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# Improvement in Efficiency of Solar Panel

**Amith nandakumar* Arvind Srinivasan** and Arjun. S*****

***Abstract :*** There is a recent upsurge in the usage of renewable energy resources. Solar energy is the main contributor in the power generation in our country. With coal resources left only for the next 10 years, renewable energy would become the next big thing. But the problem here is the efficiency and the power generation capabilities of the these energy methods which are yet to be tested clearly. Sensing the need of an alternative there has been an increase in the usage of PV system and also to the fact that it produces electricity without hampering the environment. In order to produce a good amount of energy, efficiency must to high. So the study on improving the efficiency of the solar panel is very important. In this paper we have discussed various methods to improve the efficiency of a 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.

## 1. 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.

## 2. SOLAR TRACKER

A solar tracker is a device that orients a payload toward the sun. Solar trackers are classified into two types.

### 2.1. Single Axis Tracker

This type of tracker rotates on a single axis (*ie*) back and forth in a single direction.

#### 2.1.1. Horizontal Single Axis Tracker

The axis of rotation for horizontal single axis tracker is horizontal with respect to the ground. The posts at either end of the axis of rotation of a horizontal single axis tracker can be shared between trackers to lower the installation cost. Field layouts with horizontal single axis trackers are very flexible. The simple

* Dept. of Electrical and Electronics Engineering SRM University Chennai, India Email:amith1503@gmail.com
** Dept. of Electrical and Electronics Engineering SRM University Chennai, India Email:arvindsrini@hotmail.com
*** Dept.of Electrical and Electronics Engineering SRM University, Chennai,India Email:arjunsundar7@gmail.cim

geometry means that keeping all of the axes of rotation parallel to one another is all that is required for appropriately positioning the trackers with respect to one another.

Appropriate spacing can maximize the ratio of energy production to cost, this being dependent upon local terrain and shading conditions and the time-of-day value of the energy produced.

### 2.1.2. Vertical Single Axis Tracker

The axis of rotation for vertical single axis trackers is vertical with respect to the ground. These trackers rotate from East to West over the course of the day. Such trackers are more effective at high latitudes than are horizontal axis trackers. Field layouts must consider shading to avoid unnecessary energy losses and to optimize land utilization. Also optimization for dense packing is limited due to the nature of the shading over the course of a year. Vertical single axis trackers typically have the face of the module oriented at an angle with respect to the axis of rotation. As a module tracks, it sweeps a cone that is rotationally symmetric around the axis of rotation

### 2.1.3. Tilted Single Axis Tracker

All trackers with axes of rotation between horizontal and vertical are considered tilted single axis trackers. Tracker tilt angles are often limited to reduce the wind profile and decrease the elevated end height. With backtracking, they can be packed without shading perpendicular to their axis of rotation at any density. However, the packing parallel to their axes of rotation is limited by the tilt angle and the latitude. Tilted single axis trackers typically have the face of the module oriented parallel to the axis of rotation. As a module tracks, it sweeps a cylinder that is rotationally symmetric around the axis of rotation.

### 2.2. Dual Axis Tracker

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. A tip–tilt dual axis tracker (TTDAT) is so-named because the panel array is mounted on the top of a pole. Normally the east–west movement is driven by rotating the array around the top of the pole. On top of the rotating bearing is a T- or H-shaped mechanism that provides vertical rotation of the panels and provides the main mounting points for the array. The posts at either end of the primary axis of rotation of a tip–tilt dual axis tracker can be shared between trackers to lower installation costs.

