Relative Result And Design Analysis of SPV Tracking System on Simulink Platform

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Abstract*: *The paper describes a tracking mechanism that was implemented on the simulink stage. This review shows the distinctions in current and voltage for static and following Solar Photo Voltaic (SPV) power plants. This research also includes a comparative evaluation of alternative panel placements (static force plant). The study also included the whole model, including the tracking model of sun, static SPV model, sensor (like LDR) model, and direct current motor model. The main purpose of this research is to deconstruct the results of the static force plant. The static force plants on the tiltaion edges are 30˚, 60˚, and 90˚. Simulation findings as well as the impact of the tiltation point are also included. The greater effectiveness as a result of the tracking approach is mentioned in the final comment.

***Keywords*: SPV System, Photovoltaic, LDR, Solar Board, Simulink Model, Solar Tracking System.**

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I. Introduction

Currently, everyone is interested on sustainable power sources because they are a non-polluting source of electrical energy. Photovoltaic cells based on the sun are playing an important role in converting light energy to electrical energy [1]. When the light pillars crash into the silicon sun-arranged cells setting the electron in the outskirts of the circle to be free. The light incident on the board surface, the electrons in the load related circuit will advance. The age of an electron is controlled by the proportion of light exuberance. It has been talked about in a few papers with respect with the impact of light force on sun-situated cells. The irradiance esteem is really corresponding to the current produced by a sun powered cell [2]. The yield current increments as the irradiance esteem increments, yet the voltage esteem diminishes when the temperature of sun-controlled cells rises. Thusly, when contrasted with June, the force made by the SPV power plant is more recognizable in November. Since the yield current is relative to the measure of daylight got, the sun tracker is fundamental for expanding SPV productivity. There are various papers [3-14] introduced by the creators, some of which clarify the dynamic sun global positioning framework and others which present the uninvolved global positioning framework; be that as it may, most of the creators suggest the dynamic global positioning framework since it is easy to keep up with and gives precise following of the sun position. Furthermore, the expense of developing a functioning global positioning framework is unobtrusive. Electromechanical frameworks are utilized in the Active Tracking System. The expression "electromechanical" alludes to both an electrical and mechanical framework. Stuff framework, steel structure, and bearing are on the whole pieces of the mechanical framework. Engine, control circuit, and LDR sensor are completely remembered for the electrical framework.

The alarming rate of fossil fuel depletion and the deterioration of the earth's health as a result of increasing power demand to use the most advanced technologies discovered to date has prompted us to uncover yet another technology known as SPV or Solar Photovoltaic Technology. This method, known as solar photovoltaic technology, is based on the photovoltaic effect, which uses solar energy. A functional solar photovoltaic module or panel is made up of a number of solar cells connected in series and parallel. The solar cell is thus the most important component of a solar panel (s).

The solar cell is the most important component of a solar photovoltaic system. Solar cells require pure silicon with good crystal quality. Impurities, or doping atoms, are injected into the crystal lattice of silicon to enable it to create electrical energy.

It's a gadget that converts solar energy into direct current electricity. A pn junction diode is formed by sandwiching two different doped Silicon transistors (n-type and p-type) together. A diode is what a solar cell is. When an n-type material is exposed to sunlight, the bulk of charge carriers are electrons.

II. THE NEED FOR A SUN TRACKER

Fig. 1 depicts the sun's position in relation to the earth. The sun moves around from east to west once a day, with a 47-degree difference in its location in the raised direction throughout the course of the year [3].

