

ELECTRA

2022-23

AJAY BINAY INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ELECTRICAL ENGINEERING

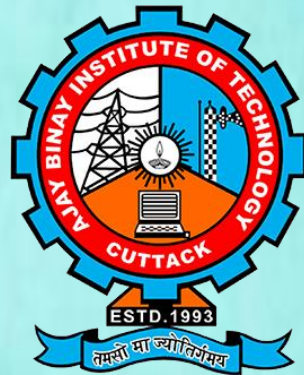


Publications Details
Academic Year- 2022-23

ELECTRA

2022-23

The Annual Technical Magazine
of
DEPT. OF ELECTRICAL ENGINEERING



AJAY BINAY INSTITUTE OF TECHNOLOGY
CUTTACK, ODISHA



DEPARTMENT OF ELECTRICAL ENGINEERING AJAY BINAY INSTITUTE OF TECHNOLOGY



VISION OF THE INSTITUTE

To promote quality teaching, exploration, research and facilitate holistic development of students that would help create capable technical manpower needed for industry and academia.



MISSION OF THE INSTITUTE

M1: To enable efficiency and prosperity in the society through application of technical knowledge and in collaboration with industry and other institutions.

M2: Ensure an effective teaching on contemporary topics and a rational examination system.

M3: Support and create centers of excellence for exploratory technical and behavioral projects that would promote originality and uniqueness.

M4: Establish partnership with local industries for collaborating, understanding and addressing real life technical challenges.



VISION OF THE DEPARTMENT



To become a leader in bringing out proficient Electrical Engineers, academicians and entrepreneurs and thereby contribute values to knowledge-based economy and society.

MISSION OF THE DEPARTMENT



M1 : To impart high quality technical education, & promote research activities among the students enabling them to excel as innovative and globally competent professionals.

M2 : To bridge the gap between industry and academia by fostering student development initiatives that meet industry needs.

M3 : To develop expertise in complex technical problem-solving skill among the students through application-based learning approach.

M4 : To nurture ethical and socially responsible engineers by providing an educational environment that emphasizes professional integrity, creativity, and teamwork.



DEPARTMENT OF ELECTRICAL ENGINEERING AJAY BINAY INSTITUTE OF TECHNOLOGY



PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO 1 : Apply technical knowledge to solve complex engineering problems, emphasizing ethics, social responsibility, and professional integrity.

PEO 2 : Excel in various engineering roles such as design, research, testing, and manufacturing, with skills tailored to meet industry demands.

PEO 3 : Engage in continuous learning to enhance their professional skills, fostering innovation and leadership in their respective fields.

PEO 4 : Demonstrate creativity and entrepreneurial spirit in developing sustainable solutions to engineering challenges.

PEO 5 : Contribute positively to society by applying their engineering expertise to address societal needs, while upholding ethical standards and social commitment.

PROGRAM SPECIFIC OUTCOMES (PSOS)

PSO1. Apply electrical engineering knowledge to design and solve complex electrical and power system problems, ensuring safety and sustainability.

PSO2. Use modern tools and techniques to model, analyze, and improve electrical systems in areas like power and automation.

PSO3. Demonstrate project management, teamwork, and ethical skills to contribute to engineering projects that address societal and environmental challenges.

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ELECTRA
2022-23



MESSAGES



FROM THE HEAD GOVERNING BOARD'S DESK



Information compilation and sharing through various channels is an inherent mechanism of knowledge building in a team. I am very happy that the Electrical Engineering Department has taken the initiative of publishing “ELECTRA”, which is a major step towards this philosophy. I am grateful to the leaders who have planned this and hope that the faculty members as well as students will take away necessary learning from this publication.

Er. Satyadarshi Mishra

Head of Governing Board

ABIT, Cuttack



FROM THE DIRECTOR (P&NI)'S DESK



I am happy to know that the Electrical Engineering Department is publishing “ELECTRA”. I am sure that such effort will trigger a flurry of activities leading to higher motivation and energy levels. This will certainly enhance the competence of the department. I thank the H.O.D and faculty members for taking up this initiative.

Er.(Mrs.) Payal Mahapatro

**Director (P&NI)
ABIT, Cuttack**



FROM THE PRINCIPAL'S DESK



I am happy to learn that the Department of EE is bringing out its E-Magazine. Also glad to pen few words exclusively meant for churning out latent writing skills on the different recent technical field of research. ABIT has come a long way & has made its impact felt in not only in state but also in country and abroad. Our students and faculties have performed exceedingly well and competent enough in all the fields. Beyond academics, the research activities are being conducted. The college also motivates and encourages staff and students to undertake research and enterprising skills. The faculty members plays major role in the overall development of department and institute.

I congratulate the department, the contributors and editorial boards for bringing out such technical publication. I extend my greetings and best wishes to the faculties and students of the department and wish their endeavors my very best.

Dr. Leena Samantray

Principal, ABIT, Cuttack



Editorial Message

It is an occasion of immense pleasure for the Department of Electrical Engineering to publish the second volume of E- magazine “ELECTRA” for the year 2022.

The Editorial board of department of EE wants to thank all the faculty members and students who have made this issue a success by providing articles.

This magazine focuses on the recent trends evolved in the field of electrical engineering & wants to provide advanced knowledge and awareness among the students about the same.

The Editorial board also wants to thank the Management of the Institute and Head of the department for inspiring us to go forward in publishing this magazine.

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Er. Satya Ranjan Das (Editor & Author)



SCHOLARLY ARTICLES BY FACULTIES

ARTICLES BY STUDENTS

POETRY SECTION

STORIES SECTION

PAINTINGS BY STUDENTS

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Electra



MAKING OF AN 'ALL REASON' ELECTRIC VEHICLE

Dr. Prasanta Kumar Pany

Department of Electrical Engineering

The development of an “all-season” electric vehicle (EV) presents a significant engineering and design challenge, but it is a pursuit that holds great promise in achieving sustainability and versatility in the transportation industry.

To create an all-season EV, several key components and features must be carefully considered and integrated:

1. Battery Technology: An all-season EV requires advanced battery technology capable of performing efficiently in a wide range of temperatures. Lithium-ion batteries with effective thermal management systems can help maintain performance in extreme heat and cold.

2. Electric Drive Systems: The electric motor and drivetrain must be designed to optimize power delivery and traction across different terrains and weather conditions. This includes developing all-wheel-drive systems for enhanced stability on slippery surfaces.

3. Climate Control: Effective cabin heating and cooling systems are vital for passenger comfort and battery efficiency. Energy-efficient climate control can extend the range of the EV in extreme temperatures.

4. Regenerative Braking: Regenerative braking systems should be enhanced to work efficiently in varying road conditions, helping to capture and store energy during deceleration.

5. Tire Technology: High-quality, all-season tires with good traction on wet, icy, and snowy surfaces are essential. Some concepts explore the use of adaptive tire technology to adjust tire performance based on road condition.

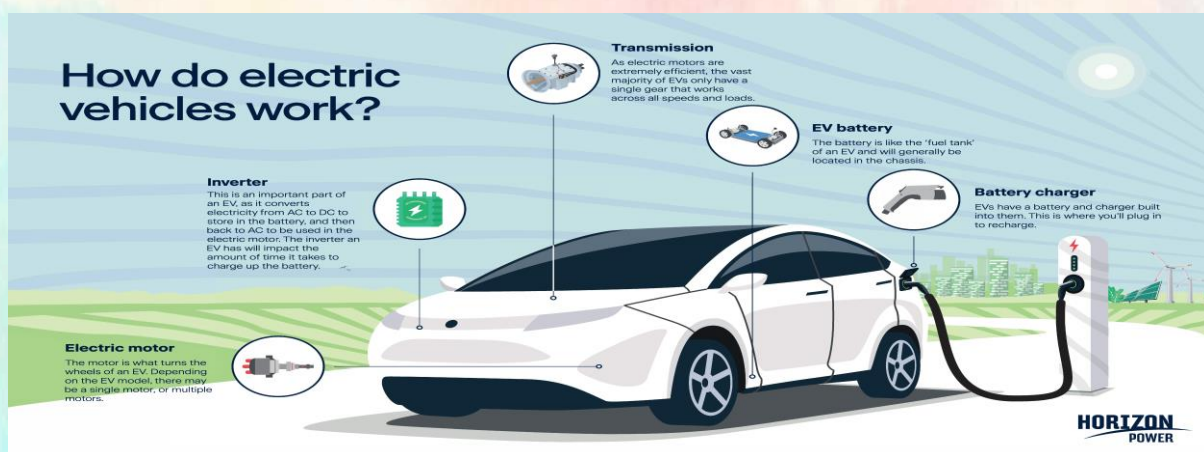
6. Aerodynamics and Body Design*: Streamlined vehicle shapes can improve efficiency and reduce energy consumption. It is also crucial to ensure that the



vehicle's exterior materials and seals are well-insulated against temperature extremes.

7. Range Optimization: To mitigate range anxiety in extreme conditions, larger battery packs and efficient energy management systems may be needed. Predictive algorithms can help optimize energy use based on upcoming weather conditions.

8. Charging Infrastructure: To support all-season EVs, there must be a reliable and widespread charging infrastructure that can accommodate various power levels and charging speeds.



9. Safety Features: Advanced safety features, including adaptive cruise control, collision avoidance, and traction control, are essential to ensure driver and passenger safety in challenging weather conditions.

10. Software and Connectivity: All-season EVs should have intelligent software that can adapt to changing conditions, utilizing data from sensors and external sources to optimize performance and safety.

Creating an all-season EV is a complex endeavour that requires a multidisciplinary approach involving automotive engineers, material scientists, software developers, and environmental experts. The goal is to make electric vehicles practical and reliable options for consumers living in regions with extreme weather conditions.

