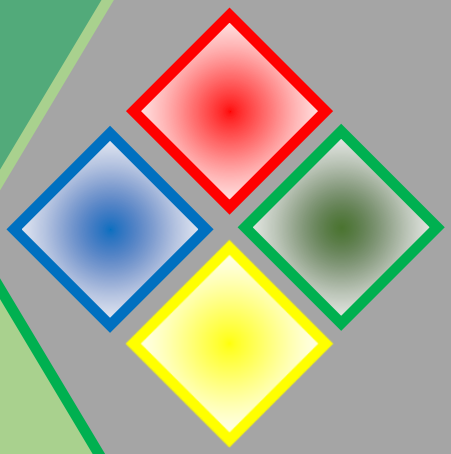
VOLTAFFAIR - 2021



DEPARTMENT OF ELECTRICAL ENGINEERING

Departmental Journal of Electrical Engineering

TECHNIQUE POLYTECHNIC INSTITUTE

Hooghly - 712102

VOLTAFFAIR – 2021

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Department of Electrical Engineering

Technique Polytechnic Institute

Panchrokhi, Sugandhya, Hooghly

West Bengal - 712102

EDITORIAL

Viola Davis said, "All dreams are within reach. All you have to do is keep moving towards them." Not all dreams are so, one may argue, nevertheless, rational ones do fulfil the criteria. The essence is, manoeuvre is looked-for. Amidst all the circumstantial setbacks, pandemic initiated pessimisms, a tinge of fighting spirit still alive is evident from the approach from the students end. This is the thing that provokes us to dream and dream beyond.

Vision

To become a nationally recognized centre of excellence in Electrical Engineering

Mission

- To provide training to the students by promoting active learning, critical thinking and engineering judgment coupled with business and entrepreneurial skills to succeed as leading engineers
- To prepare students with the capability to meet ever-growing socio-economic necessity of the industry and society
- To create opportunity to encourage self-learning leading to competence of lifelong learning

Programme Educational Objectives (PEOs)

PEO.1. To produce Electrical engineers having strong foundation in mathematics, science, basic engineering & management for providing solution to industrial problem

PEO.2. To train students with good practical exposure to test & verify the characteristics of common electrical equipment/machines/control system & to develop the skill to analyse, appreciate & interpret the data for engineering applications

PEO.3. To inculcate professional & ethical attitude, communication & team work skills

PEO.4. To inculcate the ability to relate engineering issues from social perspective for truly contributing to the needs of society

PEO.5. To develop attitude to deal with multidisciplinary approach in self-learning

Programme Outcomes (POs)

1. Basic and Discipline specific knowledge: Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.

2. Problem analysis: Identify and analyse well-defined engineering problems using codified standard methods.

3. Design/ development of solutions: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.

4. Engineering Tools, Experimentation and Testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

5. Engineering practices for society, sustainability and environment: Apply appropriate technology in context of society, sustainability, environment and ethical practices.

6. Project Management: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.

7. Life-long learning: Ability to analyse individual needs and engage in updating in the context of technological changes.

PROGRAM SPECIFIC OUTCOMES

PSO-1. (Engineering knowledge and analysis)

Analyse specific technological problem relevant to electrical engineering by applying knowledge of basic science, engineering mathematics and engineering fundamentals

PSO-2. (Maintenance and technological development)

Ability to fabricate maintenance and system operation of electrical engineering devices using significant technical skills, analytical ability and uses of modern tools

PSO-3. (Application of the knowledge on society/environment)

Apply the acquired knowledge of electrical engineering assess societal, health, safety, legal and cultural issues with professional ethics and function effectively as an individual or a leader in a team to manage different projects in multidisciplinary industrial environment

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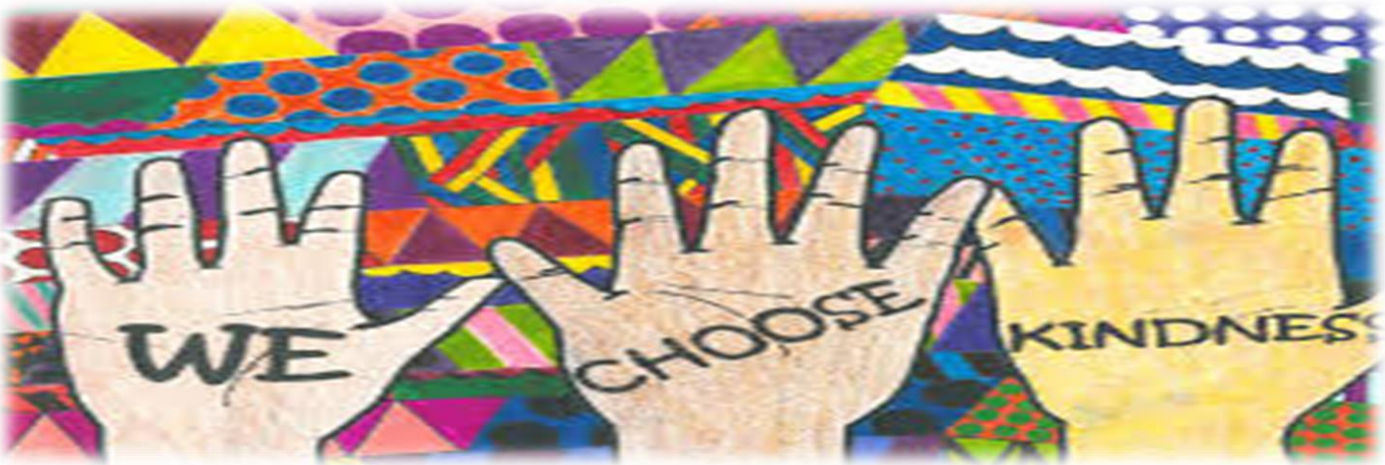


ELECTRICAL CAR

PRITAM KUMAR MONDAL, PRABRAJIT DEY & SANCHAYAN CHATTERJEE
Student of Electrical Engineering Department
Technique Polytechnic Institute, Hooghly, West Bengal, India

1. INTRODUCTION

"Electric cars" generally refer to road-going automobiles powered by electricity and it is propelled by one or more electric motor using batteries. Electric motors give instant torque and smooth acceleration. Its rechargeable batteries can be charged by common household electricity.

For the last several decades, the number of vehicles in the major metros city of the country has been continuously increasing, as a result, people of these cities are falling into the grip of pollution.

Along with this, the common people are getting upset due to the rising prices of diesel and petrol. To overcome these problems, scientists have found electric vehicles as an option.

In this era of the Corona epidemic, we saw how the presence of fewer vehicles on the roads during the lockdown has reduced carbon emissions and made the environment clean.

The use of electric vehicles will reduce pollution and import dependence on other countries for oils will also be reduced.

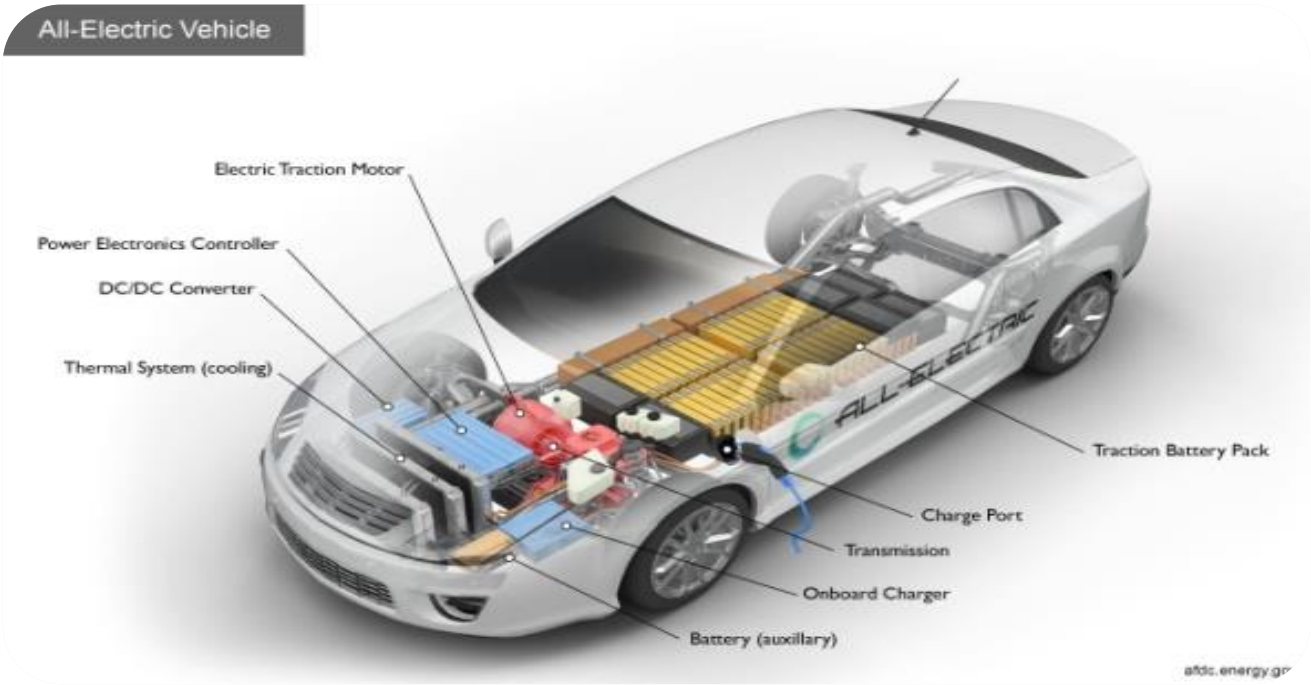
2. HISTORY OF ELECTRIC CARS

It was approximately started in the 1800s, it's very hard to pinpoint the exact date, time, and who invented it because it was a combination of different times as well as different inventors.

In the 1900s, Some Inventors from Hungary, Netherland, and the United States were working on the concept of Battery-powered vehicles. They create a small scale of electric cars and the first electrical-carriage was created by a British inventor.

3. NEED OF ELECTRIC CARS

- Contributes to cleaner air
- To preserve fossil fuels
- Less maintenance



- More efficient
- Cost-effective

4. WORKING PRINCIPLE OF ELECTRIC VEHICLES

The driver presses the accelerator which in turn, sends the signal to the controller.

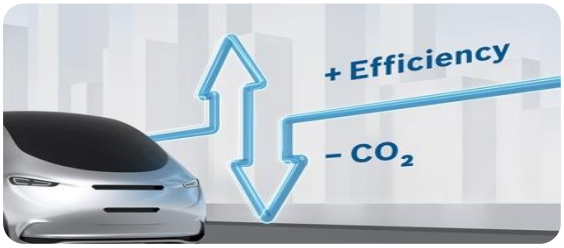
When fully accelerated, the maximum voltage is supplied to the motor.

On releasing the accelerator, no voltage is supplied.

Two potentiometers are connected. When both potentiometers show the same deviation, voltage is supplied further and the car moves.

5. TYPES OF ELECTRIC CARS

There are three types of electric vehicles:



Plug-in Hybrid Electric Car
Hybrid Electric Car
Battery Electric Car

5.1 PLUG-IN HYBRID ELECTRIC CAR

Both electric motors and internal combustion engines needed to run the car.

A combustion engine is used only to charge the battery.

Rechargeable batteries- recharged by internal combustion and regenerative braking.

It has a larger battery pack that is plugged into the electric grid for charging, increasing the share of electric power used by the car.

