International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 05 | May -2020 ISSN: 2582-3930

SMART FLOWER:-An Intelligent Solar Panel System

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Abstract: This paper deals with the design and execution of a solar tracker system devoted to the PV conversion panels. The proposed double-axis solar tracker system ensures the optimization of the conversion of solar energy into electricity by properly adjusting the PV panel in accordance with the actual position of the sun. The operation of the experimental model (Smart Flower) is based on DC motors which are intelligently controlled by an Atmega microcontroller which moves a mini PV panel according to the intensity of the sunlight which is received by the four light dependent register.

Keywords: **Dual-axis solar tracker, design and implementation, experimental output, Efficiency, Solar energy.**

Introduction

The increasing demand for energy, the continuous reduction in non-renewable sources of fossil fuels has pushed mankind to invent new technologies for the production of electrical energy using clean, renewable sources, such as solar energy, wind energy, etc. Among the non-conventional, renewable energy sources, solar energy affords great potential for conversion into electricpower.

The conversion of solar energy into electrical energy represents one of the most promising and challenging energetic technologies, in continuous development, being clean, silent and reliable, with very low maintenance costs and minimum environmental impact. Solar energy is free, practically endless, and involves no polluting particles or greenhouse gases emissions.

The conversion principle of solar light into electricity, called Photo-Voltaic or PV conversion, is not very new, but the efficiency improvement of the PV conversion equipment is still one of the top priorities for many academic and/or industrial research groups all over the world.

In the process of converting solar energy to electricity, we use photovoltaic panels which consist of silicon made solar cells. The photovoltaic effect is the concept used in the panels where light energy due to the sun's radiation is converted into electric power. The conversion of solar energy into electric power also depends on the angle at which the panel is fixed or made to rotate. In the smart flower system, the aim is to obtain the more power from the panel by maintaining an angle of incidence as close to 90 degree as possible. Optimum solar energy levels can be obtained by using smart flower which have dual axes of freedom due to their ability to follow the sun vertically and horizontally.SOLAR TRACKING SYSTEM DESCRIPTION

Solar tracking system in comparison with the static rooftop system, the unit starts generation earlier in order to produce the more amount of electricity which we need. It consistently maintains the electricity supply and even uses the energy from the last sun rays efficiently enough to cover your early evening electricity requirements. At night, it automatically closes up to its initial position. The constant production rate during the whole day, in order to enable a more effective use of the produced energy. By adopting solar tracking system in place of existing fix solar panel we can increase 40 % efficiency. Off course some power is used for tracking purpose but till we got better efficiency. Since in single axis, the aim is that it can only track in any two directions. That is in east and west or in north and south. To achieve maximum output power that produced by solar panels as the sun moving across the sky and keeps the panel perpendicular to the radiation sun. We used two-axis solar tracking system with the help of light detecting sensors to achieve maximum efficiency.

Component of project:
Four solar panels of 10 watts, each has length 35 cm and width 30 Cm, Silicon mono/multi crystalline type.
Three DC motor with the rating of 12V DC
Five LDR (Light Detecting Resistor)
Solar charge controller Motor driver controller

The mechanical part:

The mechanical structure of the solar tracking system consists of fixed parts and movable parts to allow the system to track the movement of the sun throughout the day. The structure is designed to be portable to carry the system as well as be resistant to natural elements such as hail.
The first part of a design of structure is the strong base that can be carried the solar panel with motors, and also can be moved to change the place of the system. At the top of the base, one rotatory structure with caster wheels is mounted and it is for the purpose of rotation of whole solar system in 360-degree revolution in X-direction and also other supporting structure used to move the solar panels in Y-direction with the help of DC motors. Below figure.(1.a),(1.b) and (1.c) shows the different positions of the solar tracker system.

Fig.1.a: Panels at Initial Position

Fig.1.b: Panels in Open Position

Fig.1.c: Panels in Open Position

The electronic part:

Solar cells work to give more energy and better efficiency when they are at the right angle with the sun means solar radiation falling vertically on the solar cell that happens by using a solar tracking system that uses sensors that are detected thesunlight.