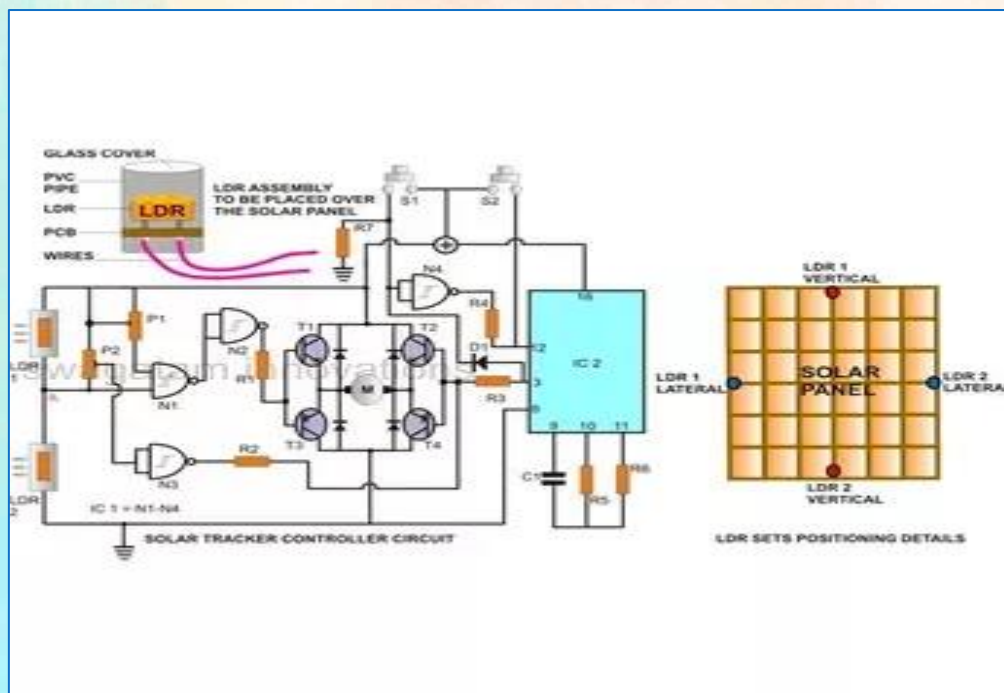


Automatic Solar Tracker

Dr. Subhalaxmi Mohapatra

Department Of Electrical Engineering

In the quest for more efficient and sustainable energy sources, solar power has emerged as a promising solution. To harness the full potential of solar energy, technological advancements like automatic solar trackers have become integral components of solar installations. These systems utilize sensors and advanced mechanisms to track the sun's movement across the sky, ensuring that solar panels remain optimally aligned with the sun's rays throughout the day. This article explores the working principles, benefits, and applications of automatic solar trackers, shedding light on their role in enhancing solar energy harvesting.



Working Principle:

An automatic solar tracker operates on a simple yet effective premise: follow the sun. It achieves this by employing various sensors and motors, which work in unison to orient solar panels or photovoltaic arrays towards the sun's position in the sky.

Key components of a solar tracker include:



1. **Light Sensors:** Light sensors, often in the form of photodiodes or photovoltaic cells, detect the sun's intensity and direction. These sensors provide essential input to the tracking system, ensuring it knows the sun's location.
2. **Control Unit:** The control unit processes data from the light sensors, calculating the sun's position based on the intensity of light hitting each sensor.
3. **Actuators or Motors:** Actuators, driven by the control unit, adjust the orientation of solar panels. These can be linear actuators, rotary actuators, or other mechanisms that physically move the panels.
4. **Mounting Structure:** Solar panels are mounted on a frame that allows for movement in two axes: azimuth (east-west) and elevation (north-south). This movement enables precise tracking.

Types of Solar Trackers:

There are two primary types of solar trackers:

1. **Single-Axis Trackers:** These trackers move solar panels along one axis, typically the north-south (elevation) axis. They follow the sun's path from east to west during the day. Single-axis trackers are cost-effective and suitable for most locations.
2. **Dual-Axis Trackers:** Dual-axis trackers move panels along both the north-south (elevation) and east-west (azimuth) axes. This allows for more accurate tracking, capturing the sun's movement in all directions, but they tend to be more complex and expensive.

Benefits of Automatic Solar Trackers:

The implementation of automatic solar trackers brings several advantages to solar energy systems:



1. **Increased Energy Yield:** Solar trackers significantly enhance energy production by keeping panels perpendicular to the sun's rays. This results in a higher energy yield compared to fixed installations.
2. **Improved Efficiency:** By maintaining the optimal angle to the sun, trackers reduce the impact of shadows and obstructions, improving the overall system efficiency.
3. **Extended Operating Hours:** Trackers can capture sunlight for a more extended period during the day, from sunrise to sunset, by continually adjusting panel orientation.
4. **Enhanced Seasonal Performance:** Solar trackers are particularly useful in regions with distinct seasons, as they can adapt to the sun's varying paths and lower angles in the sky.
5. **Lower Cost per Watt:** While initial investment costs are higher for solar trackers, the increased energy output leads to a lower cost per watt of electricity generated over time.

Applications of Automatic Solar Trackers: Automatic solar trackers find applications in various sectors, including:





1. **Utility-Scale Solar Farms:** Large-scale solar installations benefit significantly from trackers, as they maximize energy production and cost-effectiveness.
2. **In Residential Solar Systems:** Some residential solar arrays also incorporate tracking systems, especially in areas with abundant sunlight.
3. **Agricultural and Industrial Facilities:** Solar trackers are used to power irrigation systems, industrial processes, and provide clean energy for various applications.
4. **Remote and Off-Grid Locations:** In remote or off-grid areas, solar trackers help ensure a consistent power supply, reducing reliance on conventional fuels.
5. **Space Exploration:** Solar trackers are used in space exploration to keep solar panels on satellites and spacecraft aligned with the sun for power generation.

As the world continues to transition to renewable energy sources, the development and implementation of advanced tracking systems play a pivotal role in maximizing the potential of solar power, contributing to a more sustainable and energy efficient future





Booster Converter
Mr.Durgamadhab Swain
Department Of Electrical Engineering

A booster converter, also known as a step-up converter, is a fundamental power electronics circuit used to increase the output voltage level of a DC power source. This device plays a crucial role in various applications, from portable electronics to renewable energy systems, by efficiently converting low-voltage DC input to higher DC output voltage. In this essay, we will explore the working principle, components, applications, and advantages of boost converters.

Working Principle:

The basic principle of a boost converter involves the periodic switching of a transistor (usually a MOSFET) to control the energy transfer from the input to the output. The primary components of a boost converter include an inductor, a diode, a capacitor, and a control circuit. Here's how it works:

1. During the “on” state, the transistor switches on, allowing current to flow from the input source through the inductor and to ground. This stores energy in the inductor in the form of a magnetic field.
2. In the “off” state, the transistor switches off, causing the inductor to release the stored energy into the load and the output capacitor. The diode prevents reverse flow from the output to the input.
3. The duty cycle of the switching, which is controlled by the feedback loop or control circuit, determines the output voltage. By adjusting this duty cycle, the boost

Converter can regulate the output voltage efficiently.



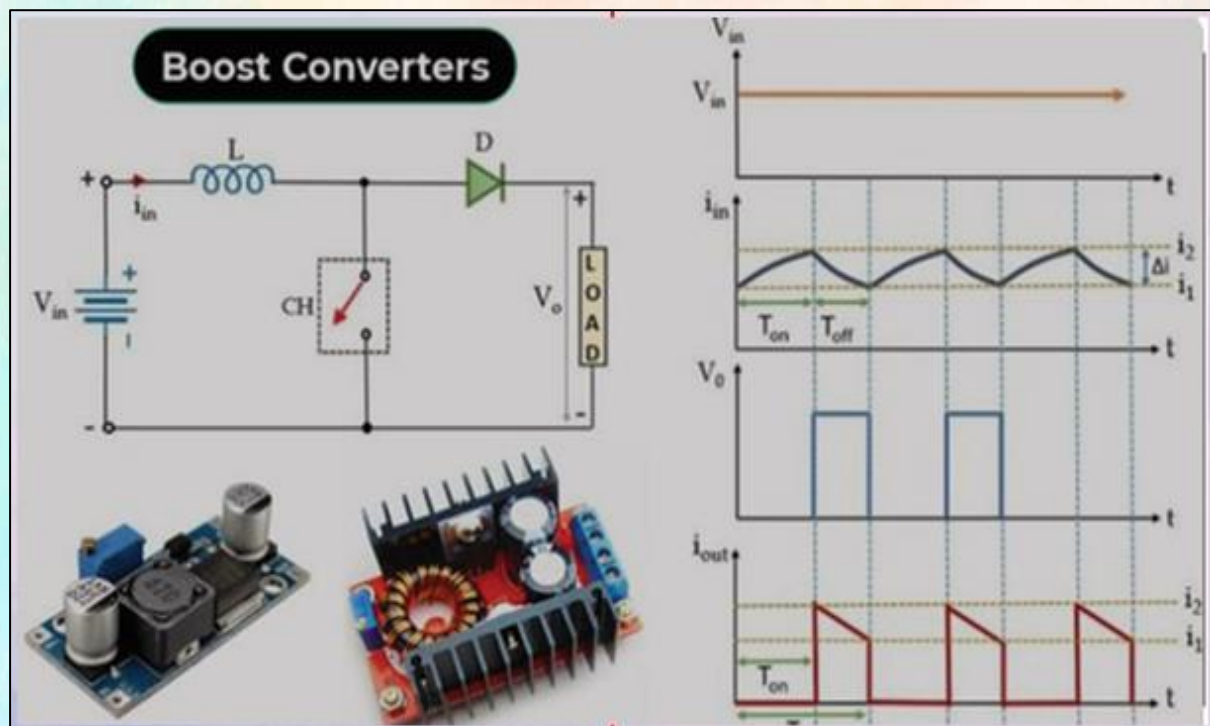
Components:

Transistor (MOSFET): Controls the flow of current from the input to the inductor.

1. Inductor: Stores energy in its magnetic field during the “on” state and releases it during the “off” state.

2. Diode: Allows current to flow in one direction, preventing reverse flow from the output to the input.

3. Output Capacitor: Smoothens the output voltage and reduces ripples. 4. Control Circuit: Manages the duty cycle and feedback for voltage regulation.



