

## Experimental Analysis of Solar Panel Cleaning System

Vivek Dhengare, Kunal Gajbhiye, Pankaj Raut, Arshad Sheikh, Abhishek Gaurkhede, Manish Umredkar,

Dr. V. R. Khawale

Mechanical Engineering Department, RTMNU/DBACER, Nagpur, Maharashtra, India

### ABSTRACT

The Solar Panels Farms are generally situated in dirt and dust areas which is mostly in case of tropical countries. The performance of solar panels depends on various factors, the power generated by farm can decreased if there is dust and dirt on panels and this is the main factor for reduction in efficiency of PV panels. One can generally assume a reduction of about 40% - 50%, if the panels are not clean properly for 1-2 months. So to overcome this problem and to increase the efficiency of power production cleaning of module on regular basis is necessary. To clean the dust, an automatic cleaning robot is developed, which will clean the panels on regular interval of time. The mechanism is based on control circuit, DC motor to clean the panels. The paper provides you with the idea how the robot will work and its effect on the energy production by solar farms. It will also to help to understand the problem arise due to not cleaning of solar cells.

**Keywords:** Solar Panels, Energy loss, Design, Cleaning.

### I. INTRODUCTION

The robots are alternative method to the conventional methods and they are design so to avoid the wastage of water and to reduce the human effort to clean solar modules, but also labour-intensive, method of sending human workers to hose and wipe down panels manually or use a truck-mounted sprayer to do so., Dirty panels produce less electricity, so to increase the production of electricity cleaning of panels should be must, but the need to use water for cleaning those panels, especially in dry regions, makes even a clean power project less eco-friendly. In certain remote corners, the water digged out from the ground is too brackish for use and also it contains the corroded elements, if not being treated properly, due to this there is increase in production cost of a solar power plant. In dusty areas such as the Middle East and India, solar panels could lose electricity production by 10 % to 35 % over time if they are not washed on regular basis. There is increase in 2-3 % more electricity production than employing humans due to use of such

robots, the challenge of Keeping solar panels dust free will grow as more solar power projects are built worldwide. The cheap labour and plenty of water supply will able to continue for making manual washing the low-cost choice for solar power plant owners. The natural way to clean is air; air flow removes a bulk of the dust while the brushes get rid of the rest. So to avoid the wastage of water, to reduce the human effort and time require cleaning the modules, a robot is developed which will help to clean the module on regular interval of time, and also it will overcome all the problems arise. The robot itself is a solar power charged but it will runs on two 12-volt lead-acid batteries at night. Solar electricity recharges the batteries during the day. The robot will clean the panels to and fro on regular interval of time. After completing its task the robot returns to a docking station and uses the rotational energy to get rid of the dust captured by the microfiber. With about one year of field data of its robots' Hence this paper will help to get an idea and innovative method of cleaning solar panels automatically.

## II. METHODS AND MATERIAL

The solar panel was clean by using robotic arm and water sprinkle. The robotic arm consist of two dc motor of 100 rpm and two brushes which is mounted on two shaft of two dc motor which is perpendicular to the panel and other two dc motor of 30rpm arranged in the rack and pinion arrangement helps in moving the robotic arm throughout the panel area for cleaning purpose of the panel the submersible pump place in the water tank that provide water to the sprinkle which is fixed at the head of the panel for wet cleaning of the panel the battery is provided to run the dc motors and the pump.

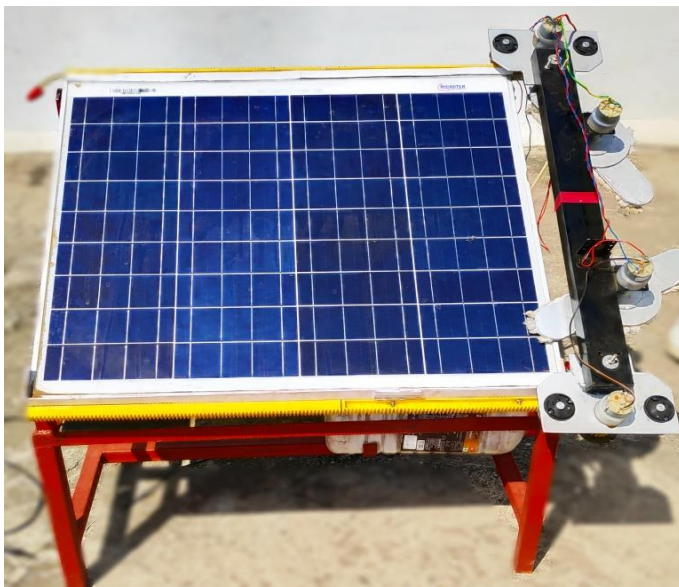


Figure 1. Front view of solar panel cleaning system

Component specification

Table 1

S.N.	Components	Size(mm)	Quantity
1	Solar panel	666x560	1
2	Robotic arm	572x50	1
3	Brush	Diameter(110), Length(133)	2
4	Rack	765	2

