Smart Solar Panel using Light Dependent Resistors

S Karthik¹, P Vivek Karthick², R R Thirrunavukkarasu³*, S Satheesh Kumar⁴, D Selvakumar⁵

¹Assistant Professor, ⁵Associate Professor, Department of Electronics and Communication Engineering, Sri Krishna College of Engineering and Technology, Coimbatore.
²Assistant Professor, Department of Electronics and Communication, Engineering, Sona College of Technology, Salem.
³Assistant Professor, Department of Electronics and Communication Engineering, Sri Krishna College of Technology, Coimbatore.
⁴Assistant Professor, Department of Electronics and Communication, Engineering, KPR Institute of Engineering and technology, Coimbatore.

Corresponding Author mail id: karthicks@skcet.ac.in

Abstract: Solar energy is gradually approaching a most important form of renewable energy. Using solar tracker, additional energy can be produced, since the solar plate can maintain a vertical angle to the sunrays. Given the substantial initial expense of setting up the tracking device, there are less expensive alternatives that have been suggested over period. This paper addresses the strategy and development of solar tracking device prototype which has one axis of independence. Here, Light Dependent Resistors (LDRs) are used to sense the sunlight.

Keywords: Light Dependent Resistor, Solar System, Solar Tracker, Servo Motor.

1. Introduction

For the first time in 1985, silicon solar cells achieved 20% output. Although the performance of the solar panels has been gradually rising, the standard is still not at its peak. The majority of panels are now working for a smaller amount than 40%. Solar cells comparatively give higher effectiveness but they stay to be very expensive [1].

The control module is based on a microcontroller with the ATMega328P. Sunlight is sensed via the LDRs before servo was actuated to align the solar panel. The Solar Panel is placed where maximum light can be received [2,3,4]. The servo motors can be able to regulate their force even at high speediness when compared to other motors. In this paper, solar panel’s performance and characteristics are experimentally analyzed.

A particular dedicated device was used for monitoring. It is inexpensive, have a smaller amount of complexity and it accomplishes the efficiency that is needed. The system is feasible in terms of cost. Here, power increase was substantial, and hence there is slight cost increase. Perhaps the maintenance costs are not much high.

2. Proposed Method

The proposed method is intended to design the system, which will automatically monitor the location of the sun and adjust the angular position of the solar panel to achieve a high output from the solar...
panel cells. A solar tracker can be used for optimizing and connecting the solar energy in different structures. The issue here is the execution of a program capable of rising power output by 30-40%. The micro-controller follows the controlling circuitry. Then, the controlling circuitry adjusts the motor by which the solar panel can be aligned in an optimal way. The proposed system has been undertaken to ensure that the sunrays falling above the solar panels vertically to give a comparative increase in the solar energy, with the existing system. Then, it used to manipulate the electric strength. Between 1200hrs and 1400hrs maximum energy is collected, with the highest being about midday. The sun is nearly vertical, at this time. Around the same time, moving the panel would take the least energy, which additionally gives rise to substantial increase in the system's performance. The proposed system was intended to face the challenge of a low-powered, reliable, inexpensive micro-controller based sunrays tracking system that is executed with the available resources, within the stipulated time. They were intended towards monitoring the movement of the sun (basically earth). The solar panel-based project was realized with a servo-motor. The Atmega328P were coded using the C-programming language. During fabrication it is then used as a stand-alone device on a PCB. The architecture is restricted to single axis tracking as it does not add much benefit towards using a dual axis tracking device.

3. Design and Implementation

This Tracking System circuit was splitted into three parts. There exists input or first stage containing potentiometers and sensors, a code of program that to be encoded in the microcontroller's core chip and, lastly, required servo motor driving circuit. The input stage has 4 Light Dependent resistors organized such that, so as to form a circuitry for the voltage divider. A C-code of program loaded onto the UNO arduino.

![Fig.1. Structure of an LDR](image)

Phototransistors, photodiodes, LDR and LLS05 provide light detection sensors that may be used to create solar trackers. Fig.1 shows the structure of an LDR.