Applications:

Boost converters are employed in a wide range of applications:

1. Portable Electronics: They are used in battery powered devices like smartphones, laptops, and cameras to efficiently step up the voltage from a low battery voltage to power the device.



2. Solar Power Systems: Boost converters help in converting the low-voltage output from solar panels to a higher voltage, suitable for battery charging or grid integration.
3. Electric Vehicles: They play a role in electric vehicle powertrains by raising the voltage of the battery pack to drive the motor.
4. LED Lighting: Boost converters can efficiently power LED lighting systems, which require constant voltage.
5. DC-DC Power Supplies: They are used in various power supply applications to provide stable output voltages.





POWER MONITORING SYSTEM

Mrs Debayani Mishra

Department Of Electrical Engineering

Power monitoring systems play a crucial role in various industries, businesses, and residential settings, enabling the measurement and analysis of electrical parameters. These systems provide critical data on voltage, current, power factor, active power, and reactive power, facilitating efficient power management, maintenance, and energy conservation. In this comprehensive essay, we will explore the importance, components, working principles, applications, and benefits of power monitoring systems in measuring and analysing these vital electrical parameters.

Importance of Power Monitoring:

Power monitoring is essential for several reasons:

- 1. Energy Efficiency:** Monitoring voltage, current, and power parameters allows organizations to optimize their energy consumption and reduce costs. By identifying power inefficiencies, businesses can take corrective actions to improve energy usage.
- 2. Equipment Maintenance:** Continuous monitoring helps in the early detection of electrical anomalies and potential equipment failures. This proactive approach minimizes downtime and extends the lifespan of electrical systems.
- 3. Power Quality:** Maintaining the desired power factor, active power, and reactive power levels ensures that electrical equipment operates optimally. Poor power quality can lead to equipment damage and power outages.
- 4. Compliance and Billing:** Accurate power measurements are essential for regulatory compliance and billing in industrial and commercial settings. Reliable data ensures fair billing and adherence to standards.



Components of a Power Monitoring System:

A comprehensive power monitoring system typically consists of the following components:

1. *Sensors*: Voltage and current sensors are used to measure the electrical parameters. Current transformers (CTs) and voltage transformers (VTs) are common sensor types.

2. *Data Acquisition System (DAS)*: The DAS collects data from sensors and transfers it to a central monitoring unit. It may use wired or wireless communication.

3. *Central Monitoring Unit*: This unit processes and stores data, providing real-time information and historical records. It often includes software for data analysis and visualization.

4. *Power Analysers*: These devices provide advanced analysis of power quality and parameters, including power factor, active power, and reactive power.

5. *Display and User Interface*: Power monitoring systems often include displays, dashboards, and user interfaces for easy access to data and analysis.

Working Principles:

Power monitoring systems operate on the principles of electrical measurement and data analysis:

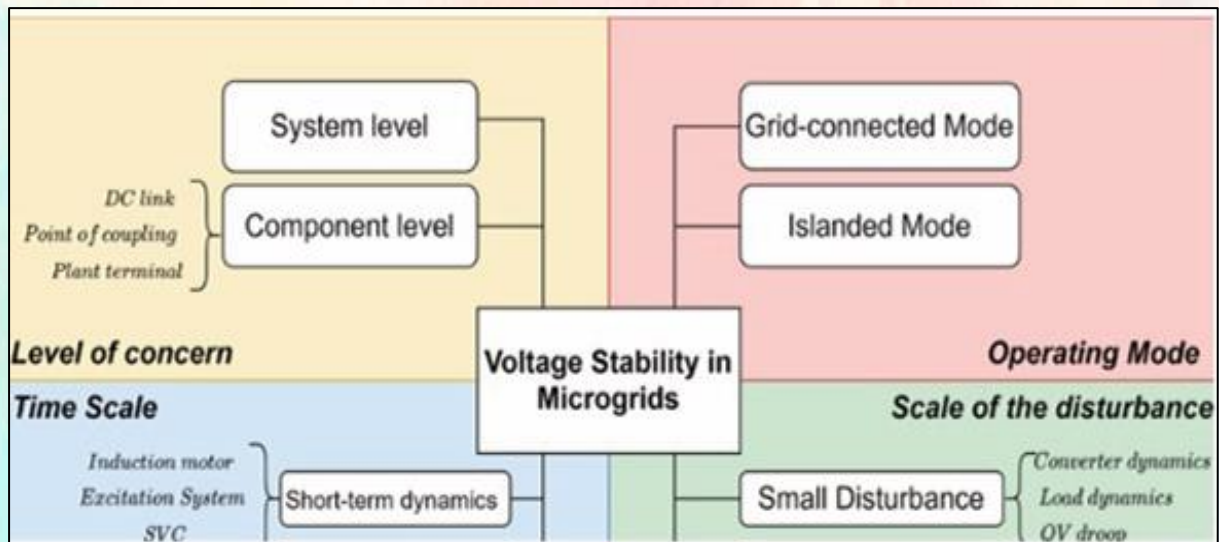
1. *Data Collection*: Sensors, such as CTs and VTs, measure current and voltage values at specific points in the electrical distribution system.



2. Data Transmission: The collected data is transmitted to the DAS, which can be located at a central monitoring point. This transmission can be wired (e.g., Ethernet) or wireless (e.g., Wi-Fi, Zigbee).

3. Data Processing: The DAS processes the data, calculates parameters like power factor, active power, and reactive power, and stores it for analysis.

4. Analysis and Visualization: Power monitoring software analyses the data, providing real-time and historical information on the electrical parameters. Users can visualize this data through user interfaces and dashboards.



Applications:

Power monitoring systems find applications in various sectors:

1. Industrial Facilities: These systems ensure reliable and efficient power distribution in manufacturing plants, helping maintain equipment and production lines.

2. Commercial Buildings: In offices and commercial spaces, power monitoring optimizes energy use, reduces operational costs, and supports sustainability goals.

3. Utilities: Power companies employ monitoring systems for grid management, load balancing, and power quality analysis.



4. Renewable Energy: In solar and wind farms, monitoring systems help manage the integration of renewable energy sources into the grid and ensure power quality.

5. Data Centres: Power monitoring is critical for data centres to safeguard against power fluctuations and ensure uninterrupted operations.

Benefits:

Power monitoring systems offer numerous advantages:

1. Energy Savings: By identifying areas of energy waste, businesses can take steps to reduce consumption and cut costs.

2. Equipment Protection: Early detection of electrical issues prevents equipment damage and reduces downtime.

3. Optimized Power Quality: Maintaining the right power factor and power distribution ensures the efficient operation of electrical systems.

4. Data-Driven Decisions: Access to accurate data enables informed decision-making for energy management and infrastructure improvements.

5. Cost Reduction: Efficient power usage and equipment maintenance lead to lower operating costs and increased profitability.

In conclusion, power monitoring systems are indispensable tools in today's world, helping organizations and individuals manage and optimize electrical systems. By monitoring voltage, current, power factor, active power, and reactive power, these systems contribute to energy efficiency, equipment reliability, and overall cost reduction. Their widespread adoption is essential for a sustainable and well-managed electrical infrastructure.



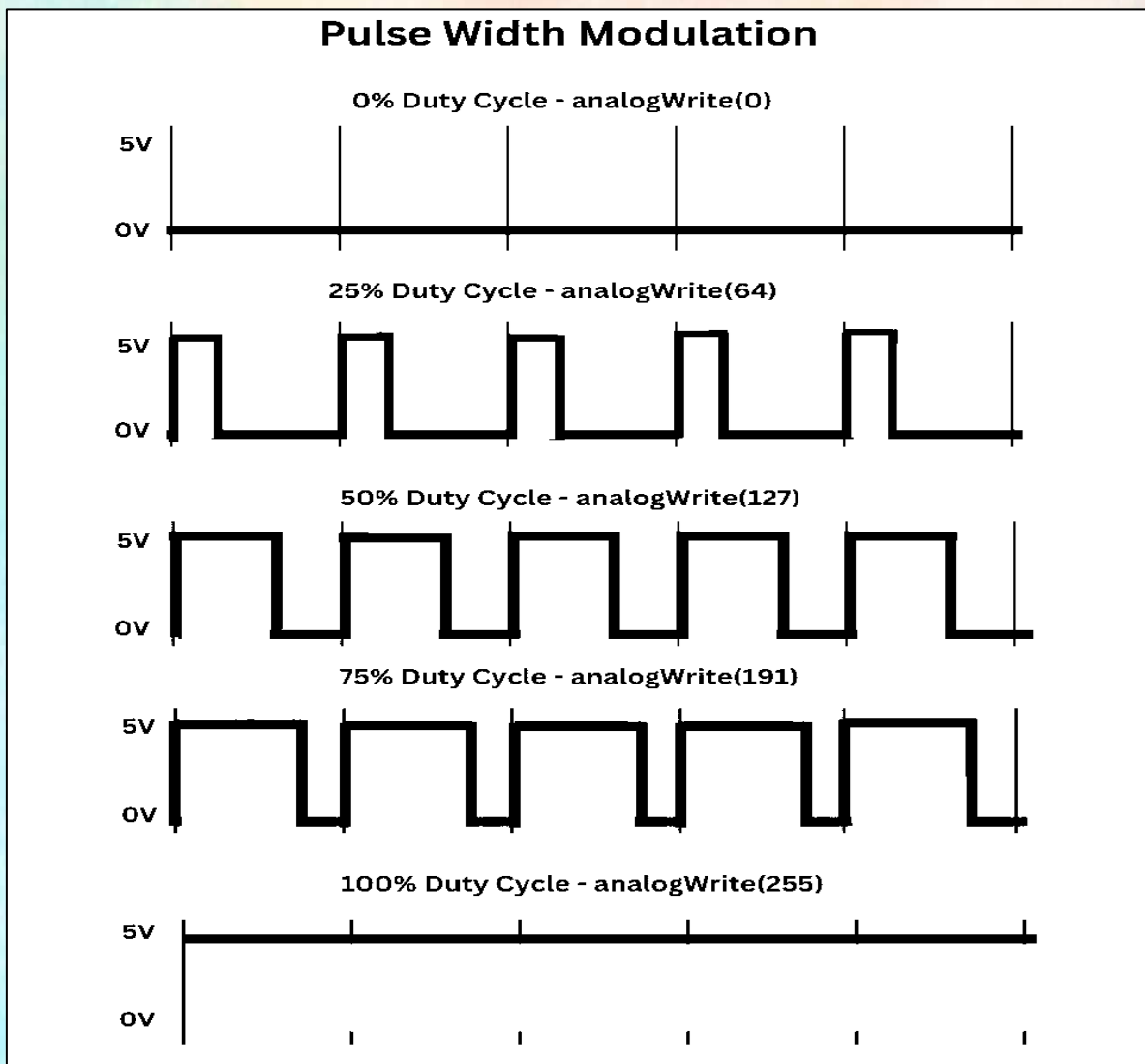
SPEED CONTROL OF DC MOTOR

Mr Satya Ranjan Dash

Department Of Electrical Engineering

Speed Control of DC Motor Using Pulse Width Modulation (PWM)

Direct Current (DC) motors are widely used in various applications due to their simplicity, reliability, and ease of control. One crucial aspect of operating DC motors is controlling their speed effectively. Pulse Width Modulation (PWM) is a widely adopted technique for achieving precise and efficient speed control in DC motors. This article explores the principles, benefits, and practical applications of PWM for DC motor speed control.





