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A Review on Automatic Solar Panel Cleaning and Sun Tracking System

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***Abstract*: Now-a-days electricity is one of the basic necessities of mankind. As the demand of electricity is increasing, there is need to exploit renewable sources of energy. In the current era of power shortage in India, the use of solar energy could be beneficial to great extent. For this reason, the number and size of the Photovoltaic (PV) systems are growing and consequently the amount of the investments and the related opportunities and risks are increasing. To make solar energy more fruitful, the efficiency of solar array systems must be maximized. For the efficiency evaluation of PV panels, that has been discussed with particular attention to the presence of dust and maximum intensity of light on the panel surface. Mainly, the effects of the dust and intensity of light on the efficiencies of the PV panels have been highlighted. This paper gives the brief description of the design and construction of microcontroller based cleaning and tracking system.**

***Keywords*: Enter key words or phrases in alphabetical order, separated by commas.**

1. Introduction

To make the Solar panel much effective, the solar PV panel should always receive the maximum intensity of light. For that the panel should always face perpendicular to the sun and there should not be any dust particles on the panel [3, 4]. But in some heavy pollution areas the dust particles are directly deposited on the solar panel, so that most of the light coming from the sun is reflected rather than refracting because of the dust deposited on the panel by making the front portion of the panel shaded [5, 6], the dust deposited panel.

Fig. 1. Solar panel

The efficiencies of the panels descend because of the dust depositing even though the panel is tracking the sun. This paper explains the efficient self-cleaning and tracking mechanism and obtains the results of the panel for the different conditions such as cleaned panel without tracking, dusty panel without tracking, dusty panel with a tracking and cleaned panel with tracking, dusty panel without tracking, dusty panel with tracking and cleaned panel with tracking.

The rest of this paper is described as follows: First, we provide the design development in the Section II. In section III, we represent the implemented algorithm. Experimental setup is shown in the section IV. Finally, we give the conclusion in the section V.

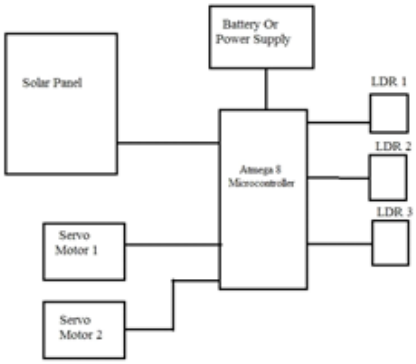

Fig. 2. Block Diagram

Solar trackers are rising in popularity, but not everyone understands the complete benefits and potential drawbacks of the system. Solar panel tracking solutions are a more advanced technology for mounting photovoltaic panels. Stationary mounts, which hold panels in a fixed position, can have their productivity compromised when the sun passes to a less-than-optimal angle. Compensating for this, solar trackers automatically move to “track” the progress of the sun across the sky, thereby maximizing output. It’s a fantastic system for energy output, but there are a few considerations to bear in mind before pursuing one for a particular jobsite.

A. Circuit Diagram

The Sun tracking solar panel consists of two LDRs, solar panel and stepper motor and ATMEGA8 Micro controller.

Two light dependent resistors are arranged on the edges of the solar panel. Light dependent resistors produce low resistance when light falls on them. The stepper motor connected to the panel rotates the panel in the direction of Sun.

Panel is arranged in such a way that light on two LDRs is compared and panel is rotated towards LDR which have high intensity i.e. low resistance compared to other. Stepper motor rotates the panel at certain angle. When the intensity of the light falling on right LDR is more, panel slowly moves towards right and if intensity on the left LDR is more, panel slowly moves towards left. In the noon time, Sun is ahead and intensity of light on both the panels is same. In such cases, panel is constant and there is no rotation.