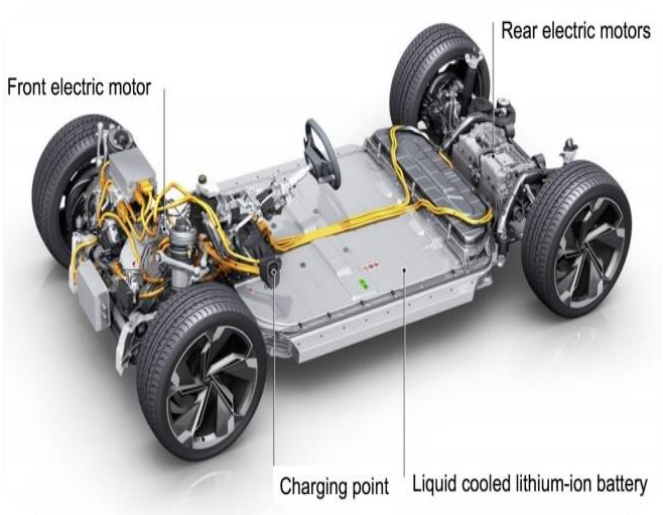
5.2 HYBRID ELECTRIC CAR

Uses a small electric battery to support the internal combustion engine.

Provides increased fuel efficiency.

The battery is recharged by both the gasoline engine and regenerative braking.

Regenerative braking captures kinetic energy to charge the batteries when the driver pushes the brakes.



5.3 BATTERY ELECTRIC CAR

Battery electric vehicles are fully-electric.

No internal combustion engine.

Needs a large recharge time (7-8 hours).

Car halts when the battery dies.

In order to run 80 plus mils, it requires a large battery ie. 18kwh to 36kwh.

Comparison between Electric Cars and Combustion Cars

Electric cars

Combustion Engine

Energy Produced by Batteries.

6. ADVANTAGES AND DISADVANTAGES OF ELECTRIC CARS

Advantages of Electric Cars

1. Cheaper to run because of the low price of electricity than petrol.
2. Zero harmful emissions, better for the environment.
3. Nearly 100% recyclable batteries.
4. Reduce noise pollution.
5. Electric cars contribute to cleaner air.

Disadvantages of Electric Cars

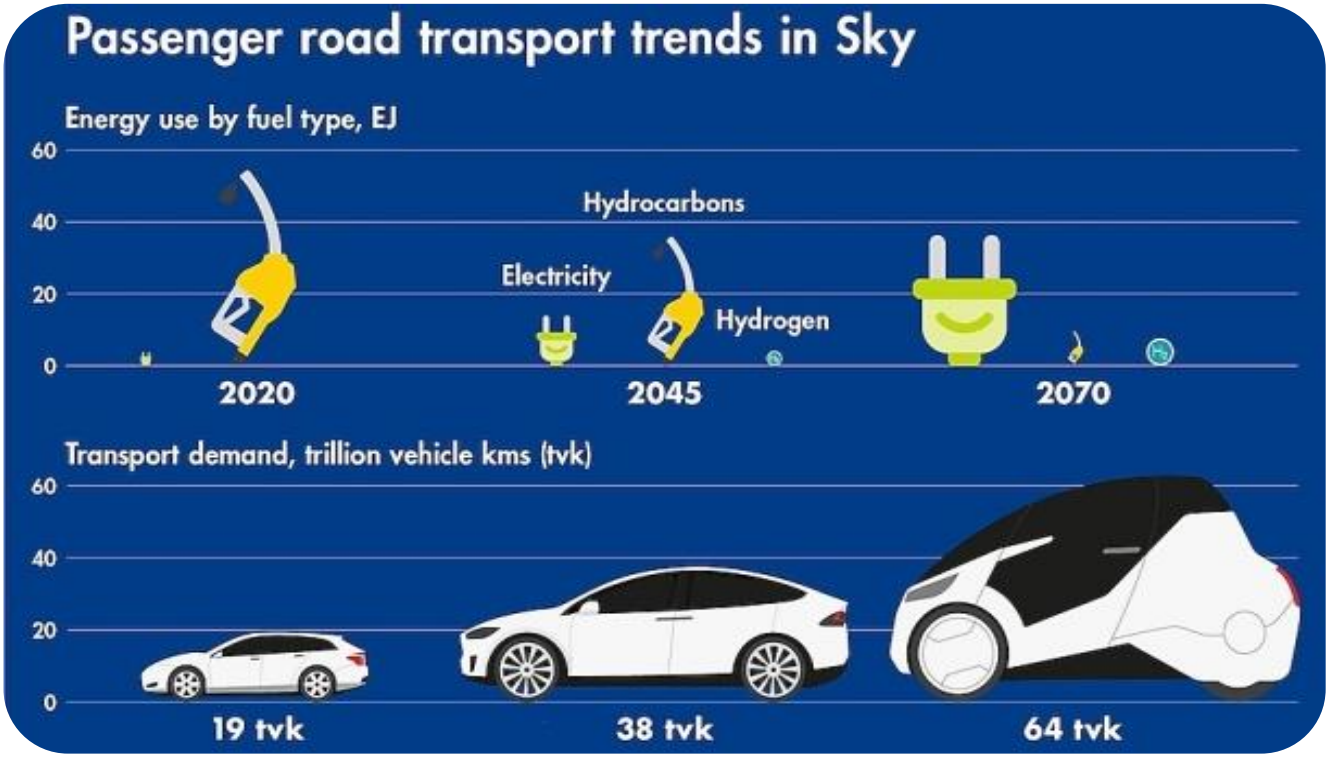
1. The time required to recharge the batteries is more.
2. Lesser charging stations.
3. More expensive than the combustion engine cars
4. The batteries provided are quite heavy increasing the net weight of the car

7. CONCLUSION

India is making a big push for electric cars. The reason behind this is the cost of petrol, diesel and air pollution. Many people think that electric vehicles are far better than Petrol and diesel vehicles.

The Government of India has decided to make the country a 70% electric cars nation by 2030. Thus the adoption of electric vehicles will not only reduce import dependence but will also improve local air quality. Adopting an electric vehicle will prove to be an important and ambitious step.

Therefore, it is necessary that proper policymaking should be given prominence in this direction, and work in the right direction should be taken forward so that electric cars can be used by the common people.



UNDERGROUND CABLE FAULT DETECTION

SATADAL SAHA, PARTHA SARKAR & DIGANTA NEOGI
Student of Electrical Engineering Department
Technique Polytechnic Institute, Hooghly, West Bengal, India

1. INTRODUCTION

In this project we proposed a fault localization model for the underground cable lines with Arduino. The purpose of this paper is to determine the distance from the base station's underground cable fault in kilometres. In this project we used a simple concept of ohm's low. When a fault occurs in the system the distance located on liquid crystal display (LCD). Until the last decade, cables were designed to be placed above the head and, at present, there is no underground cable that is higher than the previous method. adverse weather conditions such as storms, snow, torrential rains and pollution does not effect on underground lines But when a fault occurs in underground lines it is difficult to locate the fault in underground cable. We will find the exact location of the fault. Now the world has become digitized so, the project is to detect exact location of the fault in digital form. Underground cabling system is a more common practice in many urban areas. Although the fault occurs for some reason, at that time, the repair process for this particular cable is difficult because of not knowing the exact location of the cable breakdown. Fault in cable can be classified in two groups: Open circuit fault:-In open circuit fault there is no current because there no conducting complete loop for current flowing that is I=0.in this fault supply voltage is equal to the output voltage. Open circuit fault is better than short circuit fault. Short circuit fault: - In this fault output voltage is zero but current is same Further short circuit fault can be categorized in two types: Symmetrical fault: - In this fault: equal lead current and equal phase shift. Unsymmetrical fault: - In this fault magnitude of current is not equal & phase shifting is not equal by 120 degree. Terminal method:- in this method used to detect the fault location in underground lines without any effort This method used to locate the type of circuit occurs; the voltage drop varies with the default length on the cable, as the current varies. A plurality of resistors is used to represent the cable and a DC voltage is supplied at one end and the defect detected by detecting the voltage variation the defect area to accelerate the tracking of the buried cable.

2. LITERATURE SURVEY

Presented Design & Implementation Of Fault Identification In Underground Cables Using IOT.

This project is to determine the distance of underground cable fault from the base station in kilometres and displayed over the internet. Underground cable system is a common followed in major areas in Metro cities. While a fault occurs for some reason, at that time the fixing process related to that particular cable is difficult due to exact unknown location of the fault in the cable. This Technology is used to find out the exact location of the fault and to send data in graphical format to our website using a GSM module at the same time it display on the LCD screen.

The project uses the standard theory of Ohms law, i.e., when a low DC voltage is applied at the feeder end through a series

resistor (Cable lines), then the current would vary depending upon the location of the fault in the cable as the resistance is proportional to the distance. In case there is a short circuit (Line to Ground), the voltage across series resistors changes according to the resistance that changes with distance .This is then fed to an ADC to develop precise digital data which the programmed microcontroller of the 8051 family displays in kilometres. Underground cables are prone to a wide variety of faults due to underground conditions, wear and tear, rodents etc. Also detecting fault source is difficult and entire line is to be dug in order to check entire line and fix faults. So here we propose cable fault detection over IOT that detects the exact fault position over IOT that makes repairing work very easy. The repairmen know exactly which part has fault and only that area is to be dug to detect the fault source. This saves a lot of time, money and efforts and also allows to service underground cables faster. We use IOT technology that updates the monitored fault information to internet. The system detects fault with the help of potential divider network laid across the cable. Whenever a fault gets created at a point shorting two lines together, a specific voltage gets generated as per the resistors network combination. This voltage is sensed by the microcontroller and is updated to the user. The information conveyed to the user is the information regarding faults detection.

3. ARDUINO BASED UNDERGROUND TRANSMISSION CABLE FAULT LOCATION SYSTEM

The transmission line fault location requires intense human effort and resources. Typically this process is time consuming and while digging the cable there is a risk of damaging the insulation .This paper provides a simple and safe alternative by automating the process of fault detection and location. The project uses the simple concept of OHMs law where a low DC voltage is applied at the feeder end through a series resistor.

The current would vary depending upon the length of fault of the cable in case there is a short circuit of LL or 3L or LG etc. The series resistor voltage droop changes accordingly which detects the exact location of the fault for process of repairing that particular cable. The proposed system finds the exact location of the fault. This system uses an Arduino micro controller kit and a rectified power supply. Here the current sensing circuits made with a combination of resistors are interfaced to Arduino micro controller kit to help of the internal ADC device for providing digital data to the microcontroller representing the cable length in kilometres.

The fault creation is made by the set of switches. The relays are controlled by the relay driver. A 16x2 LCD display connected to the microcontroller to display the information. In case of short circuit, the voltage across series resistors changes accordingly, which is then fed to an ADC to develop precise digital data to a programmed Arduino micro controller kit that further displays exact fault location from base station in kilometres. The project in future can be implemented by using capacitor in an AC circuit to measure the impedance which can even locate the open circuited cable.

Presented Underground Cable Fault Detector Using GSM. The main aim of the project is to detect and locate the fault in underground cable. In the urban areas, the electrical cable runs in undergrounds

instead of overhead lines. Whenever the fault occur the repairing process becomes difficult. It is very difficult to identify the exact location of the fault in underground power cable line. This project will ensure a shorter response time for technical crew to rectify these faults. Fault occur due to short circuit fault, low voltage fault, high voltage fault. Previously proposed technique is used to identify short circuit fault only. This project is used to detect not only detect short circuit fault but also detect, low voltage fault, high voltage fault. The system developed here works on the basis of Ohm's law. The proposed technique is used not only for identification but also it is used to send the detail information about the fault to the authority using GSM and also it cut the power supply on that particular location for the security of the people .It also used to display the type of the fault in LCD display. Whenever a fault occurs in a cable the buzzer produces the sound to alert and to take an immediate action.

4. UNDERGROUND CABLE FAULT DETECTION USING RASPBERRY PI AND ARDUINO

This paper proposes fault location model for underground power cable using raspberry pi and the Internet of Things which is based on the internet, which means the information will be transferred through the internet access. The aim of this method is to determine the distance of underground cable fault from base station in kilometres and also find the location of that faulty place. This paper uses the simple concept of Current Transformer Theory (CT Theory). When any fault like short circuit occurs, voltage drop will vary depending on the length of fault in cable; since the current varies Current Transformer is used to calculate the varying current. The signal conditioner manipulates the change in voltage and a microcontroller is used to make the necessary calculations so that the fault distance is displayed by IOT devices. These fault details are after sent to any access point through the internet and displayed.

