A REVIEW ON DESIGN AND DEVELOPMENT OF DUAL AXIS SOLAR PANEL TRACKING SYSTEM

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ABSTRACT

The global energy crisis and continued supporting evidence of worldwide global climate change have begun to shift the planet economies towards solutions that solve both challenges. Solar power has become one of the most recognizable and popularized renewable energy methods to date. In comparison to other photovoltaic systems, this project demonstrates the performance advantages of a dual-axis solar tracker. It also addressing its viability on a non-commercial scale. The objective was to improve upon previous solar tracker projects at Central Washington University by adding another axis to the system. This system implements both an actuator and a stepper motor to look at the benefits of using different drivers. Initially, the theoretical design and construction plan of the device was developed. Sketches and drawings were created with engineering analysis and supporting research for the simplest possible results. The manufacturing phase encompassed project management, risk mitigation and materializing the theoretical design. Materials, logistics, and human resources are all processed during this era, in accordance with the proposed budget and schedule, to make sure the project came to fruition. Based on the deliverables set out by the design requirements, the project provided largely successful results. The entire project was developed under budget, on schedule, with both axes functioning as intended, and under the weight limits. The photovoltaic was ready to maintain a perpendicular relationship with sunlight within 3% tolerance. The energy collected was approximately 38.9% more than the PV cell without the tracking system.

Keyword: - *Dual Axis, Solar PV System, Sensor, Mechanical System.*

1. INTRODUCTION

The ability to capture and transform a tiny portion of the sun's daily heat and light efficiently, to beat the limitation of energy resource threat rapidly becoming unavoidable. Also most solar panels operate at less than 40% efficiency, which forces to meet the energy need either purchasing high cost solar panel or by solar tracking system. Solar tracker is an automated solar panel that follows position of the sun to maximize the solar energy collection. One well known type of solar tracker is the heliostat, a movable mirror that reflects the moving sun to fixed location. But

many other approaches are used as well. Active tracker use motors and gear trains to direct the tracker as commanded by a controller responding to the solar direction. The solar tracker are often used for several applications like solar cells day lighting system and solar thermal arrays.

A comparative study shows an increase of energy extraction by about 40% over fixed planes and big advantages of the optimized scheme over continuously rotating panel. It was found that the energy saving on the consumption side is simply over 20%.

In this work an automated solar tracking system integrated with a low cost solar sensor has been designed and simulated for residential agriculture or large scale solar grid application which will improve the overall efficiency of a solar panel by tracking the movement of the sun at very high precision and accuracy. To track the position of the sun, the light dependent resistor is used to design the solar sensor. For processing and control the Arduino has been used which will generate pulse to the servo motor along with the solar panel in clock wise or counter clock wise direction.

1.2 Motivation

The motivation from the project came from the social relevance of solar power . Amid a global energy crisis, instruments such as solar panels need to be used to their highest potential. Therefore, there's a considerable need for methods which will optimize their energy collection. One of these methods is that the use of solar tracking systems. These devices became more utilized within the past decade, resulting in several sorts of tracking systems. In fact, a previous student at CWU, completed a solar tracker within the past. The hope for this project is to supply a totally operation, dual-axes, active solar tracker, which will improve upon the capabilities of the previous model.

1.3 Function Statement

A device is required which will vertical and horizontally adjust a solar array , so it's going to maintain a perpendicular relationship with direct sunlight. In turn, it will generate more electricity than a standard, fixed solar panel**.**

1.4 Problem Identification

A sunlight based tracker is employed as a neighborhood of various frameworks for the change of saddling of sun powered radiation. The issue that's postured is that the usage of a framework which is fit improving creation of energy by 30-40%. The negative feedback circuit is actualized by the microcontroller. The control circuit at that point positions the engine that is utilized situate the sun oriented board ideally.

2. LITERATURE REVIEW

Hossein Mousazadeh et Al.,[(2011), Journal of Solar Energy Engineering,Vol.133] studied and investigated maximization of collected energy from an on-board PV array, on a solar assist plug-in hybrid electric tractor (SAPHT). Using four light dependent resistive sensors a sun tracking system on a mobile structure was constructed and evaluated. The experimental tests using the sun-tracking system showed that 30% more energy was collected in comparison to that of the horizontally fixed mode... Four LDR sensors were used to sense the direct beams of sun. Each pair of LDRs was separated by an obstruction as a shading device. A microcontroller based electronic drive board was used as an interface between the hardware and the software. For driving of each motor, a power MOSFET was used to control the actuators. The experimental results indicated that the designed system was very robust and effective. K.S. Madhu et al., (2012) International Journal of Scientific & Engineering Research vol. 3, 2229–5518, states that a single axis tracker tracks the sun east to west, and a two-axis tracker tracks the daily east to west movement of the sun and the seasonal declination movement of the sun. Concentrates solar power systems use

lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. PV converts light into electric current using the photoelectric effect. Solar power is the conversion of sunlight into electricity. Test results indicate that the increase in power efficiency of tracking solar plate in normal days is 26 to 38% compared to fixed plate. And during cloudy or rainy days it's varies at any level.