Principles of DC Motor Speed Control:

DC motors operate based on the interaction of a magnetic field and current flow through coils (armature windings). The speed of a DC motor is directly proportional to the voltage applied to it. To control the speed of the motor, one can manipulate the voltage supplied to it. This is where PWM comes into play.

Pulse Width Modulation (PWM):

PWM is a technique that allows for the control of the average voltage supplied to a DC motor by varying the width of the voltage pulses while keeping the amplitude constant. It essentially simulates variable voltage by rapidly switching the supply on and off. Here's how PWM works in DC motor speed control:

1. Generation of PWM Signal: A microcontroller, a dedicated PWM controller, or other control devices generate a PWM signal. This signal consists of a high (ON) state and a low (OFF) state, with varying widths. The duty cycle represents the ratio of the ON time to the total time (ON + OFF).

2. Amplitude Control: The supply voltage is maintained at its maximum level during the ON state of the PWM signal. The voltage supplied to the motor is effectively controlled by varying the duration of the ON state.

3. Average Voltage: The motor perceives the PWM signal as an average voltage. By adjusting the duty cycle, you can control the speed of the motor. A higher duty cycle results in a higher average voltage and faster motor speed, while a lower duty cycle reduces the average voltage and slows down the motor.

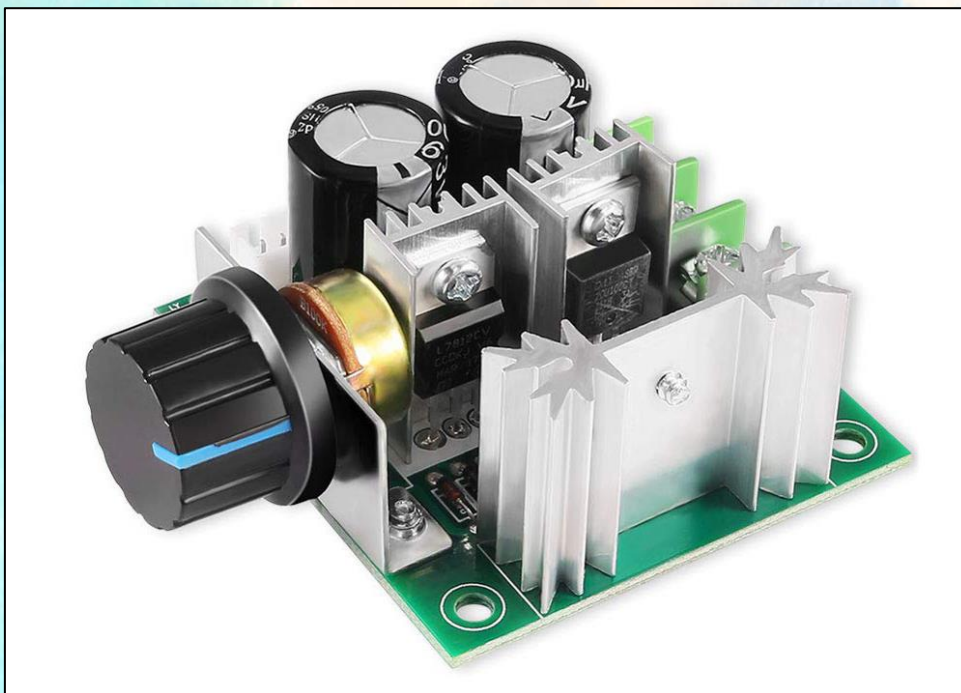
Benefits of PWM in DC Motor Speed Control:

Precise Speed Control: PWM allows for very precise speed control, with a wide range of speed adjustments, making it suitable for applications with strict speed requirements.



1. **Energy Efficiency:** Unlike traditional methods of speed control (e.g., using variable resistors), PWM does not dissipate excess energy as heat. It efficiently regulates the motor's speed without significant energy loss.
2. **Improved Motor Life:** Running a motor at reduced speeds using PWM can prolong the motor's lifespan. It reduces wear and tear, heat generation, and mechanical stress.
3. **Quick Response:** PWM controllers can quickly respond to changes in speed requirements, making them ideal for applications that need rapid adjustments, such as robotics.
4. **Reduced Heat Generation:** Traditional voltage regulation methods create heat as excess voltage is dissipated as waste energy. PWM generates less heat, improving overall system efficiency.

In conclusion, Pulse Width Modulation (PWM) is a versatile and efficient technique for controlling the speed of DC motors. It offers precise control, energy efficiency, and improved motor longevity. With applications ranging from robotics to electric vehicles and industrial automation, PWM has become a fundamental technology in modern engineering, enabling us to tailor the performance of DC motors to a wide range





CARBON CAPTURE AND STORAGE

Mr.Chandan Mandal

Department of Electrical Engineering

As the global climate crisis deepens, the urgency to reduce greenhouse gas emissions has never been more critical. Among the various technologies developed to mitigate emissions, Carbon Capture and Storage (CCS) has emerged as a powerful solution to decarbonize heavy industries and reduce atmospheric CO₂. CCS refers to a suite of technologies that capture carbon dioxide emissions from industrial processes or directly from the atmosphere, then transport and store them in underground geological formations to prevent their release into the atmosphere.

Carbon Capture and Storage is a three-step process:

1. **Capture:** CO₂ is separated from gases produced in industrial processes such as cement, steel, or chemical production, or from fossil fuel-based power generation.
2. **Transport:** The captured CO₂ is compressed and transported—typically via pipelines, but sometimes by ship or truck—to a storage site.
3. **Storage:** The CO₂ is injected deep underground, typically into depleted oil and gas reservoirs, deep saline aquifers, or unmineable coal seams where it remains trapped for thousands of years.

THE IMPORTANCE OF CCS IN CLIMATE STRATEGY

CCS is considered crucial for several reasons:

- **Mitigating Industrial Emissions:** Sectors like cement, steel, and chemical manufacturing are carbon-intensive and difficult to decarbonize. CCS offers a way to reduce their emissions without fully replacing current processes.
- **Balancing Energy Transitions:** Fossil fuels still play a role in many countries' energy systems. CCS allows continued use of these fuels while minimizing environmental impact.



- **Enabling Negative Emissions:** When combined with bioenergy (BECCS) or direct air capture (DAC), CCS can remove CO₂ from the atmosphere, helping to reverse past emissions.

The Intergovernmental Panel on Climate Change (IPCC) has repeatedly stated that achieving net-zero emissions without CCS would be significantly more difficult and expensive.



CHALLENGES AND LIMITATIONS

Despite its promise, CCS faces multiple challenges:

- **High Costs:** The technology is expensive to install and operate, especially in low-carbon price environments.
- **Energy Intensive:** Capturing and compressing CO₂ requires significant energy, sometimes reducing the efficiency of the original process.
- **Public and Environmental Concerns:** There are fears about long-term leakage of CO₂ from underground storage, though studies show that well-managed sites are very secure.
- **Policy and Regulation:** In many regions, there is insufficient regulatory support or incentive to make CCS commercially viable.



TRANSMITTING SOLAR POWER WIRELESSLY FROM SPACE

Mr. Ilyas Ahmed

Department Of Electrical Engineering

THE CONCEPT OF SPACE-BASED SOLAR POWER

The idea behind SBSP is simple yet revolutionary: solar panels are deployed on satellites in geostationary orbit (around 36,000 km above Earth), where sunlight is constant, unaffected by weather, time of day, or seasons. These panels capture solar energy and convert it into electrical power. Then, using a wireless transmission system, the energy is transformed into microwaves or laser beams and beamed to Earth, where a rectenna (a special antenna that converts electromagnetic waves back into electricity) receives and feeds it into the power grid.

The space environment offers significant advantages over Earth-based solar power:

- **Uninterrupted Sunlight:** Solar satellites in orbit receive sunlight 24/7, unlike ground systems affected by night, clouds, or atmospheric filtering.
- **Higher Efficiency:** Solar irradiance in space is about 30% higher than on Earth, providing more energy per unit area.
- **Global Coverage:** Power can be transmitted to any part of the planet, particularly remote or underdeveloped areas lacking energy infrastructure.
- **Reduced Land Use:** Unlike ground-based solar farms, SBSP does not require vast stretches of land, preserving valuable ecosystems and agricultural zones.

MICROWAVE TRANSMISSION

- Energy is converted into low-frequency microwaves (around 2.45 GHz or 5.8 GHz).
- These waves are transmitted to large receiving stations on Earth.
- Microwaves can penetrate clouds and atmospheric layers, ensuring minimal loss.



