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Review on Impact of Installing the Solar Tracking System Its Challenges and Types

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Abstract

Solar energy is a non-conventional source of energy. Because of this, a solar panel has been developed for the generation of electricity. The solar panel system can be used gradually in these recent years to convert solar energy that is energy from the sun to electrical energy. This solar tracker automatically changes the position of the solar panel and tracks the sun accordingly to maximize the power output. In implementing the whole system, a Photoresistor will be used as sensors in the system. The system will consist of a light-sensing system, microcontroller, gear motor system, and a solar panel. Therefore, the tracking of the sun's location and position of the solar panel is very important. These solar panels can be used either as a standalone system or as a huge solar system that is connected, to producing a large amount of electricity for our daily activities.

Keywords: Sun, Solar panels, Photoresistor sensor, gear motor system, and microcontroller.

1. Introduction

In nowadays epoch, the main problem the world is facing especially African countries is energy catastrophes and we all know that fossil fuels are available in very inadequate quantity. Likewise there overdo in the previous years has abridged them more. Therefore, now if we want to meet our energy demands in this world, the only option we are left with is to exploit the renewable resources of energy that are accessible in copiousness. In this world nowadays, there are numerous sources of renewable energy such as the sun, wind, and geothermal but the most cost-effective among this renewable energy is solar energy. This solar energy cannot only meet our current energy hassles but can also provide us with cheap and clean energy. The solar panels once installed can give us energy for numerous years without having any or much maintenance cost [1]. Solar photovoltaic (PV) panels (figure one below shows the image of the photovoltaic solar panel) are panels, which are used in coupling solar energy, but since the earth is revolving around the sun, due to which the solar energy in existing, the solar panels are available only for a limited time throughout the day. To overcome such tricky, a solar tracker is used [2]. Most of the research done on the solar tracker system makes use of a photosensor, which is normally used, in conjunction with a stepper motor that will help in controlling the movement of the solar panel. For this tenacity, a Phototransistor is mounted on the solar panel frame in which the panels are fixed. The stepper motor used in the research will be programmed using a Microcontroller; the microcontroller is the brain of the whole research because all instructions are given from there. Due to the rotation of the stepper motor, the solar panel mount on it moves in a direction to search for the maximum light intensity. When the light-dependent resistor (LDR) use in the research receives maximum light, the stepper motor will stop in the position of the sun; this is done with the help of the microcontroller as the brain of the research. Henceforth, with changing light intensity, the position of the solar panels also changes. The solar tracker is a device onto which the solar panels are fixed which tracks the movement of the sun across the sky ensuring that the maximum amount of sunlight strikes the panels throughout the day. In terms of cost per watt of the completed solar tracker system, it is generally cheaper (for all but the smallest solar installations) to use a solar tracker and fewer solar panels where space and planning laws permit. A good solar tracker system can usually lead to an increase in electricity generation. Despite its comparatively hoary age, the microcontroller 8051 is one of the most popular microcontrollers that is used currently [3].

2. Related works

2.1 The single-axis trackers

The single-axis trackers, this usually places around the equator where there is no sizeable change in the divergent position of the sun. Mayank Kumar Lokhande [4] offered an automatic solar tracking system. Mayank Kumar Lokhande designed a solar panel tracking system based on a microcontroller and observed that the single-axis tracker system increases proficiency by about 29.99% if you are going to compare it to the fixed module. Runsheng Tanf, Guiha Li, and Hao Zhong [5] scrutinized the horizontal single-axis solar panels tracked. They got the result as east-west axis tracking was deprived to improve the energy while tracking the sun about south-north was the best. The proficiency increased for the east-west axis was less than 7.9% while for the south-north axis increased by 9.98 to 23.56%. Rizk. J and Chaiko [6] established a tracking system using solar panels proficiently. Rizk and Chaika. Y designed a simple single-axis tracking system using a light sensor and stepper motor. This Rizk and Chaiko detected that this system gives the proficiency of power collection by keeping the perpendicular of the solar panel to the sunrays. Rizk and Chaiko also found that this power gain system using solar panels proficiently. Rizk and Chaika. Y designed a simple single-axis tracking system using a light sensor and stepper motor. This Rizk and Chaiko detected that this system gives the proficiency of power collection