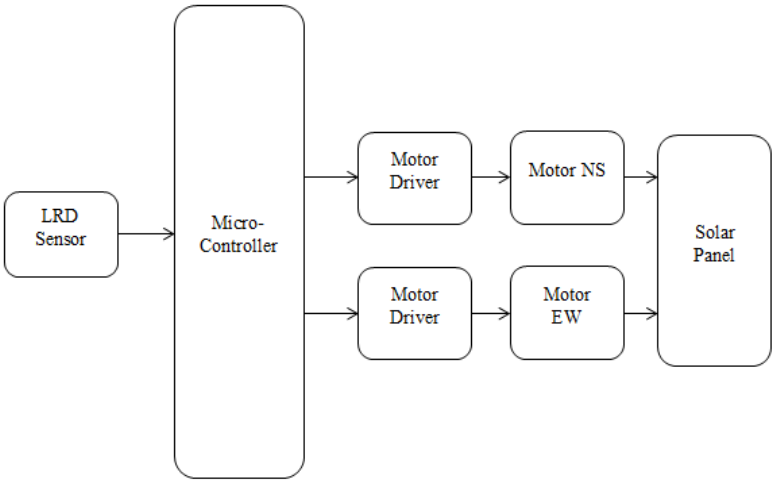
Balabel et al., (2013) used a mathematical analysis to achieve optimal operational efficiency of solar photovoltaic module. He focused on design and testing of control system. The study was based on calculated data of the altitude angle at Taif city, Saudi Arabia. The researcher showed that the sun tracking algorithm can be divided into closed-loop and open-loop systems depending on its controlled. The literature on tracking process for the dual axis sun tracker by a sliding mode control law was reviewed by Rhif et al (2010). The power production can be increased up to 40 percent by using this autonomic dual axis sun tracker. The result showed the usefulness of the sliding mode control in the tracking process, its strength and the high quality of the sliding mode observer.

It was stated by Madhu et al (2012) that the sun is tracked from east to west by single axis tracker whereas the daily east to west movement of the sun and the seasonal declination movement was tracked by two axis tracker. A large area of sunlight is focused into a small beam by using lenses or mirror. Sunlight is converted into electric current using the photo electric current by PV. Test results suggest that the increase in electricity efficiency of monitoring solar plate in everyday days is 26 to 38% compared to fixed plate. And during cloudy or rainy days it's varies at any degree Generally, solar panels are motionless and do not monitor the movement of the sun. In this project a solar tracker device that tracks the movement of sun throughout the sky and tries to maintain the solar panel perpendicular to the rays, ensuring that the maximum quantity of sunlight is incident on the panel during the day. The solar tracking system starts following the sun right from sunrise, in the course of the day until night, and starts all over again from the dawn next day. The solar panels are powerful means of storing energy, their performance at doing so is immediately associated with their perspective with the sun. Because PV cells get the maximum power from facing the solar, a stationary solar panel collects less sunlight one which follows the sun throughout the sky. In this project the dual axis system is used that includes both a horizontal and vertical axis. In this project the tracking system can track the motion of sun exactly around the world at any location.