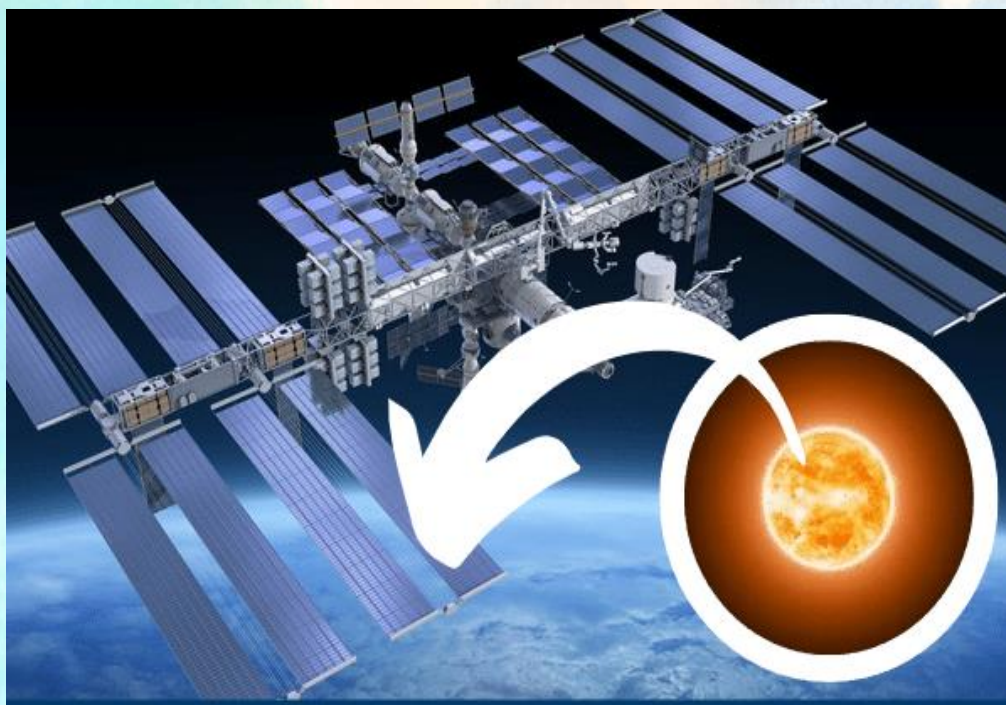
LASER TRANSMISSION

- Higher-frequency laser beams carry the energy.
- They require more precise aiming and clear weather conditions.
- Suitable for targeted, smaller-scale power delivery.

CHALLENGES AND LIMITATIONS

Despite its enormous potential, SBSP faces several technical and economic challenges:

- **Launch Costs:** Sending massive solar arrays and transmitters into orbit remains expensive, though falling launch prices and reusable rockets offer hope.
- **Energy Conversion Efficiency:** Multiple conversions (solar-to-electric, electric-to-microwave, and microwave-to-electric) can reduce overall efficiency.
- **Beam Safety and Control:** Ensuring that beams are safe and precisely targeted to avoid damage or interference is a top priority.
- **International Regulations:** SBSP requires global cooperation for spectrum allocation, orbital placement, and transmission safety protocols.





TRANSPARENT SOLAR WIND

Mrs.Madhuchhanda Bhanjadeo

Department Of Electrical Engineering

TRANSPARENT SOLAR PANELS: HARNESSING LIGHT WITHOUT BLOCKING IT

Transparent solar technology refers to solar cells that allow visible light to pass through while converting other parts of the light spectrum (ultraviolet and infrared) into electricity. These materials can be integrated into windows, mobile devices, vehicles, and building facades, effectively turning any surface into a power generator without compromising aesthetics or light transmission.

KEY FEATURES:

- **Light Transmission:** Up to 70-80% of visible light can pass through.
- **Power Generation:** Though less efficient than traditional opaque panels, they compensate by offering more surface area for energy collection.
- **Materials Used:** Organic Photovoltaic (OPVs), Perovskites, and Dye-Sensitized Solar Cells (DSSCs) are common in transparent designs.

This technology is a game-changer for urban environments, where glass-covered skyscrapers and vehicles could double as power sources. When integrated with smart glass and IoT systems, they also help regulate building temperature, reducing HVAC energy demands.





SOLAR WIND: THE SUN'S HIDDEN STREAM OF POWER

Solar wind consists of a stream of charged particles (mostly electrons and protons) released from the sun's atmosphere. These particles travel at high speeds and interact with Earth's magnetic field, often causing phenomena like auroras. Scientists have long considered whether this stream of energetic particles can be captured and converted into usable electricity.

THEORETICAL CONCEPTS INCLUDE:

- **Electrodynamics Tethers in Space:** Long conducting wires that generate electricity as they interact with the magnetic field and plasma in space.
- **Plasma Sails or Magnetic Sails:** Devices that use solar wind pressure for propulsion or potentially power generation.
- **High-Altitude Satellites or Platforms:** That could harvest energy from solar wind before it diffuses or gets deflected by Earth's magnetic shield.

Although capturing solar wind on Earth's surface is not feasible due to atmospheric interference, space-based collectors or upper-atmosphere systems might someday provide a means to harness this energy source.





ARTICLES BY STUDENTS

SOLAR 3.0

Arian Mishra

Department Of Electrical Engineering

EVOLUTION OF SOLAR POWER: FROM 1.0 TO 3.0

To understand Solar 3.0, it's helpful to look at the evolution of solar technology:

- Solar 1.0 (1970s-2000s): This was the early era of photovoltaic (PV) adoption, primarily using silicon-based solar panels for off-grid or niche applications. Efficiency was low (around 10-15%), and costs were high, limiting widespread use.
- Solar 2.0 (2000s-2020s): With advancements in manufacturing, subsidies, and grid-tie technologies, solar panels became more efficient (15-22%), affordable, and mainstream. This era brought large-scale solar farms, rooftop solar installations, and global growth in solar energy production.
- Solar 3.0 (2020s and beyond): The current wave is pushing beyond traditional PV systems. It introduces next-generation solar materials, transparent and flexible panels, AI-driven smart grids, energy storage, and integrated urban and wearable solar technologies.

WHAT DEFINES SOLAR 3.0?

Solar 3.0 is not just about new panels; it's about a fully intelligent, decentralized, and digitally connected energy ecosystem. Key features include:

ADVANCED MATERIALS AND TECHNOLOGIES

- Perovskite solar cells, multi-junction photovoltaic, and organic solar cells are replacing or complementing silicon.



- Transparent solar panels can be used on windows, vehicles, and mobile devices.
- Flexible and lightweight solar films allow integration into clothing, backpacks, and tents.
- AI and Smart Energy Management
- AI-based energy systems analyse weather, usage patterns, and grid conditions to optimize power generation and storage.
- Smart inverters and energy block chain systems allow peer-to-peer energy trading.

STORAGE AND GRID INDEPENDENCE

- Coupled with next-gen batteries like solid-state or lithium-sulphur, Solar 3.0 allows consumers to go completely off-grid or form micro grids.
- Solar-powered homes and businesses can store energy for night-time or emergency use, reducing dependence on centralized utilities.

URBAN INTEGRATION

- Solar becomes embedded into buildings, roads, vehicles, and infrastructure, rather than just mounted on rooftops.
- Smart cities are integrating solar with electric vehicles (EVs), Internet of Things (IoT), and 5G technology.





VEHICLE MONITORING AND SECURITY SYSTEM

Satya Narayan

Department Of Electrical Engineering

VEHICLE MONITORING AND SECURITY SYSTEM

A vehicle monitoring and security system is a set of integrated electronic tools and technologies designed to:

- Track the real-time location of a vehicle.
- Monitor its performance, speed, fuel usage, and mechanical health.
- Detect and prevent unauthorized access, theft, or tampering.
- Provide driver behaviour analysis for safety and efficiency.
- Enable remote diagnostics, defencing, and emergency response.

These systems work using combinations of GPS, GSM (mobile networks), on board diagnostics (OBD), RFID, and sensors, all of which are typically controlled via mobile apps or centralized fleet dashboards.

KEY COMPONENTS AND FEATURES

GPS-BASED VEHICLE TRACKING

The most basic and widely used feature is real-time tracking. GPS modules in the vehicle transmit its exact location at all times. This helps with:

- Theft recovery
- Trip history
- Route optimization
- Parent or employer supervision

ENGINE AND FUEL MONITORING

OBD-II or CAN-bus connections allow systems to monitor:

- Engine performance
- Fuel consumption



- Battery health
- Temperature and RPM Alerts are generated if any readings cross safe thresholds, helping with preventive maintenance and efficiency.

GEO-FENCING AND ROUTE ALERTS

Geo-fencing creates a virtual boundary. If the vehicle exits or enters a designated area (e.g., a school zone or city limit), the system sends immediate alerts. This is ideal for:

- Monitoring school buses
- Commercial fleet tracking
- Preventing misuse of private or rented vehicles

DRIVER BEHAVIOR MONITORING

Advanced systems use accelerometers and AI to evaluate driving patterns, such as:

- Over-speeding
- Harsh braking or sharp turns
- Unusual idling
- This is vital for insurance telematics, driver training, or safety compliance in fleets.

