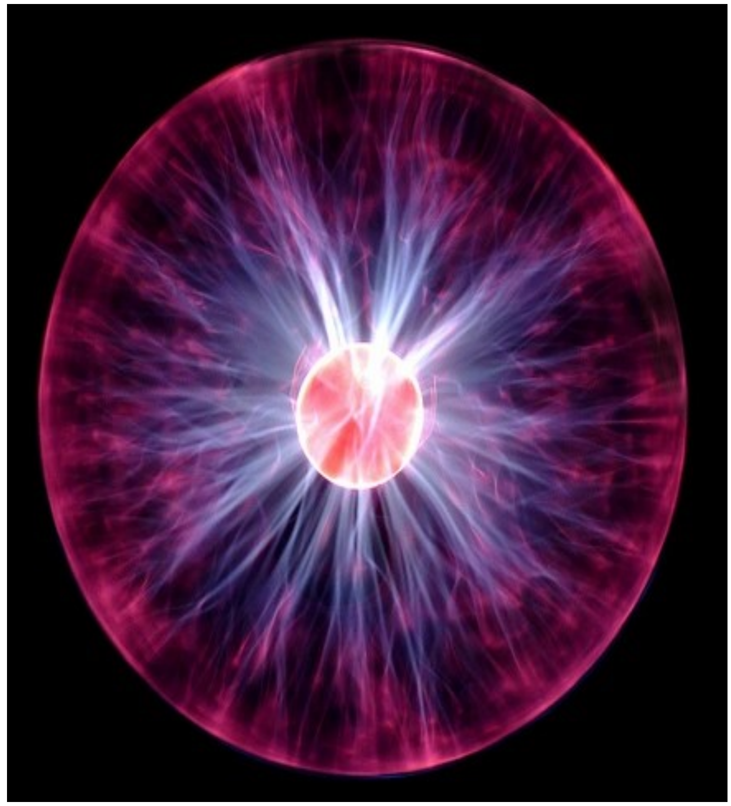
Academic Year : 2022- 2023



ELECTROSPHERE

---- A Technical Magazine

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

Volume VI

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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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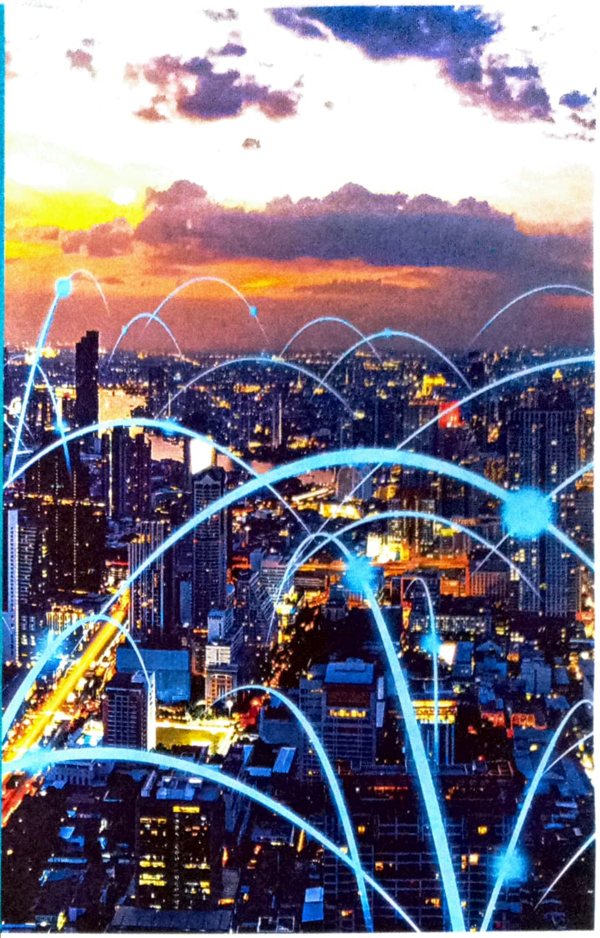
Mr. S S. Shingare	Mr. V.S. Kamble	Mrs. S.S. Landge	Mr. S.M. Shaikh
			
Mrs. V.P. Kuralkar	Mr. P.P. Mahajan	Mr. S.D. Raste	Mr. Y.D. Rashinkar

Electrical Department Faculty Members

Technical Articles

IOT enabled VIRTUAL ENERGY METERS



With the advent of information technology, the microprocessor based energy meters (which are three phase numeric meters) have been provided at the electrical installations of HT/LT consumers and transmission & distribution utilities. These meters generally work as billing meters. However, these meters are physical in nature and therefore location specific. The utility engineers have to visit these installations personally on number of occasions such as meter reading , resetting of maximum demand and routine testing. Now, with the advent of Internet of Things (IoT) technology, the virtual energy meters have been developed. These meters are location in-specific and can be accessed from any location in the world. The virtual energy meters can be made available on desktop computers, laptops and mobile phones. In this article, the working principle, applications and pros & cons of virtual energy meters have been discussed. The probability of hacking of metering data can not be ignored. For this reason, the implementation of cyber security using cryptography is discussed in this paper.

Introduction to iot technology

IoT is the system of interconnected devices connected to internet. It is a platform that enables us to connect embedded systems, smart sensors and devices to the internet for exchange of data. Take the example of smart home, wherein we can connect air conditioner, door lock and home appliances to the internet. Before we enter the house from far end we switch on the air conditioner so that the home would be cool by the time we reach there. The lock is opened automatically when we enter house. Even the key is not required to open the door. How this happens? The air conditioner, lock, home appliances and our mobile phone are connected to the same platform through internet. The figure illustrates basic working of IoT systems.

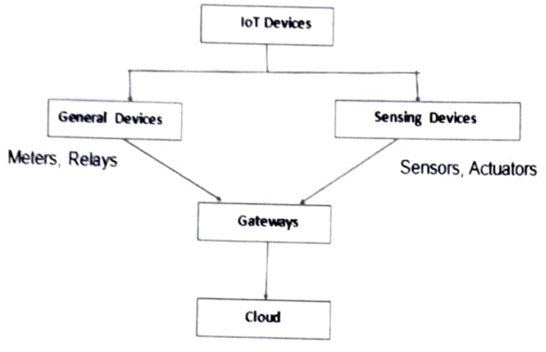


Fig - Basic working IoT System

The IoT devices are broadly categorized as general devices and sensing devices. The general devices are meters, relays, air conditioners, TV, Fridge etc. The sensing devices are basically senors and actuators. The sensing devices perform measurement of certain parameters as as temperature, pressure, humidity etc. The IoT devices are connected to internet through gateways as shown in figure. For example, the air conditioner is a general device. In order to make it ON, the commend given by the user through his mobile phone or laptop is sent to cloud and then to gateway. From gateway the command to switch on air conditioner is given to the sensor/actuator. Accordingly the air conditioner would be switched on.

Number of such IoT devices are provided at electrical installations. Here are few examples-

1. The virtual energy meters have been established by providing IoT sensors at numeric meters at electrical installations. This is explained in details in this article.
2. The parameters such temperature, humidity and pressure are required to be monitored for smooth working of transformer. It is monitored that the temperature of oil and windings do not cross the permissible limits. It is often monitored whether the moisture has entered the transformer tank. The pressure of the oil is required to be checked to check whether the gases are dissolved in transformer oil. Using IoT sensors, these parameters are regularly monitored.
3. The Nitrogen injection system provided at transformers for protection against fire hazards is equipped with IoT based temperature sensors. In the event of fire hazards, quick operation of quench fire will be initiated.

Conventional Physical energy meters

The figure shows a functional block diagram of conventional physical energy meter.

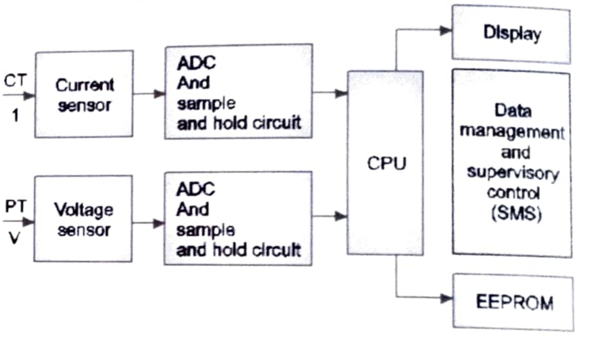


Fig - Functional block diagram of numeric meter

The figure shows functional details of a smart meter which is a conventional physical meter. It works on the principle of sampling. The meter comprises of main components such as sensors, sample and hold circuit, Analog to Digital Convector (ADC), processor (CPU) etc. The input signals are current and voltage which are drawn from secondary side of instrument transformers (CT and PT). These signals are chopped into number of pieces called samples. The sampled signals are analogue signals and converted to digital signals by ADC. The output of ADC is given to the processor shown as CPU in the diagram. The processor calculates the parameters such as RMS Voltage (Vrms), RMS Current (Irms), Power (W), Power factor and Energies (kWh and kVARh). The basic parameters are current, voltage and power whereas the derived parameters are power factor, energies and demand. These outputs processed by CPU are sent to Display unit (after Digital to Analog Conversion), HMI, SCADA & SMS and storage systems.

Iot based virtual energy meters

The physical meters are installed at number of electrical installations of consumer and utility. Now in the advent of IoT technology, the virtual energy meters have been developed. The meter parameters can be monitored on computers or mobile phones.

The concept of working of virtual energy meters has been emerged after evolution of IoT technology .The design of virtual meter is based mainly on IoT technology and TCP/IP protocols. The IoT sensors are provided at conventional meters . The data communication takes place from IoT sensors to the monitoring station where the server is installed. This meter data is received at server and it is then sent to other terminals such as laptop, mobile phones etc. The communication takes place through the Internet media. The advantage of virtual energy meter over conventional physical meter is that the virtual meter can be read anywhere in the world. Secondly, the cost of virtual meter is lesser. Moreover the report generation is quick and simple. Figure shows a load curve by the virtual meter pertaining to 33 kV City Feeder emanating from 220 kV substation.

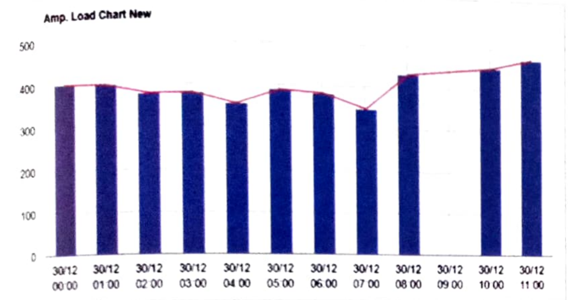


Fig Load Curve Generated by Virtual Meter

The data communication from IoT sensors to Monitoring Station takes place in the following manner.

1. The working of virtual meter is based on client-server based communication. The journey of information starts from monitoring station which acts as a server It sends start command to the client which is situated as IoT sensors at electrical installations. On receipt of start command, the client starts sending data to the server. The monitoring station may be thousands of kilometers away from the electrical installation. The data communication takes place through internet media and TCP/IP protocol. The addressing is analogues to the postal system. The letter (data) is send to the receiver(i.e. Monitoring server) through his postal address (IP Address).
2. IP address is a dot quad address specified in 123.45.67.89 format. Each component of the network is having a unique IP address. For example, data center, router, computer, mobile phone, meter have different IP addresses. The IP address is allocated by the agency called Internet Service Provider (ISP). Thus IP address is a shipping address at which the information reaches its destination. The server stores number of websites. Therefore it is possible to have access to the website through IP address of a server.
3. It is difficult to remember IP address of every entity. This problem is sorted by providing domain name which is easy to remember. The IP address the corresponds to domain name. For example, the domain name and IP address of some services are given below in a table-

Table Domain name & Ip address

Name of service	Role	Domain name	IP address
33KV City feeder	Client	city33kv.com	218.62.123.138
Monitoring station	Server	cmsserver.com	46.120.144.27

4. DNS Server – DNS Server is a huge phone book. The DNS server is similar to telephone directory comprising of domain name and corresponding IP address. The overall procedure is as follows- a. the user enters domain name. b. the DNS Server finds corresponding IP address. c. After getting IP address, the web browser sends data request to the monitoring station.
5. The data comprises of huge information in form of zeros and ones. This data is divided into number of packets. The size of each packet is 6 bits. Each packet is assigned an IP address. This is analogous to the postal envelop having address and sequence number. Each packet takes its path in a network to reach user. Once received, all the packets are reassembled as per sequence number. In case some packet is not received, the request is send by receiving end to resend the same.
6. The transmission of packets is based on rules of communication called protocols. Some main protocols are TCP/IP (For data transport), http/https (For web access) and RTP (for live video streaming and VOIP calls) . The virtual meters use TCP/IP communication protocols.

The Table shows virtual meter data taken on 33 kV City feeder. It shows limited parameters viz. date, time current, real & reactive power and import & export energies.

Table Virtual Meter Data

DtTm	Amp	Mw	Mvar	MwhI	MwhE
30/12 00:01	399.6	22.87	2.14	514481.44	0.03
30/12 01:01	397.8	22.70	1.96	514504.44	0.03
30/12 02:01	378.4	21.75	1.53	514526.63	0.03
30/12 03:01	380.0	21.87	1.65	514548.91	0.03
30/12 04:01	355.4	20.49	1.26	514570.66	0.03
30/12 05:01	389.6	22.34	1.51	514592.22	0.03
30/12 06:01	382.9	21.51	0.90	514614.44	0.03
30/12 07:01	348.4	19.49	0.42	514635.56	0.03
30/12 08:01	433.1	24.14	2.29	514658.09	0.03
30/12 10:00	452.7	24.95	3.63	514707.56	0.03
30/12 11:00	476.0	25.57	3.66	514732.78	0.03

Comparison between physical meters and virtual meters

The comparison between conventional physical energy meter and virtual energy meter is furnished in the following table.

