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Sun Tracking For Solar Panel Using Arduino

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ABSTRACT

Automatic sun tracking solar panels adjust their position to follow the path of the sun in the sky. These panels are designed to increase the amount of sunlight they receive, which can improve their efficiency and power output. Sensors, motors, and a Arduino (like an microcontroller) are typically used to detect the sun's position and adjust the panel's angle and orientation. By tracking the sun's movement throughout the day, these solar panels can capture more energy and improve the overall performance of a solar energy system. Automatic sun tracking solar panels are particularly useful in areas where the amount of sunlight varies significantly throughout the day or throughout the year. These panels can be more expensive than fixed solar panels, but their increased efficiency can make them a worthwhile investment in the long run. Some automatic sun tracking systems are designed to operate without any external power source, using only solar energy to power the tracking mechanism. The utilization of solar energy through photovoltaic systems has gained significant attention due to its eco-friendly and renewable nature. To enhance the efficiency of solar panels, it is crucial to maximize their exposure to sunlight throughout the day. This abstract presents an innovative approach to improving solar panel efficiency through automatic sun tracking using an Arduino-based system .The proposed system employs light sensors to continuously monitor the sun's position in the sky. These sensors provide real-time data that is analyzed by an Arduino microcontroller. By utilizing a predefined algorithm, the microcontroller calculates the optimal orientation of the solar panels relative to the sun's position. The solar panels are then adjusted through a motorized mechanism to ensure they are aligned for maximum solar energy absorption .Key features of the system include its low-cost implementation, flexibility, and adaptability to various geographical locations. The Arduino's computational capabilities, coupled with accurate light sensors, allow for precise sun tracking. The system's algorithm ensures smooth panel movement and minimizes power consumption during tracking adjustments .

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INTRODUCTION

Automatic sun tracking solar panels adjust their position to follow the path of the sun in the sky. These panels are designed to increase the amount of sunlight they receive, which can improve their efficiency and power output. Sensors, motors, and a Arduino (like an microcontroller) are typically used to detect the sun's position and adjust the panel's angle and orientation. By tracking the sun's movement throughout the day, these solar panels can capture more energy and improve the overall performance of a solar energy system. Automatic sun tracking solar panels are particularly useful in areas where the amount of sunlight varies significantly throughout the day or throughout the year. These panels can be more expensive than fixed solar panels, but their increased efficiency can make them a worthwhile investment in the long run. Some automatic sun tracking systems are designed to operate without any external power source, using only solar energy to power the tracking mechanism. Fixed solar panels are installed at a fixed angle and orientation, which may not allow them to capture the maximum amount of sunlight throughout the day. Automatic sun tracking solar panels can adjust their position to follow the path of the sun, which can significantly increase the amount of sunlight they receive. This increased efficiency can improve the overall performance of a solar energy system and increase the amount of energy that can be generated. In areas where the amount of sunlight varies significantly throughout the day or throughout the year, automatic sun tracking solar panels can be a necessity to ensure that the solar panel is capturing the maximum amount of sunlight possible.

Automatic sun tracking solar panels are particularly useful in areas where the amount of sunlight varies significantly throughout the day or throughout the year. These panels can be more expensive than fixed solar panels, but their increased efficiency can make them a worthwhile investment in the long run.

PROPOSED METHODOLOGY

The research methodology employed in the development and evaluation of "Sun Trackin For Solar Panel using Arduino" encompasses several key aspects:Base Paper 1: -Through literature surveys, it was found that this project offers numerous advantages, including energy efficiency, convenience, and improved security. -Overall, literature surveys have confirmed that automatic automatic sun tracking solar panel using Arduino and LDR sensor is a practical and efficient solution for modern-day solar panel challenges. Its benefits of energy efficiency, convenience, and improved system make it a popular choice for homes, offices, and other public spaces.

Through literature surveys, it was found that this project offers numerous advantages, including energy efficiency, convenience, and improved security. Overall, literature surveys have confirmed that automatic automatic sun tracking solar panel using Arduino and LDR sensor is a practical and efficient solution for modern-day solar panel challenges. Its benefits of energy efficiency, convenience, and improved system make it a popular choice for homes, offices, and other public spaces.

This Paper describes, the design and implementation of an Arduino-based solar tracking system using light dependent resistors (LDRs) and servo motors.

