flow rate and flow gain) and dynamic (frequency response) valve characteristics. The model accurately reproduces the amplitude Bode diagram up to 200 Hz. The phase response still has room for improvement, mainly at high frequencies.

Lee et al. introduced a tracking position controller (type PID) for a pneumatic actuator and evaluated it experimentally. The positioning system is composed of a pneumatic actuator and a 5- port proportional valve. The experimental results indicate that the tracking performance can be significantly improved with the proposed controller. If the model of dynamic nonlinearities such as friction and compliance are identified and incorporated into the feedback linearization, and if the noise coming from differentiating position is minimized by directly measuring the velocity, further improvement of tracking accuracy may be achieved.

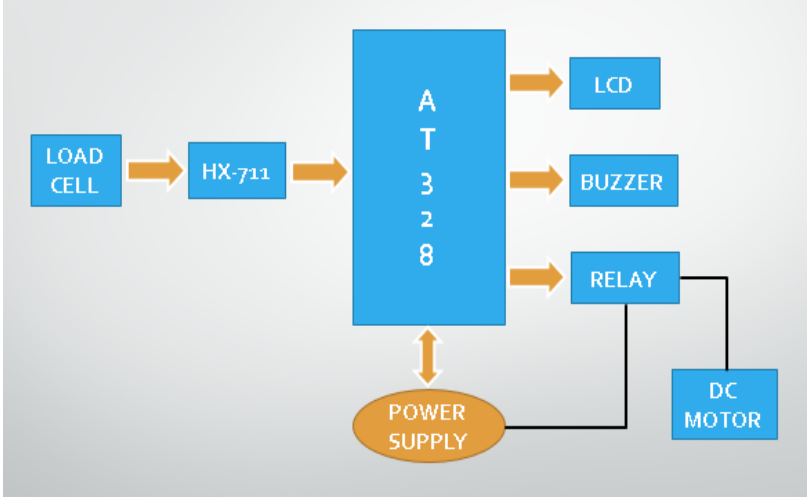
## 3. Problem Statement

A vehicle's wheel shaft bearing may not be assembled correctly, which could cause grinding or scraping sounds, wheel separation, or vehicle imbalance, which could be extremely dangerous and result in serious accidents. In addition to affecting overall vehicle performance and safety, this problem may result in premature wear on the bearing.

In order to minimize reliance on imported controllers from overseas businesses, optimize manufacturing costs, and boost the competitiveness of the electric vehicle firm, develop an affordable solution for monitoring temperature and pressure in bearings used in electric vehicles.

## 4. System Design

**Figure 1: Block Diagram**




In this prototype model, a pressure of up to 1 kg is delivered to the load cell, which is then transformed into an electrical signal by a voltage-sensitive load cell.

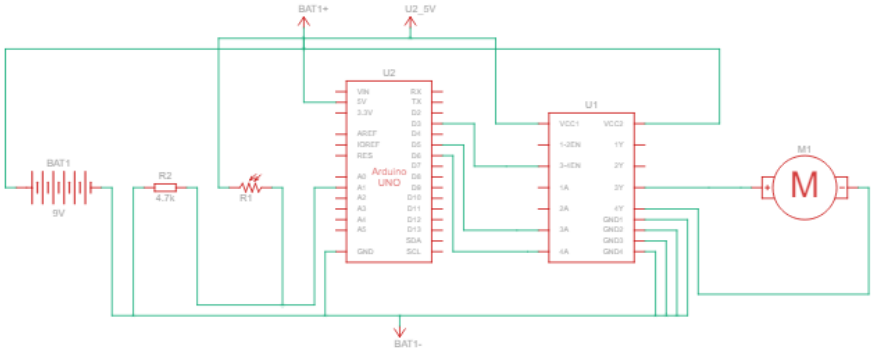
The load cell's output voltage reference is fed into the HX-711's input, which transforms the analog signal into a digital signal. Additionally, the Arduino UNO, which is coupled to an SMD ATmega 328 microcontroller, receives the digital signal from the HX-711. The ATmega 328, which regulates the output connected to the Arduino board, checks and processes the C program produced for the Arduino UNO.

An LCD is connected to an Arduino Uno, allowing it to show the load cell's pressure as well as whether or not the weight that the Arduino is configured to measure falls within the specified range.
When the load cell experiences pressure within the specified range, that is, above 500 grams, it will first check with the Arduino microcontroller software. The microcontroller will then send a signal to the relay, which will control the associated Dc motor to switch it off.

