Design Solar Module For A Measurement Of different parameters Different Inclination Angles.

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Abstract :

This project aims to design and manufacture a passive solar tracking system to enhance the performance and efficiency of solar power systems. The proposed tracking system utilizes passive techniques that do not rely on active control mechanisms or external power sources, reducing complexity and energy consumption. The project involves the conceptualization, design, prototyping, and testing of the passive solar tracking system to optimize the incident angle of sunlight on solar panels.

The design process begins with a comprehensive study of solar tracking principles, including the movement of the Sun, geographical location considerations, and the effects of incident angle on energy capture. Various passive tracking mechanisms, such as bimetallic strips, compressed gas systems, and shape memory alloys, are evaluated to determine the most suitable approach for the project.

Based on the analysis, a novel passive tracking mechanism is developed, taking into account factors such as simplicity, reliability, cost-effectiveness, and adaptability to different solar panel configurations. The design includes mechanical components, such as linkages, gears, and pivots, that enable the tracking system to follow the Sun's path autonomously throughout the day.

The outcome of this project is expected to demonstrate the feasibility and benefits of a passive solar tracking system in improving energy production and maximizing the utilization of solar resources. The findings can contribute to the development of more efficient and cost-effective solar power systems, particularly in applications where active tracking systems may not be practical or economically viable.

Keywords*: passive tracking system, solar power systems, incident angle optimization, mechanical design, manufacturing, energy efficiency.*

1. Introduction:

Solar energy is popular due to its renewable nature, widespread availability, and decreasing costs, making it a sustainable, accessible, and cost-effective source of power with minimal environmental impact. Solar power is becoming increasingly popular as a source of renewable energy due to its numerous benefits such as cost- effectiveness, reliability, and sustainability. The use of solar energy for agricultural purposes has been gaining attention as it provides farmers with a reliable and sustainable source of energy for irrigation, crop drying, and other activities. However, the efficiency and effectiveness of solar panels in agriculture can be improved by employing a single-axis sun-tracking mechanism.

In this project, we aim to design and manufacture a passive solar tracking system with single axis tracking, in this there is no use of any kind of electrical power required for the rotation for solar panel instead of electrical use we using mechanical source of power. In the spiral spring mechanical energy is stored and with the help of gear arrangement speed will reduce such a way that that can match the sun speed throughout the day.
The main goal of this project to design tracking system for the domestic and industrial purpose solar plate for increase the efficiency of panel.

2. Problem Definition

The main problem is the eliminating power consumption required to solar tracking system. Design the pure mechanical solar tracker. The problem addressed by the proposed solar power system is the limited availability of sustainable and cost- effective power generation solutions for various settings, particularly in domestic as well as industrial.

The problem addressed in this project is the suboptimal energy production and efficiency of conventional fixed-tilt solar power systems due to the inability to track the movement of the Sun. Fixed-tilt systems have a fixed angle, resulting in reduced exposure to direct sunlight and suboptimal incident angles throughout the day. This leads to lower energy output and missed opportunities to harness the full potential of solar radiation.

3. Objectives of the Project

Performance Parameter Measurement: To accurately measure the electrical parameters of a 10 W photovoltaic (PV) module, specifically open-circuit voltage

- **Angle-Dependent Analysis:** To investigate how varying the inclination angle (tilt angle) of the 10 W panel from 0° (horizontal) up to 90° (vertical) impacts the electrical output.
- **Optimal Tilt Determination:** To identify the optimal inclination angle that maximizes power generation at a specific geographical location.
- **Temperature Impact Study:** To monitor the solar module temperature using sensors and analyze its relationship with panel inclination and environmental factors.
- **Energy Generation Optimization:** To evaluate the effect of temperature and tilt angle on efficiency, demonstrating that higher output is achieved when sunlight hits the panel perpendicularity.
- **Data Modeling and Analysis:** To generate I-V (Current-Voltage) and P-V (Power-Voltage) curves to analyze the efficiency drops or gains at different angles.

Expected Outcomes:

- A calculated optimum tilt angle for the 10 W panel.
- Data demonstrating the inverse relationship between panel temperature and electrical efficiency.
- A comparative analysis of power output at different angles.

4. Methodology

- **Power Calculation:** Calculate the power generated for each angle:
- **Inclination Mapping:** Plot the voltage, current, temperature, and calculated power against the inclination angle (x-axis) to identify the optimum angle that yields the highest power.
- **Efficiency Analysis:** Evaluate the efficiency based on the ratio of output power to the input irradiance across different tilts.

4. Safety and Environmental Controls

- **Clean Surface:** Ensure the solar panel is clean to prevent reduced output due to dust.
- **Cable Connection:** Check connections to ensure they are secure and the multimeter is set to the correct range to avoid overload.
- **Sun Orientation:** Ensure the panel faces south (in the northern hemisphere) and is adjusted to avoid shading from nearby objects

5. Design

Design process for the proposed solar power system involves several key steps:

1. Defining the requirements: This involves identifying the power requirements of the system and the specific application of the system, such as water pumping or irrigation in agriculture and domestic.

2. Selecting components: Based on the power requirements, suitable solar panels, tracking mechanism, and portable power unit will be selected.

