SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE
(An Autonomous Institution)
(Approved by AICTE, New Delhi & Affiliated to Pondicherry University)
(Accredited by NBA-AICTE, New Delhi, ISO 9001:2000 Certified Institution &
Accredited by NAAC with "A" Grade)
Madagadipet, Puducherry - 605 107

23 years of ACADEMIC EXCELLENCE

DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING

RENEWABLE ENERGY CLUB

(Academic Year: 2022 to 2023)

Submitted by
Dr. D.Sivaraj
Assistant Professor
Faculty Coordinator

Preface

The Renewable Energy Club of the Department of Electrical and Electronics Engineering, Sri Manakula Vinayagar Engineering College, serves as a dedicated platform to promote awareness, innovation, and practical learning in the field of renewable and sustainable energy systems. The club is established with the objective of bridging the gap between theoretical knowledge and real-time applications in areas such as solar energy, wind energy, energy storage systems, electric vehicles, smart grids, and sustainable power generation technologies. The club actively encourages students to explore emerging trends in renewable energy through hands-on demonstrations, technical workshops, training programs, expert lectures, project development, and interdisciplinary activities, including practical exposure to solar power generation, solar pumping systems, solar trackers, autonomous solar-based robots, and sensor-based energy applications. By fostering analytical thinking, problem-solving skills, environmental responsibility, and teamwork, the club aims to prepare students to address global energy challenges and contribute to sustainable development. The effective functioning of the club is supported by a committed team of faculty coordinators and student office bearers, including the President, Vice President, Secretary, and Technical Members, who work collaboratively to plan, organize, and execute various technical and co-curricular activities. Through continuous learning, innovation, and industry-oriented initiatives, the Renewable Energy Club strives to develop technically competent, socially responsible, and professionally skilled engineers, thereby contributing to the academic excellence and technological advancement of the institution.

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ABOUT THE INSTITUTION

Sri Manakula Vinayaga Educational Trust was founded to provide quality and affordable education to the weaker sections of society. The trust established Sri Manakula Vinayagar Engineering College (SMVEC) in 1999. SMVEC is an autonomous institution affiliated to Pondicherry University. It offers 13 undergraduate, 8 postgraduate and 11 Research programme in engineering. SMVEC has been accredited by NAAC with “A” grade and NBA. The institution is also accredited by TATA consultancy services. The college has a good placement record with students getting job offers from top companies in India and abroad. SMVEC students have won many awards and accolades for their academic achievements.

Vision

- *To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society*

Mission

M1: Quality Education: To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2: Research and Innovation: To foster value-based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

M3: Employability and Entrepreneurship: To inculcate the employability and entrepreneurial skills through value and skill-based training.

M4: Ethical Values: To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

DEPARTMENT VISION AND MISSION

Vision

To promote proficiency in the field of Electrical and Electronics Engineering by creating a stimulating environment for research, innovation and entrepreneurship

