Comparative Results of Single Axis Solar Tracking System with Dual Axis Solar Tracking System Using Mono-Crystalline Solar Panel

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Abstract — In today's life, Electric power is most useful source generated from the air & water. The usage of electricity is rapidly increasing due to globalization and industrialization. Thus to reduce the load on power generation, there is a need to search for an alternate source of energy. Solar energy is one of the sources for the generation of electricity from the sun energy. Solar panels are photovoltaic panels which absorb sun's radiation and convert them into electricity efficiently. But, the sources (Fixed solar panel system) used for conversion of radiation into electricity are slightly inefficient. This inefficiency of fixed mount solar system is eliminated by using the solar trackers. Solar tracker is an arrangement done with the solar panel to determine the exact position of the sun radiation and change the position of the panel accordingly. This paper describes the comparison between single axis solar trackers and dual axis solar trackers using mono-crystalline solar panel.

Key Words — Dual axis solar tracker, Mono-crystalline solar panel, Single axis solar tracker

I. INTRODUCTION

During last two decades, the electric power has become the basic need for residential and industrial purpose. Nowadays, the electricity is used in abundance so that, researchers were compelled to find an alternate source of energy which leads to discovery of solar energy. Solar energy is inexhaustible, ecofriendly and can be easily converted into electricity using photovoltaic panels. These panels consist of silicon cells which are activated by the sun's radiation after incidence and cause the electrons to revolve in a circuit resulting in electricity generation. The conversion of radiation into electricity depends upon the angle at which the solar panel is mount. There are two types of panel usage 1) Fixed mount & 2) Solar tracker. Fixed mount solar panels are less efficient as the radiations are not fixed in direction throughout the day. This inefficiency can be overcome by using solar trackers. Trackers are used to minimize the angle of incidence between the incoming sunlight and a photovoltaic panel. Again the solar trackers are of two types a) Single axis tracker & b) Dual axis tracker. In this paper we have experimentally verified the results of single axis tracker with dual axis tracker.

II. SINGLE AXIS SOLAR TRACKING SYSTEM

Single axis trackers have one degree of freedom that acts as an axis of rotation. The axis of rotation of single axis trackers is typically aligned along a true North meridian. It is possible to align them in any cardinal direction with advanced tracking algorithms. There are several common implementations of single axis trackers. These include horizontal single axis trackers (HSAT), vertical single axis trackers (VSAT), and tilted single axis trackers (TSAT). For our convenience we have used tilted single axis trackers (TSAT). The tilted single axis tracking system consists of two LDR's placed on either side of the panel. Depending on the intensity of the sun rays one of the two LDR's will be shadowed and the other will be illuminated. The LDR with the maximum intensity of the sun's radiation sends stronger signal to the controller which intern sends signal to the motor to rotate the panel in the direction in which the sun's intensity is maximum[1].

