DUAL AXIS SOLAR PANEL USING ARDUINO

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Abstract - Solar energy is a clean, easily accessible and abundantly available alternative energy source in nature. Getting solar energy from nature is very beneficial for power generation. Using fixed Photovoltaic panels extract maximum energy only during 12 noon to 2 PM in Nigeria which results in less energy efficiency. Therefore, the need to improve the energy efficiency of PV solar panel through building a solar tracking system cannot be over-emphasized. Photovoltaic panels must be perpendicular with the sun in order to get maximum energy. The methodology employed in this work includes the implementation of an Arduino based solar tracking system. Light Dependent Resistors (LDRs) are used to sense the intensity of sunlight and hence the PV solar panel is adjusted accordingly to track maximum energy. The mechanism uses servo motor to control the movement of the solar panel. The microcontroller is used to control the servo motor based on signals received from the LDRs. The result of this work has clearly shown that the tracking solar panel produces more energy compared to a fixed panel.

***Key Words*:** LDRs, PV panel, Solar Energy, Microcontroller, Arduino, and Servo.

1. INTRODUCTION

Presently, public electricity covers only 40% of homes and this is not still on a consistent basis. Due to lack of constant power supply, people have started embracing the culture of generating their own power supply. The use of fossil fuels as a means of generating electricity has become expensive making cost of living very high, especially in the rural part of the country. Also, the use of fossil fuel has brought about pollution to the environment which in turn is not safe for our health. It releases carbon dioxide which causes the greenhouse effect. This brings about the deforestation of land and also the pollution of air and water. Solar energy is gotten solely from the sun and as a result does not emit carbon dioxide which prevents the green-house effect. The development of solar energy in Nigeria has the potential to create jobs. Employment in renewable energy industry would reduce occupational hazards especially when compared to coal mining and the extraction of oil. Nowadays solar energy is becoming one of the most reliable sources of energy as a result of its surplus and environmentally friendly. According to reference a system that tracks the sun will be able to know the position of the sun in a manner that is not linear. The operation of this system should be controlled independently. Maximum energy is produced by a solar PV panel when it is positioned at right angle to the sun. Therefore, the

aim of this research is to develop an Arduino based solar tracking for energy improvement of solar PV panel.

2. BODY OF PAPER

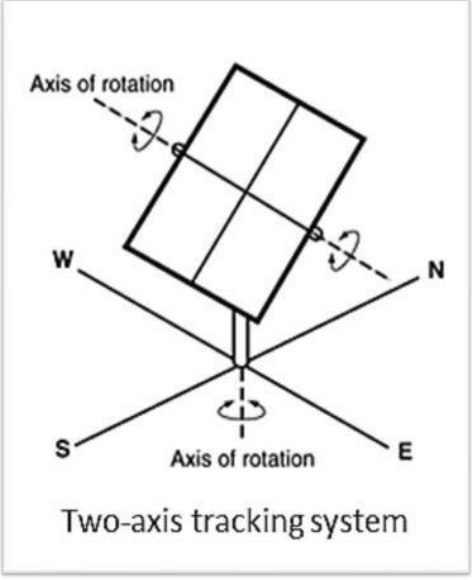
DUAL AXIS MOVEMENT OF SOLAR TRACKER

➢ The dual axis solar tracker is device which senses the light and positions towards the maximum intensity of light. It is made in such a way to track the light coming from any direction.

➢ To simulate the general scenario of the Sun's movement, the total coverage of the movement of the tracker is considered as 120˚ in both the directions.

➢ The initial position of both the servo motors are chosen at 90˚i.e, for east-west servo motor as well as for north-south servo motor.

➢ The position of the tracker ascends or descends only when the threshold value is above the tolerance limit.



Two-axis tracking system

Thesis Objective-

A typical solar panel converts only 30 to 40 percent of the incident solar irradiation into electrical energy. Thus, to get a constant output, an automated system is required which should be capable to constantly rotate the solar panel. The Sun Tracking System (STS) was made as a prototype to solve the problem, mentioned above. It is completely automatic and keeps the panel in front of sun until that is visible. The unique feature of this system is that instead of taking the earth as its reference, it takes the sun as a guiding source. Its active sensors constantly monitor the sunlight and rotate the panel towards the direction where the intensity of sunlight is maximum. With the rapid increase in population and economic development, the problems of the energy crisis and global warming effects are today a cause for increasing concern. The utilization of renewable OPEN ACCESS Sensors 2013, 13 3158 energy resources is the key solution to these problems. Solar energy is one of the primary sources of clean, abundant and inexhaustible energy that not only provides alternative energy resources, but also improves environmental pollution. The most immediate and technologically attractive use of solar energy is through photovoltaic conversion. The physics of the PV cell (also called solar cell) is very similar to the classical p-n junction diode. The PV cell converts the sunlight directly into direct current (DC) electricity by the photovoltaic effect. A PV panel or module is a packaged interconnected assembly of PV cells. In order to maximize the power output from the PV panels, one needs to keep the panels in an optimum position perpendicular to