Figure1: photovoltaic solar panel

system using solar panels proficiently. Rizk and Chaika. Y designed a simple single-axis tracking system using a light sensor and stepper motor. This Rizk and Chaiko detected that this system gives the proficiency of power collection by keeping the perpendicular of the solar panel to the sunrays. Rizk and Chaiko also found that this power gain was increased by 29.89%. Ali Mustafa, Imam Abadi, and Adi Soeprijanto [7] designed a fuzzy logic-based single-axis solar tracker system. Ali Mustafa, Imam Abadi, and Adi Soeprijanto implement a fuzzy logic controller on the ATMEGA 8353 microcontroller to improve the powerful energy of the photovoltaic (PV) panel. They found that the photovoltaic (PV) panel has maximized and it exceeded up to about 46.87% compared to the stationary system. Varun A.K, Ashwin R, et al. [8] offered a sensor-based single-axis solar tracker to attain the highest degree of energy through the solar panel. This keeps tracking continuously for the maximum strength of light. This system extemporaneously changes its direction when the sun moves from its position to get the maximum light energy. Therefore, the investigational outcome shows the productiveness and robustness of the proposed method. Abou-Hashema, Gamal M Dosouky et al. [9] offered an improved orientation design for energy-productivity in photovoltaic (PV) panels. For maximum incident radiation, the panels are inclined with a monthly-based angle. They scrutinize the suggested strategy in two cities that is Egypt

(AI-Kharijah) and Japan (Fukuoka). The outcomes revealed that the proposed design accomplished progress of energy building in both the cities. In the year 2013, Mohan Reddy, Anusha, K., and Chandra. S [10] designed a solar tracking system based on a real-time clock. Reddy, Anusha, and Chandra compared a static photovoltaic (PV) panel and single-axis tracker based on a real-time clock using the ARM processor. Their research revealed that the tracking system builds up the proficiency of about 39.87 percent(%) and the energy that is normally achieved from the sun is boosted from morning 9:00 am to afternoon 6:00 pm. Constantin Daniel once, Liviu Kreindler, and Tiberiu Tudorache [11] offered a tracking system fanatical to the photovoltaic (PV) conversion panels. The proposed design verifies the accomplishment of converting solar energy into electricity by genuinely bring into line the solar panel according to the actual position of the sun. The result concluded as output energy is maximized by the photovoltaic (PV) panel through desirably locating implemented only for a sufficient amount of light intensity. Below are the images of the single tracker solar system.