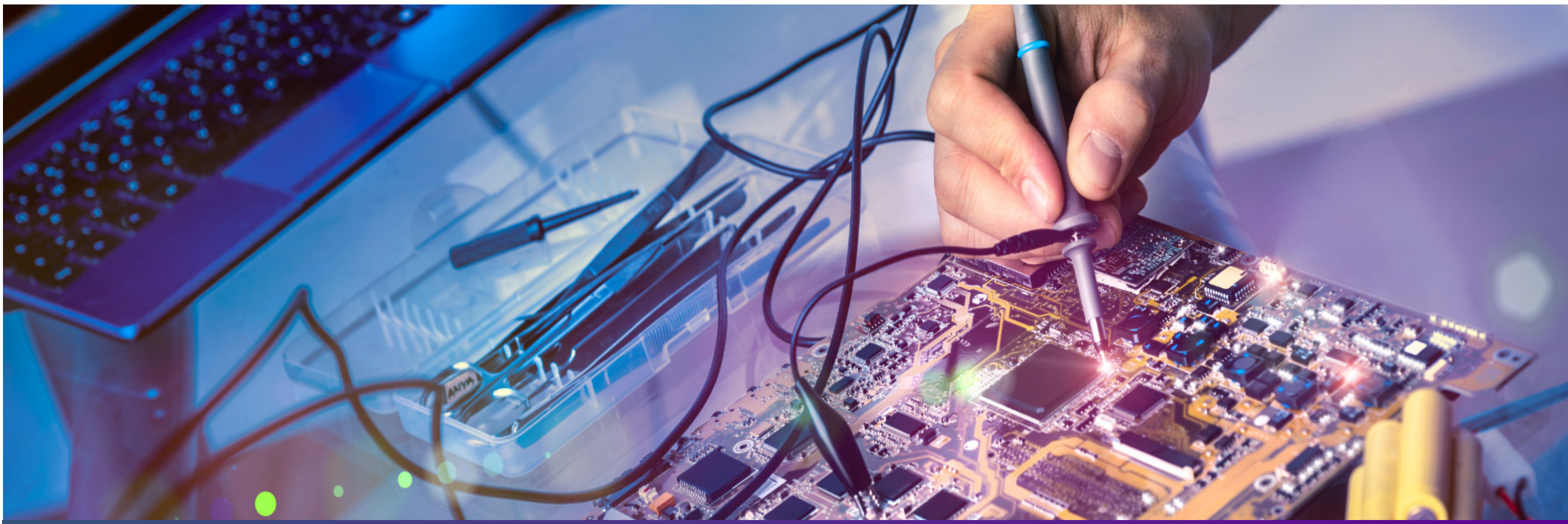
Mission

M1: Quality Education: To impart high quality technical education with problem solving capabilities by innovative pedagogy in emerging technologies.

M2: Industrial and Societal Needs: To cater the dynamic needs of the industry and society by strengthening industry-institute interaction.

M3: Research and Innovation: To nurture the spirit of research attitude by carrying out innovative technologies pragmatically.

M4: Placement and Entrepreneurship: To inculcate the professionalism in career by advancing synergetic skills to compete in the corporate world.



ABOUT THE RENEWABLE ENERGY CLUB

Renewable energy systems are referred to as sustainable power solutions designed to harness naturally replenished energy sources such as solar, wind, biomass, hydro, and geothermal energy. Renewable energy technologies are widely applied in areas such as power generation, electric vehicles, smart grids, energy storage systems, green buildings, and rural electrification. Considering the increasing global energy demand, environmental concerns, and the need for sustainable development, renewable energy can be regarded as one of the most significant technologies of the present and future.

The function of the Renewable Energy Club is to build strong fundamentals in energy systems and sustainability concepts. This club aims to explore emerging topics and practical applications that extend beyond the regular curriculum, including recent advancements, policies, and real-world case studies. The club supports students by integrating knowledge from electrical, mechanical, electronics, and environmental engineering, enabling them to develop innovative, eco-friendly solutions and prepare for challenges in the evolving energy sector.

OBJECTIVES:

- To create awareness about the importance of renewable energy and sustainable development among students.
- To provide fundamental knowledge on various renewable energy sources such as solar, wind, biomass, and hydro energy.
- To expose students to emerging technologies and recent advancements in the renewable energy sector beyond the curriculum.
- To encourage hands-on learning through workshops, projects, and demonstrations related to renewable energy systems.

OFFICE BEARERS AND THEIR PORTFOLIOS

S.No	Name	Position
1.	Dr.D.Sivaraj Assistant professor/EEE	Faculty Coordinators
2.	Mr. A.Janagiraman Assistant professor/EEE	
3.	Mr. Elamparuthi K	President
4.	Mr. K. Jothikrishnan	Vice president
5.	Mr.Srisanthosh B	Secretary
6.	Mr. E.K Abdullah	Joint Secretary
7.	Mr. Tom Tijo Edattukaran	
8.	Ms. M. Savitha	Executive Members
9.	Mr. Mohanlal	
10.	Ms. M.Swetha	Technical Members
11.	Mr. Jeeva sudhan	
12.	Ms. Susangati Samantaray	

