Solar tracking system to make solar panels more efficient

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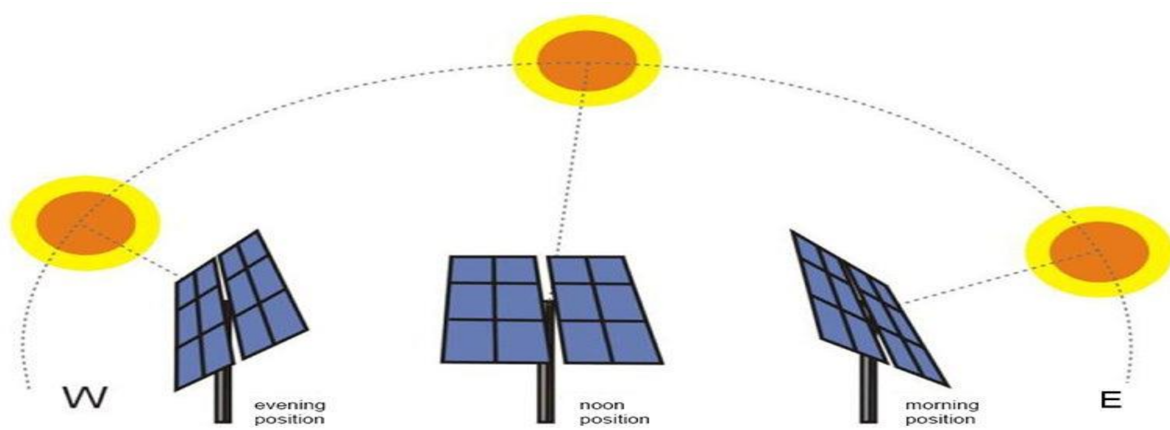
Abstract— In this research, we studied the characteristics and advantages of the solar tracker with an electric motor depending on the Sun's daily movement from east to west. Measurements were taken for current and voltage, and then the electrical power was produced according to Ohms Law. These measurements were made for different daylight hours, from sunrise to sunset. The power obtained from solar panels based on solar trackers has been compared to constant panels to demonstrate the importance of using solar trackers with solar panels due to the large energy generated by this highly stable system.

INTRODUCTION:

To overcome the global energy crisis caused by fossil fuels. Sun energy can be used As an alternative and clean energy, where it always exists and everywhere. Most of the renewable and non-renewable sources of energy available on the Earth's surface are due to solar radiation, all of which, including petroleum, gas and coal, were formed by sunlight and subsequent heat and pressure across time trails, as well as secondary energy sources such as wind and living mass energy. It has become necessary to find solutions and alternatives that will ensure a continuous abundance of energy. We need it on the one hand while maintaining the integrity of the environment, on the other hand, solar energy can be converted into electric energy according to the photovoltaic mechanism, and photoelectric conversion is meant to convert solar or photovoltaic radiation directly into electric energy by solar photovoltaic cells. The Solar cell is a device that converts light energy directly into electric energy through the photovoltaic effect and is also called (a photovoltaic cell). Solar cells are an essential energy provider where they do not need chemical reactions or fuel to produce electric power, and unlike electric generators, they do not have any moving parts .Solar Trackers (Solar Trackers) play an essential and influential role in increasing the productivity of projects as they move photovoltaic panels installed on them so that they remain directly facing the Sun throughout the day, thus contributing to an increase in the amount of solar radiation converted to electric energy. The primary goal of using solar tracking systems is to boost the efficiency of the solar system because they move the linked panels along with them and maintain them directly facing the Sun all day. This makes sure that as much solar radiation as possible hits the panels, increasing the quantity of solar energy that is converted into electric energy, allowing us to acquire more energy from the same number of boards in the same area. Using photovoltaic tracking systems can help us achieve the same electrical power with fewer panels compared to installed panels, or we can use the same number of panels and get a more significant amount of the same space. Another essential aspect to emphasize is that not only does energy production increase when solar tracking systems are used, but these systems also improve the power generation curve and make it more stable. Using solar tracking, the maximum energy time available can be extended and thus produce more hours per day with greater capacity.

THE SENSING ELEMENT AND SIGNAL PROCESSING:

The tracking of the Sun's position has been done using a wide variety of techniques. The most basic method uses a Light Dependent Resistor(LDR) monitor changes in light intensity on the resistor surface. Other approaches, like the one described by Jeff Damm in "Home Power" [8], employ two phototransistors that are protected from sunlight by a tiny plate, as illustrated in Fig. 1.



State A State B State C

Fig. 1 The way the solar tracker works

When dawn arrives, solar tracker is still in condition A from the previous day.