Particulars	Physical Energy Meter	Virtual Energy meter
Principle of working	Sampling	Sampling
State of existence	Physical existence as panel mounted, rack mounted or box/ cubicle mounted.	Virtual existence on desktop computers, laptops or mobile phones.
Mode of data communication	Wired and wireless	Wireless
Billing of energy	Used as a billing meter	Used as a back up meter
Meter testing	Routine meter tests are conducted such as dial test, accuracy test and load test.	Meter testing is not conducted.
Location	Location specific. Location is fixed at electrical installation. This location is called metering point.	Location in-specific. The meter can be accessed from any location in the world.
Cost	More	Lesser

Cyber security using Cryptography

Unauthorized data capturing and forging is one of the major issues to be dealt by system developers. Cryptography can be used as major tool for maintaining cyber security. Cryptography is a technique based on encryption and decryption of data.

Cryptography is the method by which the data communication is performed using coded messages. The process of cryptography involves data encryption (coding) at sending end and decryption (decoding) at receiving end [basic process of cryptography is illustrated in Fig.

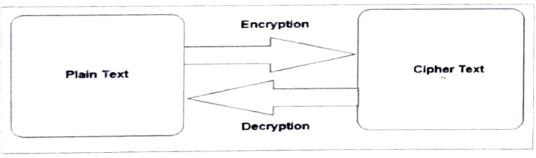


Fig Basic model of cryptography

The plain text is readable and understood by all users. Cipher is the message obtained after applying encryption. Therefore it is also called encrypted message.

The modern cryptography comes with significant features such as layers of encryption, operation on bit sequences, use of mathematical algorithms for data security and secure communication channel to achieve privacy. In multiple encryption or double end encryption, the already encrypted text is encrypted one or more times. Hybrid cryptography is the process wherein multiple ciphers are used .

See the figure below. In addition to the normal transformation of message from sender to receiver, the figure also shows possible threats of attack from the miscreant. There may be active or passive attack. During an active attack, the intruder forges the data and sends it to the receiver. As shown in figure the altered Cipher text is decrypt and sent to the receiver. In case of passive attack, the data is stolen. No forgery is made. Compared to active attack, the passive attack can not be detected easily. Active attack is more destructive, but can be detected easily and quickly.

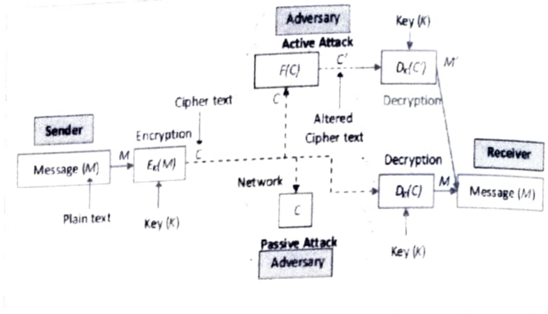


Fig Active and passive attacks

Conclusion

With the advent of IoT technology, the virtual energy meters have been developed. The minimum requirements for virtual meters are internet connection and TCP/IP protocols. The virtual energy meters offer significant features compared to conventional physical meters, such as low cost, monitoring from any location in the world and availability on handy equipments such as laptops and mobile phones .The data displayed by virtual meters is usually considered as a back up data. In a normal practice, the electricity bills are generated from physical meters. In case of unavailability of physical meters, the billing may be done on basis of virtual meters. However, the virtual meters are not considered to be a replacement against the conventional physical meters. Both the metering systems would coexist. The virtual energy meters would be a vital component in upcoming smart grids and micro grids. The issue of unauthorized data capturing and forging is required to be dealt by system engineers. The cryptography is a major tool for maintaining cyber security.

Acknowledgments

The authors desire to acknowledge the support received from Mr. Shamkant Vasekar, Ex. Superintending Engineer. Maharashtra State Electricity Transmission Co. Ltd., Mumbai and M/s Akshara Computer Center, Aurangabad, while writing this article ■

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Powering the Future: Electric Vehicle Battery Technology

Mr. Om Chaudhari

In recent years, the need for electric vehicles (EVs) has grown exponentially as societies around the world confront the challenges of climate change and environmental degradation. With their numerous benefits, EVs are emerging as a crucial solution to reduce greenhouse gas emissions, improve air quality, and foster a sustainable future.

Electric vehicle (EV) batteries are essential for powering electric vehicles by supplying the energy needed for movement. These batteries, usually based on lithium-ion technology, have a high energy density and are dependable. They are designed as packs of multiple lithium-ion cells connected together. Most electric vehicles use lithium-ion batteries and take advantage of regenerative braking, which both slows down the vehicle and generates electricity simultaneously.

The types of EVs that use batteries include:

All-electric vehicles, also known as battery electric vehicles (BEVs), are completely powered by electricity. To recharge, the vehicle can be plugged into a wall outlet or charger.

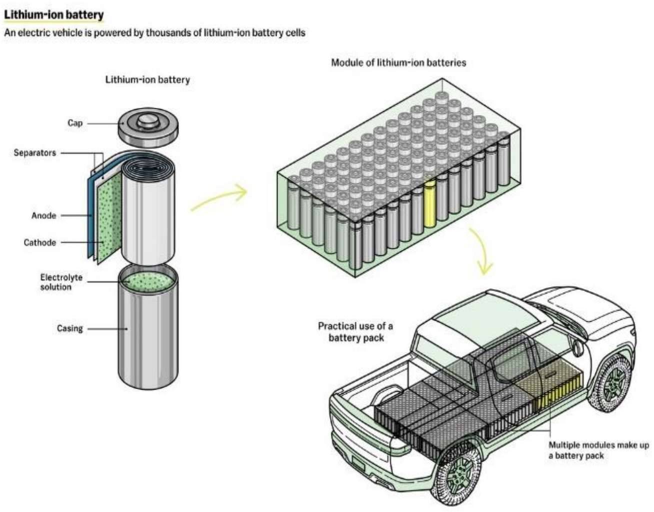
Plug-in hybrid electric vehicles (PHEVs) are powered by both electricity and an internal combustion engine (ICE). Unlike older hybrid electric vehicles, PHEVs can be operated on electricity alone. The gas-powered engine is available for longer trips when charging is unavailable.

Hybrid electric vehicles (HEVs), like PHEVs, are powered by electricity and an ICE. However, an HEV cannot be plugged in to charge the battery. Since they cannot operate on electricity alone, they are not nearly as efficient as BEVs and PHEVs.

There are several types of lithium-ion batteries, with lithium nickel manganese cobalt oxide (NMC) and lithium iron phosphate (LFP) batteries being the most common ones used in EVs.

Why are lithium-ion batteries used in EVs?

EVs use lithium-ion batteries because they have some great advantages. They can store a lot of energy in a small and light package compared to other batteries. They work well in both hot and cold temperatures and won't get damaged easily. They don't lose their energy quickly when not in use, so they hold their charge for a long time. They can be charged and discharged many times without losing much of their capacity.



How do lithium-ion batteries work?

lithium-ion batteries are made up of four main parts:

1. The cathode - the positive electrode
2. The anode - the negative electrode
3. The electrolyte - a liquid that allows the lithium ions to flow between the anode and cathode
4. A separator - which physically separates the anode and cathode so that only lithium-ions can pass through.

When your electric vehicle car battery is charging, lithium-ions move from the cathode (positive) through the electrolyte and onto the anode (negative), where they're stored until they're needed. When you drive your EV, the process reverses, with the lithium-ions moving back from the anode and across the electrolyte to the cathode positive. That produces the electricity that powers the EV's motor and off you go.

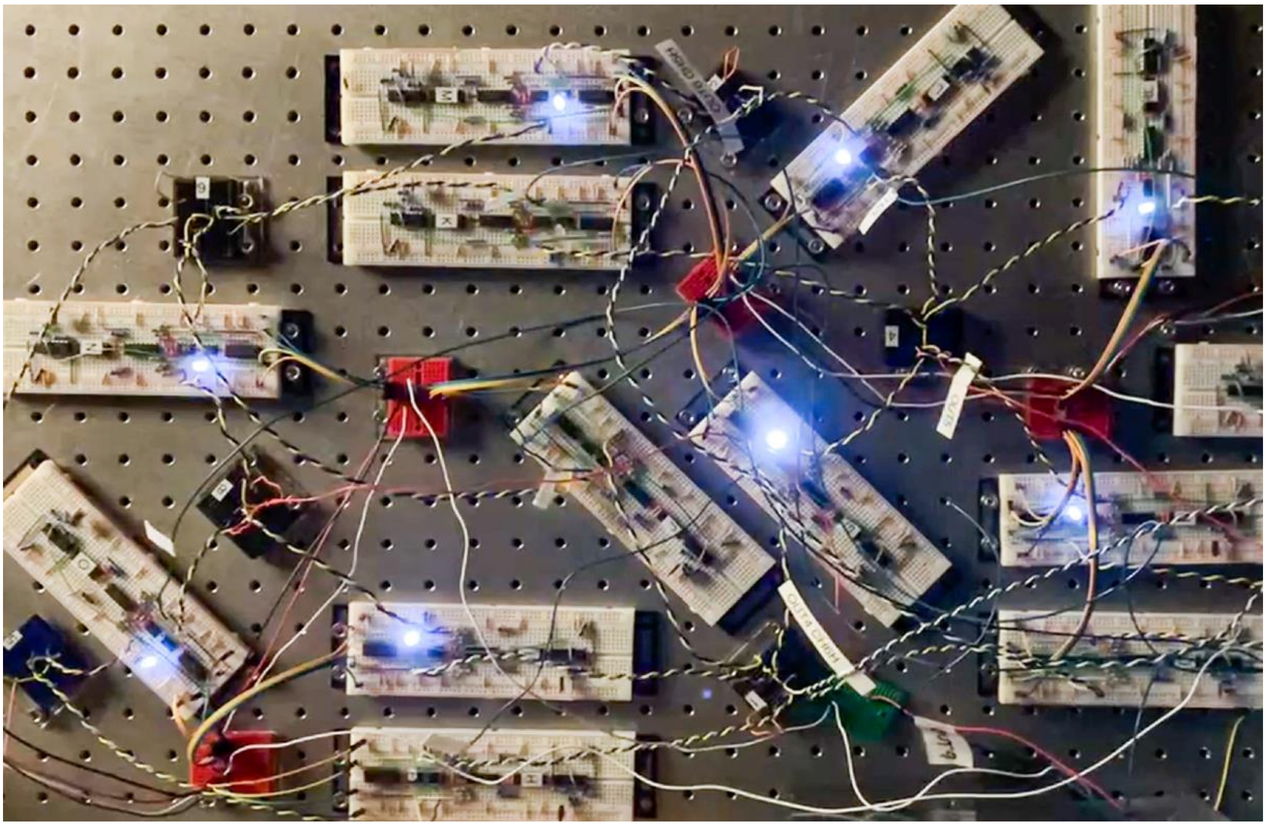
Currently, the electrolyte used in Li-ion batteries is a liquid compound consisting of lithium salts. Several carmakers are currently researching the use of solid-state electrolytes rather than liquid, which could give electric vehicles a range of up to 900 miles on a single charge.

The future of electric vehicle (EV) batteries looks bright, with ongoing aim to make them better in various ways. Researchers are working on improving the amount of energy they can store, how quickly they can be charged, and how environmentally friendly they are. They are exploring new materials and designs to create batteries that can store more energy, so EVs can drive longer distances and be charged faster. One exciting development is solid-state batteries, which are safer, store more energy, and last longer than traditional lithium-ion batteries. These improvements will not only make more people choose EVs but also help make transportation cleaner and more sustainable.

Simple electrical circuit learns on its own with no help from a computer

Prof. Y. D. Rashinkar

System sidesteps computing bottleneck in tuning artificial intelligence algorithms



A simple electrical circuit has learned to recognize flowers based on their petal size. That may seem trivial compared with artificial intelligence (AI) systems that recognize faces in a crowd, transcribe spoken words into text, and perform other astounding feats. However, the tiny circuit outshines conventional machine learning systems in one key way: It teaches itself without any help from a computer—akin to a living brain. The result demonstrates one way to avoid the massive amount of computation typically required to tune an AI system, an issue that could become more of a roadblock as such programs grow increasingly complex.

"It's a proof of principle," says Samuel Dillavou, a physicist at the University of Pennsylvania who presented the work here this week at the annual March meeting of the American Physical Society. "We are learning something about learning."

Currently, the standard tool for machine learning is the artificial neural network. Such networks typically only exist in a computer's memory—although some researchers have found ways to embody them in everyday objects. A neural network consists of points or nodes, each of which can take a value ranging from 0 to 1, connected by lines or edges. Each edge is weighted depending on how correlated or anticorrelated the two nodes are.

The nodes are arranged in layers, with the first layer taking the inputs and the last layer producing the outputs. For example, the first layer might take as inputs the color of the pixels in black and white photos. The output layer might consist of a single node that yields a 0 if the picture is of a cat and a 1 if it is of a dog.