Dr. D.Sivaraj
Assistant Professor
Faculty Coordinator

Elamparuthy
President

Jothi krishnan
Vice President

Mohanlal
Executive Member

Jeeva Sudhan
Technical Member

LIST OF STUDENT MEMBERS`

S.NO	NAME OF THE STUDENT	YEAR
1	Swetha M	III
2	A. Sakthi	III
3	Arunprasath.S	III
4	Akash Sv	III
5	Poobathi	III
6	V. Arthi	III
7	Mohan Raj P	III
8	Badhma Priya M	III
9	Kalpanadevi	III
10	Devapriya D	III
11	Kriahna Kumar. R	III
12	Anusha.C	III
13	Savitha.M	III
14	Nithishkumar.K	III
15	Srisanthosh B	III
16	Mohamed Thofique	III
17	Kabilan S	III
18	Kirankumar S	III
19	Abdullah E K	III
20	Surendhar V	III
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23	Vighneshwar.V	III
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25	Rozalan J	III
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32	Priyadharshini	II
33	Tom Tijo Edattukaran	II
34	Sanjai.S	II
35	Jothikrishnan K	II
36	Mohan Lal	II
37	Srinivasan S	II
38	S. Logesh	II
39	Pranav	II
40	Abdul Hafreed	II

Demonstration of solar power generation using solar cell

Date: 26.11.2022

Introduction

Solar energy represents a clean, renewable, and sustainable source of power, directly converting sunlight into usable electricity. The core technology enabling this conversion is the photovoltaic (PV) cell, which operates based on the principle of the photovoltaic effect. Understanding the performance characteristics of a single PV cell is essential to designing and optimizing large-scale solar arrays. This demonstration serves as a fundamental exercise in renewable energy technology.

Objective

The objectives of this demonstration are:

1. To visually demonstrate the direct conversion of light energy into electrical energy (DC) using a photovoltaic cell.
2. To establish the relationship between light exposure (intensity and angle) and the resulting electrical output (Voltage and Current).
3. To confirm the working principles of a simple solar power circuit by powering a designated load.

Theoretical Background

Photovoltaic Effect

A solar cell is typically made of a semiconductor material, most commonly silicon, which is doped to create a p-n junction. When photons from incident light strike the cell with sufficient energy, they excite electrons in the semiconductor material. The electric field at the p-n junction acts to sweep these photo-generated electrons to the n-side and holes to the p-side, establishing a potential difference (voltage). When an external circuit is closed, the separated charges flow as an electric current, generating usable Direct Current (DC) power.

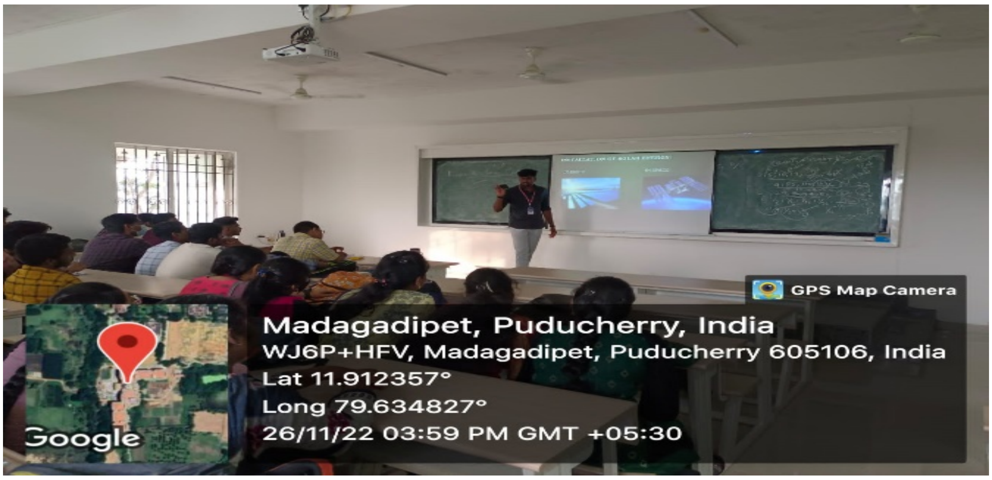
Key Electrical Parameters

The performance of a PV cell is characterized by two key electrical parameters:

Open Circuit Voltage (Voc): The maximum voltage produced by the cell when no load is connected (i.e., when the current is zero). This value is primarily dictated by the semiconductor material and temperature.

