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Performance Improvement of Solar PV Panel Using Reflectors and Bi-Axial Tilting Mechanism

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ABSTRACT: *Solar energy is becoming one of the important energy in the future as a great renewable energy source. Solar cells vary its performance under temperature changes. Change in temperature affects the power. The rapid development of solar PV cells has created challenging environment in the future. However the cost of electricity from solar PV cells is still several times higher than the conventional power generation. So it is very necessary to improve the efficiency of the solar PV cells. Efficiency can be increased either by changing PV material, concentrating solar rays or using solar tracking system. There are various methods for concentrating solar rays. In this study we used optimised angled collector for concentration and manual Bi-axial Sun tracking system. It is found that by using Collector of optimized size and biaxial tilting of the panel, performance of the PV cell panel is increase tremendously.*

Keywords: *Photovoltaic Cells, Bi-axial Sun tracking mechanism, solar energy, Optimised Collector*

I. INTRODUCTION

A large amount of energy is available within the core of sun. The energy that is received from sun in an hour is more than that is consumed by us in a year. If human is able to capture even 1% of the total energy which sun delivers then one can cater the need of our race for decades[1] Efforts are continuously being made to capture as much energy as we can in order to store most of the energy which we are getting.

Renewable energy solutions are becoming increasingly popular. Photovoltaic (solar) systems are but one example. Maximizing power output from a solar system is desirable to increase efficiency. In order to maximize power output from the solar panels, one needs to keep the panels aligned with the sun. As such, a means of tracking the sun is required. This is a far more cost effective solution than purchasing additional solar panels. It has been estimated that yield from solar panels can be increased by 30 to 60 percent by utilizing a tracking system instead of a stationary array [1]. This paper develops a Manual tracking system which will keep the solar panels aligned with the sun in order to maximize performance.

In this paper using Reflectors and Bi-Axial Tilting Mechanism, solar tracker has been discussed. Solar panels give maximum output when the plane of the solar panel is normal to incident radiations. we have traced the motions of the sun by Bi- axial tilting mechanism.

II. ADJUSTING THE TILT

There are two types of trackers (i) Single axis (ii) Dual axis. Single axis has one degree of freedom (only the daily rotation of earth is considered) while dual axis has two degrees of freedom (seasonal change in the position of sun is also considered).

For six months sun remains towards northern side and for next six months it remains towards southern side [2]. Dual axis trackers are designed to follow exact path of sun during these seasonal changes.

The output which we get from Bi Axial is more than that obtained from single axis but it also requires more input as it has more complexity. In this study, the simple construction of fixture is designed. It is useful to position collector as well as solar panel according to sun position. The fixture consist of a rod, perpendicular to a surface, parallel to solar panel as shown in figure(3). The exact path of sun is followed manually by using this fixture. In this paper biaxial mechanism for solar Panels has been discussed.

III. METHODS USED FOR TILTING

To get tilting motion of the panel with collector we have used simple mechanism of rotation of semicircular bar on fixed path. In this we have used 12mm square bar, bended into semicircle curve. A guide is provided for the motion of the bar on its perimeter as shown in fig (2) .we have achieved this motion manually. In which we connected dead weight at one side end and a wire on other side for adjusting the tilt. We have achieved this motion for tracing the sun. To trace the exact path of the sun we have given rotational motion in which we have used mechanical pair as shown in fig (3).The male part rotates in the female part and rotational motion is achieved. We rotated the whole assembly manually by a string attached at one end.

