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MULTI - DIRECTIONAL AUTOMATIC SOLAR TRACKER

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Abstract: The process of energy conservation has become quite predominant in the recent years since all the non - renewable energy sources such as fossil fuels, minerals, organic matters etc. Sun is the most versatile renewable source of energy and because of its everyday radiations we can acquire light and heat energy from it in a large manner. Solar panels are the ones used to convert its very light energy into electrical energy and to make it more efficient automatic solar trackers are developed in order to gain access to its energy till the very twilight which rotates according to the sun's direction so that sun rays can fall perpendicular to it so as to generate more amount of electricity than the regular solar panels.

Keywords - Photovoltaic effect, Solar panel, Solar tracker, LDR.

Introduction:

The sun was prehistorically used to determine the time as well as by plants for the process of photosynthesis which liberates oxygen in exchange of carbon dioxide from the nature . Alongside , the sun being the soul of the world it also bears some serious side effects of harmful radiations and hazards to the Earth . The sun has a surface temperature of about 5,600 degree Celsius while the inner core temperature reaches up to 15,000,000 degree Celsius . So , an entity having such a huge amount of energy is mostly unstable and thus releases a number of radiations alongside the visible light and some of them , especially the ultraviolet , tends to become extremely harmful and sometimes deadly to almost every life form on Earth .

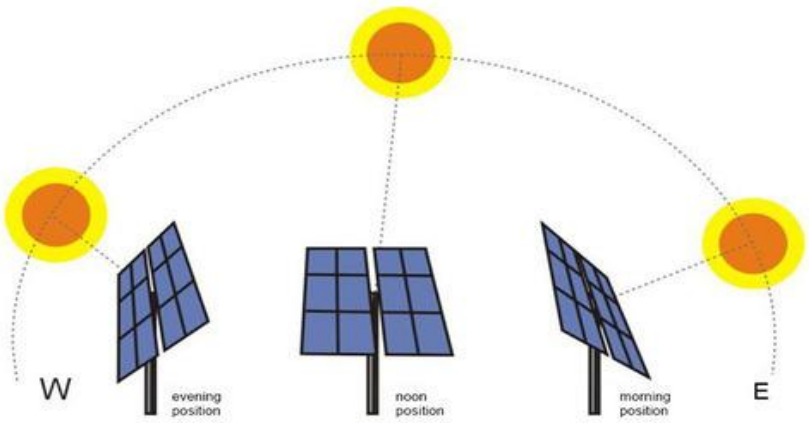

Fig - 1 : The angular tracking of the sun's direction

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One of the most modern uses of solar energy is the solar cell (photovoltaic cell) as well as the solar panels . Solar panels are arrays of solar cells which convert light energy into electrical energy thus generating both voltage and current .In order to make the most out of sun's energy , solar trackers are used intensively nowadays . These are basically solar panels attached to a light dependent resistor (LDR) , such that the panel itself moves according to the position of the sun in the sky and the sun's light energy which is falling on the panel will always be about 100% . So , in this way we are able to collect a large amount of energy which can be used for domestic household purposes as well as commercial purposes .Automatic Solar Trackers are used in probably every public places nowadays , such that railway stations , offices and in many domestic apartments .

Generally , solar trackers are of two types –> single - axis and dual - axis . In single - axis the solar panels will only move along one direction , vertical or horizontal but in dual - axis the panels would move in multiple directions and thus it is multidirectional . The idea of dual - axis trackers is mainly focused in the following .

Methodology:

It mainly consists of a stepper motor , previously used AC induction motors , rechargeable batteries , signal conditioning circuits , LDRs and a microcontroller (BasicX-24p) .

Besides having a very good efficiency it also bears some losses which are basically reflective losses where a small part of the incident sunlight gets reflected away from the panel . The amount of reflected light is also dependent upon the polarization of the incident light . The reflective loss is constant up to angles of incidence of around 50^{o} . Solar trackers are also made domestically using Arduino microcontroller as well .

It is based on the concept that two LDRs will be placed on either sides of the solar panel and as the voltage of LDR increases or resistance decreases as light falls on it , the difference between the two values of LDRs is calculated and the panel is moved by the servo or stepper motor towards the LDR which bears the greater voltage . At first , sunlight falls on the solar panel and since the tracker is dual axis two servo or stepper motors are used . The light energy is converted into electrical energy . As the sun moves away , the difference between the voltage values of the LDR increases and thus motor rotates towards the LDR of higher voltage .

The right alignment of the panels and the calculation of LDR values are all done by the microcontroller which is used in the tracker . The microcontroller is not specific for any tracker and a number of microcontrollers can be used i.e. Arduino, PIC , AVR etc .

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Schematic Diagram of the Procedure:

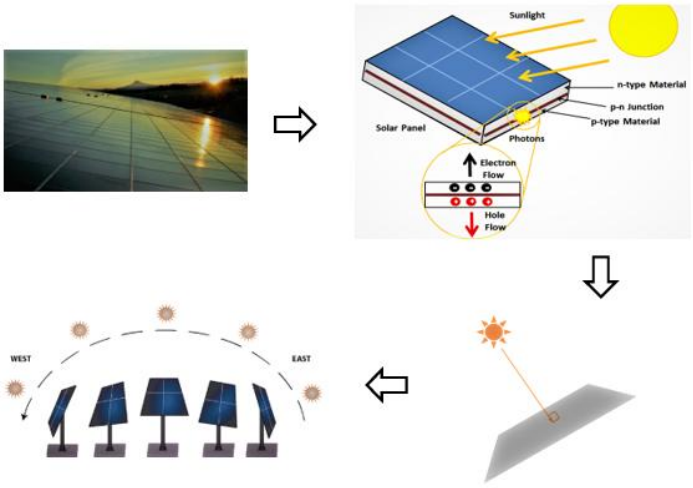

Fig. 2 : Schematic Diagram of the whole process of energy conversion via solar tracker

1) Sunlight falls on the surface of the solar panels thus , exciting the electrons in it and transferring them to higher energy levels .

2) The flow of electrons generate a significant amount of current in the panels . The process is known as photovoltaic effect , where light energy is converted into electricity . Photovoltaic effect is different from photoelectric effect on the basis that electrons are excited and moves inside the material only while in case of photoelectric electrons are excited and jumps out of the very material.

3) Sunlight is fallen on the solar panels in a perpendicular manner so as to achieve maximum efficiency of energy conversion .

4) The panels keep on rotating with respect to the sun throughout the day so as to maintain the similar level of energy absorption and generation of electric current as well .

Results:

Using dual - axis automatic solar trackers a significant amount of energy can be saved and conserved thus, it has turned out to be a commercially successful design . The average energy that can meet all the domestic and commercial needs are significantly high nowadays .

So , with the use of solar trackers , the power which is generated by the fixed solar panel , the solar tracking systems generate about 23% of more power. The results indicate that the solar tracking system generates approximately about 20% to 25% more power than the fixed panel . So , in solar tracking systems production power is rapid and thus , comes in handy and becomes money saving for many domestic purposes .

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LDR intensity	Output Voltage (V)
11	0.0538
372	1.8174
520	2.5379
607	2.9655
667	3.2545

Conclusion:

The above idea has been one of the citied and influential ones in the field of energy conservation and is widely used for commercial and domestic purposes . The average efficiency is around 40 - 50 percent which means it would require 40 - 50 percent less solar panels to produce the same amount of electric energy . India generates about 1,160.1 billion units of electric current per year which is still not enough to meet the needs of the large democracy . So , solar trackers turn out to be an important energy conserving unit for the whole world and even though the initial cost is quite high it works flawlessly for long time periods .

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