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Automatic Sun Tracking Solar Panel Mounting

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Abstract

Looking at the current scenario of conventional sources of energy i.e. coal, natural gas, oil, etc. it is noticeable that they're at the fringe of extinction. Due to which utilization of renewable resources is increasing. In company with that popularity and quality of solar panels is also growing. With the help of sun tracking solar panel mounting, we will be able to harness the maximum amount of sunlight which will result in increasing efficiency of solar panels. The reason behind solar panel efficiency is the perpendicular proportionality of it's with the sun light. By aligning the solar panels perpendicular to the sun ray's maximum amount of electrical energy can be generated. The aim behind this concept is to generate maximum amount of clean and pollution free electrical energy.

I. INTRODUCTION

The most common form of energy used by us is electrical energy. Electrical energy is used every day to its best to fulfil the desires and mission of people. Electrical energy has become the essential factor. In order to fulfil the need of massive population it is necessary to have an everlasting source of energy. We are mostly generating electrical energy through conventional sources but the conventional sources are limited and creates pollution. So now there is a need of switching to non-conventional sources, the Solar Energy is the biggest form of energy. We can convert the solar energy into electrical energy using photovoltaic cell/solar cell. In spite of all this we're not able to harness maximum amount of energy. We can achieve maximum output when sun rays are incident on 90 degrees. Thus, this present project, therefore, is orchestrated with components like LDR module, DC servo Motor, Solar panel etc. according to that while the functioning would not emit any pollution and the power generation output will also be more than the traditional method.

II. LITURATURE SURVEY/BACKGROUND

No other energy is as ample as solar energy as per as its availability and freeness are concerned. Historically if counted, within the year 1881 first solar panel was invented. Later on, in the year, 1941 concept of the solar cell was proposed by Russell Ohl.

Photovoltaic cells are created from semiconductor materials, like silicon. This cells are used to convert solar energy into electrical energy. Solar cells use the principle of the photovoltaic effect which is same as photoelectric effect. The electrons in solar cell are contained in material around the surface, resulting in a

voltage difference. They are made up of crystalline silicon. Silicon is the commonly used material in solar cells. Solar cells can also be fabricated with Copper indium gallium (di)selenide (CIGS), cadmium telluride (CdTe) etc. The manufacturing of solar cells with these material cost slightly higher than compare to silicon.

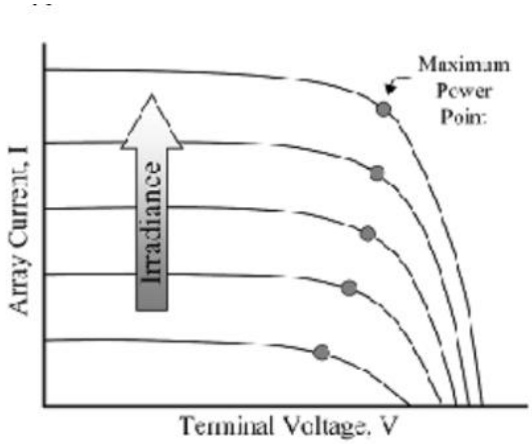

Figure1: Characteristic of solar cell

(https://www.researchgate.net/publication/323735040_Sun_Tracking_Solar_Panel_System)

Solar panels are found in two forms

A] Monocrystalline

B] Polycrystalline

The most commonly form silicon used is Monocrystalline. Monocrystalline silicon has high efficiency which is typically around 15-20%

The another form of silicon used is polycrystalline. It is cheaper then monocrystalline but has the same band gap. Though it has the same band gap its efficiency is low. Thus this material is used in low cost projects.

Cell Technology	Crystalline Silicon
Types	• Mono-crystalline silicon (c-Si) • Poly-crystalline silicon (pc-Si/ mc-Si)
Temperature resistivity	Lower
Module Efficiency	13-19%

Figure2: Types of solar cell based on material

(https://rcciit.org/students_projects/projects/aeie/2019/GR2.pdf)

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The sun tracking solar panel mounting is designed to keep the angle of 90 degrees between sun rays and PV array

The mounting structure of the solar panel has two major categories **dual axis** and **single axis.**

Dual axis trackers, keeps the sun's rays perpendicular to the solar panel, thereby allowing for a gain in maximum energy absorption. However, these systems can be complex

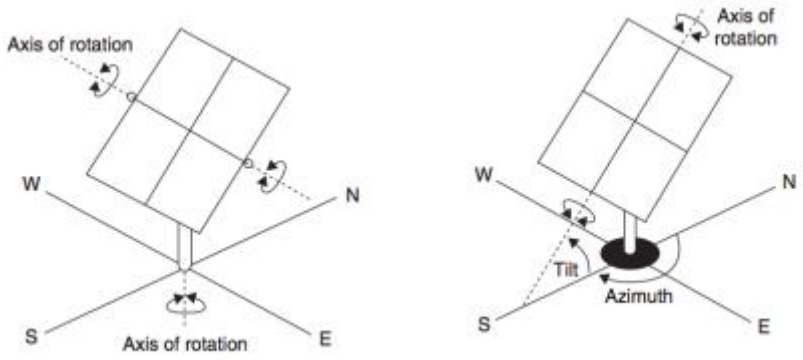

Figure 3: Different dual axis geometry

(https://kth.diva-portal.org/smash/get/diva2:1216641/FULLTEXT01.pdf)

The single axis trackers are less complex than dual axis trackers. They rotate around single axis, hence they require less amount of area for operation. The performance increase by using single axis tracker ranges between 17-34%.