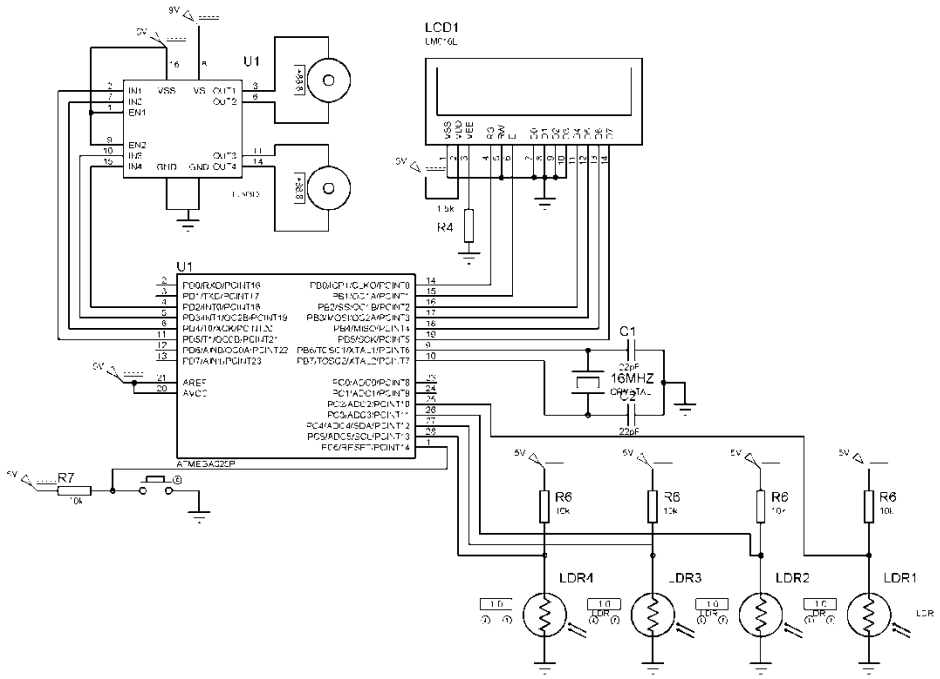
3. SYSTEM OVERVIEW

The solar project was implemented using two servo motors. The choice was informed by the very fact that the motor is fast, can sustain high torque, has precise rotation within limited angle and doesn't produce any noise. The Arduino IDE was used for the coding. Nashik has coordinates of 19.9975° N, 73.7898° E and therefore the position of the sun will vary in a significant way during the year. In the tropics, the sun position varies considerably during certain seasons. There is the design of an input stage that facilitates conversion of Time using RTC Module. There is comparison of the time, then the microcontroller uses the difference as the error. The stepprt motor uses this error to rotate through a corresponding angle for the adjustment of the position of the solar panel until such a time that the time outputs in the RTC are equal. The difference between the times of the rtc is received as i2c pins. Function of the processor: The I2C readings are converted to integer values I2C input ports which is compared in order to get the difference value for motor movement. The difference is transmitted to the stepper motor and it thus moves to ensure the two times are an equal inclination. This means they're going to be receiving an equivalent amount of sunshine , and therefore the solar array will receive the daylight at 90°, (the plane of PV panel will make an angle 90° with the Sun, and therefore the perpendicular drawn on the plane makes an angle 0° with the Sun, to make sure maximum illumination: Lambert's cosine Law) The procedure is repeated throughout the day. Tracker systems work on two simple principles together. One being, the traditional principle of incidence and reflection on which our tracker works and therefore the other is that the principle on which the solar (PV) panel works, which can produce electricity. Both these principles are often combined and as a results of which it can produce nearly double the output that the panel specifies normally

3.1. Block Diagram



3.2. Circuit Diagram



4. Applications

- Parks & Playgrounds
- Corridors and Open Places
- Open Restaurants and Terraces
- Schools & Colleges
- Residential Societies
- Railway, Metro Stations and Airports
- Public Places

5. Limitations

- Works when solar ligtht is present
- Regular Sensor Cleaning Needaed

6. Advantages

- Heavy Duty Purifiers
- Automatic Operation
- Easy to Clean
- Improve Efficiancy
- Giving way to cleaner environment.
- Eco friendly.

7. CONCLUSION

The current project is based on tracking solar panels. These panels change their orientation in relation to solar radiation to increase the efficiency and results in maximum production of energy and helps in getting full benefit of optimal angle between solar panels and solar radiations. The execution of solar tracking system was made clear because of our sufficient research and preplanning of our goals and objectives. The main agenda of this project was to make simple machinery on low cost basis. Trial and error method help us in achieving our goal. We made use of our engineering knowledge in this three month project and were successful in developing and designing low cost solar tracking system. Because the issue of global warming must be controlled by making use of alternatives that are environmental friendly. The goals of this project were outlined keeping in mind the timeline and resources that were attainable.

However this initial design can be subjected to many improvements. Initially this design represents a miniature scale model which can be modified into a much larger scale. Easy to bend cables can be used which do not apply any force on the motor when it is rotating the solar panel. To get a better tracking precision, a photo transistor with and amplification circuit can be used. Furthermore accuracy can also be increased by utilizing dual axis design versus single axis design. Future projects can make use of microcontroller. This microcontroller can serve as standalone unit in the fabricated circuit

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