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IoT Based Dual Axis Solar Tracking System

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Abstract: *This paper focuses on the development of a dual-axis solar tracker system that integrates IoT (Internet of Things) technology. Solar energy is a renewable, clean, and efficient energy source. Using solar trackers that move photovoltaic panels towards the sun can increase the energy output of solar panels. This paper presents the design and implementation of a dual-axis solar tracker system that is controlled by an IoT ESP32 microcontroller drive unit. The system also includes a LDR sensor that monitors ambient light. This sensor allows the system to adjust the angle of the photovoltaic panels to ensure maximum exposure to the sun. The system is also equipped with an IoT monitoring system using an ESP32 microcontroller that allows users to observe data such as voltage-current, and the power generated by the photovoltaic panels. The goal of this system is to improve the efficiency of solar panels and provide a convenient method for users to monitor the performance of their solar energy systems*

Keywords: Solar Panel, ESP32 Microcontroller, 4 LDR, 2Moter, Mechanical Structure, cloud, IOT

I. INTRODUCTION

In the past decade of years there is increase in demand for reliable and huge electrical energy derived from renewable energy sources renewable energy plays important role in energy difficulty of country.The government started to decrease the usage of conventional energy sources and motivate people to use renewable energy sources like hydro and solar. Solar power is one of the example of renewable energy. Solar energy is a very large, never-ending source of energy.

A device which works for orienting a photovoltaic array solar panel or for concentrating solar reflector or len toward the sun is solar tracker. We can determine the voltage and current in the solar panel. The energy fetched from the solar panel is further stored in the battery.

It introduces the concept of dual-axis solar trackers and their advantages over single-axis trackers. The integration of IoT technology in solar tracking systems is explained, highlighting its potential for improved efficiency and control.

Solar Tracking Systems: Solar tracking systems are mechanisms that orient solar panels, mirrors, or other solar energy collection devices to follow the path of the sun throughout the day. By tracking the sun's movement, these systems maximize the amount of sunlight received by the panels, thus increasing energy output. There are different types of solar tracking systems, including single-axis and dual-axis trackers, each offering varying levels of efficiency and complexity.

Internet of Things (IoT) and Solar Energy: The Internet of Things (IoT) refers to the network of physical objects embedded with sensors, software, and other technologies that enable them to connect and exchange data with other devices and systems over the internet.Solar energy is power derived from the sun's radiation. It's harnessed using various technologies like solar panels, which convert sunlight into electricity. Solar energy is renewable, sustainable, and environmentally friendly, making it an increasingly popular alternative to traditional fossil fuels for generating electricity. Integrating IoT into solar energy systems allows for better monitoring, management, and optimization of solar power generation and distribution.

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Dual-Axis Solar Tracker System: This section focuses specifically on dual-axis solar tracker systems. It provides an overview of the mechanical and electrical components involved, such as sensors, motors, controllers, and communication modules. Existing research studies and projects implementing dual-axis solar trackers are reviewed, highlighting their design considerations, control algorithms, and performance evaluations.

IoT Integration in Dual-Axis Solar Trackers: Integrating IoT into a dual-axis solar tracking system can enhance its efficiency and control. With IoT, you can remotely monitor and manage the system's performance, adjust tracking angles based on real-time weather conditions, and receive alerts for maintenance or malfunctions. Additionally, data collected through IoT sensors can be analyzed to optimize energy production and predict maintenance needs, improving overall system reliability and output.

II. LITERATURE REVIEWS

Light is converted into power by solar panels. They are named after the sun or "Sol" since it is the most powerful source of light. available for usage. They are also referred to as photovoltaic, which meaning "light-electricity" in some cases. Solar cells, often known as PV cells, employ the photovoltaic effect to absorb solar energy and induce current to flow between two oppositely charged layers.

A solar panel is made up of solar (cells Silicon is, by far, the most common semiconductor material used in solar cells). Although each solar cell produces a modest quantity of electricity, a huge number of solar cells dispersed across a big area can provide enough power to be helpful. Solar panels must be oriented directly at the Sun to produce the greatest electricity. The evolution of solar cell technology starts with 1839 research of French physicist Antoine-Cesar Becquerel. While testing with a solid electrode in an electrolyte solution, he noticed the photovoltaic effect. When light landed on the electrode, he noticed a voltage grow. According to Encyclopaedia Britannica, Charles Fritts created the first true solar panel about 1883. He created junctions by covering selenium (a semiconductor) with a very thin layer of gold.

