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Comparison of Solar Panel Performance without and with Tracking

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Abstract:- Electricity currently plays an essential role for the permanence and development of life. Still, the electric power sources have been depleted, forcing researchers to look for an alternative source of power, which led to discovery of anew sources of energy. Solar energy is renewable and environmentally benign, and photovoltaic panels can convert it to electricity. These panels can be utilized in a fixed configuration or in a single or dual-axis solar tracking system., The efficiency is low in a fixed form because the panels are tilted at a limit angle, whereas in a tracking system, the panel is t design o move on a single or dual-axis. A single-axis model in which the board is moved from east to west its more efficient than fixed panels. On the other hand, a dual axis model allows the board to rotate in four directions. In this study, the practical measurements of both models proved that the electric energy in the dual-axis model is more by an amount 44% Compared with the measured power from the single-axis model.

I. INTRODUCTION

Electricity has impacted the world so much that it is now unimaginable to imagine a world without it. It's Contributed to the development of many technologies. The photovoltaic effect is a phenomenon in solar panels that converts light energy from the sun's radiation into electric power. We use photovoltaic panels, which are solar cells constructed of silicon, to convert solar energy into electricity. Panels can be used in two ways: There are two models of solar trackers: fixed and solar trackers. When a board is fixed, it is oblique in the ground or on a roof at an angle that allows the sun rays to pass through. The panel in a solar tracker is designed to rotate inthe direction of the sun. The angle at which the panel is fixed or rotary also affects the transformation of solar energy into electric power. Compared to the stationary panel and single- axis solar tracker systems, we have experimentally verified that dual-axis systems' efficiency andpower are higher [1].

II. SOLAR TRACKING SYSTEM

Solar panel tracking system development has been active for several years. Solar tracking systems are necessary for solar energy-based power generation systems because the sun moves across the sky, making it necessary to track the location of the solar panels so that they are always aligned at right angles to the sun[2]. conventional solar panels, which are inclined and securely set at a specific angle, have a restricted area of exposure to the light throughout the day.

As a conseqently, the average output energy is underutilized. Solar panels are more expensive onthe market. More solar panels are required to improve the power output. As a result, instead of purchasing extra solar panels, this technology provides a cost-effective solution. This study proposes an effective tracking method to improve the system's overall efficiency[3].

A. Single Axis Tracking System

Tracking the sun has been attempted in a variety of methods. A single-axis tracking system is one of these ways. One direction of freedom works as a circular axis in a single-axis sun-trackingsolar system. A single-axis tracker's rotating axis is usually in line with with the true North meridian. With strong tracking algorithms, they may be arrange in line in any cardinal direction. This type can track and follow the sun's intensity to get the maximum power at the output, regardless of motor speed. The system is used for alternative electricity generation in the home, notably for non-critical and low-power equipment[4].

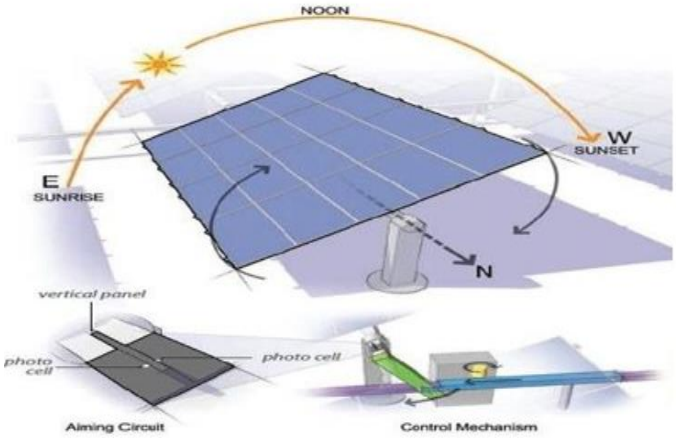

Fig 1. Single-Axis Tracker[5].