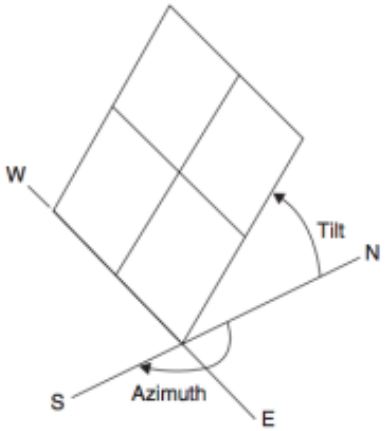

Figure 4: Single axis geometry

(https://kth.diva-portal.org/smash/get/diva2:1216641/FULLTEXT01.pdf)

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III. PROPOSED WORK/SYSTEM

The project named "Automatic Sun Tracking Solar Panel Mounting" is designed through installation of various components such as Solar Panel, Arduino Uno, Two LDR Sensor Module, Servo Motor, DC-DC converter.

The input system has two LDR module that is so used to form a voltage divider circuit, the programming of microcontroller is done through the software named Arduino ide. Lastly the driving circuit that has the Servo motor helps in rotating the solar panel. The two LDR sensor modules are takeover to the scaffolding with Arduino Uno analogue inputs. The light dependent resistors are then fixed along the length, on either side of the solar panel. With the help of LDR sensors the pattern is formed on the basis of which the solar plate rotates towards sun.

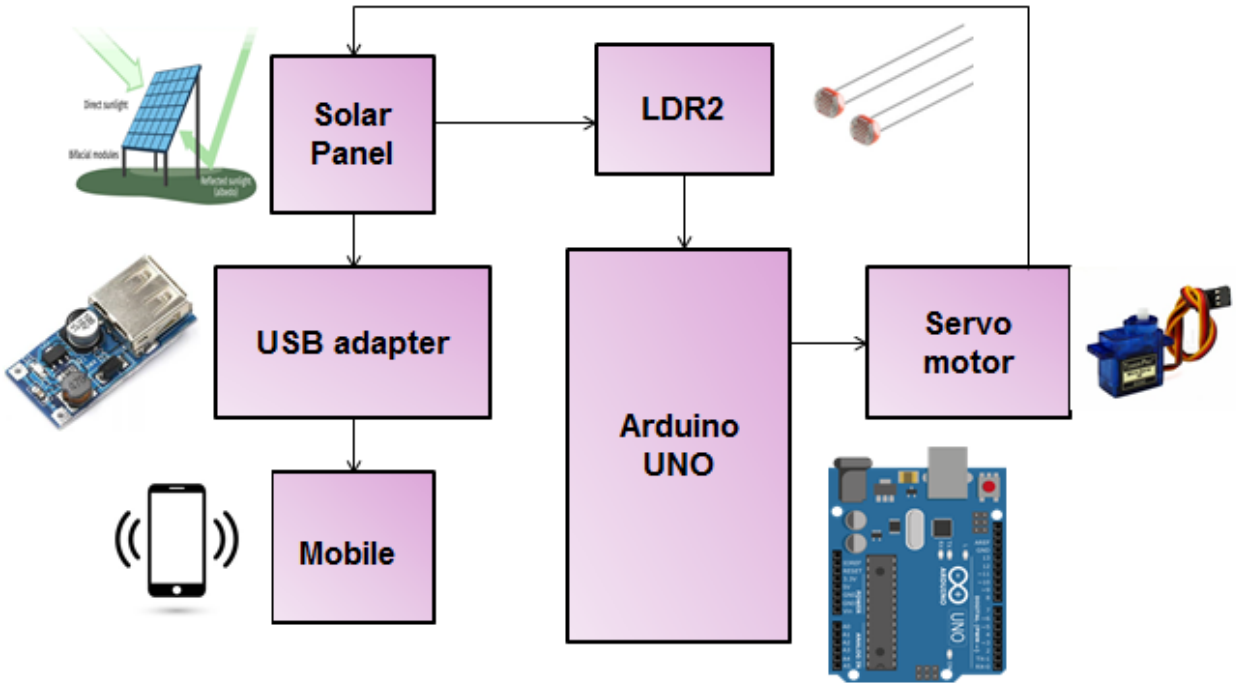

Figure 5: Block Diagram of Automatic Sun Tracking Solar Panel Mounting

Arduino:

The Arduino Uno is an single-board microcontroller. It can be powered with a 5 Volt external power supply or with Universal Serial Bus (USB). It uses ATMega328. The board has 14 input/output digital pins. The board also has 6 analog input pins and one reset button. The programming of the board is done with the Arduino IDE software. The programming language used is C with arduino library.

