Department Of Electronics and Communication Engineering(ECE)

Solar Energy Tracking and Optimization System Using Inverter Control With Arduino

Batch-Code:**ECEAK6232414**

Project Associates:

R.P.S.N.Sowjanya	20K61A04C1
J.Sai Babu	20K61A0460
J.Venkata Vamsi	20K61A0459
T.S.S.Durga Prasad	20K61A04D9

Under the Guidance of:

Mrs. N.Sannajaji

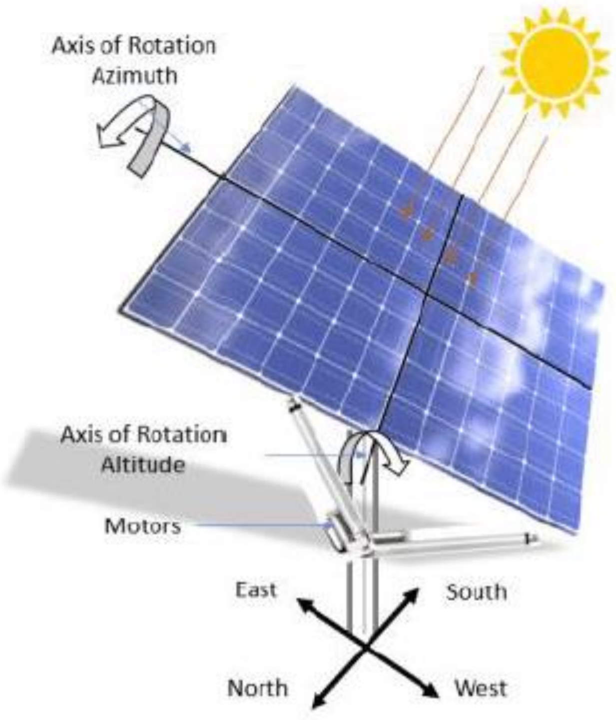
Assistant professor

Department of ECE

Contents:

Aim/Objective:

The aim of our project is to create a solar power system that optimizes energy use. It uses dual-axis solar tracking, automatic cleaning, and real-time monitoring to improve efficiency and reliability. The aim is to make solar power more accessible and sustainable by addressing issues like dust accumulation through intelligent self-maintenance.



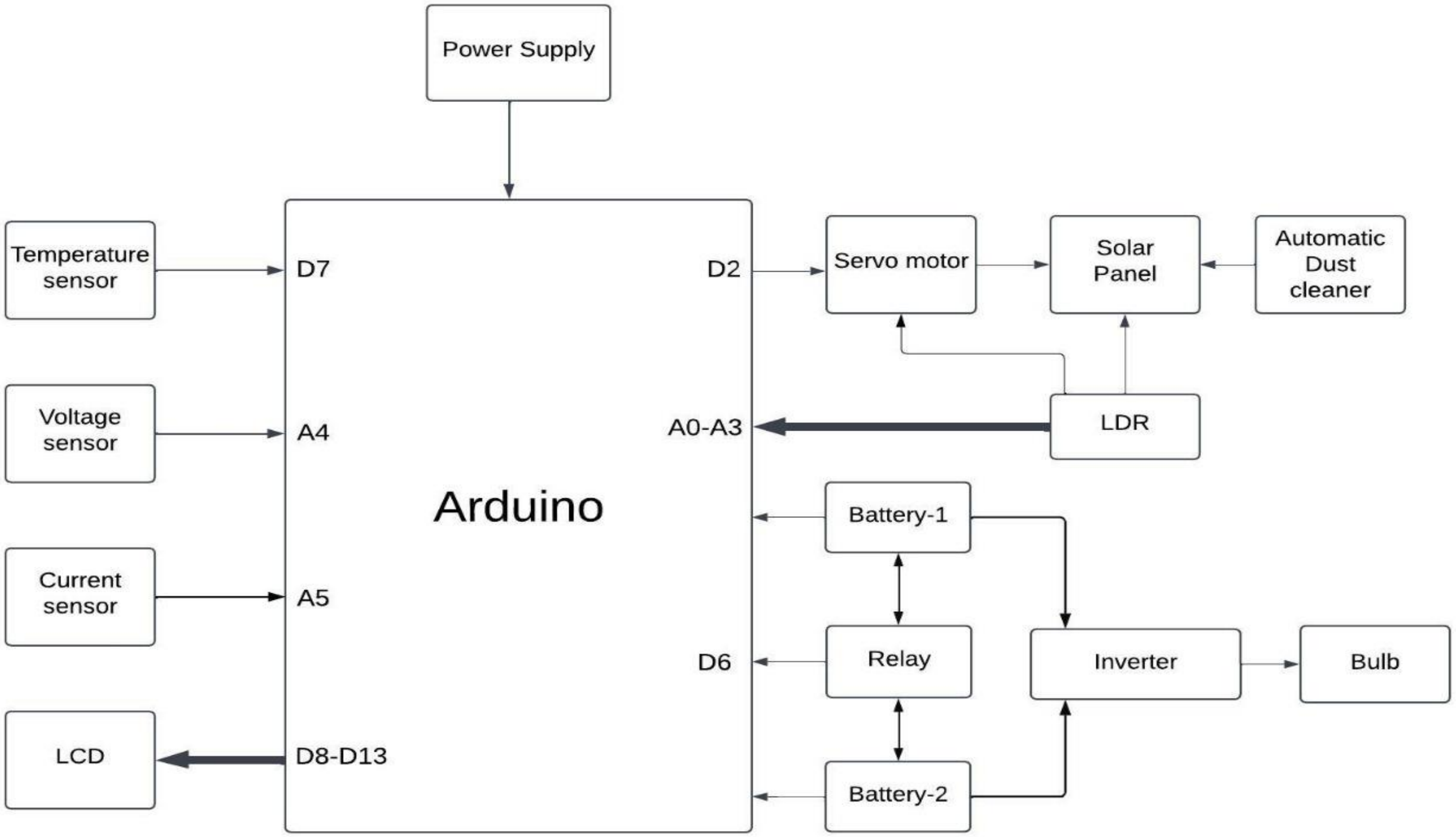
Abstract:

