Samrat Ashok Technological Institute

Vidisha (M.P.)

Department: Information Technology (IT)

Branch: Internet of Things (IOT)

Report on Major Project

Subject Code: IOT - 2078

Project Title:

"Arduino-based Dual-axis Solar Tracker for Efficient Solar Energy Harvesting"

Submitted to: Prof. Ramratan Ahirwar

Student Details:

Name	Enroll. No.	Phone No.	Email
Sanskar Singh Thakur	0108IO211053	9343877586	sanskar25io053satiengg.in
Yashwini Tomar	0108EI211021	9302296989	yashwini25ei021satiengg.in
Anirudh Tiwari	0108io211D01	8103479341	
Pronit Rahangdale	0108IO211045	9993559128	pronit25io045satiengg.in
Abhay Rahangdale	0108ME211003	8817493030	abhay25me003satiengg.in

Details

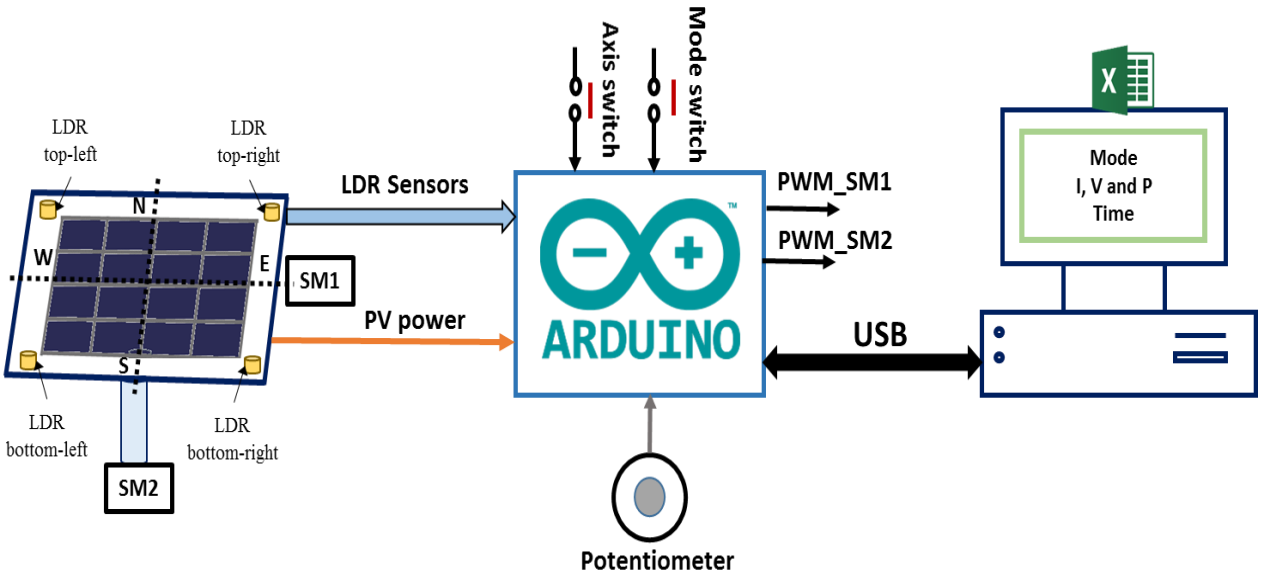
- **Title :**
  - **“Arduino-based Dual-axis Solar Tracker for Efficient Solar Energy Harvesting”**

- **Objective/Aim :**
  - **Primary Objective:**
    Design and implement an Arduino-based solar tracker that maximizes solar panel efficiency by tracking the sun’s movement.
  - **Specific Aims:** ○ Increase solar energy output by adjusting panel orientation. ○ Automate the tracking process using sensors and actuators. ○ Develop a cost-effective and scalable solution.