5. PROCEDURE

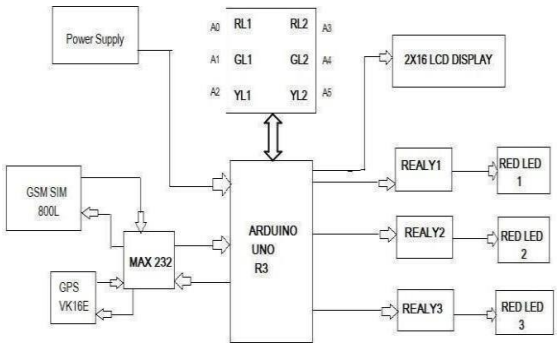
The circuit consists of a power supply, 4 line display, and Arduino and resistance measurement circuit. To induce faults manually in the kit, fault switches are used. About 12 fault switches are used which are arranged in three rows with each row having 4 switches. The 3 rows represent the 3 phases namely R, Y and B. The fault switches have 2 positions-No fault position (NF) and fault position (F).Main component of the underground cable fault detection circuit is low value resistance measurement. It is constructed using a constant current source of 100mAmps. It can measure very low value resistance as the cables have around 0.01 Ohm/meter resistance. For 10meter cable resistance becomes 0.1 Ohm. This circuit can measure resistance up 50 Ohm, Maximum cable length it can check up to 4 kilometres.

So starting from the reference point 3 sets of resistances are placed in series. These 3 sets of resistances represent the three phases and the neutral. Short circuit faults, Symmetrical and unsymmetrical faults can be determined by this method. This project uses three set of resistances in series (ie)R10R11-R12R12,R17-R16-R14R21,R20-R19-R18-R25 one for each phase. Each series resistor represents the resistance of the underground cable for a particular distance and so here four resistances in series represent 1-3kms.Value of each resistance is 10kΩ.

One relay for each phase R,Y and B as three relays are used and the common points of the relays are grounded and the NO points are connected to the inputs of R17,R21 and R25 and being the three phase cable input. As supply needed for the relays is higher than that of the arduino, Relay driver is used to boost the supply and provide it to the relays. A 230V AC supply is applied to the transformer from where it is stepped down to 12V AC From the transformer the alternating current gets converted into direct current when it passes through a Bridge wave rectifier .The 12V DC then goes to the voltage regulator where it gets converted from 12V DC to 5V DC Voltage regulator is used also converts the variable Dc supply into constant DC supply. This 5V DC is used to supply power to the Arduino and the LCD Power supply to the LCD is given from the voltage regulator.

When fault is induced by operating any of the 12 switches (to F position), they impose conditions like LG, LL, LLG fault as per the switch operation. As a result of the fault, there is a change in voltage value. This voltage value measured across the resistance is fed to the ADC of the Arduino. Using this value, the Arduino computes the distance. Finally the distance of the fault from the base station is displayed in kilometre.

6. BLOCK DIAGRAM



7. COMPONENT RATINGS

COMPONENTS	RATINGS
Diode	IN4007
Capacitor	22pF
Resistor	1k Ω
Resistor	470 Ω
Resistor	10k Ω
LED	3
BJT	BC547
Arduino	UNO R3
Crystal	16MHZ
Relay	12V
Push buttons	-
IC base	-
PCB	-
Wires	2 METERS
Transformer	12V

8. SOFTWERE REQIREMENTS

Proteus ISIS [System Design]

The Proteus Design Suite is an Electronic Design Automation (EDA) tool including schematic capture, simulation and PCB Layout modules. It is developed in Yorkshire, England by Lab centre Electronics Ltd with offices in North America and several overseas sales channels. The software runs on the Windows operating system. The micro-controller simulation in Proteus works by applying either a hex file or a debug file to the microcontroller part on the schematic. It is then simulated along with any analog and digital electronics connected to it. This enables it's used in a broad spectrum of project prototyping in areas such as motor

control, temperature control and user interface design.

9. ADVANTAGES

Less maintenance

- It has higher efficiency
- Less fault occur in underground cable. This method is applicable to all types of cable ranging from 1kv to 500kv
- It can detect other types of cable fault such as Short circuit fault, cable cuts, Resistive fault, Sheath faults, Water trees, Partial discharges.

10. FUTURE SCOPE

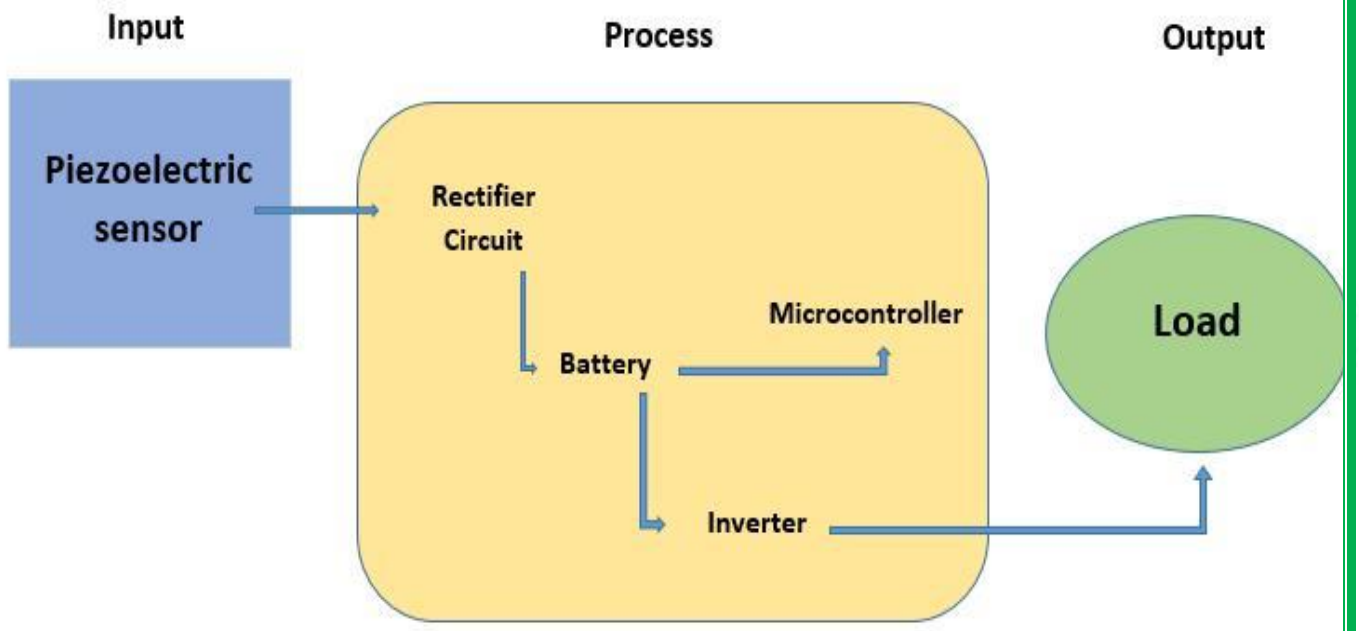
In this project we detect the exact location of short circuit fault in the underground cable from feeder end in km by using Arduino. In future, this project can be implemented to calculate the impedance by using a capacitor in an AC circuit and thus measure the open circuit fault.

FOOT STEP POWER GENERATOR

AYAN BHAR, SAYAN MAITY, SUMIT GUCHAIT & SUMAN DAS
Student of Electrical Engineering Department
Technique Polytechnic Institute, Hooghly, West Bengal, India

1. INTRODUCTION

We are using converts battery charging unit also for giving supply to the circuitry.



In this project we are generating electrical power as non-conventional methods by simply walking or running on the foot step. Non-conventional energy system is very essential at this time to our nation.

Non – conventional energy using foot step is converting mechanical energy into electrical energy. Man has need and used energy at an increasing rate for his sustenance and well-being ever since he come on the earth a few million years ago. Due to this a lot of energy resources have been exhausted and wasted.

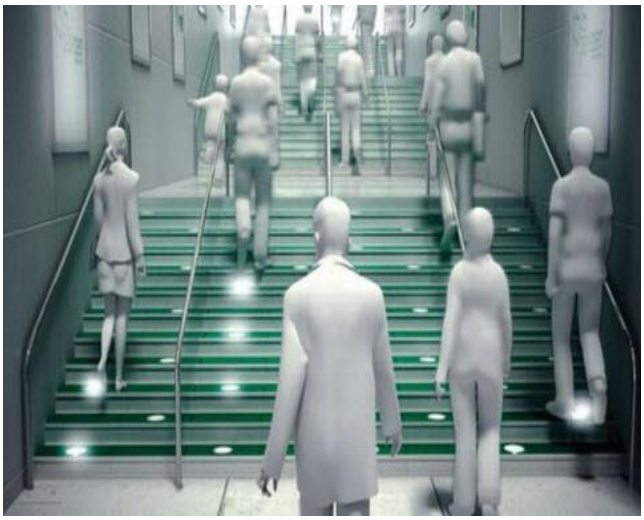
2. WORKING

Whenever forced is applied on piezoelectric crystal that force is converted to electrical energy is used to driven DC loads. And that minutes voltage which is stored in the lead acid battery. The battery is connected to the inverter. This inverter used to convert the 12V D.C to the 230 V A.C voltage used to activate loads.

3. APPLICATIONS

Foot step generated power can be used for agricultural, home applications, street lighting.

Foot step power generating can be used in emergency power failure situations. Motors, rural applications etc.



4. CONCLUSION

The project is successfully tested and implemented which is the best economical, affordable energy solution to common people. This can be used for many applications in rural areas where power availability is less or totally absence. As India is a developing country where energy management is a big challenge for huge population. By using the project we can drive both A.C.as well as D.C loads according to the force we applied on the piezo electric sensor.

TECHNOLOGY IN THE CLASSROOM: THE BENEFITS OF SMART BOARDS

MANOJ DAS, AVIK MAITY, SAYAN MAITY & SUVANKAR DAS
Student of Electrical Engineering Department
Technique Polytechnic Institute, Hooghly, West Bengal, India

If you are "with the times," then you may be so lucky as to have a Smart Board in your classroom. This interactive whiteboard is replacing the overhead projector in many classrooms across the United States. Smart Board technology in the classroom can enrich your curriculum by taking a typical lesson and turning it into a fun, more interactive one. Here are a few of the amazing advantages to utilizing technology in the classroom by having a smart board.

Smart Boards Enhance Students' Learning Experience

In classrooms all over the country, Smart Boards are being installed because this amazing technology not only enhances the way teachers teach, but it also enhances the way students learn. It can provide students with an enriched learning experience by projecting visual elements. It also makes differentiated learning much easier because teachers are able to accommodate different learning styles. Visual learners are able to observe the whiteboard, while tactile learners can learn by touching the board. The touchscreen option allows teachers to run programs with the tap of their finger. This makes it not only easy to navigate for the teacher but for the students as well.

In addition to that, a student's learning experience is enhanced by technology because of its ability for students to view diagrams, charts, videos, and more right on the huge screen in front of them. Their learning comes to life, and many students find it more fun to learn than ever before.

Smart Technology is Interactive

Perhaps one of the greatest advantages of Smart Boards is their ability to be interactive. Students learn best when they are fully engaged, and hands-on learning is one of the best ways to do that. With this technology, every child in the classroom has the ability to utilize the Smart Board at the same time. For example, advanced Smart Boards have the ability for students to use their finger and write directly on them. Most Smart Boards have separate workspaces so several children can utilize the smart board at once. This interactivity provides students the ability to write, draw, or take notes via a tablet as well.

They Are Low Maintenance

Smart Boards are very easy to use and require very little maintenance. The boards do not use chalk or markers (which can be messy); you only use your finger or a special pen. You will also find that they are very easy to clean.

You Have Access to Online Resources

Smart technology offers learners easy access to online resources. They can be set up in the class so all students can view any website or video through a computer application. Teachers have access to a slew of knowledgeable databases that can help them reinforce their lessons. Students can easily access a wide range of resources to help them complete a project or conduct research.