To teach the system, developers typically expose it to a set of training pictures and adjust the weights of the edges to get the right output. It's a daunting optimization problem that grows dramatically more complex with the size of the network, and it requires substantial computer processing distinct from the neural network itself. Making matters more difficult, all of the edges across the entire network must be tuned simultaneously rather than one after another. To get around this problem, physicists have been looking for physical systems that can efficiently tune themselves without the external computation.

Now, Dillavou and colleagues have developed a system that can do just that. They assembled a small network by randomly wiring together 16 common electrical components called adjustable resistors, like so many pipe cleaners. Each resistor serves as an edge in the network, and the nodes are the junctions where the resistors' leads meet. To use the network, the researchers set voltages for certain input nodes, and read out the voltages of output nodes. By adjusting the resistors, the automated network learned to produce the desired outputs for a given set of inputs.

To train the system with a minimal amount of computing and memory, the researchers actually built two identical networks on top of each other. In the "clamped" network, they fed in the input voltages and fixed the output voltage to the value they wanted. In the "free" network, they fixed just the input voltage and then let all the other voltages float to whatever value they would, which generally gave the wrong voltage at the output.

The system then adjusted resistances in the two networks according to a simple rule that depended on whether the voltage difference across a resistor in the clamped network was bigger or smaller than the voltage difference across the corresponding resistor in the free network. After several iterations, those adjustments brought all voltages at all the nodes in the two networks into agreement and trained both networks to give the right output for a given input.

Crucially, that tuning requires very little computation. The system only needs to compare the voltage drop across corresponding resistors in the clamped and free networks, using a relatively simple electrical widget called a comparator, Dillavou says.

The network was tuned to perform a variety of simple AI tasks, Dillavou reported at the meeting. For example, it could distinguish with greater than 95% accuracy between three species of iris depending on four physical measurements of a flower: the lengths and widths of its petals and sepals—the leaves just below the blossom. That's a canonical AI test that uses a standard catalog of 150 sets of measurements, 30 of which were used to train the network, Dillavou says.

It seems unlikely that the resistor network will ever replace standard neural networks, however. For one thing, its response to different inputs likely has to vary more dramatically if the resistor network is to match an artificial neural network's ability to make fine distinctions Dillavou says

But Jason Rocks, a physicist at Boston University, says it's not out of the question that the idea might have some technological utility. "If it's made out of electrical components then you should be able to scale it down to a microchip," he says. "I think that's where they're going with this."

Automation of Sowing Process in Agriculture

Prof. S. S. Shingare

Now a days it is important to save time with savings of money with increased production and efficiency. With conventional techniques used in agriculture field, it is almost impossible to achieve all the above constraints in a single attempt. Also conventional methods require more efforts to complete an agricultural task. The more things to take in account is that, it is difficult to work in farm with several atmospheric conditions which are not good to work in.

The basic objective of sow in operation is to put the seed and fertilizer in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide proper compaction over the seed. The recommended row to row spacing seed rate, seed to seed spacing and depth of seed placement vary from crop to crop and for different agro-climatic conditions to achieve optimum yields.

With conventional techniques used in agriculture field, it is almost impossible to achieve all the above constraints in a single attempt. Also conventional methods require more efforts to complete an agricultural task. The more things to take in account is that, it is difficult to work in farm with several atmospheric conditions

Introduction:

we prefer automation of sowing machine for overcome some disadvantages of conventional sowing process. [5]

i. In manual seeding, it is not possible to achieve uniformity in distribution of seeds. A farmer may sow at desired seed rate but inter-row and intra-row distribution of seeds is likely to be uneven resulting in bunching and gaps in field.

ii. Poor control over depth of seed placement.

iii. It is necessary to sow at high seed rates and bring the plant population to desired level by thinning.

iv. Labour requirement is high because two persons are required for dropping seed and fertilizer.

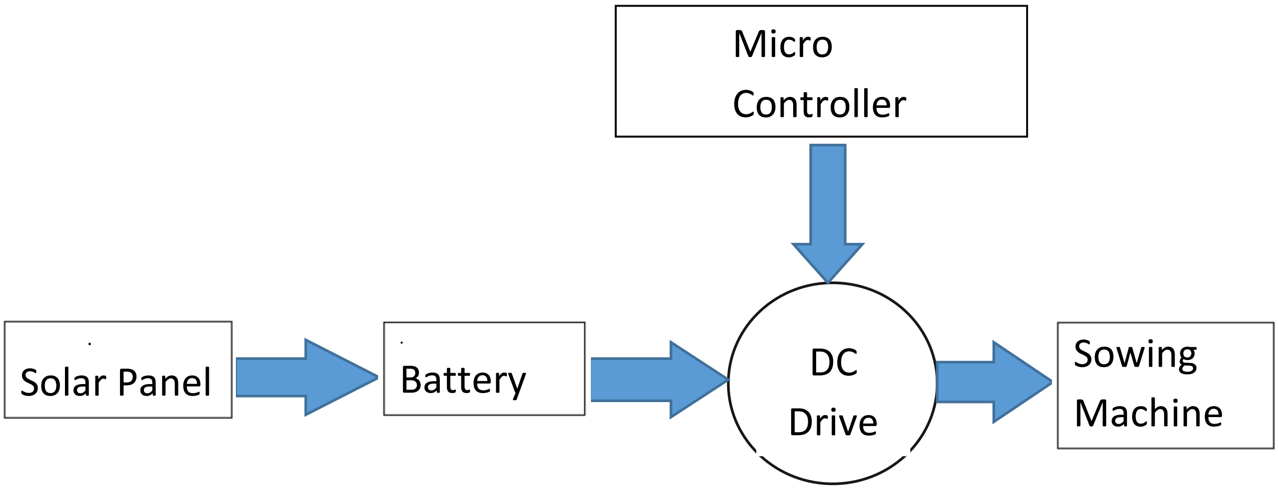
v. The effect of inaccuracies in seed placement on plant stand is greater in case of crops sown under dry farming conditions.

vi. During kharif sowing, placement of seeds at uneven depth may result in poor emergence because subsequent rains bring additional soil cover over the seed and affect plant emergence.

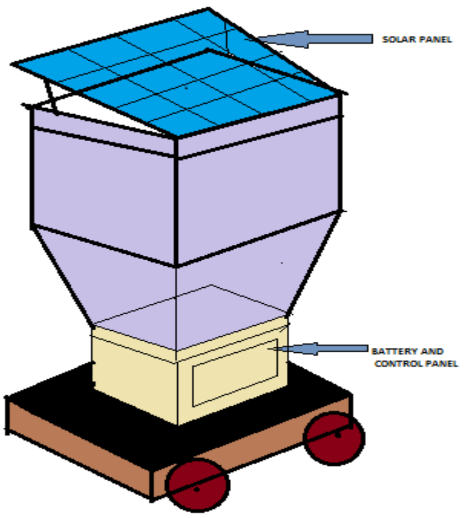
Factors Affecting Seed Germination and Emergence

Conventional method can damage the seed in following ways

1. Uniformity of depth of placement of seed.
2. Uniformity of distribution of seed along rows.
3. Transverse displacement of seed from the row.
4. Prevention of loose soil getting under the seed.
5. Degree of soil compaction above the seed.
6. Uniformity of soil cover over the seed; and
7. Mixing of fertilizer with seed during placement in the furrow.



Block diagram of Sowing Machine



Future of Electric Vehicles in India

Prof. K. S. Gadgil

Electric Vehicles are a boon to India in the sense of Economy development and Environment Concerns. Moreover, in the upcoming generations, India will be moving forward to overpower the Electric Vehicles. In this article , we will be understanding the 'Future of Electric Vehicles in India'.

What is an Electric Vehicle?

An electric vehicle (EV) is one that runs on electricity rather than an internal-combustion engine, which creates power by burning a mixture of fuel and gasses.

As a result, such a vehicle is being considered as a possible replacement for current-generation vehicles in order to address challenges such as rising pollution, global warming, diminishing natural resources, and so on.

Though the concept of electric vehicles has been around for a long time, it has gotten a lot of attention in in order to address challenges such as rising pollution, global warming, diminishing natural resources, and so on.

Though the concept of electric vehicles has been around for a long time, it has gotten a lot of attention in the recent decade due to the increasing carbon footprints and other environmental repercussions of fuel-based vehicles.

Why Electric Vehicles are Boon to India?

The discussion over whether e-vehicles are beneficial or harmful for India does not need many conclusive factors.

Facts

- India has six of the world's ten most polluted cities. The main cause of this growth in pollution is the use of fossil fuels. Almost all vehicles in India, including two-wheelers, four-wheelers, and trains in some places, operate on fossil fuels.
- India's Oil Import-overall India's dependency on crude oil imports is 86%, which implies the country meets just 14% of its own energy needs; the rest is imported. However, these imports need the use of US dollars, resulting in a reduction in the Indian Forex Reserve.
- Global Climate Change, Heat Emissions, the Paris Climate Accord, and the impact of sophisticated Artificial Technology on Self-Driving Cars are all discussed. E-vehicles are definitely the next transportation revolution.

All of these considerations support the transition from fossil fuels to electric automobiles. All developed countries are already transitioning to electric automobiles.

Electric Vehicles Future in India

Most Indian buyers believe that an electric vehicle will be ready by 2023, but the majority also believe that it would no longer be available until 2025. Consumers in India are looking for a lower price for EVs than those in other countries, with the global average tipping price for EVs being $36,000. (around Rs27 lakh).

The cost of lithium-ion batteries is roughly $250/kWh globally, which translates to approximately Rs5.7 lakh in battery prices alone. Currently, lithium-ion batteries account for half of the cost of an electric vehicle, making them more expensive than conventional vehicles.

The safety of the batteries against explosion serves as a stumbling block for Li-ion batteries. Charging is a significant barrier for EVs in India, and a lack of charging stations may also be considered, rendering them impracticable or significantly less feasible for long-distance rides.

Furthermore, some EVs are slower than standard gas-powered engines.

At a critical moment, as many nations are working to free Mother Earth from the clutches of carbon emissions and CO2, India should take the lead by transitioning to EV mobility, making the country a greener and cleaner ecosystem.

Electric Vehicles Market Share in India

The Indian automobile industry is the world's fifth biggest, and it is anticipated to become the third largest by 2030. According to the India Energy Storage Alliance (IESA), the Indian EV market would develop at a 36% CAGR.

As India's population grows and demand for automobiles increases, reliance on conventional energy supplies is no longer a viable option, as the country imports over 80% of its crude oil.

By 2030, NITI Aayog expects to reach 70% EV market penetration for all commercial vehicles, 30% for private vehicles, 40% for buses, and 80% for two and three-wheelers. This is consistent to reach net zero carbon emissions by 2070.

The Indian electric vehicle market was worth USD 1,434.04 million in 2021, and it is predicted to grow to USD 15,397.19 million by 2027, at a CAGR of 47.09% during the forecast period (2022-2027).

In India, Uttar Pradesh had the biggest proportion of EV sales in 2021, with 66,704 units sold across all categories, followed by Karnataka with 33,302 units and Tamil Nadu with 30,036 units.

Uttar Pradesh dominated the three-wheeler category, while Karnataka and Maharashtra lead the two-wheeler and four-wheeler segments, respectively.

The projected move to electric vehicles by the Indian government will cut carbon emissions by 37% by 2030.

The EV deployment must include all sorts of automobiles on Indian roadways. Apart from carbon emissions, diesel and gasoline are deadly because they emit harmful air pollutants.

According to the World Health Organization, 13 of the top 20 worldwide cities with the worst air pollution are in India. Cities will be able to breathe easier with EVs in place. With better grid electricity, EVs looks to be a potential option for the urban environment.

State-Wise Subsidy for Electric Vehicles in India

State	Per kWh of battery capacity	Max Subsidy	Road Tax Exemption
Andhra Pradesh	No	No	100%
Delhi	Rs 5,000	Rs 30,000	100%
Maharashtra	Rs 5,000	Rs 25,000*	100%
Kerala	No	No	50%
Uttar Pradesh	No	No	100%
Odisha	NA	Rs: 5,000	100%
Assam	Rs 10,000	Rs 20,000	100%
Gujarat	Rs 10,000	Rs 20,000	50%
Bihar	Rs 10,000	Rs 20,000	100%
Meghalaya	Rs 10,000	Rs 20,000	100%
Rajasthan	Rs 2,500	Rs 10,000	NA
West Bengal	Rs 10,000	Rs 20,000	100%
Karnataka	No	No	100%
Tamilnadu	No	No	100%
Telangana	No	No	100%
Madhya Pradesh	No	No	99%
Punjab	No	No	100%

Under their rules, states like as Andhra Pradesh, Karnataka, Madhya Pradesh, Telangana, Tamil Nadu, Uttarakhand, Punjab, and Uttar Pradesh do not provide any direct subsidies to electric two-wheeler customers.

Road tax for electric cars is totally eliminated in most states where the program has been implemented, with the exception of Gujarat and Kerala, where buyers must pay 50% of the total road tax amount.

Meghalaya, Assam, Gujarat, and West Bengal provide a greater per kWh subsidy of Rs 10,000, with a total subsidy available of Rs 20,000. Bihar's EV policy, which has yet to be authorized, promises comparable advantages.

