PAPER TITLE: IMPROVEMENT OF EFFICIENCY OF SOLAR PANEL USING DIFFERENT METHODS.

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ABSTRACT

The recent upsurge in the demand of PV systems is due to the fact that they produce electric power without hampering the environment by directly converting the solar radiation into electric power. Solar energy is completely natural, it is considered a clean energy source. So the study on improving the efficiency of solar panel is very necessary In this paper I have discuss various methods of efficiency improvement of solar panel. We can improve efficiency of solar panel by using solar tracker with panel which continuously tracks sunlight throughout the day to get maximum solar energy. Second method to improve the efficiency is dust cleaning. Dust is barrier between sunlight and solar panel. Third method is cooling technique. As panel temperature increases output voltage of solar panel decreases so cooling of panel is necessary for improvement of efficiency. Other method is anti-reflecting coating for solar panel, which improve efficiency of panel. Aim of this paper is to increase the efficiency and power output of the solar panel.

Keywords: Cooling Technique, Dust Cleaning, Efficiency, Solar panel, Solar Tracker

I. INTRODUCTION

One type of renewable energy source is the photovoltaic (PV) cell, which converts sunlight to electrical current, without any form for mechanical or thermal interlink. PV cells are usually connected together to make PV modules, consisting of 72 PV cells, which generates a DC voltage between 23 Volt to 45 Volt and a typical maximum power of 160 Watt, depending on temperature and solar irradiation. Solar panel efficiency depends on various factor such as solar intensity (brighter the sunlight, the more there is for the solar cell to convert), temperature, dust which decreases the efficiency of panel etc. Following methods are used to improve efficiency of solar panel.

1.1 Solar Tracker

Trackers direct solar panels or move toward the sun. These devices change their orientation throughout the day to follow the sun's path to maximize energy capture. In photovoltaic systems, trackers help minimize the angle of incidence between the incoming light and the panel, which increases the amount of energy the installation produces.

1.1.1 Types of Tracker

1. Single-axis tracker
2. Dual-axis tracker

Single-axis solar trackers rotate on one axis moving back and forth in a single direction. Dual-axis trackers continually face the sun because they can move in two different directions. Dual-axis tracking is typically used to orient a mirror and redirect sunlight along a fixed axis towards a stationary receiver. Because these trackers follow the sun vertically and horizontally they help obtain maximum solar energy generation.

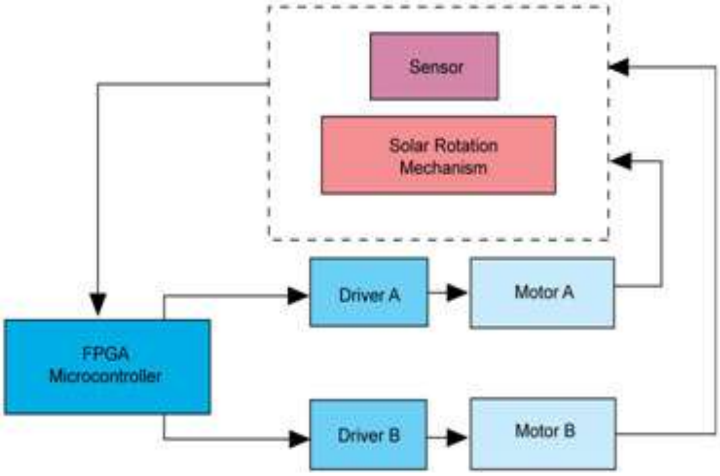

Fig.1

There are also several methods of driving solar trackers. Passive trackers move from a compressed gas fluid driven to one side or the other. Motors and gear trains direct active solar trackers by means of a controller that responds to the sun's direction shown in fig1.The system receives sunlight onto the cadmium sulphide (CdS) photovoltaic cells where the CdS acts as the main solar tracking sensor. The sensor feeds back to the FPGA controller through an analog-to-digital (A/D) converter. The processor is the main control core and adjusts the two-axis motor so that the platform is optimally located for efficient electricity generation.

Selecting a solar tracker depends on system size, electric rates, land constraints, government incentives, latitude and weather. Utility-scale and large projects usually use horizontal single-axis solar trackers, while dual-axis trackers are mostly used in smaller residential applications.

1.1.2 Advantages

The use of solar trackers can increase electricity production by around a third, and some claim by as much as 40% in some regions, compared with modules at a fixed angle. In any solar application, the conversion efficiency is improved when the modules are continually adjusted to the optimum angle as the sun traverses the sky.