The “Solar Energy Tracking and Optimization System Using Inverter Control With Arduino" project presents an integrated solution for optimizing solar energy utilization. The system combines dual-axis solar tracking, automatic panel cleaning, and battery storage to enhance efficiency and reliability. Real-time monitoring enables users to track solar power generation, battery status, and environmental conditions. The system's intelligent self-maintenance feature autonomously addresses issues like dust accumulation, ensuring continuous efficiency. This project aims to promote sustainable energy practices by improving the reliability, efficiency, and user accessibility of solar power systems.

Proposed Method:

Our solar power system features dual batteries charged by sunlight. One battery powers devices at night, and the other acts as a backup during outages. To maximize energy capture, we use dual-axis solar tracking, aligning panels dynamically with the sun for efficiency. A Solar Charge Controller regulates charging precisely, preventing overcharging and ensuring optimal battery health. For flexibility, we have dual AC outputs – one for low-power devices, the other for high-power ones. Voltage and current sensors monitor usage, assess battery capacity, and quantify energy wastage. In summary, our system combines dual batteries, solar tracking, charge control, and dual AC outputs, aiming for optimal performance and reliability in harnessing solar energy.

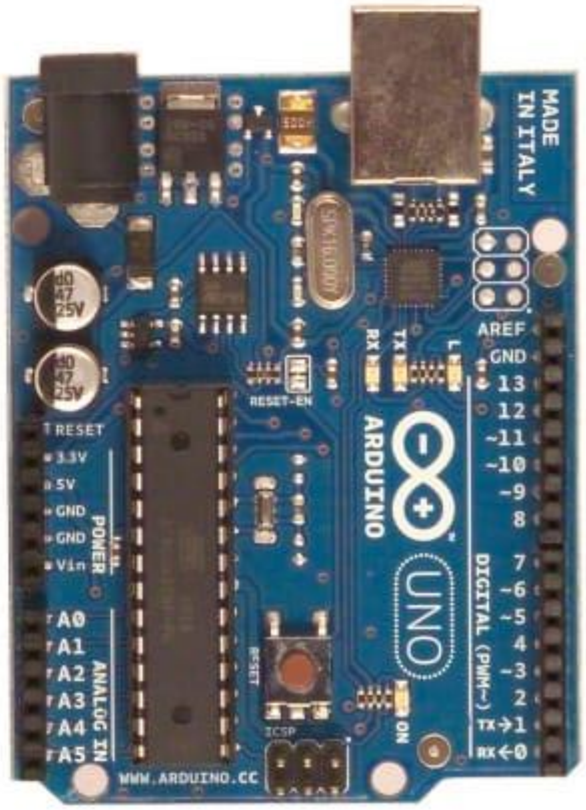
Block Diagram:



Components:

- Arduino
- Solar panel
- Servo motor
- LDR
- LCD display
- Current sensor
- Voltage sensor
- Temperature sensor(DHT11)
- Relay
- Inverter
- Batteries

