

Double Axis Solar Tracking System

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Abstract - A dual axis solar tracking system is designed to enhance the performance of solar panels by continuously adjusting their position according to the movement of the sun. Unlike conventional fixed solar panels, this system allows the panel to rotate in both horizontal and vertical directions so that it always faces the sun from sunrise to sunset. The system generally consists of light sensors, a microcontroller, and motors that automatically adjust the orientation of the solar panel. By maintaining the optimal angle with respect to sunlight, the system improves solar energy absorption and increases the overall electrical output. Dual axis solar tracking technology is widely used in solar energy research and renewable power generation applications to improve efficiency and reduce dependence on conventional energy sources.

Key Words: Solar Energy, Solar Panel, Dual Axis Tracking, LDR Sensor, Microcontroller, Renewable Energy, Automatic Tracking.

1. INTRODUCTION

Solar energy is one of the most important renewable energy resources used for electricity generation. It is clean, sustainable, and environmentally friendly. In most traditional solar power systems, solar panels are installed in a fixed position. Because of this fixed arrangement, the panel cannot follow the movement of the sun during the day, which reduces the total solar energy received.

The system generally uses light sensing devices such as Light Dependent Resistors (LDRs) to detect the intensity of sunlight. A microcontroller processes the signals from the sensors and controls motors that adjust the orientation of the panel. By maintaining proper alignment with the sun, the system can collect more solar radiation and generate more electrical energy compared to fixed solar panel systems.

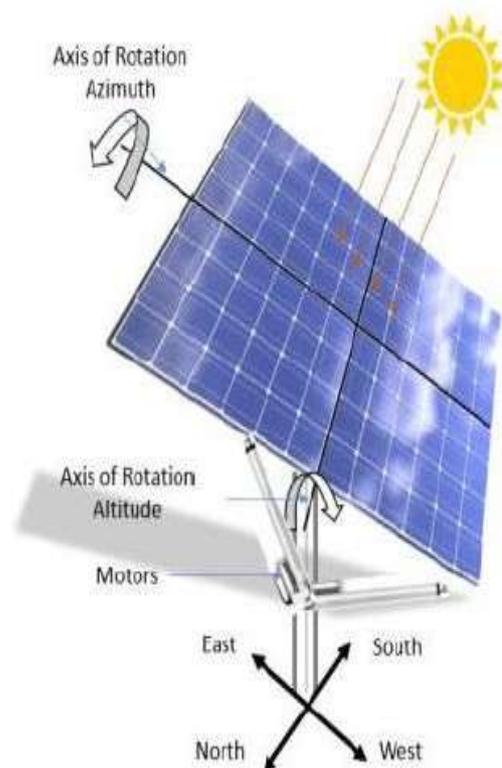


Fig -1: DOUBLE AXIS SOLAR TRACKING

2. Working Principle

Solar Panel

A solar panel converts sunlight into electrical energy using photovoltaic cells. When sunlight strikes these cells, photons transfer their energy to electrons in the semiconductor material. This process causes electrons to move and produce an electric current. This phenomenon is known as the photovoltaic effect.

The electrical power generated by a solar panel is in the form of direct current (DC). In a dual axis tracking system, the solar panel is mounted on a mechanical structure that allows it to rotate in two directions. This movement helps the panel remain perpendicular to the sun's rays, which improves energy conversion efficiency.

Light Dependent Resistor (LDR) Sensors

A Light Dependent Resistor is an electronic component whose resistance changes according to the intensity of light falling on it. When light intensity increases, the resistance of the LDR decreases, and when light intensity decreases, the resistance increases.

In a dual axis solar tracking system, four LDR sensors are usually placed around the solar panel. These sensors detect sunlight from different directions and continuously measure the intensity of light. If one sensor receives more light than the others, the system recognizes that the panel is not perfectly aligned with the sun. The signals from the sensors are then sent to the microcontroller for further processing.

Microcontroller Unit

The microcontroller acts as the main control unit of the solar tracking system. It receives signals from the LDR sensors representing the intensity of sunlight. The controller compares these signals using programmed instructions.

If a difference in light intensity is detected between the sensors, the microcontroller determines the direction in which the solar panel should move. It then sends control signals to the motor driver circuit to activate the motors. The panel continues to rotate until the sensors receive nearly equal light intensity, indicating that the panel is properly aligned with the sun.

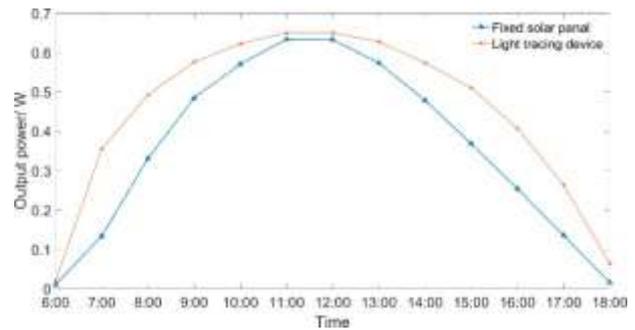
Motor Driving Mechanism

The movement of the solar panel is achieved using two motors. One motor controls the horizontal movement of the panel from east to west, while the other motor controls the vertical movement from north to south.

When the microcontroller detects an imbalance in light intensity from the sensors, it sends a signal to the motor driver. The motor driver provides the required current to operate the motors. The motors rotate the solar panel in the required direction until the sensors detect equal sunlight. Once the correct alignment is achieved, the motors stop rotating.

This mechanism allows the solar panel to follow the path of the sun and maintain maximum exposure to sunlight throughout the day.

3. BATTERY CURRENT CURVE



The battery current curve represents the variation of charging and discharging current of the battery during different periods of the day.

Morning:

In the early morning, sunlight intensity is low. Therefore, the solar panel generates a small amount of current, and the battery charging current is also low. As sunlight gradually increases, the current begins to rise.

Midday:

Around noon, sunlight intensity reaches its maximum level. At this time, the dual axis tracking system aligns the solar panel directly with the sun. As a result, the solar panel generates maximum current and the battery charging current reaches its peak value.

Afternoon:

During the afternoon, sunlight intensity starts to decrease as the sun moves toward the horizon. Consequently, the current produced by the solar panel gradually decreases.

Evening/Night:

When sunlight is no longer available, the solar panel stops generating power. During this time, the battery supplies energy to system components such as the microcontroller and motors.

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5. FUTURE SCOPE

The Dual Axis Solar Tracking System has strong potential for future improvements and wider applications in renewable energy generation. One important development is the integration of advanced sensors and intelligent control systems. Using technologies such as Internet of Things (IoT) and artificial intelligence, the solar tracker can automatically adjust the panel position more accurately according to sunlight intensity and weather conditions, which can further improve energy efficiency.

Another future scope is the use of wireless monitoring systems. By connecting the tracker to cloud platforms or mobile applications, users can monitor the performance of solar panels, power generation, and system status in real time from remote locations. This can make solar power systems easier to manage and maintain.

6. CONCLUSION

The dual axis solar tracking system developed in this project demonstrated improved efficiency in solar power generation by continuously aligning the solar panel with the sun's position. By allowing movement in both horizontal and vertical directions, the system maintained an optimal angle between the solar panel and sunlight.

7. REFERENCES

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