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A SYNOPSIS ON

“IoT BASED SUN TRACKING, SOLAR PANEL MONITORING & SOLAR POWER MANAGEMENT SYSTEM”

BACHELOR OF ENGINEERING

In

ELECTRONICS AND COMMUNICATION ENGINEERING

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INTRODUCTION

Solar energy is one of the most abundant and renewable sources of power available today. However, the efficiency of solar panels depends greatly on their alignment with the sun's position. Traditional fixed solar panels fail to capture maximum sunlight throughout the day, leading to reduced power output.

To overcome this limitation, an IoT-based sun tracking and monitoring system is introduced. This system uses Light Dependent Resistors (LDRs) to detect the direction of sunlight and servo motors to automatically adjust the panel's position for optimal energy absorption. The integration of IoT technology enables real-time monitoring of voltage, current, and power through cloud platforms such as ThingSpeak or Blynk, allowing users to track performance remotely.

This smart system not only enhances energy generation efficiency but also provides intelligent power management, fault detection, and data analysis, contributing to the advancement of sustainable energy solutions.

PROBLEM STATEMENT

Traditional fixed solar panels are unable to maintain an optimal angle toward the sun throughout the day, resulting in significant energy loss and reduced overall efficiency. Environmental conditions such as temperature, humidity, and light intensity also affect the output, yet these parameters are not continuously monitored in most existing systems. Additionally, users lack real-time information about the performance of their solar panels and the amount of power being generated or consumed.

To address these limitations, there is a need for an IoT-based intelligent sun-tracking solar panel monitoring and power management system that can automatically adjust the panel's orientation, collect environmental and electrical data, and provide real-time monitoring through IoT platforms. This system aims to enhance energy efficiency, improve power generation, and enable smart renewable energy management.

OBJECTIVES

- To design and implement an IoT-based dual-axis sun tracking system that automatically adjusts the solar panel position to capture maximum sunlight throughout the day.
- To monitor solar panel performance in real time by measuring parameters such as voltage, current, temperature, humidity, and light intensity.
- To enhance the overall efficiency of solar energy generation by reducing energy losses caused by the fixed positioning of panels.
- To integrate ESP8266 with cloud platforms (such as Thingspeak, Blynk, or MQTT) for remote data access, visualization, and system control.
- To ensure effective power management by tracking battery status, power production, and energy consumption.
- To create a reliable, low-cost, and user-friendly system suitable for homes, educational institutions, and small solar installations.
- To analyze collected data for understanding environmental influence on solar performance and improving future system designs.

LITERATURE SURVEY

TITLE	AUTHORS	PUBLICATIONS	ABOUT
IoT Based Solar Panel Tracking System with Weather Monitoring System	K.Dinesh , Lakshmi Priya.A , Sandhya. M	Recent Trends in Intensive Computing M.Rajeshet al.(Eds.) @ 2021 The authors and IOS Press.	This Created framework can be executed in several solar plant stations to measure the precise strength created from the ones devices
A Study of IoT Based Real-Time Solar Power Remote Monitoring System	Nazmul Hassan, Sakil Ahammed and Abu Zafor Md. Touhidul Islam	International Journal of Ambient Systems and Applications (IJASA)Vol.09,No.1/2June 2022	The system could collect instantaneous data from remote locations or far from the control center and monitor in real- time of the produced power
Sun Tracking Solar Panel Monitoring & Solar Power Management System	S.Sabitha, S.Mohanalakshmi	International Journal of Advanced Trends in Engineering and Management (IJATEM) March 2023	to optimize the solar panel's exposure to light and hence improve power efficiency, the Solar Panel Tracker is made to move with the sun

METHODOLOGY

The methodology describes the systematic procedure followed to design, develop, and implement the IoT-based sun tracking and solar power management system. The project is divided into several stages, including sensor integration, tracking mechanism design, IoT connectivity, data monitoring, and performance analysis.

System Analysis and Requirement Study

The project begins with identifying the limitations of fixed solar panels and the need for automation. Requirements such as LDR sensors for light detection, ESP8266 for IoT communication, servo motors for tracking, and monitoring sensors for environment and power parameters are finalized.

Design of the Sun Tracking Mechanism

A dual-axis tracking system is designed using two servo motors:

- Horizontal Axis (Azimuth Rotation)
- Vertical Axis (Elevation Rotation)

LDR sensors are placed in a cross-like arrangement to detect the intensity of sunlight in different directions. The difference in their readings helps determine the required angle of the solar panel.

Hardware Integration

- All electronic components are connected according to the system circuit design:
- LDR Sensors measure light intensity.
- DHT11 Sensor measures temperature and humidity.
- Voltage/Current Sensor records electrical output of the panel.
- ESP8266 Module serves as the microcontroller and Wi-Fi module.
- Servo Motors adjust the solar panel orientation.
- Battery & Charge Controller store and regulate the generated power.

The microcontroller processes sensor data and drives the servo motors accordingly.

Development of Control Algorithm

A program is developed using embedded C/Arduino IDE to perform:

- Reading of sensor values.
- Comparing LDR intensities to decide best angle.
- Rotating the servo motors to align the panel with maximum sunlight.
- Collecting environmental and electrical data periodically.
- Sending data to a cloud server through Wi-Fi.