Short Circuit Current (Isc): The maximum current produced by the cell when the terminals are shorted (i.e., when the voltage is zero). This value is directly proportional to the intensity of the incident light.

Power Output (P): The electrical power generated, calculated by the product of voltage and current ($P=V\times I$). Maximum power is typically achieved at a point between Voc and Isc.



Materials and Apparatus

The following equipment is required to perform the demonstration:

S. No.	Component	Specification / Type	Function
1.	Photovoltaic (Solar) Cell	Single crystalline silicon cell (Approx. 0.5 V)	Converts light energy to electrical energy.
2.	Digital Multimeter (DMM)	Capable of measuring DC Voltage and DC Current.	Measures the cell's electrical output.
3.	Electrical Load	Small DC Motor or LED	Demonstrates the power generation.
4.	Light Source	Natural Sunlight or High-Wattage Desk Lamp	Provides the input energy (photons).
5.	Connecting Wires / Clips	Alligator clips and insulated wires.	Connects the cell, meter, and load to form a circuit.
6.	Protractor/Goniometer (Optional)	Manual or Digital	Measures the angle of incidence of light.

Procedure (Methodology)

The following steps outline the procedure for demonstrating solar power generation and characterizing the cell's output:

Initial Setup

1. Secure the solar cell on a stable, flat surface.
2. Position the light source (lamp or direct sunlight) to illuminate the cell uniformly.
3. Set the Digital Multimeter (DMM) to the appropriate DC voltage range.

Measuring Electrical Characteristics

1. **Open Circuit Voltage (Voc):** Connect the DMM leads directly across the positive and negative terminals of the solar cell. Record the stable voltage reading.
2. **Short Circuit Current (Isc):** Change the DMM function to measure DC current (Amperes or Milliamperes) and connect it in short-circuit configuration (directly across the terminals). Record the stable current reading.
3. **Load Test:** Disconnect the DMM. Connect the solar cell terminals to the designated electrical load (DC motor or LED) and observe its operation.

Investigating Variables (Variable Test Conditions)

1. **Effect of Intensity:** While maintaining a perpendicular angle (90∘), systematically change the distance between the light source and the solar cell (e.g., 10 cm, 20 cm, 30 cm). At each distance, repeat the Voc, Isc measurements, and load test.
2. **Effect of Angle:** Fix the distance of the light source. Use the protractor to vary the angle of incidence of the light on the solar cell (e.g., 90∘, 60∘, 45∘, 30∘). At each angle, repeat the Voc, Isc measurements, and load test.

Discussion and Expected Observations

- **Observation of Power Generation:** The successful operation of the small DC motor or illumination of the LED is expected to provide a clear, visible demonstration of electrical power generated from light.
- **Impact of Light Intensity:** A direct correlation is expected between light intensity and current output. As the light source is moved closer (higher intensity), the Short Circuit Current (Isc) is expected to increase due to more photons generating more free electrons. The Open Circuit Voltage (Voc) is expected to change only marginally.
- **Impact of Angle:** The power output is expected to be maximized when the solar cell surface is positioned perpendicular (90∘) to the incident light. As the angle decreases from 90∘, the same amount of light energy is spread over a larger area of the cell, leading to reduced current and power output.

- **Limitations:** The power output observed in this small-scale demonstration represents the capability of a single cell. In real-world applications, multiple cells are connected in series and parallel within a panel, and inverters are used to convert the DC power to usable AC power.

Conclusion

The demonstration is designed to provide practical evidence of the photovoltaic effect. It will successfully show that the power output of a solar cell is fundamentally dependent on the intensity and angle of the light source, thus validating the basic operating principles of photovoltaic technology.

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49	SRIDHASAN NAMBI	Present
50	SRINIVASAN S	Present

Renewable Energy Club - Activity Report-1

Demonstration about solar pump, solar line follower bot and a study about sensors

Date: 23.07.2022

Introduction

This report documents the study and practical demonstration of key concepts in renewable energy and autonomous robotics, specifically focusing on a Solar Water Pump, a Solar Line Follower Robot, and a foundational study on Sensors critical to these systems. The aim is to demonstrate the conversion of solar energy into mechanical work and autonomous navigation, and to understand the role of various sensors in enabling intelligent system operation
.