They Are Environmentally Friendly

If you are looking to "go green," here is your chance. Smart Boards are environmentally friendly because they eliminate the need for paper. There will be no need to photocopy and print a class set of papers. These interactive boards will help the environment in eliminating the tons and tons of wasted paper and ink that are dumped each year.

Smart Boards Allow for Technology Integration

One of the many benefits of Smart Boards is the ability for technology integration. Teachers are able to connect their computers, video cameras, digital cameras, microscopes, and pretty much anything else that you can think of to help aid in instruction.

Proven Success Rates

Using smart technology in the classroom can help raises test scores, improves student learning, enhances literacy, boosts attentiveness, and increases comprehension, to name a few.

Teachers report that the number one benefit that they see in their classrooms that use Smart Boards is an increase in student engagement. These interactive boards provide an extraordinary opportunity for teachers to create a classroom environment where students with different learning styles can learn from each other. This easy-to-learn technology ensures that both teachers and their students are developing the 21st century skills that they need in order to succeed in today's world.

SOLAR POWER VIA THE MOON

GOURAB GHOSH, DEBOLIN GUPTA & SAYAN SANTRA
Student of Electrical Engineering Department
Technique Polytechnic Institute, Hooghly, West Bengal, India

Prosperity for everyone on Earth by 2050 will require a sustainable source of electricity equivalent to 3 to5 times the commercial power currently produced. Because of the low average incomes in developing countries, however, this energy must be provided at one-tenth the present total cost per kilowatt-hour. Solar-power stations constructed on the moon from com-mon lunar materials could provide the clean, safe, low-cost commercial electric energy needed on Earth. Currently, commercial energy production on Earth raises concerns about pollution, safety, reliability of supply, and cost. These concerns grow as the world's nations begin to expand existing systems to power a more prosperous world. Such growth could exhaust coal, oil, and natural gas reserves in less than a century, while the production and burning of these fossil fuels pollute the biosphere. Expanding nuclear fission power would require breeder reactors, but there is intense political resistance to that idea because of concerns about proliferation, nuclear contamination of the environment, and cost. Thousands of large commercial fusion reactors are highly unlikely to be built by 2050.Terrestrial renewable systems (hydroelectric, geothermal, ocean thermal, waves, and tides) cannot dependably pro-vide adequate power. Using wind power would require capturing one-third of the power of the low-level winds over all the continents. Although energy coming directly to Earth from the sun is renewable, weather makes the supply variable. Very advanced technologies, such as 30% efficient solar cells coupled with superconducting power transmission and storage, imply solar arrays that would occupy selected regions totalling 20% of the area of the India. Studies funded by the World Energy Council project that terrestrial solar energy will provide less than 15% of the electric power needed for global prosperity by 2050.

Benefit of space

A possible way around this would be to generate solar energy in space. There are many advantage to this. A space based solar power station orbit to space the sun 24 hours a day the earth atmosphere also observe and reflect some of the sunlight, so solar cells above the atmosphere will receive more sunlight and produce more energy. But one of the key challenges to overcome is how to assemble, launch and deploy such large structures. A single solar power station may have to cover as much as 20 sq. km (4.9 askew Mills) equivalent to 1400 football ground, as the biggest expenses will be the cost of launching the station into space on a rocket.

One proposed solution to develop is to develop swarm of thousands of smaller satellites that will come together and configure to from a single, large solar generator. In 2017, research at the "California institute of technology". Out leader design for modular power station, consisting of thousands of ultralight solar cell tills. They also demonstrated a prototype still weighing just 280g per square metre, similar to the weight of card.

Recently development the manufacturing such as 3D printing are also investigated for their potential in in space power at the University of Liverpool we are exploring new manufacturing technology for printing ultra-light solar cell on to solar cells. A solar cell is a foldable, light-weight and highly reflective membrane capable of harnessing the effect of the sun radiation pressure to propel a space craft forward without fuel. We are exploring how to embed solar cell on soil structure to create large, fuel free Power station.

These method would enable us to construct the power station in space. Indian IIT could one day be possible to manufacture and deploy unit in space from the international space station on the future lunar gate way station that will orbit the moon. Search devices schooled in fact help provide power on the moon.

The Possibilities don't end there will we are currently reliant on materials from Earth to build power station, scientist are also considering using resonance from space for manufacture such as materials found on the moon. But one of the major challenges ahead will be getting the power transmitted back to earth the plan is to convert electricity from the solar cell into energy waves and use electromagnetic field to transfer them down to an antenna video on the earth surface. The antenna would the convert the waves back into electricity. Research lead by the Japan aerospace exploration agency have already developed design and demonstrated on orbiter system which should be able to do this.

There is still a lot of work to be e don't in this field but the aim is that solar power station in space I will become a reality in the coming decades. Research in China have designed a system called Omega, which they aim to have operational by 2050. The system should be e capable of supplying 2 GW of power into earth s grid at peak performance which is a a huge amount. To produce the much power with solar panels on earth you would need more than 6 million of them.

A system called Omega which they aim to have operational by 2050. This system should be capable of supplying 2GW OF POWER in to earth grid at peak performance which is a huge amount. To produce that much power with solar panels on earth, you would needed more than 6 million of them.

Across the globe, the scientific community is committing time and effort to the development of solar power station in space. Our hope is that they could one day be a visual tool in our fight against climate challenge.

“Amanda Jane Hughes is a lecturer in energy engineering at the University of Liverpool, where research are includes the design of solar cell and optical instrument. Stefanie Soldini is a lecturer in aerospace engineering at the University Of Liverpool and her expertise includes numerical simulation for spacecraft mission design and guidance, navigation and control, asteroid and solar sail mission"

SMART GRID

ANIRBAN DEY, SURAJIT MONDAL, PRITIKA PAL & PRASUN DAS
Student of Electrical Engineering Department
Technique Polytechnic Institute, Hooghly, West Bengal, India

The electric power industry needs to be transformed in order to cope with the needs of modern digital society. Customers demand higher energy quality, reliability and a wider choice of extra services, at the same time they want energy prices to be lower. As a consequence, a structural change in traditional electricity supply systems is demanded, which provides alternative solutions of grid integration as well as daily electricity system operation at minimal cost for society. The vision for Smart Grid is due to growing recognition for electricity grid modernisation to integrate, enable new electricity generation sources and consumption schemes. Modern power grid needs to be smarter in order to provide an affordable, reliable and sustainable supply of electricity.

Smart Grid Smart Grid is a broad collection of technologies that delivers an electricity network that is flexible, accessible, reliable and economic. Smart Grid facilitates the desired action of its users and these may include distributed generation, deployment of demand management and energy storage systems or optimal expansion and management of grid assets. In general, the 'Smart Grid' can be defined as 'a system of systems'. It is a platform that enables functioning of different technologies and systems. From the Information Technology point of view, the Smart Grid technology will significantly increase the amount, quality, and use of data received from various sensors and meters. Another driving factor of Smart Grid is the new 'smart' way of energy use. It implies energy resource optimisation (e.g., own generation or distribution grid), as well as optimisation of time of use (e.g., avoiding peak hours usage). In smart grid, network flow of electricity from utility to consumer becomes a two way conversation, saving consumers money, energy, delivering more transparency in terms of end-user use, and reducing carbon emissions. Smart Grid Technology can be grouped into five key areas, Sensing and measurement, Smart meters, Phasor measuring units and integrated communications with advanced control.

The characteristics of Smart Grids are:

1. Optimised for best resource and equipment utilisation, open for all types and size of generation
2. Interactive (customers, retailers, markets)
3. Adaptive and scalable (for changing situations)
4. Proactive rather than reactive (to prevent emergencies)
5. Reliable and secure (from threats and external disturbance)
6. Efficient
7. Environmental friendly (using renewable energy resources)

Technology Development some of the technologies that enable Smart Grids are available on the market today. Smart Grids will move the utility industry into the information age as the information about energy consumption, generation, distribution and storage will become available in the real-time. Until today, the electric utility industry has lagged behind other industries in taking advantage of the modern communication and networking technologies. Therefore, first steps towards introducing Smart Grids will not be 'creating new technologies', but introduce and synergise the technologies of today.

Applications of Smart Grid

Demand Response (DR) has recently gained a lot of interest among regulators, utility, consumers and government. It is a relatively simple concept, the benefits of which are mostly experienced by end-customers. It encourages consumers to reduce their electricity consumption during peak price hours. Demand response solutions vary from simple advanced metering systems to fully automatic home systems. The demand response system consists of at least two interconnected devices,

installed at customer's premises: a smart load controlling device and a smart meter. DR is a faster, cleaner, cheaper and more reliable solution compared to adding a new power plant during peak hours. Both end-customers and utilities will benefit from the introduction of this solution. The fact that both parties will save money will be a huge driver for adoption of demand response technique. Smart Grid Initiatives in India: India Smart Grid Forum (ISGF), which is a non-profit voluntary consortium of public and private stakeholders, was launched on 26th May 2010. India Smart Grid Task Force (SGTF) has been formed, which is an Inter-Ministerial Group – and will serve as a focal point for activities related to the smart grid technology. Power Grid Corporation of India ltd. is coming up with Smart grid project in Pondicherry. Uttar Gujarat Vij Company limited (UGVCL) has commissioned the first smart grid at Naroda in North Gujarat. Smart-grids must help India move away from coal and oil to renewable resources as its economy grows.

Smart Grid in India can be used to

1) Reduce distribution losses

2) Enable decentralised power-generation and optimise usage;

3) Explore alternate methods of storage, including storage of heat (cool);

4) Handle peak-demand better;

5) Manage demand and supply to meet activities at all points of time, by using storage and high-cost instantaneous power-sources at different levels

6) Intelligently decide where to do load shedding if no other options

7) Enable time of day metering with remote monitoring.

Conclusion

Smart Grid platform promises to transform the way power is delivered, consumed, and accounted for. This can also facilitate network planning and construction, operation management, market trading and service in power sector. Introduction of smart grid in India will improve security, reliability, safety and efficiency of the power supply.

WIRELESS ELECTRICITY

SUDIPTA SADHUKHAN, SWARUPA BOSE, SAYAN PAUL & VANAPALLI KEERTI
Student of Electrical Engineering Department
Technique Polytechnic Institute, Hooghly, West Bengal, India

1. INTRODUCTION

First demonstrated by Nicholas Tesla in the 1890s, wireless power transfer is an innovative technology that has permeated major areas in the consumer and industrial electronic market. The various forms of WPT include solar energy, microwaves, and magnetic energy. In this article, we will focus on wireless power transfer using magnetism and induction coils. The following offers an insight into the working principle, features, and applications.

2. WORKING PRINCIPLE

Wireless power transfer works on the inductive power transfer principle, as found in the conventional transformers. The only difference is that while in the transformer the two coils are in very close proximity and contain a ferrite material to increase the coupling, inductive chargers have an air gap between the two coils. The process follows the following procedure:

The mains voltage is converted into alternating current, preferably, high-frequency AC This current (the high-frequency AC) is transferred to the coil via transmitter circuit. This AC induces a magnetic field in the transmitter coil. The induced magnetic field generates a current in the adjacent receiver coil. However, in the earlier applications, the designers faced a challenge; the strength of a magnetic field decreases with distance. The decrease in strength is proportional to the square of the distance from the source. This made it difficult to regulate power and reduced energy efficiency. To solve this, the designers introduced resonance. You acquire resonance by multiplying the capacitance of the plates attached to the ends of the coil with the coil inductance. The introduction of resonators with the same frequency in the sources and receiver coil respectively ensures that the two systems couple magnetically, thus allowing for higher energy transfer efficiency. This means that the power transfer happens over an air gap without the need for metal or other material connection. For this to happen, both the transmitter and the receiving coil must resonate at the same frequency. The generated AC is converted into direct current for charging the battery. However, in cases where the two objects are far apart, power transfer can still be achieved through resonating the two coils at the same frequency. This eliminates the need for perfect alignment. Greater power transfer distances can be achieved by introducing resonant repeaters between the two components.