## 5. Experimentation

Test Case 1: When the pressure is applied up to 250gm the motor is remained ON.
Test Case 2: When the pressure is applied at accurate 500gm the motor turned OFF.
Test Case 3: When the pressure is applied above 500gm the motor will remain OFF.

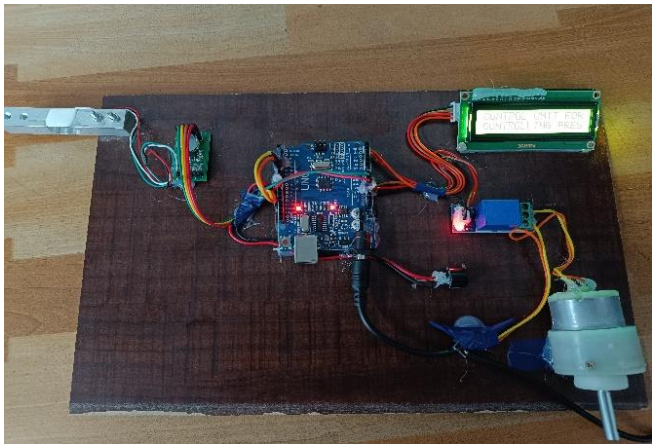
**Figure 2: Circuit Diagram**




## 6. Results

It's also crucial for one to understand that hydraulic presses come in automatic and manual varieties. It is vital to follow certain safety precautions, such as barrier guards and interlocking, when using manual hydraulic presses to ensure both your own safety and the safety of your employees. In summary, both automatic and manual hydraulic presses are subject to safety regulations. Use every safety precaution that is advised. For industrial uses, hydraulic presses are quite beneficial. Its operation is also quite straightforward.
The hardware setup for the project is depicted in the following figure:

**Figure 3: Hardware Setup**



## 7. Conclusion

Using a microcontroller, we designed and implemented an automatic pressure control system. Our key goal is to create a system that efficiently satisfies the requirements.

The implementation's components were reasonably priced and conveniently accessible. By its loads, this system keeps the pressure constant. The project's device features a very basic structural design. As a result, these gadgets are incredibly inexpensive when compared to other gadgets on the market. As previously indicated, the systems have the potential to make a significant contribution in a number of sectors. However, for these kinds of systems to be a superior option, they still require some sort of enhancement.

## 8. Acknowledgement

We would also like to show our gratitude to, *Prof. S. S. Landge (professor, department of Electrical Engineering, AISSMS Institute of Information Technology, Pune, Maharashtra, India.)* for sharing their pearls of wisdom with us during the course of this research. We are also immensely grateful to him for his comments on an earlier version of the manuscript, although any errors are our own and should not tarnish the reputations of these esteemed persons.

## 9. References

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# Department Activities:

## (Professional Chapter, PQ Cell, REC Cell, Student Association)

# IE (I) and ISTE:

## Prof. V. P. Kuralkar- coordinator

Department of Electrical Engineering has professional chapters namely The **Institution of Engineers IE(I)** and **Indian society of technical education (ISTE)**, the headquarters of IE(I) is at Kolkata.

The aim of establishing these chapters is to conduct various technical as well extracurricular activities for students to develop the overall personality of the students apart from the academics. Financial help is also provided by these chapters to the students. These activities provide a platform for the personality development of the students and also help to bridge the gap between the academics and the industries.

1) Under these chapters various technical activities such as paper presentation, project competition, model making, technical quiz etc are conducted. These activities enhance the technical skills as well as verbal and communication skillset of the students.
2) Workshops (PLC, Programing, electronics, microprocessor etc.) are also conducted for the students and are sponsored by the chapters. These workshops are conducted by highly proficient and skilled industrial experts.
3) Expert lectures, technical demonstrations, industrial visits, tutorials, special technical talk sessions, career guidance lectures, mock interviews, group discussions are also some of the activities organized under these chapters.

| | | |
|---|---|---|
| Revolutionizing Electrical Engineering with AI-ML & amp; Exploring Potential of Gen AI | 04/03/2024 | Gajanan N. Bejgamwar.<br>Manager Supply Chain Analytics & amp Optimization, TCS, Pune |
| Project Competition | 15/04/2024 | Mr. Anand Dande,<br>Director, MTech Energy, BEE Certified Auditor |
| Coffee And Conversation with Alumnus | 06/05/2024 | Mr. Gaurav Kulkarni<br>Manager, Accelya Solutions Pvt. Ltd., Mumbai |
| Coffee And Conversation with Alumnus | 15/04/2024 | Mr. Shubham Naik,<br>Founder Naik Pattern |



