

Dual Axis Solar Tracking System

P. E. Bachche¹, Raviraj Bahadure², Kunal Sawant³, Raj Sawakhande⁴, Shreeshant Patil⁵

¹*P.E.Bachche Lecturer TKIET DIPLOMA WARANANAGAR*

²*Raviraj Bahadure Student TKIET DIPLOMA WARANANAGAR*

³*Kunal Sawant Student TKIET DIPLOMA WARANANAGAR*

⁴*Raj Sawakhande Student TKIET DIPLOMA WARANANAGAR*

⁵*Sheeshant Patil Student TKIET DIPLOMA WARANANAGAR*

Abstract - A Dual Axis Solar Tracking System is an advanced solar power generation system that increases the efficiency of solar panels by continuously aligning them with the sun's position throughout the day. Unlike fixed solar panels, which remain stationary, this system tracks the sun in two directions: horizontal (azimuth) and vertical (elevation). By maintaining the panel perpendicular to the sun's rays, maximum solar radiation is captured, thereby improving overall energy output.

The system typically uses Light Dependent Resistors (LDRs) or other light sensors to detect the intensity of sunlight from different directions. A microcontroller such as Arduino Uno processes the sensor data and controls two DC or servo motors to adjust the panel's position along both axes. The horizontal axis tracks the sun from east to west, while the vertical axis adjusts according to seasonal changes and the sun's height in the sky.

The dual-axis tracking mechanism significantly increases energy generation compared to a fixed solar panel system, with efficiency improvements of up to 30–40%. This makes it suitable for applications in solar power plants, street lighting systems, and remote area electrification. Although the system has slightly higher installation and maintenance costs due to moving components, the increased power output compensates for these costs over time.

In conclusion, the Dual Axis Solar Tracking System enhances the performance of photovoltaic systems by maximizing solar energy harvesting, contributing to sustainable and renewable energy development.

Key Words: Solar, Panel, Horizontal and Vertical, Sun rays, Arduino, Tracking, Photovoltaic system, Renewable energy.

1. INTRODUCTION

A Dual-axis solar tracking automatically adjusts the position of solar panels to follow the sun, maximizing energy capture throughout the day and across seasons. Unlike fixed solar panels, which lose efficiency due to misalignment with the sun's position, a dual-axis tracker increases energy output by adjusting both the azimuth and elevation of the panel. This project proposes using an Arduino controller, LDR sensors, and servo motors to create an affordable and efficient tracker.

2. Objectives

- To track the sun in both horizontal and vertical directions (East–West and North–South) throughout the day.
- To maximize solar energy absorption by keeping the solar panel always perpendicular to the sun's rays.
- To increase the efficiency of the solar panel compared to a fixed solar panel system.
- To improve power output by reducing energy loss due to improper panel alignment.
- To demonstrate automatic control using sensors and motors (such as LDR sensors and servo/DC motors).
- To promote renewable energy usage by making solar systems more efficient and reliable.

3. Proposed Methodology

- **Hardware:** An **Arduino Uno** microcontroller, **LDRs** for light sensing, **servo/ DC motors** for positioning, and a **power supply** to drive the system.
- **Sensor Array:** Four LDRs detect the intensity of sunlight on the vertical and horizontal axes.
- **Control Algorithm:** The Arduino reads the sensor data, calculates light Intensity differences, and adjusts the panel's position via servos.
- **Optional Enhancements:** Feedback loops, Bluetooth for manual control, and potentiometers for accurate positioning.

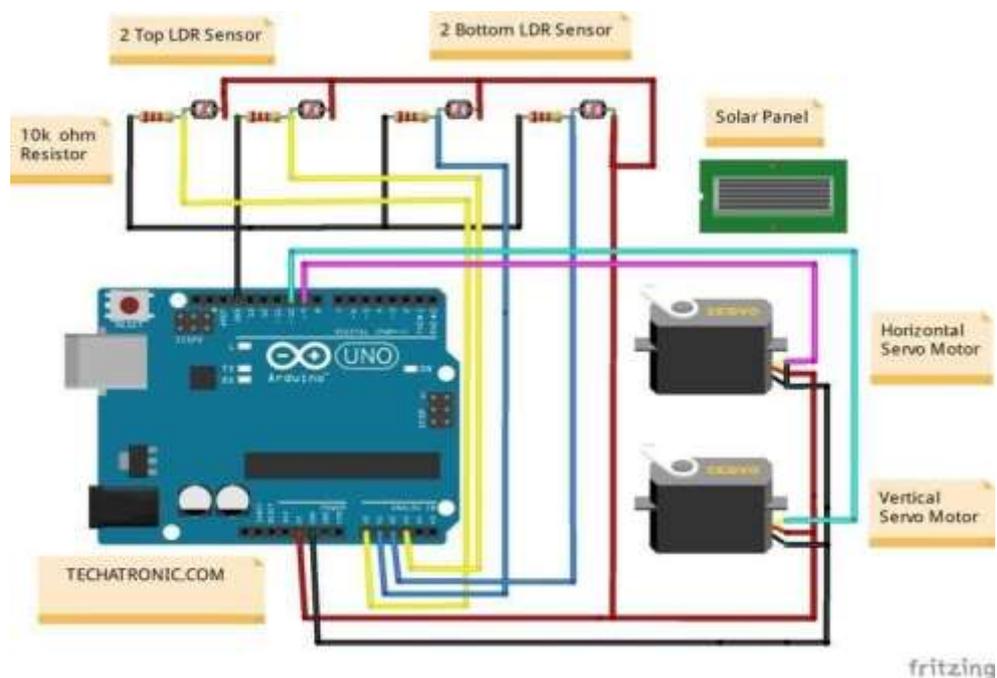


Fig -1: Block Diagram

3. CONCLUSIONS

The dual-axis tracker is a practical and impactful application of embedded systems in renewable energy, combining hardware automation with solar optimization. It stands as an excellent example of how Arduino-based automation can improve energy sustainability, making it a valuable addition to both academic projects and real-world green technologies.

REFERENCES

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