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LDR Circuit:

The LDRs have resistance of 18-50 kOhm when it is placed in light and 1 MOhms when placed in dark. When the light intensities of the two LDR become the same a secure state is obtained. The source of light energy, the sun starts moving from east to west. Due the movement of sun light intensities falling on the two LDRs varies. Comparison of light intensities is done inside the microcontroller and the motor is then commanded to rotate the solar panel.

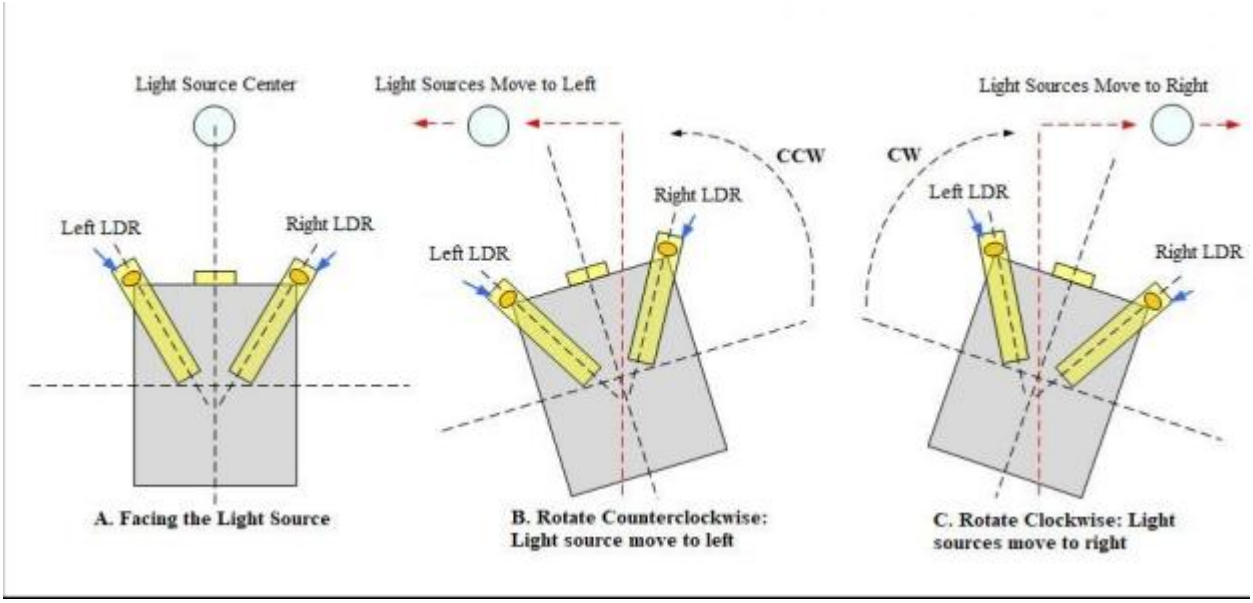

Figure 6: Reason for using two LDRs

(https://rcciit.org/students_projects/projects/aeie/2019/GR2.pdf)

IV. RESULT AND DISCUSSIONS

The Automatic sun tracking solar panel mounting follows the light source. It also works in cloudy weather. The energy harnessed by using Automatic sun tracking solar panel mounting is more than the energy harnessed by stationary panel mounting. We got to know that the solar tracking mounting with single-axis freedom can increase energy output drastically.

The assumed output is:

	With tracking			Without tracking		
S.No.	current (mA)	Voltage (V)	Power (mW)	current (mA)	Voltage (V)	Power (mW)
1	4.10	5.93	24.31	0.05	1.75	0.087
2	4.08	5.90	24.07	0.53	2.31	1.223
3	4.05	5.88	23.81	1.36	3.17	4.311
4	4.06	5.89	23.91	2.16	4.00	8.640
5	4.04	5.87	23.71	2.94	4.75	13.965
6	4.05	5.87	23.77	3.75	5.57	20.887
7	4.06	5.87	23.83	3.98	5.80	23.084
8	4.06	5.88	23.87	4.08	5.90	24.072
9	4.04	5.86	23.67	4.10	5.92	24.272
10	4.04	5.86	23.67	4.08	5.90	24.072
11	4.06	5.88	23.87	3.97	5.80	23.026
12	4.07	5.90	24.01	3.52	5.34	18.797
13	4.08	5.90	24.07	2.33	4.20	9.786
14	4.07	5.90	24.01	1.00	2.80	2.800

Figure 7: Data obtained when lamp was at 10 cm from the panel and its angular position was changing

(https://www.researchgate.net/publication/323735040_Sun_Tracking_Solar_Panel_System)

V. CONCLUSION

It is known that continuous utilization of the energy source can lead to scarcity of resource. Whereas, sun is the greatest source of light as its availability and freeness is concerned. And by using the automatic sun tracking solar panel mounting the generation of energy can be increased as compared to traditional stationary mounting. By using this design there is an assumed increment of minimum 5-10% in the generation of energy. In current scenario the demand for electric energy is increasing day by day and to fulfill the demand we need an everlasting source. Therefore, to store energy and charge electronic components use of solar panel and tracking mounting is essential.

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