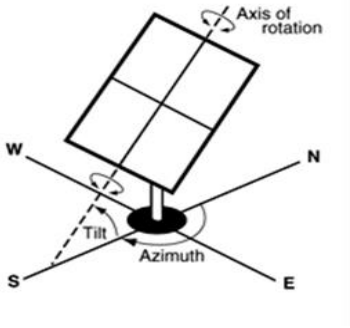

Fig. 1 Single axis tracker

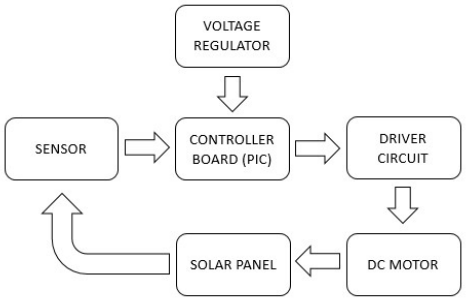

Fig. 2 Block Diagram of Tilted Single Axis Solar Tracking System

III. DUAL AXIS SOLAR TRACKING SYSTEM

Dual axis trackers have two degrees of freedom that act as axes of rotation. These axes are typically normal to one another. The axis that is fixed with respect to the ground can be considered a primary axis. The axis that is referenced to the primary axis can be considered a secondary axis. There are several common implementations of dual axis trackers. Two common implementations are tip-tilt dual axis trackers (TTDAT) and azimuth-altitude dual axis trackers (AADAT). The dual-axis works in the same way as the single-axis but measures the horizontal as well as the vertical axis. The dual axis tracker [6] consists of two sets of phototransistor sensors, two AC motors and PIC controller. One set of sensors and one motor is used to tilt the tracker in sun's east - west direction and the other set of sensors and the other motor which is fixed at the bottom of the tracker is used to tilt the tracker in the sun's north-south direction. When the sun moves in the northern direction the tracker has to track the path of the sun in anti-clockwise direction along the horizontal axis (east to west). If the sun moves in the southern direction then the tracker has to track the path of the sun in clockwise direction. The sensor senses the light from the sun and sends the signals generated by them to the microcontroller. The controller detects the stronger signal and commands the motor to rotate in clockwise or anti-clockwise direction accordingly.

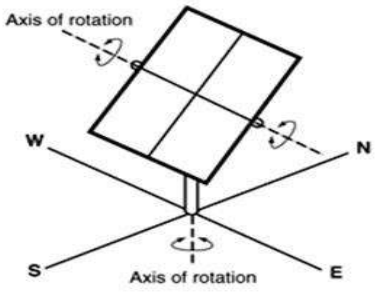

Fig. 3 Dual axis tracker

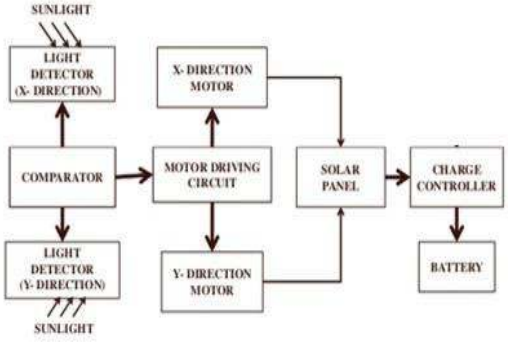

Fig. 4 Block Diagram of Dual Axis Solar Tracking System

Fig. 5 Experimental setup of Dual Axis Solar Tracking System

IV. OBSERVATIONS

Table 1.Comparison of Single Axis Tracker Vs Dual Axis Tracker

Date: 12/03/2018
Place: Yavatmal, Maharashtra (M.S.)

TIME	SINGLE AXIS TRACKER			DUAL AXIS TRACKER		
	Output Voltage (V_{oc}) Volts	Short Circuit current (I_{sc}) mA	Output Power (mW)	Output Voltage (V_{oc}) Volts	Short Circuit current (I_{sc}) mA	Output Power (mW)
07:00 - 08:00AM	10.50	1.65	17.325	18.20	2.87	53.25
08:00 – 09:00AM	11.80	1.73	20.414	18.20	2.87	57.46
09:00 – 10:00AM	12.00	1.94	23.28	20.42	2.95	60.239
10:00 – 11:00AM	12.82	2.33	29.87	21.05	3.18	66.939
11:00 – 12:00PM	13.87	2.65	36.75	23.50	3.15	74.025
12:00 – 01:00PM	13.67	3.15	43.06	24.01	3.30	79.233
01:00 – 02:00PM	13.19	3.00	39.57	22.06	3.36	74.12
02:00 – 03:00PM	12.60	2.87	36.162	21.10	3.24	68.364
03:00 – 04:00PM	12.60	2.58	32.508	20.60	3.25	66.95
04:00 – 05:00PM	12.10	2.38	28.798	19.70	3.07	60.479
05:00 – 06:00PM	11.00	1.82	20.02	17.00	2.77	47.09