3. APPLICATION

When it comes to specific applications of wireless power, each use should be carefully considered. There are a few obvious ones that nearly everyone has heard about:

a. cell phones on the low-power charging pad.

b. electrical vehicle changed wirelessly in the garage with transmit coil being located in the garage floor.

c. implant charged inside the human body. Each one of these applications has its own justifications.

d. the area covered by RF field is small and power level is small.

e. it is difficult for humans to access areas with high RF fields

f. an absolute necessity as using wireless power to charge the implant battery is still preferable to surgical intervention. Two more examples that we can think of are to wirelessly power a lamp on the ceiling, and to wirelessly power TV on the wall. Both of these examples clearly fall into “difficult to access” category. As wireless power becomes more and more a part of our lives, it is important to understand what is behind the wireless charging process.

4. ADVANTAGES

- Simple design
- Lower frequency operation
- Low cost
- Practical for short distance

5. DISADVANTAGES

- High power loss
- Non-directionality
- Inefficient for longer distances

6. CONCLUSION

Wireless power transfer has the potential to change this planet on so many different levels. Whether it is charging a handheld device, to changing the effect of global warming on this planet, wireless power transfer has an answer. The most commercially viable application arising to counter the effects of global warming and the increasing demand for electricity is WPT through microwave transmission from space. This application will supply limitless power to earth and also open up many new opportunities for space exploration. With WPT through resonance and inductive coupling, emerging technology companies are able to broaden the capabilities of most small electronics including cell phones, PDAs, and mp3 players. By forecast, Wireless Power Transfer will be the Most marketable and sustainable alternative to fossil fuel power plants. With advancements in the field happening all the time, a worldwide wireless power transfer system is a possibility in the near future.

NET-ZERO EMISSIONS BY 2050

SHAMIK CHATTARAJ
Lecturer of Electrical Engineering Department
Technique Polytechnic Institute, Hooghly, West Bengal, India

Greenhouse gas emissions from human activities are causing climate change, including global warming. To slow climate change requires reducing these emissions. Large reductions in greenhouse gas emissions in INDIA over the next decade are technologically feasible, and achieving net-zero emissions in INDIA and globally by 2050 would have a big impact on future climate change.

Achieving *zero* emissions means releasing no greenhouse gases to the atmosphere—that is, no carbon dioxide (CO_2), no methane, no nitrous oxide or other greenhouse gases. Achieving *net-zero* emissions means that some greenhouse gases are still released, but these are offset by removing an equivalent amount of greenhouse gases from the atmosphere and storing it permanently in soil, plants, or materials. Because it would be prohibitively expensive or disruptive to eliminate some sources of emissions entirely, achieving net-zero emissions is considered more feasible than achieving zero emissions at a nationwide scale.

Many governments and businesses have set a goal of achieving net-zero emissions by 2050. Huge amount of greenhouse gas emissions is measured in terms of CO_2-equivalent, which is the amount of CO_2 that would have an equivalent global warming impact as a different greenhouse gas (for example, methane or nitrous oxide). To achieve net-zero emissions across the entire INDIA would require reducing net emissions by an average of 0.2 Gigatons of CO_2-equivalent per year over the next 30 years. If the INDIA were to achieve this goal, it would reduce global greenhouse gas emissions by about 10%.

Technologies are needed to achieve this goal – *Generate electricity without emissions.* Using sources such as wind, solar, nuclear, and water power combined with advances in electricity storage can provide much of the nation's electricity with minimal CO_2 emissions. Other low-carbon energy sources can be used alongside these power sources to make sure electricity is always available.

2. *Use vehicles and equipment that are powered by electricity instead of fossil fuels.* Many of the biggest sources of greenhouse gas emissions can be replaced with equipment powered by electricity. In particular, switching to electric cars and trucks and using electric heating for buildings would greatly reduce emissions.

3. *Use energy more efficiently.* More efficient technologies and processes that reduce energy use can also reduce emissions significantly. Switching to electric equipment often improves efficiency. Also, "smart" technologies, which sense when energy is needed and when it is not, can help to optimize how electricity is generated and used, helping minimize waste.

4. *Remove carbon dioxide from the atmosphere.* To offset emissions that are too costly or difficult to avoid, it is necessary to remove CO_2 from the atmosphere and store it permanently. This can be done with technologies that directly capture CO_2 from the air and trap it so it cannot re-enter the atmosphere. Plants and soils already remove CO_2 from the atmosphere, and certain land management practices can increase their capacity to absorb and store carbon. Existing technologies can support all of these strategies, but they will need to be implemented rapidly at a very large scale to achieve net-zero emissions nationwide by 2050. This will require new policies and investments as well as careful attention to the social and economic trade-offs involved. It will also require participation and commitment by government, industry, and individuals. Additional innovation can further improve technology solutions and reduce the costs.

Electricity becomes the core of the energy system –

It will play a key role across all sectors, from transport and buildings to industry. Electricity generation will need to reach net-zero emissions

globally in 2040 and be well on its way to supplying almost half of total energy consumption.

This will require huge increases in electricity system flexibility – such as batteries, demand response, hydrogen-based fuels, hydropower and more – to ensure reliable supplies.

A clean energy world

The global energy sector in 2050 is based largely on renewables, with solar the single largest source of supply. Achieving this cleaner, healthier future will rely on a singular, unwavering focus from all governments, working closely with businesses, investors and citizens.

It will also require greater international cooperation among countries, notably to ensure that developing economies have the financing and technologies they need to reach net zero in time.

Renewables

Renewable energy technologies like solar and wind are the key to reducing emissions in the electricity sector, which is today the single largest source of CO2 emissions.

In our pathway to net zero, almost 90% of global electricity generation in 2050 comes from renewable sources, with solar PV and wind together accounting for nearly 70%.

Electrification

As electricity generation becomes progressively cleaner, electrification of areas previously dominated by fossil fuels emerges as a crucial economy-wide tool for reducing emissions.

This takes place through technologies like electric cars, buses and trucks on the roads, heat pumps in buildings, and electric furnaces for steel production.

Reducing global carbon dioxide (CO_2) emissions to net zero by 2050 is consistent with efforts to limit the long-term increase in average global temperatures to 1.5˚C. This calls for nothing less than a complete transformation of how we produce, transport and consume energy. The growing political consensus on reaching net zero is cause for considerable optimism about the progress the world can make, but the changes required to reach net-zero emissions globally by 2050 are poorly understood. A huge amount of work is needed to turn today's impressive ambitions into reality, especially given the range of different situations among countries and their differing capacities to make the necessary changes. This special IEA report sets out a pathway for achieving this goal, resulting in a clean and resilient energy system that would bring major benefits for human prosperity and well-being.

COST ESTIMATION, SIMULATION & DEVELOPMENT OF A SMALL SCALE THREE PHASE TRANSMISSION LINE FAULT DETECTION SYSTEM USING ARUDINO UNO

ANJANA SENGUPTA[1], SANDIP KUNDU[2], SITAL MONDAL[2], PRASUN DAS[2], MANAS CHOWDHURY[2] & KRISHENDU GHOSH[2],
[1]Lecturer Technique polytechnic Institute, [2]Student. Technique polytechnic Institute

ABSTRACT: -This paper introduces an overhead fault location model of cable using ARDUINO, used for remote indication to diminish the chances of faults in overhead line. In an overhead system, two main fault can be occurr-1) Line to Line fault, 2) Line to Ground fault. This prototype made as the circuit diagram and a set of switches are used to create fault, the faults are displayed on a LCD connected with the ARDUINO UNO board, and also the lamps indicate the faults which are connected with ARDUINO UNO by relay switch. Further Proteus software is used to simulate the fault. This project is beneficial to reduce the accident occurs by those faults and will save the time and efforts for sectionalization of faults and improving the power availability to consumers through an enhancement of overall efficiency of power nets.

1. INTRODUCTION

In our three phase overhead transmission & distribution line system, we faced some problems due to the faults take place in those transmission lines. We know the faults mainly are: 1) Line to Line fault & 2) Line to Ground fault. This project uses ARDUINO UNO technology so that we can detect any fault in the transmission line & cut the supply to avoid danger. Relay will be responsible for turn off the supply.

In rural area, we see that there are manual fault detection systems in every transmission line. But we arrange a prototype model of Automated Transmission Line Fault Detection System, which helps to cut off the supply of the line & send a signal to the respective authority.

2. PARAMETERS WHICH ARE OF CONCERN

1. **FAULT OCCURES IN TRANSMISSION & DISTRIBUTION LINE:** We know the faults mainly are: 1) Line to Line fault & 2) Line to Ground fault. When two transmission lines of different phases make contacts with each other mainly while swinging of lines due to wind, then a fault occurs, which is known as 'Line to Line fault'. In this case a huge amount of current flows through the transmission circuit which can damage a lot of equipment associated with it.
   Also due to insulation breakdown between one of the phase & earth, single line fault or 'Line to Ground fault' occurs in the transmission line. This type of fault can interrupt the power flow for indefinite time.
2. **FAULT CURRENT:** Fault current is calculated by the formula of Ohm's Law, where the current is equal to the voltage divided by resistance. In case of line to line fault, fault current become large as the resistance becomes low due to short circuit.
3. **RESPONSE TIME:** Relay module should take less time to interact. It is measured of other parameters such as fault current.
4. **CT RATING:** CT rating is plays an important role in this module. The module can be used in distribution (400V to 11 KV) as well as transmission (33 KV to 765 KV) line by replacing the C.T according to the required ratio.
5. **ROBUSTNESS:** The module should perform consistently.
6. **COST:** Total cost of this system should not costly.

The importance of this project is high in the market because Automated Transmission Line Fault Detection System, can help the Electric Supply Authority to prevent faults quickly in a

transmission line. They can control those faults easily & more accurately. The employs also have the proper details of those faults & the automatic system helps to prevent any damage or accident by cutting off the supply. Here are the some advantages of implementing Time & Attendance Management solution.

3. WORKING PRINCIPLE

This TPLED gives the fault location & immediately isolates the faulty part from the healthy part of the network .The circuit under the faculty area creates a message of location provided to it & will be transferred it directly to the area In-charge rather than the Electricity board. Also at each & every pole the RYB indicators are placed which gives ease of access of faulty phase up to the fault location. According to our survey the cost of one distance relay is 65 times higher than our TLED circuit, it can be used in distribution (400V to 11 KV) as well as transmission (33 KV to 765 KV) line by replacing the C.T according to the required ratio.

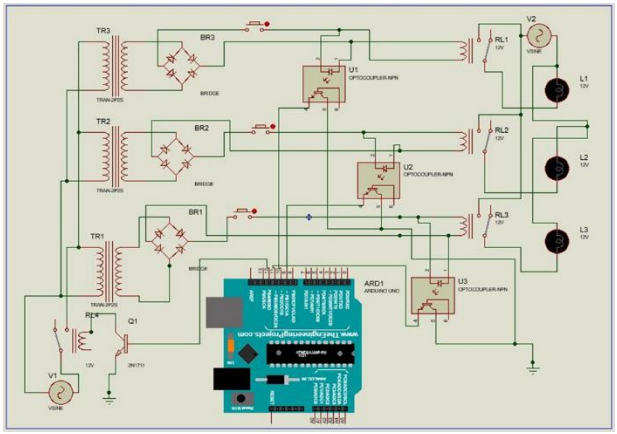
Distance relays respond to the voltage and current, i.e., the impedance, at the relay location. The impedance per mile is fairly constant so these relays respond to the distance between the relay location and the fault location. As the power systems become more complex and the fault current varies with changes in generation and system configuration, directional over current relays become difficult to apply and to set for all contingencies, whereas the distance relay setting is constant for a wide variety of changes external to the protected line.

A Three Phase Line Fault Detection (TPLFD) is a device which provides visual indication & remote detection of the abnormal condition on electrical power distribution system. The solid faults as mentioned can be detected by GSM module via calls and messages. While patrolling of this fault it can be indicated by RYB indication lamps, in recent working condition impedance relay or distance relays are used to locate the fault. But this requires long time to calculate the distance using the impedance & the pre-fault current, till to reach the fault location and repair the faulty phase, the system will be in OFF state and the supply to the consumers is unreliable.