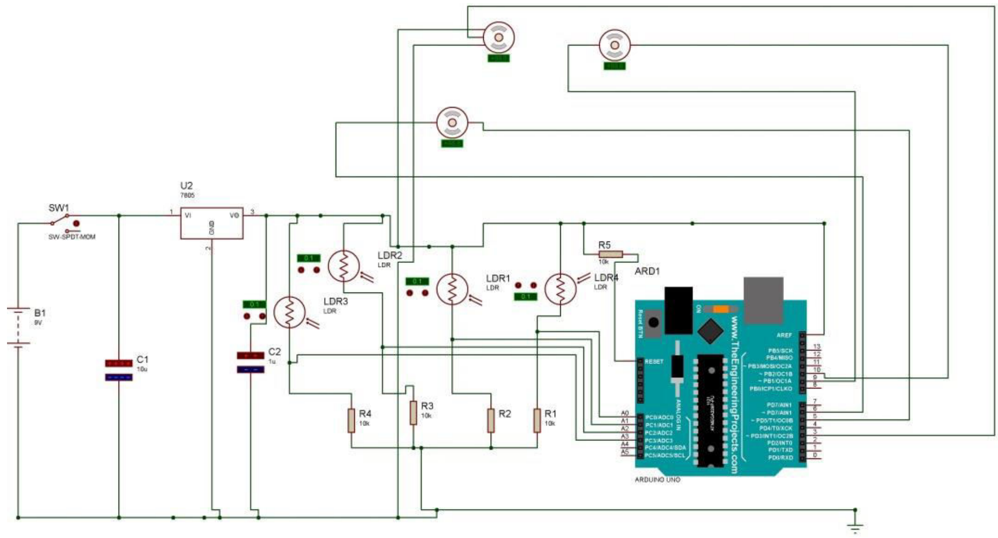

Fig. 2 Simulation Circuit of Solar Tracking System

Proteous Simulation of solar tracking system is shown in this fig.(2) As shown in above figure, four resistors (R1, R2, R3 and R4) are connected in series with the light detecting resistors. Now those LDRs and two capacitors are connected in parallel along with IC7812. Two capacitors are used for filtering purpose of voltage. It gives pure DC voltage at output and blocks the AC voltage. IC7812 is used for constant 12V output. This IC and LDRs are connected with battery for 12V DC supply. We use three DC motor in this system and which are controlled by arduino. Motor 1 is connected at pin number 5 & 6; Motor 2 is connected across pin number 7 & 8. While Motor 3 is connected at pin number 9 & 10. When sun radiation is fall on light detecting

resistors the change in resistance of LDRs is sensed by Atmega microcontroller which control the DC motors and according to that the position of the solar panels ischange.

Initially the position of sun is tracked by the LDR sensors in two directions. That is either in X direction or Y direction. LDR sensors module consists of five light dependent resistors. The working principle of LDR is when the intensity of the sunlight is increases the resistance of the LDR is decrease. These five LDRs are placed on a circular plate and separated by 90 degree space rotation through perpendicular rectangular plastic sheets. Now at morning when the sunlight is fall on the center LDR then it gives signal to controller and controller checks that the sunlight is sufficient or not. If sunlight is sufficient than it opens the solar panels via motors otherwise it remains in close positions. After opening of panels If one pair of the LDRs get more light intensity than the others, which create resistance difference and according to that analog signal is generated that is node voltage difference and this analog signal is given to ADC (Analog to Digital Converter) channel in controller and this data generates a logic signal to actuate the motor to move the tracker to a position.

The sensors generate logic signal that are responsible for movement of motor either in anti-clockwise and clockwise directions depending upon the comparison of intensity and shadow due to plastic sheets on the LDRs. If all the four LDRs are received equal intensity by the sun, then the analog voltage signals received at the ADC channel of the microcontroller will have equal values

and the microcontroller will not generate any logic signal to actuate the motors. Finally the output of the solar panel is delivered into two parts that is to the load and to the storage system via solar charge controller. Main purpose of charge controller is to stable the voltage level received from the solar panel to achieve the maximum power from thesystem.

Schematic Arrangement of Proposed System

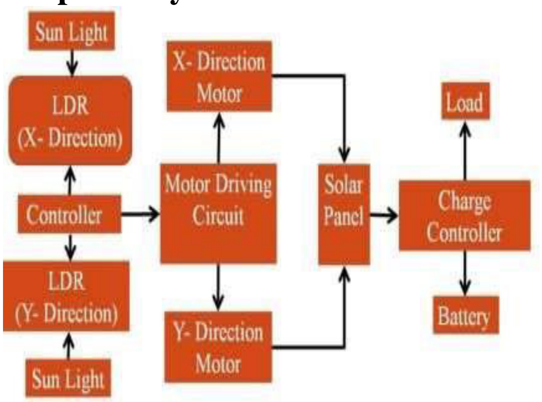

Fig. 3 Block diagram of Schematic Arrangement of proposed system

From the above fig.(3) we can say that when the sunlight is come on the LDR's the difference of intensity is measured by controller, which gives the command to the motor driving circuit and rotates the XY direction motor. According to that solar panel rotates in XY direction. Charge controller gives the constant DC output.