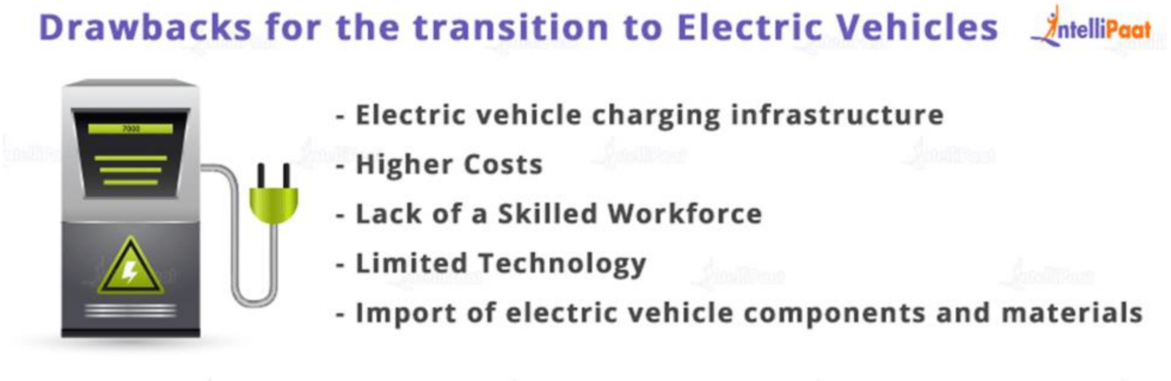
Rajasthan provides a subsidy of Rs 5,000 for two-wheelers with a battery capacity of 2 kWh and up to Rs 10,000 for those with a battery capacity of 5 kWh or above. Odisha, on the other hand, grants a Rs 5,000 fixed subsidy.

COVID-19's Impact on the Electric Vehicle Industry

During the period of COVID-19, we saw how the environment improved as a result of lower emissions from petrol and diesel-powered vehicles and industries in India. The pollution has completely disappeared in several cities.

Drawbacks for the transition to Electric Vehicles

The following problems must be addressed if we are to transition to EVs by 2030, as promised by the Government.



Electric vehicle charging infrastructure

In the current circumstance, if a person needs to go a long distance because his e-vehicle has a low charge. His options for recharging are quite limited. In India, there are around 70,000 filling stations spread among 718 districts.

A gas station may be found every 5-6 kilometers. On the other side, there is only 300 electric vehicle charging outlets. A person driving an electric car will have a difficult voyage in such a circumstance.

The government is taking measures to address this issue, but the pace is slow.

Higher Costs

Let’s say a person wishes to buy a medium automobile in India, such as a Maruti Suzuki Swift. The vehicle’s on-road pricing in the fuel form is 6-7 lakhs. Tesla’s electric automobile, on the other hand, begins at 60 lakhs in India.

India is a price-sensitive market, and the transition to e-vehicles would be sustainable only if it is inexpensive.

Lack of a Skilled Workforce

In terms of electric cars, India has a trained labor shortage. The technology is new, and prominent educational institutions are unable to adapt to the world’s developing EV technology.

Limited Technology

India has a major technological dilemma. A typical Maruti Suzuki Swift Petrol vehicle has a fuel tank capacity of 40 liters. The automobile can travel up to 600 kilometers if the mileage is 15 km per liter.

Similarly, in terms of technology, will a totally charged car go the same distance? Ather is a well-known EV manufacturer in India. According to the business, it can travel up to 120 kilometers on Indian roads on a full charge.

Import of electric vehicle components and materials

Due to a lack of technology, India must import the majority of e-vehicle supplies. The battery of an EV is quite important. At the moment, all batteries use Lithium-Ion technology.

Again, India’s lithium reserves are uncertain. As a result, India must import the majority of battery and EV electrical components from China, resulting in India’s strategic reliance on China.

Conclusion

The Future of Electric vehicles is bright and shining! Manufacturing businesses are putting more effort into transitioning from traditional automobiles to electric vehicles. There are several advantages to owning an electric car with the appropriate level of functionality and infrastructure.

Source : https://intellipaat.com/blog/future-of-electric-vehicles-in-india/#no1

The Potential Of Renewable Energy Sources In The Energy Sector In India

Prof. V. A Yawale

India became the world's third largest producer of electricity in the year 2013 and accounts for 4.8% of global share in electricity generation. But its per capita electricity consumption is only 746 kWh, which is lower compared to many countries, though electricity tariff is cheaper in India.

India became the world's third largest producer of electricity in the year 2013 and accounts for 4.8% of global share in electricity generation. But its per capita electricity consumption is only 746 kWh, which is lower compared to many countries, though electricity tariff is cheaper in India. Energy is the basic input in all sectors of the nation's economy, and the standard of living is directly related to per capita energy consumption. As the country is heavily populated, provision of adequate quantities and kinds of energy is a challenge to the government, and the institutions in the country engaged in tasks relating to energy supply and transport. The commercial energy inputs to the Indian economy are from conventional sources like coal, hydroelectricity and nuclear energy. The country currently has total installed capacity of thermal 70%, hydroelectric 16%, nuclear 2% and renewable 12%. For long-term sustainability, minimum utilisation of fossil fuel for energy and maximum utilisation of renewable energy are to be considered. At the same time, minimum losses during generation, transport and utilisation sector is also important.

Renewable sources and their potential for supplying electricity

Renewable energy is generally defined as energy that comes from resources, which are naturally replenished on their own. Renewable energy sources are all essentially based on the direct or indirect use of solar energy. The only exception is tidal energy, which essentially derives its power from the interaction between the earth and the moon.

Renewable energy can replace conventional fuels in the distinct areas like electricity generation, water heating, space heating, motor fuels, and rural energy services. The important renewable energy sources, which can be utilised for generating electricity in our country are as follows: (i) solar energy (direct): Solar thermal power and solar photovoltaic (PV) power, Solar energy (indirect), (ii) Hydroelectric power (large and small units); (iii) Wind energy (on land and offshore), (iv) Biomass power, (v) Wave energy, marine currents, and ocean thermal energy conversion (vi) Tidal energy.

Solar thermal power and PV power

Solar energy is utilised for direct thermal applications and for solar-electric applications. Solar thermal applications include water heating, space heating, drying, cooking etc. Generation of electricity is possible in solar thermal-electric power plants.

These plants use concentrating collectors to collect the sun's energy at high temperatures and use this energy to generate high-pressure steam. The steam in turn is used in a conventional Rankine cycle to generate electricity. India is ranked number one in terms of solar electricity production per watt installed. As on 30 March 2015, the installed grid connected solar power capacity is 3,383 MW, and India expects to install an additional 10,000 MW by 2017 and a total of 100,000 MW by 2022.

Photovoltaic conversions are also a direct method of utilising solar energy, which makes use of solar cells to convert solar energy directly into electrical energy. The electrical energy requirement for localised use in the remote locations all over India is estimated at about 11,000 MW – a substantial part of which is expected to come from PV systems that are not connected to the grid. These systems may be located as far as possible on rooftops, so that no land space is used. India has total installed capacity of almost 4101.68 MW grid-connected PV power systems having small capacities.
Indirect solar energy is the solar power that goes through more than one change to become in the useful form of energy. Examples of indirect solar energy are hydropower, biomass and wind energy.

Hydroelectric power

India is ranked as the 6th largest producer of hydroelectric power in the world and has great potential for hydro-electric power. Hydroelectric power projects are the largest contributors amongst renewable energy sources in our country. Apart from generating electricity, they provide water for irrigation, help in flood control and drinking water purposes.
Hydroelectric power is the generation of electric power which utilises the potential energy of water at a high level. A hydroelectric facility requires a dependable flow of water – and the water head is created by constructing a dam across the river. In a typical installation, water is fed from a reservoir through a channel or pipe into a turbine and the pressure of the flowing water on the turbine blades causes the shaft to rotate, which, in turn, is connected to an electrical generator, which converts the motion of the shaft into electrical energy.
The present installed capacity is approximately 40,661.41 MW, which is 16.36% of total electricity generation in India and small hydro power capacity is 4101MW.
India has huge hydro potential of about 84,000 MW at 60% load factor, which can be economically exploited. Almost 49 large hydropower projects are under construction in India, which will be completed by the year 2022 with a cumulative capacity of 15,006 MW.
In addition, a potential of 6,740 MW of installed capacity from small, mini and micro hydel schemes have been assessed – and pumped storage schemes with an aggregate installed capacity of 94,000 MW have been identified. Pumped storage schemes would be helpful for meeting peak load demand and storing the surplus electricity, which can also produce power at no additional cost when rivers are flooding. India has already established nearly 6,800 MW pumped storage capacity. For small units, 5,718 sites with a total capacity of 15,384 MW have been identified all over the country.

Wind energy

India has great potential of wind energy to project as an alternate source of energy. Electricity can be generated from wind power by converting the kinetic energy in the wind into mechanical energy utilising wind turbines. The energy in the wind is utilised to turn propeller shaped blades around a rotor, which when connected to the main shaft can spin a generator to produce electricity.
The power that can be extracted theoretically from wind is proportional to the cube of its velocity and the energy generated depends on wind speed and rotor size of the turbine. Wind energy is regarded as a means of saving fuel by injecting power into an electrical grid and to run wind power plant in conjunction with a pumped storage plant. Wind power has application to rotate machinery to do physical work, such as crushing grain or pumping water and has application to desalinate water.

The estimation of the potential wind resources in India is 102,788 MW assessed at 80m Hub height. The installed capacity of wind power in India was 22,645 MW as of 30 March 2015. The target set for wind power generation capacity is 60,000 MW by the year 2022. The preliminary assessments along the 7,600 km long Indian coastline have indicated prospects of development of offshore wind power as the wind speeds offshore are usually higher and steadier.

Energy from biomass

Biomass energy has been an important alternate energy source for the countryand more than 70% of the country’s population depends on biomass for energy needs. It is renewable, widely available, and free from greenhouse gases. Biomass is biological material derived from agricultural and forest resources including plant and animal manure. As an energy source, biomass can be used directly via combustion to produce heat. Indirectly, biomass can be converted into forms of bio fuel, like ethanol and methanol, to be used in engines; gaseous fuel called biogas can be obtained from biomass by anaerobic fermentation.

Biomass fuels can be most efficiently used when generating both power and heat through a combined heat and power (or cogeneration) system. A total of 288 biomass power and cogeneration projects with 2,665 MW capacity have been installed in the country for feeding power to the grid. Bagasse cogeneration projects in sugar mills have capacity aggregating to 1,666 MW. A target of 10,000 MW has set for biomass energy till 2022.

Wave energy

Wave energy is indirectly derived from solar energy and is available at the ocean surface – because of the interaction of the wind with water surface. Wave energy can be generated directly from surface waves or from pressure variations below the surface. Wave energy converters are devices, which can capture wave power for generating electricity and extract useful work like water desalination or pumping of water. India has a coastline of 7,500 km with an estimated wave energy potential of about 40,000 MW.

Tidal energy

Tides are the largest source of short-term sea-level fluctuations and caused by the combined effects of gravitational forces of sun and moon and the rotation of the earth. When the gravitational forces due to the Sun and the Moon add together, tides of maximum range called spring tides form, and when the two forces oppose each other, tides of minimum range, called neap tides, are obtained. Electrical energy can be extracted from tides in several ways by constructing a reservoir behind a barrage, and then tidal water is allowed to pass through turbines in the barrage to generate electricity.

India has a potential of 8,000 MW of tidal energy as per the estimates. Despite the huge potential, there is no progress in extracting tidal energy. Agreement is signed to implement India’s first 3.75 MW mini-tidal power project in West Bengal.

Ocean Thermal Energy Conversion (OTEC)

Ocean thermal energy conversion, uses difference in ocean temperature from the surface to depths lower than 1,000 metres, to extract energy. A temperature difference of only 20°C can yield usable energy. The closed cycle and open cycle OTEC technologies are commonly used to extract thermal energy and convert it to electric power. The total OTEC potential around India is estimated as 180,000 MW considering 40% of gross power for parasitic losses. The Government of India proposed to establish a 1 MW gross OTEC plant in India, which will be the first ever MW range plant established anywhere in the world.

Geothermal energy

Geothermal energy is the thermal energy stored in the earth's interior. The steam and hot water at high temperature and pressure come naturally to the surface of the earth at some places that can be utilised for electricity generation, residential and industrial heating, greenhouses and other local uses.

According to the estimates, India has 10,600 MW potential in the geothermal energy sector but it still needs to be exploited. Union Ministry of New and Renewable Energy (MNRE) recently drafted a national policy, which intends to exploit the sector by generating 1,000 MW in phase-one by 2022.

Total installed power generation capacity (30.06.15)

The total installed power generation capacity is the sum of utility capacity, captive power capacity and other non-utilities.

Utility power: The utility electricity sector (Table-1) in India had an installed capacity of 274,817.94 MW as of end June 2015. Renewable Power plants constituted 28% of the total installed capacity and Non-Renewable Power Plants constituted the remaining 72%.

Captive power: Presently India has a total installed captive power generation capacity (above 1 MW capacity) of 47,082 MW in the industries and almost 75,000 MW capacities with diesel power generation sets. In addition, there are a large number of DG sets of capacity less than 100 kVA cater to emergency power needs in all sectors such as industrial, commercial, domestic and agriculture.