In LFD we had used the Current transformer (C.T.) of good sensitivity. As shown in the C.T. is connected or Clamped on each phase and the secondary terminal of each C.T. is connected to three single bridge rectifier which gives D.C. current and converted into respective voltage by using I to V converter. Here some reference output voltage with respect to current is set to the input of microcontroller. Here the microcontroller circuit acts as the zero crossing detector, if the voltage of any circuit exceeds the reference voltage then the microcontroller sends the command to the GSM module and relay of phase indication lamp.

The GSM module creates the message using microcontroller which reads the faulty phase and the location of feeder and sends it to the Operator, Sub Engineer and Junior Engineer of that location. After these the operator will receive the location of fault and faulty phase and alerting calls at certain period. If that operator does not respond the clearing of fault or reset the abnormal condition to normal condition in between the period of calls. The next call will be transferred to the area Sub Engineer; similarly if Sub Engineer does not respond to the Operators work then further call will be transferred to the Junior Engineer.

By this process the work or clearance of fault will be done quickly with their responsibility. The RYB indication is placed at the top of the pole or tower which will indicate at long distance and shows the faulty phase from far end which will shows the actual location of fault and hence Operator can find out the TPLFD circuit and can repair. The digital display is provided to show the pre fault current and the faulty phase on the location. Also after the fault is occurred the supply to the circuit is disconnected, so the external battery source with battery charging circuit is provided to keep the TPLFD circuit continuously in operation.



4. SIMULATION RESULT

The simulation of the system is done in the Proteus software. In this software it is difficult to show the total connection of this system including ARDUINO & Relay Module.

Firstly we step down the 230V supply voltage to 12V supply as our module required. Then we step down the current through CT. There is a rectifier circuit which provides the required DC supply to ARDUINO & Relay module.

We used to show faults by operating the push button switches.

When faults occur the buzzer rings & the LED lamps stop glowing to indicate the fault.

Also there is a LED display, which displays the particular line or phase where the fault actually occur.

5. FUTURE SCOPE

This technology has a high future scope as compare to the other. We mansion some point which's makes it different from other system

1. In future we can make a voice call which give information about fault and fault location.
2. In future by using SCADA system the fault location will be displayed on computer screen.
3. Separate three microcontrollers for individual phase can be provided to give accuracy of the fault indication.

6. ADVANTAGES

1. It very easy to handle.
2. It can be used for Distribution (400V to 11kV) as well as Transmission (33kV to 765kV) line by replacing the C.T according to the required ratio.
3. The system will helps to save time & money.
4. The system will helps to prevent any damage or accident.
5. This system doesn't allow any current flow if there is a fault.
6. The respective authority can give service to public more properly.
7. After applying these system the authority can control this more accurately.
8. Power supply will be easier & accurate.

7. LIMITATION OF THIS SYSTEM:

1. High maintenance required.
2. Experience employees are required to handle this module.

G. CONCLUSION

This paper concludes that the GSM technology used for the fault detection of three phase line through calls and messages is provided to the in-charges of that location, by the means of communication protection schemes. The Messages of fault location will send to the all In-charges at a same time by the internal programming of microcontroller connected to GSM Module. But the Calls at some delay will forwarded to that area in- charges according to their post of working Authority. Also the Lamp or Buzzer can be provided if any of the area In-charge doesn't respond the clearing of fault. To get the exact faulty phase under abnormal condition has been occurred, the RYB Indicators are also provided for faulty phase indication purpose.

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A REVIEW ON ENERGY STORAGE SYSTEMS

KAUSTAV MALLICK
Lecturer of Electrical Engineering Department
Technique Polytechnic Institute, Hooghly, West Bengal, India

1. INTRODUCTION

Electrical energy storage is now becoming the integral part of the power generation infrastructure. Energy storage is highly required to balance supply and demand. However, when both demand and supply are fluctuating rapidly continuously with time, the grid, which is the interface of power distribution, faces several problem in managing the power generation and distribution according to the demand. The grid balance can also be achieved through the use of different energy storage technologies. More over Higher levels of energy storage are required for grid flexibility and grid stability and to cope with the increasing use of intermittent renewable energy sources. Within the context of distributed generation, new energy sources rely mainly on renewable resources. Consequently, an energy reserve is required and energy storage devices can be very useful for an efficient energy management. Energy storage technologies basically perform two functions:

- Storing the excess energy generated in the system,
- Providing the stored energy for use whenever demanded by the system. Different Energy storage technologies—such as compressed air energy storage, various types of batteries, flywheels, superconducting capacitors, etc., provide for multiple applications: energy management, backup power, load levelling, frequency regulation, voltage support, and grid stabilization.

2. NEED OF ENERGY STORAGE SYSTEMS AND TECHNOLOGIES

The major need of energy storage system is due to importance given to utilize more renewable sources of energy and diminishing the use of fossil fuel and for the development of the future smart grid. Not only that there are other factors which encourages the need for the advanced storage systems such as

1. High generation cost during peak hours. There is a huge scope to reduction of total generation costs through storage of electrical energy generated by low-cost power plants during the night and being reintroduced into the power grid during peak demand periods.

2. Sometimes the distance between generating stations and consumers is very large. As a result, there is a great probability of power interruption for several causes like natural disasters or due to some other reasons like over load or operational accidents which may result in disruption of the supply and potentially affect large areas. Thus, energy storage systems and technologies come into act to supply power continuously for a certain period of time.

3. Sometime difficulty in meeting up power demand as well as output power fluctuations also occurs which can be minimized by these energy storage systems and there by stabilizing the transmission and distribution grid.

3. DIFFERENT PARAMETERS

There are different parameters which determine the quality of the storage devices. Some of them are given below:

1. Storage capacity: It is defined as the amount of energy that the device can hold after completing the charging cycle.

2. Energy density: It can be defined as the amount of energy that can be supplied from a particular storage device or technology per unit weight. The energy density determines the quantity of the energy that the device can deliver or can store energy.

3. Discharge time: it can be defined as the period of time for which the energy storage device or technologies completely discharge the stored energy.

4. Efficiency: it can be defined as the ratio of the total energy released is to total energy stored.

5. Durability: It is given by the number of times the storage device can be discharged. It can be expressed as the number of cycles, each cycle consisting of one charging and discharging process.

6. Autonomy: it is the defined as the maximum time that the system continuously releases energy.

7. Energy rating: Energy rating determines how long the device can supply energy. It is expressed in MWh or KWh.

8. Power rating: Power rating determines how much energy is released in a particular period of time. Costs of energy storage device are usually given in terms of cost/kWh or costs/kW.

4. TYPES OF ENERGY STORAGE SYSTEMS

There are different types of the energy storage technologies that vary in cost, performances and technological maturities.

Electrical energy storage system can be classified according to the energy forms as given below

1. Mechanical system- flywheel, compressed air energy storage system, pumped hydro storage system, etc.
2. Electro chemical system- secondary batteries, flow batteries.
3. Chemical systems- hydrogen (electrolysis of water).
4. Electrical systems-super conducting magnetic coils (SMES).
5. Thermal storage system- sensible heat storage, ACAES system.

5. CONCLUSION

Storage of large amount of energy will be a challenge in upcoming years to meet up the demand during peak hours. Pumped hydro storage plant is currently the most economical solution for this purpose. Another alternative for pumped hydro storage plant is adiabatic CAES plant which also have a very high efficiency rate. This paper presents the most relevant properties of mechanical energy storage technologies currently being developed in the design of power systems. It describes the most important parameters that characterize the behaviour of different mechanical energy storing technologies.

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COGENERATION

SNEHASHIS DAS
Lecturer of Electrical Engineering Department
Technique Polytechnic Institute, Hooghly, West Bengal, India

1. INTRODUCTION

Cogeneration or combined heat and power (CHP) is the use of a heat engine [1] or power station to generate electricity and useful heat at the same time.

Cogeneration is a more efficient use of fuel or heat, because otherwise-wasted heat from electricity generation is put to some productive use. Combined heat and power (CHP) plants recover otherwise wasted thermal energy for heating. This is also called combined heat and power district heating. Small CHP plants are an example of decentralized energy.[2] By-product heat at moderate temperatures (100–180 °C, 212–356 °F) can also be used in absorption refrigerators for cooling.

The supply of high-temperature heat first drives a gas or steam turbine-powered generator. The resulting low-temperature waste heat is then used for water or space heating. At smaller scales (typically below 1 MW), a gas engine or diesel engine may be used.

Cogeneration was practiced in some of the earliest installations of electrical generation. Before central stations distributed power, industries generating their own power used exhaust steam for process heating. Large office and apartment buildings, hotels, and stores commonly generated their own power and used waste steam for building heat. Due to the high cost of early purchased power, these CHP operations continued for many years after utility electricity became available.[3]

2. OVERVIEW

Many process industries, such as chemical plants, oil refineries and pulp and paper mills, require large amounts of process heat for such operations as chemical reactors, distillation columns, steam driers and other uses. This heat, which is usually used in the form of steam, can be generated at the typically low pressures used in heating, or can be generated at much higher pressure and passed through a turbine first to generate electricity. In the turbine the steam pressure and temperature is lowered as the internal energy of the steam is converted to work. The lower-pressure steam leaving the turbine can then be used for process heat.

Steam turbines at thermal power stations are normally designed to be fed high-pressure steam, which exits the turbine at a condenser operating a few degrees above ambient temperature and at a few millimetres of mercury absolute pressure. (This is called a *condensing* turbine.) For all practical purposes this steam has negligible useful energy before it is condensed. Steam turbines for cogeneration are designed for *extraction* of some steam at lower pressures after it has passed through a number of turbine stages, with the un-extracted steam going on through the turbine to a condenser. In this case, the extracted steam causes a mechanical power loss in the downstream stages of the turbine. Or they are designed, with or without extraction, for final exhaust at *back pressure* (non-condensing).[5][6] The extracted or exhaust steam is used for process heating. Steam at ordinary process heating conditions still has a considerable amount of enthalpy that could be used for power generation, so cogeneration has an opportunity cost.

A typical power generation turbine in a paper mill may have extraction pressures of 160 psig (1.103 MPa) and 60 psig (0.41 MPa). A typical back pressure may be 60 psig (0.41 MPa). In practice these pressures are custom designed for each facility. Conversely, simply generating process steam for industrial purposes instead of high enough pressure to generate power at the top end also has an opportunity cost (See: Steam supply and exhaust conditions). The capital and operating cost of high-pressure boilers, turbines, and generators is substantial. This equipment is normally operated continuously, which usually limits self-generated power to large-scale operations.

3. CLASSIFICATIONS

Large cogeneration systems provide heating water and power for an industrial site or an entire town. Common CHP plant types are:

- Gas turbine CHP plants using the waste heat in the flue gas of gas turbines. The fuel used is typically natural gas.
- Gas engine CHP plants use a reciprocating gas engine, which is generally more competitive than a gas turbine up to about 5 MW. The gaseous fuel used is normally natural gas. These plants are generally manufactured as fully packaged units that can be installed within a plant room or external plant compound with simple connections to the site's gas supply, electrical distribution network and heating systems. Typical outputs and efficiencies see [9] Typical large example see [10]
- Biofuel engine CHP plants use an adapted reciprocating gas engine or diesel engine, depending upon which biofuel is being used, and are otherwise very similar in design to a Gas engine CHP plant. The advantage of using a biofuel is one of reduced hydrocarbon fuel consumption and thus reduced carbon emissions. These plants are generally manufactured as fully packaged units that can be installed within a plant room or external plant compound with simple connections to the site's electrical distribution and heating systems. Another variant is the wood gasifier CHP plant whereby a wood pellet or wood chip biofuel is gasified in a zero oxygen high temperature environment; the resulting gas is then used to power the gas engine.
- Combined cycle power plants adapted for CHP
- Molten-carbonate fuel cells and solid oxide fuel cells have a hot exhaust, very suitable for heating.
- Steam turbine CHP plants that use the heating system as the steam condenser for the steam turbine
- Nuclear power plants, similar to other steam turbine power plants, can be fitted with extractions in the turbines to bleed partially expanded steam to a heating system. With a heating system temperature of 95 °C it is possible to extract about 10 MW heat for every MW electricity lost. With a temperature of 130 °C the gain is slightly smaller, about 7 MW for every MWe lost.[11] A review of cogeneration options is in [12] Czech research team proposed a "Teplator" system where heat from spent fuel rods is recovered for the purpose of residential heating.[13]

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RECENT DEVELOPMENTS OF INDIAN RAILWAYS AND ITS LOCOMOTIVES

SAYAK PAL
Lecturer of Electrical Engineering Department
Technique Polytechnic Institute, Hooghly, West Bengal, India

ABSTRACT
Indian Railway (IR) are the life line of India. Since 1853, it is servicing to the nation. Approximately 67000 km rail paths are exist in India and out of which 34000 km rail paths are electrified as per last report came in March 2019. In last 3 to 4 years many modernizations have been taken place in to the railway. This modernization includes locomotives, electrical power generation etc. Many new locomotives, both diesel and electrical, have been inducted to the railway fleets in recent years. IR is also transforming towards the solar power generation for the last couple of years. In this paper we have pointed out some very recent developments in the railways.