This paper presents an Arduino-based sun tracking system for solar panels that uses light sensors and servo motors to track the sun's position.

presents a solar tracking system using Arduino, LDRs, and servo motors. This paper presents a sun tracking solar panel system using Arduino, LDRs, and servo motors. The authors suggest using other sensors, such as GPS, to improve the system's accuracy. The Authors Suggest using other sensors in addition to LDRs to improve the system's performance. The authors suggest improving the system's efficiency by using more advanced sensors and motors.

Due to the scarcity of fossil fuels, scientists are now research alternative energy sources. Solar energy is one of the renewable energy sources available. Solar panels that convert solar light to electrical current based on the photoelectric effect are one approach to turn solar energy into electricity. The more the energy equivalent of light to the solar panel surface is changed into electricity, the The study's findings indicate that VR technology influences customers emotionally rather than rationally, ultimately driving customer satisfaction and intention to participate in online shopping. Factors such as interactivity, escapism, flow, personalization, and informativeness contribute positively to customer satisfaction in VR-enabled online shopping experiences. The methodology employed includes a survey of 154 respondents, data collection through various online platforms, and statistical analyses to test the hypotheses.

Hanei (2009) conducted a study in Amman Jordan focusing on the demand of the sun tracking for solar panels. This study basically discussed about increasing efficiency of PV panels in dessert regions. The author explained that by using part of the power output of the solar panel two degrees of freedom orientation can be achieved. If we consider the symmetry of the system, the kinematics of the system can be controlled using astronomic calculation. Solar tracking sensors and feedback control loops can be used to add close loop control to the system. This solves the problem of cloudy days. The author further explained that special consideration should be given to the grid arrangement of panels in the collecting plants. In another study conducted by Rao et al (2012) a project using ARM7 TDMI processor was explained. The processor did the task of gather input from sensor and giving command to the motor to track the sun. ARM7 TDMI processor was used to design and implement closed loop algorithm which form the bases of monitoring controller. This resulted in maximum current from solar panel to increase the energy production.

