Maximum Efficiency Solar Tracking Using Image Processing

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Solar energy is a renewable source that is easily accessible in most parts of the world and is a great and cost-effective way to generate clean electricity without damaging the Earth's ecosystem. From research done, we found that 80% of the energy that was being consumed in 2018 worldwide was nonrenewable energy, while only 11% of the energy consumed was from renewable sources. With technological advances in renewable power generation and consumption, the use of renewable energy is expected to grow worldwide to around 38% by the year 2030 [1]. The United States Energy Information Administration reported that about 20% of the US electricity generation in 2020 was from renewable resources [2]. Solar energy is at the forefront of renewable energy generation and is a fantastic way to power the Earth.

There are limitations to generating solar power, and our project's goal is to address one issue of solar power generation. To help improve the generation of clean energy from the Sun, there are several methods that can be implemented to assist in increasing the efficiency of power generation. Our project investigates the details of implementing a solar tracking device to increase the output power of a solar panel. The proposed method of our project is to compare power output by using a dual-axis solar tracking device on one solar panel and having a stationary solar panel as the control.

The system is equipped with two different algorithms to track the sun. The first method is to use four photoresistors mounted to the solar panel to accurately determine the position of the sun. The system moves the solar panel into a position orthogonal to the sun to maximize the output power. The second method is to take advantage of an image processing system to track the sun's position accurately. Our results show that this method is more accurate than the first method because it would be able to look at the sun and determine its position with a higher precision. Output power data is collected throughout the day to measure if the efficiency of the solar panels increases.

A prototype of the system was built and tested using low-cost materials to show the effectiveness. The prototype was constructed using a simple metal base which could easily be moved and placed on the ground. The solar panel was mounted on the top of the base and connected using a 3D modeled and printed mounting system which was designed after not finding a cost-effective dual-axel mounting system available. For the solar tracking system, the idea to use a hybrid system was decided on using both image processing and developing a system using photo resistors. Using images, our dual-axis system can alternate the azimuth and elevation angles according to the location of the sun. Our camera will take pictures and based on the x and y coordinates of the brightest spot and the program will tell our servo motors how to move. The photoresistors are strategically placed on the solar panel so that the direction of the light can be found.

It was found through this project that the maximum efficiency of a solar panel can be increased with the implementation of a tracking system. Looking at the effectiveness of the system, costs of the tracking and movement of the panel can be high compared to the price of the solar panels, however, when looking at the large space required for the solar panels maximizing the efficiency is critical. Another aspect to consider is one tracking system could be used to move many different solar panels, making the system cost effective as the number of panels scales.

REFERENCES

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