A
Project Report
On

Design and Fabrication of Solar Panel Cleaning Mechanism

submitted to

Sant Gadge Baba Amravati University,
Amravati (M.S.) 444 602

in partial fulfillment of the requirement

for the degree of

BACHELOR OF ENGINEERING
in
MECHANICAL ENGINEERING

by

Manthan Waghaye

Pranav Tathod

Samyak Wankhade

Vedant Deshmukh

Yash Parikh

under the guidance of

Prof. A.S. Bharule

Department of Mechanical Engineering
Shri Sant Gajanan Maharaj College of Engineering
Shegaon-444203 (M.S.)
(Recognised by AICTE, accredited by NBA, New Delhi, NAAC, Banglore & ISO 9001:2000)
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Certificate

This is to certify that the project report entitled **"Design and Fabrication of Solar Cleaning Mechanism."** is hereby approved as a creditable study carried out and presented by

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in manner satisfactory to warrant of its acceptance as a pre-requisite in a partial fulfillment of the requirements for the degree of Bachelor of Engineering in Mechanical Engineering of Sant Gadge Baba Amravati University, Amravati during the **Session 2022-23.**

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Acknowledgement

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– Projectees

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ABSTRACT

Today energy demands are increasing sharply, therefore the need to conserve energy and utilize available energy efficiently is very important. There are many forms of renewable energy available, with the increasing demands there is a need to exploit renewable sources of energy. Solar is one of them and it is a time-dependent and intermittent energy source. Thus, it is important to store available energy and use later when the need is greatest. While storing solar energy which will drive us towards the goal of universal energy access, there is one major drawback. Dust accumulation on PV modules is the area of growing concern for the reliability of solar panels. So, developing such a mechanism that will maintain the efficiency of PV modules connected in arrays as in solar farms spread over a large area and for the rooftop assemblies at low cost is the main concern.

To address this need, a solar panel cleaning mechanism has been developed that automatically cleans solar panels, increasing their efficiency and boosting the productivity of solar power plants.

This project is developed for the betterment of the solar panel users. We providing transparency in cleaning system which provide a better performance, integrity, consistency, cost-effective and scalable solution for the removal of dust. Also, this system reduces manpower for cleaning of solar panel.

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CHAPTER 01

INTRODUCTION

Chapter 1

INTRODUCTION

1.1 Overview

There is more than enough solar radiation available around the world to satisfy the demand for solar power systems. The proportion of the sun's rays that reach the earth's surface is enough to provide for global energy consumption 10,000 times over. On average, each square meter of land is exposed to enough sunlight to produce 1,700 kWh of power every year. Solar Panel has a huge effect on our world. It can help our environment to be better without using other power generation plants that can harm the environment, but solar power plant needs to be cleaned at least every 3 days.

With the increasing demand for solar energy, the efficiency of solar panels is more important than ever. However, solar panels are very inefficient; typical peak efficiency for converting solar energy into usable energy is 11% to 15%. Contamination of PV panels reduces the efficiency of the panel even more. This build-up of dirt on the panels is a well-documented effect that can cause efficiency losses of up to 27% per year.

Dust accumulating factors include:

1. Dust properties
2. PV panel composition
3. PV panel orientation
4. Surrounding environment
5. Wind velocity
6. Temperature and humidity

1.2 Project Objectives

1. Design a solar panel cleaning system which can increase the efficiency of solar panels.
2. Increase the use of solar panels.
3. Make the cleaning of solar panels simple and automated.
4. Minimize human intervention.
5. A cleaning system that does not affect the quality of the original solar panel.
6. An environmentally friendly cleaning system.

