

# Solar Panel Cleaning System

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**Abstract-** The project is about developing a cleaning system for solar panel users. Solar energy is a renewable source of energy , which has great potential and it is radiated by the sun. Solar energy application is coming into boom. In countries like India solar PV modules are generally employed in dusty environments where they can easily get dusty. The panels are installed at greater heights where it becomes difficult to clean manually and if it is not clean within intervals then dust accumulation may convert into thick sticky layers with addition of morning dew drops, this blocks the incident light from the sun gradually leading to reduction of solar panel output efficiency. This project provides crystal clear view in cleaning system by using the most recently invented technology, which provide a better performance, integrity, and scalable solution for the removal of dust and speckle. Also the system reduces the manpower for cleaning purposes .

**Keywords-** Adjustable size , automatic system , solar panels , Arduino board , RTC , Wheels , DC motors .

## I. INTRODUCTION

The world gets more than sufficient solar radiation to satisfy the demand for all solar power driving equipment . Of the many alternatives, photovoltaic methods of harnessing power from solar energy has been proved to be promising toward meeting the continuously increasing demand for energy

The efficiency of solar panels is reduced due natural conditions so it is essential to take care of several parameters including dust, humidity and temperature. It can help our environment to be better without using any other harmful power generation plants. Taking a note that solar panel systems need to be cleaned at specific intervals for getting optimized power generation efficiency . Keeping this in mind , the work has been taken up to study the efficiency of solar panels with and without cleaning them.

This project of cleaning the solar panels has taken to overcome the difficulties arising in the manual cleaning like risk of staff accidents , damage of the panels, movement difficulties, poor maintenance, etc. and also produces an

effective cleaning and removes the irregularities in the energy production due to the deposition of dust .

## Project Overview :

There are a lot of techniques for cleaning solar panels ;the purpose is to design a solar panel cleaning mechanism that cleans itself automatically, maintaining a high level of efficiency. This project is about a solar panel automatic cleaning system with a *unique feature* added to its mechanism of having a length adjustable frame on which the cleaning mechanism is bounded.

## Project Objectives

- To manufacture and design the cleaning mechanism which ultimately helps to increase efficiency of panels .
- For effective cleanliness of solar panels.
- Increasing usage of solar panels in day to day life .
- To reduce manual work.
- To overcome dust associated problems.
- To develop a cleaning system which works without affecting the quality of original panels.
- To make it environmentally friendly.

## Construction and Mechanism

The cleaning mechanism developed in this project is an automated system with length adjustable frame and does not just cleans dust particles but also has efficiency to clean stains on solar arrays by first spraying water using a water jet and wiping the panels clear with a wiper .

The main components in the project are :

Micro - controller

DC Motors Motor Driver

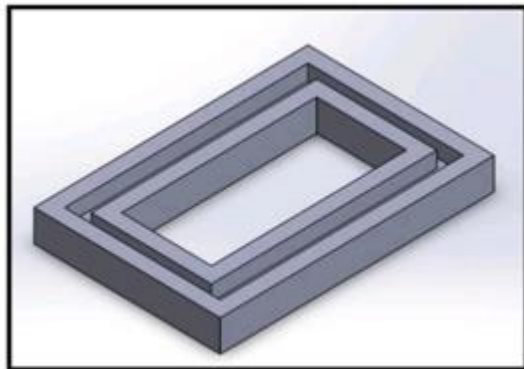
Real Time Clock (RTC)

Aluminium Frame ( as cleaning mechanism frame ) Cleaning Mechanism :

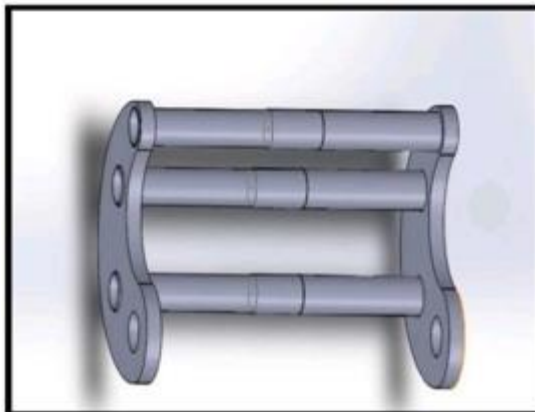
1. Water Jets
2. Wiper
3. Cleaning Mop

Wheels ( for translational motion of mechanism .

Frame : Our project frame will be adjustable as per required by solar array size . It consists of a hollow cross - sectional part on the face where wheels are aligned horizontally for translational motion the cleaning system . (Fig. 1)



Cleaning Mechanism :



Water Jets - We have used Atomizers which covers a large area compared to simple sprinklers .

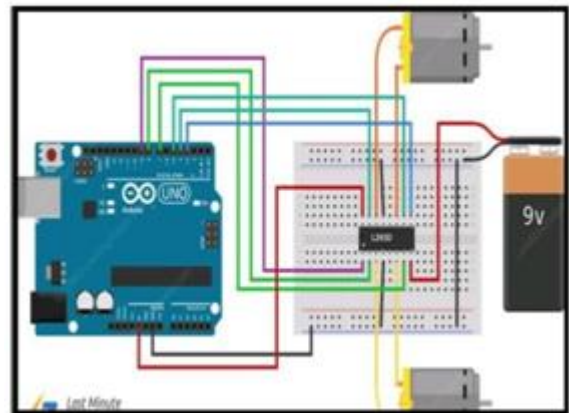
Wiper - Wiper can be installed of any size as per users demand.

Cleaning Mop - It will be cylindrical in shape and have non-abrasive material so that solar panels are not harmed while cleaning.