Revolutionizing Electrical Engineering with AI-ML & amp; Exploring Potential of Gen AI

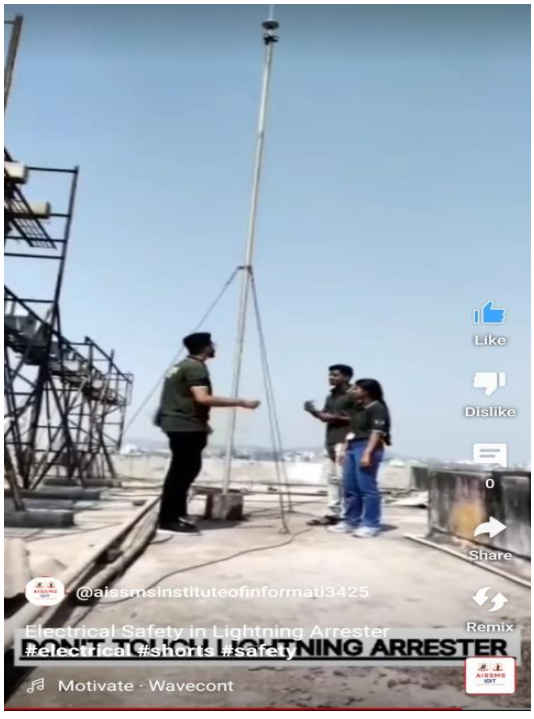
# National Federation Of Engineers For Electrical Safety

**Students' Chapter**

- Create awareness on electrical safety, improve skills of practicing electrical engineers, improve safety measures followed in the industry, Introduce modern safety measures in engineering & Improve quality of electrical installation.
- Facilitate accreditation system for engineering professionals and providing better employability. Create a platform in which professionals are accepted globally with the accreditation system.
- Support standardization, R&D, test laboratories.
- Working with governments for improving electrical safety scenario, reduce the number of accidents and fatality, support in creating Chartered Electrical Safety Engineer. Support and research on new technologies such as Solar PV, EV, micro grid.

**Activities:**

| | |
|---|---|
| Expert Lecture on "Electrical Safety" | 29/08/2023 |
| Short video making by the Girls on "Electrical Safety while doing Electrical Practical" | 08/03/2024 |
| Health Awareness programme for girl student on Women's Day | 05/04/2024 |




**Reel making contest on electrical safety 15/04/2024**


**Reel making contest on electrical safety 15/04/2024**

# IEEE Students Chapter:

### Dr. A. D. Shiralkar - coordinator

**Institute of Electrical and Electronics Engineers (IEEE)**, is the world's largest professional association. It is dedicated to advancing technological innovation and excellence for the benefit of humanity. IEEE and its members inspire a global community through IEEE's highly cited publications, conferences, standards, professional and educational activities.

IEEE students Chapter, AISSMS IOIT was formed in the year 2014. It is dedicated to serving the purpose of helping its members to enrich their technical knowledge and expertise. Currently, 30 students are active members of the branch volunteering various activities and 160 students are members. The main focus of this branch is to conduct technical, social, and techno social activities such as webinars, expert lectures, workshops, hands on sessions, and competitions, etc. for students of all branches. It also creates awareness and encourages students to utilize the benefits of IEEE membership, including competitions, and international conference grants.

## POWER QUALITY CELL

**POWER QUALITY (PQ) CELL ESTABLISHED IN 2017 AIMS TO PROVIDE HANDS-ON EXPERIENCE TO THE STUDENTS AND HELP VARIOUS INDUSTRIES FOR SOLVING THE PROBLEMS RELATED TO ELECTRICAL POWER QUALITY.**

**Consultancy Provided to:**

1. Western Metal Industries Private Limited, Hadapsar, Pune
2. Gennova Biopharmaceuticals Ltd, Hinjewadi, Pune
3. Bosch Chassis Systems India Pvt. Ltd., Chakan, Pune
4. Ksolare Energy Private Limited, Katraj, Pune
5. Rao Nursing Home, Bibvewadi, Pune
6. Bosch Chassis Systems India Pvt. ltd., Chakan, Pune
7. Conductor Core Technologies India Pvt. Ltd., Khed, Pune
8. Brawn Energy, Baner, Pune
9. pqExcel Solutions LLP, Pune