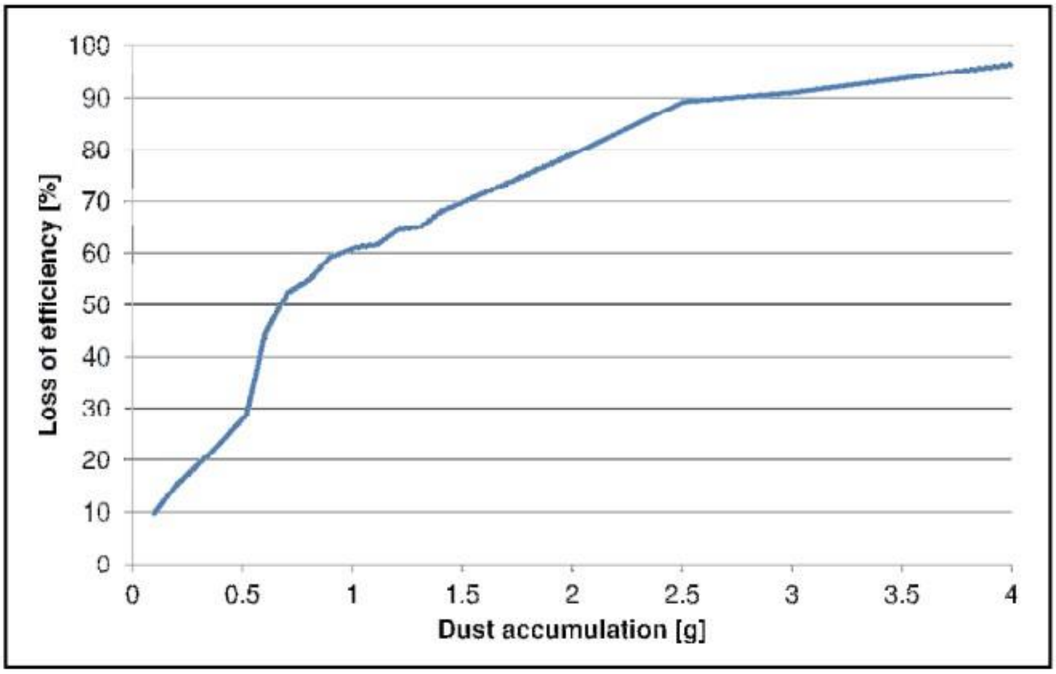

Table 1. Loss of Efficiency [1]

1.3 Statement of purpose

Research collected on the ground shows that solar panels must be completely cleaned to collect the most energy possible. To answer the need for this cleaning mechanism, our team developed an automatic cleaning system for solar panels. Our device will increase efficiency by increasing the energy output of solar panels in a fast and cheap way. Automation of the system will also reduce the risk of operator injury in high voltage environments.

A successful device will clean multiple solar panels and maximize their efficiency with the least amount of rain. We strive for a zero-waste approach to cleaning commercial-sized solar panel systems, using minimal water and energy, but requiring little maintenance. The system software periodically clears the row panel.

CHAPTER 02

LITERATURE REVIEW

Chapter 2

LITERATURE SURVEY

In paper [1] “Automatic Solar Panel Cleaning System Based on Arduino for Dust Removal” paper focus on water less and economical and automatic solar panel cleaning. They use two step mechanism system consist of an exhaust fan which works as an air blower and a wiper to swipe the dust from the panel surface. a dc motor is used to power the wiper. The proposed system is waterless and works on two steps cleaning mechanism. Therefore, wastage of water is completely avoided by this system. Exhaust fan works as an air blower which initially removes the dust from the surface of the solar panel. Then, a wiper is utilized to swipe the remaining dust on the surface. They use waterless system for cleaning solar panel due to which the wastage of water is avoided these features makes this system applicable in the desert areas and where no water source is available. They use two step method for cleaning with the help of blower and by wiper. This feature ensures the safety of solar panel.

In paper [2] “Solar Dust Detection System” they study the impact of soiling loss on the electrical performance of solar panel and study the optimum solar panel cleaning time. They study a on Mono, Multi crystalline and CdTe panels where one panel was kept always clean and the counter part was subjected to natural dust accumulation. In this experimental setup consists of two Multicrystalline panels, a load, a voltmeter, and an ammeter. The soiling effect is brought about artificially by using dusts of different proportions. Various dusts such as chalk powder, wheat husk, sand and brick powder are used for experimental purpose.