(Water jet spray atomizer)



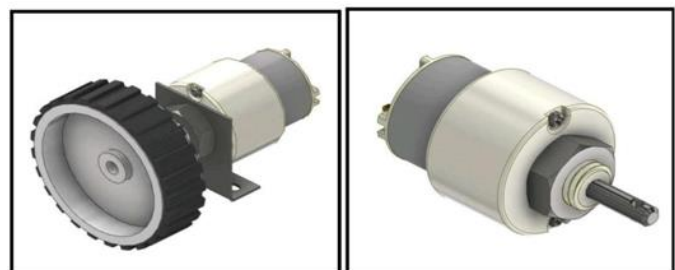
Micro - controller : To set the coordinations among all other components



In this project , L293D -ARDUINO has been used which is a typical Motor Driver which allows DC motors to drive in either direction . L293D is a 16 pin Integrated circuit which controls a pair of DC motors simultaneously in any direction .

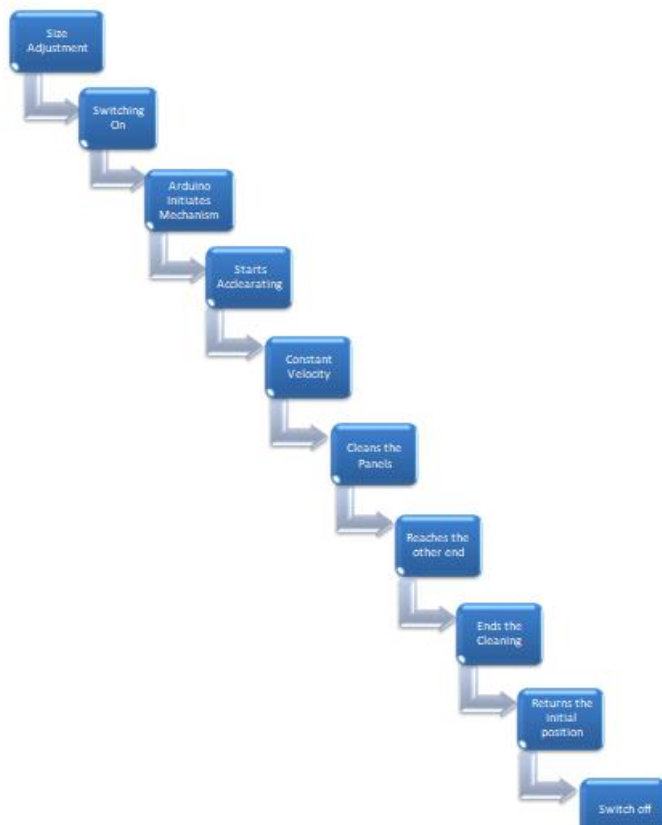
RTC : RTC is being used as a micro-controller is timer based which can be programmed as per users desired interval of time required for cleaning .

Wheels : Wheels would be aligned horizontally over the frame in the gap(hollow) part so that its motion could be controlled properly .



(DC MOTOR with Wheel) (DC MOTOR without Wheel )

**WORKING FLOWCHART**



**Working:**

The mechanism initially begins with adjusting the size of the cleaning system with solar panels size so that the array gets cleaned up efficiently in less time and effort. The moment the switch is turned on , Arduino begins its working part by moving wheels fixed on frame via DC motors followed by starting the cleaning process .

The first step in cleaning is spraying water over the entire solar panel surface with the help of Atomizers (Water Jet Spray). Once the panels are wet completely , attached to the same mechanism after water sprayer is Wiper which removes stains on panels and also clear the water on panel by forcing it downward if any . Water makes the wiper work of removing stains easier . Now in order to dry the panels and give it a final clean touchup , the Cleaning Mop moves through the panel . This mop consists of non abrasive materials which keeps panels safe from getting destroyed.

The entire cleaning process takes place with constant velocity so that each and every corner gets cleaned properly .

Once done with cleaning , the water spray stops spraying water and the entire cleaning mechanism ends. In order to return back, Arduino relays the mechanism and the cleaning system moves upwards to its initial position .

Entire Process can be repeated as per users choice also as Arduino is time based and RTC is being used , a fixed timing could be set priorly so that cleaning is done within fixed intervals .

**Comparing Panels :**



\_As per comparison between clean and dirty panels, with their output efficiencies we have positively concluded with the following result table where it is clearly seen that dirty panels reduce efficiency and thus timely cleaning is necessary.

**II. RESULT TABLE**

Testing Loads	Clean	Dust	Sand
Short Circuit	0	0	0
12V Bulb 21/5W	3.00	2.04 (-68%)	2.34 (-78%)
12V Bulb 10W	8.32	5.824 (-70%)	6.24 (-75%)
12V Festoon Bulb 10W	8.50	5.525 (-65%)	5.95 (70%)
12V Motor 18W	7.89	4.734 (-60%)	5.36 (68%)
12V Bulb 8W	2.89	0.289 (-10%)	0.0289 (1%)
No Load	0	0	0

**III. CONCLUSION**

- In conclusion , we notice the system works effectively and we get proper solar panel cleaning done .Also we can operate this system anywhere.
- Cleaning a solar panel with water increases efficiency of the panel by removing majority dirt particles deposited on the panel. The dust particles settled on solar panels reduces efficiency of energy output of solar array systems by approx. 50% , of which 30% can be overcome by implementing cleaning processes.
- Also frequent periodic cleaning of solar panels ensures that the solar panel works with a good consistency at all times.

- As this will be an automated system ,it reduces human efforts and is more efficient by cancelling out human errors.
- This system mainly consists of water jet spray thus can be cheaper than other mechanisms available in the market.
- Our system can be installed for rooftop solar panels.
- This is an automatic solar panel cleaning system.

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