Consultancy offered 8,80,000/-

**PQ cell Benefits to Students:**

- Internship opportunities provided: Total of 03 Students
- Total Final Year Projects – 03
- Products developed – 03
- Hands-on experience opportunities provided – 25 students.
- Placements – 09

**Power Quality Audit Glimpses**


Western Metal Industries Pvt Ltd, Hadapsar


Rao Nursing Home, Bibvewadi, Pune


Gennova Biopharmaceuticals Ltd, Hinjewadi


Bosch Chassis Systems India Pvt. ltd., Chakan


Bosch Chassis Systems India Pvt. ltd., Chakan


Conductor Core Technologies India Pvt. Ltd., Khed, Pune

# Renewable energy club (REC)

**Prof. K. S. Gadgil - coordinator**

The department of electrical engineering established the **Renewable energy club (REC)** in 2007 under the guidance of the then HOD Mrs. M. H. Dhend. The club was initially funded by **MEDA (Maharashtra Energy Development Agency)** and MNRE (Ministry of New and Renewable energy sources).

The club was established to enhance the knowledge of students about renewable energy sources and carry out various activities like energy conservation drives, poster competitions, quizzes, slogan competitions etc.

The students of the department carry out energy conservation drives and also celebrates Akshay Urja diwas on 20th August every year.

This A. Y. 2022-23 the Department had invited our Alumni Ms. Poonam Kothari who gave a seminar on “Opportunities in Renewable Energy”.

| | |
|---|---|
| 21/08/2023 | Akshay Urja Diwas<br>Celebration Seminar On “Career Opportunities in The Energy Sector” |
| 14/12/2023 | Energy Conservation Day<br>A Short Video Making Contest on CONSERVE TO PRESERVE |

# Electrical Engineering Students' Association (EESA)

**Mrs. V. P. Kuralkar – Faculty coordinator**
**Pratik Gadre – EESA President**

EESA provides platform for the development of all rounded individuals through co-curricular and extra-curricular activities and which positively impact students' emotional, intellectual, social, and inter-personal development. EESA not only renders forum for students to approach real world tasks but also develop innovative, socially responsible Engineers with High Human Values.

**Selection Process**

In Electrical Department SE, TE, BE students are members of Electrical Engineering Students' Association. Students nominate themselves for various post of the EESA committee. Under the guidance of Head of the Department, Senior Faculties & EESA coordinator, interview rounds are conducted for various posts of EESA committee to select committee members and further they execute Cultural, Technical & Sports activities throughout the academic year.

| EESA Committee Role |
|---|
| General Secretory |
| Joint General Secretory |
| Treasurer |
| Technical Head |
| EESA Event Coordinator |
| Renewable Energy Club Coordinator |
| Sports Secretary |
| Executive Members Sports Section |
| T and P Coordinator |
| Study Circle Coordinator |
| Library In-charge Study Circle Coordinator |
| Cultural Event Coordinator |

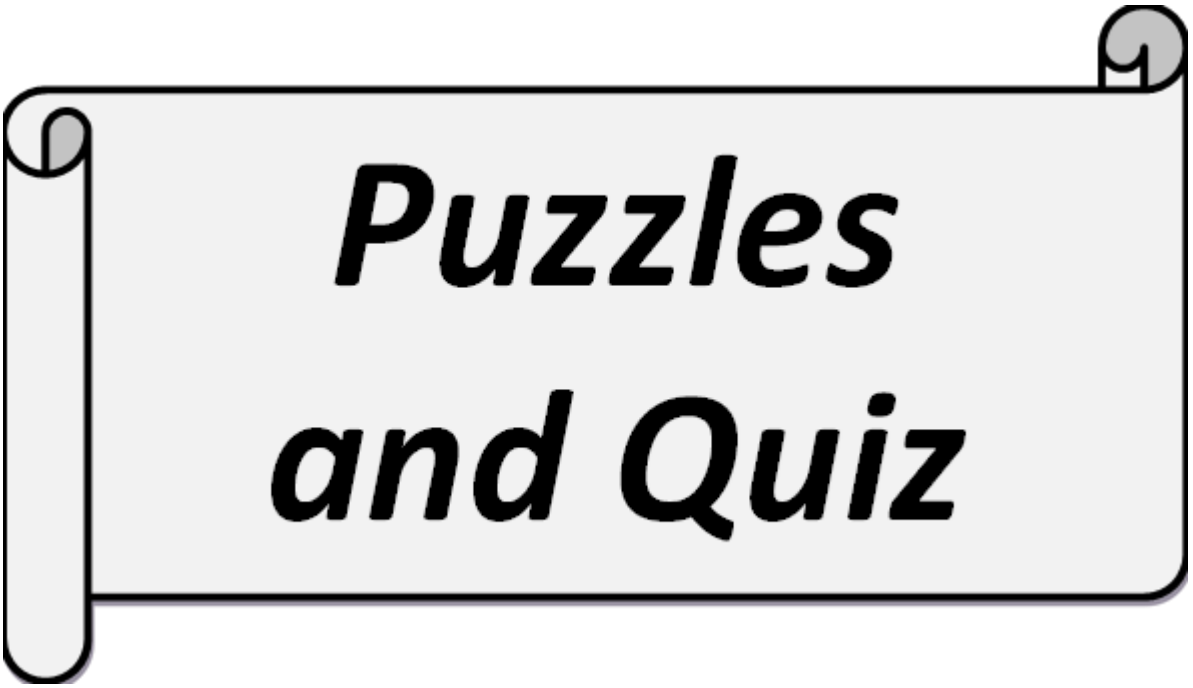
By working together with other individuals, students learn to negotiate, communicate, manage conflict, and lead others. Taking part in these out-of-the-classroom extracurricular and co-curricular activities helps students to understand the importance of critical thinking skills, time management, and academic and intellectual competence.