They measure voltage and current of both the panels individually but at the same time of the day. Depending on difference in power obtained is noted between clean and unclean panel. The algorithm provides the optimum time for cleaning the panels such that the consumer does not suffer even minimum losses. It is estimated that there is an average increase of more than 11 % in net power once the panel is cleaned. It is also estimated that for the same location, considering nominal man power and material costs.

In paper [3],” Design and fabrication of Automatic Solar Panel Cleaning System’’ we learned that the demand for energy is increasing rapidly today, so saving energy andusing available energy efficiently is very important. There are many forms of renewable energy and as demand increases there is need to use renewable energy sources. Solar energy is one of them, and it is a time-dependent and discrete source of energy. Therefore, it is important to conserve available energy and use it later when needed.

This paper aims to eradicate that drawback by designing and installing an automatic solar panel cleaning system. Dust accumulation on PV modules is the area of growing concern for the reliability of solar panels. So developing such a mechanism that will maintain the efficiency of PV modules connected in arrays as in solar farms spread over a large area and also for the rooftop assemblies at low cost is the main concern. This paper includes the study of effects of change in efficiency of PV modules due to the accumulation of different dust particles found in different regions, factors governing for the decrease in efficiency accounts a lot due to soiling and developing an automated mechanism for cleaning. Labor-based cleaning methods for PV modules are expensive and uses a large amount of water.

This prototype includes a DC motor controlled by a drive that moves the cleaning head in a horizontal direction with or without a spray system. The result is an increase in the efficiency of all solar modules, an increase in renewable energy usage, and a decrease in water consumption.

In paper [4],” Automated Solar Panel Cleaning System using IoT” we have learned about using new technologies, advance equipment’s which can be use for cleaning purposes. If we use the latest technologies properly then our output can be increased by about 32%. Automation plays a key part here in this type of mechanism. Here we try to reduce the manpower by increasing automation in our system, thus reducing the man work. In starting phase, it may look slightly overpriced because we must learn the technologies and equipment first but in a long run it is very useful in a long run.

In paper [5],” Artificial Intelligence Based Solar Panel Cleaning Robot” we saw that a significant amount of research has been done in this area and others have used different methods to solve cleaning problems. When the number of panels was very low, hiring someone to clean was the only option accepted by most plant owners. Over time, however the number of panels per plant has increased significantly. People are implementing solar power plants with multiple panels. Monitoring and manually cleaning all these panels was a very tedious process. People chose to build their factories offshore because land availability is a big problem. When installing power plants on land, users have to deal with issues, including dust, dirt and bird droppings. Sea salt is now the biggest problem when installing power plants offshore.

CHAPTER 03

MARKET SURVEY

Chapter 3

MARKET SURVEY

We have done a survey of our nearby area to find out difficulties related to the cleaning and maintenance of the solar panel system. We have found out that

1. In households the solar panel are usually situated on the roof of a house. If the stairs are absent in house, then cleaning is hectic task for the owner of house.
2. Usually, large number of solar panels are placed in a row which are beyond our arm limit for cleaning.
3. Due to inclination of solar panels, people are not able to clean the upper part of solar panel properly since it is beyond their reach.

Fig.1 Solar panels in row

Fig.2 Solar panel placed at height

Fig.3 Solar panel at inclination

CHAPTER 04

CONCEPT AND DESIGN

Chapter 4
CONCEPT AND DESIGN

4.1 Methodology

This Chapter covers the detail explanation of method that is being used to make this project complete and putting it to the level of generating precise and acceptable results. here in this chapter, we have proposed methods, steps taken at various times for accomplishment of project This include decision making planning calculations and validation etc.

4.2 Concept of project

While solar energy is a sustainable and environmentally friendly source of power, solar panels can face certain difficulties when it comes to cleaning. Here are some challenges associated with solar panel cleaning:

1. Accessibility: Solar panels are often installed on rooftops or in remote areas, making them difficult to access for routine maintenance and cleaning. This can pose challenges in terms of safety, logistics, and efficiency of the cleaning process.