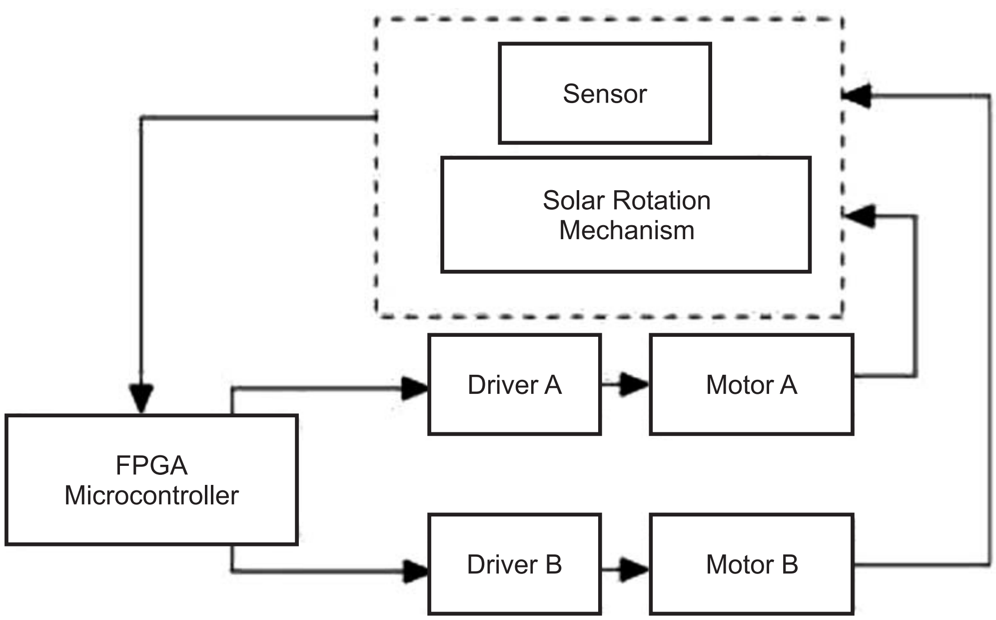


**Figure 1**

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 analogue-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.

### 2.3. 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

### 2.4. 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

## 3. DUST REMOVALS

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.

### 3.1. Electro Dynamic System

**Figure 2**

Electrodynamic system (EDS), is a self-cleaning technology that can be embedded in the solar device or silkscreen-printed onto a transparent film adhered to the solar panel or mirror. The EDS exposes the dust particles to an electrostatic field, which causes them to levitate, dipping and rising in alternating waves (the way a beach ball bounces along the upturned hands of fans in a packed stadium) as the electric charge fluctuates.

Within seconds, the transparent EDS sweeps away at least 90 percent of dust and sand atop a solar panel. The entire process takes seconds and uses a minuscule amount of power, generated by the solar device itself—about 1/100th of what it produces daily. In its final version, the EDS will be programmable or will automatically detect the presence of surface dust and switch on

### 3.2. 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 labour 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 Mechanical Automated Dusting Device (NOMADD) robot from Saudi Arabia is trying to solve.

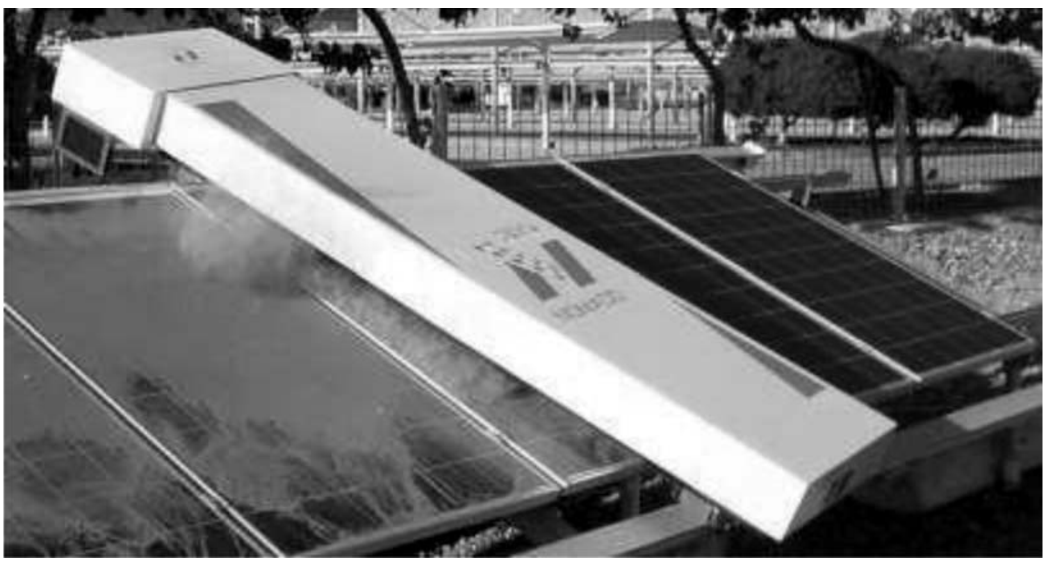

**Figure 3**

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.

