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DUAL AXIS SOLAR TRACKING SYSTEM

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Abstract: In general, solar trackers are either single-axis or dual-axis. The former follows the sun from east to west or north to south, whereas the latter does both. Dual-axis trackers capture solar energy from East, West, North, and South. Their axes are 'primary' and 'secondary'. One axis moves the solar tracker East-West, and the other North-South. They are called 'dual-axis' solar trackers. An sophisticated dual-axis tracker has benefits. If you want to acquire a dual-axis solar tracking system, the following perks will assist. Check it out!
These trackers are great since they travel in all directions and monitor the Sun for longer hours and more energy. They don't wait for sunlight on the panels. Instead, the panels track the Sun all day. A dual-axis solar tracker requires little space. It adapts to small spaces. Dual axis solar tracking technology gives extra energy to compensate for grid power shortages. These solar trackers generate 40% more energy than static ones. These trackers are suitable for uneven terrain or stone protrusions when sun energy is scarce. The dual-axis solar tracker's initial investment will pay off. The electricity it generates will break even this device's hefty investment cost much faster.

I. INTRODUCTION

Researchers, technologists, investors, and people in charge of making decisions all over the globe are becoming more interested in various forms of renewable energy as a result of the impending and inevitable depletion of supplies of fossil fuels. The use of hydroelectricity, bioenergy, solar, wind, and geothermal energy, as well as tidal power and wave power, are examples of emerging forms of energy that are gaining prominence. Because of the ease with which they may be replenished, they are being evaluated as viable alternatives to supplies of fossil fuel. Solar photovoltaic (PV) energy is one of the resources that is readily accessible among these many kinds of energy. As a result of ongoing research and development efforts to boost the efficiency of solar cells and bring down their prices, this technology is currently being used in residential settings to a greater extent than ever before. Since the beginning of the 2000s, the total PV capacity around the globe has increased at an average rate of 49% annually, as reported by the International Energy Agency (IEA). It is quite likely that photovoltaic (PV) solar energy will emerge in the future as a significant contributor to the generation of electricity.

Nevertheless, solar photovoltaic (PV) energy still has a long way to go before it can fully replace more conventional forms of energy on the market. In regions that do not get a significant quantity of solar radiation, it is still difficult to optimize the power output of photovoltaic (PV) systems. It is still necessary for manufacturers to develop more cutting-edge technologies in order to boost the performance of PV materials, but it is possible to boost the efficiency of solar PV power by improving system design and module construction. This would make solar PV power a more dependable option for consumers. This effort had been carried out to help the development of such a potentially fruitful piece of technology with the intention of achieving that goal.

Maximizing the amount of time spent in the sun is one of the primary strategies that may be used to achieve greater levels of productivity. This is made possible with the assistance of tracking devices, which ensure that photovoltaic solar panels are always oriented in the optimal direction relative to the sun's beams. The construction of a prototype of a light tracking system at a smaller size is the objective of this project; nevertheless, the concept may be used for the implementation of any solar energy system. In addition to that, a quantitative evaluation of how well a tracking system operates in comparison to a system with a fixed mounting technique is anticipated from this study.

II. LITERATURE SURVEY

On a solar assist plug-in hybrid electric tractor (SAPHT), Hossein Mousazadeh and colleagues explored and investigated ways to maximize the amount of energy received from an on-board PV array. Their findings were published in the Journal of Solar Energy Engineering in 2011. A sun-tracking system that was built on a movable frame and put through its paces by using four light-dependent resistive sensors was recently examined. In the scientific experiments employing the sun-tracking system, it was discovered that around thirty percent more energy was gathered in contrast to the mode in which it was collected in a horizontally fixed position. In order to detect the direct rays of the sun, four LDR sensors were used. Every LDR pair was kept apart by a physical obstacle that served as a shade mechanism. An electronic drive board that was controlled by a microcontroller was used in order to act as an interface between the program and the hardware. A power MOSFET was used in order to regulate the actuators and drive each motor individually. The findings of the experiments demonstrated that the system that had been created was both reliable and efficient.

