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IOT Based Dual Axis Solar Module Tracking Using Cloud Computing

Prof.G.B.Murade[1], Shelke Om[2], Ashish Pujari[3],Saurabh Kharde[4]
[1]Assistant Professor, [2, 3, 4]Research scholar Department of Electrical Engineering Dr. vithalrao Vikhe Patil College of Engineering, Ahmednagar

Abstract: We require various kind of energy to survive. Solar energy, which leaves no waste or harmful residue behind, is one of the cleanest and most sustainable energy sources. To exercise it easily, solar photovoltaic (PV) panels can be employed. The bulk of solar panels, it has been observed, are installed at set angles. In order to capture as much incident solar energy as possible and improve the system's performance ratio, the solar tracking device is employed to maintain the solar panel pointed towards the sun throughout the day. Consequently, this research investigates a dual axis sun tracking system from a two-dimensional perspective. carried out to plot a trajectory of where we are on the efficiency map, it was discovered that the current 35–43% effectiveness of two axis tracking arrangement. Second, a general functional model of how an efficient and effective is derived from the review above. Solar panels, two DC motors, an LDR sensor module, a temperature sensor, a humidity sensor, and an electrical circuit typically make up the hardware portion.
Keywords: Arduino UNO; Boost Converter, Buck Converter, Current Sensor, Shaft Bearing Photovoltaic (PV) panel; Solar Tracking System; Temperature Sensor; Omni phobic material; IOT;

I. INTRODUCTION

Due to their abundance and environmental friendliness, the use of renewable energy resources in the production of electricity has expanded. These resources serve as substitutes for fossil fuels, whose availability is continuously diminishing. Solar energy is the most important renewable resource due to its vast availability. Due of this, there is currently a lot of research being done on solar energy sources, particularly photovoltaic (PV) systems. Using semiconductors, photovoltaic systems transform solar energy into electrical energy. Despite the fact that solar energy is frequently associated with low conversion rates, years of testing and research have improved the PV system's conversion output. New solar cell technologies have been created. Additionally, solar tracking systems have become more advanced and popular than traditional fixed PV systems.

II. LITERATURE REVIEW

First solar tracker was a mechanical system by C. Finster, invented in 1962. Though the Finster solar tracker realized insignificant energy gains, years of testing and research have led to improvement of the conversion output of the PV system and consequently the emergency of different tracking technologies and applications (e.g. concentrator and non-concentrator). In short, improved solar cells have been developed and the use of solar tracking system over the use of conventional fixed PV system has grown. In fixed photovoltaic system the solar receiver (PV module) is in a stationary position facing the true north. However, with mechanical or electro-mechanical systems, the orientation of the collector changes continually in reference to the azimuthal directions (east-west) and also in its elevation. This is dependent on the tracker's geometrical capacity.

A. Research Methodology

The concept describes a novel IoT-based solar power monitoring system with cloud computing. In this system, solar panels with solar cells put inside them, which convert sunlight into energy, are used. Our fleet contains an Arduino. Current voltage characteristics are tracked using sensors. The values of the current and voltage are same and stored in cloud.

B. Problem Statement

The existing solar module tracking systems are limited in their capabilities due to the constraints of on-site computing resources. The lack of computational power hinders real-time and efficient tracking of solar modules, resulting in suboptimal energy generation and reduced overall system performance.

To address this issue, the problem at hand is to develop a solar module tracking solution that leverages the power of cloud computing. The goal is to design a system that utilizes cloud-based resources to enable accurate and timely tracking of solar modules, optimizing their positioning to maximize energy generation and overall system efficiency.

Specifically, the challenges to overcome include

1) *Scalability:* Current tracking systems are constrained by the limited computational capacity of on-site hardware, limiting the number of solar modules that can be effectively tracked. The solution should leverage cloud computing to scale the system.
2) *Real-time Data Processing:* Efficient solar module tracking requires processing a large volume of data, including inputs from multiple sensors, weather conditions, and historical performance. The solution should employ cloud computing techniques to process this data in real-time, ensuring timely adjustments to the position of solar modules based on accurate information.
3) *Communication and Synchronization:* The cloud-based tracking system needs to establish seamless communication and synchronization between the cloud infrastructure and the on-site solar module tracking hardware. This includes reliable data transmission, efficient command execution, and real-time feedback mechanisms to ensure smooth coordination and precise module positioning.

