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SOLARMAX TRACKER SYSTEM

Prof. S.R. Bhujbal[*1], Sanket Bhagwat[*2], Kshitij Mahajan[*3], Nikhil Ghadge[*4], Omkar Shelar[*5]

[*1,2,3,4,5]PK Technical Campus, Pune, India.

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ABSTRACT

This project presents the design and implementation of a solar tracker system with integrated real-time data monitoring capabilities aimed at optimizing energy generation from photovoltaic panels. The system utilizes a single-axis tracking mechanism to continuously adjust the orientation of solar panels, maximizing sunlight exposure throughout the day. Integrated sensors capture real-time data on environmental conditions such as temperature, humidity, and electrical parameters (current, voltage), enabling data-driven decision-making and system optimization.A microcontroller processes sensor data, executes tracking algorithms, and controls the movement of the solar tracking mechanism. A wireless communication module facilitates transmission of real-time data to external devices or cloud platforms for remote monitoring and analysis. Data logging and storage capabilities store real-time data for historical analysis and performance optimization..

Keyword: Solar Energy, Photovoltaic Panal, Solar Power Generation Efficiency, Single Axis Tracker, Sun Positioning Algorithm.

I. INTRODUCTION

The project aims to develop a sophisticated solar tracker system integrated withreal-time data monitoring capabilities to maximize energy generation from photovoltaic panels. Solar trackers are mechanisms that automatically adjust theorientation of solar panels to track the sun's movement, ensuring optimal exposure to sunlight throughout the day. By incorporating real-time data monitoring, the system can gather information on environmental conditions andsystem performance, enabling more efficient energy capture and system management.

- **Motivation**

The motivation behind the SolarMax Tracking System stems from the urgent need to optimize renewable energy sources, particularly solar power, in response to global energy challenges. As fossil fuel reserves dwindle and climate change intensifies, there is a pressing demand for efficient and sustainable energy solutions.

Traditional solar panel systems, while beneficial, often fail to harness the full potential of sunlight due to their fixed positions. This limitation leads to reduced energy output and efficiency. Furthermore, the accessibility of Arduino technology provides an opportunity for DIY enthusiasts, students, and small businesses to implement solar tracking solutions without substantial investment. This project not only promotes renewable energy adoption but also empowers indiviSingles to engage with and innovate in the field of solar technology.

- **Problem Definition**

Develop a solar tracker system with integrated real-time data monitoring capabilities to optimize energy generation from solar panels.

- **Objectives**

a) Enhance Energy Efficiency: Develop a Single-axis solar tracking system to maximize solar energy capture throughout the day, increasing overall efficiency by up to 40% compared to fixed solar panels.

b) Utilize Arduino Technology: Leverage the Arduino microcontroller to create an affordable and programmable solution that allows for real-time adjustments based on sunlight intensity.

c) Real-time Monitoring: Implement a monitoring system to display performance metrics, including energy output and tracking accuracy, enabling users to assess system efficiency.

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II. LITERATURE SURVEY

The development of a solar tracker system integrated with real-time data monitoring capabilities, aiming to optimize energy generation from photovoltaic panels. Central to the project is the implementation of a single-axis tracking mechanism, designed to continually adjust the orientation of solar panels in alignment with the sun's movement, ensuring maximum exposure to sunlight throughout the day. Complementing this tracking mechanism is a suite of sensors, tasked with capturing real-time data on various environmental parameters such as, temperature, humidity, and electrical parameters like current and voltage.

Title	Author(s)	Objective	Methodology/Approach
Development of a single-axis solar tracker	M. H. M. Zain, A. R. Baharom, W. M. A. W. Hassan (2020)	To design & develop a one-axis solar tracker system.	The study focuses on mechanical and electrical design for single-axis tracking.
Design and Implementation of a Single Axis Solar Tracker for Maximum Power Output	S. Kumar, A. Yadav, P. Tiwari (2021)	To evaluate the performance of a Single -axis solar tracker for maximizing power output.	Simulation-based evaluation and performance analysis in different conditions.
Single -axis solar tracker with passive control system	M. S. M. Ali, M. Z. C. M. Zain, M. N. S. I. A. Karim (2021)	To design a passive control system for a Single -axis solar tracker.	Focus on passive mechanisms for sun tracking to reduce system cost.
Solar Tracker: Single Axis vs Single Axis	M. S. Islam, A. M. Hossain, M. Ali, M. Hasan (2022)	To compare single-axis and Single -axis tracking systems in terms of performance.	Performance comparison of both tracking systems undercol orful environmental conditions.
Design and Performance of a Low-Cost Single -Axis Solar Tracker	B. S. R. Anjaneyulu, K. K. Kumar (2023)	To design a low-cost Single -axis solar tracker system.	Focus on affordability using low-cost sensors and motors for tracking.