Demonstration 1: Solar Water Pump System

Principle and Objectives

The solar water pump demonstration illustrates the direct conversion of solar energy (photovoltaic effect) into hydraulic energy (pumping water). This system provides a practical, off-grid solution for irrigation and water supply, minimizing reliance on conventional power sources.

Principle: A Photovoltaic (PV) panel converts sunlight into Direct Current (DC) electricity, which directly powers a DC water pump.

Objective: To demonstrate the feasibility of using solar power for a practical mechanical task and to observe the pump's performance variability with changing light intensity.

Sl.No	Component	Function
1.	**Photovoltaic (PV) Panel**	Converts sunlight into DC electrical energy.
2.	**DC Submersible Pump**	Moves water using the power generated by the PV panel.
3.	**Water Source/Reservoir**	Provides the water to be pumped.
4.	**Piping/Tubing**	Directs the flow of water from the source.
5.	**Multimeter (Optional)**	Measures voltage and current output from the PV panel.

Components and Methodology

Demonstration Procedure Outline:

1. Place the PV panel in direct sunlight.
2. Connect the panel's output directly to the DC pump terminals.
3. Submerge the pump head into the water reservoir.
4. Observe and record the rate of water discharge.
5. *Experimental Variation:* Introduce partial shading or change the panel's angle to simulate variable solar conditions and observe the resulting change in pump speed and water flow rate.

Discussion of Expected Observations

The pump operation is entirely dependent on the solar irradiance. The water flow rate is expected to be highest under direct, perpendicular sunlight and to decrease significantly under cloudy conditions or partial shading. This demonstrates the critical relationship between solar input and mechanical output in a PV-direct system.

Demonstration 2: Solar Line Follower Robot (LFR)

Principle and Objectives

The Solar LFR is a fundamental example of an Autonomous Guided Vehicle (AGV) that uses onboard power generation (solar) and sensory feedback to navigate a predetermined path (a black line on a white surface, or vice versa).

- **Principle:** The robot uses a sensor array to detect contrast changes (the line) and feeds this information to a microcontroller. The microcontroller processes the sensor data to adjust the speed and direction of the drive motors, keeping the robot centered over the line. Power is derived from an integrated PV panel and a battery/capacitor bank.
- **Objective:** To demonstrate autonomous navigation using sensor feedback and to utilize solar energy as the primary source of power for a mobile platform.

Components and Methodology

Component	Function
Photovoltaic (PV) Cell	Charges the onboard battery/capacitor.
IR Sensor Array	Detects the line by measuring the contrast difference (reflectivity of black vs. white).
Microcontroller (e.g., Arduino)	Processes sensor inputs and controls motor outputs.
DC Gear Motors	Provide the motive force for the wheels.
Motor Driver (e.g., L298N)	Acts as an interface between the microcontroller and the high-current motors.
Power Storage (Battery/Capacitor)	Stores solar energy to ensure continuous operation.

Demonstration Procedure Outline:

1. Ensure the onboard power storage is adequately charged by the PV cell (in sunlight).
2. Place the robot on a clearly drawn line track.
3. Activate the control system.
4. Observe the robot's movement as it autonomously tracks the line.
5. *Key Observation:* Note how the system uses proportional control (e.g., speed adjustment) based on which IR sensor is over the line/off the line to continuously correct its path.

Discussion of Expected Observations

The robot is expected to follow the line by oscillating slightly across the track, making continuous, rapid corrections. If a sensor moves onto the white surface, the motor on that side may slow down or stop, causing the robot to pivot back towards the line. This illustrates a closed-loop control system where sensors provide input → the microcontroller processes the logic → actuators (motors) perform the action.

Study of Sensors in Solar and Robotic Systems

A sensor is a device that detects and responds to some type of input from the physical environment. They are the "eyes" and "nerves" of any smart system.