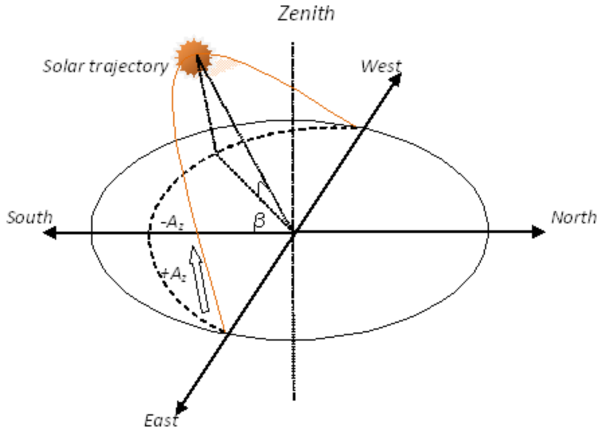

Fig. 1. The Sun's Path

The difference in current owing to irradiance value variation is seen in Fig. 2. The current carried by a photovoltaic cell is proportional to the irradiation value [5].

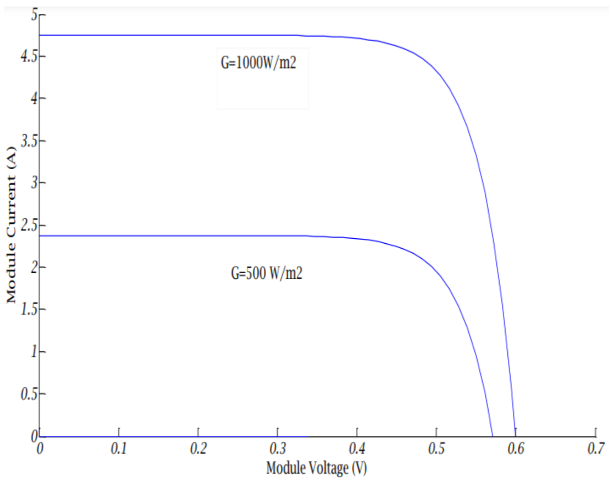

Fig. 2. Current vs. voltage at various irradiation values

As can be seen from the diagrams above, the sun tracker is critical for increasing the output power supplied by solar cells.

III. OVERALL SYSTEMS SIMULINK MODEL

The simulink model is expected for the SPV power plant without global positioning framework and with following idea to explore upgraded productivity by executing the sunlight based following thought. It's vital to understand about the Simulation findings for the Static board PV framework with the sun-oriented tracker PV framework [2] to support the proposed genuine framework fabrication. Fig. 3 depicts the suggested Overall framework model as a square graph in the SIMULINK stage. In addition, a simulation was run using the static SPV system at various raised angles.

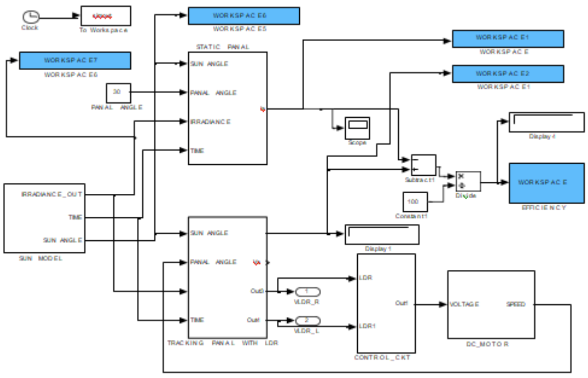

Fig. 3. Overall SPV system simulation model

If the angular location of the fixed panel changed then it has an effect on the static SPV system current, as shown in Fig. 4. Also, the static PV system angle, measured from a horizontal direction, has a important role in maximizing the energy efficiency of the static PV system, according to the simulation results [1]. When the panel is set to 90˚ degrees, it produces the maximum amount of current and efficiency. The current variation at various angles is seen in the simulation result (45, 60 and 90 degree).

