

Sun Tracking Solar System

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Abstract: *Solar energy has become an increasingly important and popular renewable energy source. By using a solar tracking system, we can produce an abundance of energy and improve the efficiency of solar panels. The solar panel's efficiency lies in its perpendicular proportionality with the sun's rays. Although cheaper options are also available, its installation charge is high. A prototype solar panel is discussed in this paper based on the sun's rays as the reason for its design and construction. Arduino is used as the main control circuit. As a result of the programming of this device, the LDR sensor, when it detects sun rays, will provide direction to the Servo Motor in order to move the solar panel. Consequently, the solar panel is positioned so that it can receive the maximum amount of sunlight*

Keywords: ESP-32, LDR Sensor, Solar Panel, Servo Motor, Inverter, Display Panel

I. INTRODUCTION

A sun-tracking solar system, also known as a solar tracker, is a technology designed to optimize the efficiency of solar panels by automatically orienting them towards the sun throughout the day. The primary goal of sun tracking is to maximize the absorption of sunlight and, consequently, enhance the energy output of the solar panels. Here's a brief introduction to the key aspects of a sun-tracking solar system:

1. Basic Principle:

Sun-tracking systems operate on the principle of following the path of the sun across the sky. By adjusting the tilt and orientation of solar panels in real-time, they can ensure that the panels are constantly facing the sun's rays, thereby optimizing energy capture.

2. Types of Sun Trackers:

There are mainly two types of sun trackers:

- **Single-Axis Trackers:** These trackers move in one dimension, usually rotating the solar panels from east to west to follow the sun's daily path.
- **Dual-Axis Trackers:** These trackers move in two dimensions, adjusting both the azimuth (east-west) and elevation (up-down) angles to precisely track the sun's position throughout the day and across seasons.

3. Advantages:

- **Increased Energy Output:** Sun-tracking systems can significantly boost energy production compared to fixed solar installations by capturing more sunlight throughout the day.
- **Optimal Angle:** By adjusting the tilt and orientation of the panels, trackers can maintain an optimal angle for sunlight absorption, reducing energy loss due to oblique sunlight angles.

4. Applications:

- **Utility-Scale Solar Farms:** Large-scale solar power plants often employ sun trackers to maximize their electricity generation capacity.
- **Residential and Commercial Installations:** While less common in smaller installations due to cost considerations, sun trackers can still be used for certain residential and commercial solar setups.

5. Challenges and Considerations:

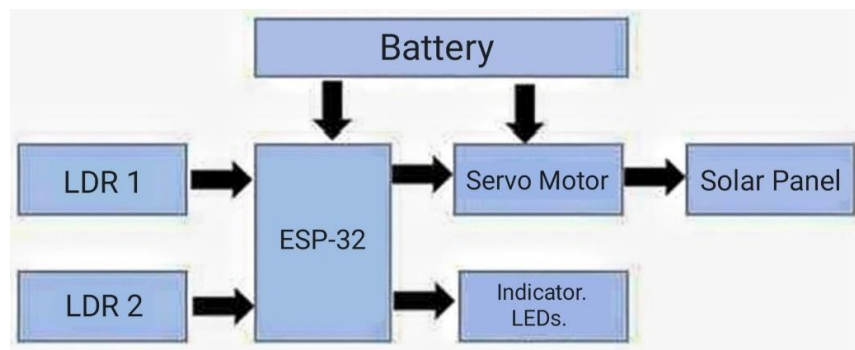
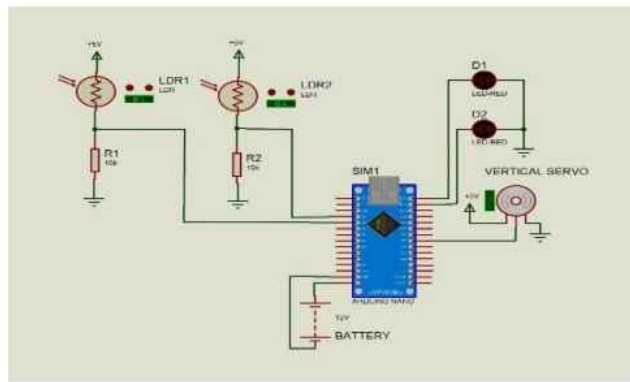
- Cost: Sun-tracking systems are generally more expensive to install and maintain compared to fixed solar installations
- Maintenance: Moving parts in tracking systems may require more maintenance, adding to the overall operational costs.
- Space Requirements: Dual-axis trackers, in particular, may require more space compared to fixed installations.

