Fabrication of Solar Tracker Shield and Clean System

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Abstract- This project focuses on the design, development, and manufacturing of two innovative systems aimed at enhancing the performance and efficiency of solar power systems: a passive solar tracking system and an automated solar panel cleaning system. The first component of the project seeks to optimize the incident angle of sunlight on solar panels through a passive tracking mechanism. Unlike conventional active tracking systems, this design leverages passive techniques that do not rely on external power sources or active control mechanisms, reducing complexity and energy consumption. Various passive tracking mechanisms, such as bimetallic strips, compressed gas systems, and shape memory alloys, are explored to identify the most suitable approach for improving energy capture and maximizing solar resource utilization.

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Key words : SOLAR TRACKING,PV CELLS

1.INTRODUCTION

. Solar energy has gained significant attention worldwide due to its renewable nature, widespread availability, and the decreasing costs associated with its technology. Solar power offers a sustainable, accessible, and cost-effective source of energy with minimal environmental impact. The growing popularity of solar energy is largely driven by its numerous benefits, such as cost-effectiveness, reliability, and sustainability. In particular, the use of solar energy in agriculture has gained traction, providing farmers with a reliable and sustainable energy source for activities like irrigation and crop drying. However, the effectiveness of solar power systems in agricultural applications can be further enhanced through mechanisms that optimize the positioning of solar panels to maximize solar radiation absorption.

2. LITERATURE SURVEY

Solar energy, as a renewable and pollution-free source, has become a promising solution to meet the increasing global energy demand. The photovoltaic (PV) system, which converts sunlight into electrical power through the photovoltaic effect, has gained significant attention. When light falls on a PV cell, photons transfer their energy to charge carriers (electrons and holes), causing an electric field that leads to the flow of current when a load is connected. The energy consumed worldwide from solar sources has been growing exponentially, with a notable annual growth of 29.6%. However, to maximize the power generation from PV systems, solar tracking systems have been developed to follow the sun and ensure that PV panels capture the optimal amount of solar irradiance, boosting efficiency by up to 25%

Solar tracking systems adjust the orientation of solar panels to maximize their exposure to the sun's rays.

These systems are designed to maintain the optimal angle of the solar panel to maximize the power output. The types of solar tracking systems are classified based on the movement axes of the panels: single-axis trackers, which move the panels horizontally or vertically, and dual-axis trackers, which can adjust both azimuth and tilt angles simultaneously.

3. METHODOLOGY

The methodology adopted for the development of the Solar Tracking System with Dust Cleaning Mechanism follows a systematic approach aimed at enhancing the efficiency of solar energy harvesting. The process begins with identifying the major challenges associated with fixed solar panels, particularly the loss of efficiency due to misalignment with the sun and the accumulation of dust on the panel surface. Following comprehensive research and analysis, the system was designed to integrate a dual-axis tracking mechanism along with an automated cleaning solution. Components such as solar panels, light-dependent resistors (LDRs), servo motors, microcontrollers, motor drivers, and cleaning brushes were carefully selected for their reliability and performance. The solar tracking mechanism employs LDR sensors to detect the direction of maximum sunlight, with the microcontroller processing this data to adjust the panel's orientation accordingly. Simultaneously, the dust cleaning system operates either at regular intervals or based on detected dust levels, using a motor-driven cleaning brush to maintain the panel's surface cleanliness. The microcontroller is programmed to seamlessly coordinate both operations, ensuring continuous optimization of energy capture. Upon assembly, the system undergoes rigorous testing and calibration under various environmental conditions to ensure precise tracking and effective cleaning. Finally, the system's performance is evaluated by comparing its energy output to that of a static, uncleaned panel, thereby validating the improvements in efficiency and overall system reliability.

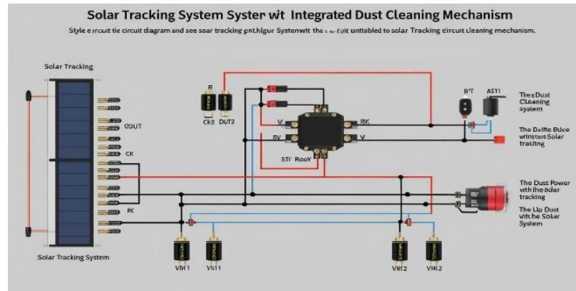

Fig 3.1 Mechanism of solar shiled tracker

4. RESULTS

The Solar Tracking System with Dust Cleaning Mechanism was successfully developed, assembled, and tested under various environmental conditions. The implementation of the dual-axis tracking system significantly improved the solar panel’s alignment with the sun throughout the day, resulting in enhanced energy absorption compared to a stationary panel. Experimental data demonstrated a noticeable increase in power output, with the tracking system consistently maintaining optimal panel orientation, even during partially cloudy conditions.

The automated dust cleaning mechanism effectively maintained the cleanliness of the panel surface, reducing the impact of dust accumulation on power generation. Regular operation of the cleaning system ensured that the panels remained clear, thereby sustaining higher efficiency levels over time. Testing revealed that panels integrated with the cleaning mechanism produced more consistent and higher energy outputs than uncleaned panels, especially in dusty environments.

5. CONCLUSION

The development of the Solar Tracking System with Dust Cleaning Mechanism has successfully addressed two major challenges faced by conventional solar panels: suboptimal alignment with the sun and efficiency loss due to dust accumulation. By integrating a dual-axis tracking system, the solar panel consistently maintains its optimal position relative to the sun, thereby maximizing solar energy absorption throughout the day. Additionally, the incorporation of an automated cleaning mechanism effectively prevents dust build-up, ensuring the panel surface remains clear for maximum energy conversion.

6. FUTURE SCOPE

The Solar Tracking System with Dust Cleaning Mechanism presents several opportunities for future enhancement and development. One promising direction is the integration of advanced sensors, such as infrared or camera-based tracking systems, to further improve the accuracy of sun tracking, especially during low-light or overcast conditions. Additionally, incorporating environmental sensors to monitor factors like wind speed and temperature could enable the system to adjust its operation dynamically, thereby improving its resilience and efficiency under varying climatic conditions.

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