Flowchart:

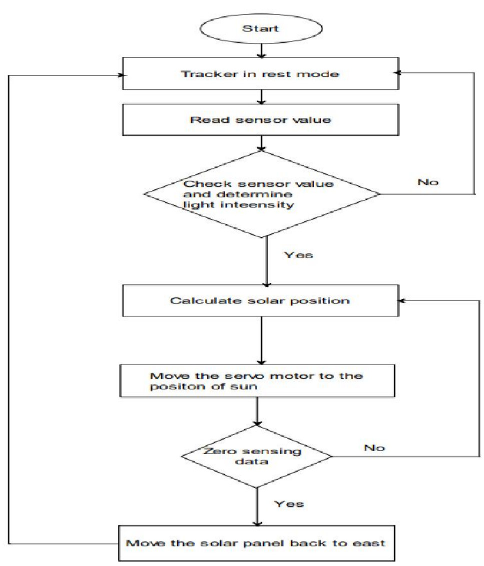

Fig 1:- Working flowchart

III. METHODOLOGY

The methodology for a dual-axis rotating solar panel using IoT can be summarized as follows:

- Design and hardware selection: Determine the specifications and requirements of the solar panel system, including power output, panel size, and tracking accuracy. Select suitable solar panels, motors, sensors, and microcontrollers that can be integrated with IoT technology.

- Assembly and installation: Build the mechanical structure to support the solar panels and rotating mechanism. Install the sensors for tracking sunlight and the motors for panel movement. Ensure proper wiring connections between the components.
- IoT integration: Connect the microcontroller or IoT device to the internet, allowing it to communicate and receive commands remotely. Choose a suitable IoT platform or cloud service for data monitoring and control.
- Sun tracking algorithm: Develop or implement a sun tracking algorithm to calculate the optimal position for the solar panels based on the sun's position throughout the day. This algorithm can utilize data from the integrated sensors, such as light intensity.
- Data acquisition and analysis: Continuously collect data from the sensors, such assunlight intensity, panelposition, and power output. Analyze this datato monitor the performance of the solar panel system and identify any anomalies or inefficiencies.
- Remote control and monitoring: Implement a user interface, such as a mobile app or web portal, to enable remote control and monitoring of the solar panel system. Users should be able to adjust panel positions manually or automatically, monitor power generation, and receive notifications or alerts.
- Maintenance and optimization: Regularly inspect and maintain the mechanical components, sensors, and motors to ensure proper functioning. Continuously monitor the system's performance and analyze the data to identify opportunities for optimization and efficiency improvements.
- Safety considerations: Implement safety features to protect the system from extreme weather conditions, such as high winds or hail. Ensure that the rotating mechanism has appropriate limit switches or safety sensors to prevent damage or accidents.

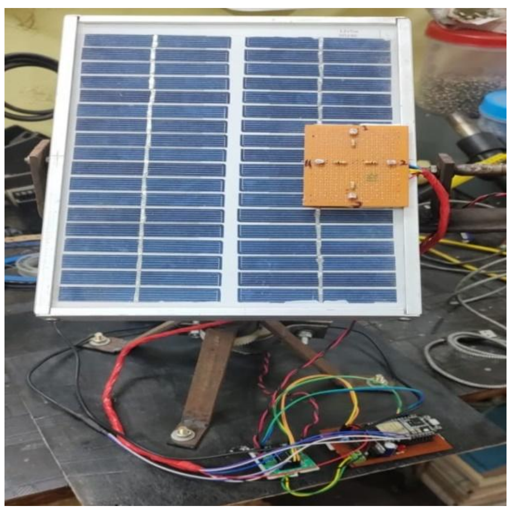

Fig 2:- Image of our developed module Dual Axis Solar Panel

IV. CONCLUSION

The literature review concludes by summarizing the key findings and insights gained from the existing research on dual-axis solar tracker systems using IoT. It emphasizes the potential of these systems for increasing energy production and efficiency in solar energy systems. Additionally, it identifies areas for further research and development to overcome the existing challenges and improve the performance of such systems.

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3. **IoT Platform Providers**: We would like to express our appreciation to the providers of the Internet of Things (IoT) platforms and technologies used in our project. Their robust and reliable platforms allowed us to efficiently monitor and control the solar tracker's movement and performance.

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