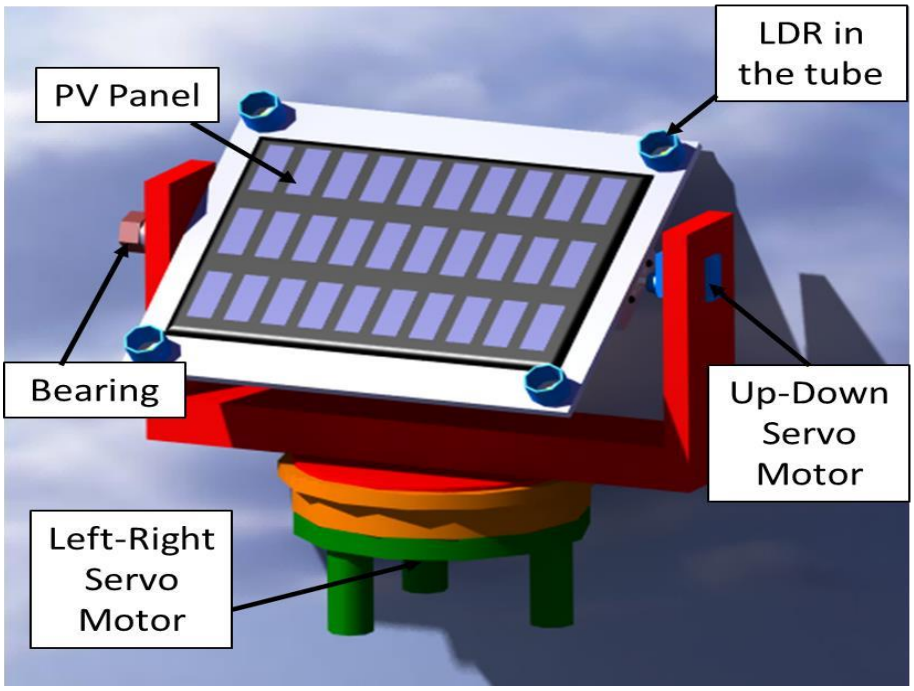
- **Project description:**

This project presents an open hardware/software test bench for solar tracker. The proposed prototype is based on a dual-axis solar tracker controlled with Arduino Uno which is an open-source prototyping platform based on easy-to-use hardware and software. The solar tracker can be controlled automatically with the help of Light Dependent Resistor (LDR) sensors or manually using a potentiometer. Moreover, this test bench provides virtual instrumentation based on Excel in which its solar tracker data can be recorded and presented. The hardware used has been chosen to be inexpensive, compact and versatile. The proposed test bench is designed to help students develop their understanding of control theory and their application.

It is based on a solar tracker that can rotate automatically to track the sun with the help of four LDR sensors and two servomotors (SM1 and SM2), or manually using a potentiometer. To switch between the two modes (automatic and manual), a pushbutton is used. Another push-button is used to link either the SM1(up-down servomotor) or SM2 (left-right servomotor) to the potentiometer to control their movement. Moreover, a computer is used as a virtual instrument to visualize the mode and current, voltage and power of the PV panel according to time in MS Excel. Arduino Uno board is utilized to implement all software requirements of the system.



The computer-aided design (CAD) 3D model of the solar tracker is designed in CATIA. It is composed of the PV panel, the left-right and up-down servomotors, and four LDR sensors. For the horizontal axis, a bearing is fixed in parallel with the up-down servomotor for better flexibility. The solar tracker is designed to have two degrees of freedom, from east to west by the left-right servomotor and from south to north by the up-down servomotor. The LDR sensors are placed in the four corners of the PV panel and are put in dark tubes with a small hole on the top to detect the illumination of the sun. These dark tubes are also considered a concentrator of radiation and are used to increase the solar tracker robustness.



- **Technical Details/ Methodology/ Planning of work :**
  - **Hardware Components:**

    Microcontroller: Arduino UNO/Nano

    Sensors: LDRs (Light Dependent Resistors) for sunlight detection

    Motors: Servo or Stepper motors for panel movement

    Motor Driver: L298N or similar

    Power Supply: Solar panel and rechargeable battery

    Structure: Panel mounting frame with rotational freedom ○

    Software Tools:

    Arduino IDE for programming

    Proteus or Tinkercad for simulation ○

    Methodology:

    Design Phase: Develop circuit diagrams and 3D model designs.