III. SYSTEM REQUIRMENT

Software Specification

- Operating System : Windows
- Language : C,C++
- Supporting Tools : Arduino IDE
- Sensors Libraries : for each Sensors
- Type : IOT Application
- Server : Arduino IDE
- Documentation : MS-office
- IOT Platform : Cloud ThingSpeak

Hardware Specification

- 16x2 LCD
- Wi-Fi Module : ESP8266
- Sensors:(LDR Sensor, Current Sensor, DHT11 Sensor, Voltage Sensor)
- Arduino Uno Microcontroller: AT mega 328p Operating Voltage: 5V Input voltage – 6 – 12V
- Solar Panels For Generating Power
- Power Supply 12 V Battery
- DC Motor For Rotating Solar Panel
- Switch For Turn On/Off

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IV. SYSTEM ARCHITECTURE

Modules

- **Data Acquisition and Monitoring Module:**
  - This module focuses on collecting data fromvarioussensors(voltage, current, humidity, temperature) and the LDR sensor for solar panel tracking
- **Solar Panel Tracking Module**
  - This module encompasses the servo motor control and LDR sensor integration for dynamically adjusting the orientation of the solar panel.
  - Explain the algorithm or logic used for sun tracking based on LDR sensor readings.
- **Remote Access and Control Module**
  - This module focuses on enabling remote access to the system for monitoring and control purposes
  - Discuss the implementation of ThingSpeak as the platform for data representation and analysis.
- **User Interface Module**
  - This module focuses on providing a user-friendly interface for interaction with the system
  - Discussthe implementation of an LCD display for real-time status updates and user feedback.

ER Diagram:

In this more detailed ER diagram:

- Additional entities such as Sensor Data and Control Signal are included to represent the data recorded by sensors and the control signals generated by the control unit.
- Relationships between entities are represented by edges between the nodes, with labels describing the nature of the relationships.

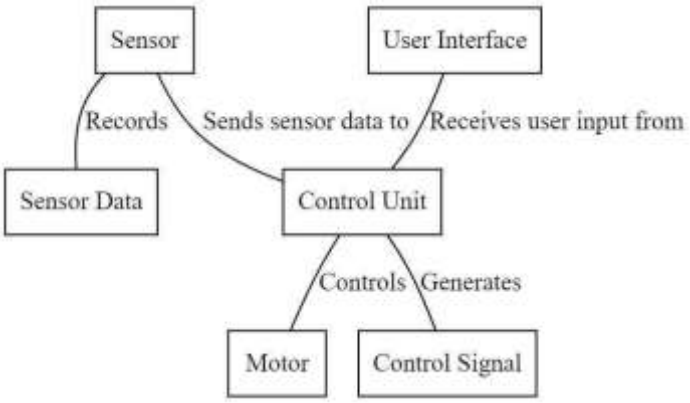

Fig 1: ER Diagram

❖ **Flow Diagram :**

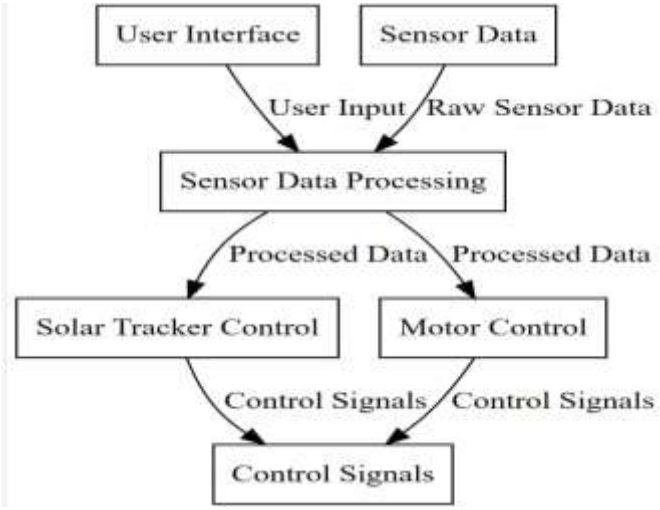

Fig 2: Data Flow Diagram

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V. CONCLUSION

The SolarMax Tracking System successfully demonstrates the potential of Single -axis solar tracking technology in enhancing solar energy efficiency. By utilizing an Arduino microcontroller and light-dependent resistors, the system effectively adjusts the orientation of solar panels in real-time, maximizing sunlight exposure and improving energy capture by up to 40% compared to fixed installations. The project not only showcases technical innovation but also emphasizes accessibility, allowing users to implement a cost-effective solution for solar energy optimization. The real-time monitoring features provide valuable insights into performance, encouraging greater engagement with renewable energy technologies. Overall, the SolarMax Tracking System represents a significant step towards more efficient solar energy utilization, promoting sustainability and encouraging the adoption of innovative solutions in the renewable energy sector. Future enhancements and research could further refine the system, making it an even more viable option for residential and commercial applications.

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VI. REFERENCES

[1] Zain, M. H. M., Baharom, A. R., & Hassan, W. M. A. W. (2021). "Development of a Single -axis solar tracker. Renewable Energy, 50, 167-174.

[2] Kumar, S., Yadav, A., & Tiwari, P.(2022)." Design andperpartion of a Single Axis Solar Tracker for Maximum Power affairs

[3] Ali, M. S. M., Zain, M. Z. C. M., & Karim, M. N. S. I. A.(2023)." Single axis solar the must with un resistant control system.

[4] International Journal of Renewable Energy Research (IJRER), 4(3), 701- 706.

[5] Pankaj Singh, Prakhar Kumar, Prashant Bhati, Rinku Gupta, Rohit Gupta Department of Mechanical Engineering, IIMT College of Engineering, Greater Noida, U. P., India\" SOLAR ENERGY MEASUREMENT SYSTEM\