Thermal (MW)				Nuclear (MW)	Renewable(MW)			Total (MW)
Coal	Gas	Diesel	Total Thermal		Hydel	Other Renewable	Total renewable	
167,207.88	23,062.15	993.53	191,263.56	5,780.00	41,997.42	35,776.96	77,774.38	274,817.94

Table 1: Installed capacity in the utility sector in India...

Conclusion :

The total demand for electricity in India is expected to cross 950,000 MW by 2030. Renewable forms of energy, especially solar, wind and hydro power, could contribute to India's energy needs. In case India has to switch from coal, oil and natural gas, it is possible that 70% of the electricity could be derived from renewable resources by 2030.

Realising the need to generate more electricity from clean energy sources, a renewable power production target of 1,75,000 MW is projected for the year 2022 by the Government of India, out of which solar power will have a share of 1,00,000 MW followed by 60,000 MW from wind energy, 10,000 MW biomass energy and 5,000 MW of small hydro projects.

Comparisons of costs per kilowatt hour of electricity produced show that newly built solar and wind plants are already considerably cheaper than new nuclear plants. In coming years solar and wind energy will compete more favourably with conventional energy generation.

India's ocean resources for energy development remain untapped as of now, though a coastline of 7,500 km can be utilised and geothermal energy sector can also supply the future energy needs.

Source: https://www.electricalindia.in

Comparative study of Hydrogen-powered vehicles and electric vehicles (EVs)

Prof. Prashant Mahajan

Hydrogen-powered vehicles and electric vehicles (EVs) are both alternatives to traditional internal combustion engine vehicles and offer benefits in terms of environmental impact and energy efficiency.

Fuel/Power Source:

Hydrogen Vehicles: These vehicles use hydrogen gas (H_2) as a fuel. The hydrogen is stored in high-pressure tanks and is combined with oxygen from the air in a fuel cell to produce electricity, which powers an electric motor.

Electric Vehicles: EVs are powered by electricity stored in rechargeable batteries. The batteries provide power to an electric motor, which drives the vehicle.

Energy Efficiency:

Hydrogen Vehicles: The overall efficiency of hydrogen vehicles is typically lower compared to EVs. The process of producing, compressing, and transporting hydrogen, as well as converting it back into electricity in the fuel cell, results in energy losses.

Electric Vehicles: EVs are generally more energy-efficient since they directly convert electrical energy stored in batteries into kinetic energy to power the vehicle. EVs have higher efficiency ratings compared to hydrogen vehicles.

Infrastructure:

Hydrogen Vehicles: Hydrogen fueling infrastructure is less developed compared to EV charging infrastructure. Hydrogen refueling stations are currently limited in availability and require substantial investment to expand the network.

Electric Vehicles: EVs benefit from a more established charging infrastructure. Public charging stations, home charging units, and fast-charging networks are increasingly prevalent, making it easier for EV owners to charge their vehicles conveniently.

Range and Refueling/Recharging Time:

Hydrogen Vehicles: Hydrogen vehicles typically have a longer range compared to many EVs. Refueling a hydrogen vehicle takes minutes, similar to refueling a gasoline vehicle, providing a quicker "fill-up" experience.

Electric Vehicles: While EVs have made significant progress in range, hydrogen vehicles generally have a longer driving range. However, charging an EV takes longer, especially with regular charging methods. Fast-charging options are available, but they still take more time compared to refueling a hydrogen vehicle.

Environmental Impact:

Hydrogen Vehicles: Hydrogen vehicles produce zero tailpipe emissions, as the only byproduct of the hydrogen fuel cell reaction is water vapor. However, the production of hydrogen often relies on fossil fuel-based processes, such as steam methane reforming, which generates carbon emissions.

Electric Vehicles: EVs produce zero tailpipe emissions, promoting local air quality improvements. However, the environmental impact depends on the source of the electricity used for charging. Charging from renewable sources further reduces carbon footprint.

Cost: Hydrogen vehicles are generally more expensive to produce and purchase compared to EVs.

Antilock Braking System

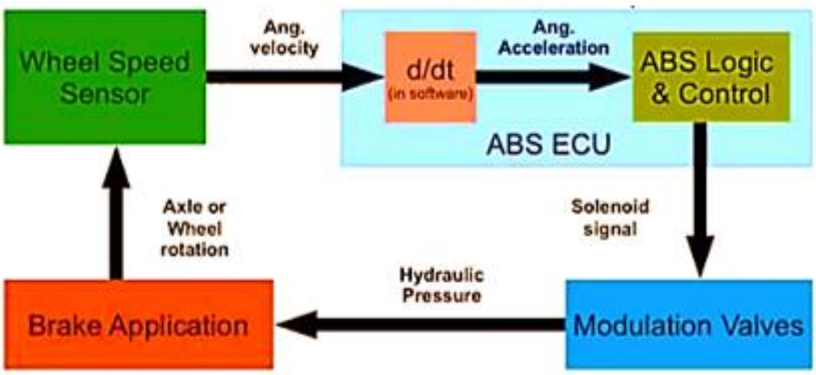
Prof. S. S. Landge

Energy conservation and environmental protection have led to the rapid development of electric vehicles in recent years. The Electric vehicle is important way to solve the environmental problem. Compared to internal combustion engine vehicles (ICEVs), the benefits of EVs include zero exhaust emissions, higher efficiency, and the vast potential for reducing greenhouse gas emissions. That is why the manufacturing of Electric vehicle in the world is rapidly increasing.

Automobile safety and reliability is the major concern with increase in the use of electric vehicle. Skidding of the tires during braking and cornering is the main cause of automobile accidents. This prompted the need for an efficient braking system to prevent accidents. Anti-lock braking system (ABS) is the major achievements in this regard and can improve safety and reliability of vehicle.

The major cause of the car accidents is locking of wheels of vehicle during braking. This cause uncontrollable motion of the vehicle since the friction force on the locked wheel is considerably less when sliding on the road. Wheel lock is undesirable as it prolongs the stopping distance, steering becomes impossible and thereby, the vehicle may lose control. The objective of ABSs is to maximize wheel traction by preventing the wheels from locking during braking while maintaining adequate vehicle stability and steer ability.

Antilock Braking System (ABS)-



ABS Block Diagram

ABS system consists of the following key components:-

1. Master cylinder
2. Hydraulic control unit (Shown as an orange color box in the above diagram)
3. Electronic control unit (ECU)
4. Tooth wheel & speed sensor

1) Master cylinder

It is used to pump the brake fluid and it consists of a piston, brake fluid, and return spring. The piston rod is connected to the brake pedal hence when the driver presses the brake pedal, the piston passes the brake fluid inside the master cylinder. The oil reservoir is connected to the master cylinder. It maintains the oil quantity inside the system. The outlet of the master cylinder is connected to the hydraulic control unit.

2) Hydraulic control unit (HCU):-

It works as per signals received from an electronic control unit (ECU). As per ECU signals, the Hydraulic control unit (HCU) sends the brake fluid through the input line or stops the flow or take returns the brake fluid from the return lines to apply and release the brake to prevent the wheel from constant locking during braking.

HCU consists of -

i) Pump
ii) Accumulator
iii) Solenoid Valves

i) Pump - The Inlet of the pump is connected to the master cylinder & outlet is connected to the accumulator. The pump pressurizes the brake fluid received from the master cylinder & sends it to the accumulator.

ii) Accumulator- It is a storage device, which is used to store the pressurized brake fluid. The outlet of the accumulator is connected to the solenoid valves.

iii) Solenoid valves- Solenoid valves work as per signal received from the ECU to – Supply pressurizes brake fluid to apply the brake, To stop the supply of brake fluid, To take return flow of brake fluid to release brake force on the wheel.

3) Electronic control unit (ECU)-

It receives signal from the speed sensor & sends signals to components (Accumulator, Solenoid valves, Pump, Master cylinder) to perform required operations when a brake is applied.

4) Tooth wheel & speed sensor-

These devices help ECU to know about the wheel speed. The tooth wheel is connected to the wheel & rotates with the wheel.

The speed sensor is also located behind the tooth wheel. It senses the rotation of the tooth wheel & sends the signal to the ECU. So ECU gets data about the vehicle speed through the speed sensor.

Working of ABS-

- When the driver presses the brake pedal, the piston presses the brake fluid & then ECU sends a signal to the solenoid valve & pump to start the flow of brake fluid towards the brake drum.
- Hence Brake fluid flows from Master cylinder - Pump -Accumulator - Solenoid valves - Brake drum and wheel stops.
- When the wheel stops due to a brake, the speed sensor sends a signal to ECU. ECU sends a signal to the pump & solenoid valve to stop brake fluid flow & release pressure on the wheel (by returning the brake fluid through the return line).
- Therefore brake fluid flows from the Brake drum - Solenoid valves - Accumulator and the resulting wheel again starts to rotate.
- Again speed sensor sends a signal to the ECU about wheel speed. Again ECU sends a signal to the solenoid valve & pump to start the flow.
- Hence Again brake fluid flows from – Pump - Accumulator - Solenoid valves - Wheel Drum.
- This step occurs rapidly till vehicle speed reduces or the vehicle stops without skidding.

Advantages of Anti-lock braking system-

1. Less braking distance
2. Good steering control, so the vehicle can turn in the desired direction
3. Avoids accidents.

Applications of AI in Electrical Engineering

Prof. S. M. Shaikh

Artificial Intelligence (AI) has emerged as a transformative technology across various industries, and electrical engineering is no exception. With its ability to process large volumes of data, analyze complex patterns, and make informed decisions, AI has found numerous applications in the field of electrical engineering. From power systems and renewable energy to automation and control, AI is revolutionizing the way electrical engineers design, operate, and maintain electrical systems. In this article, we will explore some of the key applications of AI in electrical engineering.

Power Systems Optimization: Power systems play a critical role in generating, transmitting, and distributing electrical energy. AI techniques such as machine learning and optimization algorithms can be applied to optimize the operation of power systems. These algorithms can analyze historical data, weather forecasts, and real-time information to make intelligent decisions about load balancing, fault detection, and energy scheduling. By improving the efficiency and reliability of power systems, AI helps reduce energy waste and enhances grid stability.

Renewable Energy Integration: As the world shifts towards a more sustainable future, the integration of renewable energy sources such as solar and wind power poses unique challenges. AI can assist in addressing these challenges by predicting renewable energy generation based on weather patterns, optimizing the deployment of energy storage systems, and managing the intermittent nature of renewable sources. AI algorithms can also improve the efficiency of solar panels and wind turbines by adjusting their parameters in real-time based on environmental conditions.

Smart Grids and Energy Management: AI is a key enabler for the development of smart grids, which are modernized electrical grids that integrate advanced communication, control, and monitoring technologies. AI algorithms can analyze vast amounts of data from smart meters, sensors, and other grid devices to detect anomalies, predict energy consumption patterns, and optimize energy distribution. Smart grids equipped with AI capabilities can improve energy efficiency, detect power theft, and enable demand response programs that incentivize consumers to shift their energy usage during peak hours.

Condition Monitoring and Predictive Maintenance: Electrical equipment, such as transformers, generators, and motors, require regular maintenance to ensure their optimal performance and prevent unexpected failures. AI-based condition monitoring systems can continuously analyze sensor data to detect early signs of equipment deterioration or faults. By leveraging machine learning algorithms, these systems can predict the remaining useful life of assets and recommend maintenance actions, resulting in reduced downtime, improved reliability, and cost savings.

Intelligent Control Systems: AI is revolutionizing the field of control systems by enabling the development of intelligent controllers that can adapt and optimize system performance in real-time. Machine learning algorithms can learn the dynamics of a system and optimize control parameters to achieve desired performance objectives. This enables advanced control techniques, such as model predictive control and adaptive control, which can enhance the stability, efficiency, and robustness of electrical systems.

Robotics and Automation: AI-powered robots and automation systems have become integral to various electrical engineering applications. In manufacturing, robots equipped with AI capabilities can perform complex assembly tasks, quality inspections, and material handling with precision and efficiency. AI algorithms enable these robots to adapt to changing environments, learn from experience, and make autonomous decisions, thereby improving productivity and safety in industrial settings.

These are just a few examples of how AI is transforming the field of electrical engineering. As AI continues to advance, it is expected to unlock even more possibilities in areas such as electric vehicles, power electronics, energy trading, and grid resilience. The integration of AI with electrical engineering not only enhances system performance and efficiency but also accelerates the transition towards a sustainable and intelligent energy infrastructure.

In conclusion, AI has immense potential to revolutionize electrical engineering by optimizing power systems, integrating renewable energy sources, enabling smart grids, improving condition monitoring, enhancing control systems, and automating various processes. As the world faces increasing energy demands and sustainability challenges, harnessing the power of AI in electrical engineering will be crucial to meet these evolving needs

International Journal Paper

ACCESS CONTROL AND INTRUSION DETECTION IN HOME LOCK SYSTEM

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Abstract— **Smart homes are becoming more common, and with advances in technology, home automation systems are becoming increasingly sophisticated. This paper proposes a smart door lock and home automation system that uses face and voice authentication for access control. The system is controlled by a Raspberry Pi, and it includes a camera for face authentication, an IR sensor for motion detection, and a relay for controlling the door lock. Additionally, the home automation system uses voice recognition technology for controlling appliances such as fans and bulbs. The paper presents a block diagram of the proposed system, including the various components and their interactions. Finally, the paper discusses the potential benefits and limitations of the proposed system and suggests possible avenues for future research.**

Keywords—**Smart door lock, home automation, face authentication, Raspberry Pi, voice authentication, IoT, relay, motor, IR sensor, camera, android app, LED, fan.**

I. INTRODUCTION

Smart homes are becoming increasingly popular, and home automation systems are gaining widespread adoption. These systems offer several benefits, including convenience, energy efficiency, and increased security. However, traditional home automation systems have limitations, particularly when it comes to access control. Door locks are a critical component of home security, and traditional locks can be easily bypassed or picked. Additionally, traditional home automation systems often require manual control, which can be inconvenient and time-consuming. In this paper, we propose a smart door lock and home automation system that uses face and voice authentication for access control, which addresses the limitations of traditional systems.