Sensor Type	Principle of Operation	Application in Demonstration/Robotics
Infrared (IR) Sensor	Emits IR light and measures the reflected intensity; high reflection (white) vs. low absorption (black).	**Solar LFR:** Used in an array to detect the line/track surface.
Photovoltaic Cell	Converts light energy into an electrical signal (voltage/current).	**Solar Pump/LFR:** Primary component for power generation; can also be used as a light sensor for a solar tracking mechanism.
Soil Moisture Sensor	Measures the electrical conductivity of the soil, which is proportional to water content.	**Solar Pump (Advanced):** Used to autonomously turn the pump ON/OFF based on the crop's real-time irrigation needs.
Ultrasonic Sensor (or LiDAR)	Emits sound waves/laser pulses and measures the time-of-flight of the return echo.	**Robotics (General):** Used for obstacle detection, mapping, and collision avoidance in autonomous vehicles.
Temperature Sensor	Measures ambient temperature (thermistor/IC).	**Solar Systems:** Monitors the PV panel temperature, as high temperature can reduce cell efficiency, informing system optimization.

Conclusion

The three components of this report—the Solar Pump, the Solar Line Follower Robot, and the Sensor Study collectively illustrate the convergence of renewable energy, automation, and control systems.

The **Solar Pump** demonstrates a viable and sustainable application of converting solar energy into useful mechanical work.

The **Solar LFR** showcases the fundamentals of autonomous navigation, using sensor feedback and control logic to achieve a goal.

The **Sensor Study** highlights that robust, intelligent systems are defined by their ability to accurately perceive the environment, with sensors acting as the indispensable interface between the physical world and the digital control system.

These technologies represent foundational pillars for future development in smart agriculture, sustainable infrastructure, and autonomous transport.

Date: 23.07.2022

S.NO	NAME	Present/Absent
1.	KASTHURI C	Present
2.	KAVEEYA K	Present
3.	KAVIARASAN M	Present
4.	KAVIYA S	Present
5.	KEERTHIRAJ. V	Present
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30.	SRIDHASAN NAMBI	Present
31.	SRINIVASAN S	Present
32.	SUSANGATI SAMANTARAY	Present
33.	SWETHA S	Present
34.	THAMIZHARASAN. S	Present
35.	THILAK BASKARAN C M	Present
36.	TOM TIJO EDATTUKARAN	Present
37.	VENKATESHWARAN R	Present
38.	VIGNESHWARAN V	Present
39.	VIJAYALAKSHMI S	Present
40.	VINISHA LAXMI G	Present
41.	VISHWA M	Present
42.	YOGARAJAN R	Present
43.	YOGESH .R	Present
44.	SRIBALAN R	Present

45.	VEDHAVALLI K	Present
46.	VISHWASAKTHI A	Present
47.	MICHAEL ROBIN K	Present
48.	NIRMALKUMAR V	Present
49.	KAVIBHAARATHI M	Present
50.	PAVITHRA C	Present

Renewable Energy Club - Activity Report-2

Demonstration of solar tracker

Date: 30.07.2022

Introduction

Background: Briefly introduce solar energy, the purpose of solar trackers (to maximize energy collection by keeping the panel perpendicular to the sun's rays), and the types (single-axis, dual-axis).

Objective: State the primary goal of the project/demonstration (e.g., to design, construct, and test a single/dual-axis solar tracker and quantify its efficiency gain over a fixed panel).

Scope: Define the limitations (e.g., prototype scale, light-dependent resistor (LDR) sensor based, only tracks during daylight hours).

System Design and Components

Tracker Type: Specify if it's a Single-Axis (tracks East-West or North-South) or Dual-Axis (tracks both azimuth and altitude).

Hardware Components:

Solar Panel: Size, power rating (e.g., 5V, 6W panel).

Control Unit: Microcontroller (e.g., Arduino, Raspberry Pi, PLC).

Sensors: Light Dependent Resistors (LDRs) or other sensors, detailing their arrangement (e.g., four LDRs in a cross pattern for a dual-axis tracker).

Actuators: Motors (e.g., Servo Motors, Stepper Motors, Linear Actuators) and their mechanism (e.g., gears, linkages).

Power Supply: Battery, voltage regulator, etc.

Structure: Description of the physical frame/mounting.

Software/Control Algorithm:

Operating Principle: Describe the logic (e.g., comparing voltage readings from LDRs; if the East LDR reads higher, the motor moves East until the readings are equal).