III. RESULTS FROM OUTDOOR EXPERIMENT

The implementation of an IoT-based solar module tracking system using cloud computing can yield several outdoor results, enhancing the performance and efficiency of solar installations. Some of the key outcomes include:

1) *Improved Energy Generation:* By dynamically adjusting the position of solar modules based on real-time data and predictive analytics, the system can optimize the capture of solar irradiation.
2) *Enhanced Tracking Accuracy:* The integration of IoT sensors and cloud-based computation enables precise tracking of solar modules. Real-time data from on-site sensors, such as light intensity, temperature, and module orientation, is continuously processed in the cloud. This ensures accurate positioning of the modules, minimizing misalignments and maximizing solar exposure.
3) *Data-Driven Insights and Reporting:* With the IoT sensors and cloud-based architecture, the system collects and analyzes a vast amount of data related to solar module performance, environmental conditions, and energy generation. This wealth of data can be leveraged to gain valuable insights into the system's operation and performance. By utilizing data analytics tools and visualization techniques, operators can monitor key performance indicators, detect patterns, and identify areas for further optimization.
4) *Adaptive Response to Environmental Changes:* The cloud-based system leverages the power of predictive analytics to anticipate changes in weather conditions and solar irradiation. By analyzing historical data and weather patterns, the system can proactively adjust the position of solar modules in advance. This adaptive response ensures that the modules are optimally aligned, even in the presence of cloud cover, shading, or other environmental factors. As a result, the system maintains consistent energy generation and minimizes performance fluctuations.

IV. CONCLUSION

A conclusion, the dual axis solar tracker has been developed successfully. The monitoring system is equipped with ESP8266 WIFI module in order to transfer the data from solar panel to IOT monitoring system. The system can work in one condition which is the dual axis solar tracker must work within the WIFI coverage so that the user can attach the system with ESP8266 WIFI module and access the solar panel parameter via IOT monitoring System. The other success part is to develop the solar tracker to have two angle. There are 2 movements in this solar tracker that can be classifies as horizontal and vertical. Both of the movements are used two servo motor 180-degree angle.In order to determine the functionality of the system, an experiment done to determine either the sensor will operate properly when the tracker is testing in outdoor. The outputs in storage of IOT system can improve in the future by improve or change the platform. Lastly, the solar tracker can have made a game changer to our world and it safe more to use because it does not have any pollution Two 180-degree servo motors are employed in both movements. An experiment was conducted to see if the sensor would perform effectively when the tracker was tested outdoors in order to establish the system's functionality. Future platform updates or changes may lead to an improvement in the outputs stored by IOT systems. Last but not least, the solar tracker has the potential to change the course of history and is safer to use because it is pollution-free.

V. PROCESS OF DUAL AXIS SOLAR TRACKER

Dual-axis solar tracker process: This project used the internet of things to track the functioning of the solar tracker system. This project is divided into two parts: first, the creation of the software, and then, the development of the hardware. The system block diagram is displayed in Figure 1. The system begins with sensors that detect the position of the sun and relay that information to an Arduino[8].

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The 180-degree servo motor holding the photovoltaic is then ordered to move towards the sun by the Arduino after processing the information from the sensor. The photovoltaic system then collects solar energy, charges the battery, and communicates a value to the Arduino. Last but not least, the Arduino will transmit the data collected by the solar module to the Wifi module.as illustrated in Figure 1, and send to the IOT monitoring system for records. Every three seconds, the IOT monitoring system will refresh its data.