Keywords: Diesel & Electric locomotive, DLW, DFC, OHE, RDSO, Solar panel, Train-18, UIC, WAG-12B, WDAP-5, WDG-6G, WDP-4D.

1. INTRODUCTION

Indian railway (IR) contain both type of locomotives i.e. diesel and electrical. Till today 50% of total 67000 km rail path i.e. approximate 33000 km is non-electrified. So for this reason IR maintains both the locomotives. In recent years due to technology up gradation, environmental pollution etc, IR introduces many new locomotives within its fleet. The locomotives are both diesel and electrical. The horse power (HP) of the new locomotives is very high than any other previous locomotive. The new locomotives are manufactured in India, under 'MAKE IN INDIA' project by the Indian companies or foreign companies or public-private partnership (PPP) basis. In present days the IR also moves towards the green or eco-friendly energy. So, the IR has started to use solar energy for its daily operation. Here we will discuss about some modern locomotives with their technical specifications and some solar power projects which are already using and constructing in the IR. This paper has been divided by two sections. First section consists of the locomotive engines & train-18 and 2nd section will be about solar projects.

i. Locomotives section:

(a) WAG-12B:

It is the highest horse power locomotive of the IR. It is 12000 hp locomotive. From the name 'W' stands for wide gauge, 'A' denotes AC power supply, 'G' indicates goods, and '12B' is the series no. of the locomotive. It is generally used for carrying coal and iron ore wagons. In the December, 2019 first commercial launching took place at Madhepura, Bihar, where the locomotives are contructed. The first two locomotives number are 60020 & 60021 respectively. In the May, 2020, another six WAG-12Bs (60022-60027) have come out of factory at Madhepura. This locomotive is made by 'ALSTOM', a French company. This is an 'MAKE IN INDIA' initiative. This locomotive is equipped with insulated gate bipolar transistor (IGBT) propulsion system, which is fully automated control system. Regenerative braking is used to save the energy consumption. The IR sets up two maintenance depot for this locomotive. They are in Saharanpur (UP) and Nagpur (MH). This locomotive contains two cabins with loco pilot toilet facility. The cabins are fully air conditioned so that any kind of fatigue will not come to the loco pilots during a long journey. The technical specifications are given below.

Manufacturer	ALSTOM
Origin	France
Model	WAG-12B Prima 2TB
Configuration	BO-BO+BO-BO, 8 axels
Rated power and speed	9000kw (12064 hp), 120 km/h (Max)
Weight	180tones, upgraded up to 200 tones
Axel loading	22.5tones, upgraded up to 25 tones
Motors	6 PRA, 4576 D, Asynchronous, 3775 volts, 1125kw at 1750rpm, high torque, Forced ventilated.
Pinion drive transfer	2700kgs
Drive	Water cooled, IGBT drive

Traction effort	Starting TE-750kN at 22.5T/Axel
Transformer	ABB
Maintenance	Workshops at Ajni(Nagpur) and Saharanpur
Load hauling capacity	This locomotive is capable of hauling trains up to 7000tones at 75 km/h at 1:200 running gradient of EDFC (Electrified Dedicated Freight Corridor).

Table 1: Technical specification of WAG-12B

Figure 1: WAG-12B with serial number 60023

Figure 2: WAG-12B with serial number 60020

(b) WDAP-5(DUAL MODE LOCOMOTIVE):

Since 2018, India is manufacturing the dual mode i.e. this locomotive operates in both diesel and electric. Diesel Locomotive Works (DLW), Varanasi is manufactured the locomotive. From the name 'W' stands for wide gauge, 'D' is the diesel, 'A' denotes AC power supply, 'P' indicates passenger, and '5' is the series no. of the locomotive. Originally this locomotive is the modified version of WDP-4D (wide-diesel-passenger-4D series) locomotive. In the WDAP-5 locomotive, for diesel operation the rated horse power is 4500 and for electrical system it is 5000hp. The maximum speed is 135km/h for both diesel and electric performance. In WDP-4D, the fuel tank capacity was 6000 liter. But after converting into WDAP-5, the fuel tank capacity is reduced to 3000 liter. The total body of the engine is made of stainless steel instead of structural steel. In the November, 2019, this locomotive completed the successful trial under the Research Designs & Standards Organization (RDSO), a completely subsidiary under the Ministry of Railways, Govt. of India. During modification in WDP-4D a dual transformer is used. The main purpose of the transformer is to step down the OHE (Over Head Equipment) voltage i.e. 25kV and fed to the converter. This converter will convert into DC, then back to AC to supply the AC motors. The dual mode transformer has high impedance and due to this property transformer also acts as a filter for harmonics. This harmonics is produced by the converter during conversion process. The above mention works is done by the transformer during electrical mode. But the transformer has also worked during diesel operation. In the diesel locomotive part there is an alternator which is coupled with diesel engine. The alternator produces electrical power during diesel operation mode. A part of the generated electrical power has to pass through the transformer as 'Hotel Load'. This was achieved by better coupling impedance resulting in smooth operation during both modes. The 'Hotel Load' means the electrical load in the coaches for lighting, fans, air-conditioning, heating, pantry etc. The technical specifications are as follows:

Manufacturer	Diesel Locomotive Works(DLW)
Origin	Varanasi, India
Model	WDAP-5(Dual mode locomotive)
Locomotive weight	126 tones(maximum)
Nominal axel load	21 tones
Wheel diameter	1092 mm
Gear ratio	17.77 mm
Maximum operating speed	135 km/h

Starting traction effort	40.7 tones
Mode of operation	Diesel-Electric
Traction effort	Starting TE-750kN at 22.5T/Axel
Rated power	4500 hp(diesel operation) & 5000 hp(electrical operation)
Maintenance	DLW
Load hauling capacity	This locomotive is capable of hauling a passenger train of 26 coaches in 1:37 gradient.

Table 2: Technical specification of WDAP-5(Modified WDP-4D, Dual mode locomotive)

Figure 3: WDAP-5 at DLW Varanasi

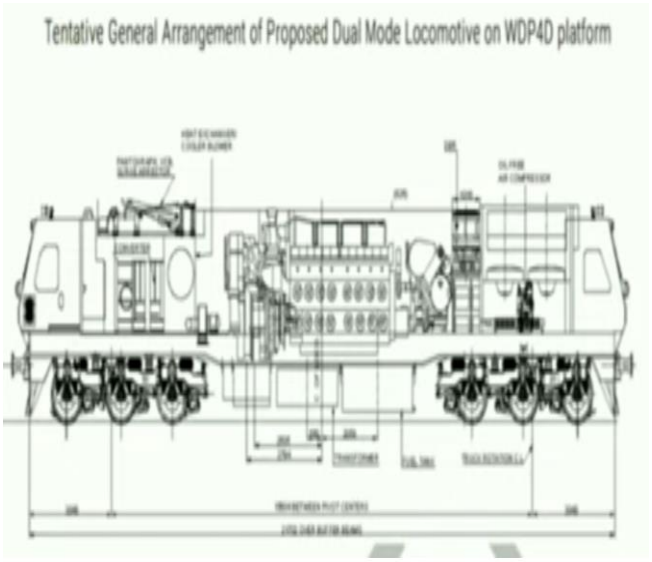

Figure 4: Design diagram of WDAP-5(Modified WDP-4D, Dual mode locomotive)

Figure 5: Dual mode locomotive transformer

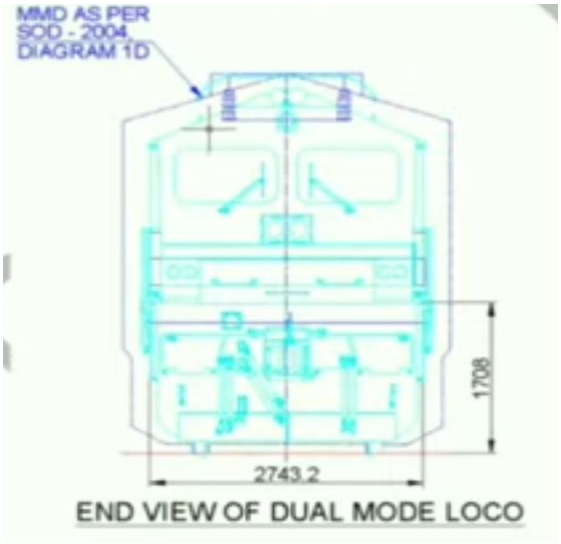

Figure 6: End view of dual mode locomotive

(c) WDG-6G:

It is the highest horse power diesel locomotive of the IR. It is rated 6000hp. This locomotive has high torque and high traction effort. From the name 'W' stands for wide gauge, 'D' is the diesel, 'G' indicates goods , and '6G' is the series no. of the locomotive. It is designed for hauling a large no. of goods wagons through the dedicated freight corridor (DFC). This locomotive is manufactured by the General Electric (GE) Transportation, USA. Since the year of 2015, this loco comes in service to the IR. It is the India's first UIC certified diesel locomotive. In French, the UIC stands for 'Union Internationale Des Chemins De Fer' (The International Union of Railways in English language). It certifies that WDG-6G is less carbon emission locomotive because of electronic fuel injection technology. The technical specification of this locomotive is given below.

Manufacturer	GE Transportation
Origin	USA/India
Model	WDG-6G
Capacity	6000 hp
Engine type	4 stroke 16 cylinders with turbo charged
Fuel injection	Electronic fuel injection type. Because of this less fuel burns and efficiency increased.
Axel control	IGBT type control system
Air brake	Microprocessor based air brake system is provided
Traction effort	570kN
Fuel tank capacity	6100 liter
Axel load	23 tones
Speed restriction	Maximum speed 65 m/h for 60 kg rail track and 60km/h for 52 kg rail track
Maintenance	Maula ali(MLY) diesel shed

Table 3: Technical specification of WDG-6G

Figure 7: WDG-6G locomotive named 'Angad' with serial no 69012

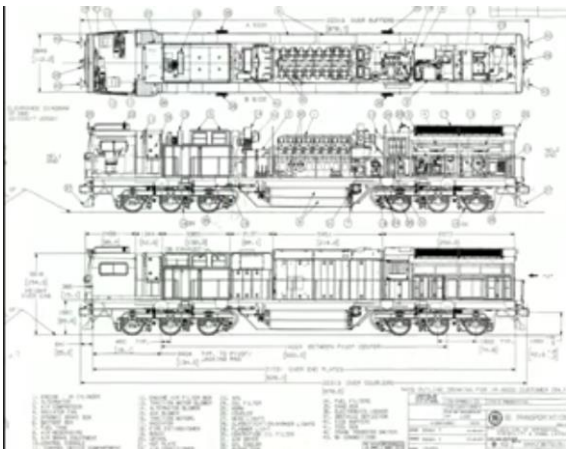

Figure 8: WDG-6G locomotive design diagram with top and side view

(c) Train-18 (Vande Bharat Express):

It is the most ambitious project of the IR under 'MAKE IN INDIA' initiative. It is made by Integral Coach Factory (ICF), Chennai. Train-18 is a semi high speed MEMU train. Maximum speed limit is 160km/h. it is 16 coaches train within which 8 coaches are motorized. The sixteen coaches are arranged in the following manner:

DTC+MC+TC+MC+NOT+MC+TC+MC+MC+TC+MC+NOT+MC+TC+MC+DTC

8 coaches of forward part of the train 8 coaches of backward part of the train

DTC:

DTC means driver trailer coach. It consists of battery, battery charger & compressor. In DTC loco pilot seats here. Battery is used to provide power supply the control panels of the coach. Obviously charger is for battery charging purpose. Compressor is provided here to control the air brake of the train.