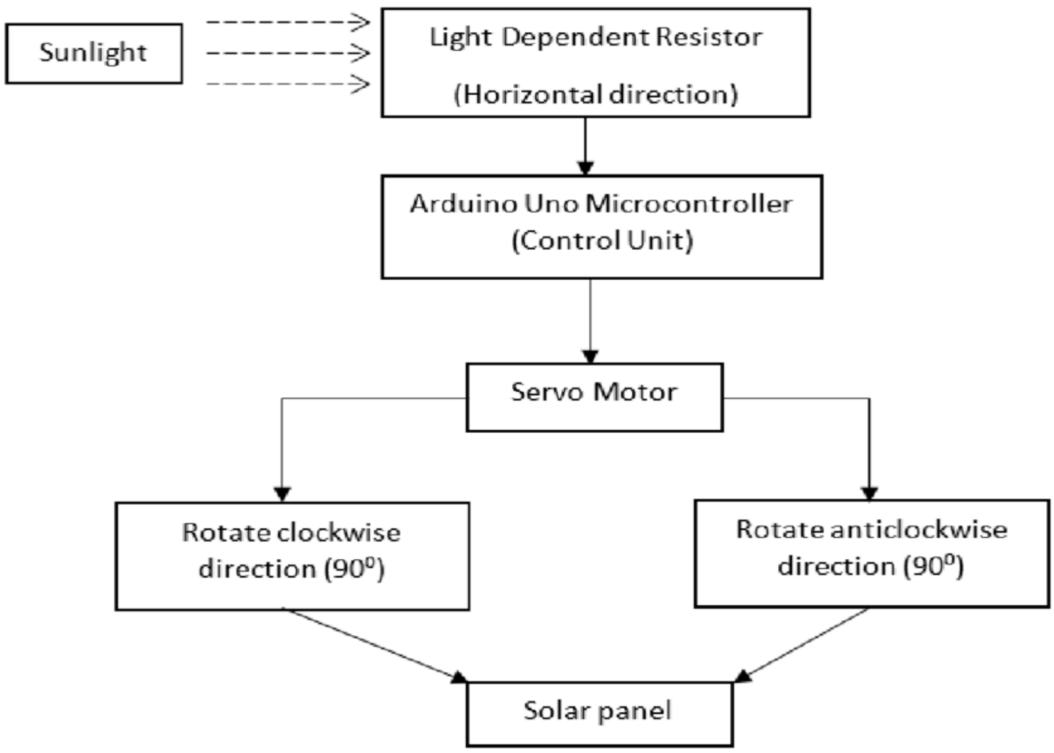

Fig 1: Sequence Diagram

RESULTS AND ANALYSIS

When we compare automatic sun tracking solar panels with fixed-position solar panels, we found that automatic systems can produce more energy and improve efficiency by up to 30 50%. However, these systems can be more expensive to install and maintain. But, in the long run, the increased energy production can save money. The system's ability to adapt to different weather conditions is also important for optimal energy output. In summary, an automatic sun tracking solar panel system can significantly increase energy production, but we need to consider the initial costs and maintenance requirements. After analyzing the results, it is essential to compare the energy output of the automatic sun tracking system with a fixed solar panel system. This can be done by measuring the power generated by both systems over a certain period, under similar weather conditions. The energy output of the automatic sun tracking system should be higher than the fixed system due to its ability to track the sun's movement and ensure that the solar panel is always facing the sun.

Figure 2. Top View Of Prototype

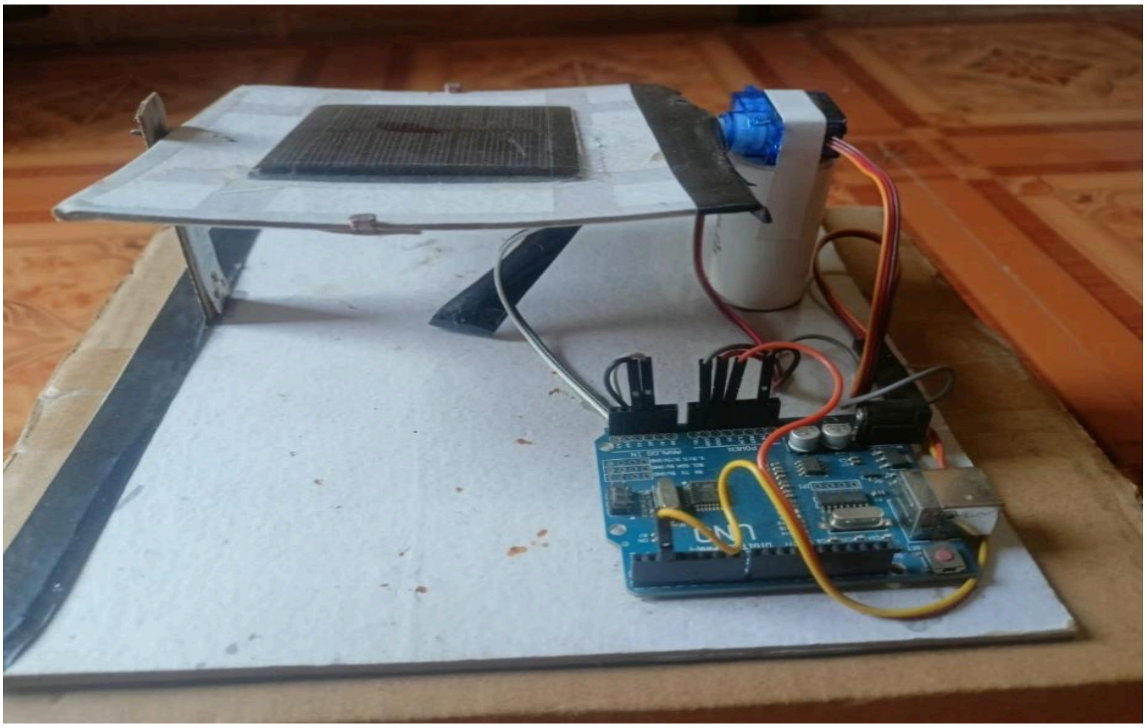

Figure 2.Side view of Prototype

To implement an automatic sun tracking solar panel system using Arduino, you need a solar panel, sensors (light sensors or GPS modules), a microcontroller (like Arduino), and a motor to move the solar panel. The system tracks the sun's position throughout the day and adjusts the panel's position accordingly. The microcontroller interprets the sensor data and controls the motor. The motor can be a servo or stepper motor and connects to the microcontroller via a driver module. Additional features can include a display, battery backup, and wireless communication.

The sensors used in the system can be either light sensors or GPS modules that provide information on the position of the sun. The microcontroller is programmed to interpret the sensor data and control the motor to move the solar panel to the optimal position. • The motor used to move the solar panel can be a servo motor or a stepper motor, depending on the specific system design. The motor is typically connected to the microcontroller through a motor driver module. The system can also be designed to include additional features such as a display to show the current status of the system, a battery backup system to ensure continued operation during power outages, and wireless communication for remote monitoring and control. Comparison of Power Output from Static and Moving Panels:

In this case, to investigate the advantage of the using sun tracker to move solar panel we have compared the power output of fixed and the moving solar panels. To get maximum power output, solar panels in Southern Sweden are installed at an angle of about 45 degrees [49]. This result was obtained by moving the torch light from east to west first with respect to the static panel, then with the same distance between the torch and the panel now with respect to the moving panel, the readings were noted in table 5.13 and plotted a graph shown in figure 5.11 between angle of incidence of torch and power (W), shows the variation of the power output of the static and moving solar panels at different angle of incidence of torch.