6. Technological Advances:

- Continuous advancements in sensor technology, control systems, and materials have improved the efficiency and reliability of sun-tracking systems.
- Integration with smart technologies, weather forecasting, and AI can enhance the precision of tracking, optimizing energy capture.

In summary, sun-tracking solar systems play a crucial role in maximizing the efficiency of solar energy capture. While they come with additional costs and maintenance requirements, the increased energy output can make them a compelling choice, especially in large-scale solar installations where maximizing efficiency is critical.

II. BLOCK DIAGRAM

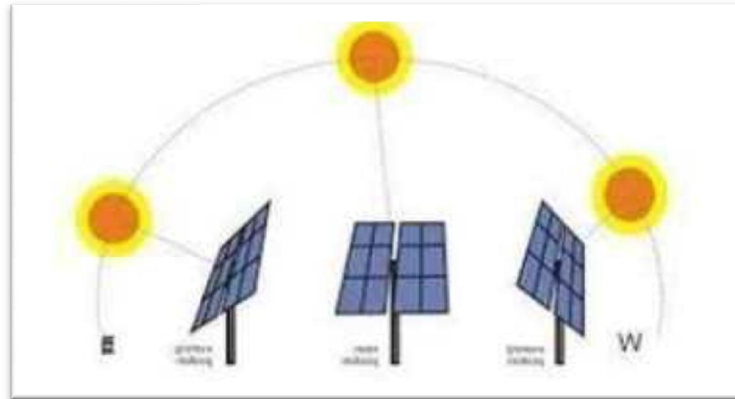


III. WORKING

Above is the circuit diagram of the working of the project. The construction of a prototype for a solar tracking system is along the horizontal axis. The circuit design of the solar tracking system uses an Arduino nano board & servo motor to control the position of the solar panel. Light-dependent resistors are used to track the position of the sun and to start the operation. This system is controlled with an SG90 servo motor. The single-axis solar tracking system is implemented here. Whenever the sunlight is incident on the LDR sensors the signals are sent to the servo motor through the microcontroller. Thus, the LDR rotates in a direction perpendicular to the initial one. Two such LDRs arranged two on

the side of the panel. Due to the partition between two LDRs, each of them is isolated from the other. When the intensity of light falling on the LDR sensor increases the resistance is decreased.

The two sensors are again connected with resistors in series. Thus, whenever the position of the sun changes, the intensity of sunlight falling on the LDR arrangement also differs from each other due to the partition. The voltage drop is formed at the junction of the LDR and the resistor. This voltage drop is passed as the input to the microcontroller. The digital signals are sent to the servo motor and thus it rotates at a desired angle and thereby the panel also rotates in the direction of maximum intensity. Thus, it rotates by about 15 degrees per hour. Hence, a delay of 1.5 minutes is required. Because of this algorithm, sunlight radiating from every direction is tracked and the orientation of the panel is achieved.



IV. CONCLUSION

In conclusion, sun tracking solar systems represent a significant advancement in renewable energy technology. The dynamic orientation of solar panels, facilitated by precision tracking mechanisms and sophisticated algorithms, ensures optimal exposure to sunlight throughout the day. This results in a substantial increase in energy output compared to fixed installations, contributing to improved economic viability and sustainable energy practices. The adaptability of these systems to different geographical locations, user customization options, and the integration of advanced technologies, such as remote monitoring, further enhance their overall effectiveness. As ongoing research and technological innovations continue to refine sun tracking solar systems, they remain a promising and environmentally conscious solution for maximizing solar energy capture and advancing the transition towards cleaner and more sustainable energy sources.

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