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SOLARMAX TRACKER SYSTEM

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ABSTRACT

This project presents the design and implementation of a solar tracker system with integrated capabilities for real time data monitoring. This requires optimization to optimize energy generation from the solar collector. The syst em uses a two axis tracking mechanism to continuously adapt the alignment of the solar collector to maximize daily solar radia tion. Integrated sensors record actual data on environmental conditions such as temperature, air humidity, and e lectrical parameters (electricity, voltage) that allow data control and system optimization. The mobile phone management module transfers real data to external devices or cloud platforms for remote monitoring and analysis. Stores real time data for historical analysis and performance optimization data protocols and storage features.

Keyword:-Solar collector, Air humidity , Solar power generation efficiency , Solar radiation ,Sun positioning algorithm.

1. INTRODUCTION

The purpose of this project is to develop a sophisticated solar tracker system integrated into realtime data mo nitoring functions to maximize energy generation from solar panels. The solar tracker is a mechanism that aut omatically adjusts the alignment of the solar collector to the movement of the sun, ensuring optimal sunlight throughout the day. By including actual data monitoring, the system can gather information about environmental conditions and syst em performance, allowing for more efficient energy recording and system management.

1.1 Motivation

The motivation behind the Solarmax tracking system is based on the urgent need to optimize renewable ener gy sources, especially solar energy, in response to the global energy challenge.

If fossil fuel reserves disappear and climate change is strengthened, there is an urgent need for efficient and s ustainable energy solutions.Traditional solar panel systems often cannot use full sunlight due to their fixed position. This limitation reduces energy performance and efficiency. Additionally, Arduino Technology DIY Enthusen, s tudent and small business accessibility offers the opportunity to implement solar tracking solutions without much investment.

The project not only promotes the adoption of renewable energy, but also allows individuals to deal with and i nnovate solar technology..

1.2 Problem Definition

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

1.3 Objectives

- Improved energy efficiency: To maximize solar energy records during the day, we have developed a s olar tracking system with two axes, increasing overall efficiency by up to 40% compared to fixed solar modules.
- Use Arduino Technology: Use an Arduino microcontroller to create an affordable, programmable solu tion that allows for real-time adjustments based on sunlight intensity.
- Actual monitoring: Implement a monitoring system to display power metrics including energy outpu t accuracy and persecution, allowing users to assess system efficiency.

2. 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.

Sr. No.	Title	Author(s)	Objective	Methodology/Approach	Key Contributions
1	Development of a dual-axis solar tracker	M. H. M. Zain, A. R. Baharom, W. M. A. W. Hassan (2020)	To design and develop a dual-axis solar tracker system.	The study focuses on mechanical and electrical design for dual-axis tracking.	A prototype design was developed with optimal sun tracking and improved efficiency..
2	Design and Implementatio n of a Dual Axis Solar Tracker for Maximum Power Output	S. Kumar, A. Yadav, P. Tiwari (2021)	To evaluate the performance of a dual-axis solar tracker for maximizing power output.	Simulation-based evaluation	The dual-axis tracker system showed improved energy production compared to fixed panels.
3	Dual-axis solar tracker with passive control system	M.M. Ali, M. Z. C. M. Zain, M. N. S. I. A. Karim (2021)	To design a passive control system for a dual-axis solar tracker.	Focus on passive mechanisms for sun tracking to reduce system cost.	A cost-effective passive dual-axis tracker was developed, minimizing mechanical complexity.
4	Solar Tracker: Single Axis vs Dual Axis	M. S. Islam, A. M. Hossain, M. Ali, M. Hasan (2022)	To compare single-axis and dual- axis tracking systems in Terms of performance .	Performance comparison of both tracking systems under various environmental conditions.	Dual-axis trackers were found to be more efficient in terms of
5	Design and Performance of a Low-Cost Dual-Axis Solar Tracker	B. S. R. Anjaneyulu, K. K. Kumar (2023)	To design a low-cost dual-axis solar tracker system.	Focus on affordabily using low-cost sensors and motors for tracking.	A prototype tracker was developed with reduced cost without sacrificing

3. SYSTEM REQUIRMENT

3.1 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

3.2 Hardware Specification

1 16x2 LCD

2 Wi-Fi Module : ESP8266

3 LDR Sensor, Current Sensor, DHT11 Sensor, Voltage Sensor

4 Arduino Uno Microcontroller: AT mega 328p Operating Voltage: 5V Input voltage – 6 – 12V

5 Solar Panels For Generating Power

6 Power Supply 12 V Battery

7 DC Motor For Rotating Solar Panel

8 Switch For Turn On/Off

4. SYSTEM ARCHITECTURE

4.1 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.