the solar radiation during the day. As such, it is necessary to have it equipped with a Sun tracker. Compared to a fixed panel, a mobile PV panel driven by a Sun tracker may boost consistently the energy gain of the PV panel.

3. LITERATURE REVIEW

A solar cell is a device which converts light energy to electrical energy through photovoltaic effect. Solar cells are the building blocks of photovoltaic modules known as solar panels. In solar tracking system, the module's surface tracks the position of the sun automatically as the day runs by. The position of the sun varies as the sun moves across the sky. For a solar powered equipment to work best, it must be placed near the sun and the solar tracker can increase the efficiency of that equipment at any fixed position. Based on sophistication, costs and performance. One common type of tracker is the heliostat, a movable mirror that reflects the position of the sun to a fixed location. A solar trackers accuracy depends on the application. Concentrators, especially in solar cell applications, require a high degree of accuracy to make sure that the concentrated sunlight is directed exactly to the powered device, which is close to the focal point of the reflector or lens. Without tracking, concentrator systems will not work at all, therefore single-axis tracking is mandatory. Non-concentrating applications require less accuracy, and many are likely to work without any tracking. However, tracking with great effect can improve both the amount of total output power produced by a system and that produced during critical system demand periods (usually late afternoon in hot climates). Researches have been done to improve the energy production of solar panels. These researches include; double-sided panels, conversion stages improvement, building panels integration geometrically and so on. Maximum energy is produced by a solar PV panel when it is positioned at right angle to the sun. For this reason, several researches developed different types of solar panel tracking systems [9 and 10]. Therefore, the primary purpose of this work is to develop a solar panel tracker based on Arduino advances so as to enhance the energy production of solar panel.

4. BLOCK DAIGRAM

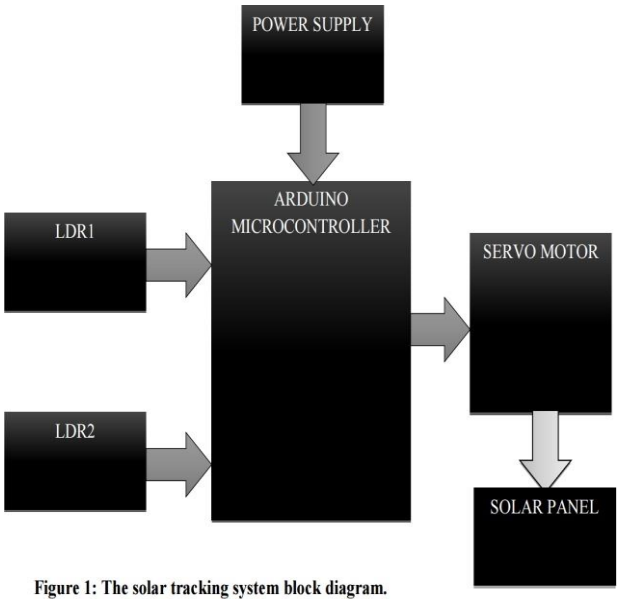
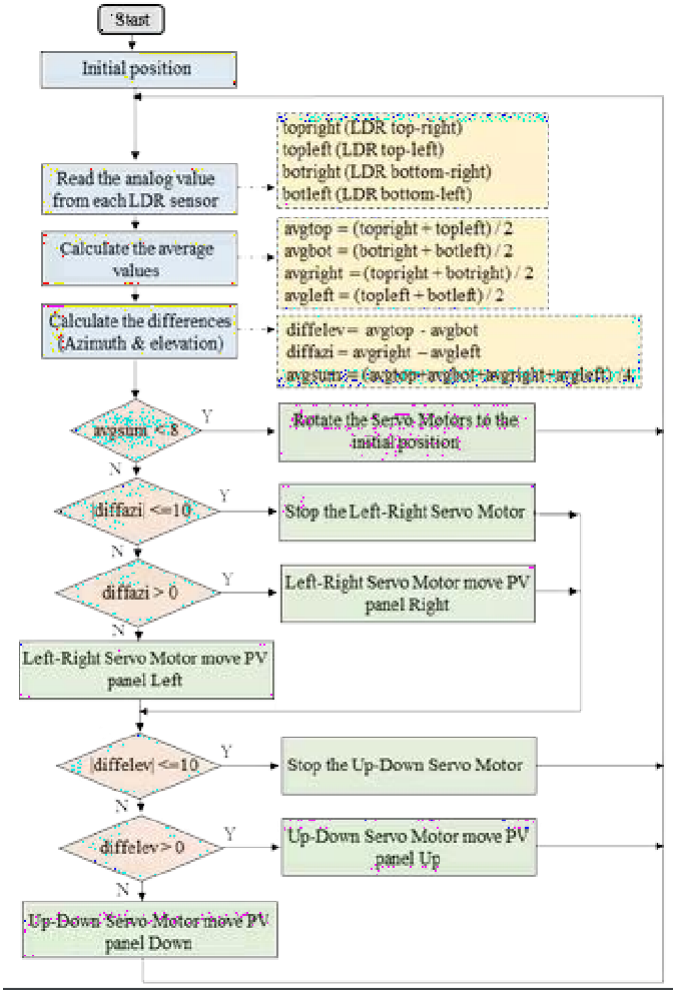


