Report on Arduino Based Sun Tracking Device

Ishani M. Kumar, Ruchit Jagodara

***Abstract*—This project aims to build a sun-tracking solar panel using an Arduino microcontroller. The solar panel is designed to track the sun's movement throughout the day, ensuring that it always faces the sun and maximizes its power output. The project requires assembling various components such as the solar panel, servo motor and LDR sensor. The project is a great example of how microcontrollers like Arduino can be used to automate simple tasks, resulting in more efficient and cost-effective solutions.**

I. Introduction

THE solar energy is one of the most used renewable source of energy. It finds uses in almost all aspects where consumption of electricity or heat is necessary. But it has a setback. That is, it's efficiency. It is, at it's peak, only 20%[1]. Even that is compromised, due to dirt, orientation and so on. A stationary solar panel can only generate maximum power output when the sun is at its highest point in the sky, resulting in suboptimal energy production during other parts of the day. A sun-tracking solar panel that follows the sun's movement throughout the day can increase the power output, resulting in a more efficient and cost-effective solution.

II. AIM

The objective of this project is to build a sun-tracking solar panel using an Arduino microcontroller. The project involves assembling various components such as a solar panel, servo motor, and LDR sensor and programming the Arduino to control the system. The system is designed to move the solar panel towards the sun and adjust its orientation throughout the day to maximize its power output.

III.THEORY

The theory behind the Sun Tracking Solar Panel using Arduino project is to increase the power output of a solar panel by accurately tracking the position of the sun throughout the day. Solar panels generate the most energy when they are pointed directly at the sun, so by tracking the sun's movement, the solar panel can be positioned optimally for maximum energy output.

The Arduino receives input from light sensors that detect the sun's position and then uses stepper motors to adjust the position of the solar panel. The project uses an algorithm to calculate the position of the sun based on the time of day and the location of the solar panel.

IV.INSTRUMENTS REQUIRED

1. Arduino Uno:
   Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button.
2. SG 90 180 Degree servo motor:
   Properties:
   - Operating Voltage is +5V typically
   - Torque: 2.5kg/cm
   - Operating speed is 0.1s/60°
   - Gear Type: Plastic
   - Rotation : 0°-180°
   - Weight of motor : 9gm
3. Power supply for Arduino
4. 5mm LDR:
   Properties:
   - Diameter: 5mm
   - No. of Pins: 2
   - Type of Mounting: PCB Through Hole
   - Maximum Operating Temperature: +800°C (Approx.)
   - Dark resistance:1-20 Mohm
5. connecting wires
6. Solar Panel (use the small size for this prototype)
7. 1k resistor

VI. PROCEDURE

1. Assemble the mechanical structure to support the solar panel and the stepper motors. The structure should be able to rotate the solar panel horizontally and vertically.
2. Connect the light sensors to the Arduino Uno board. The sensors should be positioned on opposite sides of the solar panel to detect the direction of the sunlight.
3. Connect the stepper motors to the Arduino Uno board. The motors should be able to rotate the solar panel horizontally and vertically.
4. Write the code for the Arduino to control the movement of the stepper motors. The code should use the input from the light sensors to track the position of the sun and

adjust the position of the solar panel accordingly.

5. Upload the code to the Arduino Uno board using the Arduino software.

VII. MECHANICAL STRUCTURE

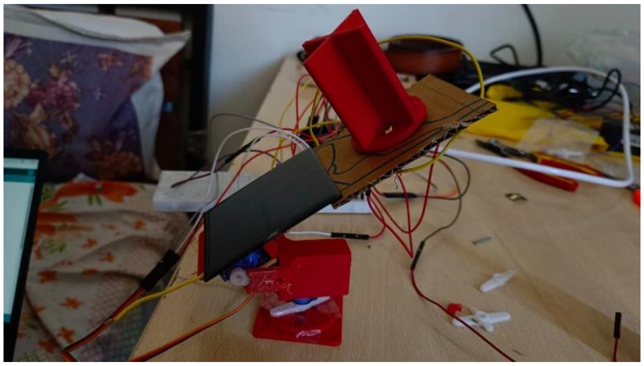

Fig 1. Structure of the revolving part.

