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Dual Axis Solar Tracking System

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Abstract: *Dual axis solar tracker can simultaneously track sun's radiation in both horizontal andvertical axis. The dual-axis solar tracker tracks the angular height position of the sun in addition to following the suns east- west movement. The dual-axis works similar to single axis but it captures the solar energy more effectively by rotating its axis along vertical and horizontal axis. They use the same principle as the mountings of astronomical telescopes. In order to achieve maximum efficiency, the device tracks seasonal variations and dailytilt. The work focuses on the design and fabrication of automatic dual axis solar tracker prototype using Arduino code based on microcontroller along with fundamental of solar panel parameter and its use. The device is able to simulate the sun's tracking of 12 months thus, enhancing the conventional solar panels.*

Keywords: Dual Axis, Stepper Motor, LDR Sensors, Declination Angle

I. INTRODUCTION

When it comes to the development of any nation, energy is the main driving factor. There is an enormous quantity of energy that gets extracted, distributed, converted and consumed every single day in the global society. The world population is increasing day by day and the demand for energy is increasing accordingly. Oil and coal are the main source of energy nowadays but there is a fact that the fossil fuels are limited and hand strong pollution. Even the price of petroleum has been increasing year by year and the previsions on the medium term there are not quite encouraging. Utilization of this resources increases the emission of carbon monoxide (CO), hydrogen chloride (HCL), Nitrogen Oxides, and Sulphur Oxides which are responsible for the global warming and greenhouse effect. This results the devastating effect in the environment.

In 1839, Alexandre Edmond Becquerel discovered that certain materials produced smallamounts of electric current when exposed to light. In 1876, When William Grylls Adams and his student, Richard Evans Day, discovered that an electrical current couldbe started in selenium solely by exposing it to light, they felt confident that they had discovered something completely new. Werner von Siemens, a contemporary whosereputation in the field of electricity ranked him alongside Thomas Edison, called the discovery "scientifically of the most far-reaching importance."

Although selenium solar cells failed to convert enough sunlight topower electrical equipment, they proved that a solid material could change light into electricity without heat or any moving parts. Later in 1905 Albert Einstein published the first theoretical work describing the photovoltaic effect titled "Concerning a Heuristic Point of View Toward the Emission and Transformation of Light." In the paper, he showed that light possesses an attribute that earlier scientists had not recognized. Light, Einstein discovered, contains packets of energy, which he called light quanta. Einstein's bold and novel description of light, combined with the [1898] discovery of the electron, gave scientists in the second decade of the twentieth centurya better understanding of photo electricity.

II. LITERATURE REVIEW

Mousazadeh et al, (2009) carried a review study, which resulted in the general categorisation of solar tracking systems according to two main typologies, namely, Energy source (i.e. passive, active and manual), and Degree of freedom (i.e. single or dual axis). Passive tracking systems- designate all devices that position solar collectors for optimum capture of energy using mechanical potential and thermal energy principles. Passive systems do not use of electrical energy. Some of the typical mechanical working principles are Shape Memory Alloy (SMA), Thermo-fluids, Mechanical potential system (lever, weight and springs). In Shape Memory Alloy, cylindrical actuators to change the shape the SMA receivers through mirrors until an optimum orientation is achieved developments, among others by Kusekar et al

(2015), have seen the use of high pressure fluids to convert the potential energy in the mechanical structure that hold up the PV panel into kinetic energy, which is then used to move the panel toward the sun.

Active tracking systems- use electrical energy as their source. A number of categories exist such as; Electro-optical based tracker, Auxiliary bifacial solar cell and chronological (time and date based) tracker. At some instances, a combination of these different systems may be realised and the resulting system will be referred to as Hybrid. Of all active trackers, electro-optical basedtrackers are is generally more popular.

Mousazadeh et al (2009) reports the use of differential illumination of coupled electrosensors to generate a differential signal to a controller which then sends a signal to drive the solar system. For improved photosensitivity, the sensor can be mounted on a pyramidal structure (in the figure outlines the photo-diode mounted on pyramid) or use of collimator tube might be vital as it prevent diffuse irradiation from reach the sensors therefore ensuring precise measurement of the position of the sun. Fig.1c is a system made up of four mini- solar module positioned on the North- south and east-west that detect the light intensity, this is system also use the Programmable Logic Controller (PLC) manipulate the two positioning mechanism through two DC motors.

Chen-Sheng, et al., (2008) repots a 49.2% increase in efficiency due to a system, developed and filed tested in Tibet. The tracker was developed to deploy a Microprocessor as a controller, (time based system with feedback from position sensors). Also it had a poor environment protection (Wind, Vibrations and cloud) and human -machine interface.