Each year EESA receives overwhelming response for social activities such as Tree Plantation, Social awareness drive, Food-clothing Donation campaign, Blood Donation Drive, Fort-Hill cleanliness drive.

The Enthusia event held at AISSMS Institute of Information Technology (IOIT) on September 25th and 26th,2023, marked a vibrant and dynamic celebration of talent and innovation. Under the esteemed leadership of Dr. P.B. Mane, the Principal of AISSMS IOIT, the event commenced with an inaugural ceremony that set the tone for two days of engaging activities.

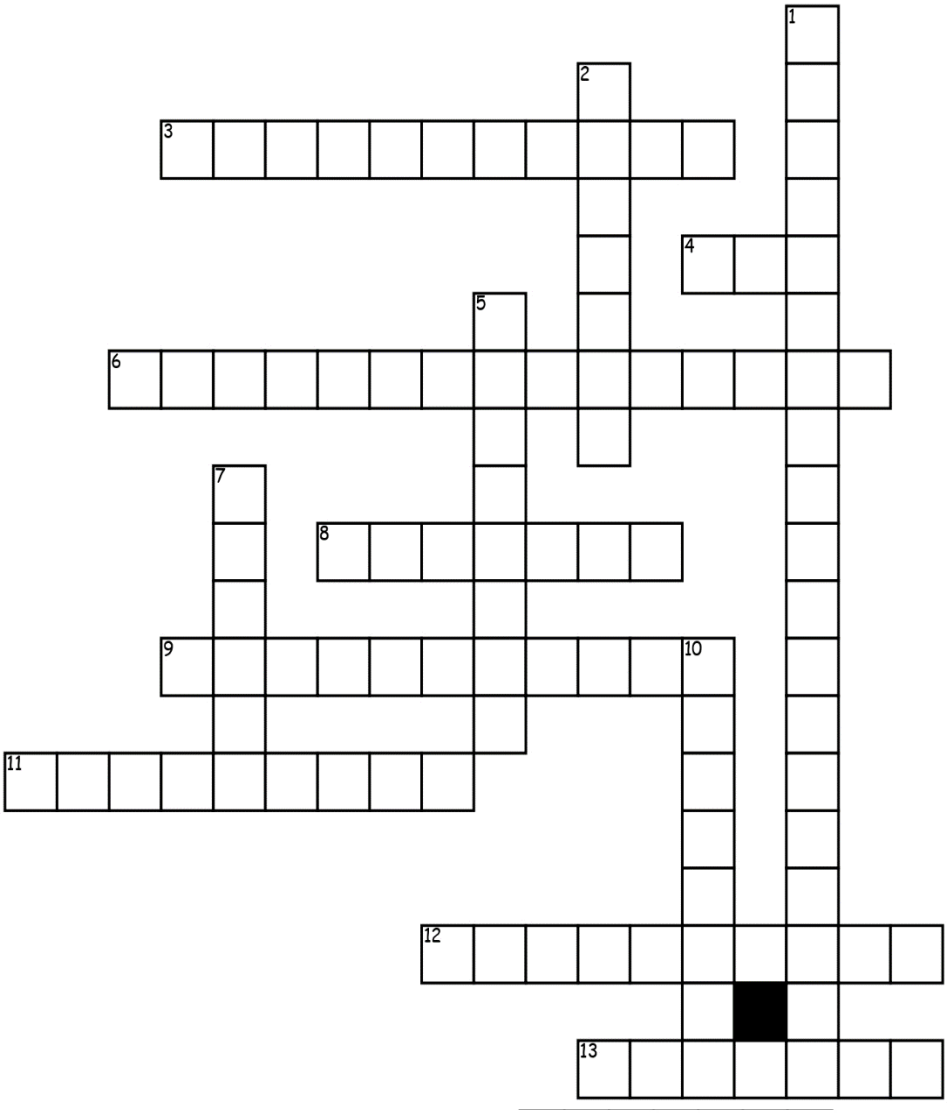
The event encompassed diverse domains, including cultural, technical, and training and placement departments, reflecting the holistic development focus of the institution. Participants and attendees were treated to a spectrum of activities, ranging from cultural performances that showcased the artistic prowess of the students to technical competitions that demonstrated their innovative and problem-solving skills.