Table: Comparison of power output between static and moving panel

Angle of torch	Moving Panel (W)	Static panel (W)
15°	0.17 W	0.15 W
30°	0.17 W	0.16 W
45°	0.18 W	0.17 W
60°	0.18 W	0.17 W
90°	0.18 W	0.18 W
120°	0.18 W	0.17 W
135°	0.18 W	0.17 W
150°	0.17 W	0.16 W
165°	0.17 W	0.15 W
Total Power	1.58 W	1.48 W

Here, the readings are taken under the torch light at angles with respect to the static panel. The static solar panel is placed at angle of 45 degrees to the ground. We can see the difference of power outputs in moving and static panel in the table .The working of the motors has been established by selecting a tolerance or a constant value. On the servo object, the servos are attached on digital pins. Pin Mode in used to select analog pins as input.

Analysis

Performance of Solar Panel without TrackingThe below table shows the performance of the solar panel without tracker

Table 1: Solar panel without tracking

Time (Hrs)	Voltage (V)	Current(A)	Power (W)
9am	5.5	0.11	0.605
10am	9	0.19	1.71
11am	10.5	0.2	2.1
12 pm	12.5	0.28	3.5
1 pm	14	0.32	4.49
2 pm	13.5	0.3	4.05
3 pm	11	0.26	2.86
4 pm	8	0.16	1.28
5 pm	6	0.12	0.72

Performance of Solar Panel with Tracking

The table given below shows the efficiency and performance of the solar panel with tracking.

Table 2: Solar Panel with tracking

Time (Hrs)	Voltage (V)	Current(A)	Power (W)
9am	12.2	0.23	2.8
10am	13.5	0.25	3.4
11am	14	0.28	3.92
12 pm	14	0.3	4.2
1 pm	15	0.3	4.5
2 pm	14	0.3	4.2
3 pm	13	0.26	3.38
4 pm	10	0.25	2.5
5 pm	7	0.2	1.4

2.134watts is the average power obtained from solar panel without tracking and 3.18watts power is obtained from solar panel with tracking.41.64% is the improved efficiency neglecting the power consumption of motor. So the proposed dual axis tracking system presents efficient system to connect solar energy which ensures that consumption of energy is more than the fixed solar panel. In our project the hardware of solar tracking solar panel design and the implementation of the design has been proposed. Our result shows that the solar tracking system increases the efficiency of the solar panel. Solar tracking solar panel is completely automatic and it ensures the minimum low cost. So, it is a dual axis system which maximizes the efficiency and can be obtained over a period of time. Normally a solar panel converts only 30 to 40 per cent of the incident solar radiation in to electrical energy.

CONCLUSION

An automatic sun tracking solar panel using Arduino can significantly increase energy output and efficiency. By using LDR sensors and servo motors, the solar panel can track the movement of the sun and optimize its angle for maximum exposure. This type of system is effective for solar power generation in various applications. Overall, an automatic sun tracking solar panel using Arduino is an innovative and practical way to harness the power of the sun for renewable energy generation. Use in agriculture: Sun tracking systems could be used in agriculture to power irrigation systems and other equipment , reducing the reliance on fossil fuels and improving the sustainability of farming practices.•Integration with urban design: Sun tracking systems could be integrated into urban design, such as building facades or street furniture, to generate clean energy and reduce the carbon footprint of cities. Use in disaster relief efforts: Sun tracking systems could be used in disaster relief efforts to provide a reliable source of clean energy in remote or off-grid areas. Integration with wearable technology: Sun tracking systems could be integrated with wearable technology to power devices such as smartwatches or fitness trackersusing an Arduino to automatically track the sun for a solar panel can greatly increase its efficiency and energy output. By continuously adjusting the angle of the panel to face the sun, the system can ensure that the panel is always receiving the maximum amount of sunlight, regardless of the time of day or year. This type of system can be a cost-effective and environmentally friendly solution for those who want to harness solar energy. It can be easily implemented with basic programming skills and can be customized to fit specific needs and preferences. However, it is important to note that building a sun-tracking system requires some technical knowledge and expertise.

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