According to K.S. Madhu et al., (2012) International Journal of Scientific & Engineering Research vol. 3, 2229–5518, a single-axis tracker follows the sun from east to west, whereas a two-axis tracker follows the daily movement of the sun from east to west as well as the seasonal movement of the sun's declination. Concentrated solar power systems do this by using lenses or mirrors and tracking devices to concentrate the sunlight from a wide region into a narrow beam. The photoelectric effect is used by PV in order to transform light into electric current. The transformation of sunshine into usable energy is the process known as solar power. According to the findings of the tests, the power efficiency of tracking solar plates increases by between 26 and 38% compared to those of stationary solar plates on typical days. In addition, it fluctuates greatly from day to day when there is cloud cover or precipitation.

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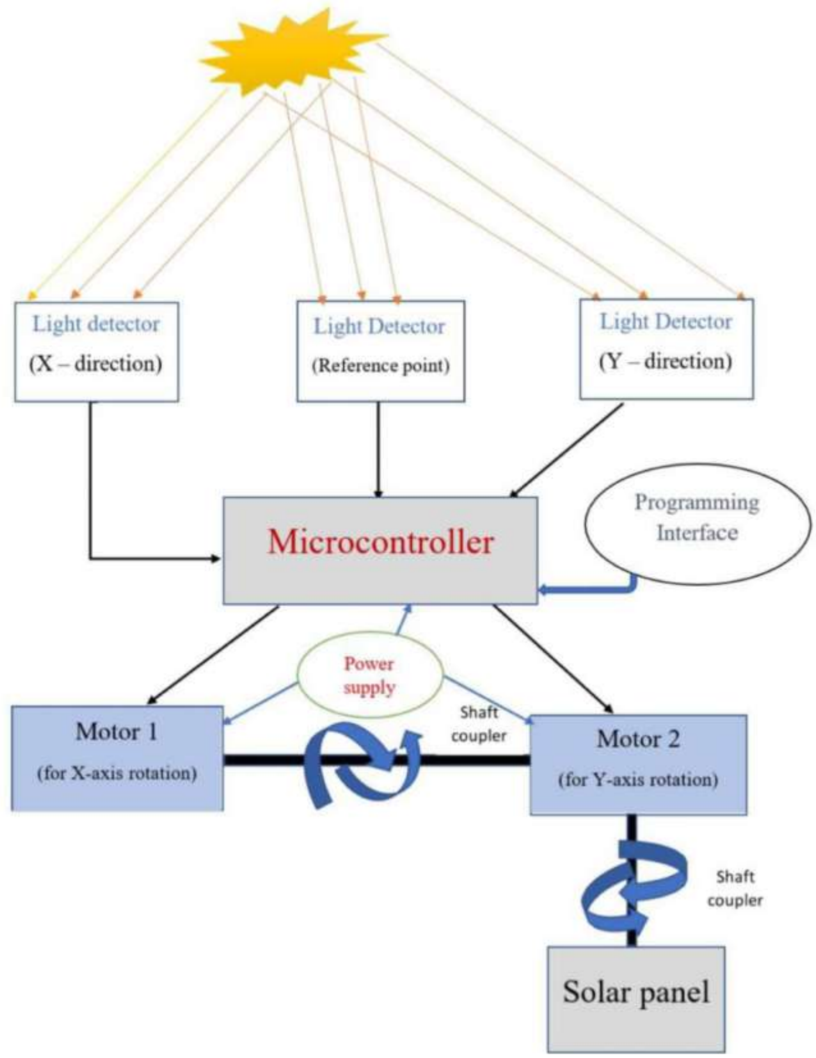
III. BLOCK DIAGRAM



Explanation of the block diagram:

The block diagram reveals that there are three Light Dependent Resistors (LDRs) that are mounted on the same plate as the solar panel. The quantity of light that hits each of them from a given source varies. The value of the resistances of all LDRs is not always the same. This is because LDRs have an intrinsic feature known as photoconductivity, which causes their resistance to decrease as the intensity of the incoming light increases. Each LDR is responsible for sending an equivalent signal to the microcontroller, which is then programmed by the necessary programming logic based on the individual resistance value. When comparing the values, one single LDR value is used as a reference point throughout the process.