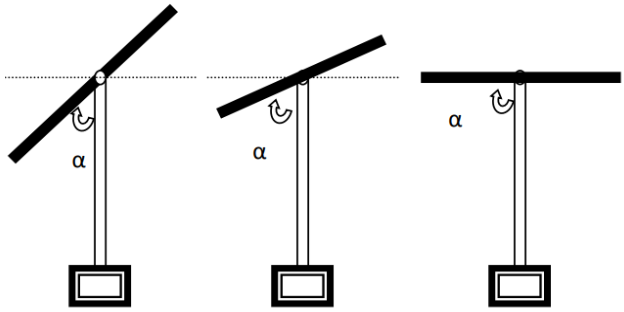

Fig. 4. Different Angles of Mounting a Static Panel (45^0, 60^0 and 90^0)

The change in voltage due to light across the LDR sent to comparator based control circuit which will give the signal to DC motor to rotate the tracker system. DC motor start to rotate the tracker till the output of comparator does not reach to zero. The control circuit was designed with the use of different logic gates (NAND, OR, and XOR).

Figure 5 shows the designed control circuit, was implemented in SIMULINK platform. AND and XOR logics are used so that both control circuit did not receive the signal at the same time. In this circuit four NAND and two XOR logic gates are used.

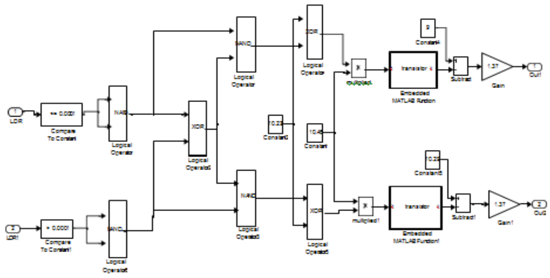

Fig. 5. Tracker Control Circuit Designed in SIMULINK Platform

In the HOMER Pro simulation environment, the SA-SPV system is modelled with a bi-directional converter instead of a unidirectional converter. The system's functioning is prioritised to charge the BES until it is completely charged during the day, and then discharge the BES during the night when the lights are turned 'ON,' until the BES voltage drops to 42 V. The electricity produced is fed to the grid once the BES is fully charged during the day in this mode of operation. As a result, the bi-directional inverter assures daily charging, discharging, and feeding electricity to the grid, optimising the SA-SPV system's installed capacity. Using HOMER Pro software, a schematic diagram of the SA-SPV system with bi-directional converter was created.

IV. Result of the Simulation

The differences in LDR resistance as the intensity of sunlight changes is depicted in Fig 5. LDR exhibits low resistance during the brightest hours of the day, when solar energy is at its highest. At point 28000 seconds, it may be seen in Fig. 5.

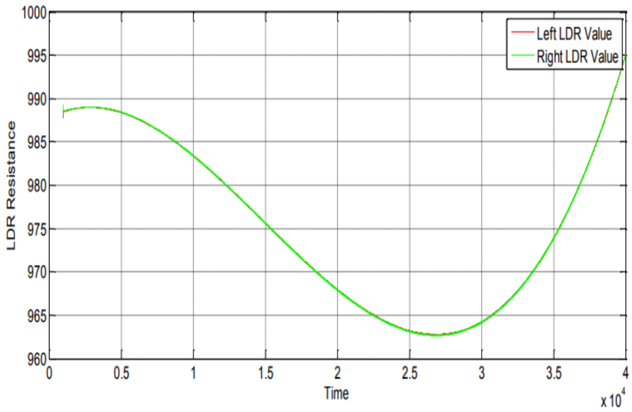

Fig. 5. LDR resistance (left and right) vs. time simulation result

The shifting impact on the SPV framework was additionally dissected utilizing recreation (Fig. 6). The thick green line portrays the scope of current created by sun tracker SPV power plants; though the slim green line portrays current attributes when static SPV structure is set at 90^0. At the point when a Static SPV board is introduced at 60^0, the blue line addresses the current variety. At the point when the board is introduced at 30^0, the red line portrays the current variety. The proficiency of a sun based photovoltaic force plant with global positioning framework is higher than the effectiveness of a static force plant, as shown in the simulation results.