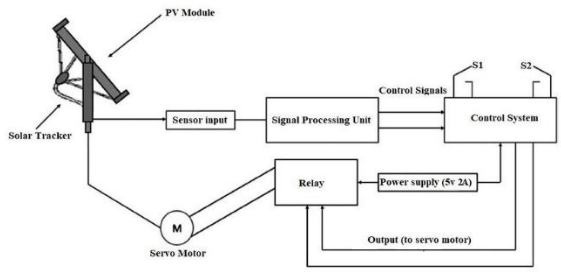

Fig: dual axis solar panel

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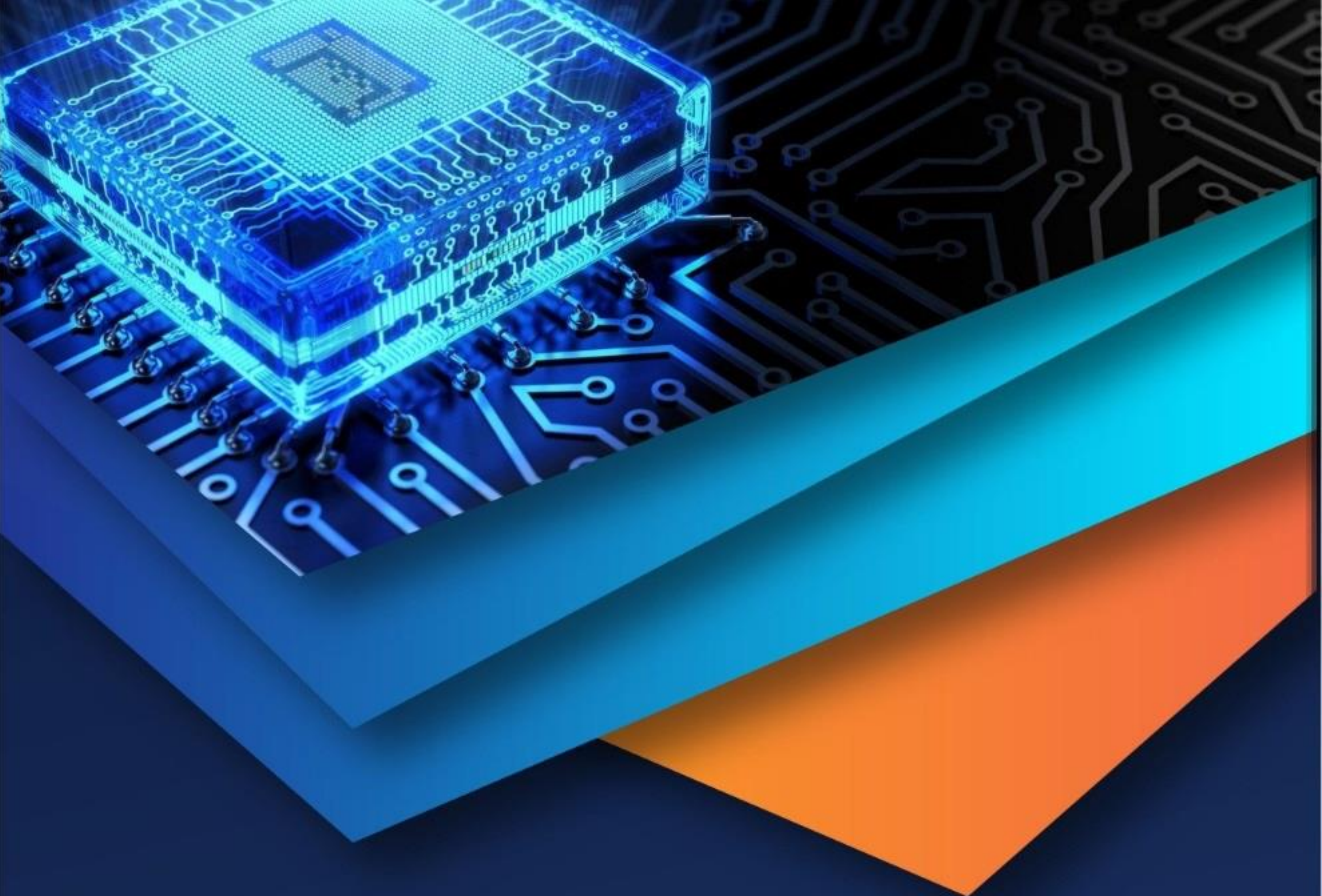

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