Flowchart: A diagram illustrating the system's operational logic (start, read sensors, compare values, actuate motor, loop).

Experimental Setup and Procedure

Setup: Describe the arrangement of the demonstration:

Tracker Prototype: Details on its positioning and initial calibration.

Fixed Panel: A comparison solar panel fixed at an optimal angle (e.g., fixed tilt angle facing South in the Northern Hemisphere) for the same location.

Measurement Tools: Multimeters, data loggers, light meters (for irradiance), to measure voltage, current, and power output.

Data Collection Procedure: Step-by-step process:

Select a clear sunny day.
Measure and record the voltage (V) and current (I) from *both* the fixed panel and the tracking panel at regular intervals (e.g., every 30 minutes) from sunrise to sunset.
Optional: Measure solar irradiance (W/m2).

Results and Data Analysis

Raw Data Table: Present the collected data (Time, VTracker, ITracker, PTracker, VFixed, IFixed , PFixed).
Note: Power (P) is calculated as P=V×I.

Performance Graphs: Visually compare the outputs:

Graph 1: Power (P) vs. Time (Plot both PTracker and PFixed on the same axes).

Graph 2: Total Energy Generation over the test period (Calculated by integrating the Power vs. Time graph, usually done by summing the power readings multiplied by the time interval).

Comparison and Efficiency:

Total Energy Output:
$E_{Tracker}=\sum P_{Tracker}\times\Delta t$
$E_{Fixed}=\sum P_{Fixed}\times\Delta t$

Efficiency Gain (η_{Gain}):
.Calculate the percentage increase.

$\eta_{Gain} = E_{Fixed}\ \ E_{Tracker} - E_{Fixed}\times 100\%$

A successful demonstration typically shows a gain between **20% and 40%** depending on the tracker type and weather conditions.

Discussion

Analysis of Results: Interpret the graphs and efficiency gain. Explain *why* the tracker performed as it did (e.g., peak power was maintained for a longer duration).

Challenges and Errors: Discuss any issues encountered (e.g., clouds interfering with LDRs, motor inertia, power consumption of the tracker itself).

Economic Viability: Briefly discuss the added cost of the tracker versus the increased energy yield.

Conclusion

- Summarize the achievement (The single/dual-axis solar tracker was successfully demonstrated, resulting in an X% increase in energy generation compared to the fixed panel).
- Reiterate that the objectives were met.

Demonstration of solar tracker

Date: 30.07.2022

S.NO	NAME	Present/Absent
1	ABDUL HAFREED H	Present
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49	SRIDHASAN NAMBI	Present
50	SRINIVASAN S	Present
51	SUSANGATI SAMANTARAY	Present
52	SWETHA S	Present
53	THAMIZHARASAN. S	Present
54	THILAK BASKARAN C M	Present
55	TOM TIJO EDATTUKARAN	Present
56	VENKATESHWARAN R	Present
57	VIGNESHWARAN V	Present
58	VIJAYALAKSHMI S	Present
59	VINISHA LAXMI G	Present
60	VISHWA M	Present
61	YOGARAJAN R	Present
62	YOGESH .R	Present
63	SRIBALAN R	Present
64	VEDHAVALLI K	Present
65	VISHWASAKTHI A	Present
66	MICHAEL ROBIN K	Present
67	NIRMALKUMAR V	Present
68	KAVIBHAARATHI M	Present
69	PAVITHRA C	Present
70	VIJAYAN N	Present
71	KARTHIKEYAN	Present
72	GUNASEELAN RJ	Present
73	VEDHAVARSHINI M	Present
74	SHRUTHI R	Present
75	KAMALAKANNAN S	Present
76	CHANDHINE V	Present
77	THAMIZHARASU T	Present
78	UMAPATHY K	Present
79	MUFEED M	Present
80	ABILASH P	Present
81	GAUTHAM G D	Present
82	NIJANTHAN S	Present
83	PASUPATHI S	Present
84	PERIASAMY R	Present
85	SESHATHRI N	Present
86	SOWMIYA J	Present
87	VISUVAMOORTHY G	Present
88	YUVARAJ N	Present