One of the two dc servo motors has a mechanical connection to the driving axle of the other dc servo motor. This connection allows the first dc servo motor to move in conjunction with the rotation of the driving axle of the second dc servo motor. A solar panel is now driven by the axle of what was a servo motor in the past. The solar panel may be moved along the X-axis as well as the Y-axis thanks to the configuration of these two servo motors in such a manner that they are positioned.

Based on the input signals that are received from the LDRs, the microcontroller is programmed to provide the necessary signals to the servo motors. Tracking along the x-axis is handled by one servo motor, while tracking along the y-axis is handled by the other.

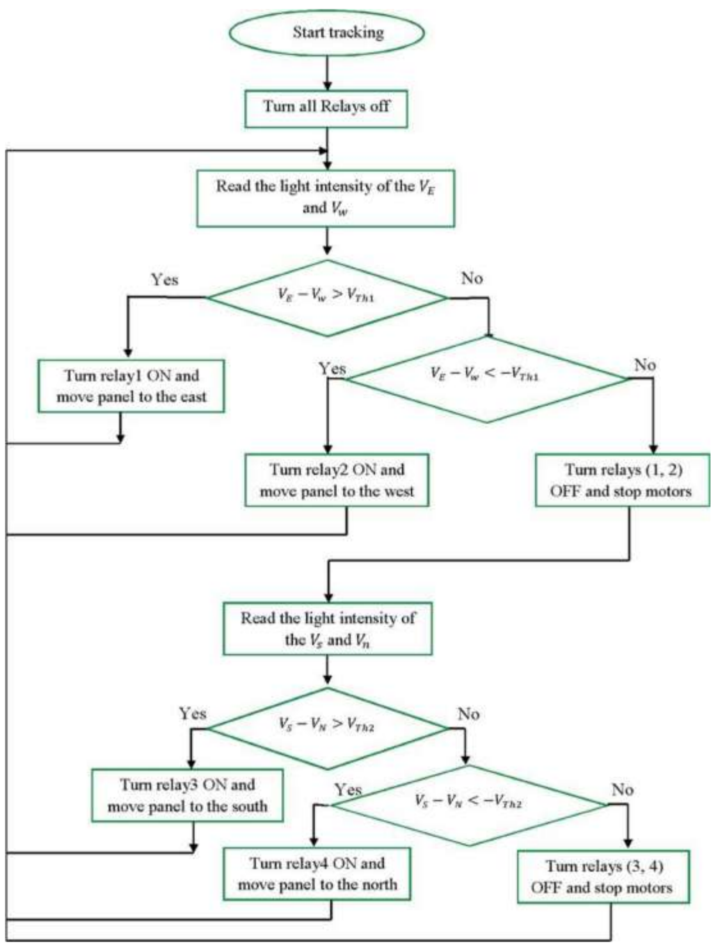
IV. WORKING PRINCIPLE

The resistance of an LDR fluctuates depending to the intensity of the light, which is a factor that determines the resistance. When the light intensity is low, the LDR resistance will be high, and this will result in a greater output voltage. The opposite is true when the light intensity is high; the lower the light intensity, the lower the LDR resistance will be, and the lower the output voltage will be.

In order to get the output voltage from the LDR sensors, a potential divider circuit must first be constructed.This picture demonstrates the circuit.

The analog input of the LDR is measured in voltages ranging from 0 to 5 volts, and the LDR delivers a digital value at the output that typically falls somewhere in the range of 0 to 1023. At this point, the feedback will be sent to the microcontroller using the Arduino program (IDE). This mechanism, which will be explained further on in the hardware model, has the ability to regulate where the servo motor is positioned.

V. IMPLEMENTATION



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VI. OBSERVATION AND RESULT

In this Dual Axis Solar Tracker, we have seen that when source light falls on the panel, the panel will alter its position such that it receives the highest intensity of light falling perpendicular to it. This is something that we have noticed.

The project's goal has been successfully accomplished. This was made possible by the use of light sensors, which are in a position to determine the quantity of sunshine that is received by the solar panel. When the values acquired by the LDRs are compared, there is actuation of the panel using a servo motor to bring it to a position where it is approximately perpendicular to the rays of the sun. If there is a substantial discrepancy in the values, there is also actuation of the panel.

