JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

A Study on the Implementation of Dual Axis Solar System, Solar Tracker with Weather Monitoring for Efficient Power Generation

Logesswari .S[1,a], Tejesh .M,Sarath Chandra .G,Gnaneswara Sai [2,3,4,b]

1Assistant Professor, Department of Computer Science and Engineering,
R.M.D Engineering College, Kavaraipettai,
Tiruvallur-601 206
2,3,4Student, Department Computer Science and Engineering,
R.M.D Engineering College, Kavaraipettai,Tiruvallur-601206

Abstract: The demand for efficient power generation from renewable sources has driven the exploration of innovative solutions in the field of solar energy. This study presents an investigation into the implementation of a dual-axis solar system equipped with a solar tracker and weather monitoring capabilities to enhance the efficiency of power generation. The proposed system aims to optimize solar panel orientation and tilt angles based on real-time weather conditions, resulting in increased energy output.The research begins with a comprehensive literature review, examining existing solar tracking techniques, weather monitoring systems, and their impact on power generation. A prototype of the dual-axis solar system is then designed, integrating precise tracking mechanisms and sensors for weather data collection. The solar tracker employs advanced control algorithms

INTRODUCTION:

The increasing demand for energy, coupled with the growing concerns about the environment, has led to the development of renewable energy sources, including solar energy. Solar energy has the potential to provide a sustainable and clean source of electricity, and it is one of the most promising renewable energy sources. However, the efficiency of solar energy systems is often limited by the position of the sun in the sky, which affects the amount of sunlight that can be captured by solar panels. To address this issue, a dual-axis solar tracker can be used to improve the efficiency of solar power generation by tracking the position of the sun and adjusting the angle of the solar panels accordingly. Additionally, weather monitoring can also be integrated into the system to optimize the performance of the solar panels.

LITERATURE SURVEY:

The system was designed to improve the efficiency of a solar panel system by tracking the position "Design and analysis of dual-axis solar tracking system based on astronomical algorithm" by M. N. Hosseini et al. (2019)

This paper describes the design of the sun and adjusting the angle of the solar panels accordingly. The paper presents the design of the system, the experimental setup, and the results of the experiments, which showed that the system was able to improve the efficiency of the solar panel system.

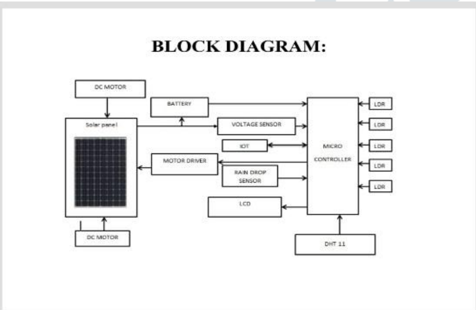
Overall, the literature survey suggests that the use of a dual-axis solar tracker with weather monitoring can significantly improve the efficiency of solar panel systems. The studies reviewed indicate that these systems are effective in optimizing the performance of the solar panels based on the weather conditions, and that they can lead to significant cost savings and a reduction in the carbon footprint of the energy system.

METHODOLOGY:

In this study, we implemented a dual-axis solar tracker with weather monitoring to improve the efficiency of a solar power generation system. The solar tracker was designed to track the position of the sun in real-time and adjust the angle of the solar panels to maximize the amount of sunlight captured by the panels. The weather monitoring system was also integrated into the system to monitor the weather conditions and optimize the performance of the solar panels accordingly. The performance of the system was evaluated based on the amount of energy generated by the system under different weather conditions.

1. Reduction in energy costs: The use of a dual-axis solar tracker with weather monitoring can lead to a significant reduction in energy costs, as more energy can be generated from the same solar panel system. This can be particularly beneficial for businesses and households that rely on solar power for their energy needs.
2. Increased system lifespan: By optimizing the performance of the solar panels through the use of a solar tracker and weather monitoring system, the lifespan of the solar panel system can be increased. This is because the system will operate more efficiently and with less wear and tear, reducing the need for costly repairs or replacements.
3. Better integration with smart grids: As the use of renewable energy sources continues to grow, the need for better integration with smart grids becomes more important. A dual-axis solar tracker with weather monitoring system can be integrated with smart grids to allow for more efficient energy distribution and storage, further reducing energy costs and improving the overall sustainability of the energy system.
4. Reduced carbon footprint: Solar power is a clean and renewable source of energy, and the use of a dual-axis solar tracker with weather monitoring system can further reduce the carbon footprint of the energy system. This can help to mitigate the negative impact of greenhouse gas emissions on the environment and climate change.