The algorithm ensures continuous tracking and real-time monitoring.

IoT Platform Configuration

A cloud platform (such as ThingSpeak, Blynk, or Firebase) is configured to store, visualize, and analyze real-time data.

The ESP8266 uploads:

- Light intensity
- Voltage
- Temperature & humidity
- Panel orientation
- Power output

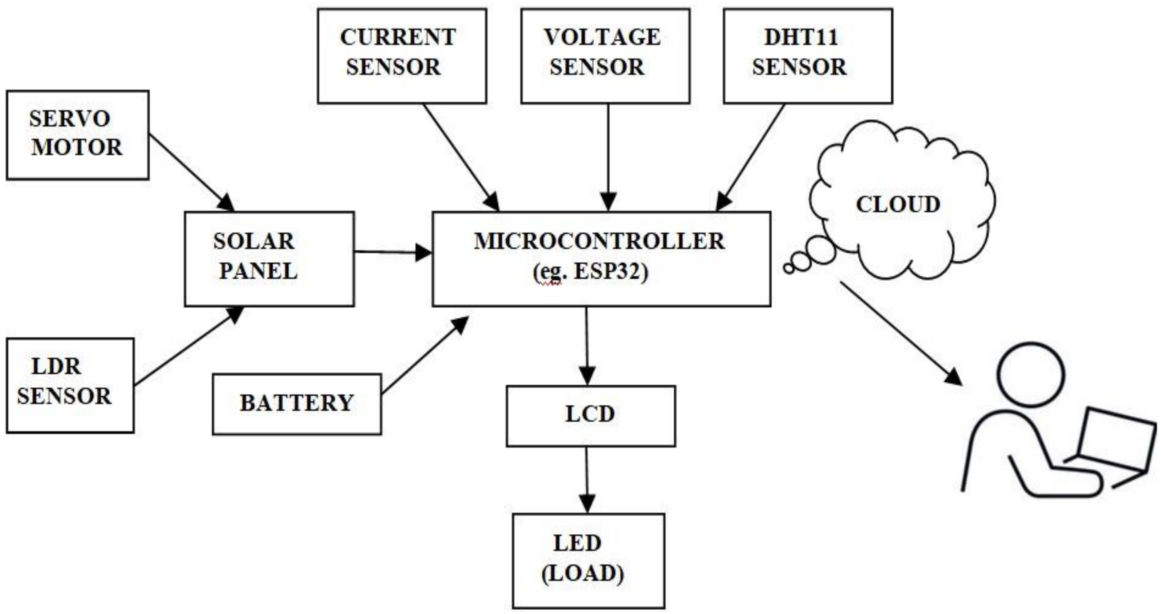
Dashboard charts, widgets, and gauges are used for easy monitoring.

Final Implementation

The final system runs continuously, tracking sunlight throughout the day and uploading real-time data.

The methodology successfully integrates mechanical, electronic, and IoT technologies into a functional renewable-energy solution.

BLOCK DIAGRAM



COMPONENTS REQUIRED FOR THE PROPOSED PROJECT

- Solar Panel
- Microcontroller
- LDR Sensor
- Current Sensor
- Voltage Sensor
- LCD
- Servo Motor
- DHT 11
- LED

REFERENCE

- Johnson, etal,"Real-Time Monitoring and Control of Solar Tracking Systems via Thing Speak Platform, "in Proc. IEEE International Conference on Renewable Energy Systems (ICRES), July2022, pp.45- 52. Barcelona, Spain,
- S. Gupta, "Implementation of IoT-Based Battery Monitoring with ESP8266 on Thing Speak Platform," Journal of Energy Management, vol. 5, no. 2, pp. 78-85, May 2023.
- R. Patel, et al., "Wireless Monitoring and Optimization of Solar Panel Angles Using ESP8266 Modules on Thing Speak," in Proc. IEEE International Conference on Industrial Electronics (ICIE), Shanghai, China, Sept. 2022, pp. 210-217.
- K. Kumar, et al., "Implementation of Solar Tracking System Using Arduino and ESP8266 on Thing Speak Platform," Renewable Energy Journal, vol. 15, no. 3, pp. 201-215, Aug. 2023.
- J. Lee, "Remote Monitoring of Solar Panel Performance with IoT Battery Management on Thing Speak," Journal of Sustainable Energy Engineering, vol. 8, no. 1, pp. 45-52, Jan. 2024.
- M. Patel, "Design and Implementation of Solar Tracking System with IoT-Based Battery Monitoring on Thing Speak," Sustainable Energy Technology Review, vol. 7, no. 2, pp. 110-125, March 2023.
- C. Gupta, et al., "Remote Monitoring and Control of Solar Tracking Systems Integrated with ESP8266-Based IoT Battery Management on Thing Speak," Journal of Energy Engineering, vol. 7, no. 4, pp. 210-225, July 2023.
- D. Sharma, "Design and Implementation of Solar Tracking System with ESP8266-Based Battery Monitoring on Thing Speak Platform," Sustainable Energy Technology Review, vol. 6, no. 3, pp. 150-165, Sept. 2023.