A SURVEY ON THE SUN TRACKING SYSTEMS AND ITS PRINCIPLE FOR GETTING MAXIMIUM SUN RADIATION

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Abstract. **Discovering different energy resources to full fill the world growing demand is now one of the society's bigger challenge for the next half-century. The main task is to convert the sun radiation into electricity via photovoltaic solar cells which is suddenly decreasing $/watt of delivered solar electricity. Therefore, in this context the sun trackers are those devices that can be used to ameliorate efficiency. In this paper, a variety of the sun tracking systems are evaluated and their merits and demerits are highlighted. The most adept and proficient sun-tracking devices are polar axis and azimuth - elevation types.**

Keywords: Dual Axis, Fixed Axis, Sun Tracker.

INTRODUCTION

Nowadays, with the advancement in the technology and in research and development there exist many reasons why renewable sources are getting more reliable. The people attention are diverting now towards the renewable energy resources due to the continuous environmental threads and shortage of the fossil fuel around the globe. These renewable resources are the sign of the unlimited energy potential for the future. The significance of the solar energy as a renewable energy resource is growing all over the world and is so called as the Green Energy[1] and now became a key source of the energy. The solar cells connected within the panels are the primary components of the photovoltaic (PV) systems. They use to change the available solar radiation directly into the electricity. Conversion of the solar energy is the hot topic these days that attracts people attention .A extensive research has been carried out to develop different methods to convert solar radiation into electric and thermal energy.

The atmospheric condition is the key factor for the solar radiation that reaches on the earth surface. However, the solar rays that reaches on the solar cell can be affect by a proper control of the sun tracking system. Despite of the fact that solar energy being a proficient source of energy, there is still a need to improve the methods to harness this energy[2]. This can be attain by axial tracking and maximum power point tracking. Sun tracking is a technique that is use to constantly track the sun's direction throughout the day to increase the efficiency of the system. It can be enact by using an actuator and sensors. Position can be control in two directions i.e. horizontal and vertical using two different motors.

LITERATURE REVIEW

As the technology is getting mature and the use of the fossil fuel leads to the environmental pollution, the demand of the solar energy is growing tremendously for the last few years and now became a major source of renewable energy. Thermal energy storage systems and electric power generation systems use collectors in the form of optical reflectors or Photovoltaic (PV) modules to collect the solar radiation. The amount of the energy collected by a fixed system during the day is minimum than the peak value attainable. The main reason of collecting minimum energy is the static placement of the collector, which decreases its area of exposure to direct sun radiation [1]. Maximum energy can be achieve in a day, if the solar panel is mounted on a tracker, with a motor that follows the sun like a sunflower. As sun is a moving object, the fixed panel system is not a good technique for extracting the maximum energy. Another solution is to follow the sun trajectory by installing a sun-tracking device to rotate the solar collector to follow the Sun. With the Sun always facing the panel, the maximum energy can be extracted and the panel is operating at their highest efficiency [3].

The term "Solar Tracker" is mostly used to describe the devices that contains various payloads towards the sun. Trackers can enhance the PV system output by up to 50 % as compared to the fixed tilt system by direct exposure of the sun on the Panels .This increase in the output depends upon the type of tracker used. Single axis trackers 5-10% [4], while dual-axis trackers can lead to an increase of 35-45% [5] .

A lot of work has been done on controlling strategies of trackers.[6] has used a PID controller for adjusting DC motors in a tracker. It has also been concluded in that fuzzy logic is a more suitable technique. [7] and [8] have used a fuzzy logic controller for tracking. Khlaichom et al. developed a closed loop control using genetic algorithm (GA) technique for a dual axis tracking system. The tests and analyses explained that the solar tracking system using GA increases the output voltage to 7.1% as compared to that with no GA [9] . [10] has proposed a dual axis sun tracking and discuss the development of GA-based solar tracking system by orienting PV panel on two axis to obtain maximum power. In [7] the researchers proposed a sun tracking system, which uses the fuzzy logic control approach to control the stepper motors. [11] has developed a fuzzy knowledge-based computer controlled sun tracking system.

J. Armendariz presented a novel dual-axis solar tracking controller. The structure of the control system depends upon fuzzy rules constructed by means of the astronomical yearbook records [12]. [13] has simulated a dual axis sun tracker for Photovoltaic panels and proved the significance of the virtual prototyping in the design of the tracking system, open loop systems used to control the tracking mechanism. Freddy in [14] developed an algorithm using adaptive step perturbation method that can search the maxima location for the V_{oc}. In [15] authors have presented the simulation of a dual axis sun tracking system in Matlab, their simulation consists of the four modules solar tracking cell, signal conditioning, Controller and motor driver. They developed an algorithm for the controlling of the motors position.