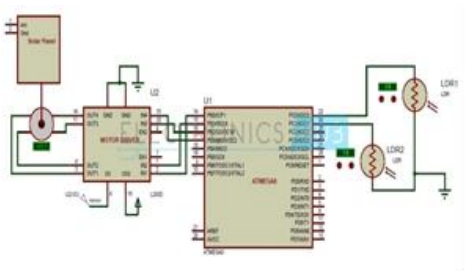

Fig. 3. Circuit Diagram

B. Implementation

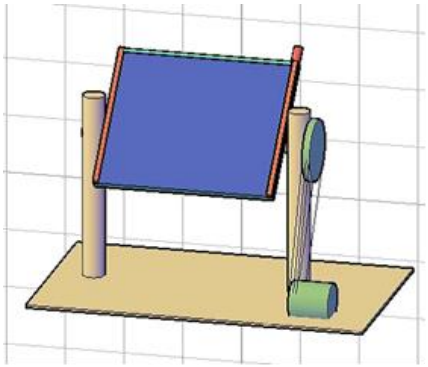

Fig. 4. Implementation

The prototype for the solar panel cleaning and tracking mechanism for the better efficiency power output is illustrated This prototype consists of two dc motors of 1000rpm for cleaning and 10rpm for tracking mechanism. The wiper which is placed on the panel is used for cleaning the dust particles which are deposited on that. These dc motors can be controlled by the microcontroller. The 1000rpm dc motor which is used for cleaning is connected to the threaded rod. When the motor is in forward direction, the threaded rod rotates and the wiper connected to the road moves downwards and when the motor rotates in opposite direction the wiper moves upwards as the threaded rod rotates in opposite direction.

C. Advantages

- Trackers generate more electricity than their stationary counterparts due to increased direct exposure to solar rays. This increase can be as much as 10 to 25% depending on the geographic location of the tracking system.
- There are many different kinds of solar trackers, such as single-axis and dual-axis trackers, all of which can be the perfect fit for a unique jobsite. Installation size, local weather, degree of latitude and electrical requirements are all important considerations that can influence the type of solar tracker best suited for a specific solar installation.
- Solar trackers generate more electricity in roughly the same amount of space needed for fixed-tilt systems, making them ideal for optimizing land usage.
- In certain states, 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 peak times of the day. Using a tracking system helps maximize the energy gains during these peak time periods.
- Advancements in technology and reliability in electronics and mechanics have drastically reduced long-term maintenance concerns for tracking systems.

D. Disadvantages

- Solar trackers are slightly more expensive than their stationary counterparts, due to the more complex technology and moving parts necessary for their operation. This is usually around a $0.08 – $0.10/W increase depending on the size and location of the project.
- Even with the advancements in reliability, there is generally more maintenance required than a traditional fixed rack, though the quality of the solar tracker can play a role in how much and how often this maintenance is needed.
- Trackers are a more complex system than fixed racking. This means that typically more site preparation is needed, including additional trenching for wiring and some additional grading.
- Single-axis tracker 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.
- Solar trackers are generally designed for climates with little to no snow making them a more viable solution in warmer climates. Fixed racking accommodates harsher environmental conditions more easily than tracking systems.
- Fixed tracking systems offer more field adjustability than single-axis tracking systems. Fixed systems can generally accommodate up to 20% slopes in the E/W direction while tracking systems typically offer less of a slope accommodation usually around 10% in the N/S direction.