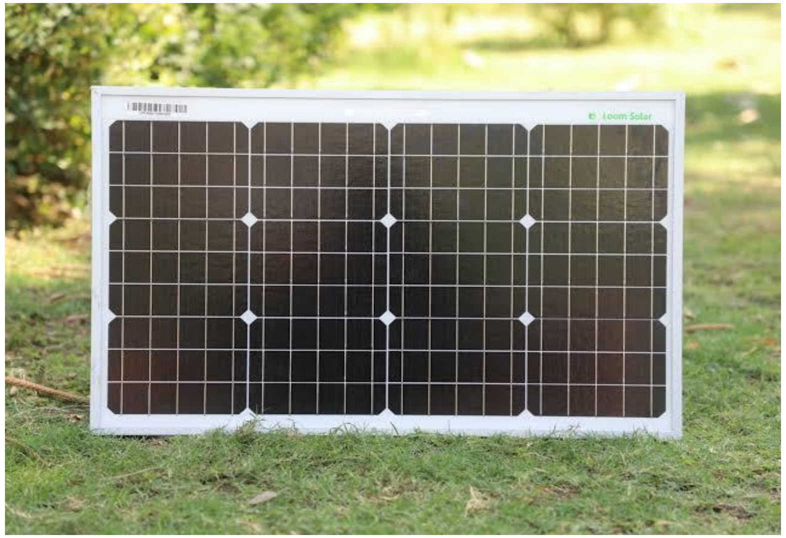
Arduino



The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Solar Panel

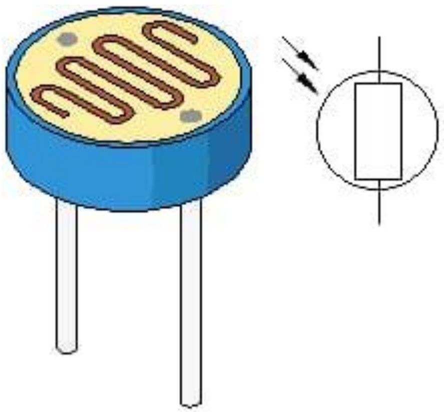
Solar panels, also known as photovoltaic (PV) panels, convert sunlight into electricity. Each solar panel consists of multiple interconnected solar cells made of silicon. When sunlight hits the solar cells, it generates an electric current through the photovoltaic effect.



Servo motor

A servo motor (or simply servo) is a rotary or linear actuator that enables precise control of position, velocity, and acceleration in a mechanical system.It is part of a servomechanism and consists of a suitable motor coupled to a sensor for position feedback.

LDR



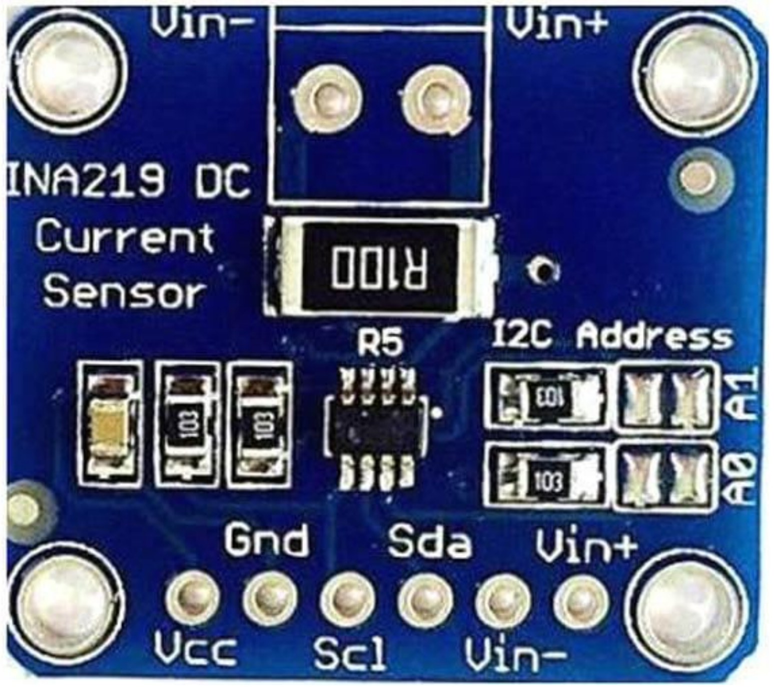
An LDR, also known as a photoresistor, photocell, or photoconductor, is a type of resistor whose resistance varies based on the amount of light falling on its surface. These devices are commonly used to sense the presence of light in various applications.