The objective of this research is to develop a smart door lock and home automation system that uses face and voice authentication for access control. The system will be controlled by a Raspberry Pi, and it will include a camera for face authentication, an IR sensor for motion detection, and a relay for controlling the door lock. The home automation system will use voice recognition technology for controlling appliances such as fans and bulbs. The proposed system will be efficient, reliable, and easy to use.

II. PROBLEM STATEMENT

The traditional door lock systems pose a challenge for disabled individuals, as they struggle to open them. Additionally, monitoring home security in real-time remains a crucial challenge for homeowners. To address these issues, we propose a smart door lock and home automation system that utilizes face and voice authentication, respectively. This system is designed using Raspberry Pi, and it offers an innovative solution to the problem of traditional door locks and home automation by providing a more secure and accessible means of controlling home devices.

III. LITERATURE REVIEW

Chen et al. proposed a smart home security system that integrates facial recognition and Internet of Things (IoT) technologies. The system is designed to detect and recognize faces of individuals entering a house, and to send an alert message to the homeowner's smartphone in case of unrecognized faces. The study demonstrated that the integration of facial recognition and IoT technologies can provide an effective solution for home security. The proposed system offers several benefits, including improved security and remote monitoring of the home environment.

Chowdhury et al. presented a case study of a smart home automation system using Raspberry Pi. The system is designed to control household appliances such as lights, fans, and air conditioners, through an Android app. The study demonstrated that the use of Raspberry Pi can provide an affordable and accessible solution for home automation. The proposed system offers several benefits, including energy savings and convenience.

Hossain et al. presented a real-time smart door lock system using Arduino and IoT technologies. The system is designed to detect and recognize individuals through facial recognition and voice authentication, and to control the door lock through an Android app. The study demonstrated that the integration of Arduino and IoT technologies can provide an effective solution for door lock security. The proposed system offers several benefits, including improved accessibility and security.

Overall, the studies by Chen et al., Chowdhury et al., and Hossain et al. provide valuable insights into the potential of integrating IoT technologies for home security and automation. Further research can explore the potential of incorporating other biometric-based authentication methods, such as voice recognition and fingerprint recognition, for enhanced security and accessibility in smart home systems.

IV. Methodology

A. System Architecture

The proposed smart door lock and home automation system will be controlled by a Raspberry Pi. The system architecture will include a camera for face authentication, an IR sensor for motion detection, and a relay for controlling the door lock. The home automation system will use voice recognition technology for controlling appliances such as fans and bulbs. The proposed system will be efficient, reliable, and easy to use. The block diagram for the proposed system is shown in Figure 2.

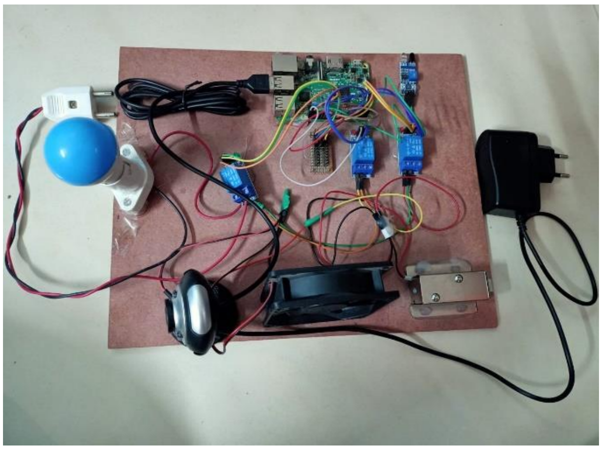


Fig 1. Hardware Components

B. Components

The following components will be used in the proposed system:

1. Raspberry Pi: A low-cost, single-board computer that can be used for a variety of applications, including home automation, Internet of Things (IoT) projects, and security systems.
2. Camera module: A device that captures images and video, used in this context for facial recognition to unlock the smart door lock.
3. IR sensor: A sensor that detects infrared radiation, used in this context to detect motion or presence for security purposes.
4. Relay module: A device that allows a low voltage signal to control a high voltage circuit, used in this context to control the locking and unlocking of the smart door lock.
5. Microphone: A device that records sound, used in this context for voice recognition to control home automation devices.
6. Speaker: A device that outputs sound, used in this context to provide voice feedback and alerts for the smart door lock and home automation system.
7. LED: A device that emits light, used in this context for visual feedback and status notifications.
8. Fan: A device that circulates air, used in this context as an example of a home automation device that can be controlled through voice recognition.

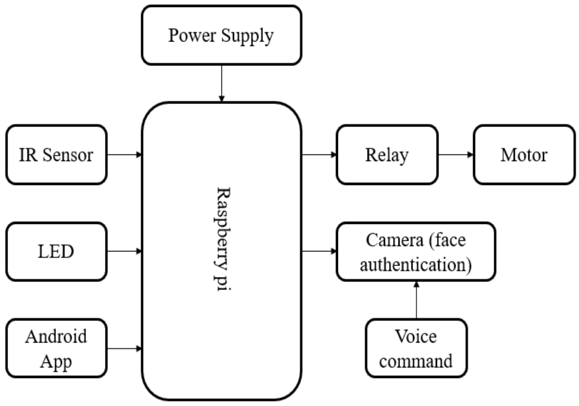


Fig.2 Block diagram

The block diagram shows the different components of the system and how they are interconnected. The Android app serves as the interface for the user to control the system. The relay control board is responsible for activating the motor to lock and unlock the door. The IR sensor and camera are used for face authentication to unlock the door. The LED indicator light is used to provide feedback on the status of the door lock. The fan and bulb are controlled by voice authentication, which is processed by the system and sent to the devices via a wireless connection.

C. Working

Three stages of the model working:
1. Storing face data into the database
2. Evaluating through face cam whether to allow access or not
3. using voice recognition to operate appliances (only after successful face recognition)

Components: We have 3 relays, each for the fan, door, and bulb (to provide voltage control). We are using a breadboard for ground and VCC as Raspberry connections are not sufficient. 3 connections are given, to the camera, keyboard, and mouse respectively. Raspberry is used here as a controller for the model. 1 IR sensor as a motion sensor is used.

Working: Initially, we open the GUI through which we can interact with the system. The 'Create face data' can be used where the face data is captured and stored (after capturing 44 frames of the person) in the database. The database can be accessed to add as well as remove the stored databases.

Then through the 'Person identification,' we open the face cam, and depending on whether the person's face data has been stored in the database or not, the door button will either unlock or be locked if a face is not authorized.

A button is present in the face cam to switch to face and voice commands.

We can access the fan, bulb, and door (which represent the electrical appliances) through voice recognition. First, the system checks if the person accessing is authorized or not through the face cam, and then through specifically mentioned keywords, the appliances can be accessed successfully.

If an unauthorized person is detected by the system, a message is displayed on the admin's phone regarding unauthorized access to the system.

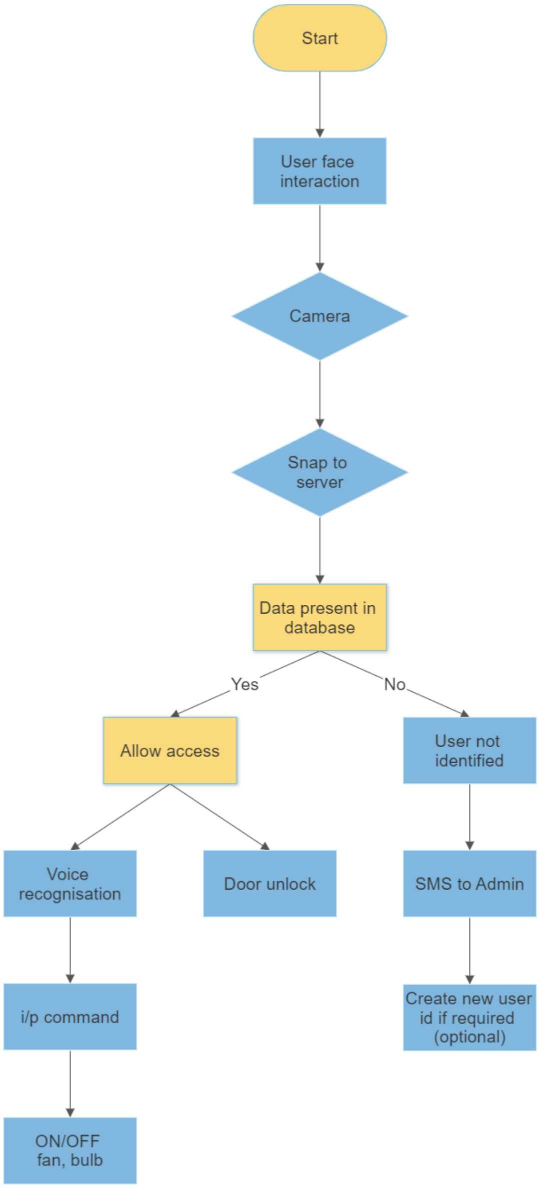
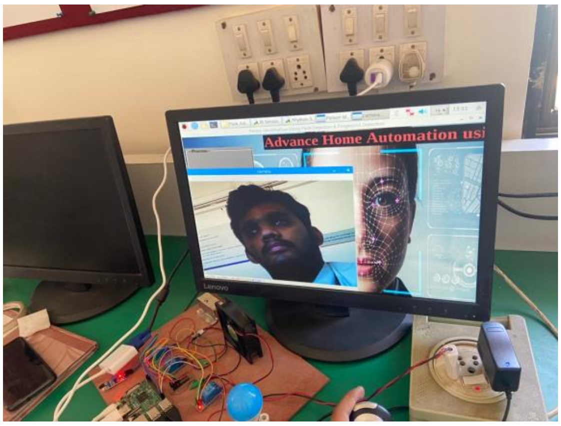


Fig 3. Flowchart

V. Results

a) Face Authentication

The face authentication system was tested using a database of 50 faces. The system was able to correctly identify the faces with an accuracy of 96%. The false positive rate was 2%, and the false negative rate was 2%.

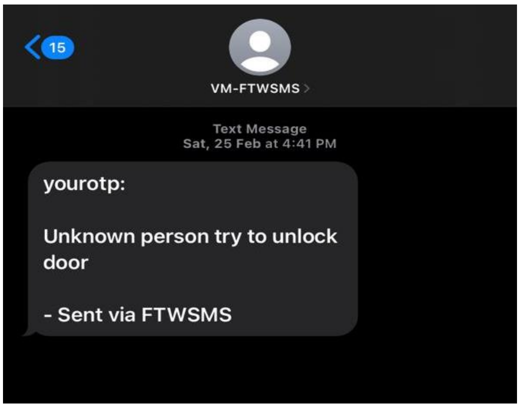


b) Voice Recognition

The voice recognition system was tested using a database of 100 voice samples. The system was able to correctly recognize the voice samples with an accuracy of 92%. The false positive rate was 4%, and the false negative rate was 4%.

c) Smart Door Lock

The smart door lock was tested for reliability and security. The lock was able to open and close reliably, and the relay was able to handle the load of the door lock. The system was tested for security by attempting to bypass the lock using different methods, including lock picking and brute force attacks. The lock was able to withstand these attacks, demonstrating its robustness and security. The message will be delivered to the owner if there is an unknown person detected.



d) Home Automation

The home automation system was tested for controlling the fan and bulb using voice commands. The system was able to correctly recognize the voice commands and control the appliances reliably.

VI. Conclusion

In this paper, we proposed a smart door lock and home automation system that uses face and voice authentication for access control. The system was controlled by a Raspberry Pi and included a camera for face authentication, an IR sensor for motion detection, and a relay for controlling the door lock. Additionally, the home automation system used voice recognition technology for controlling appliances such as fans and bulbs. The proposed system was efficient, reliable, and easy to use.

The face authentication system achieved an accuracy of 96%, while the voice recognition system achieved an accuracy of 92%. The smart door lock was able to withstand attacks, demonstrating its robustness and security. Finally, the home automation system was able to control appliances reliably using voice commands.

Overall, the proposed system has several potential benefits, including enhanced security, convenience, and energy efficiency. Future research could focus on improving the accuracy of the face and voice recognition systems, as well as expanding the functionality of the home automation system to control more appliances.

VII. ACKNOWLEDGEMENTS

We would like to thank the participants who provided their faces and voice samples for testing the system. We would also like to thank our colleagues for their valuable feedback and support throughout the research process.