### DC motor Specifications:

DC motor 30 rpm

Motor Type : DC with Gear Box, Metal Gears

Base Motor : DC 3000 RPM  
 Shaft Type : Center, Circular 6mm Diameter with Internal Hole for coupling, 23 mm shaft length.  
 Maximum Torque: ~2.5 Kg-cm at 12V  
 RPM : 30 RPM at 12V  
 Weight : 145 Gms  
 Max Load Current : 250mA at 12V-30RPM  
 Power : 770 watt  
 Horse Power : 0.0010328 HP  
 Dc Motor 100 rpm  
 Shaft Type : 6mm shaft diameter, 23mm shaft length.  
 Maximum Torque : 1.2 Kgcm  
 RPM : 100  
 Weight : 125 gm  
 Load current : 300 mA at 12v  
 Power : 1026.2 Watt  
 Power in HP : 0.0018659

## III. RESULTS AND DISCUSSION

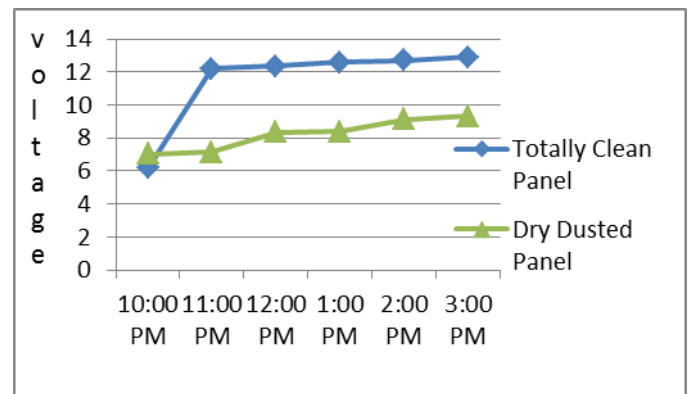


Figure 2. Voltage vs Time For dusted and Non-dusted solar panel

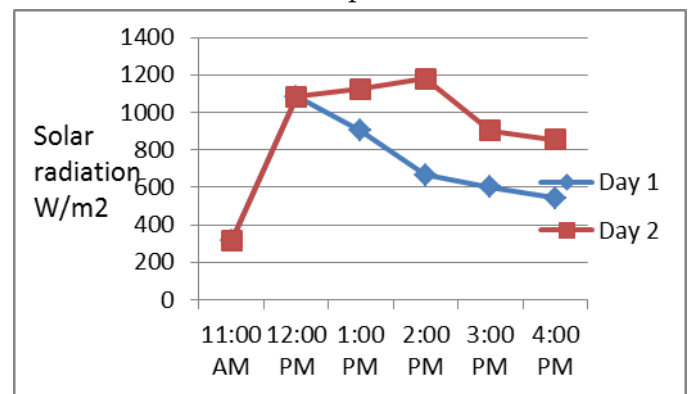


Figure 3. Graph of Time vs Solar Radiation Intensity

## V. REFERENCES

Panel efficiency

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Timing between 1-2 PM

Panel output

For totally clean panel = 21.05 volts

For dry dusted panel = 19.28 volts

Hence

Efficiency of panel  $= (21.05 - 19.28) / 21.05 * 100$   
 $= 8.40 \%$

Hence the efficiency loss due to dusted panel is 8.40%

- [1]. "Robotic Device for Cleaning Photovoltaic Panel Arrays" by mark Anderson, Ashton Grandy, Jeremy Hastie, Andrew Sweezey, Richard Ranky, Constantinous Mavroidis
- [2]. "Development of an automatic robotic cleaning system for photovoltaic plants", by Nawaf Albaqawi and Alireza Gheitasi, Waikato Institute of Technology, New Zealand, 2014.

A. The Following are the Result Obtained after Analysing the Robot

- 1) Single robot for single row ( row length doesn't matters)
- 2) Brush length can be adjusted according to panel width.
- 3) Robot self charged from battery.
- 4) Designed to run fully autonomous (No human is required)

B. There are some Benefits also which are stated as follows

- 1) Improvement in performance of solar
- 2) system
- 3) Reduce cost of operations of solar plants
- 4) Extend lifetime of solar panels
- 5) Make solar power plants greener.

## IV. CONCLUSION

1. In that project we are saving time and money.
2. In future it can reduce the weight and can made compact design of the system with the help of new technology.
3. Due to use of robot cleaning mechanism the efficiency of PV panel increases.
4. There is no labour requirement for cleaning.
5. This project is used for both wet cleaning and dry cleaning process.