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Comparison of Various Solar Tracking Technique: Review Paper

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ABSTRACT

This paper describes different solar tracking method for tracking sun position and getting maximum solar power point. In recent time power generation is one of the biggest problem in sustainable growth. The sun tracking solar system allows step up of solar panel power ratio. So, to illustrate this concept, this paper presents a basic and didactical small scale system for educational application and sensitizing deed. Different sun tracking solar tracking described in this paper are MMPT, dual axis solar tracking system, Automatic solar tracking system , High precision solar tracking system, Finite element method of solar collector's tracking system.

Keywords: MPPT(Maximum power point tracking).

i. INTRODUCTION

Recently, much attention has been given towards the study of Photovoltaic (PV) cells and their conversion efficiencies. It is necessary to provide PV systems with Maximum Power Point Tracking (MPPT) controllers in order to draw maximum electrical power from the PV modules under varying loads and atmospheric conditions[1]. The tracking systems of the solar collectors are used to orient the solar collector normal to the solar radiation, in the way to catch the maximum amount of

light from the sun[2]. solar energy is rapidly getting popularity as an important means of expanding renewable energy resources. But most of the solar panels in are positioned on a fixed surface such as roof. As sun is a moving object, this approach is not the best method. One of the solutions is to use a solar tracker that will actively follow the Sun. A solar tracker is a sensory device built with the solar panel which tracks the motion of the sun across the sky and moves the solar panel according to that motion of the sun, ensuring that the maximum amount of sunlight strikes the panels throughout the day[3].

II. LITERATURE SURVEY

More than 170 years ago, in France, the development of the solar cell started from the work of the French experimental physicist Antoine-Cesar Becquerel back in the 19th century[1]. In 1839, Becquerel observed that shining light on an electrode submerged in a conductive solution would create an electric current[2]. In the same year, another French physicist, Edmond Becquerel found that a certain material would produce a small amount

of an electric current when it was exposed to light[3]. This was described as the photovoltaic (PV) effect[1]. It was an interesting part of science for the next three quarters of a century[2].

In 1877, Charles Fritts constructed the first true solar cell (made from solid materials) by using junctions formed by coating the semiconducting selenium with an ultrathin, nearly transparent, layer of gold[4]. Fritts's devices were very inefficient, transforming less than 1 percent of the absorbed light into electrical energy[3]. Sera et al (2008) have proposed optimized change in power Perturbation & Observation (dp P&O) algorithm for PV system under fast changing environmental conditions[6]. This method overcomes the drawbacks of conventional P & O methods such as oscillations and slow response time and gives the guidelines for proper tracking direction[7]. But the proposed method consumes more time to reach maximum power point (MPP) than the conventional algorithms[2]. Here constant step size is used for perturbation under lower change in irradiation condition. Abu-Rub et al (2013) have proposed Adaptive Neuro-Fuzzy Inference System (ANFIS) based maximum power point tracking for quasi-Zsource inverter based PV system[4]. This algorithm controls the shoot through duty ratio and modulation index, to maintain the required voltage, current, and frequency as required and harness maximum power from PV plant[5]. Nevertheless, these algorithms require previous knowledge of PV plant characteristics to train the algorithms and result in increased memory space and complex computation[8]. De Brito et al (2013) have presented detailed comparisons of maximum power point tracking (MPPT) techniques for PV applications[9]. This analysis is performed with dc-dc converter based on the amount of energy extracted from PV plant, PV voltage ripple, dynamic response, and use of sensors[2]. Ellabban et al (2009) have presented the design of voltage mode and current mode controller for Z source inverter[10]. The proposed controller controls the peak dc link voltage by measuring the input and capacitor voltages. The authors have used a small signal modeling for controller design[11]. However, the authors did not give attention to shoot through ratio control[2]. Gajanayake et al (2007) demonstrated a multi loop controller for Z-source inverter based distributed generation system[1]. The authors have employed indirect DC link controller for DC side and synchronous reference frame controller in the AC side, which maintains the power quality of the power supply to the grid during disturbances[4]. The controller is designed using state space averaging technique[5]. The proposed system has good voltage regulation and disturbance rejection capability[9]. However, the authors have not given the attention to the resonant problem in the inverter[2].

III. MPPT

Maximum power point tracking (MPPT) is a method that grid connected inverters, solar battery chargers and similar devices use to get the maximum potential power from one or more photovoltaic devices, normally solar panels[11].

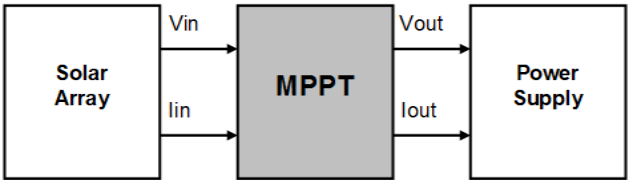

Fig5 Basic Block Diagram of MPPT

the purpose of the MPPT system to model the output of the cells and apply the appropriate load resistance to obtain maximum power for any given ecological conditions[11]. solar radiation energy is most Viable & eco

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friendly source of energy[11]. It shows ways to Integrate solar design into multi-units of small household PV plant, and provides calculations and examples to show how better design optimization decisions can increase the useable solar energy. The improvement in overall system efficiency of integrated PV modules embedded in power plant increased power generation is achieved by minimizing and capturing energy losses[11].