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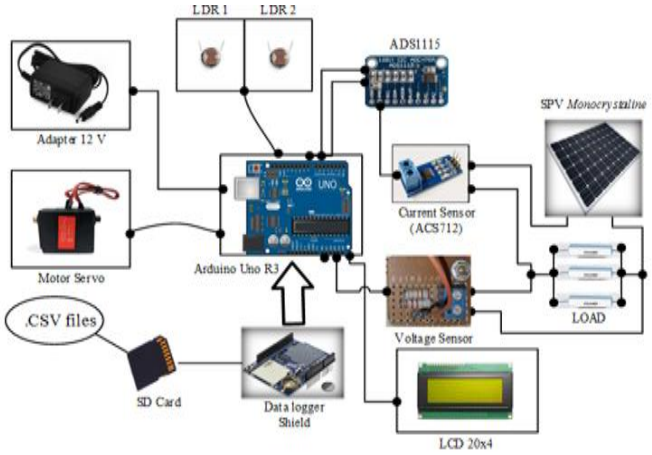

Fig 2. Diagram for Single Axis Tracker

B. Dual Axis Tracking System

Solar trackers with dual axes feature two directions of freedom that operate as rotation axes. Axes are perpendicular to one another. As a feedback signal, the tracker detects direct solar energy falling on photo-sensors to ensure that the PV panel always follows the sun. Due to their capacity to track the sun vertically and horizontally, dual-axis trackers provide optimal solar energy levels. They're most commonly seen in modest residential installations and areas with highly high government feed-in tariffs.

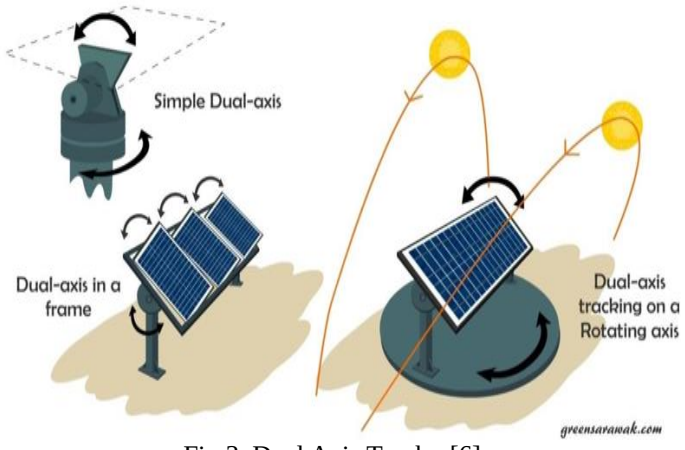

Fig 3. Dual Axis Tracker[6].

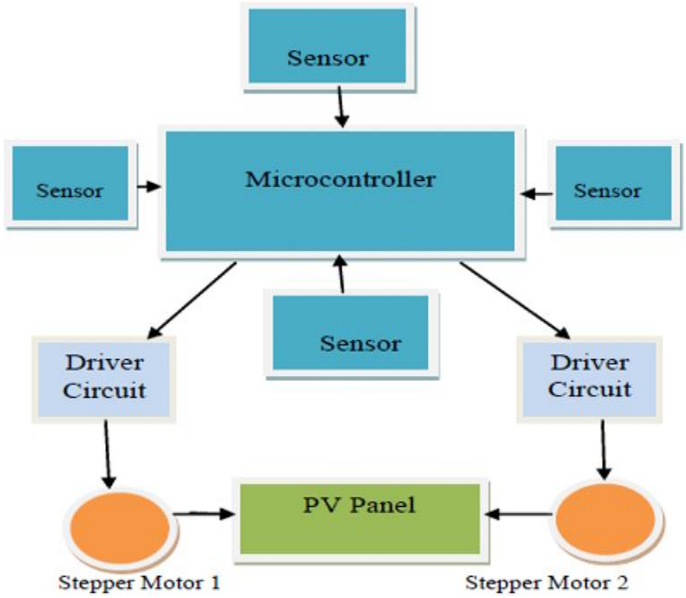

Fig 4. Diagram for Dual - Axis Tracker [7]

III. EXPERIMENTAL SETUP

A. Test Performance without Tracking

The solar panel is placed in a permanent position, and its performance is monitored from dawn to evening. The solar panel has a 12 volt, 5-watt rating. The solar panel is linked to a 30- ohm rheostat load, and the voltage and current are measured with a voltmeter and an ammeter, respectively. Every hour, the voltage and current values are recorded.