2. Dust and Debris: Solar panels are exposed to the elements and can accumulate dust, dirt, leaves, bird droppings, and other debris over time. This accumulation reduces the amount of sunlight reaching the solar cells, decreasing the panel's efficiency. The removal of stubborn or sticky debris can be particularly challenging.

3. Fragility: Solar panels are delicate and can be easily damaged if not handled properly. Using harsh cleaning methods or abrasive materials can scratch the surface or cause other forms of damage, compromising the panel's performance and lifespan.

4. Water Availability: Water is a common cleaning agent, but its availability can be limited in some regions, especially in arid or drought-prone areas. Relying solely on water-based cleaning methods may not be feasible in such situations.

5. Cleaning Frequency: The required frequency of cleaning depends on various factors such as the local climate, air quality, and surrounding environment. Determining the

optimal cleaning schedule can be challenging, as overcleaning or under cleaning can both affect panel performance.

6. Maintenance Cost: Regular cleaning and maintenance can add to the operational costs of a solar panel system. Manual cleaning may require significant labour, especially for large-scale solar installations. Implementing an automated cleaning mechanism involves upfront costs for the development, installation, and maintenance of the system.

7. Environmental Impact: The choice of cleaning method and cleaning agents used can have an environmental impact. Water-based cleaning may require a significant amount of water, and the runoff water can carry pollutants into the environment. Additionally, the chemicals used in cleaning solutions can potentially harm the environment if not properly managed.

Addressing these difficulties requires careful consideration and the development of effective and sustainable cleaning solutions that balance efficiency, cost-effectiveness, and environmental impact. Automation, advanced cleaning techniques, and intelligent monitoring systems can help overcome these challenges and ensure the optimal performance of solar panel installations.

4.3 Sustainability of project

The sustainability of a solar panel cleaning project can be evaluated from multiple perspectives:

1. Environmental Sustainability: Solar panel cleaning mechanisms contribute to the overall environmental sustainability of solar energy systems by ensuring the panels operate at their maximum efficiency. Clean panels generate more electricity, reducing the need for additional panels and minimizing the environmental impact associated with other energy sources.

2. Energy Efficiency: Dirty solar panels can experience reduced efficiency, resulting in lower energy production. By implementing an automated cleaning mechanism, the project aims to maintain optimal performance and maximize energy generation. This enhances the overall energy efficiency of the solar power system.

3. Water Conservation: Water scarcity is a concern in many regions, and water-based cleaning methods may consume significant amounts of water. To enhance sustainability, alternative cleaning techniques that minimize water usage or use recycled water can be explored. Additionally, scheduling cleaning during rain events can leverage natural precipitation for cleaning purposes.

4. Cost-effectiveness. A sustainable project should be economically viable in the long term. While the upfront costs of implementing a solar panel cleaning system may be significant, the improved energy production and extended lifespan of the panels can provide a return on investment. Considering the reduction in manual labour costs and potential savings from optimized energy generation, the project can demonstrate cost-effectiveness

5. Durability and Maintenance: A sustainable project should ensure the long-term durability and reliability of the solar panel cleaning system. The components and materials used should be chosen with longevity in mind, reducing the need for frequent replacements. Regular maintenance and monitoring are crucial to identifying issues early on and extending the lifespan of the cleaning system.

6. Scalability and Adaptability: The project's sustainability is also influenced by its scalability and adaptability to different types and sizes of solar panel installations. A modular design that can be easily implemented in various settings enhances the project's sustainability by allowing it to be deployed across diverse applications.

7. Social Impact: Solar energy projects have a positive social impact by reducing greenhouse gas emissions, promoting clean energy adoption, and creating job opportunities. Similarly, a solar panel cleaning project can contribute to local employment opportunities, particularly in areas with a high concentration of solar installations.