LCD

LCD is ”Liquid Crystal Display” it is a passive device, which means that it does not deliver any light to display characters, animations, videos, etc. LCD uses fluorescent tubes to lighten the picture, but can’t provide a clearer picture as LED delivers.

Current Sensor

A current sensor, also known as a current transducer or current meter, is a device used to measure the flow of electric current in a circuit. It's an essential component in various applications where monitoring and controlling current.

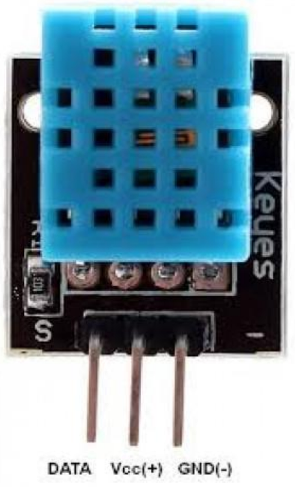


Voltage sensor

Voltage sensors, also known as voltage detectors or voltage transducers, are devices used to measure the voltage across a component or within an electrical circuit. providing essential information for monitoring and controlling voltage levels to ensure safe and efficient operation.

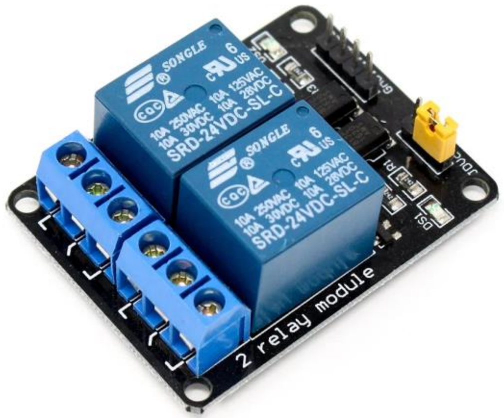
Temperature sensor

Temperature sensors are devices used to measure temperature by converting temperature changes into electrical signals. Enabling precise temperature measurement and control in various applications. Advances in sensor technology continue to improve their accuracy, reliability, and versatility.



Relay

Relays are electromechanical switches that are used to control the flow of electricity in a circuit. They consist of a coil and one or more sets of contacts. When an electrical current is passed through the coil, it generates a magnetic field that attracts an armature, causing the contacts to close or open

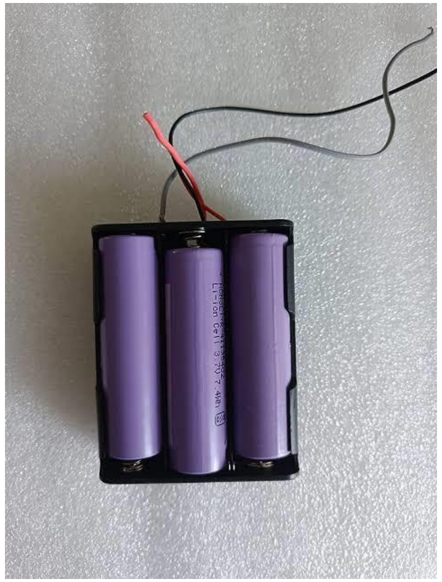


Inverter

An inverter is an electronic device used to convert direct current (DC) electricity into alternating current (AC) electricity. This conversion is essential for many applications where AC power is required, such as in homes, businesses, and industrial settings.