MC:

MC stands for motor coach. According to the coach arrangement shown in the above there are 8 motor coaches. Each motor coach contains 4 three phase induction motors (traction motors). So, the total no. of traction motors is 32. Each motor is rated 3 phase, 415 volts and 250kW. Total capacity of 32 traction motors is 32*250=8000kW or 10723 hp (1hp=0.746 kW).

Traction converter is present in the motor coach. This converter feds input power to the motor. This converter is totally based on power electronics. Operation of the converter is controlled by adjusting the firing angle of SCRs. By this method the output voltage of the converter is also changed as well as the input voltage of the motors. Thus speed of the motors is also controlled.

Brake chopper resistor is also provided in the motor coach. This resistor is used for regenerative braking purpose. Mainly by regenerative braking process the coaches' 'Hotel Loads' get electrical power. The regenerative braking diagram is given below:

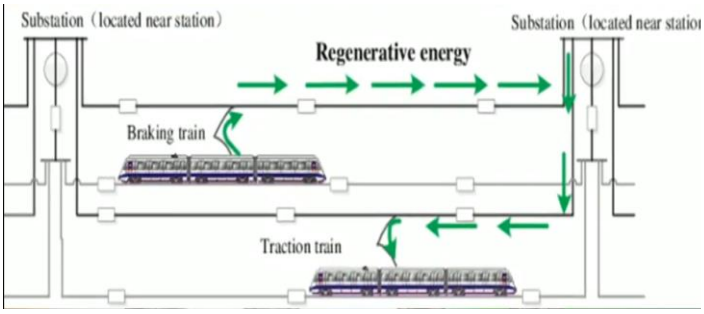

Figure 9: Regenerative braking process of the tain-18

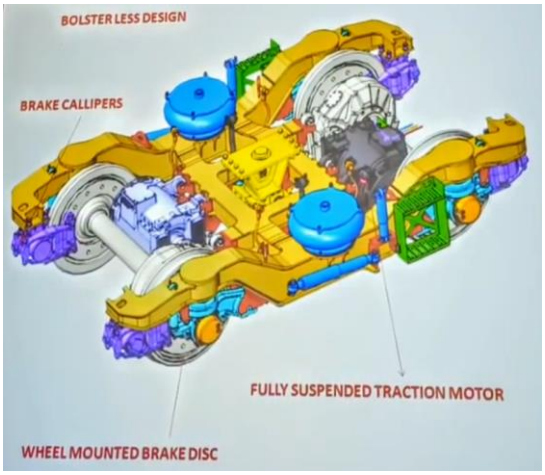

Figure 10: Mechanical design of wheel and traction motors of train-18

TC:

The full form of the TC is trailer coach. It consists of traction transformer, auxiliary converter, pantograph and vacuum circuit breaker (VCB).

According to the coaching arrangement total 4 trailer coaches are present. So total 4 transformers are in hand for the service but in practical condition only two transformers are used. It is because the transformers are very high rated. The rating of the each transformer is 2880 kVA. During trial run it is seen that two transformers are sufficient to supply the power to 32 traction motors. Similarly two pantographs are in service. Total 2880*2=5760 kVA power is supplied by two transformers. Rest of the two transformers are kept in standby mode.

VCB is provided here for protection purpose against short circuit.

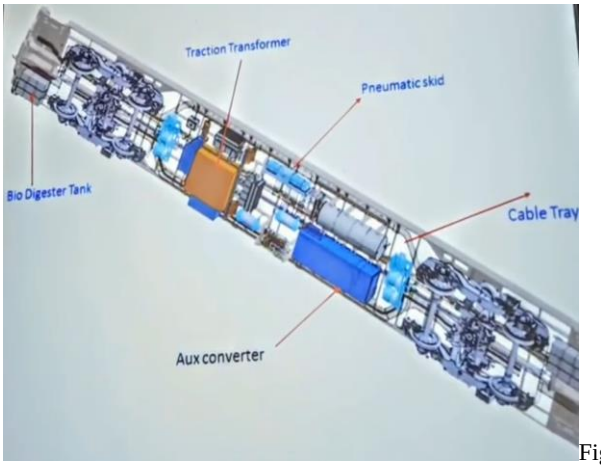

Figure 11: Top view of traction transformer and VCB of train-18

Figure 12: Train-18 at ICF, Chennai

Figure 13: Train-18 in running condition

ii. Solar project section:

The ministry of railways has decided to generate 10GW & 200MW electrical energy from the solar plants and wind mills respectively by 2031. So this section has been divided in four sub sections.

a. Solar power plants at zonal railways:

Ministry of railways has decided to set up solar power plants in all the zonal railways (17 zones). It is aimed to produce 10 GW by 2031. Within 10GW, 3-5GW will be utilized by the railway itself and rest of energy will be given to the grid or sale to the government power organizations. This zonal solar power will be utilized for train movement purpose mainly because of reducing the dependency on conventional power plants.

b. Solar panels on stations' roof tops:

IR plans to set up 500MW solar panels on the roof tops of various railway stations for generation of electricity in the financial year of 2020-21. Out of 500MW, already 96MW capacity has been installed. This solar energy will be used for daily operations of the stations.

Figure 14: Solar panels install at a station roof top

c. Sharing of load between thermal and solar power plants:

The IR plans to share load between thermal power plant sand solar power plants. After set up of solar power plant, the load on the conventional power stations will reduce very much. The reduced load will be applied on the solar power plants. Thus a large amount of electrical energy will be saved. Keeping in mind this idea, the IR is developing two such solar power plants at Diwana railway station, Panipath, Haryana comes under Northern Railway zone and Bina junation, Madhya Pradesh, under West-Central Railway zone. The capacity of the solar power plants is 2MW and 1.7MW for Diwana and Bina railway stations respectively.

d. Train roof top solar panels:

All the solar projects are working under the Indian Railways Organization for Alternate Fuels (IROAF). Recently IROAF is setting up flexible solar panels along with the Li-ion batteries to supply the internal power of DEMU (Diesel Electric Multiple Unit) coaches. This organization is also targeting to install flexible solar panels along with the present batteries to 500 passenger coaches. Before few months ago, a 10 coaches train was tested by solar panel set up. Each coach contained 20 solar panels with 4.5kW power capacity. So total solar power= 20*10*4.5=900kW for the 10 coaches. It was a off grid system. It was found that total arrangements were sufficient to supply power to the train.

Figure 15: Train roof top solar panels

Fig 16: Li-ion batteries

2. CONCLUSION

Beside the above mentioned projects, IR is also working on 'will run between Bullet Train' which is a high speed train. It has been decided that the Bullet train will run between Mumbai and Ahmadabad. The technology is being transferred by Japan. Japan has also given monetary loan for this project. India should also build more solar power plants to reduce dependency on conventional power plants. India is also constructing the dedicated freight corridor (DFC) for smooth

transportation of the goods trains. At last it can be said that India will have one of the very modern railway system in the world in near future.

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Weird Facts

1. Acacia trees can warn each other of danger

Arcadia trees, which grow all over the African savannah, have a unique defense system. When animals like antelopes start to gobble up its leaves, the tree increases tannin production to levels that are toxic to animals.
But that's not all. The tree then emits a cloud of ethylene gas that travels through the air, reaching other trees so they too can begin producing more tannins.

2. Owls don't have eyeballs

What they have instead are better described as eye *tubes*. Since they can't move these tubes back and forth, owls have developed incredible neck flexibility to be able to see the world around them. They can turn their heads a whopping 270 degrees, whereas humans can only manage about 180.

3. Our brains are shrinking

Fossil evidence shows us that, over the past 10,000 years, the average human brain has shrunk about the size of a tennis ball. But that doesn't mean we're any less intelligent. Our smaller brains are probably more efficient, particularly since most of us live in settled societies and don't need to constantly be on the lookout for predators. So don't worry too much; your own brain is probably just fine.

4. Armadillos are bulletproof

There have been numerous reports that if you shoot an armadillo, the bullet will ricochet off the animal's armour and instead, hit the shooter. When a man in Texas pulled out his .38 revolver and fired three shots at an armadillo, the bullet wound up hitting the man in the face, resulting in him needing to have his jaw wired shut

5. Your femur is stronger than concrete

Your femur, which is your thigh bone, is the largest and strongest bone in your body. Pound for pound, a human femur can withstand four times as much pressure as the same amount of concrete because of the bone's structure and density. Again, this is not something worth trying at home.

6. The ocean produces up to 85 percent of the Earth's oxygen

Tiny sea-dwelling creatures called phytoplankton are actually the ones that produce the vast majority of the oxygen in our atmosphere: 50 to 85 percent to be exact. Though they're too small to see without a microscope, they live in the upper layers of water and use the same method plants do—photosynthesis—to convert sunlight into energy, creating oxygen in the process.

7. Planets have sound

Though it's true that sound can't travel through the vacuum of space, NASA has launched multiple probes that have flown close by the planets in our solar systems to make recordings. As it turns out, charged particles in the planets' atmospheres interact to create radio waves, and NASA has translated these waves into audible sounds. Each planet has its own unique "song," and they're all a bit eerie. Jupiter sounds a bit like being underwater, Neptune sounds like ocean waves, and Saturn sounds like the background of a horror movie.

8. Home of a mysterious skeleton lake

Located in the Himalayas at about 16,470 feet, the glacial Lake Roopkund has become famous for the human skeletons found in the lake and surrounding areas. It is thought that the skeletons are the remains of people from the 9th century who perished during a severe hail storm.

9. "Indian food" has become one of the most widespread cuisines in the world

From London to New York City, Indian food has spread across the world and continues to gain popularity. Many argue that authentic flavour and spice is lost in many of the restaurants outside of India itself.

10. The world's largest sundial is located in India

The town of Jaipur is home to the largest sundial in the world, which is a towering 27 meters (90 feet) tall! If that's not impressive enough, the sundial is constructed from beautiful polished stone to create a truly impressive work of architecture.

11. North Sentinel Island is one of the last "untouched" places on Earth

The Indian government has prohibited anyone from going within three miles of North Sentinel Island, home of the Sentinelese people. n 1991, the anthropologist Madhumala Chattophadhyay had several peaceful encounters with the Sentinelese, but in subsequent years, the people made it very clear (sometimes violently) that they did not want to be disturbed. It is now considered one of the last places untouched by the outside world.

12. Varanasi is the most ancient surviving city in the world

A few countries around the world claim they have the oldest living city in the world, and India is no exception.
The holy city of Varanasi, also known as Banaras or Kashi, is believed to be one of the oldest living cities in the world.
In fact, it is believed that this place was once the home of Lord Shiva and Goddess Parvati.
As Mark Twain puts it, Varanasi is "older than history, older than tradition, older even than legend, and looks twice as old as all of them put together."

13. There's a floating post office in India

Not only does India have the largest network of postal services in the world, but it also has some very unique post offices, including one that floats on the water. Located in Dal Lake, Srinagar, the post office has begun to serve as a tourist destination for curious visitors who hope to photograph the unique site.

14. Teachings of Sherlock

Actor Benedict Cumberbatch a.k.a Dr. Strange, once taught English in a Tibetan Monastery in Darjeeling