1.1.3 Disadvantages

Adding a solar tracking system means added more equipment, moving parts and gears that will require regular maintenance and repair or replacement of broken parts. If the solar tracker system breaks down when the solar panels are at an extreme angle, the loss of production until the system is functional again can be substantial

1.2. Dust cleaning

Effect of dust on the performance of solar PV panel

The electrical parameters of solar panel are sensitive to the dust density so it is very essential to provide auto cleaning mechanism to remove the dust particles from the surface of the panel in order to ensure high performance. Dust is the lesser acknowledged factor that significantly influences the performance of the PV installation. Dust prevents sunlight from reaching the solar cells in your solar panels. Due to dust efficiency of solar panel can decrease.

Following methods are used to clean dust from solar panel.

1.2.1 Rugged Robot

Deserts are sunny, so they're ideal for solar power. But they're also very dusty, so solar panel efficiency decreases. (lose about 0.4-0.8% in efficiency *per day*). But hosing panels down with water in the middle of an arid area is problematic on so many levels. And anything that requires a lot of human labor in the middle of a remote desert where temperatures can go over 122 degrees fahrenheit during the day.

These are the problems that the **NO**-water **M**echanical **A**utomated **D**usting **D**evice (NOMADD) robot from Saudi Arabia is trying to solve. (fig 2).

Fig. 2

Shown in fig 2 little robots are mounted on tracks along rows of panels, and at least once a day they pass over the panels, cleaning them with a brush designed and without any water required. This makes a big difference over manual cleaning which only happens every week or two most of the time. A single NOMADD can clean a row of panels about 600 feet long, with plans to upgrade that to 900 feet. Because each row of panels has its own NOMADD robot, they can work in parallel and it doesn't take longer to clean a gigantic solar farm. The NOMADD is not a cleaning solution developed in mild conditions. It is a system designed, developed and tested in Saudi Arabia for the harshest desert conditions.

1.2.2. Self Cleaning Technique

The self-cleaning technology was developed by Boston University professor Malay K. Mazumder and his colleagues, in association with the National Aeronautics and Space Association, and was originally intended for use in rovers and other machines sent to space missions to the moon and to Mars.

The technology involves the deposition of a transparent, electrically sensitive material on glass or on a transparent plastic sheet that cover the panels. Sensors monitor dust levels on the surface of the panel and energize the material when dust concentration reaches a critical level.

The electric charge sends a dust-repelling wave cascading over the surface of the material, lifting away the dust and transporting it off of the screen's edges. Within two minutes, the process removes about 90 percent of dust on a solar panel. The mechanism reportedly requires only a small amount of the electricity generated by the panel for it to work.

Coating the surface of solar cells can increase their efficiency and reduce maintenance costs, especially for large-scale installations. Self cleaning solar panels would be especially effective in large installations. The desert environments where many of these installations reside often challenge the panels with dust storms and little rain. Currently, only about 4 percent of the world's deserts are used in solar power harvesting. Conventional methods of cleaning solar panels usually involve large amounts of water which is costly and scarce in such dry areas.

1.2.3. Robotic Vacuum Cleaner

This system is implemented using two subsystems namely a Robotic Vacuum Cleaner and a Docking Station.. The robot uses a two stage cleaning process to remove dust effectively from the solar panels. A rolling brush is placed in front to disperse the dust towards the vacuum cleaner. A high speed motor capable of creating suitable suction is used for removing dust from the panels. It traverses the solar panel using a pre-defined path controlled by the accelerometers and ultrasonic sensor. It is designed to work on inclined and slippery surfaces. A control strategy is formulated to navigate the robot in the required path using an appropriate feedback mechanism. The battery voltage of the robot is determined periodically and if it goes below ,it returns to the docking station and charges itself automatically using power drawn from the solar panels. It is robust, commercially viable product which provides a simple, cost-effective solution to the clean small solar panels.

1.2.4. Motor fitted to solar panel and periodically a jerk can be given to panels, so dust slides down.

1.3 Cooling Technique

Photovoltaic panels (PV) get overheated due to excessive solar radiation and high ambient temperatures. Overheating reduces the efficiency of the panels. The ideal *P–V* characteristics of a solar cell for a temperature variation between 0 °C and 75 °C are shown in Fig.3.The *P–V* characteristic is the relation between the electrical power output *P* of the solar cell and the output voltage, *V*, while the solar irradiance, *E*, and module temperature, T_m, are kept constant. The maximum power output from the solar cells decreases as the cell temperature increases, as can be seen in Fig.3. This indicates that heating of the PV panels can affect the output of the panels significantly.