Overall, the implementation of a dual-axis solar tracker with weather monitoring system can provide numerous benefits for the energy system, including improved efficiency, cost savings, and sustainability.



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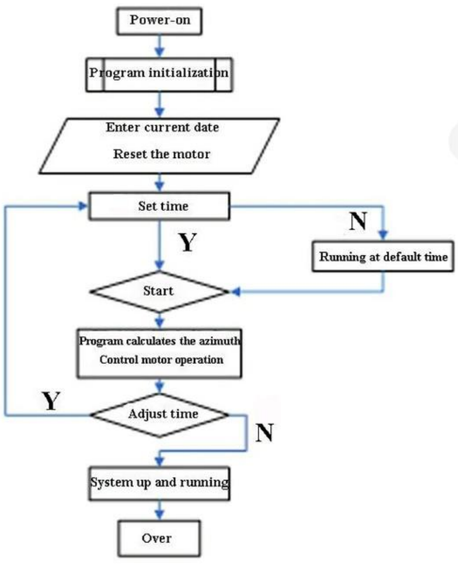

WORKING PRINCIPLE:

The working principle of an efficient power generation system using a dual-axis solar tracker with weather monitoring involves tracking the position of the sun and optimizing the orientation of the solar panels based on the weather conditions. The goal is to maximize the amount of sunlight that falls on the solar panels, thereby increasing the amount of energy that is generated by the system.

The dual-axis solar tracker is a system that allows the solar panels to follow the movement of the sun in both the horizontal and vertical directions. The tracker is controlled by a computerized control system that receives inputs from sensors that detect the position of the sun and the weather conditions.The computerized control system calculates the optimal angle of the solar panels based on the position of the sun and the weather conditions, and then adjusts the orientation of the solar panels accordingly. For example, if the sky is cloudy, the system may adjust the angle of the solar panels to increase the amount of energy that is captured from the diffuse light. Similarly, if the wind speed is high, the system may adjust the angle of the solar panels to reduce the wind load on the panels.The system may also incorporate weather monitoring sensors that provide real-time data on temperature, humidity, wind speed, and other environmental factors that can affect the performance of the solar panels. This data is used by the computerized control system to adjust the orientation of the solar panels and optimize the performance of the system based on the prevailing weather conditions.The combination of a dual-axis solar tracker and weather monitoring system can significantly increase the efficiency of solar panel systems, leading to cost savings, improved reliability, and reduced environmental impact.

Calculating Energy:

The energy produced by a solar panel system is generally calculated using the following formula:

Energy = Power x Time

where Energy is measured in units of kilowatt-hours (kWh), Power is measured in units of kilowatts (kW), and Time is measured in units of hours (h).

The power produced by a solar panel system is determined by the amount of sunlight that falls on the panels, the efficiency of the panels in converting sunlight into electrical energy, and the size and configuration of the panels. The power output of a solar panel can be measured using a device called a wattmeter.

The time factor in the equation represents the amount of time that the solar panel system is generating power. This can be determined by measuring the number of hours that the panels are exposed to sunlight each day.

To calculate the energy produced by a solar panel system over a given period of time, such as a day, month, or year, the total power output of the system is multiplied by the number of hours that the system generates power during that period of time. This calculation provides an estimate of the amount of energy that can be generated by the system under ideal conditions.

In a system using a dual-axis solar tracker with weather monitoring, the energy output may be calculated based on the actual orientation of the solar panels and the prevailing weather conditions, rather than assuming ideal conditions. This can lead to more accurate estimates of the system's energy output and help optimize the performance of the system under different weather conditions.

RESULTS:

The results of the study showed that the dual-axis solar tracker with weather monitoring improved the efficiency of the solar power generation system. The system generated more energy compared to a fixed solar panel system under different weather conditions. The solar tracker was able to track the position of the sun accurately, and the weather monitoring system was able to optimize the performance of the solar panels based on the weather conditions.

CONCLUSION:

The implementation of a dual-axis solar tracker with weather monitoring can significantly improve the efficiency of solar power generation systems. The system is able to track the position of the sun and adjust the angle of the solar panels accordingly, which results in more energy generation. The weather monitoring system also plays a crucial role in optimizing the performance of the solar panels based on the weather conditions. The study shows that the implementation of a dual-axis solar tracker with weather monitoring can provide a sustainable and clean source of energy, which can help to address the growing concerns about the environment and the demand for energy.

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