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Design and Development for IoT Founded Twin Axis Cosmological Tracker with Power Monitoring Structure

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ABSTRACT: The main objective of this paper is to create a very accurate solar tracker and communicate the data via IoT. The main and secondary steps of sensing the sun's location were used in this project. The first step, or indirect sensing, uses the sun-earth connection to make a crude correction, while the second stage, or direct sensing, uses a series of LDR sensors to trim the azimuth and altitude angles. When the weather is overcast or dusty, the tracking system solely employs primary stage or sun-earth geometrical connections to determine the location of the sun; as a result, the system follows the sun's position regardless of the weather. Solar irradiance determines how much energy is collected from photovoltaic (PV) panels or any other solar collector. The solar collector panel should always be normal to the incident radiation for optimal energy extraction from the sun. Solar trackers move the solar collector to follow the sun's course and maintain the solar collector's tilt angle at an ideal level. The energy efficiency of photovoltaic (PV) panels is greatly improved by using a solar tracking system. There are two elements to the paper: hardware and software. Solar panel, two DC motors, LDR sensor module, temperature sensor, humidity sensor, and electronic circuit make up the hardware portion. The software portion describes the system's cognitive behaviour, or how it behaves under various weather circumstances. An automated solar tracking system employing Light Dependent Resistor (LDR) and DC motors on a mechanical structure with gear arrangement is proposed and developed in this article. Based on Sun Earth Geometry, it is built using an Arduino UNO controller. According to the findings, an automated solar tracking system is more dependable and efficient than a stationary one.

KEYWORDS: Arduino UNO, LDR, Photovoltaic (PV) panel, Solar Tracking System, Humidity Sensor, Temperature Sensor, Omni phobic material, IOT.

I. INTRODUCTION

Climate change has reached a tipping point throughout the world. There are two types of reasons for climate change: human and natural. Ocean currents, solar fluctuations, and earth orbital shifts are all natural drivers of climate change. Human-induced climate change is mostly caused by man-made greenhouse gases. Some natural phenomena, such as the influence on crops and extreme weather conditions throughout the world, might be viewed as evidence of global warming or climate change. Renewable energy is energy that is derived from renewable natural resources such as sunshine, wind, rain, tides, and geothermal heat (naturally replenished). Renewable energy is the world's fastest-growing energy source. Renewable energy is energy that does not deplete the earth's finite resources and can be readily and rapidly supplied. Renewable energy plays an important part in a country's energy demands since it allows companies to collect energy cost investments as well as revenue, allowing them to limit the effects of climate change [20]. For a long time in Malaysia, oil and coal have been the major sources of electrical energy. Knowing that the use

of oil and coal as primary sources of electrical energy would be decreased, the government began a campaign to promote the use of alternative renewable energy sources such as solar and hydro. Residential energy consumption in Malaysia accounted for more than 14,365 GWh, or 19% of total power consumed in Peninsular Malaysia in 2006.

The need for power has been steadily growing over the years, and solar energy offers a viable solution to these issues. The energy derived from the sun in the form of solar radiation is known as solar energy. The sun is the world's most limitless and renewable energy source. All living things benefit from solar energy, which gives light, heat, and energy.

The solar energy has no cost and produces no pollution. It is also ecologically benign and has an infinite supply. The solar tracker's advances are used in this project since Malaysia's environment is classified as equatorial, meaning it is hot and humid all year. When it comes to solar energy, it is important to note that it has several benefits and disadvantages when compared to other energy sources. The primary difficulty with using solar energy is not a lack of alternative energy sources; rather, it is a question of environmental concern, as certain traditional energy sources emit large amounts of pollution into the environment [11].

II. SOLAR TRACKER

The direct beam, which carries approximately 90% of the solar energy, and the diffuse sunlight, which transports the rest, are the two components of sunshine. On a clear day, the diffuse portion is the blue sky, which rises proportionally on overcast days. Because the bulk of the energy is collected in the direct beam, the sun must be visible to the panels for as long as feasible to maximise collection. Only 30 to 40% of incoming solar irradiation is converted into electrical energy by a conventional solar panel. The two types of that are most commonly utilised are: (a). Solar tracker on a single axis. A single axis sun tracker can spin from east to west and has only one degree of freedom. This tracker only analyses the sun's daily movement in relation to the earth's position as shown figure 1. To accomplish a single degree of freedom, a single DC motor is used. Single axis solar trackers are less efficient than other trackers, despite their low cost and ease of construction.