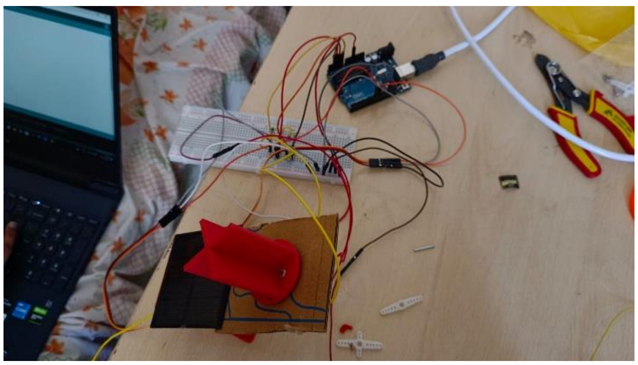

Fig 2. The whole setup

VIII. PROOF OF UTILITY

According to [2], “Compared to a fixed-slope array, a full two-axis tracking system is reported to result in gains of 40%, 30%, 44%, 29.3%, and 33–43%”.

Moreover, we are trying to get the solar panel to always be perpendicular to the sun light. It is well known that intensity of light is maximum when the angle of incidence is 90 degrees (as shown in Fig. 3[3]).

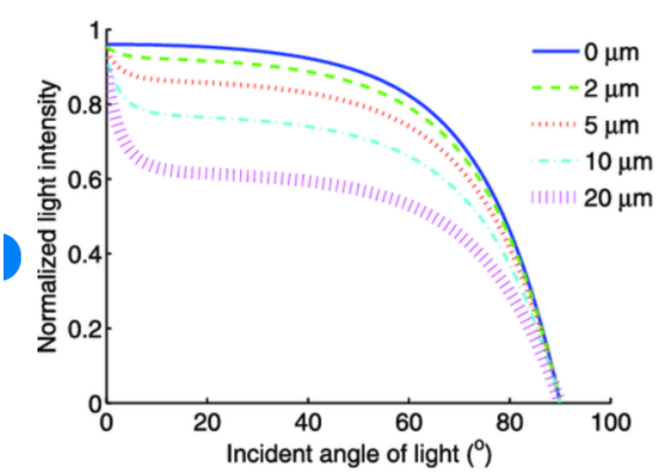

Fig 3. Graph representing the relation between light intensity and angle of incidence.

IX. RESULTS

The sun-tracking solar panel system was successfully built and tested. The system was able to track the light source's movement throughout and adjust the solar panel's orientation accordingly. The LDR sensor accurately detected the light source's position, and the stepper motor responded accordingly, moving the solar panel towards the torch.

X. DISCUSSION

The sun-tracking solar panel system built in this project is a great example of how technology can be used to increase the efficiency of renewable energy sources. The system is relatively simple to build and requires only a few components. It is an excellent solution for areas with limited sunlight and can be used to power homes and other small-scale applications.

XI. REFERENCES

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[2]“Design of rural photovoltaic water pumping systems and the potential of manual array tracking for a West-African village,” *Design of rural photovoltaic water pumping systems and the potential of manual array tracking for a West-African village - ScienceDirect*, Mar. 05, 2014. [Online]. Available: https://www.sciencedirect.com/science/article/abs/pii/S0038092X14001029

[3] T. Gao, Y. Lin, and W. Huang, "Surface Plasmon Resonance Sensors Based on Polymer Waveguides and Diffraction Gratings: A Review," Sensors, vol. 12, no. 7, pp. 9055-9099, Jul. 2012. doi: 10.3390/s120709055. [Online]. Available: https://www.researchgate.net/figure/a-Effective-light-intensity-I-e-as-a-function-of-the-incident-angle-of-light-at-several_fig17_257972207