By considering these factors, implementing efficient cleaning techniques, optimizing resource usage, and designing for long-term reliability, a solar panel cleaning project can enhance the overall sustainability of solar energy systems and contribute to a cleaner and more sustainable future.

4.4 Research and collection of information

We conducted a survey to uncover some significant cleaning-related challenges that people encounter when cleaning solar panels. Over time, dirt, dust, leaves, bird droppings, and other materials can assemble on the solar panels' surface, decreasing their effectiveness. In addition, we thoroughly examined some research papers and review articles. Regular cleaning maximizes sunlight absorption and preserves the effectiveness of the panels.

When cleaning a solar panel, there are a few things to keep in mind that contribute to the efficiency and safety of the panel.

Importance of solar panel cleaning:

Dirt, dust, leaves, bird droppings, and other debris can accumulate on the surface of solar panels over time, reducing their efficiency.

Frequency of cleaning:

The frequency of solar panel cleaning depends on various factors such as the local climate, the angle of the panels, and the presence of dust or pollution in the area. In areas with heavy dust or dirt accumulation, more frequent cleaning may be required.

4.5 Cleaning methods

When cleaning solar panels, it is important to use appropriate methods and tools to avoid damaging the panels or compromising their warranties. Here are some recommended cleaning methods:

a. Water and a soft brush: Start by spraying the panels with water to remove loose dirt. Then, gently scrub the surface with a soft brush or sponge using a mild detergent or solar panel cleaning solution. Avoid using abrasive materials or harsh chemicals that can scratch or damage the panels.

b. Automated cleaning systems: Some companies offer automated cleaning systems specifically designed for solar panels. These systems use brushes, squeegees, or wipers to clean the panels automatically at scheduled intervals.

c. Robotic cleaners: Robotic cleaners are becoming increasingly popular for large-scale solar installations. These devices use artificial intelligence and sensors to navigate and clean the panels autonomously.

4.6 Safety precautions

When cleaning solar panels, it is important to prioritize safety. Here are a few safety precautions to consider:

a. Turn off the solar panel system or disconnect it from the grid before attempting any cleaning to avoid electric shock.

b. Clean the panels during cooler parts of the day or early in the morning to prevent rapid drying, which can cause soap residue.

c. Use appropriate safety equipment, such as gloves and non-slip shoes, especially when working at heights or on angled roofs.

d. If the panels are difficult to access or located at a considerable height, it is recommended to hire professional solar panel cleaning services.

Remember to consult with manufacturers' guidelines and recommendations specific to your solar panel model for cleaning instructions. Additionally, local regulations or restrictions on water usage for cleaning should be considered, as well as any warranty requirements that may exist for your solar panels.

After initializing the project, the topic was discussed with project guide, we have designed the CAD Model for the with the use of rack and pinion and frame for the mechanism to run on it.

4.7 Design of working model

We used the Shegaon solar plant, which is situated on the roof of the college, as our foundation model for the study. We noted its measurements and its location, including the angle at which it is inclined, in order to do our calculations.

There are fewer chances of getting infected of any scratch or a falling of cleaning equipment like auto robots since we built the solar panel frame so that this mechanism can run on it without disrupting the solar panel.

In addition to designing a platform for the rack to be installed on, we also attached a bar with protective jackets to the motor to ensure its stability. As a result, while the motor is running, the rack moves with the solar panel thanks to the pinion.

Following model design, we decided on components such rack and pinion, bar, frame, and brush substance. In addition, every sensor and electronic system was researched and designed appropriately. Following testing of the completed model, final results were produced.