This was accomplished by using a system that had three phases, sometimes known as subsystems. Each stage is responsible for a distinct function. The stages included: an input stage, which was in charge of converting the incident light to a voltage, and an output stage, which was responsible for producing the voltage.

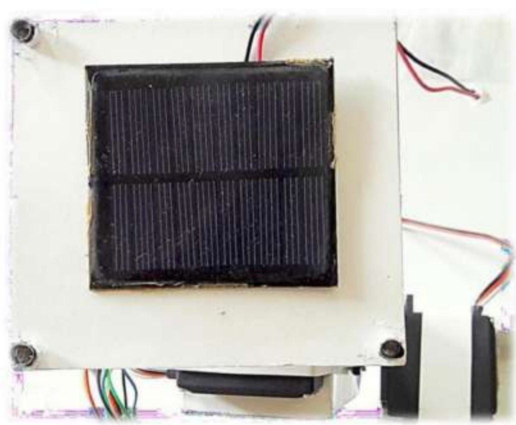
A control stage that was in charge of regulating both the actuation and the decision making.

A driver stage that is comprised of the servo motor. The actual movement of the panel was controlled by this component.

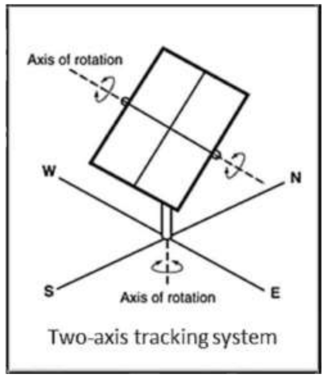
The input stage was built using a voltage divider circuit so that it could provide the necessary range of illumination regardless of whether the surrounding lighting was bright or faint. The potentiometer was fine-tuned such that it would accommodate these adjustments. Because of how their resistance changes in response to light, LDRs were determined to be the most appropriate choice for this project. They are easily accessible and affordable all at the same time. For instance, temperature sensors would have a high price tag.

A microprocessor is included into the control stage. This microcontroller is in charge of analyzing the voltages sent in by the LDRs and deciding what action has to be taken. The microcontroller is going to be programmed in such a way that it will send a signal to the servo motor that will cause it to move in line with the error that has been created.

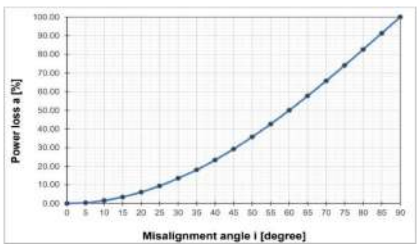
The servo motor was the primary component of the driving circuitry, which was the last step of the process. The torque provided by the servo motor was sufficient to drive the panel. Because they do not produce any noise and are very inexpensive, servo motors are the ideal option for the project.

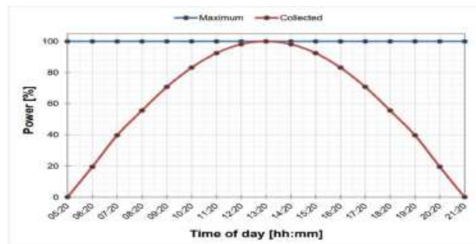


Solar Panel with Dual Axis tracking



Two axis tracking system





VII. Conclusion

In the twenty-first century, as our technology, population, and growth rise, so does the amount of energy used per person. At the same time, our energy resources—such as fossil fuels—decline quickly. Therefore, in order to meet our energy needs and promote sustainable growth, we must consider alternate strategies, such as the use of renewable energy sources.

In this Dual Axis Solar Tracker project, we have created a sample model of a solar tracker that tracks the light source's greatest intensity point to determine when the solar panel will produce the most voltage. We are happy to have finished our project successfully after many trial and error and to have contributed to our community. Now, this project has a few flaws, just like every other experiment.

• Within a detecting zone, our panel detects light; it is unable to react beyond this point.

• When more than one light source, such as a diffused light source, appears on the panel, the panel is moved to the location determined by adding up all of the light sources' vector sums. Not much was used in the implementation of this project. Simple circuitry was used.

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