## 4. COOLING TECHNIQUES

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, Tm, 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.

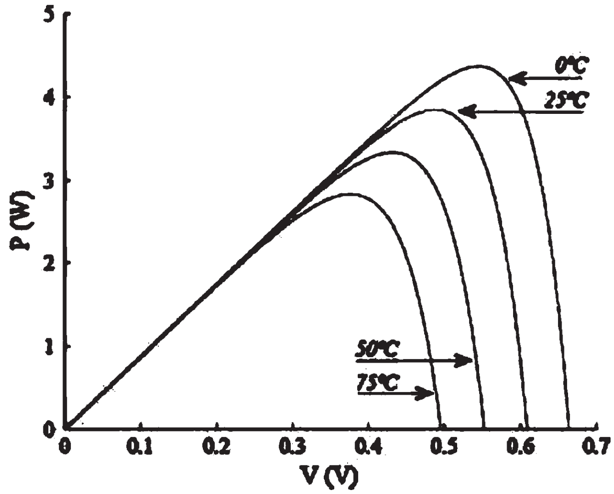


**Figure 4**

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.

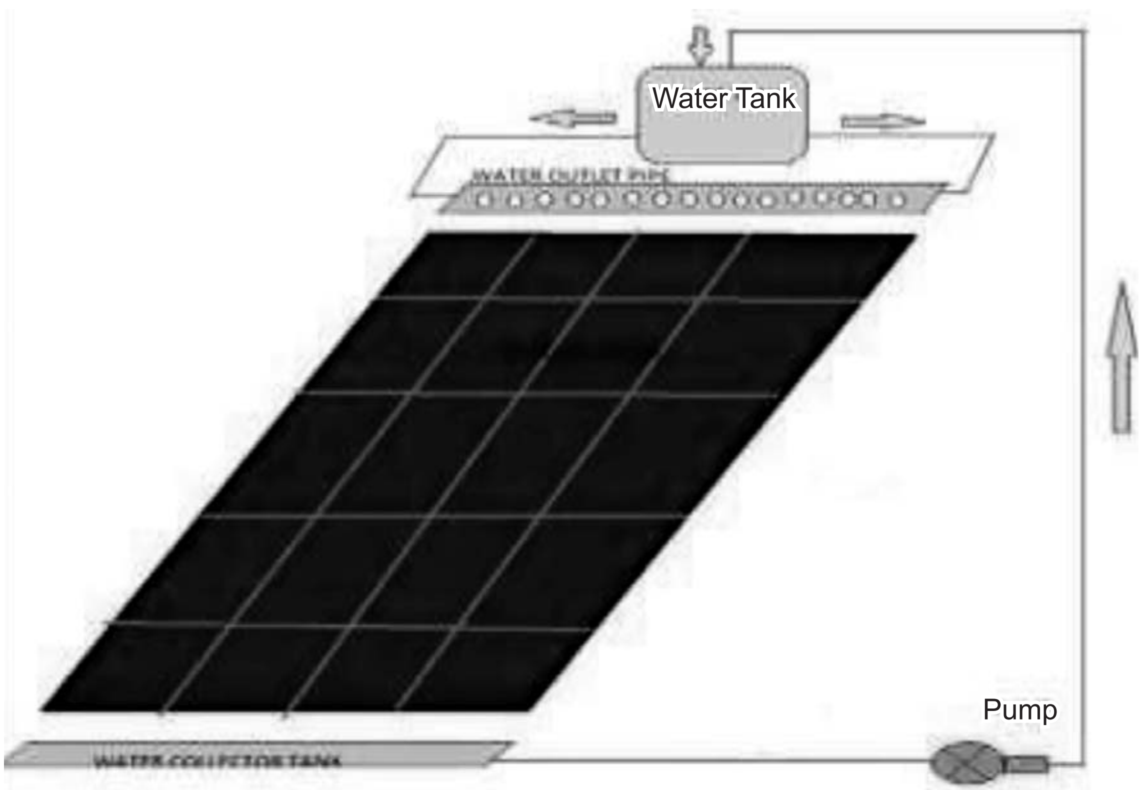


**Figure 5**

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.

### 4.1. 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. Antireflection 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.

## 5. REFERENCE

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