Batteries

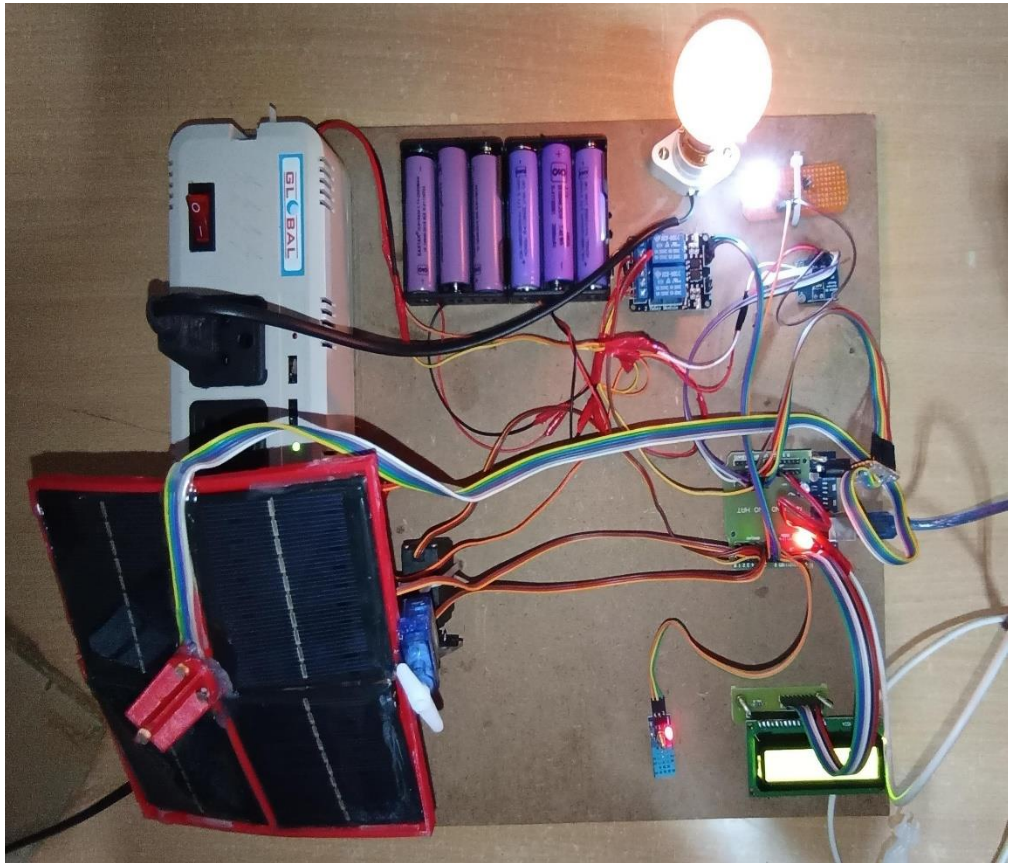
Lithium batteries are a type of rechargeable battery that utilizes lithium as one of its active materials. They have become increasingly popular due to their high energy density, lightweight, and long lifespan compared to traditional battery chemistries.



Working:

This project aims to develop an innovative Solar Energy Tracking and Optimization System that leverages Arduino-based technology for efficient inverter control. The system integrates dual-axis solar tracking mechanisms to dynamically align solar panels with the sun, maximizing energy capture throughout the day. The Arduino microcontroller is employed to manage the solar tracking, ensuring precise and real-time adjustments for optimal energy utilization. Harnessing solar energy is crucial for sustainable power generation. This project introduces a sophisticated system that employs Arduino technology for inverter control, optimizing energy extraction from solar panels. The Solar system has two batteries charged during the day by sunlight. One battery powers the devices at night, while the other acts as a backup when there's no AC power or when ever required.

Experimental Results:



Work Progress Towards Proposed System

Month	Plan of action
November	Study on various methods for implementing solar energy tracking and optimization system using inverter control with aurdino.
December	Study on Real-time application related to solar system and done Literature survey.
January	Studied on application paper-Hardware based and implementation for solar energy tracking and optimization system using inverter control with aurdino.Analyzing the existing system and gathered it's results.
February	Started implementing the proposed model and gathered it's components.
March	By connecting the components and observed it's results and started documentation.

Outcomes Mapped With PO’s

- **PO1: Engineering knowledge**

Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

- **PO2: Problem analysis**

Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

- **PO3: Design/development of solutions**

Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

- **PO4: Conduct investigations of complex problems**

Research based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.

- **PO5: Modern tool usage**

Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an under- standing of the limitations

- **PO6: The engineer and society**

Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

- **PO7: Environment and sustainability**

Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

- **PO8: Ethics**

Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

- **PO9: The engineer and society**

Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

- **PO10: Communication**

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions

- **PO11: Project management and finance**

Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

- **PO12: Life-long learning**

Recognize the need for and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change

Project Applications:

- Home Automation
- Residential Solar Power Systems
- Commercial and Industrial Solar Installation
- Off-Grid Power Solutions
- Remote Sensing and Monitoring Stations
- Agricultural Applications
- Mobile and Portable Solar Solutions
- Educational and Research Facilities

Conclusion:

In conclusion, the integration of a solar energy tracking and optimization system with inverter control using Arduino architecture represents a pioneering approach to maximize energy efficiency. By dynamically adapting to environmental conditions and optimizing solar panel orientation in real-time, this advanced system not only enhances energy harvesting but also offers scalability, cost savings, and environmental sustainability. The synergy of solar tracking, optimization, and Arduino-based control positions this technology as a pivotal advancement in the evolution of efficient and adaptive solar energy systems.

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Thank You！