

# Easy Implementation of Solar Panel Cleaner

Milin D Patil, Kiran N Patil, Suhas M Patil , Sachin S Patil

**Abstract:** Solar energy is one of biggest source of energy with high potential due to radiation of sun. The energy generated by solar having many applications in domestic, commercial and industrial application. Sand and dust particles accumulating on solar panel so reducing the power output. Also the panels which are cleaned are efficient to generate electric power. There are some traditional methods available but they are manual. Hence to overcome these problems automatic robot is designed for improving overall efficiency of solar panel. The cleaner was equipped with stepper motor, DC motors and brushes for accurate operation of vertical and horizontal motion. The Dc motors cleans the panel in horizontal direction and stepper motor in vertical direction. The various tests are performed which gives result that overall operation can be completed in particular time period. The robot's system is controlled by an atmega328 microcontroller. So it is found that these technique to clean the solar panel is better and cheaper than other method.

**Keywords :** Solar Panel cleaning, Automation, solar panel Efficiency, microcontroller atmega328

## I. INTRODUCTION

Sun is the biggest source of energy, therefore, in huge amount solar energy can be present in the nature. In extremely large rate, sun can be emitting it's energy. World's energy demand is big, but all solar energy is used then it can be sufficient. Therefore, we need increases of solar panel efficiency. Solar panel is used for conversion of solar energy to another form. Due to the technical and economic benefits, use of solar devices increases rapidly. In all over world, industry of Solar photovoltaic (PV) is expanded. In commercial level, 10 to 13% conversion can take place in solar cell. Efficiency of outdoor installed PV modules is reducing by 10 to 25%. Efficacy of solar panel is decreases due to the dust. Dust is nothing but particulate matters. Dust consists of substance which present in air and includes smoke, fog. Inorganic and organic substances. Such substances are collected and dust can be formed. Also, dust can be include volcanoes vapors, forest fires, smoke, bacteria, storms, pollen and sand. For long period, dust can be present in air; atmospheric particles which are suspended solid can be included here. Through the wind movements, dust particles can be move and transfer to long distances. Atmospheric condition such as clouds, dust and temperature is affected to solar panel efficiency. Due to the atmospheric condition, all solar energy we can't be use. Due to the dust, losses can be occurring. Photovoltaic cell

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connected together and formed solar panel. Photovoltaic cells having protective glass coating. When sun rays are subjected to radiation, photovoltaic cell generates electricity. On presence of dust layer on solar panel, reduces capability of generation of electricity. The mechanism primarily consists of roller brush to offer slippage-free motion and cleaning on a glassy surface. In our project power loss can be less in amount or unique. Our project is also self-reliant and for use it is very easy. Solar energy is more advantageous because it generates electricity without carbon dioxide emission. Sun is source of energy, which is renewable. Natural condition consists of parameters like dust, humidity and temperature. Efficiency of solar panel is depending on the natural condition. So, it is necessary to take care parameters like dust, humidity and temperature. Avoiding this problem, we can study how we can remove dust particle on solar panel and improve solar panel efficiency effectively. We used atmega328 board for cleaning of solar panel. Our project includes design and implementation of solar panel cleaner. The actual goal is developed automatic solar panel cleaner. Manually solar panel can be clean but big disadvantage is risk of staff accidents, hard work and man power can be required. To overcome this all disadvantages we can make automatic solar panel cleaner. It is more effective, smooth cleaning, and avoids the irregularities in the productivity due to the deposition of dust. Our system is work very smoothly. There is no requirement of external power, it takes power from battery. Battery is charge with the help of solar panel. Charge controller is attached in between them.

## II. LITERATURE SURVEY

Thanaphon Sorndach and Noppadol Pudcheun et.al.,[1] explained solar panel cleaner using Omni-wheels, sensors, encoders etc. The advantage of this robot is that consume 64% cleaning time than another robot. The test is conducted with Omni-wheels and without Omni-wheels. In conclusion, we found that Omni-wheels robot is better than non-Omni wheels robot. Omni-wheels robot having driving speed 50-60% faster than non-Omni wheels robot. Mohammad. A. Jaradat and Mohammad Tauseef et.al., [2] explained a robotic device for cleaning purpose consist of an Arduino microcontroller for controlling. A single robot is used. When one panel is cleaned completely the robot transfer to next panel. For these operation it consists of two main parts first is cleaning robot and another is automated carrier cart. Carrier cart which moves on rail platform and they transfer the robot from one panel to another panel. In conclusion, it is autonomous cleaning solution of the solar panel. Hiroyuki Kawamoto and Takuya Shibata et. Al[3] explained unique cleaning system has been used in which electrostatic force is used to remove sand from solar panels. Electrostatic travelling waves remove 98% of dust particles from the solar panel and these electrostatic travelling waves generated by a four- phase rectangular voltage

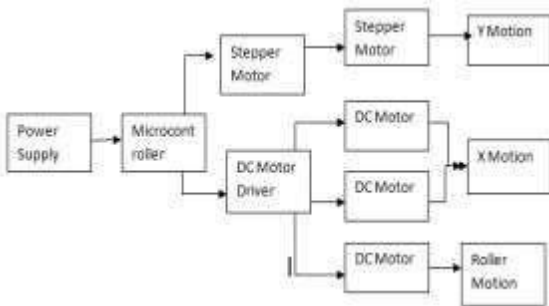
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applied to a transparent conveyer having transparent indium tin oxide (ITO) electrodes printed on a declined from the database of journal and publishing house. It is noted that: 1. Each author profile along with photo (min 100) glass substrate. But this technique having one disadvantage that it requires expensive ITO electrodes. So it is not suitable for a commercial mega solar system. In conclusion, there is unique cleaning system for desert areas and operates automatically without water and others consumables. Aravind G, Gautham Vasanth\*, Gowtham Kumar T.S.B, Naresh Balaji Ret.al.[4] explained dust accumulation on solar panel, hence reduces its efficiency there is loss in generated power output. They are developed automatic robotic cleaner to improve efficiency and life of solar panel. It is constructed using two systems which are namely robotic vacuum cleaner and docking station. For controlling purpose MSP430G2553 microcontroller is used. It is master control element of robot. In conclusion, these system is used in desert areas at low latitude due to no requirement of power, water and other consumables and these are used for mega solar power plants.