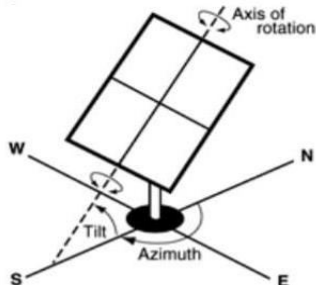


Fig.1 One axis tracking PV array with axis oriented south

(b) Tracker with two axes the dual axis tracker has two degrees of freedom and takes into account both the daily movement of the sun (from east to west) and the annual movement of the sun (North South) as shown figure 2. To accomplish two degrees of freedom, it usually comprises of two DC motors. The construction of this tracker is tough; however, the increased efficiency outweighs the difficulties in design.

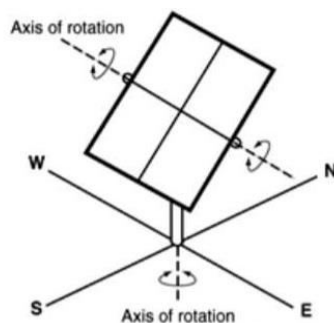


Fig 2. Two -axis tracking PV array



III. LITERATURE SURVEY

Working in various weather situations necessitates the employment of several methods, one of which has a tracking error of 0.15, allowing for excellent tracking accuracy for solar systems. [1] When compared to a single axis solar system, one of the advantages of a dual axis solar tracker is that solar energy may be gathered more successfully at adverse sites and weather conditions. [2].

When comparing a fixed PV system to an automated two-axis solar tracker, the average improvement in maximum power and efficiency attained with a two-axis PV tracking system is 5.0423 W per hour and 28.87 percent, respectively. [3] A paper detailed the design and execution of data recording in an automated solar tracker for saving data such as solar radiation, voltage, and temperature on board.

Construction of a solar tracker using a direct and indirect sensor method to function under various situations. Research that demonstrates how to build a basic solar tracker with a dual axis solar tracking device and a 555 timer. Including a back sensor circuit to assist in adjusting the solar panels for the following sunrise [18]. A solar tracking system with a combination of open loop and closed loop tracking techniques based on solar movement models and a dynamic feedback controller was described [13].

It takes a holistic approach to solar PV capacity development, addressing other domains such as economic growth and gender equality, which might have an influence on solar PV lighting capacity. By imparting information, educating, and employing rural residents. [14]

IV. PROBLEM STATEMENT AND OBJECTIVE

As the price of fossil fuels fluctuates; renewable energy is fast gaining relevance as a source of energy. It is consequently important for engineering and technology students to grasp and appreciate the technologies involved with renewable energy at the educational level. Solar energy is one of the most widely used renewable energy sources. Many studies have been carried out in order to discover strategies for improving the efficiency of photovoltaic systems (solar panels). One A solar panel tracking system is one such approach.

This system is a solar panel tracking system based on RTCs. Because the solar panel is constantly able to maintain a perpendicular profile to the sun's rays, solar tracking allows for more energy to be created. Solar panel tracking systems have been in development for some years. Because the sun travels across the sky during the day, it is beneficial to have the solar panels follow its location so that they are constantly perpendicular to the solar energy emitted by the sun. PV systems will be able to absorb more electricity as a result of this. It has been predicted that using a tracking system instead of a fixed system can boost power production by 30% to 60%. Despite the higher system cost, the gain is large enough to make tracking a realistic option. Using electrical control and a micro controller, the tracking heliostat may be aligned normal to the sun.