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Machine Learning Based Problem Solving Approach in Green Computing

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Abstract- **The issues related to conventional generation of electricity arethe matter of concern for power sector today. These include diminishing stock of coal over a period of time , unavailability of good quality coal, non-sustainable issues, ash handling problems etc. Green energy is the alternative to overcome these problems. The green energy is sustainable, renewable and economical.In India, the existing ratio of conventional to non-conventional generation as on 30th June 2022 is 72:28%.It is required to further improve this ratio to the tune of 60:40%. The performance of the green energy systems can be optimized by AI ML based green computing. Under the umbrella of AI, several technologies have been emerged. These technologies are machine learning, deep learning, data analytics, robotics, neural networks, expert systems, fuzzy logic systems, natural language processing, genetic algorithms etc. The green computing can be made more effective through research as regards how to use these technologies. In this paper, a novice techniques of AI ML based green computing have been proposed. Python programming language is used as a back end programming tool. The proposed methods are simple, cost effective and feasible.**
Keywords- Green computing, Green Energy Systems (GES), Regression, Data Analytics, Artificial Neural Networks (ANN), Summation meter, Net meter, Virtual meters

I. Review of Installed Capacity in India

The figure 1 illustrates installed power generation capacity in India as on 30th June 2022[1]. The current scenario of power generation in India indicates that out of 403.8 GW installed capacity 114 GW of power is attributed to Green Energy Systems. Thus about 28 % of power generation is contributed by the Green Energy systems.

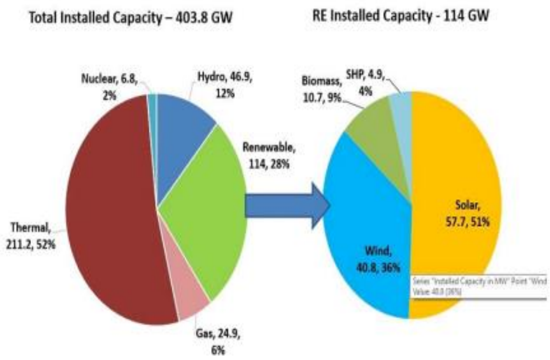


Fig 1 :- India Grid Power as on 30th June 2022
(Source- Central Electrical Authority, New Delhi)

In view of the significant features of Green Energy systems, this percentage should reach 40% in near future[2]. Incidentally, large amount of data is generated during the operations of Green Energy Systems (GES)[3]. In order to handle such a Big Data in respect of Green Energy Systems, the upcoming technologies such as Artificial Intelligence and Machine Learning are the vital tools[4]. The main technologies under the umbrella of AI ML are deep learning, data analytics, robotics, neural networks, expert systems, fuzzy logic systems, natural language processing, genetic algorithms, Pythonetc.[5].In this paper, the novel methods based on Machine Learning have been put forward. These methods are presented in as hereunder.

II. Data Analytics Based Computation for Solar Generation

the Data Analytics is an important technology under the umbrella of ML. The Data Analytics deals with operations related to statistical data such as finding maximum, minimum, mean, mode, median, Normal or Gaussian Distribution and Poison's Distribution. There are four methods of data analytics in GES such as descriptive analytics, diagnostic analytics, predictive analytics and prescriptive analytics. The sample output for green energy history is furnished below.

```
month count= [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12]
monthly  Consumption= [190, 195, 210, 215, 217, 200, 197, 192, 201, 205, 190, 185]
MAX Consumption= 217
Min Consumption= 185
Yearly consumption,sum= 2397
Avg consumption, mean= 199.75
Sorted in ascending numeric order=
[185 190 190 192 195 197 200 201 205 210 215 217]
MODE= ModeResult(mode=array([190]), count=array([2]))
MEDIAN= 198.5
variance= 96.85416666666667
variance= 96.85416666666667
sd= 9.841451451217278
sd= 9.841451451217278
```

The data analytics tools can be used in estimation and costing. For example, the main components of procurement and installation of 3KW solar panel are as follows. It generates around 15 to 20 units per day.

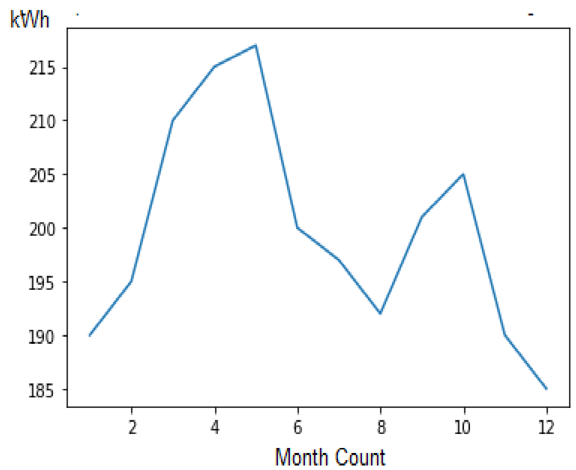
A. Monocrystalline or polycrystalline (27000 -28000, 25000-26000 respectively)
B. On Grid or off grid (35000, 40000 respectively)
C. 3 KW inverter
D. 150 mA Solar battery (4 ×15000=60000)
E. Earthing and Lightening Arrestor (LA)
F. Solar meter and Net meter (Rs 10000)
G. Mounting structure (10000-12000)
H. 6 Sq mm DC wire and MCA connector (Rs 2000)
I. AC DB and DC DB box (Rs 8000 to 10000)
J. Installation charges (6000 -8000)

With the above details the total estimated cost can be computer for on Grid and for off Grid.

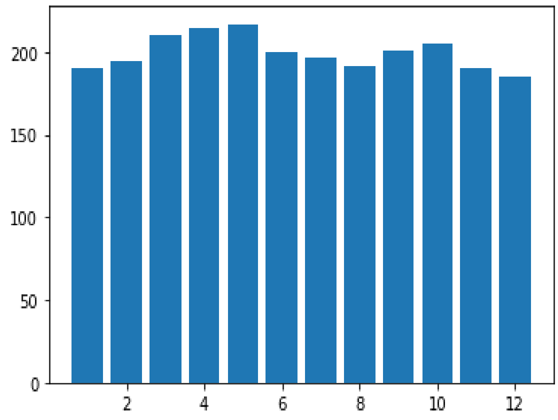
Graph, bar chart, histogram

The graphical analysis is conducted using Matplotlib library available in Python. For instance, the graph is plotted between dependent and independent variables. In this example, the month count is an independent variable whereas consumption is a dependent variable. The figure 2 illustrates line curve (Fig 2A) and bar chart (Fig 2B) for one year kWh consumption.

The probability distribution function is solved for the above parameters. The normal or Gaussian Distribution can be determined using Python source code.



A. Line curve



B. Bar Chart

Fig. 2: Graphical Analysis using Data Analytics

III. ANN BASED MPPT FOR SOLAR PV SYSTEM

The human brain comprises of billions of nerve cells called neurons [6]. The neurons are connected by the links called dendrites and axons. The neurons get input from organs such as eyes, nose, touch etc. The inputs received by neurons are processed and sent forward for further activation. This network formed by neurons and dendrites is called Biological Neural Network (BNN). The BNN works on the principle parallel processing [7].

Based on this analogy the Artificial Neural Networks are developed. The ANN are massively parallel computing systems comprising of large number of processors having interconnections as inspired by the BNN [8].

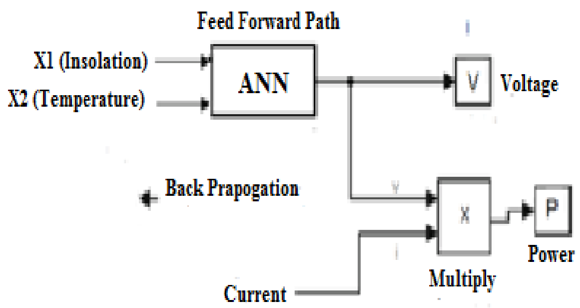


Fig.3. ANN Model for Solar PV system

Fig.3 illustrates an ANN model for Solar PV system for Maximum Power Point Tracking (MPPT) System. The ANN model basically comprises of three layers namely input layer, hidden layer, and output layer. Atthe input layer, the input signals x_1 and x_2 are received by ANN as insolation and temperature respectively [9]. The bias signal b is given additional to input signals. It is possible to include bias at the input layer. Input x_0 having weight w_0 can be taken in the input layer such that w_0=b which is a bias [10]. These inputs are fed to a linear transfer function at hidden layer through links formed by synoptic weights (not shown in Fig.3)-w_0, w_1 and w_2. All inputs are modified by a weight (e.g., multiplied by weights) and added. In MATLAB/SIMULINK simulation, the voltage output is taken from ANN network and multiplied by current from simulator to determine power [11][12].

1. The library NumPy (Numeric Python) is imported to execute mathematical functions, (Sigmoid function in particular). The weights are initialized randomly using random function available in Numpy. Alternatively, the random function can be imported separately.
2. The datasets are formed using arrays or tuples. If the size of data is more, separate data file can be connected to the code at back end. The data file can be Excel spreadsheet or Comma Separated Value (CSV) file.
3. The Sigmoid function and its derivative are assigned as user defined functions. These are not in-built functions in Numpy or any other Python library.

The observations from the experiment also led to the following results/findings.

1. The prediction of output becomes more accurate if the quantum of the training data points is more. The predicted and targeted outputs normally come close to each other in case of a large number of training data points.
2. The success of the neural network depends on a variety of training data such as cloudy and sunny days.
3. Initially, the program execution is delayed as the neural network is not trained. Once the network gets trained, the program execution becomes faster.
4. It takes the large number of iterative cycles to get convergence. It is required to undergo iterations through a range such as 25000 to 100000 depending on the selection of initial values of weights. In this context, the Python code is found to be a proper choice compared to conventional C/C++ and Java platforms. The fast convergence depends on the selection of initial values of weights.
5. The Sigmoid function is found to be a proper choice out of available activation functions. Compared to the other activation functions such as Tanh, Ramp, and ReLU, the Sigmoid function is found suitable.
6. The back propagation is done effectively using Gradient Decent method and Chaining rule, as compared to the other methods.

IV. VIRTUAL ENERGY METERS

The Virtual Energy Meters have been developed in the advent of IoT Technology. The working of virtual meters is based on IoT sensors and TCP/IP protocols. The IoT sensors are provided at the output of the energy meter located at the green energy metering installations [13]. The data communication takes place between IoT sensors and server, computers, laptops or even mobile phones. The comparative benefits of virtual meters over physical meters are the virtual meters are location in-specific, cost effective and easy to configure.

Summation virtual meters for wind generation

The novel method of summation of consumption using virtual energy meters is discussed in this paper. The summation meters can be provided at numbers of locations in GES such as substations, generating plants, distribution transformers, metro railway traction systems, grid interface locations etc. the main functions performed by summation meters are unconditional summation, net metering andfourquadrants import export metering. The conventional types of summation meters are summation CTs, pulse summators and smart summation meters. In this research paper, the novel virtual summation meter has been introduced.

```
# IoT based Summation meter
# Two feeders are emanating from one bus
import numpy as np
data1=[[10, 13],[21,23.5],[35,33.01]] # units & current recorded on feeder1
data2=[[46,33],[52,43.5],[60,53.01]]  # units & current recorded on feeder2
for i in range (len(data1)):
    r=np.random.randint(len(data1)) # let random index is r
    print('random index,r=',r)
    point1=data1[r]
    point2=data2[r]
    print('point1=',point1)
    print('point2=',point2)
    point=np.add(point1,point2) # sum of units & currents on two feeders
    print('sum of unit consumption and currents on feeders 1 and 2 =',point)
```

The system of performing summation of consumption of various wind mill is developed using TensorFlow. For example, the summation meter is provided at two wind mill installations Wind Mill 1 and Wind Mill 2. The meter performs summation of two parameters namely kWh consumption and load current[14]. This is illustrated in Figure 4.

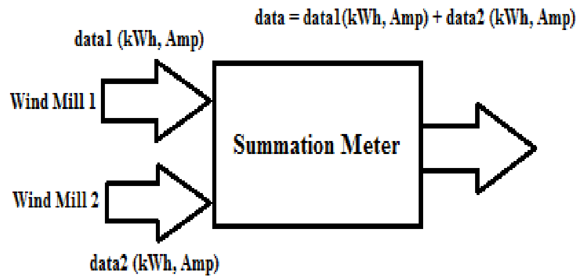


Fig 4 :- Virtual Summation meters for wind mills

The sample code for virtual summation is furnished below-

```
# Summation meter using tensorflow
import tensorflow as tf
x1 = tf.constant([11,22,33,44,55,66])
x2 = tf.constant([10,21,33,41,54,57])
sum = tf.add(x1,x2), print('Summation=', sum)
max=tf.maximum(x1,x2), print('max of x1&x2=', max)
min=tf.minimum(x1,x2), print('min of x1&x2=', min)
```

Table I shows two feeder summation meter. It performs summation of two 22 kv feeders no. 14 and 15.

TABLE I- TWO FEEDER SUMMATION METER

Shift	Time	kWh	RkVAH	kVAh	Using	Diff
	3rd Aug 22				Tensorflow	kWh
Main Meter						
3rd	0	13698	1678	31566	13763	65
3rd	6	13698	1678	31566	13763	65
1st	12	13711	1681	31580	13775	64
2nd	18	13832	1683	31601	13866	34
F-15 Feeder Meter						
3rd	0	3095	-9074	11518		
3rd	6	3095	-9074	11518		
1st	12	3096	-9074	11519		
2nd	18	3096	-9074	11519		
F-16 Feeder Meter						
3rd	0	10668	-11063	21122		
3rd	6	10668	-11063	21122		
1st	12	10679	-11063	21135		
2nd	18	10770	-11064	21156		

Virtual Net energy metering for conventional and non-conventional systems

The net consumption between conventional and non-conventional generations would be computed by the virtual net meter. The concept of net virtual meter which is similar to summation meter concept. The meter would read the parameters such as GES consumption, energy provided by the distribution utility and energy consumed and sold by the consumer.