Figure 2: prototype of a single-axis solar tracking system

Figure 3: single-axis solar tracking system

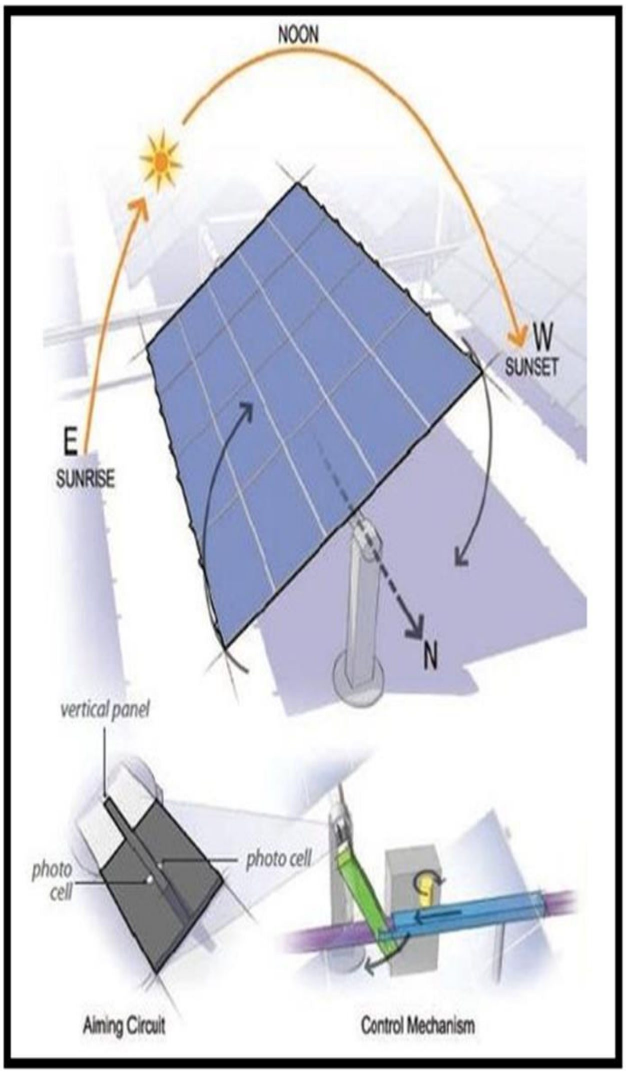

Figure 4: single-axis solar tracker

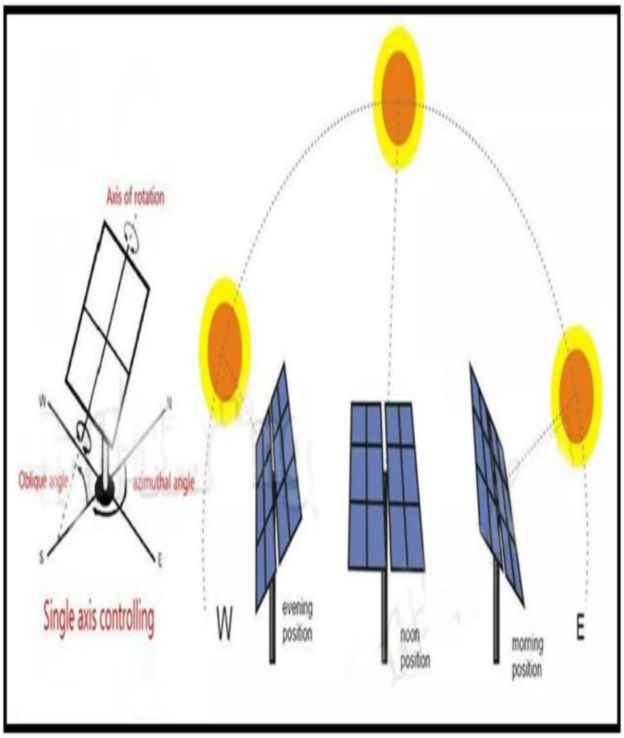

Figure 5: single-axis solar tracker

2.2 Dual-axis solar tracking system

The dual-axis trackers are for places where the movement of the sun is a track from east to west all over the day and from east to north or south throughout the seasons. S Jha, Shibani K., Puppala, Harish, [12] suggested a dual-axis tracking system to develop and implement a simple and proficient control scheme with merely a single tracking motor. Jha, Shibani K., Puppala, Harish, core purpose is to improve the power gain by precise tracking of the sun. In the work, they successfully designed, built, and scrutinized a dual-axis sun tracking system and received the best result. S Suryanarayana and V Sundara Siva resolved that saying that this tracking technology is very modest in the design, accurate in tracking, and low-cost. Lakshmi Prasanna H.N and Dhanalakshmi. V [13] offered a smart dual-axis solar tracker. Lakshmi Prasanna H.N and Dhanalakshmi. V used Arduino for the development of their suggested prototype. After their research, they witnessed that maximum voltage was a track of about 24.97% to about 29.68% and the generating power is increased by 29.69% compared to a static system. M. Kacira, M. Simsek, Y. Babur, and S. Demirko [14] overlooked the cause of a dual-axis solar tracking with the development of power energy compared to a fixed photovoltaic (PV) panel in Sanliurfa, Turkey. M. Kacira, M. Simsek, Y. Babur, S. Demirko found that everyday power gain is 29.29% in solar radiation and 34.57% in power generation for a particular day in July. In the year 2017, Tejas Gaidhani and Chaitali Medhane [15] implemented a microcontroller-based dual-axis prototypical working on a solar panel. Through this model, they observed that the solar panel excerpt maximum power if the solar panel is brought into line with the intensity of light-receiving from the sun. It improves the power output and precaution necessary for the system from wind and rain. Midriem Mirdanies, Roni Permana Saputra [16] suggested a dual-axis system with a joint method of an Astronomical algorithm and camera-based feedback processing for localizing and tracking light intensity to increase the proficiency in achieving power energy. They also designed a compound algorithm method to merge approximation data of the sun acquired from astronomical based and visual-based feedback. After the simulation, it resulted that the azimuth and elevation sum squared errors from the proposed algorithm are 0.3588 and 0.3774 degrees, and the astronomical algorithm is 1.0997 and 1.2877 degrees. N.H. Osman and S.B. Elagib [17] describe the development of a solar tracking system based on solar maps using a microcontroller, which can forecast the real detectable position of the sun by latitude's location for maximizing the proficiency of energy level. Their main purpose of this design was to work with minimal operator interaction in the isolated areas where network coverage is absent. Chia-Liang Lu and Jing-Min Wang [18] presented a simple execution of a sun tracker with one dual-axis AC motor to predict the sun's position and used a stand-alone photovoltaic (PV) inverter to energize the whole system. They worked in May 2012 in New Taipei City, Taiwan and the day was slightly cloudy. A static panel is placed along the south at a tilt angle of 22.5 degrees with maximal standard solar radiation when the latitude of Taiwan is 23.3 degrees along the north. The experiments stemmed that their system raised the energy level to 25.81% for a slightly cloudy day. M.M. Abu Khader [19] observed an experiment under Jordanian climate on the cause of utilizing two-axis sun tracking systems. They found that the power result enhanced by 29.67-44.89% compared to a static system for a particular day. The figures below show the dual-axis solar trackers.

