Automatic Solar Tracker System

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***Abstract*— The goal of the automated solar tracking system project is to increase the efficiency of solar panels by keeping them always facing the sun. By maintaining a constant alignment with the sun's position throughout the day, solar panels' efficiency and output may be maximized with these of an automated solar tracking system. This method allows solar panels to harness more of the sun's energy and generate more power by following its path across the sky. The project combines hardware and software elements to optimize solar panel performance and harness clean, renewable energy from the sun more effectively. It represents a step towards sustainable energy solutions and contributes to a greener future.**

***Keywords*—Solar tracking system, Solar energy, Power generation, renewable energy utilization, Solar energy.**

I. INTRODUCTION

Automatic solar tracking systems offer a significant advancement in solar panel technology by optimizing energy generation through continuous alignment with the sun's position. These systems greatly outperform stationary ones in terms of energy production because to their ability to dynamically modify the angle of solar panels to maximize sunlight absorption. The benefits of automatic solar tracking systems, such as improved efficiency and increased energy production, make them valuable in both large-scale solar power plants and smaller residential or commercial installations. The use of automatic solar tracking systems helps to increase the use of solar power and the shift to cleaner, more environmentally friendly energy sources since renewable energy is essential for reducing climate change and establishing a sustainable future. Automatic sun tracking systems have already increased the efficiency and feasibility of solar energy systems throughout the world, and this trend will only increase as these systems become more refined and integrated into a wider range of applications.

II. SYSTEMDESIGNANDCOMPONENTS

A. *Principle of Operation*

The solar tracker adjusts the orientation of the solar panel using sensor feedback. When the sunlight intensity is unequal on either side of the panel, the system moves the panel to the brighter side until both sensors detect equal light intensity.

Fig1: *Automatic Solar Tracker System*

B. *Hardware Components*

- Solar panel

Fig2: *Solar Panel*

Polycrystalline panels are made from silicon, which is a semiconductor material. Polycrystalline solar panels are manufactured by fusing together shards of silicon, as opposed to the monocrystalline panels that are constructed from a single crystal structure. This process results in a panel with a less uniform appearance, as the silicon crystals are not aligned in a single direction.

- *Servo Motor*

Fig3: *Servo Motor*

Servo motor is used to rotate the solar panel. We are using servomotor because we can control the position of our solar panels precisely and it can cover the whole path of sun. We are using a servo motor that can be operated with 5volt.

- *LDR Holder and Sensor*

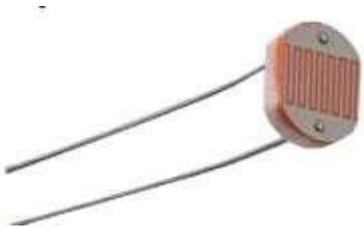

Fig4: *LDR Holder and Sensor*

This assembly houses Light Dependent Resistors(LDRs), which are sensors that detect the intensity of light. These sensors are crucial for tracking the sun's position.

- Arduino UNO

Fig5: *Arduino UNO*

This is a microcontroller board, likely an Arduino Uno, which acts as the "brain" of the system. It processes the signals from the LDR sensors and controls the servo motor to orient the solar panel.

- *18650 battery*

Fig6:*18650 battery*

This are chargeable lithium-ion battery that stores the energy harvested by the solar panel. It provides power to the system, especially when sunlight is not directly available.

III. WORKINGOFAUTOMATICSOLARTRACKING SYSTEM

And device that follows the path of the sun throughout the day and automatically positions a solar panel in the most advantageous position is called an Arduino-based single-axis solar tracker. An Arduino microprocessor, a light sensor, and a motor move the solar panel in reaction to light levels.

Fig7*: Automatic Solar Tracker System*

An device that follows the path of the sun throughout the day and automatically positions a solar panel in the most advantageous position is called an Arduino-based single-axis solar tracker. An Arduino microprocessor, a light sensor, and a motor move the solar panel in reaction to light levels. The light sensor is constantly monitoring the amount of light hitting it. The Arduino reads the light sensor data and compares it to a predefined threshold value. If the light intensity is below the threshold, indicating that the sun's position has changed or there are clouds, the Arduino activates the solar tracking system. The Arduino decides where the solar panel should be placed based on the position of the light source and its current orientation. If the desired position is within the tracking range, the Arduino will then send a signal to the motor to move the panel to that position. Once the solar panel reaches the desired position, the motor stops moving. If the light intensity is above the threshold, indicating that the sun is not visible or it is nighttime, the Arduino deactivates the solar tracking system. The system then waits for a certain period of time before repeating the process to continuously monitor the light intensity and adjust the solar panel's position as needed. Finally, the Arduino based single-axis solar tracker continuously monitors the light intensity, calculates the desired position of the solar panel, and adjusts its position using a motor to maximize the amount of sunlight it receives throughout the day, thereby optimizing the solar panel's efficiency.

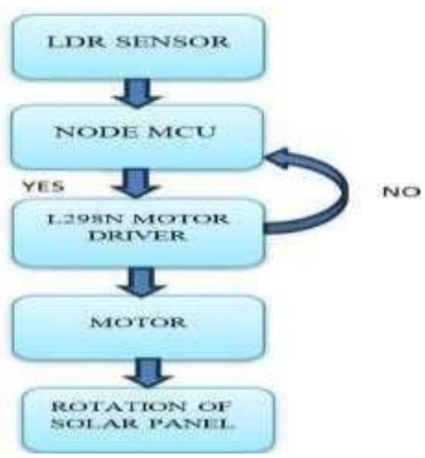

Fig8*:Working of Automatic Solar Tracker System*

IV. IMPLEMENTATIONANDRESULTS

The prototype was tested in an outdoor setting across several days. The automatic tracker system consistently outperformed a fixed panel setup, yielding approximately 20-30% more energy output. The system responded reliably to changing sun positions and consumed minimal power for operation.

V. CONCLUSION

In conclusion, the goal of the automated solar tracking system project is to increase the efficiency of solar panels by keeping them always facing the sun. The project utilizes a combination of hardware and software components to achieve this goal. The hardware prototype consists of a solar panel, photo sensors (such as Light Dependent Resistors),a controlling circuit with a microcontroller (such as Node Mcu),and driving motors. The mechanical structure provides support and rotation for the solar panel using steel rods and a rotational axis. The software architecture includes an algorithm for comparing and detecting the direction of greatest light intensity, which is programmed into the microcontroller. The solar panel's angle is adjusted thanks to the microcontroller, which takes data from the light sensors, processes it, and then sends commands to the drive module. In summary, the automatic solar tracking system project combines hardware and software elements to optimize solar panel performance and harness clean, renewable energy from the sun more effectively. It represents a step towards sustainable energy solutions and contributes to a greener future.

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VII. REFERENCES

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