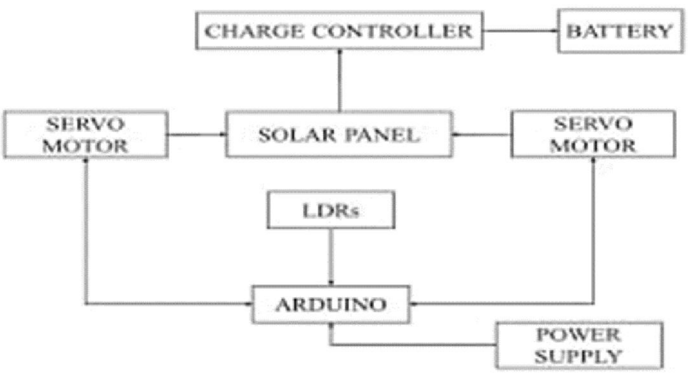
Singh, K.P., and Gupta, B., (2014) Experimental (India) Microcontroller (P1C16F877A programmed in DOTNET), Stepper Motor geared (Worm and spur) Infra-red sensor 35-42% (26). In 2015 Ceyda, A.T., and Cenk, Y., (2015) evaluated a microcontroller (PIC16F877A programmed in MPLAB IDE) with linear actuators and potentiometer (feedback sensors) based tracking system at laboratory scale in Turkey.

III. DISCUSSION

At this point in the projects progression there have been a multitude of changes from the first initial week of work. The project began with very little focus and over time narrowed down in scope. This project began basing analysis off the provided PV panel and the online resources researched to understand the concepts that were implemented in this project. It can be stated that more time was potentially done trying to understand the concept than to apply them. In total, the design of this project went through 3 major changes.

The first design had the horizontal axis powered by a single support shaft and it used 2 motors for the whole system, this design would have required far too much torque for the project to be economically viable. In hope to reduce the require torque and improve structural stability, the 2nd design implemented a linear actuator and a motor. This design was very close to the final draft however there were many complications with clearance for both axes to perform to full extent. The higher moving components also used truss, which provided to security for the more expensive electrical components. The final design which is the main design referenced in this document ended by adding separation between the moving parts and electrical system. The project also switches the dc motor to a stepper motor for the ease of programming. Lastly, the final draft implements a lazy Susan bearing to improve the ease of movement of the heavier moving components and established enough clearances, for both axes to move freely.

3.1 Block Diagram



IV. RESULT

In this Dual Axis Solar Tracker, when source light falls on the panel, the panel adjusts its position according to maximum intensity of light falling perpendicular to it. The objective of the project is completed. This was achieved through using light sensors that are able to detect the amount of sunlight that reaches the solar panel. The values obtained by the LDRs are compared and if there is any significant difference, there is actuation of the panel using a servo motor to the point where it is almost perpendicular to the rays of the sun.

V. CONCLUSION

The report has presented a means of tracking the sun's position with the help of microcontroller and LDR sensors. Specially, it demonstrates a working software solution for maximizing solar cell output by positioning a solar panel at the point of maximum light intensity. Moreover, the tracker can initialize the starting position itself which reduce the need of any more photo resistors. The attractive feature of the designed solar tracker is simple mechanism to control the system, As solar power production is used in large scale worldwide so, even an increment in efficiency by 1% than stationery plane will increases the net power production by large amount. Hence, no matter by how much tracker increases an efficiency it is always welcomed. In a conclusion, this mechanism could be manifested in wide range of applications that require solar tracking such as parabolic trough collector, solar dish, lens and other PV systems to collect maximum radiation from sun.

REFERENCES

[1]. Juang, J.N. and Radharamanan, R., 2014. Design of solar tracking system for renewable energy. In proceedings of the 2014 Zone 1 conference of the American society for engineering education (pp. 1-8). IEEE.
[2]. Das, A. and Swthika, O.V., 2016. Arduino Based Dual Axis Sun Tracking System. Advanced Science Letters, 22 (10), pp.2837-2840.
[3]. Barsoum, N., Nizam, R. and Gerard, E., 2016. New approach on development a dual axis solar tracking prototype. Wireless Engineering and Technology, 7(1), pp. 1.11.
[4]. Vit, J. and Krejcar, O., 2016. Smart solution of alternative energy source for smart houses. In International conference on Industrial, Engineering and Other Applications of Applied Intelligent Systems (pp. 830- 840). Springer, Cham.s.
[5]. Reddy, J.S., Chakraborti, A. and Das, B., 2016. November. Implementation and practical evaluation of an automatic solar tracking system for different weather conditions. In 2016 IEEE 7th Power India International Conference (PIICON) (pp. 1-6). IEEE.
[6]. Saravanan C., Dr .M.A. Panneerselvam, I. William Christopher, "A Novel Low Cost Automatic Solar Tracking System", International Journal of Computer Applications (0975 – 8887) Volume 31– No.9, October 2011
[7]. Solar Tracking, Gerro Prinsloo, Robert Dobson 2014 Book Edition ISBN: 978-0-62061576-1
[8]. John A. Duffie, William A. Beckman Solar Engineering of Thermal Processes, 4th Edition - GearTeam,page: 471, 477