CLASSIFICATION OF TRACKING SYSTEM:

The tracking systems are classified in to two types.

- Active tracking systems
- Passive tracking systems

Active tracking systems:

Active tracking systems employs the use of the sensors for measuring the position of the sun in the sky. It works on the principle of measuring the elevation and azimuth angle of the sun by using different kinds of the sensors to adjust the Panels.

The control algorithm uses the information from the sensors to estimate the sun's real position. Major active trackers can be categorized as PC controlled date and time based, auxiliary bifacial solar cell based, microprocessor and electro-optical sensor based and a combination of these three systems. Further divide the active tracking systems can be into following types as shown in the figure 1.

Passive tracking systems:

Passive trackers do not use any electronic control or motor, they uses mathematical formulae to predict the sun's motion and need not to sense the sunlight. These systems have limited accuracy but are simple due to the absence of the motors and any other electronic controls systems.

CONCLUSION

By reviewing, all the researched articles sun-tracking systems can be further be classified into one-axis or two-axis devices. However, the tracking surfaces including passive or active trackers may also be categorized as shown in figure 1.

REFERENCES

[1] H. H. G. B.C. Kok, H.G. Chua "Optimal Power Tracker for Stand-Alone Photovoltaic system using Artificial Neural Network (ANN) and Particle Swarm Optimization (PSO)," in *International Conference on Renewable Energies and Power Quality (ICREPQ'12)*, spain, 2012.

[2] M. o. N. Resources, "Photovoltaic Project Analysis," Clean Energy Decision Support Centre Canada2001-04.

[3] A. Ponniran, A. Hashim, and H. A. Munir, "A design of single axis sun tracking system," in *Power Engineering and Optimization Conference (PEOCO), 2011 5th International*, 2011, pp. 107-110.

[4] M. T. A. Khan, S. M. S. Tanzil, R. Rahman, and S. M. S. Alam, "Design and construction of an automatic solar tracking system," in *Electrical and Computer Engineering (ICECE), 2010 International Conference on*, 2010, pp. 326-329.

[5] F. R. Rubio, M. G. Ortega, F. Gordillo, and M. López-Martínez, "Application of new control strategy for sun tracking," *Energy Conversion and Management*, vol. 48, pp. 2174-2184, 2007.

[6] A. Yazidi, F. Betin, G. Notton, and G. A. Capolino, "Low cost two-axis solar tracker with high precision positioning," in *Environment Identities and Mediterranean Area, 2006. ISEIMA '06. First international Symposium on*, 2006, pp. 211-216.

[7] Y. Zhou and J. Zhu, "Application of Fuzzy Logic Control Approach in a Microcontroller-Based Sun Tracking System," in *Information Engineering (ICIE), 2010 WASE International Conference on*, 2010, pp. 161-164.

[8] M. A. Usta, O. Akyazi, and I. H. Altas, "Design and performance of solar tracking system with fuzzy logic controller used different membership functions," in *Electrical and Electronics Engineering (ELECO), 2011 7th International Conference on*, 2011, pp. II-381-II-385.

[9] S. K. Khlaichom P, "Optimization of solar tracking system based on genetic algorithms," 2006.

[10] S. Mashohor, K. Samsudin, A. M. Noor, and A. R. A. Rahman, "Evaluation of Genetic Algorithm based solar tracking system for Photovoltaic panels," in *Sustainable Energy Technologies, 2008. ICSET 2008. IEEE International Conference on*, 2008, pp. 269-273.

[11] H. A. Yousef, "Design and implementation of a fuzzy logic computer-controlled sun tracking system," in *Industrial Electronics, 1999. ISIE '99. Proceedings of the IEEE International Symposium on*, 1999, pp. 1030-1034 vol.3.

[12] C. O.-E. J. Armendariz, F. Mar-Luna, and E. Cesaretti "Dual-Axis Solar Tracking Controller Based on Fuzzy-Rules Emulated Networks and Astronomical Yearbook Records," in *WCE 2013*, London, 2013.

[13] B. N. G. Hussain A. Attia , and Yousif I. Al-Mashhadany, "Design and Simulation of Dual Axis Solar Tracker for Optimum Solar Energy Absorption," American University of Ras Al Khaimah, UAE, 2011.