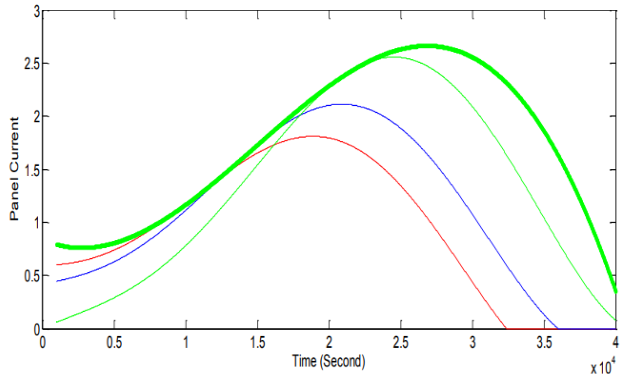

Fig. 6. Panel current vs time

V. Experimental Results

A. *Azimuthal Tracking Results*

Effect of single axis tracking on efficiency of 510 watt PV System was also studied. The data collection was done on date 23-09-2021, under clear sky day. It has been observed that the efficiency of PV system can be increased 36% due to azimuthally tracking techniques (single axis tracking). To see the performance of single axis tracking (azimuthal) over static PV system, both PV systems are mounted at 270 degree south. Tracker PV system was given freedom of movement along X-direction (azimuthal) only. The voltage and current readings were taken from 8.20 am to 4.30 pm. The variation in power during whole day is shown in Fig. 7. Here, it can be seen the power produced by both system from 10.30 am to 1.20 pm are approximately same. After that time interval tracker PV system produces more power compare to static PV system. The variation in load current connected to single axis PV tracking system is shown in Fig. 8 by blue bars.

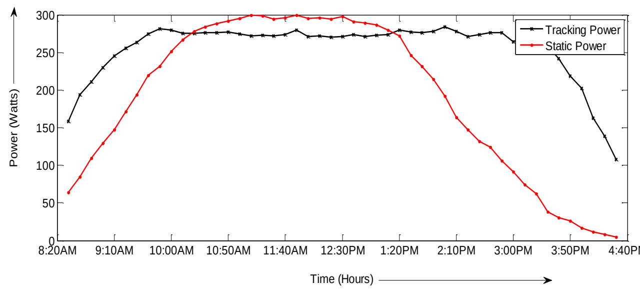

Fig. 7. Variation in power produced by pv systems due to one degree of freedom (x-axis).

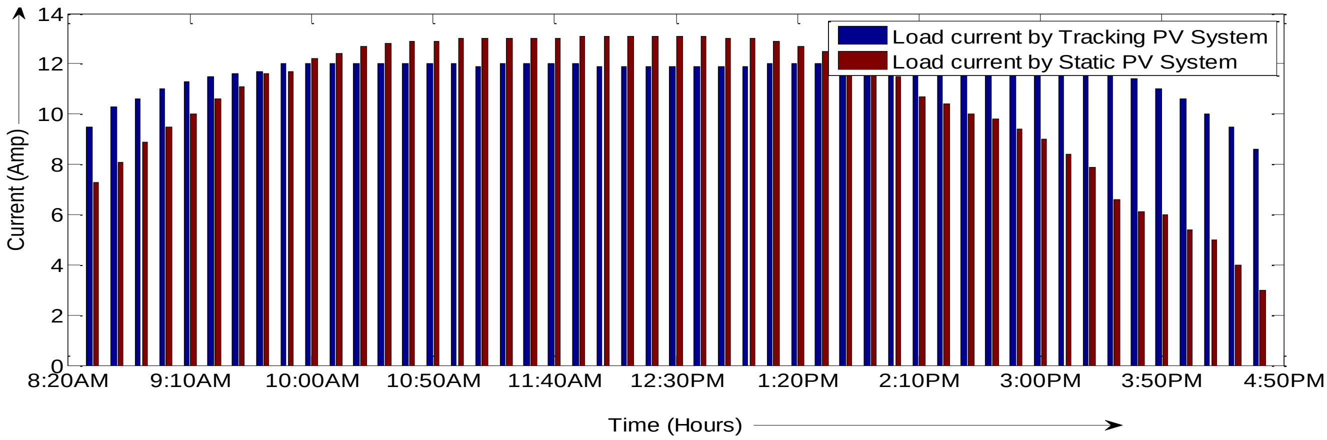

Fig. 8. Variation in load current spv systems with and without single axis tracking