APPLICATIONS ACROSS SECTORS

PERSONAL VEHICLES

Owners use monitoring systems to:

- Protect against theft
- Track teenage or elderly drivers
- Monitor maintenance needs

COMMERCIAL FLEETS

Logistics and transportation companies use fleet management systems to:

- Optimize routes and fuel use



- Ensure driver safety and compliance
- Increase operational transparency
- Reduce delivery delays

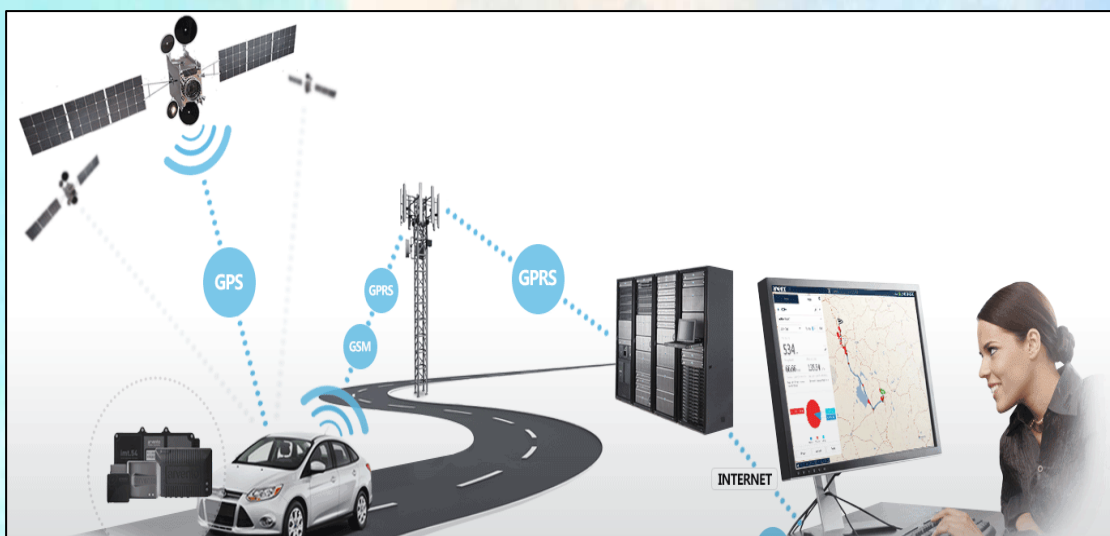
PUBLIC TRANSPORT

Government and city transport systems use vehicle monitoring to:

- Track buses and trains
- Provide ETA updates to passengers
- Improve service reliability and safety

BENEFITS OF VEHICLE MONITORING AND SECURITY SYSTEMS

- **Improved Safety:** Real-time tracking, driving alerts, and video surveillance reduce accidents and crime.
- **Operational Efficiency:** Companies save on fuel, maintenance, and logistics through smart monitoring.
- **Lower Insurance Premiums:** Insurance firms offer discounts for vehicles with advanced monitoring systems.
- **Peace of Mind:** Vehicle owners gain confidence knowing their car is always being watched and protected.





HARNESSING SOLAR ENERGY

Aditya Narayan Swain

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PHOTOVOLTAIC (PV) TECHNOLOGY

PV systems convert sunlight directly into electricity using solar panels made of semiconductor materials, typically silicon. When sunlight hits the panel, electrons are knocked loose, creating an electric current.

- Used in: Rooftop solar systems, solar farms, calculators, and satellites.
- Benefits: Silent operation, low maintenance, scalable from small gadgets to large grids.

SOLAR THERMAL SYSTEMS

These systems capture sunlight to heat a fluid, which can be used directly or to generate electricity through turbines.

- Used in: Solar water heaters, solar cookers, and concentrated solar power (CSP) plants.
- CSP uses mirrors to focus sunlight on a receiver, heating a fluid that drives steam turbines.

PASSIVE SOLAR DESIGN

Architectural designs that naturally utilize sunlight for lighting and heating without mechanical systems.

- Used in: Building design (windows, thermal mass materials), greenhouses.
- Benefit: Reduces reliance on artificial heating and lighting.

TECHNOLOGICAL INNOVATIONS IN SOLAR ENERGY

Advancements in solar technology are making it more efficient, affordable, and accessible:

- **Perovskite Solar Cells:** Offering higher efficiency at lower production costs.
- **Transparent and Flexible Solar Panels:** Can be integrated into windows, clothing, and curved surfaces.
- **Bifacial Panels:** Capture sunlight from both sides for higher energy yield.



- **Solar Paint and Fabrics:** Under development for turning any surface into a power generator.

In addition, **battery storage systems**, such as Tesla's Power wall, are solving the problem of solar's intermittent nature by **storing excess energy** for use at night or during cloudy periods.

CHALLENGES AND CONSIDERATIONS

Despite its advantages, harnessing solar energy comes with certain challenges:

- **Initial Installation Costs:** Though declining, upfront costs for panels and batteries can be high.
- **Weather Dependency:** Efficiency drops in cloudy or rainy conditions.
- **Land and Space Requirements:** Large-scale solar farms need significant space.
- **Energy Storage:** Effective storage solutions are still costly and under development.

However, ongoing research, government subsidies, and economies of scale are rapidly overcoming these hurdles.





THE FUTURE OF POWER

Jijnayansu Rout

Department Of Electrical Engineering

RISING ENERGY DEMAND AND ECONOMIC GROWTH

India's power consumption is expected to **double by 2040**, driven by:

- Urbanization and rural electrification
- Electric mobility (EVs)
- Industrial expansion
- Growing middle-class demand for modern appliances and digital services

Currently, India is the **third-largest producer and consumer of electricity** globally. Yet, **per capita energy consumption** remains lower than the global average, highlighting untapped growth potential. This growth must be managed carefully to avoid over-dependence on fossil fuels.

RENEWABLE ENERGY REVOLUTION

India is at the forefront of a global clean energy movement. The country has set ambitious targets:

- **500 GW of non-fossil fuel-based energy capacity by 2030**
- **Net-zero carbon emissions by 2070**

Key developments in renewable energy:

SOLAR POWER EXPANSION

India has become a global leader in solar energy:

- The country has installed over **70 GW** of solar capacity as of 2024.
- States like Rajasthan, Gujarat, and Tamil Nadu have large-scale solar parks.
- Rooftop solar and solar pumps for agriculture are transforming rural electrification.

WIND ENERGY

India has over **40 GW** of wind power capacity, mainly concentrated in southern and western states.

- Offshore wind projects are now being explored in coastal regions like Gujarat and Tamil Nadu.

HYDROPOWER AND BIOMASS

While large hydro projects remain significant, India is investing in small hydro and **biomass gasification** for localized clean energy generation.



GREEN HYDROGEN

The **National Green Hydrogen Mission**, launched in 2022, aims to make India a global hub for **clean hydrogen production**, especially for industries like steel, fertilizer, and refining.

ENERGY STORAGE AND GRID MODERNIZATION

One of the biggest challenges in renewable integration is **intermittency**. To manage this, India is investing in:

- **Battery energy storage systems (BESS):** For solar and wind buffering
- **Pumped hydro storage**
- **Smart grids and demand-side management**
- **Real-time digital monitoring of the power grid** for efficiency and reliability

Grid modernization is key to absorbing large-scale renewables while maintaining power quality and stability.

ELECTRIFICATION OF MOBILITY

India's transport sector is undergoing a revolution:

- The **FAME II policy** supports subsidies for electric vehicles (EVs)
- Charging infrastructure is rapidly expanding
- **Electric buses and 2-wheelers** are leading adoption in urban areas

EV growth will significantly increase electricity demand, requiring robust grid planning and localized renewable integration.

DECENTRALIZED AND DISTRIBUTED POWER SYSTEMS

Decentralized energy systems—like **microgrids, rooftop solar, and community-level energy storage**—are playing a crucial role in providing power to remote and underserved areas.

Key benefits:

- Reduced transmission losses
- Empowerment of rural communities
- Job creation in local energy markets

Solar microgrids in states like Jharkhand and Uttar Pradesh are helping achieve **energy access equity**, while also reducing dependence on diesel generators.



DIGITALIZATION AND SMART ENERGY SYSTEMS

India is rapidly adopting **digital solutions** to manage energy better:

- **Smart meters** for real-time billing and demand tracking
- **AI-based forecasting** for renewable generation
- **Blockchain in energy trading**
- **IoT-enabled appliances** for smart homes and industries

This digital transformation supports both consumers and utilities, enhancing transparency and control.

Future Perspectives for **RENEWABLE ENERGY** in India



CONCLUSION

The future of power in India is being reimagined through a blend of technological innovation, policy reforms, global collaboration, and community participation. From solar rooftops in villages to AI-driven grids in cities, India's energy landscape is evolving toward being smarter, cleaner, and more inclusive.

As India marches forward, its energy choices will define its development trajectory, climate responsibility, and global standing. The transformation is already underway, and if the momentum continues, India is poised to become a model for sustainable power in the 21st century.



ENERGY-SAVING LIGHTING TECHNOLOGIES

Sulin Behera

Department Of Electrical Engineering

THE NEED FOR ENERGY-SAVING LIGHTING

Lighting accounts for nearly **15% of global electricity use** and approximately **5% of worldwide greenhouse gas emissions**. In developing countries like India, where rapid urbanization and electrification are underway, lighting is a major contributor to peak energy demand.

Switching to energy-saving lighting technologies can:

- Reduce electricity bills
- Extend the lifespan of lighting products
- Improve light quality
- Decrease the environmental impact

These benefits are especially critical in public lighting, commercial complexes, industrial facilities, and residential buildings.

EVOLUTION OF LIGHTING TECHNOLOGIES

INCANDESCENT BULBS (OBSOLETE)

- Invented over a century ago, these bulbs convert only **5-10% of energy into light**, with the rest wasted as heat.
- Short lifespan (~1000 hours).
- Phased out in many countries due to inefficiency.

COMPACT FLUORESCENT LAMPS (CFLS)

- More efficient than incandescent bulbs, using **60-80% less energy**.
- Contain small amounts of **mercury**, posing environmental disposal risks.
- Lifespan of 8,000-10,000 hours.



LIGHT EMITTING DIODES (LEDs)

- The most advanced and widely used energy-saving lighting technology today.
- Up to **90% more efficient** than traditional bulbs.
- Lifespan of **25,000 to 50,000 hours**.
- Minimal heat generation, instant-on feature, and wide design flexibility.

Advantages:

- High luminous efficacy (lumens per watt)
- Available in a range of colors and temperatures
- Suitable for indoor, outdoor, and decorative lighting
- Compatible with smart controls and dimmers

Applications:

- Street lighting
- Home and office lighting
- Automotive lights
- Smart lighting systems
- Industrial high-bay lighting

SMART LIGHTING SYSTEMS

Smart lighting integrates LEDs with **sensors, automation, and wireless control systems**.

