ARDUINO BASED SMART SOLAR TRACKER

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Introduction:

Sun is an abundant source of energy and this solar energy can be harnesses successfully using solar photovoltaic cells and photovoltaic effect to convert energy into electrical energy. But the conversion efficiency of a normal PV cell is low. One of the main reason for this is that the output of PV cell is dependent directly on the light intensity and with the position of sun in the sky changing continuously from time to time, the absorption efficiency of an immobile solar panel would be significantly less at certain time day and year, for the solar photovoltaic cells are maximum productive when they are perpendicular to the sun and less productive otherwise. So to maximize the energy generation and improve the efficiency solar trackers are required. The solar tracker also provided lucrative solution for third world countries to integrate it into their solar system with a comparatively low cost through software based solution.

1. The study revealed that use of stepper motor enables accurate tracking of sun and LDR resistors used to determine the solar light intensity.
2. Researchers concluded that embedding the tracking system with panel can response accurate and applicable to meet the power demands at different operational conditions. A solar tracking system designed with microcontroller and LDR's that actively track the sun and change its position accordingly to maximize the energy output. The LDR incorporated on solar panel helps to detect sunlight which in turn moves the panel accordingly [2] .
3. The solar tracker described a more improved way to maximize the power consumption by solar panel from sun by just rotating the solar panel according to sun's position. By comparing the results it was discovered that direct beam of sun helps in generating energy than it is produced when solar panel is kept fixed. The studied have shown that efficiency of solar panels can be increased to a great extent if the solar panels continuously rotate

in the direction of sun. Microcontroller and an arrangement of LDR sensors can be used for the purpose of tracking the sun [3].

4. But the system was less efficient because of the low sensitivity and disturbance of light dependent resistors. The mechanism of solar tracking was implemented by the use of image processing software which combines the effect of sensors and processed image of sun and controls the solar panel accordingly. A new mechanical structure for solar trackers which implemented two stepper motors for free rotation on X and Y axis [4].
5. The rotation was intelligently controlled by a pre-programmed 2K microcontroller device PIC 18F4560 which provides simple programming strategy through C language. The designed algorithm was based on the measurement of intensity of solar radiation which was captured by an ultra violet sensitive device known as Pyranometer. The system had been tested and the results show very significant impact on the mechanical design, controlling algorithm and also the cost of the development.

Objectives:

It The aim of this solar tracker project is to keep the solar photovoltaic panel perpendicular to the sun throughout the year in order to make it more efficient. The dual axis solar photovoltaic panel takes astronomical data as reference and the tracking system has the capability to always point the solar array toward the sun and can be installed in various regions with minor modifications. The vertical and horizontal motion of the panel is obtained by taking altitude angle and azimuth angle as reference. The fuzzy controller has been used to control the position of DC motors. The mathematical simulation control of dual axis solar tracking system ensures the point to point motion of the DC motors while tracking the sun.

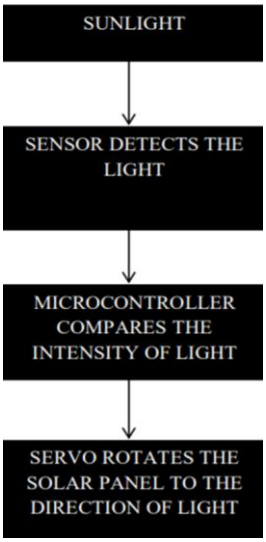
Solar Tracker is a Device which follows the movement of the sun as it rotates from the east to the west every day. The main function of all tracking systems is to provide one or two degrees of freedom in movement. Trackers are used to keep solar collectors/solar panels oriented directly towards the sun as it moves through the sky every day. Using solar trackers increases the amount of solar energy which is received by the solar energy collector and improves the energy output of the heat/electricity which is generated. Solar trackers can increase the output of solar panels by 20-30% which improves the economics of the solar panel project.

Proposed System:

Methodology:

The solar tracking system comprises of a solar panel, Arduino microcontroller and sensors. For this system to operate there must be emission of light through the sun. The LDRs serve as the sensors to detect the intensity of light entering the solar panels. The LDR then sends Proceedings of the International Conference on Industrial Engineering and

Operations Management Washington DC, USA, September 27-29, 2018 © IEOM Society International 2470 information to the Arduino microcontroller. The servo motor circuit is then constructed. The servo has 3 pins of which the positive side is connected to the +5v of the arduino microcontroller. The negative of the servo is connected to the ground. The data point on the servo is connected to the analog point on the microcontroller. A potentiometer is connected so as to regulate the speed of the servo motor.



This solar panel tracking system simulation was performed using a Proteus software. A Simulation was carried out to know if the system designed and implemented will perform to our expectation or not. Simulation process revels the exact circuit diagram and connection of the system. The simulation carried out is shown in figure 3 which performed as desired. We then carried out experimental observation between fixed solar panels and the implemented tracking solar panel to compare the performance enhancement of the implemented tracking solar panels and the fixed solar panels. We used 6W solar panel made of the same material and manufacturer.

PROJECT OUTCOMES:

The power readings of the fixed solar panel and the implemented tracking solar panel were taken hourly for three days in the year 2017 and recorded as shown in tables 1, 2. Results taken on different days show the difference in efficiency between the fixed solar panel and the implemented solar tracker.

Table 1: Power readings for a cloudy morning and sunny afternoon, 11th of March 2017.

Time	Power reading of fixed solar panel (6W)	Power reading of the implemented tracking solar panel system (6W)
7.00	0.176	1.487
8.00	0.210	1.839

9.00	0.196	2.933
10.00	0.567	3.783
11.00	0.816	3.798
12.00	2.297	3.969

Table 2: Power readings for a bright sunny day, 12th March 2017

Time	Power reading of fixed solar panel (6W)	Power reading of the implemented tracking solar panel system (6W)
7.00	0.697	1.477
8.00	0.792	2.804
9.00	1.779	3.203
10.00	3.167	3.990
11.00	3.456	4.130
12.00	4.604	4.800

Conclusion:

A solar panel tracking system was designed and implemented. The aim of the solar panel tracking system is to track the position of the sun for better efficiency of the solar panel has shown in the experimental results. This work can be executed on an industrial scale which be beneficial to developing countries like Nigeria and Sub-Sahara Africa countries. Our recommendation for future works is to consider the use of more sensitive and efficient sensors which consume less power and which are also cost effective. This would increase the efficiency while reducing cost.