The report will delve into the specifics of each department's contributions, highlighting the notable achievements and showcasing the collaborative spirit that defined Enthusia 2023.


Puzzles
and Quiz

# Cross word Puzzle - Electricity

**Mrs. S. M. Shaikh**




**Across**

**3.** a form of energy resulting from the existence of charged particles

**4.** an atom or molecule with a net electric charge due to the loss or gain of one or more electrons

**6.** a closed circuit in which the current divides into two or more paths before recombining to complete the circuit

**8.** an electromotive force or potential difference expressed in volts

**9.** A device used to transfer electrical energy from one circuit to another

**11.** a force that acts at a distance due to a magnetic field

**12.** a hindrance to the flow of a charge

**13.** a flow of electric charge

**Down**

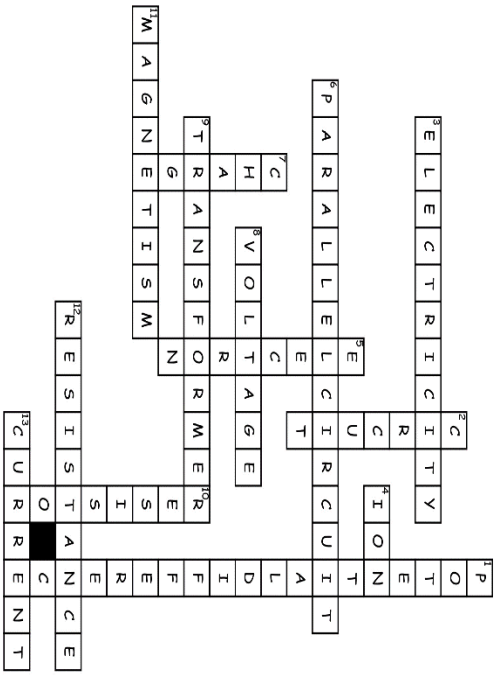
**1.** the difference of electrical potential between two points

**2.** the complete path around which an electric current flows

**5.** a stable subatomic particle that is found in atoms with a charge of negative electricity

**7.** is a characteristic of a unit of matter that expresses the extent to which it has more or fewer electrons than protons

**10.** an electronic component that is designed to offer a desired amount of resistance to the flow



# Technical Activities Glimpses

# GLIMPS OF THE ACTIVITIES

## INDUSTRY INSTITUTE INTERACTION

Industrial visit to Rasta Peth 25/10/2023


Industrial visit to Rastapeth 25/10/2023


Industrial visit to Proexcel Systems 16/8/2023


Pune Auto Expo 19/04/2024

## WORKSHOPS

PLC and SCADA workshop 10/10/2023 to 14/10/2023


IPR Workshop session conducted by Mr. Avinash Lavnis 27/10/2023


Electrical Safety & Literacy Exhibition at Mumbai 28/02/2024


Electrofunda 25/04/2024

**EXPERT LECTURE**



Group photo with the alumnus Mr.Alok Kumar 12/09/2023

**********

ACADEMIC YEAR :

# 2023-2024

## Magazine Editor

**Student Editor:**

Prisha Jagdale
(Student-T. E. Electrical)

**Faculty Editor:**

Mr. Sandip Raste
(Assistant Professor)