

Dual Axis Solar Tracker Using Aurdino With Mobile Charger

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ABSTRACT

Solar energy is without doubt one of the most significant renewable energy resources, while the effectiveness of a stationary solar panel is restricted because of the sun's constant movement. To deal with this restriction, a Dual Axis Solar Tracker system is suggested which will be the solar panel's chase towards the light source with utmost brightness. In this paper, a low-cost dual axis solar tracking system using Arduino, light dependent resistors (LDRs), and servo motors is described and implemented.

The MG995 high-torque servo motor is used for horizontal (east-west) movement and the SG90 servo motor is used for vertical (north-south) movement. Each axis has its LDR pairs assigned to it in order to obtain higher tracking accuracy and stability. The soft and smooth servo motion is realized by controlling in steps with more time to minimize mechanical jerk. Also, a hard stop mechanism is put into action by disengaging the servo motors during low-light (night) conditions so that there would be no unnecessary power consumption. The tracker is also designed to react only to very bright artificial light, such as a torch, thus making controlled movement during testing possible. From the experiments carried out, the results show that the tracking accuracy has improved, the mechanical stress has been reduced, and the energy utilization is higher when compared to that of fixed solar panels.

Keywords: -Solar Tracker, Dual Axis, Arduino, LDR, Servo Motor, Renewable Energy.

1. INTRODUCTION

The need for clean and renewable energy is continuously increasing which has brought about the wide acceptance of solar photovoltaic systems. On the other hand, the solar panel performance is very much dependent on its positioning toward the sun. A solar panel that is fixed in a particular position will be able to absorb the maximum energy only for a short period of time during the day, and its performance will be low as the sun is gradually moving.

The installation of solar tracking mechanisms is being done so that the solar panel always remains the same way pointing at the sun and thus getting more energy. The dual-axis solar trackers are said to have a higher efficiency as compared to single-axis trackers due to the fact that they are capable of following the sun in both horizontal and vertical planes. Moreover, microcontroller-based solar tracking systems are becoming more and more popular in recent years because they are very simple, cheap, and trustable.

In this study, we mainly center on the development of a dual axis solar tracker employing Arduino that includes things like smooth servo control, night detection, and light-based selective activation in order to boost system stability and practical usability.

2. SYSTEM ARCHITECTURE

The suggested dual-axis solar tracking system is made up of three components: a sensing unit, control unit, and actuation unit. The sensing unit detects light intensity in four different directions through the use of four LDRs. The control unit which is an Arduino microcontroller, interprets the signals from the LDRs and then issues control commands. Finally, the actuation unit consists of two servo motors which physically turn the solar panel. The MG995 servo motor is specifically selected for horizontal rotation because it can handle a lot of weight and the SG90 servo motor is assigned for vertical movement because it is less powerful. In addition, for each axis, dedicated LDRs are allocated making it possible for the system to track the sun accurately. Moreover, the system features a night detection circuit and a hard stop that prevents the movement of servos when it is dark.

3. PROBLEM IDENTIFICATION

The fixed solar panels are not efficient to the fullest due to the sun's movement during the day. Traditional tracking systems usually encounter problems like mechanical jerk, high power consumption at night, and

unstable movement when light levels change. Moreover, solar trackers may unintentionally react to the ambient sunlight during laboratory testing, thus making the controlled testing procedure tricky.

All these issues point out the necessity of a solar tracking system that will ensure smooth motion, will not operate in low-light conditions, and will be capable of activation with artificial light sources.

4. RESULTS

The techniques mentioned below are the ones through which the proposed system tackles the problems that have been recognized:

- Step-wise servo angle adjustment with increased delay for smooth motion
- The use of separate LDRs positioned on the horizontal and vertical axes in order to minimize the cross-axis interference
- The hard stop mechanism that is implemented by servo detachment in the nighttime conditions
- The light intensity threshold that guarantees the movement is under high intensity light (torch) only

The experimental tests verified the servo's stable and smooth movement without jerks. The hard stop mechanism worked efficiently in darkness by stopping the motor. The system has been enhanced in terms of directional response and its reliability which is what makes it appropriate for educational and small-scale renewable energy applications.

5. CONCLUSION

A dual-axis solar tracker that employs an Arduino, LDR sensors, and servo motors was designed and installed. The system well tracks the direction of light with motor movement that is smooth and stability that is high. A hard stop mechanism when there is low light has been included and that led to a significant reduction in power consumption and mechanical stress. Moreover, light-based selective activation permits a controlled testing and operation. The proposed system is inexpensive, dependable, and appropriate for both academic and real-world solar energy applications.

6. FUTURE SCOPE

- Connection with the actual solar panels for the purpose of comparing power output.
- Realization of auto morning reset (east orientation).
- Incorporation of IoT-based surveillance and data recording.
- Application of DC motors with encoders for over-the-top setups.
- Installation of weather and wind protection devices.

7. REFERENCES

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