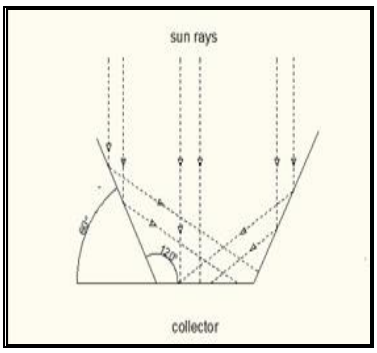

Figure 1. Concentrating rays

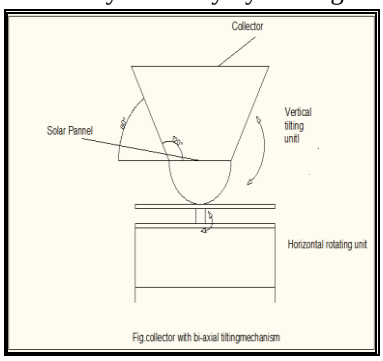

Figure 2. Biaxial Tilting Mechanism

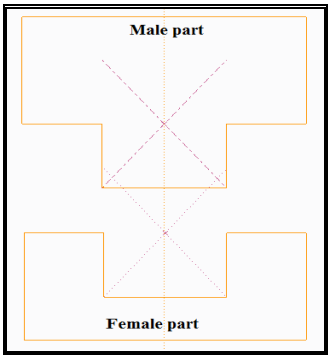

Figure 3. Mechanical pair

IV. EXPERIMENTATION

The experimentation is carried out in order to determine the performance of the biaxial solar tracking PV panel with collector in comparison with a regular position PV panel (45 degree in south direction) without collector. The two PV panels were subjected to the same solar radiation conditions at the same time and the energy output of each panel was monitored and tabulated.

For experimentation we have used a Solar panel of 6 volt 5 watt Capacity (Specification Imax 0.58Amperes, Vmax 8.7volts). We have taken reading of Voltage and Current produced by the panel. We have taken the reading throughout the day for various positions of the panel.

1. Panel at 45 degree placed without collector
2. Panel normal to the sun rays without collector
3. Panel normal to the sun rays with collector.

If the angle of reflectors is not proper, the sunlight will skip off the surface of reflector without entering into collector. We have used optimized collector having angle of 120o , due to which incident ray will not go away from the collector. Efficiency of collector is a function of the total area exposed to the sun and the effectiveness of collection [3].

V. RESULTS

In this Study we have tabulated readings of current, voltage and power produced. The readings were taken for performance of panel at three positions. It is observed that performance of the panel with collector and with bi axial tracking is nearly 2.5times the performance of the stationary panel (45 degree in south direction) & tilted panel.

Table No.- 1. Panel at 45 degree placed without collector

Sr. No	***Time***	***Current***	***Voltage***	***Power***
1	*10.00am*	*0.22*	8.8	1.93
2	*11.00am*	*0.28*	8.9	2.44
3	*12.00noon*	*0.37*	9.7	3.58
4	*1.00pm*	*0.41*	8.77	3.59
5	*2.00pm*	*0.34*	9.73	3.56
6	*3.00pm*	*0.39*	9.14	3.33
7	*4.00pm*	*0.27*	8.5	2.29
8	*5.00pm*	*0.24*	8.9	2.13

Table No.- 2. Panel normal to the sun rays without collector

Sr. No	***Time***	***Current***	***Voltage***	***Power***
1	*10.00am*	*0.315*	*9.8*	*3.08*
2	*11.00am*	*0.331*	*9.76*	*3.23*
3	*12.00noon*	*0.4*	*8.81*	*3.5*
4	*1.00pm*	*0.384*	*8.98*	*3.44*
5	*2.00pm*	*0.366*	*8.40*	*3.07*
6	*3.00pm*	*0.317*	*8.56*	*2.71*
7	*4.00pm*	*0.270*	*8.35*	*2.254*
8	*5.00pm*	*0.252*	*9.73*	*2.45*

Table No.- 3. Panel normal to the sun rays with collector

Sr. No	***Time***	***Current***	***Voltage***	***Power***
1	*10.00am*	*0.740*	*9.98*	*7.35*
2	*11.00am*	*0.931*	*9.12*	*8.49*
3	*12.00noon*	*0.85*	*9.5*	*8.075*
4	*1.00pm*	*0.89*	*8.32*	*7.4*
5	*2.00pm*	*0.90*	*8.46*	*7.61*
6	*3.00pm*	*0.899*	*9.92*	*8.91*
7	*4.00pm*	*0.804*	*8.87*	*7.13*
8	*5.00pm*	*0.678*	*8.74*	*5.92*