IV. DUAL AXIS SOLAR TRACKING SYSTEM

Earth has two types of motion, the daily motion and the annual motion. The daily motion causes the sun to appear in east to west direction over the earth where as the annual motion causes the sun to tilt at 23 degree while moving along east-west direction [4]. So the maximum efficiency of the solar panel is not being used by single axis tracking system[12]. To track the sun movement accurately dual axis tracking system is necessary[13]. With the sun always facing the panel, the maximum energy can be absorbed as the panel operates at its greatest efficiency[14]. The main objective of this paper is to improve the power gain by accurate tracking of the sun[15]. To develop this dual axis tracking system light dependent resistor (LDR) is used as sensor. The resistance of LDR decreases with increasing light intensity [5]. Two dual Op-amps are used as comparator for comparing the light intensity in two different axes[12]. Again diodes are used for neglecting the negative voltages coming from the comparators. Microcontroller generates the suitable control signals to move the motors in the proper direction[12]. But the microcontroller output ranges from 0 to 5 volt [6]. So to increase the voltage and current level motor driver is used. Two 12 volt full geared stepper motors are used here for rotating the solar panel in two different axes[12].

V. METHODOLOGY

In order to simplify the design process the whole system is divided into four different units. These are: light sensing unit, light comparison unit, control unit and movement adjustment unit. Fig. 1 shows the overall block diagram of the whole system.

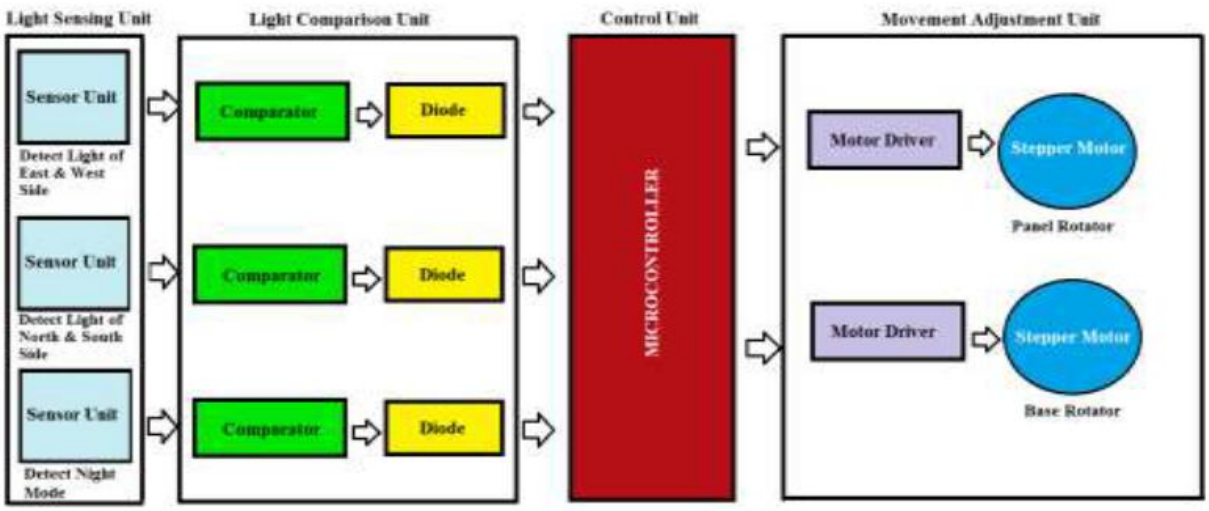

Fig. 1 shows the overall block diagram of the whole system.

VI. FINITE ELEMENT METHOD OF SOLAR COLLECTOR'S TRACKING SYSTEM

The tracking systems of the solar collectors are used to orient the solar collector normal to the solar radiation, in the way to catch the maximum amount of light from the sun. The finite elements analysis of three main solar collector tracking systems: for plate, for dish and for trough solar collectors; the aim is to find out the critical position of the tracking systems, when the equivalent stresses and the displacements have a maximum value. The solar collectors are used to transform the energy from the sun in heat used for domestic heat water or for buildings heating [3, 7]. The maximum amount of energy is collected from the sun when the solar collector's surface has a position normal to the solar radiation. During the day-light time, as inverse relative motion, the sun has a diurnal motion from east to west. During one year the sun has a smaller seasonal motion from north to south. Due to these considerations, it is necessary to find solution on the way to orient the solar collectors surface normal to the solar radiation during a day light period and during one year, also. The solution is given by the tracking systems [3, 7].

V. CONCLUSIONS

In this paper a dual axis sun tracking system has been successfully discussed[4]. It allows the sun's path from morning to evening and then it's back to the initial position facing towards east side[2]. So the system saves lot of energy by keeping the motors off during night period. This tracking technology is very simple in design, low in cost and accurate in tracking. Several solar technologies are available on the market[27][28]. But this dual axis tracking technology has higher energy gain comparing with both fixed solar panel and single axis solar tracking technologies[23][24]. Considering all above aspects of this dual axis tracking system it can be concluded that, it is an efficient tracking system with low cost electromechanical set up and low maintenance requirements[21][25]. In finite elements analysis of the presented solar collectors tracking systems, important conclusions can be issued the maximum values of the equivalent stresses are obtained in the rotational joints of the structures[18][19]. The maximum values of the equivalent stresses and displacements are obtained for big orientation angles (in this case the actuator stroke has a minimum stroke and it means that the structure is a stabile one)[8].

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