[14] S. Dasgupta, F. W. Suwandi, S. K. Sahoo, and S. K. Panda, "Dual axis sun tracking system with PV cell as the sensor, utilizing hybrid electrical characteristics of the cell to determine insolation," in *Sustainable Energy Technologies (ICSET), 2010 IEEE International Conference on*, 2010, pp. 1-5.

[15] D. L. G. M. J. H. D. A. W. Otieno, "Design and Simulation of a Sun Tracking Solar Power System," in *120th ASEE Annual Conference & Exposition*, Atlanta.

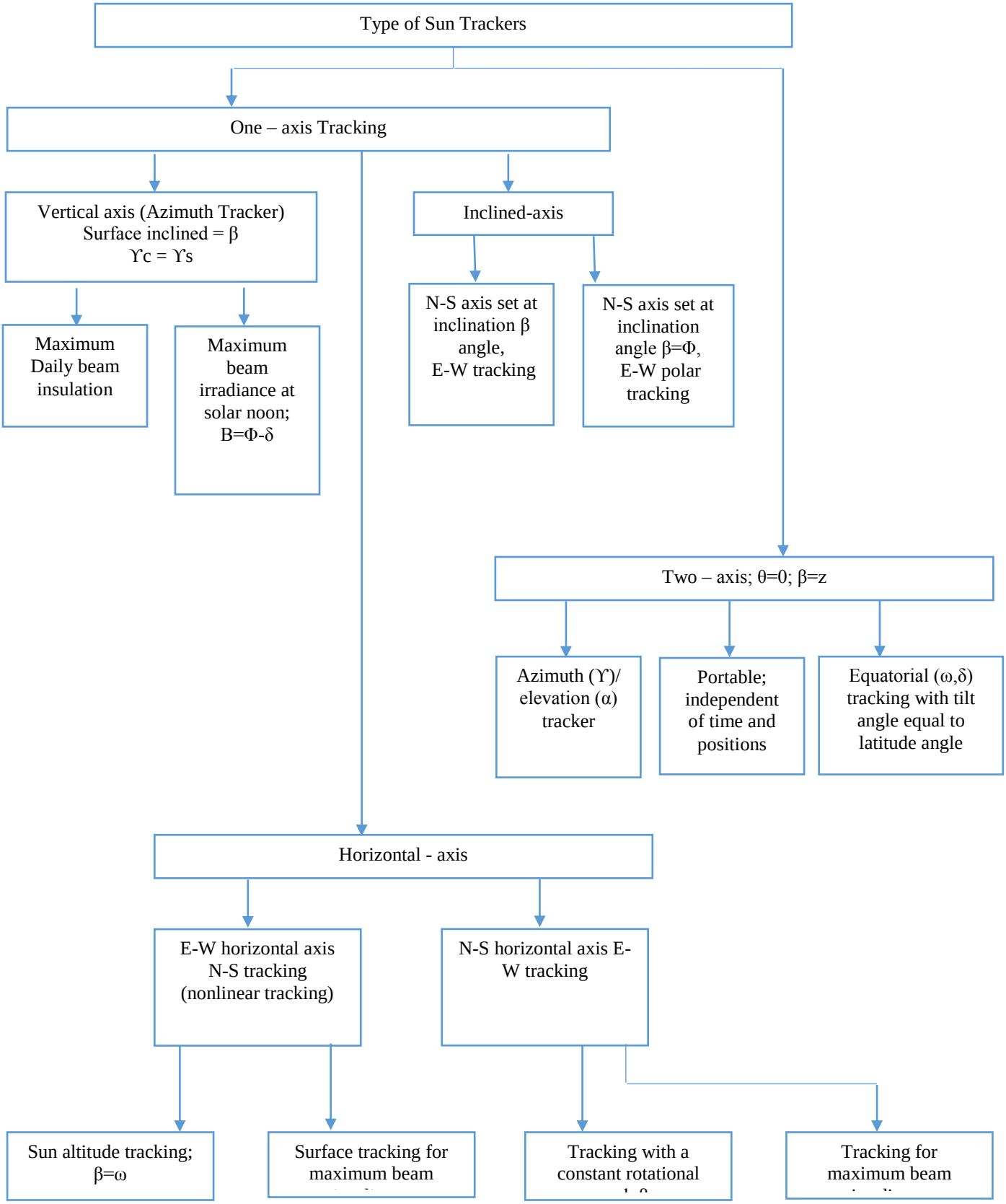

Figure 1 Types of the Sun trackers.