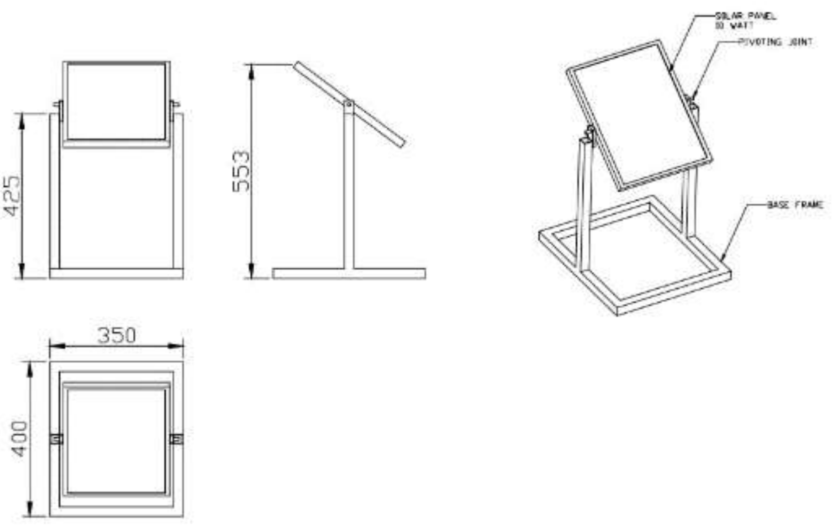

Fig.a).Tracking Design of 2D model

3. Designing the sliding mechanism: A sliding mechanism will be designed to facilitate the movement of the solar panel, ensuring optimal positioning for maximum energy generation.

4. Designing the tracking mechanism: The tracking mechanism will be designed to adjust the tilt angle of the solar panel automatically based on the position of the sun, maximizing the energy output.

5. Designing the portable power unit: The portable power unit will be designed to provide flexibility in power requirements and ease of transportation.

6. Integrating the components: All components will be integrated to form a cohesive solar power system that is efficient, portable, and suitable for various settings.7. Testing and refinement: The system will be tested and refined to optimize its efficiency and performance, ensuring that it meets the power requirements of the application.

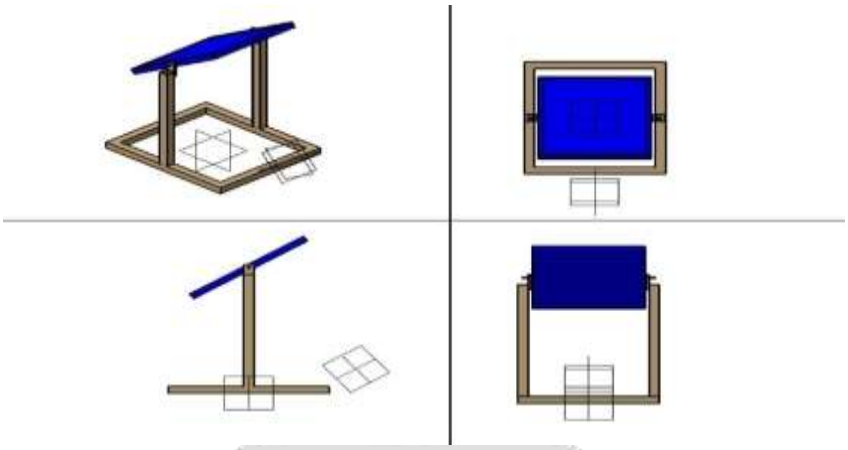

Fig.a).Tracking Design of 3D model

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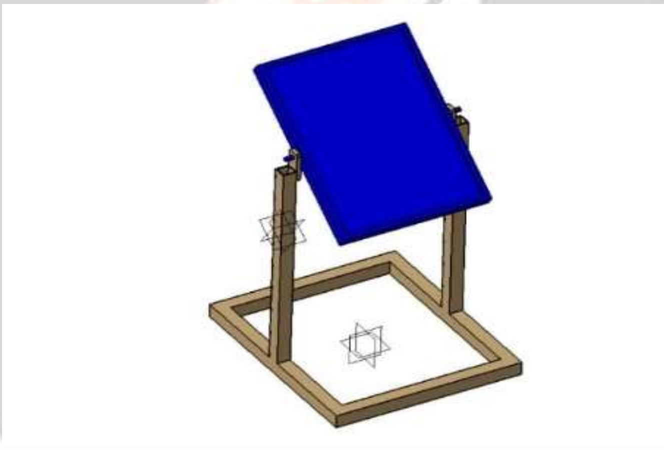

Fig.a).Tracking Design of 3D model isometric view

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6. Future scope

Future advancements can focus on improving the efficiency of solar tracking systems. This may involve incorporating advanced tracking algorithms, using more accurate Sensors and optimizing the control mechanism to maximize solar energy capture. Additionally, advancements in materials and manufacturing techniques can lead to the development of more efficient and lightweight tracking systems.

Future solar tracking systems can be designed to be adaptable and flexible, capable of tracking the sun's position in various weather conditions and environments

The future scope of solar tracking systems is wide-ranging, with opportunities for improving efficiency, integrating with other renewable energy systems, leveraging IoT technologies, reducing costs, enhancing adaptability, and incorporating advanced sensors.

7. Conclusion :

This project conclude that based on the power requirements, suitable solar panels, tracking mechanism, and portable power unit will be selected. A sliding mechanism will be designed to facilitate the movement of the solar panel, ensuring optimal positioning for maximum energy generation.

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