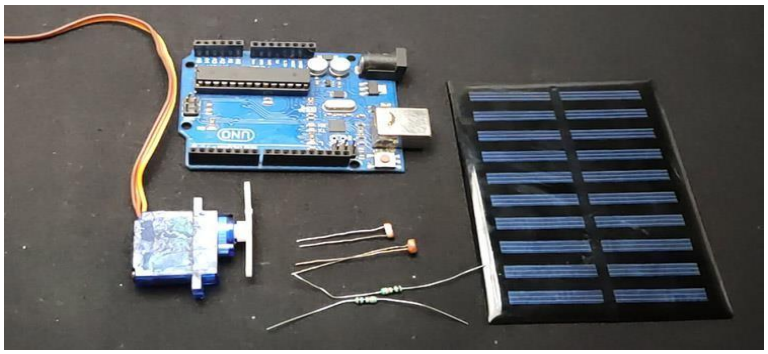
    Hardware Integration: Assemble components as per circuit diagram.

    Software Development: Write and upload the Arduino code.

    Testing & Calibration: Adjust sensor sensitivity and motor rotation angles.

    Implementation: Deploy in a field environment for real-time testing.

Components Required for Making the Solar Tracker:



- 1 x Arduino Uno
- 1 x Servo motor
- 1 x Solar panel
- 2 x LDR
- 2 x 10k Resistor
- Jumper wires
- 1 x MDF board

CURRENT PROJECT STATUS:

The development of the IoT-Based Dual Axis Solar Tracker is progressing efficiently. The software aspect of the project is more than 70% complete, and key milestones have already been achieved:

- The **source code is finalized** and has been tested using GitHub.

  Repo Link : https://github.com/sanskarthakur2/Major-Project
- The **software component is fully functional**, awaiting hardware integration.
- A **demo circuit diagram** has been created to illustrate hardware-software interaction.
- All **necessary sensors and hardware components** have been purchased and tested.

Next steps involve assembling all components, integrating the software with the hardware, and performing final testing.

Currently, our primary focus is on assembling all the components and ensuring proper connections are established as per the circuit design. Once the assembly is complete, we will proceed with thorough testing to verify functionality, optimize performance, and ensure seamless integration between the hardware and software for the successful execution of our project. With the demo frame of our project already completed, our main focus now is assembling all the components and ensuring precise connections according to the circuit design. Once everything is properly set up, we'll move on to rigorous testing to validate functionality, fine-tune performance, and seamlessly integrate the hardware and software for the project's successful execution.

Refrences :

The various references for our project include:

- Research Papers & Articles
- "IoT-Based Solar Power Monitoring System" – IEEE Xplore, ResearchGate
- "Smart Grid and IoT-Based Renewable Energy Systems" – SpringerLink
- "Real-time Monitoring of Solar Panels Using IoT" – ScienceDirect

You can search for these on Google Scholar or IEEE Xplore.

- GitHub Projects for Reference
- IoT Solar Monitoring System
- Real-Time Energy Monitoring
- ESP32 Solar Data Logger
- Components & Modules
- Microcontroller: ESP32, ESP8266, or Arduino Uno
- Sensors: INA219 (current & voltage), ACS712 (current), LDR (light intensity)
- Communication: WiFi (MQTT, HTTP), LoRa for long range
- Cloud Services: Thingspeak, Firebase, or AWS IoT
- YouTube Tutorials
- "ESP32 Solar Energy Monitoring System" – Learn Robotics
- "IoT-based Solar Panel Monitoring using NodeMCU" – Techiesms
- "Smart Solar Panel with Real-time Monitoring" – Circuit Digest

Conclusion:

The
“Arduino-based Dual-axis Solar Tracker for Efficient Solar Energy”

is progressing steadily toward completion. With the demo frame finalized and all necessary components procured, our current focus is on assembling and establishing proper connections as per the circuit design. The software is already more than 70% complete, successfully tested on GitHub, and ready for integration with the hardware. The next crucial phase involves thorough testing to validate system functionality, optimize performance, and ensure seamless communication between hardware and software. Once testing is complete, we will proceed with final refinements to achieve a fully operational, efficient, and reliable IoT-based autonomous vehicle.