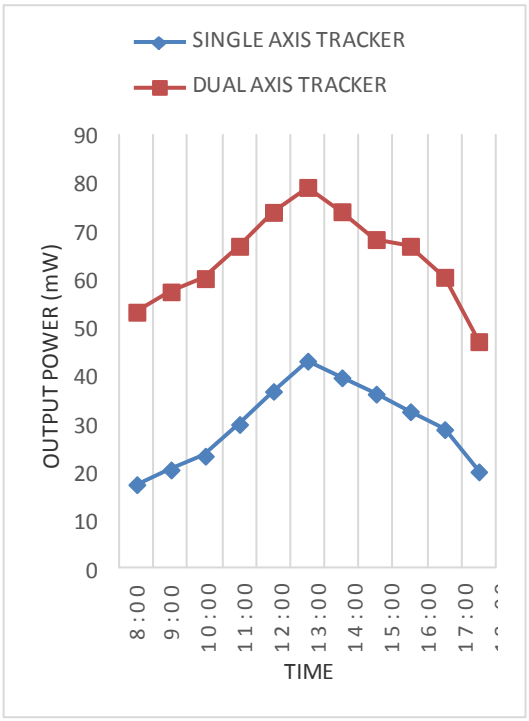

Fig. 6 Simulation of result for comparison of Single Axis Tracker Vs Dual Axis Tracker

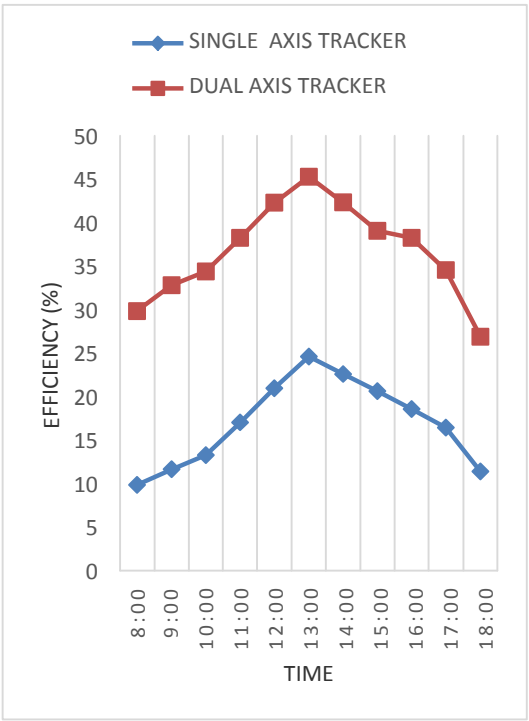

Fig. 7 Efficiency curve of Single & Dual Axis Solar Tracking System

V. Future Scope

The efficiency of the single & dual axis solar tracking concave lens on top of the panel [7] also by using mono-crystalline solar panel, since large amount of sunlight is also can reduce the size of the solar cell required to generate large power.

Conclusion

sun throughout the year. From the above graphs it can be stated that the power output and efficiency of dual axis sun tracking system. The dual axis sun tracking system is 44.28% more efficient than that of the single axis sun tracking system using mono-crystalline solar panel except it's installation is more complex and costly as compared to single axis sun tracking system due to microcontroller programming and power circuit arrangement.

References

[1] Deepthi.S, Ponni.A, Ranjitha.R, R Dhanabal, "Comparison of Efficiencies of Single-Axis Tracking System and Dual-Axis Tracking System with Fixed Mount" International Journal of Engineering Science and Innovative Technology (IJESIT) Volume 2, Issue 2, March 2013

Tracking Controller Project", Intelligent Control and Automation 2011, 2, 57-68.

Munir, "A Design of Single Axis Sun Tracking System", the 5th International Power Engineering and Optimization Conference (PEOCO2011), June 2011.

[4] Tiberiu TUDORACHE, Constantin Daniel OANCEA and Liviu KREINDLER, "Performance Evaluation of A Solar Tracking PV Panel", U.P.B. Sci. Bull., Series C,

[5] Kais I. Abdul-lateef, "A Low cost single-axis sun tracking system using PIC microcontroller", Diyala

pp.65-78, June 2012.

[6] M. Serhan and L. El-Chaar, "Two Axes Sun Tracking System: Comparison with a fixed system", International Conference on Renewable Energies and Power Quality (ICREPQ'10), March 2010.

[7] Dhanabal.R1, Bharathi.V2, Ranjitha.R3 , Ponni.A4, Deepthi.S5 ,Mageshkannan.P6, "Comparison of Efficiencies of Solar Tracker systems with static panel Single-Axis Tracking System and Dual-Axis Tracking

System with Fixed Mount", International Journal of Engineering and Technology (IJET) ISSN : 0975-4024 Vol 5 No 2 Apr-May 2013.

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