### III. DESIGN DETAILS

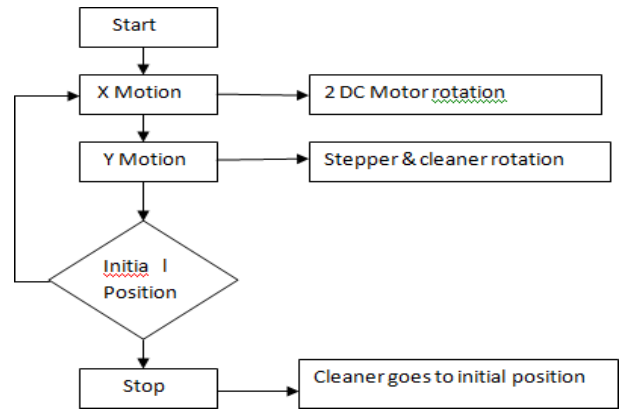
#### A. Block Diagram of Solar Panel Cleaner:

Figure 1 shows the Block Diagram of Solar Cleaner. For cleaning solar panel, we are going to design and develop the system. The system works in horizontal and vertical direction. For horizontal motion of the system 2 DC motors are used which are sliding on the slider which is fabricated to place the solar panels. Stepper motor is used for vertical motion of the frame. The dust cleaner or wiper is fitted on the system. DC motor is used to rotate the dust cleaner. This cleaner cleans the panel from top to bottom. Whole system is controlled using microcontroller. The logic supply and motor supply are designed differently to avoid damage of the controller. The microcontroller used is Atmega328.



**Figure 1: Block Diagram of Solar Panel Cleaner**

#### B. Implementation of Solar Panel



**Figure 2: Flowchart of implementation of Solar Panel**

Figure 2 gives the flow of working of Solar Panel cleaner for horizontal as well as vertical motion. Implementation of flowchart is as follows,

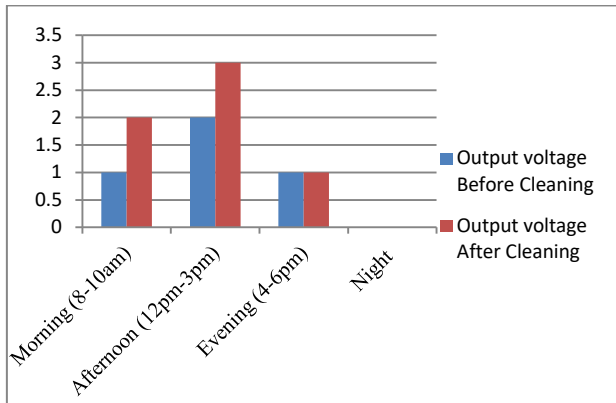
- i. Start
- ii. Initially first and second DC motor run the cleaner panel in horizontal direction. Third DC motor start which rotates the brush cleaner in circular rotation.
- iii. At the same time stepper motor is used to move brush cleaner in up down direction.
- iv. Repeat step ii and iii for cleaning the solar panel. Cleaning process of solar cell completed. Frame is transfer to next panel simultaneously process takes place as above.
- v. Stop.

### IV. RESULT:

Environmental factors like temperature, atmospheric dust, humidity, solar irradiance affect efficiency of solar panel. It is seen that if the temperature increased by 18.5 degree Celsius, the power is reduced by 5W. Due to humid environment, only 55-60% of solar energy can be utilized with the decrement of output power 10-15%. Atmospheric dust and dust deposition on solar panel both reduce efficiency of solar panel. Experimentally it is observed that efficiency of the solar panel decreases by 30-40% for indoor set up with constant illumination, whereas there is loss of 4-5% for outdoor set up with natural lightening condition. Table 1 shows reading taken at different time slot before and after cleaning. Figure 4 shows graph of output voltage of solar panel.

**Table 1: Reading taken at different time slot**

Test Time	Out Put Voltage		Batter Charging time %
	Before Cleaning	After Cleaning	
Morning (8-10am)	1V	2V	16%
Afternoon (12pm-3pm)	2V	3V	20%
Evening (4-6pm)	1V	1V	10%
Night	0V	0V	0%



**Figure 3. Graph of output voltage of solar panel**

Total time required for cleaning solar panel is about 4.5 minutes during this the energy consumed by cleaning system is around 1.89Wh energy is consumed. It is also observed that after cleaning a single 12V 10W panel its output is increased about 3V and battery charging faster by 20%. Figure 3 shows experimental setup of solar panel cleaner.



**Figure 4. Experimentally setup**

## V. CONCLUSION:

To ensure complete use of the radiated solar energy, one needs to ensure that the solar panel is cleaned. Cleaning the solar panel everyday seems difficult and overrated. Hence automatic solar cleaning finds application which also ensures the increased production of energy. Our system can be installed on single solar panel. The cleaning action of brush nicely works in horizontally and vertically direction. Our system becomes benefited for smaller solar panel mounted on roofs.

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