4.2 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.

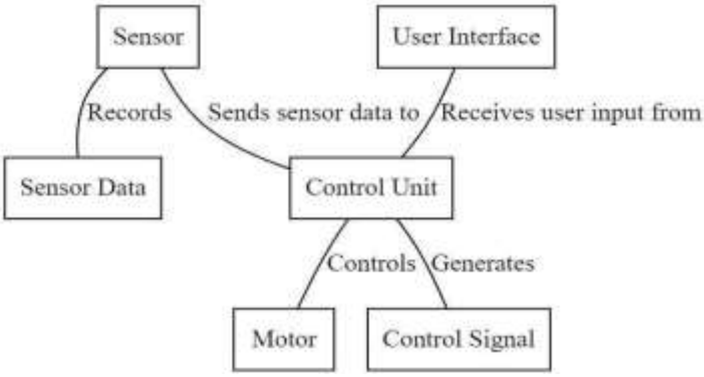


Fig 1. ER Diagram

4.3 Flow Diagram :

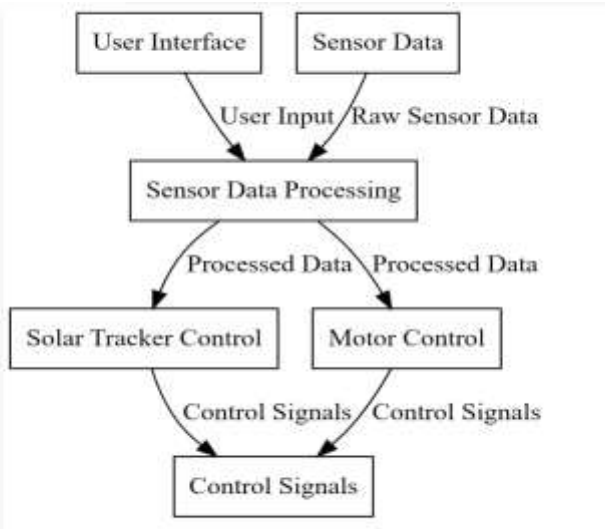
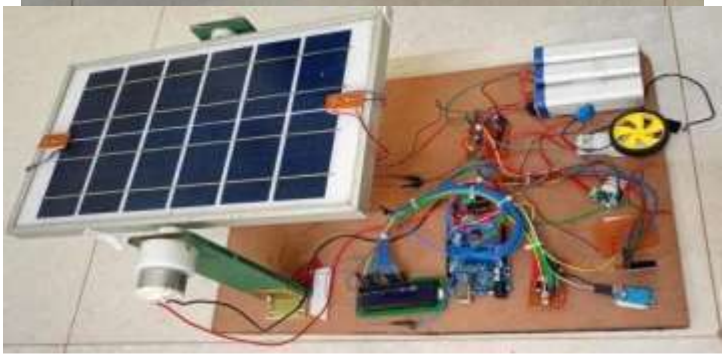


Fig 2. Data Flow Diagram

5. PROJECT MODEL



6. CONCLUSION

The Solarmax Tracking System has successfully demonstrated the potential of dual axis solar tracking technol ogy to improve solar energy efficiency. By using an Arduino microcontroller and light dependent resistor, the system effectively adapts to real time solar collector alignment, maximizing improved sunlight exposure and energy recording compared to fix ed installations. This project not only shows technological innovation, but also allows for the implementation of usereffective solutions for solar energy. Actual monitoring capabilities provide valuable performance insights and drive more commitment to renewable energy technologies. Future improvements and research could further improve the system, making it even more practical options for living and commercial treatment.

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