Features:

- Motion detection
- Daylight harvesting
- Voice control and app-based management
- Scheduling and zoning

Benefits:



- Additional energy savings through **intelligent usage**
- Improved convenience and customization
- Integration with home automation and smart cities

Energy Efficient Lighting

Techniques to Implement Energy Efficient Lighting



GLOBAL IMPACT OF LED ADOPTION

The global transition to LED lighting is projected to save over **1,400 terawatt-hours (TWh)** of electricity annually by 2030—roughly equivalent to the annual electricity output of 1,300 power plants.

Examples of large-scale LED adoption:

- **India's UJALA Scheme:** Distributed over 360 million LED bulbs across the country, reducing electricity consumption and carbon emissions.
- **Los Angeles (USA):** Replaced over 200,000 streetlights with LEDs, saving millions of dollars annually.
- **China:** The world's largest LED manufacturer and exporter, has made LEDs mandatory in government buildings and infrastructure.

WIRELESS SOLAR POWER BANK

Bedant Das



Department Of Electrical Engineering

WHAT IS A WIRELESS SOLAR POWER BANK?

A wireless solar power bank combines three key technologies:

- **Solar panels** to harvest sunlight and convert it into electricity
- **Internal batteries** (usually lithium-ion or lithium-polymer) to store the energy
- **Wireless charging coils** (typically Qi-enabled) to transmit energy without physical connectors

Users can place their smartphones, tablets, or wireless earbuds directly on the surface of the power bank to initiate charging. Simultaneously, the power bank itself can be recharged via **sunlight** or a **USB cable**, offering hybrid functionality.



HOW DOES IT WORK?



A. ENERGY COLLECTION

The solar panel absorbs sunlight and converts it into direct current (DC) electricity via the photovoltaic effect.

B. ENERGY STORAGE

The DC power is stored in the built-in rechargeable battery, which usually ranges from 5,000 to 30,000 mAh in capacity.

C. WIRELESS CHARGING TRANSMISSION

When a device is placed on the designated charging area, electromagnetic induction between coils inside the power bank and the device facilitates energy transfer wirelessly.

D. ADDITIONAL CHARGING PORTS

Most wireless solar power banks also include USB-A, USB-C, or micro-USB ports to support wired charging for multiple devices.

FEATURES OF MODERN WIRELESS SOLAR POWER BANKS

Today's wireless solar power banks are packed with user-friendly and safety features, including:

- Qi wireless charging compatibility
- Dual or triple charging ports
- Fast-charging protocols (Quick Charge, Power Delivery)
- Waterproof, dustproof, and shockproof casing (IP65-IP68 rating)
- LED indicators for battery and solar status
- Built-in flashlights, compasses, and emergency SOS signals

These features make them ideal for camping, hiking, travel, and emergency backup situations.

ADVANTAGES OF WIRELESS SOLAR POWER BANKS



A. ECO-FRIENDLY AND SUSTAINABLE

By harvesting free and abundant solar energy, these power banks reduce reliance on electricity from non-renewable sources, contributing to lower carbon footprints.

B. CORDLESS CONVENIENCE

Wireless charging eliminates the hassle of tangled cables, broken ports, and charger incompatibility. Simply placing your phone on the bank starts charging.

C. ENERGY INDEPENDENCE

Ideal for off-grid usage — such as outdoor adventures, remote work, or disaster relief scenarios — where access to power outlets is limited or nonexistent.

D. UNIVERSAL COMPATIBILITY

Most wireless solar power banks are compatible with all Qi-enabled smartphones, including iPhones, Samsung Galaxy devices, and wireless earbuds.

E. EMERGENCY PREPAREDNESS

In power outages or natural disasters, these power banks serve as reliable emergency energy sources, especially when paired with solar lanterns or radios.

LIMITATIONS AND CONSIDERATIONS

Despite their numerous benefits, wireless solar power banks do have some drawbacks:

A. SOLAR CHARGING SPEED

Solar recharging is relatively slow compared to wall charging. It may take 15-40 hours of sunlight to fully charge a 20,000 mAh battery, depending on solar intensity.



B. SIZE AND WEIGHT

High-capacity solar power banks with wireless features tend to be bulkier and heavier, making them less pocket-friendly.

C. EFFICIENCY

Wireless charging is typically less efficient (60-70%) than wired charging (85-95%), leading to longer charging times and potential heat buildup.

D. SUNLIGHT DEPENDENCY

Performance varies with weather, location, and time of day. In cloudy or indoor environments, solar charging may be ineffective.

To counter these limitations, many users pre-charge the bank at home via USB and use solar as a secondary charging option.

APPLICATIONS OF WIRELESS SOLAR POWER BANKS

A. OUTDOOR ADVENTURES

Perfect for camping, hiking, mountaineering, and road trips where electricity is inaccessible.

B. TRAVEL

Travelers can stay connected and charged on the go, even during long transits or in remote destinations.

C. EMERGENCY PREPAREDNESS KITS

A critical component of disaster kits to keep phones operational during blackouts or natural disasters.

D. URBAN CONVENIENCE

Use in cafes, parks, or public spaces without needing access to plug points – ideal for urban nomads and digital workers.



IoT-Based Waste Segregation with Location Tracking

Jatin Mallick

Department Of Electrical Engineering

THE NEED FOR SMART WASTE MANAGEMENT

Improper waste disposal and lack of segregation at source are key reasons why cities struggle with recycling, composting, and safe disposal. Key issues include:

- Low recycling rates due to mixed waste
- Inefficient and inconsistent waste collection schedules
- Lack of real-time data and traceability
- Overflowing bins causing health and hygiene issues
- Dependency on manual labour for hazardous sorting tasks

An IoT-based waste segregation system helps to address these issues by automating detection, separation, and tracking—enhancing efficiency while promoting environmental responsibility.





“Mountains Like Father, Rivers Like Mother”

My father is a mountain tall,
Unshaken by the storm's loud call.
His voice, a thunder soft and deep,
A promise made for me to keep.

My mother is a river wide,
That dances, sings, and flows with pride.
She bends through life with patient grace,
And waters all my empty space.

Together they became the land,
The sky, the sea, the guiding hand.
I walk the path their love has made,
In forest light and meadow shade.

Sidhartha Mohanty, EE

“The Garden of Their Love”

In gardens where the daisies bloom,
And sunsets chase away the gloom,
I see my mother's gentle grace,
In every leaf, her soft embrace.

The wind that hums through silent trees,
Carries my father's calm with ease.
His strength lies deep like ancient stone—
A quiet force I've always known.

Nature's heart beats warm and true,
Just like the love I got from you.
A gift that time cannot erase—
I find you both in every place.

Balaram Sabar, EE



"WHERE YOU ARE, I AM"

I've wandered through seasons, warm and cold,
Through stories half-written and secrets untold.

I've danced with the echoes of might,
But nothing compares to your light.

You entered my life like the calm after rain,
Like laughter that rises from deep-rooted pain.

You didn't come loud, no thunder or flame,
But quietly, gently—you just knew my name.

And now, in your silence, I hear my own song,
In your arms, I know where I truly belong.
No compass or clock, no map or star chart—
Just the rhythm of you in the beat of my heart.

I don't need the world, I don't need the skies,
I just need your truth, the look in your eyes.

For love isn't grand, it's not always afar—
It lives in the little things, right where you are.

Tamasa Bisoi, EE

"BEFORE I KNEW YOU"

Before I knew your voice, I knew your song,
A melody I'd been humming all along.
Before your name had ever touched my lips,
I'd traced your soul in a thousand eclipse.

Before your hand had ever held mine tight,
You lit my darkness without a light.
I knew the shape of your shadowed face,
Though time and space had yet to trace.

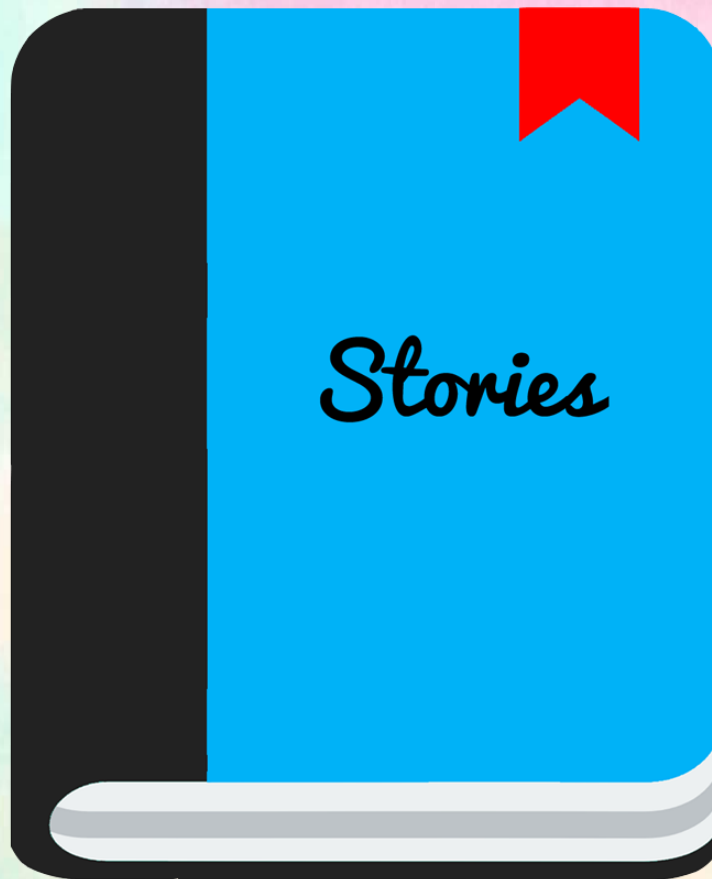
And when you came—so real, so true,
I found the missing part was you.
Not half of me, but more than whole,
The mirror to my restless soul.

Since then, the stars have looked more near,
The nights less cold, the path more clear.

And if I live ten lives, or two—
Each time, I'll fall in love with you.