B. *Elevated Tracking Results*

The voltage and current readings were taken were taken on date 15-05-2021, when the tracking PV system is allowed elevated (Y-axis) degree of freedom only. The Static PV system was mounted at 270 degree south face Tracking PV system was free to along North to south direction (Y-axis, elevated direction). Data collection was done from 7.30 am to 5.00 pm. The improvement in efficiency due to single axis (Y-Axis) tracking has been calculated as 14% as compared to that of static PV system. The variations in power are shown in Fig. 9, and Fig. 10 shows the variation in load current readings of both PV systems (Solar tracking PV System and Static PV System).

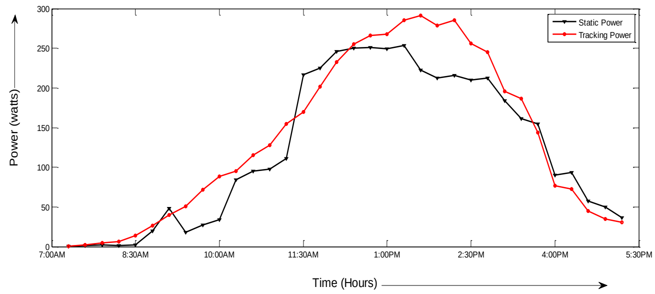

Fig. 9. Variation in power produced by pv systems due to one degree of freedom (y-axis).

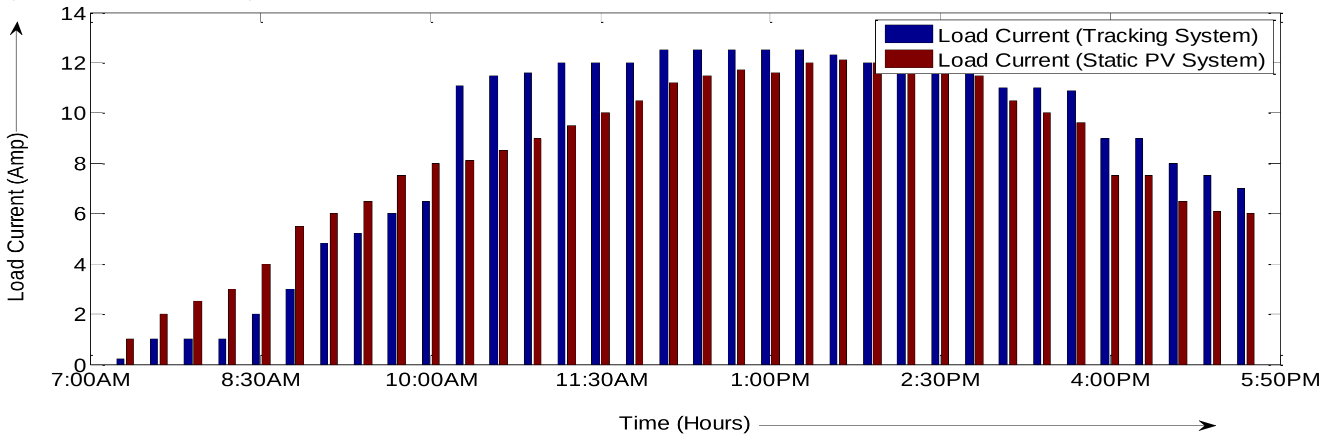

Fig. 10. Variation in load current due to one degree of freedom (y-axis tracking)

VI. CONCLUSION

The importance of a sun tracking system is demonstrated by the preceding results. When panels are mounted at a 30° tilt, the energy obtained from a tracking SPV system is the highest, while the power obtained from a static SPV system is the lowest.

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