Efficiency of Dual-Axis Tracking System over Fixed Mount

Table 1 Efficiency of Dual-Axis Tracking System over Fixed Mount

Hours	Static Panel			Solar Tracking (Dual Axis)		
	Voltage	Ampere	Watts	Voltage	Ampere	Watts
08:00 AM	13.44	0.67	9.04	15.15	2.26	32.88
09:00 AM	13.67	0.94	12.94	15.28	2.24	34.24
10:00 AM	14.2	0.93	13.26	15.48	2.21	34.26
11:00 AM	14.85	1.32	19.65	15.75	2.34	36.96
12:00 PM	15.45	1.57	24.27	15.9	2.32	36.92
01:00 PM	15.95	1.84	29.38	16	2.38	38.18
02:00 PM	16.1	2.12	34.18	16.25	2.4	38.58
03:00 PM	15.3	1.91	29.28	15.84	2.34	37.21
04:00 PM	14.76	1.65	24.5	15.7	2.4	37.81
05:00 PM	1.45	1.45	19.76	15.5	2.27	35.32
06:00 PM	1.08	1.08	14.58	15.46	2.26	32.01

Average Power	20.98		35.85

Table No. (1) Efficiency of Dual-Axis Tracking System over Fixed Mount The readings for both the static panel and dual-axis tracker are taken for from morning 8 am to evening 6 pm for every one hour. Form the above Table No. (1) weclearly say that the output of dual axis solar panel system is more as compared to static solar panel system. Especially in the duration of morning and evening the efficiency of solar tracking system is extremely high as per the abovedata.

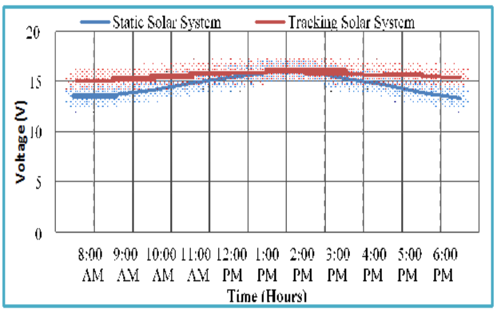

Fig.(4) Comparison of Voltage (V) for Static Solar and Dual Axis Solar Tracker system

Above Fig.(4) illustrate the magnitude of output voltages with respect to time (hours) of static solar and dual axis solar tracker system. As shown in this graph we can state that the difference in output voltage between given two systems at morning and afternoon is very large. So by using solar tracker system we get more output voltages even in morning and afternoon time as compare to static roof topsystem.

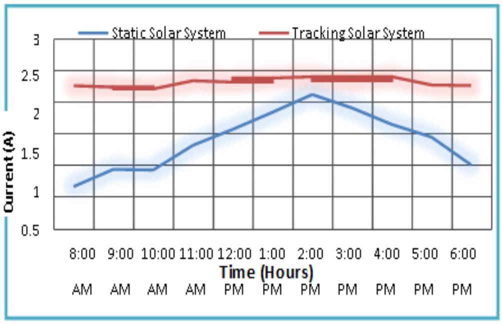

Fig.(5) Comparison of Current (A) for Static Solar and Dual Axis Solar Tracker system

Above Fig.(5) demonstrate the magnitude of output current with respect to time(hours) of static solar and dual axis solar tracker system. As we can see that the magnitude of current for static system is dynamic in nature and in peak time the value of current is maximum that is 2.12 Ampere and except the peak time value become lower. While on the other hand magnitude of the current in tracking system is approximately constant at 2.2ampere.

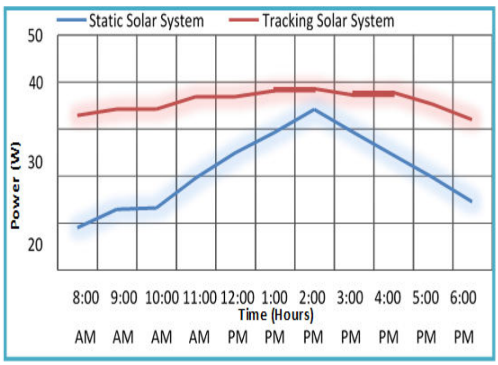

Fig.(6) Comparison of Power (Watt) for Static Solar and Dual Axis Solar Tracker System.

Above Fig.(6) shows the value of output power with respect to time (hours) of given system. As sown in above graph, the average value of output power for dual axis solar tracking system is nearly equal to 35.85 watts while the static solar system is produce only 21 watts throughout the day which is far lesser than the dual axis solar tracking system. So from above graph we can conclude that the output power of dual axis solar tracking system is 40% more than the static panelsystem.

Results and Discussion

As solar energy is considered one of the main sources of energy in the nearest future. In this paper, we give a simple overview of the solar tracking mechanism to improve the solar gain energy. Design and implementation of solar tracking system with two axes is done by with the help of LDR sensor to determine the intensity of falling sunlight. The energy received from the tracking system is approximately 40% greater than the fixed plate solar system.

In analysing the whole day generation data, the difference in energy generated from the solar tracker and static system, is mostly observe in the morning as well as in evening while at the noon time there is minor difference and this proves that the fixed solar panel is efficient during noon time only.
The results of this paper supports that the application of solar tracking systems are complicated and costly. However the annual energy production of the prototypes shows that the tracking systems can meet the same energy demand with fewer solar modules in comparison with the fixed systems. Thus it can be concluded that tracking systems are more practical when the utilization of the mounting area is required to be minimum. We found that the solar tracking system is more effective than the fixed solar panel.

ACKNOWLEDGMENT

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