When the left phototransistor is activated, a signal causes the motor to turn continuously until the plate's shadow causes the tracker to revert to state B. State C is attained over the day, activating the right phototransistor. The cycle repeats until the end of the day or until the least detectable light level is reached, at which point the motor turns until state B is once more attained. The issue with this design is that, once they have been installed in a circuit under specific bias conditions, phototransistors have a limited sensitivity range. Because of this, solar cells were selected as the sensing components. Because of their sensitivity to changing light intensities and near-linear voltage range, they offer a suitable mechanism for light that may be used to determine the current declination or angle to the Sun. As a result, a straightforward triangle configuration was suggested, as seen in Fig. 2, with the two solar cells oriented in opposite directions.

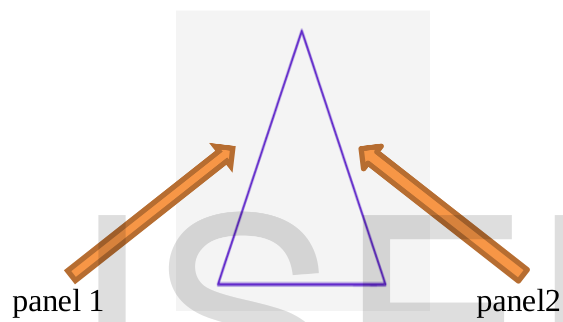


Fig. 2 Set-up of solar reference cells

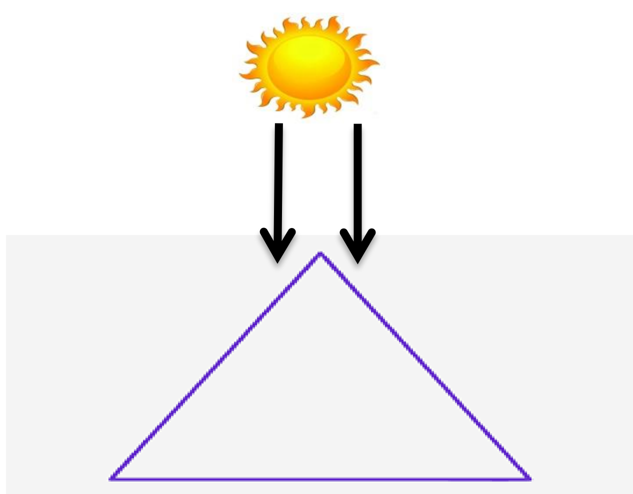


Fig. 3 rest position of Solar board

The solar cells get a similar quantity of sunlight when at rest because, as shown in

Fig. 3, the angle of incidence, while not precisely 90°, is the same in both circumstances. Assuming the solar tracker hasn't moved yet, it is evident from Fig. 4 that as the Sun moves in the space, more light will fall on one cell due to the reference panels' angle of incidence. As a result, there will be a (V) difference, with the cell in foronnt of the Sun having a higher probable than the other. Each cell will experience a measurable signal resulting from this occurrence, which an appropriate circuit may process.

A PROTOTYPE SOLAR TRACKER:

The motor was mounted onto the bracket, and the electronics was finally connected to it. Fig. 4 depicts the finished item in its entirety. It has a Solarex 9W polycrystalline silicon solar array installed on the flanges.

Fig. 4 A prototype solar tracker

Quite simply, testing was done with two subjects. In the first situation, the panel had to be removed from the tracker and laid flat. The o/p was wired to a load that could dissipate 9W, which is the maximum allowed by the panel. According to Ohm's law, load resistance of 16 was determined since 9W at 12V translates to (I) of 0.749A. The closest value was a 15 Ω 50W resistor attached to the panel. Although the tracking device still needs power, it is provided by a 12V battery connected to the solar panel in a charging configuration. On a clear day, the (V) across and (I) through the load were measured using two different multimeters and entered into an Excel programme every half-hour. The readings were taken over a period of days with similar weather circumstances, such as no clouds. The tasks are displayed below in an Excel graph (Fig. 5).