Figure 6: dual-axis solar tracker

Figure 7: dual-axis solar tracker

3. Challenges faced in installing the solar tracking system by owners or organizations

Below is the reason why owners faced challenges while installing the solar tracking system.

1.The solar tracking system is marginally more expensive than the fixed equivalents, this is due to the more complex technology and the moving parts required for the operation.

2.Even with the advancements and consistency, there is usually more maintenance required than the traditional fixed frame, though the quality of the solar tracking system can play a vital role in how much and how often this maintenance will be needed.

3. The solar tracking system is a more complex system than fixed racking. This simply means that typically more site preparation will be needed, this includes additional trenching for wiring and some additional grading.

4. The single-axis tracking system projects also require an additional focus on company stability and bankability. When it comes to getting projects financed, these systems are more complex and thus are seen as a higher risk from a financier's viewpoint.

5. The solar tracking system is usually designed for climates with little to no snowmaking them a more viable solution in warmer climates. Fixed racking accommodates harsher environmental conditions more easily than tracking systems.

6. The fixed tracking systems offer more field adjustability than single-axis tracking systems. Fixed systems can generally accommodate up to 20% slopes in the East-West direction while tracking systems typically offer less of a slope accommodation usually around 10% in the North-South direction.

Figure 8: dual-axis solar tracker

4. Reasons for installing the solar tracker System

Below are the main reasons why a solar tracking system needs to be installed

1. This automatic solar tracking system is very easy to implement since its assembly is very simple.
2. Solar Tracking systems usually produce extra electricity than their fixed equivalents, this is due to the increased indirect exposure to the solar rays. The increase can be as much as 9.9 to 24.5% subject to the topographical location of the tracking system.
3. As explained above, there are different types of solar trackers, such as dual-axis and single-axis tracking systems, all of which can be impeccably suitable for a distinctive Jobsite. Degree of latitude, Installation size, local weather, and electrical requirements are all important considerations that can influence the kind of solar tracking system best suitable for a specific solar installation.
4. The solar tracking system produces more electricity in bumpily the same quantity of space needed for fixed-tilt systems, making them perfect for improving land usage.
5. In some certain countries, some utilities offer Time of Use (TOU) rate plans for solar power, which means the utility will purchase the power generated during the peak time of the day at a higher rate. In this case, it is beneficial to generate a greater amount of electricity during these highest times of the day. Using a tracking system helps maximize energy gains during these highest periods.
6. The advancements in technology and consistency in mechanics and electronics have extremely reduced long-term maintenance concerns for tracking systems.

5. Conclusion

This research presents an overview of the improvements in the research of the solar tracking systems in the world nowadays and it highlights the enactment scrutiny of both the single and dual-axis solar tracking systems fortified with diverse techniques and designs, which have been developed in recent years. The research is also very helpful in the supply of electricity in both urban and rural areas, where we might use very high sensitive solar panels which can work in warm sunlight also by connecting several solar tracker assemblies we will be able to produce an adequately large amount of electricity. We can make use of solar panels in our day to day life for street lighting, mobile phone chargers, water heaters, etc. Solar radiation Tracker has played a vital role in increasing the efficiency of solar panels in recent years, thus proving to be a better technological achievement. We have also seen the importance of dual and single solar trackers. The dual-axis solar tracker lies in its better effectiveness and sustainability to give better output of electricity compared to a single axis solar tracking system. The tracking system is designed such that it can trap solar energy in all possible directions. The dual-axis solar tracking systems generally prove to be more resourceful than the single-axis solar tracking system. We have also seen the impact of installing the solar tracking system and its challenges.

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