Figure 1: The solar tracking system block diagram.

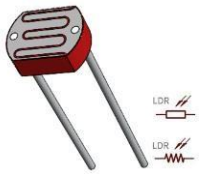
Flow Diagram



Components used

Nano Arduino

Servo Motor



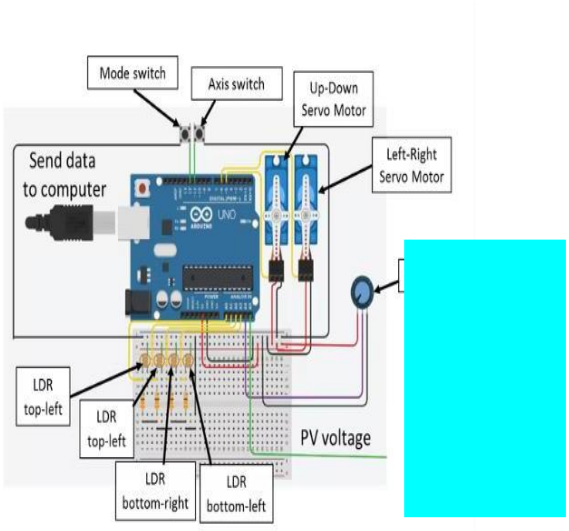
LDR Sensor

6. RESULT

This section presents and discuss the performance of different tracking system and proposed system with respect to different time period in a day. Table.3 Output power obtained in Fixed Mount, single-axis and Dual axis.

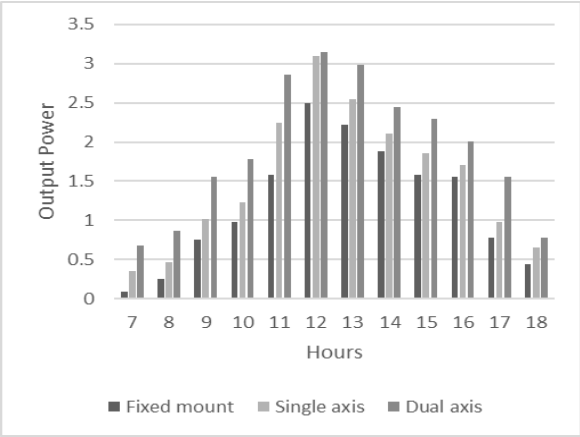
Hours	Power for Fixed Mount in W	Power for Single-Axis in W	Power for Dual-Axis in W
07. 00	0. 09	0. 35	0. 68
08. 00	0. 25	0. 47	0. 87
09. 00	0. 75	1. 02	1. 55
10. 00	0. 98	1. 23	1. 78
11. 00	1. 58	2. 24	2. 86
12. 00	2. 5	3. 1	3. 15
13. 00	2. 22	2. 54	2. 98
14. 00	1. 88	2. 11	2. 44
15. 00	1. 58	1. 86	2. 3
16. 00	1. 56	1. 7	2. 01
17. 00	0. 78	0. 98	1. 56
18. 00	0. 44	0. 65	0. 78
Sum= 12	Sum=14. 61W	Sum=18. 25W	Sum=22. 96W