When the sun is visible, the system must track the sun's location in the sky. It Active control is required, and timed motions are beneficial. It should be completely automated and easy to use. The operator interference should be minimised. It should be kept to a bare minimum and used only when absolutely necessary. The following are the key components of this system. 1) Solar Panel 2) LDR'S 3) Servo motors. 4) Temperature & Humidity sensor 5) Photovoltaic cells 6) Current sensor 7) Voltage Sensor 8) ESP8266 Wi-Fi Module 9) Omni phobic Material. The proposed system's goal is to create a dual-axis solar tracking system that can follow the sun more efficiently in every weather condition than existing systems, with lower maintenance costs and higher power generating capacity.

V. PROPOSED SYSTEMS

We Solar power facilities must be closely monitored to ensure that they produce the maximum amount of energy. This aids in the recovery of efficient power production from power plants, as well as the detection of defective solar panels, connections, dust accumulation on panels decreasing output, and other issues impacting solar performance. So, in this paper, we present an IoT-based automated solar power monitoring system that enables for automatic solar power monitoring from anywhere on the internet.

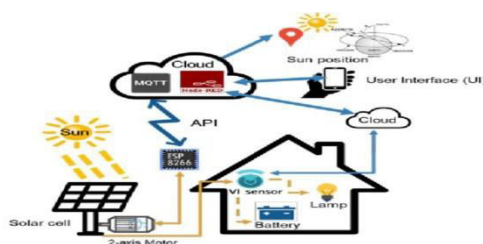


Fig 3. Monitoring system

It uses of solar panel monitoring system based on Arduino. Our technology continuously checks the solar panel's output and sends data over the internet to the IOT system. We're using IOT to send solar power parameters to IOT via the internet as shown figure 3. It now uses an effective GUI to present these parameters to the user, as well as alerting them when the output goes below certain thresholds.

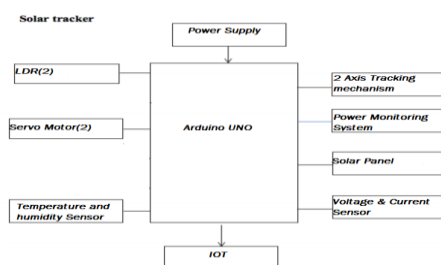


Fig 4. Solar tracking system.

This allows for convenient remote monitoring of solar plants and ensures the highest possible power output. It's included weather forecast, online data display, temperature and humidity, and other features in our model. We can observe all sorts of data on our mobile application since they are connected with a Wi-Fi module. A coating of omniphobic material will be put to the solar panels to protect them from damage in dusty and windy situations, reducing maintenance costs and time. Finally, the research's goal is to create and deploy a hybrid dual-axis solar tracking system that uses less motor power while tracking correctly as shown figure 4. The microprocessor compares the light intensity and provides appropriate control signals to drive the motors in the right direction.

VI. TRACKER COMPONENTS

Sun tracking algorithm is sun's azimuth and zenith angles are calculated using this technique. The solar panel or reflector is then positioned to face the sun using these angles. Some methods are entirely mathematical and based on astronomical references, while others make use of real-time light-intensity measurements. The control unit is in charge of executing the sun tracking algorithm and coordinating the positioning system's movement. The positioning system adjusts the angle of the panel or reflector to face the sun. There are both electrical and hydraulic positioning systems. To monitor the present position of the panel and move it to desired locations, electrical systems use encoders, variable frequency motors, or linear actuators.

VII. CONCLUSIONS

Solar tracking devices let solar power plants gain more energy. In general, the automatic solar tracking system achieves the maximum energy gain in any location. As a result, it is the most adaptable system since it can be put anywhere and yet provide a significant energy gain. From an energetic standpoint, solar trackers are suggested everywhere since they always enhance the quantity of energy gathered. It is possible to have two degrees of freedom in terms of orientation. The Arduino Uno controller is used to regulate the position of DC motors, ensuring that the DC geared motors produce point to point intermittent motion. Functioning through your own and being able to interact wirelessly. The system is dependable and visible since it can function independently and communicate wirelessly using a computer or a mobile device. The inclusion of LDR sensors as well as high-precision voltage and current sensors ensures that the tracking system is more precise and efficient. It now gives the user access to the sensor parameters through the internet. When



sensor parameters exceed certain limitations, the user is notified via an effective application. This allows for convenient remote monitoring of solar plants and ensures the highest possible power output.

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