![Fig.2. Block Diagram of the proposed method](image)

This also ensures they are considered and corrected independently when there are any errors. Phototransistors, photodiodes, LDR and LLS05 provide light detection sensors that may be used to create solar trackers. Fig.1 shows the structure of an LDR.
Fig. 2 shows the block diagram of the proposed method. The concept of sensing using four LDRs is described in Fig. 3. The constant state occurs, once both LDRs have same luminous intensity. As the source of light moves, i.e., the sun travels in west-east direction, the intensity value lowering on two Light Dependent Resistors varies and using voltage-divider biasing circuitry, adjustment is made in the voltages. The variation in voltages are measured using in-built microcontroller, and the motor available makes the solar-panel to rotate in its path to monitor light source. The solar tracker uses a photocell with Cds to detect light. A supplementary 10k resistance were used. The outcomes are stated in the following table.

| Resistance | Observation methods                                      |
|------------|----------------------------------------------------------|
| 50 KΩ      | Low light (black-vinyl tape can be placed above the solar cell) |
| 4.35 KΩ    | Medium light (average level of lighting)                  |
| 200 Ω      | High level light (applying light straight to the solar-cell) |

Voltage-divider circuitry used here is shown in the following Fig. 4.

The relationship between the input and output in voltage-divider based circuitry is

$$V_{in} = \frac{V_{cc(supply)} \times R_{opt}}{R_{opt} + \text{Light Dependent Resistance}}$$  \hspace{1cm} (1)

In this case, $V_{in}$ = Voltage input given to micro-controller, $R=10K\Omega$, potentiometer-resistance, $V_{cc(supply)}$ = Power supply to Light dependent resistors and micro-controllers connected.

Servo-motors are controlled by variable width electrical pulses, or Pulse-width modulation, through a wire control. Every 20 ms, servo-motor waits for a pulse to arrive, the width (length) of the pulse-modulated signal will control motor ON and OFF and the speed of the rotation. The working of the above experimental setup is explained in the following steps.

1. Switch on the power of the circuitry,
2. Keep the project, with very low-level light,
3. If low level light appeared on both Light Dependent Resistors, no change in the position of the solar panel,
4. Applying a flash light above the light dependent resistor, the solar-panel slowly will get tilted,
5. Moving the light from the left-side to the right of the panel, we can verify the automatic change the direction of the solar pane, which slowly tilt towards the appearance of the light,
6. At the mid-level,
where both Light dependent resistors having same voltages, the solar-panel be idle, till there is difference between the intensity of the light that falling on the Light Dependent Resistors.

4. Results and Discussions

(1) Some of the benefits are, due to increased direct exposure to solar rays, trackers produce more energy than their stationary counterparts. Based on the geographic position of the tracking device this change can be as much as 10 to 25 per cent.

(2) Several types of solar tracking model are available. System model, usage environment, and electric items related specifications stands some important factors which affects solar tracker type that is preferably appropriate for a definite solar-system.

(3) Some states, some utilities sell Time of Use (TOU) solar power rate plans, meaning the utility can buy the generated electricity at a higher rate during the day's peak period. In this case, the generation of more electricity during these peak times of the day is beneficial. Having a monitoring device helps to optimize the gains in energy during these peak hours.

(4) Advances in current technology and dependability in electronics-engineering abridged the long-standing preservation problems for tracking systems significantly.

5. Conclusion and Future work

Although dual-axis tracking system is effective in sunlight tracking, our proposed component does not require the additional circuitry and complexity. Dual-axis sun tracking systems are highly used in places wherever the angle of the sunlight varies. The above research was implemented using limited available resources. Circuit implementations have been used as it is, thus ensuring that it does not affect performance. The goal was achieved with the time and resources available. The concept can be enhanced to a much higher scale of values.

References

[1] S J Hamilton University of Queensland Department of Computer Science and Electrical Engineering Bachelors Thesis “Sun-tracking solar cell array system” 1999
[2] Nader Barsoum Curtin University Sarawak Malaysia “Fabrication of Dual-Axis Solar Tracking Controller Project” Intelligent Control and Automation 2011 2 57-68
[3] Balamurali R Maheswaran Prashanthi A R Roshan Fathima S Varshini S 2020 Enhanced Automation Using Controller and Conscripts International Journal of Advanced Science and Technology 29(3) 8620 - 8627
[4] Karthik V Karthik S Satheesh Kumar S Selvakumar D “Region based Scheduling Algorithm for Pedestrian Monitoring at Large Area Buildings during Evacuation” International Conference on Communication and Signal Processing (ICCSP) 101109/ICCSP20198697968 pp0323-0327 2019