Debasis Dash, EE





The Answer Sheet

Riya was always asked questions. “Why is the sky blue?” “Why are dreams seen?” “Why is the capital of every country memorized?” However, in school, only one correct answer was ever accepted—A, B, C, or D. One day, during a big exam, a final question was found by her: “What is thought by you?” There were no options provided, and no answer was marked as right or wrong. A pause was taken by Riya, and then a smile was shown. For the first time, her curiosity was not dismissed; instead, it was welcomed.

The question was read over and over, but no immediate answer was given. Her mind explored ideas that had always been locked away. The answer that was written on the paper was not a single fact, but a collection of thoughts, questions, and wonder. A sense of freedom was felt that day—freedom from the constraints of memorization and right or wrong. Riya realized that sometimes, the best answers are those that can’t be measured or graded. And in that moment, the entire exam felt different—more like a conversation than a test.

BEDANT DAS, EE



THE SILENT TEACHER

Every day, Aryan would come home from school, eager to talk about the lessons and friends he'd met. His father would listen intently but never comment much. He would nod, smile, and ask, "What did you learn today?"

One day, Aryan noticed his father sitting quietly at the table, his hands weathered and tired, but his eyes were focused.

"What are you doing, Papa?" Aryan asked.

"I'm learning," his father said softly.

"But you already know so much!" Aryan replied, surprised.

"Yes," his father smiled. "But sometimes, we have to keep learning to make sure we're good teachers to you."

Years later, Aryan understood. It wasn't the lessons his father spoke but the silent way he taught through action—working hard, being present, showing love.

NARESH SWAIN, EE

THE PROMISE

Ravi had always watched his father leave early in the morning, long before the sun rose. Every night, his father would come home tired, his eyes heavy, but he would still make time to listen to Ravi's day.

One day, as they sat together, Ravi asked, "Papa, why do you work so hard?"

His father's eyes softened.

"I do it for you—for your future. One day, you will understand."

Ravi nodded, not fully grasping the weight of his father's words.

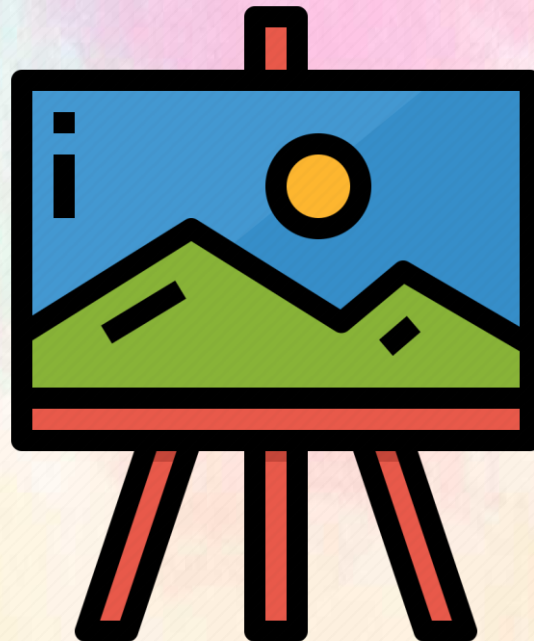
Years later, after his father had passed away, Ravi returned to the old house. He saw the worn-out shoes his father had left behind, the work clothes that had once been so familiar.

In that moment, he understood. The promise his father had made was in every sacrifice, in every long hour of work, and in the love that had shaped his life.

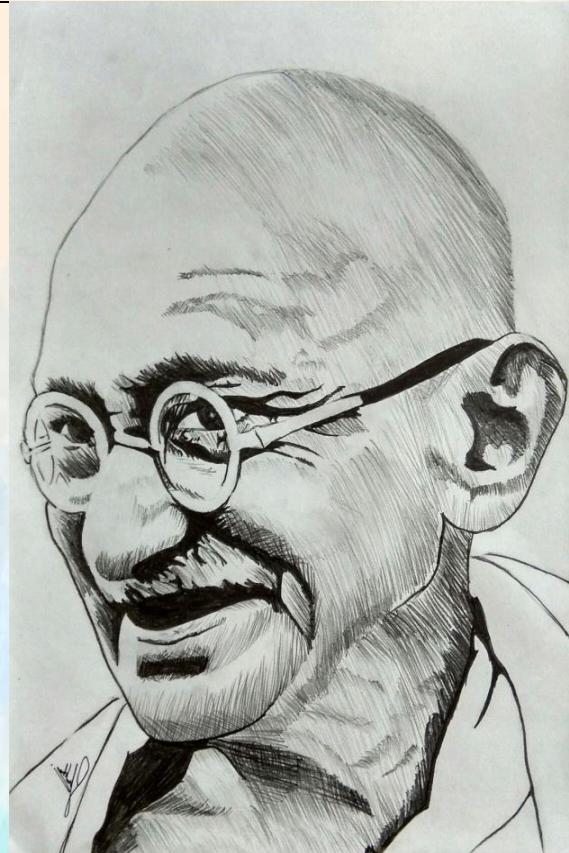
SUNIL BASKEY, EE



PAINTINGS BY STUDENTS



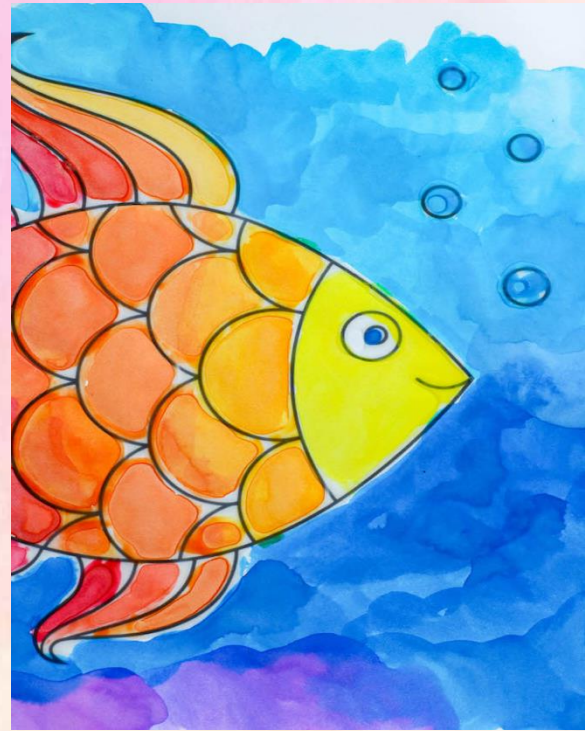
HIMANSU KALET, EE



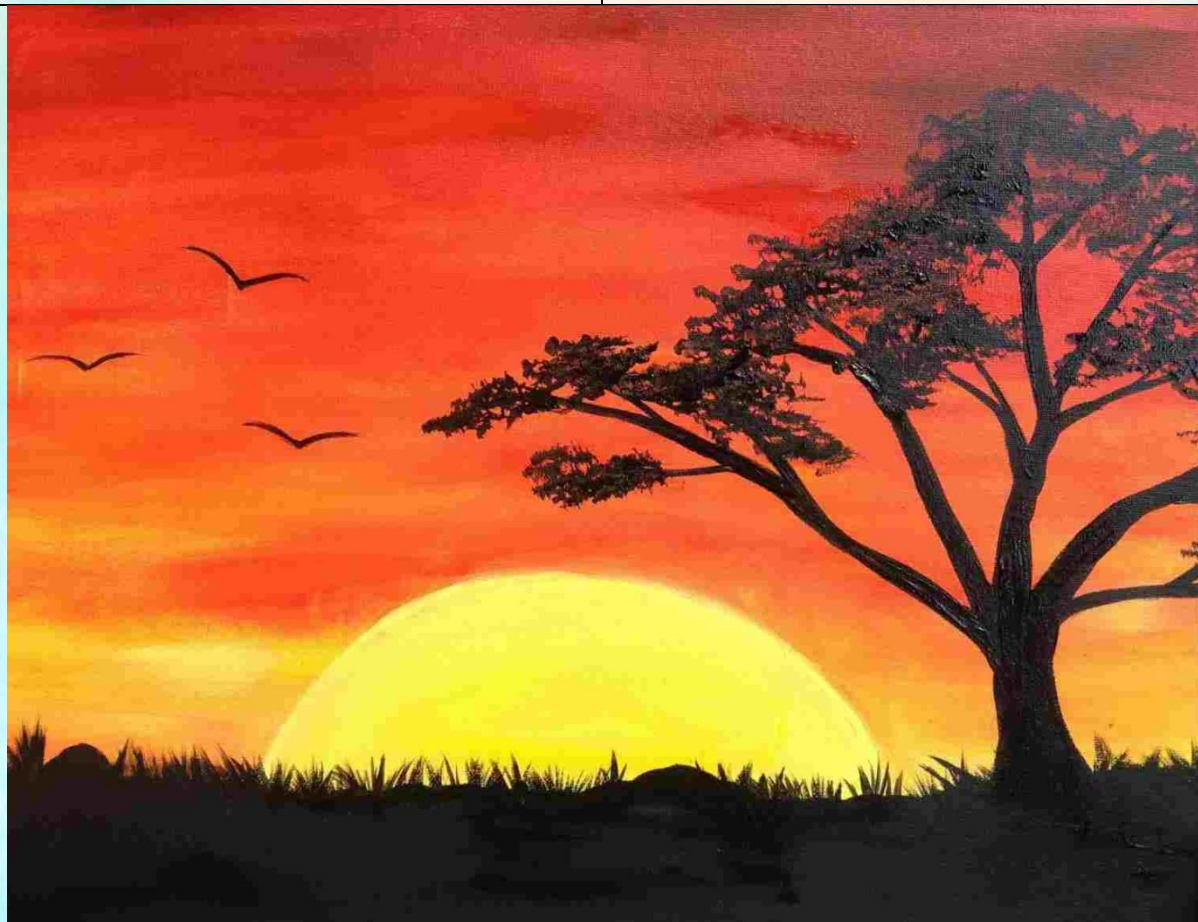
MAHESH BARIK, EE



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SUBHASHIS PATI, EE



SATYA NARAYAN, EE