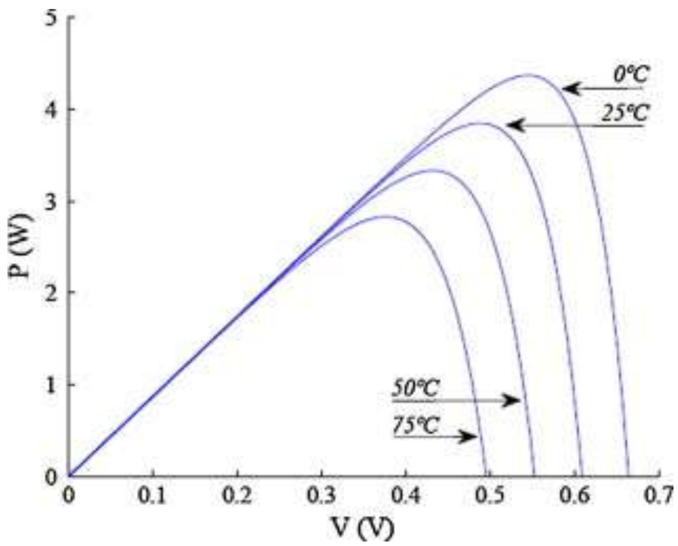

Fig .3

Hybrid Photovoltaic/Thermal (PV/T) solar system is one of the most popular methods for cooling the photovoltaic panels nowadays shown in fig4 . The hybrid system consists of a solar photovoltaic panels combined with a cooling system. Water is circulated around the PV panels for cooling the solar cells, and the warm water leaving the panels pump back to water tank. Warm water mixed with cool water of tank.

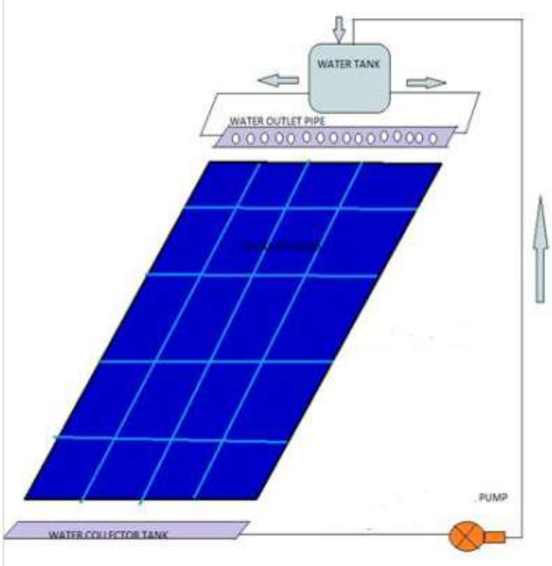

Fig. 4

It is concluded that the cooling system could solve the problem of overheating the PV panels due to excessive solar radiation and maintain the efficiency of the panels at an acceptable level by the least possible amount of water.

1.4 Antireflective Coating (ARC)

When light strikes the silicon cells, packets of solar energy are absorbed and converted into electricity. Because bare silicon has a high refractive index, more than 35 percent of incident light is reflected away from the panel's surface before it can be converted into usable energy.

The reflection is reduced by texturing and and by applying anti-reflection coatings (ARC) to the surface. Anti-reflection coatings on solar cells are similar to those used on other optical equipment such as camera lenses. They consist of a thin layer of dielectric material, with a specially chosen thickness so that interference effects in the coating cause the wave reflected from the anti-reflection coating top surface to be out of phase with the wave reflected from the semiconductor surfaces. These out-of-phase reflected waves destructively interfere with one another, resulting in zero net reflected energy.

Anti-reflective glass coating from Australian company Brisbane Materials, lets solar panels capture more light and therefore boosts their efficiency. The coating decreases light reflection by 75 percent and increases power output by three percent, which may seem small, but it's the highest improvement for any anti-reflective coating so far and, over an array of solar panels, this type of improvement can make a big difference. To coat a solar panel, the liquid solution that contains silicon dioxide is applied to the sheet of glass that protects the solar cells, then is heated to room temperature which turns it into a very thin layer of porous, reflection-dulling glass. That room temperature heating instead of a typical high-temperature (around 600 degrees Celsius) heat is what could make this coating far easier and cheaper to implement.

II. CONCLUSION

The reasonable and effective utilization of solar energy is an important path which can deal with the global energy crisis at present. Photovoltaic (PV) cell, which converts sunlight to electrical current, without any form for mechanical or thermal interlink. So the study on improving the efficiency of solar panel is very necessary. I have proposed several methods (using solar tracker, cleaning dust from panel, cooling technique of panel, using anti-reflecting coating etc.,)to improve the efficiency of solar panel. Practice has proved that the use of these methods can effectively improve the efficiency of solar power generation.

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