Fig. 5. Solar panel

Some of the best places to collect solar energy are also some of the dustiest on Earth. Dust from pollution and traffic that fall on the solar panel surface prevents the sunlight from reaching the solar cells. The efficiency of solar panel gets affected in the presence of dust particles. While many actors affect how much electricity your solar panels will produce, dusty solar panels can be one of the biggest, and easiest to fix. Experts have agreed that dusty solar panels do not produce as much power as clean panels. The power output of the panel degrades up to 50% due to the dust accumulation. A solar panel cleaning system is proposed in order to make a solar panel operate at the best power generation state, while the solar panel is used in dusty environment. This project consists of a LDR sensor, wiper unit and sprayer. The LDR sensor is used to detect whether it is a day or night. Depending on the solar output the presence of dust on the surface of solar is detected. If the dust is detected the wiper starts to work on the surface along with the water sprayer. This project highlights the effect of dust, dirt, pollen, seasalt, and bird droppings on the PV systems efficiency. However, the development of the cleaning system can solve those problems. This development is divided into two parts: hardware (stability and cleaning mechanism) and the software. The software development for the cleaner system has been done in the project. The cleaning time has been reduced by setting a path for the robot on the surface of the PV panels, instead of using the forward and backward movement of the wiper. From this project learned about the designing programs using Arduino software. Also learned how to lead manage a project in the future. The weakness of this project was the limited time. Here is urgency in improving the efficiency of solar power generation. Current solar panels setups take a major power loss when unwanted obstructions cover the surface of the panels. The obstruction turns the shaded cell into a resistor, causing it to heat up and consume extra power. To address this issue, we have successfully engineered a self-cleaning solar panel. This specific panel detects the obstruction with a Differential Measurement Unit (DMU). It makes the decision from the Microcontroller unit to either clean the panel with the Wiper and Sprayer Mechanism or continue to charge the battery with the Battery Charger. Our mechanism to combat the power loss is unique, self-reliant, and easy to use. Solar panels are generally self-cleaning, but in particularly dry areas or where panel tilt is minimal, dust and other substances such as bird droppings can build up over time and impact on the amount electricity generated by a module. Grime and bird poop doesn't need to cover an entire panel to have an effect. This is where cleaning solar panels may have to be done. And for the longer term, you may be asking "how often to replace a solar panel?" Safety first for cleaning solar panels follow the procedure in your manual for shutting down the system before commencing cleaning. For safety reasons, it's also wise to clean your panels from the ground if possible. A good quality soft brush and a squeegee with a plastic blade on one side and a cloth covered sponge on the other coupled with a long extension can make for the perfect tools allowing you to stay on the ground. Use a hose with a suitable nozzle to allow the stream of water to reach the panels.

2. Review of literature

Photovoltaic panel production has increased globally in response to the growing demand for solar energy. This has been the result of an increased awareness of the damage to the environment that using fossil fuel sources has had over the years. In 2013, Huynh, D. C., Nguyen, T. M., Dunnigan, M. W., & Mueller, M. A. they analyses and compares the open- and closed-loop trackers of a solar PV system. The obtained experimental results are to validate the effectiveness of each tracker. In 2013, Lee, J. F., & Rahim, N. A. Presented their work on A low cost prototype dual-axis solar tracking system is proposed in this study. The dual-axis solar tracker prototype adopted low cost microcontroller and light sensors to detect the sun's movement and follow it accordingly throughout the year. The performance of dual-axis tracking system and fixed-position system are compared and discussed qualitatively and quantitatively based on outdoor environment under Malaysia climate. Comparative results depicted that performance in terms of irradiance and energy gain of static solar system thrives by dual-axis tracking system. In 2016, Abhilash, B., &Panchal, A. K. presented their work on the current era of power shortage in India, the use of solar energy could be beneficial to great extent. For this reason, the number and size of the Photovoltaic (PV) systems are growing and consequently the amount of the investments and the related opportunities and risks are increasing [1]. To make solar energy more fruitful, the efficiency of solar array systems must be maximized [2]. For the efficiency evaluation of PV panels, that has been discussed with particular attention to the presence of dust and maximum intensity of light on the panel surface. Mainly, the effects of the dust and intensity of light on the efficiencies of the PV panels have been highlighted. This paper gives the brief description of the design and construction of microcontroller based cleaning and tracking system. In 2016, Chen, C. H., &Iqbal, Z. presented their work on The effect of these conditions can adversely affect the efficiency of the solar based system, most importantly the concentrated solar power system which relies on the reflection of the light on the line or point focal point. Hence soiling for the reflectors can hugely effect the overall viability of the technology in this region. This study aims to achieve it by carrying out a detailed study of effect of dust and its

composition. Further the use of combination of methods available in the market to mitigate them. Finally conceive the design based on the initial tests and approaches to make the cleaning robot for the Linear Fresnel concentrated Mirror

3. Conclusion

Two algorithms were studied one for cleaning and ne for tracking of the solar panel. The self-cleaning and tracking mechanism has been implemented. Several cases were experimentally implemented and came to the conclusion. By the above results it can be observed that the tracking is best suited then the fixed one, only when the dust on the panel is cleaned. If we implement the tracking system without cleaning the panel the efficiency is less than of the panel which is fixed and cleaned. Moreover the efficiency of the panel is decreased by 50% even though it is tracking without cleaning. It is also concluded that from the Table V the efficiency of the panel has been improved when we are going with the tracking as well as cleaning system. This system can extend to dual axis tracking by that we can achieve more efficiency.

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