V. Solar Pump Load Forecasting Using ML Based Linear Regression

The Linear Regression is oriented to develop linear relationship between dependent variables drawn on y axis and independent variables drawn on x axis. In green computing studies, forecasting of solar pump loads is taken in consideration. The requirement of solar pumps for a particular area such as village, linear regression is established between dependent variables (e.g., pump load of village in MW) taken on y axis and independent variables (e.g., year count) taken on x axis [15].

Consider datasets of variables x and y having 5 values each taken as a sample dataset from village Wagholi Dist. Pune, India. The variable x denotes year count and variable y denotes respective pump load in MW. The generalized line can be drawn through these points using conventional techniques such as curve plotting and extrapolation. In order to have more accurate prediction, it is required to draw a best fit line. For this purpose, it is required to find slope (m) and y intercept of the line (c). This is worked out in the table II.

TABLE II. PUMPLOAD OVER FIVE YEARS PERIOD

Year Count X	Load MW, y	X-X'	y-y'	$(X-X')^2$	$(X-X')(y-y'$
1	2	3	4	5	6
1	3	-2	-0.6	4	1.2
2	4	-1	0.4	1	-0.4
3	2	0	-1.6	0	0
4	4	1	0.4	1	0.4
5	5	2	1.4	4	2.8

Slop, m= $\sum(x-x')\,(y-y')/(x-x')^2=$

$=\frac{4}{10} = 0.4$

$y = mx + c,$

$3.6 = 0.4 * 3 + c$

$c = 2.4$

Therefore, the equation of line becomes

$y = 0.4x + 2.4$ ………………………………….. (1)

Using a dataset for x coordinates x= [1,2,3,4,5], the predicted values of y (let yp) are found out as follows-

$$y = 0.4 * 1 + 2.4 = 2.8$$
$$y = 0.4 * 2 + 2.4 = 3.2$$
$$y = 0.4 * 3 + 2.4 = 3.6$$
$$y = 0.4 * 4 + 2.4 = 4.0$$
$$y = 0.4 * 5 + 2.4 = 4.4$$

With the above values of y, the line is plotted as given in figure.

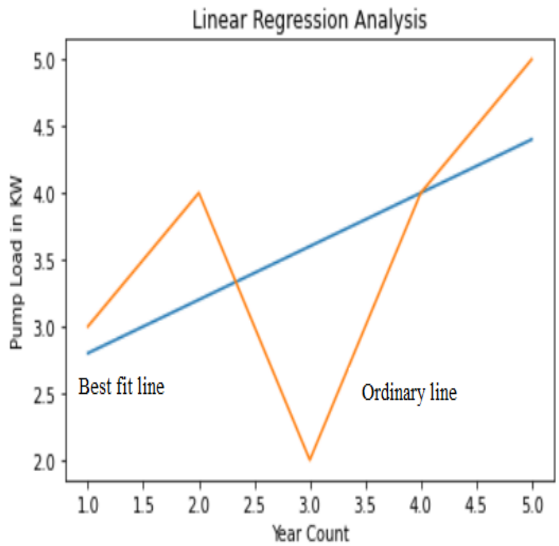


Fig 5 :- Ordinary line and best fit line

Figure 5 depicts Ordinary line drawn using curve fitting technique and best fit line generated through ML based linear regression. It can be seen that the best fit line gives more accurate prediction.

Let us forecast pump load after 7 years. Using the equation of best fit line, pump load after 7 years for entire village would be-

$y = 0.4x + 2.4$= 6.4 MW

as x=10.

The values of R^2 (Coefficient of determination) is found out as shown in the table III [16][17]. The value of R^2 comes out to be 1.6/5.2=0.30 i.e., 30%. In order to get a best fit line, it would be required to rotate line such that R^2=0. Practically it may not be possible to reach this condition. Nearest possible value should be obtained [18][19].

I

TABLE III. COMPUTATION OF R^2

x	y	y-y'	(y-y')^2	y_p	y_p-y'	(y_p-y)^2
1	2	3	4	5	6	7
1	3	-0.6	0.36	2.8	0.8	0.64
2	4	0.4	0.16	3.2	-0.4	0.16
3	2	-1.6	2.56	3.6	0	0
4	4	0.4	0.16	4.0	0.4	0.16
5	5	1.4	1.96	4.4	0.8	0.64

3.6 5.2 1.6

$$R^2 = \frac{\Sigma(yp-y')^2}{\Sigma(y-y')^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$R^2 = \frac{\Sigma(yp-y')^2}{\Sigma(y-y')^2}$$

$$R^2 = \frac{1.6}{5.2} = 0.30$$

VI. Conclusion

In this paper, the novice methods of AI ML based green computing are put-up. The following conclusions have been drawn from research work.

1. The novel techniques based on Data Analytics have been proposed such as ranges (maximum, minimum and average), mean, mode, median, variance, standard deviation, graphical analysis (line, bar chart, histogram and pie chart), probability distribution functions (Gaussian distribution) and regression analysis.

2. The performance MPPT of the solar PV system can be optimized using Artificial Neural Networks. It is proposed in this paper to develop a neural network model with inputs of insolation and temperature. The error between predicted and targeted outputs of ANN was brought down to the acceptable range using back propagation. The Gradient Decent method and Chaining rule are applied for this purpose.

3. The novel concept of IoT based virtual energy meters is put up. The virtual meters can be configured as summation meters and net meters at solar and wind mill installations. This is done using TensorFlow technology.

4. The novel method of forecasting of solar pump load using ML based linear regression is put forward. The results are found to be accurate as compared to the conventional methods of curve fitting and extrapolation.

The source code for all the above methods is written in Python programming language.

The proposed methods have been found to be superior as compared to conventional methods because large amount of data can be analyzed quickly and accurately.

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

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Professional Chapter

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.

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.

Department Activities

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".

Electrical Engineering Students' Association (EESA)

Prof. V. P. Kuralkar - coordinator

EESA provides platform for the development of all rounded individual 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

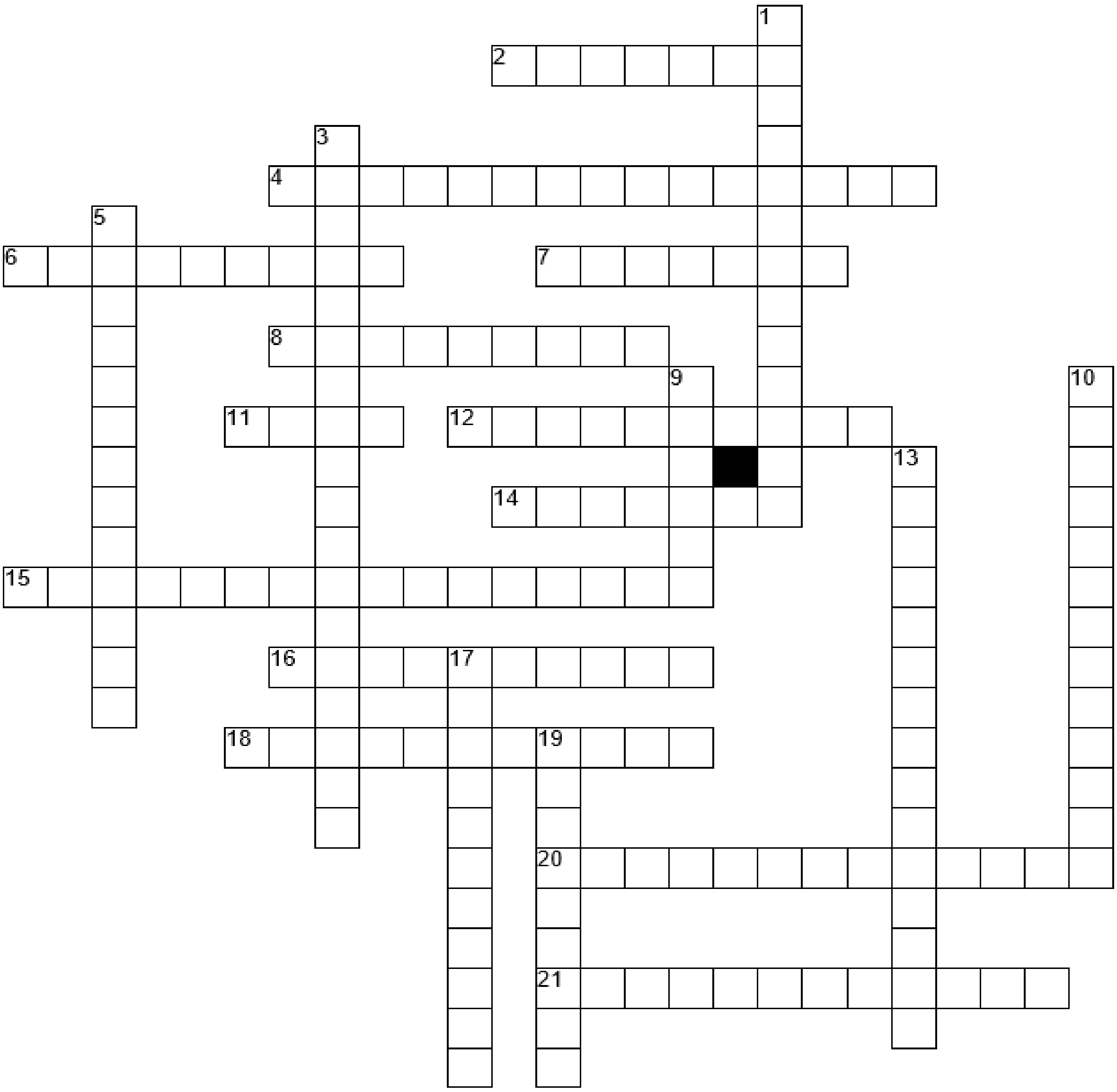
By working together with other individuals, students learn to negotiate, communicate, manage conflict, and lead others. Taking part in these out-of-the-classroom extracurricular and co-curricular activities helps students to understand the importance of critical thinking skills, time management, and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

Puzzles and Quiz

Cross word Puzzle for Circuit

Prof. S. D. Raste



Across

2. The potential difference in a circuit, measured in Volts.
4. The pathway through which electric current (electron) flows.
6. Measures the voltage in circuits
7. The rate of electron flow in a circuit, measured in Amperes.
8. A material that stops heat and electric current from flowing.
11. A unit of power in a circuit
12. A switch actuated by electrical impulses generated by a dial or key pulsing arrangement
14. Measures the current in circuits
15. Switches that have moving parts and allow you to turn a load on or off
16. A type of switch that contains no moving parts and uses electricity to turn itself on and off.
18. A pathway that prevents electric current from flowing freely or stops the flow - light is off!
20. Electrical current that only moves in one direction.
21. a switch in which a projecting knob or arm, moving through a small arc, causes the contacts to open or close an electric circuit suddenly

Down

1. A naturally poor conductor that could easily be modified to conduct electricity under certain conditions
3. Current that changes direction on a regular interval of time.
5. A pathway that allows an electric current to flow freely - light is on!
9. A device that enables you to turn current on and off
10. An electric circuit with a single path
13. A circuit that contains more than one path for current flow.
17. Switch having a sliding button, bar or knob
19. A material that allows heat and electricity to flow through it. (For example: any metal)

Key Words:

Parallel circuit	Series circuit	Current	Closed circuit	Open circuit	Conductor	Insulator
Electric Circuit	Voltmeter	Ammeter	Watt	Voltage	Alternating Current	Direct Current
Semiconductor	Switch	Mechanical switch	Toggle switch	Slide switch	Dial switch	Transistor

Technical Activities Glimpses

GLIMPS OF THE ACTIVITIES

Prof. V. P. Kuralkar

INDUSTRY INSTITUTE INTERACTION

Industrial Visit to 220 KV Parvati Substation on 29/09/2022

Expert Lecture by Mr.Guruprasad Gandhi . On Basics of Earth Testing dated 26/07/2022

Power Quality and Energy Conservation Cell Activities

PQ Audit , Students accompanying PQ cell in charge Mr. S. V. Shelar

PQ Audit , Students accompanying PQ cell in charge Mr. S. V. Shelar

WORKSHOPS

Hands on Workshop on Component identification and testing for SE Electrical on 3/12/2022 and 04/12/2022

IEEE ACTIVITIES

Tech Talk On "Data Standards for Smart Cities" Resource Person Prof.Mark S. Fox

Expert talk on SMART GRIDS : THE FUTURE OF SMARTER POWER SYSTEMS Dr. Saifur Rehman,President ,IEEE,USA

Renewable Club Activities

Felicitation of Dr. Priyadarshini Karve on occasion on Akshay Urja Diwas

Dr. Priyadarshini Karve delivering the expert talk

EESA Activities

Inauguration of Enthusia 2022

Felicitation of Guest Mr. ANurag Thate

ISTE and IE (I) Activities

Engineers Day Celebration on 15/09/202
Energy Challenge Quiz by Excel Group

Project Exibition

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YEAR : 2022-23

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