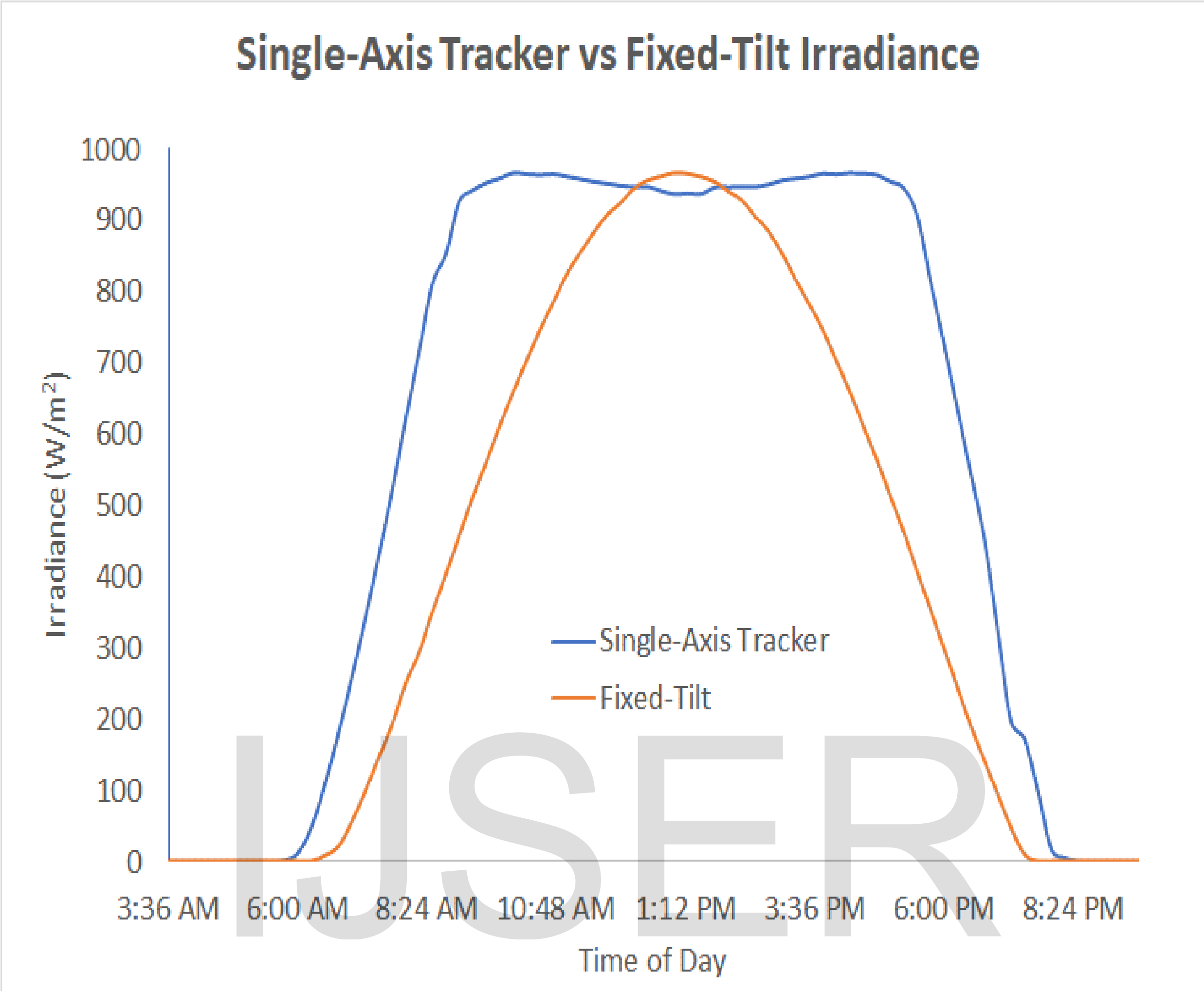


Fig. 5 tracking and fixed solar panel system

By entering the necessary formulas in Excel, it is feasible to compute both a percentage increase and an average increase. According to calculations made over 12 hours, it was discovered that the fixed panel in this instance delivered an average of 39% of its 9W, or 3.51W. In comparison, throughout the same period, the monitored solar panel generated 6.3W, or 71 percent of its total production. The power boost over the fixed panel during earlier and later hours was up to 400%. Simply by keeping the solar board perpendicular to the Sun as feasible, power can be increased by an average of 30%. The device itself was also observed to be currently being drawn to power itself to guarantee that electricity was not being squandered. An ammeter was connected directly with the battery and placed on the device while resting. Only 4mA of total current was recorded at 12V, translating to electric power squandering of 48mW without loading.

DISCUSSION:

According to measurements of achieved energy differentials, when using fixed panels, the energy outside the solar panel was about 39%. When using the solar panel with the solar tracker, the energy outside of the solar tracker was obtained at about 70%. This means that there is a 30% energy gain, so the method is considered economically feasible because of the realized energy gain, adding to the low number of panels used.

CONCLUSION:

Compared to a fixed horizontal array, more than 30% greater power was obtained. The solar tracker maintains its vertical position attributable to the sunlight of the falling sun by changing its angle of motion towards a certain direction for the purpose of obtaining the largest possible amount of radiation falling on the solar panels in addition to ensuring its high stability during the work.