B. Test Performance with Tracking

The solar board and tracking system are put outside, and the solar panel's performance is monitored from sunrise to sunset. The solar panel has a 12 volt, 5-watt rating. The solar panelis linked to a 30-ohm rheostat load, and the voltage and current are measured with a voltmeter and an ammeter, respectively. Every hour, the voltage and current values are recorded and tabulated. Table II shows the results of comparing the performance of solar panels with and without tracking systems. Figure 5 depicts the performance curve.

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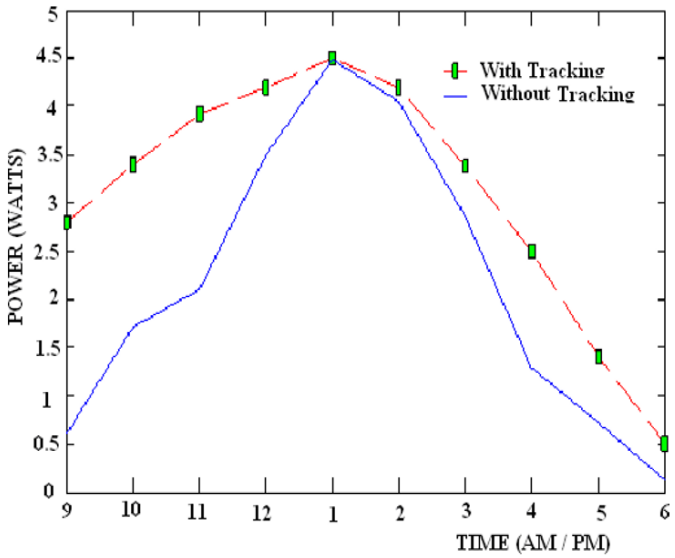

Fig 5: Performance of Solar Panels With Tracking

Table 1: Comparison of Solar Panel Performance Without And With Tracking

Time (Hr)	Without _Tracking			With _Tracking		
	Voltage (V)	Current (A)	O/P(W)	Voltage (V)	Current (A)	O/P (W)
9 am	5.5	0.1	0. 55	12.2	0.23	2.8
10 am	9	0.178	1.6	13.5	0.25	3.4
11 am	10.2	0.2	2	14	0.28	3.92
12 pm	12.5	0.28	3.5	14	0.3	4.2
1 pm	14	0.33	4.462	15	0.3	4.5
2 pm	13.5	0.3	4.05	14	0.3	4.2
3 pm	11	0.24	2.68	13	0.26	3.38
4 pm	8	0.16	1.28	10	0.25	2.5
5 pm	6	0.12	0.72	7	0.2	1.4
6 pm	2.5	0.05	0.125	5	0.1	0.5

It has been discovered that the proposed dual-axis tracking system is a more efficient technique for harnessing solar energy than the conventional fixed orientation solar module system. The average output of a solar panel without tracking is 2.3 watts, while the average output of a solar panel with tracking is 3.08 watts. When the DC motor's power consumption is considered, the enhanced efficiency is 43.65%.

IV. FUTURE WORK

Adding a concave lens to the top of the screen can boost the dual-axis tracking system's performance even more. It also has high optical efficiency. Because the panel receives a lot of sunlight and generates a lot of power, installing a lens or mirror improves the tracker's efficiency. It may also be possible to reduce the solar cell size required to create substantial amounts of electricity.

V. CONCLUSION

The structure and execution of dual-axis solar system is proposed in this research. This system improves the solar panel's efficiency. It is fully automated and requires minimal upkeep at a cheap cost. Because it is a dual-axis system, it can achieve maximum efficiency over time. The installation and execution of a dual-axis tracking system can be done anywhere because itis not affected by weather or other factors. It can be employed in various settings, including autos, residential spaces, industries, and educational institutions. The systems must be built to be more mechanically robust to accommodate a more significant number of panels. The system's power consumption can be lowered by enhancing the system's design. The dual-axis solar tracker proposed model can track the sun throughout the year. Compared to single-axis trackers and fixed panels, the dual-axis tracker produces more output power. The dual-axis tracker's effectiveness is 61.68 percent higher than that of the fixed panel, according to the measured data.

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