5. DESIGN OF EXPERIMENT



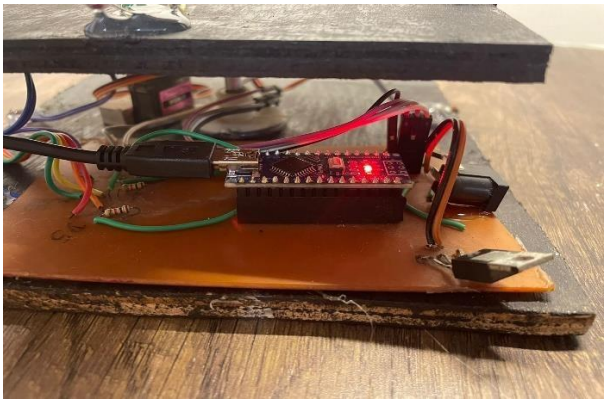
Solar Energy in W/hr. (Day Time)	1.2175 W/hr	1.5208 W/hr	1.9130 W/hr
All Day Solar Energy Output	**0.6087 W/hr**	**0.7604 W/hr**	**0.9566 W/hr**

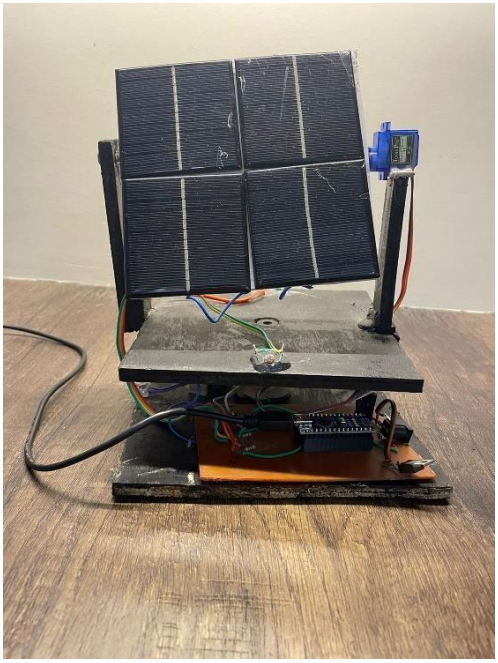
The powers tracking of solar panel with different positions are tabulated above in table 3. It is clearly evident that the proposed dual axis tracker perfectly aligns with the sun direction and tracks the sun movement in a more efficient way and has a tremendous performance improvement. The experimental results clearly show that dual axis tracker is superior to single axis tracker and fixed systems. Power Captured by dual axis solar tracker is high during the whole observation time period and it maximizes the conversion of solar irradiance into electrical energy output is shown in the table.3. As a result, it creates a solution for effective utilization of solar energy and thus helps in creating smart houses.



Bar Chart comparison for different tracking system

Bar chart comparison of solar power with different tracking methods is shown above figure.6. It is clearly showing that proposed method yields better output power compared to existing method.





Future Scope

It can be used for small and medium scale power Generations.

It can be used for power generation at remote places where power lines are not accessible. It can be used for domestic and industrial power backup sytem. Solar radiation Tracker has played a vital role in increasing the efficiency of solar panels in recent years, thus proving to be a better technological achievement. The vital importance of a dual axis solar tracker lies in its better efficiency and sustainability to give a better output compared to a fived solar panel or a single axis solar tracker. The tracking system is designed such that it can trap the solar energy in all possible directions.

7. CONCLUSION

In this 21st century, as we build up our technology, population & growth, the energy consumption per capita increases exponentially, as well as our energy resources (e.g. fossils fuels) decrease rapidly. So, for sustainable development, we have to think alternative methods (utilization of renewable energy sources) in order to fulfil our energy demand. In this project, Dual Axis Solar Tracker, we've developed a demo model of solar tracker to track the maximum intensity point of light source so that the voltage given at that point by the solar panel is maximum. After a lot of trial and errors we've successfully completed our project and we are proud to invest some effort for our society. Now, like every other experiment, this project has couple ofimperfections. (i) Our panel senses the light in a sensing zone, beyond which it fails to respond. (ii) If multiple sources of light (i.e. diffused light source) appear on panel, it calculates the vector sum of light sources & moves the panel in that point. This project was implemented with minimal resources. The circuitry was kept simple, understandable and user friendly

8. REFERENCE

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