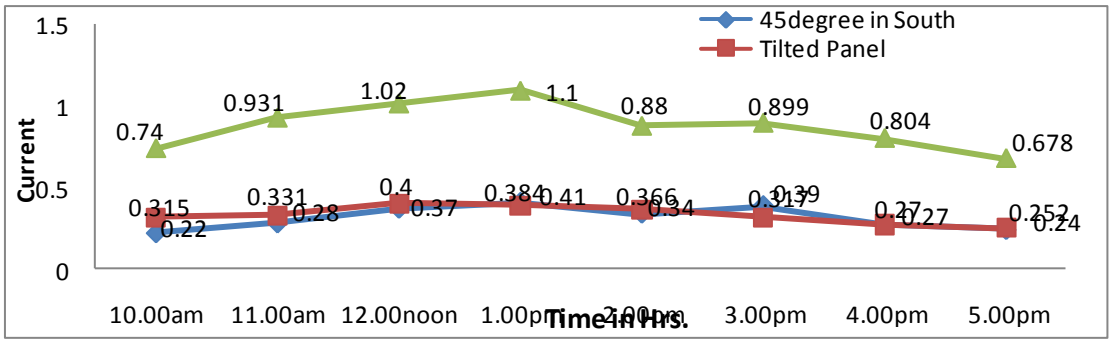

Figure 4.Current vs Time Graph

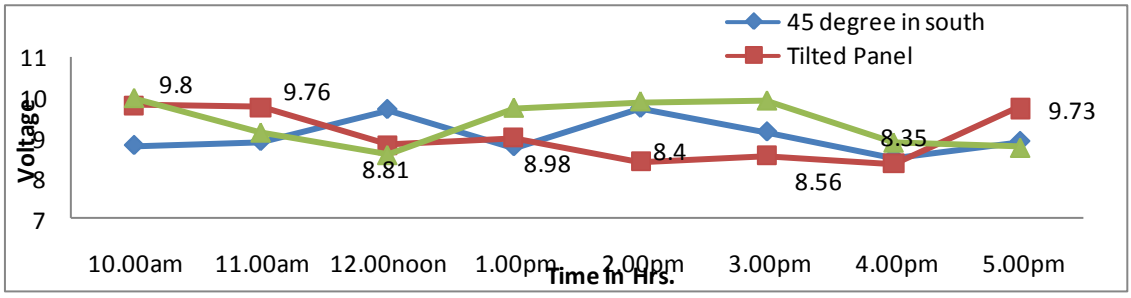

Figure 5.Voltage vs Time Graph

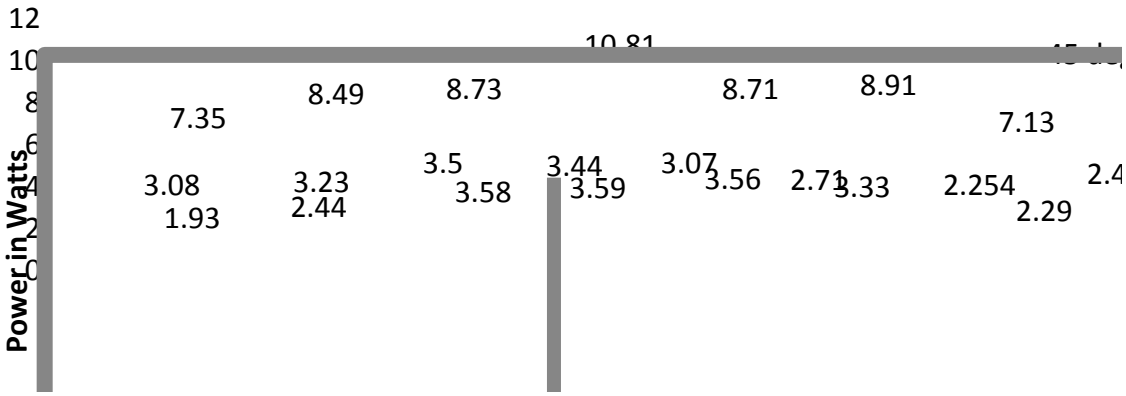

Figure 6. Power vs Time Graph

VI. ADVANTAGES

i. The main advantage of this system is maximum amount of power generated due to the biaxial motion..
ii. The total cost of tilting and tracking mechanism is less than the 25% that of cost of panel required to generate the same power.
iii. It produces 2.5 times more power than regular position of the solar panel.
iv. The construction of mechanism is very simple and handling of the system is very easy.
v. This mechanism can be used for solar oven and solar cooker and other solar equipments such as thermal solar heater.

VII. FUTURE SCOPE

i. In future this Tilting mechanism with collector can be implemented on large solar plants and also can be operated automatically.
ii. We can make the work very easy with the help of electric tilting mechanism. We are working on the same to implementing automation for same mechanism with electric or mechanical actuators or components.
iii. This mechanism can be implemented on the Solar Cookers, Ovens, Driers and on thermal Solar heater.

VIII. CONCLUSION

The purpose of the proposed paper is to implement Bi-Axial system with collector effectively. The designed tracker for sun rays is found worked efficiently. The bi-axial tracking system was found effective than single axis tilting mechanism. Due to use of collector on the panel the performance of the panel is doubled. The extracted power was found increased significantly by using Bi-Axial tilting Mechanism. The same mechanism can be used for solar apparatus like oven, cooker, heaters, etc.

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