4.8 System Requirement

Calculation [7]

Load act on pinion: -

Wb= Weight of brush

Wr= Weight of rod

Wm= Weight of motor

Wx= Weight of some other component

Total weight = Wb + Wr + Wm + Wx

= 1000g = 1kg

W= 1kg *9.81

= 9.810 N = 10N

For calculating torque, we know

T= F*d, Where F=Total load, d=Radius of pinion

Assume r = 0.02m

T = F*d

= 10*0.02 = 0.2 N-m

T = 2.03 Kg-cm

Take the speed of brush to move panel 5m/min, so

V = r*w=(2*3.14*r*N)/60

5160 = 0.02*(2*3.14*N)/60

N= 39.8 = 40

P = (2*3.14*N*T)/60

= (2*3.14*40*0.2)/60

P = 0.84 W

CHAPTER 05

MANUFACTURING

Chapter 5
MANUFACTURING

This chapter provides a full overview of the manufacturing method used for this project. Manufacturing work can be separated into three parts: mechanical components, assembly, and control systems.

5.1 Mechanical System

5.1.1 Function of mechanical system

The power subsystem's principal duty is to move the entire system down the length of a solar array. To achieve the required range of motion, the subsystem must give enough mechanical energy to the system's total mass and overcome the frictional forces associated with the solar panel. Furthermore, the power system must supply mechanical energy to drive the cleaning subsystem. This subsystem should have minimum maintenance requirements and no direct user interface.

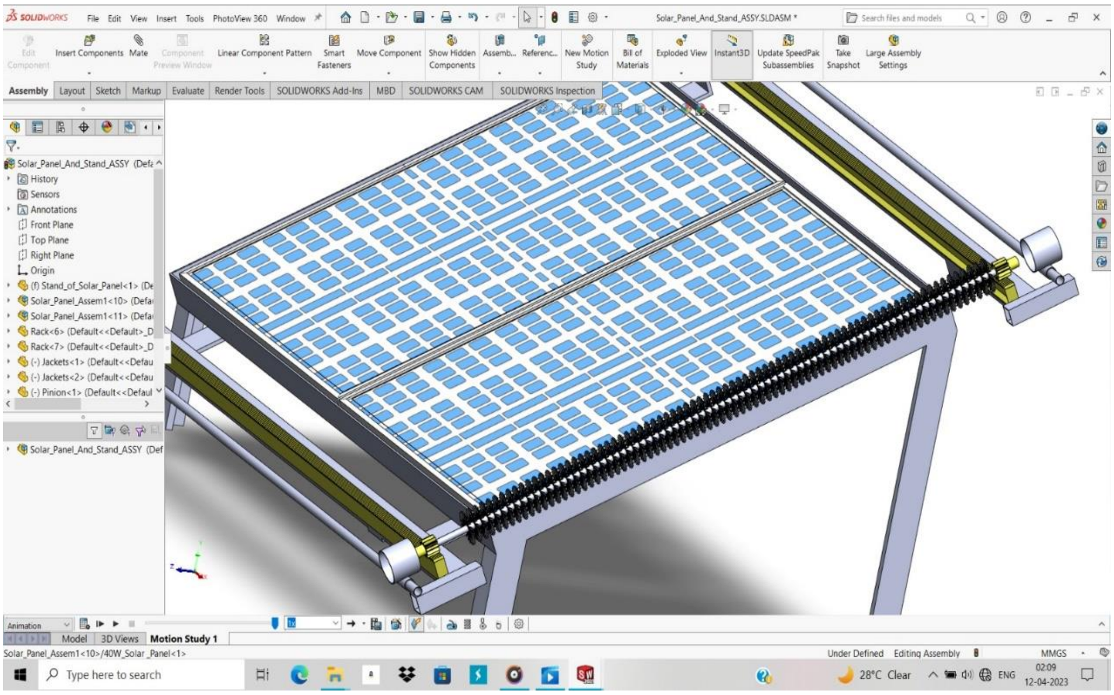

Fig.4 CAD model

Fig.5 Actual model

5.1.2 Frame

As part of our goal, we designed the frame so that the panel could be assembled on it, as well as having a square rod to stick the racks from both sides and weld the sliders to hold both motors.

Fig.6 Frame

5.1.3 Rack and Pinion

As per our objective, we designed the frame such that panels can be assembled on it and have a square rod to stick the racks from both sides and weld the sliders, which have jackets to hold both motors.

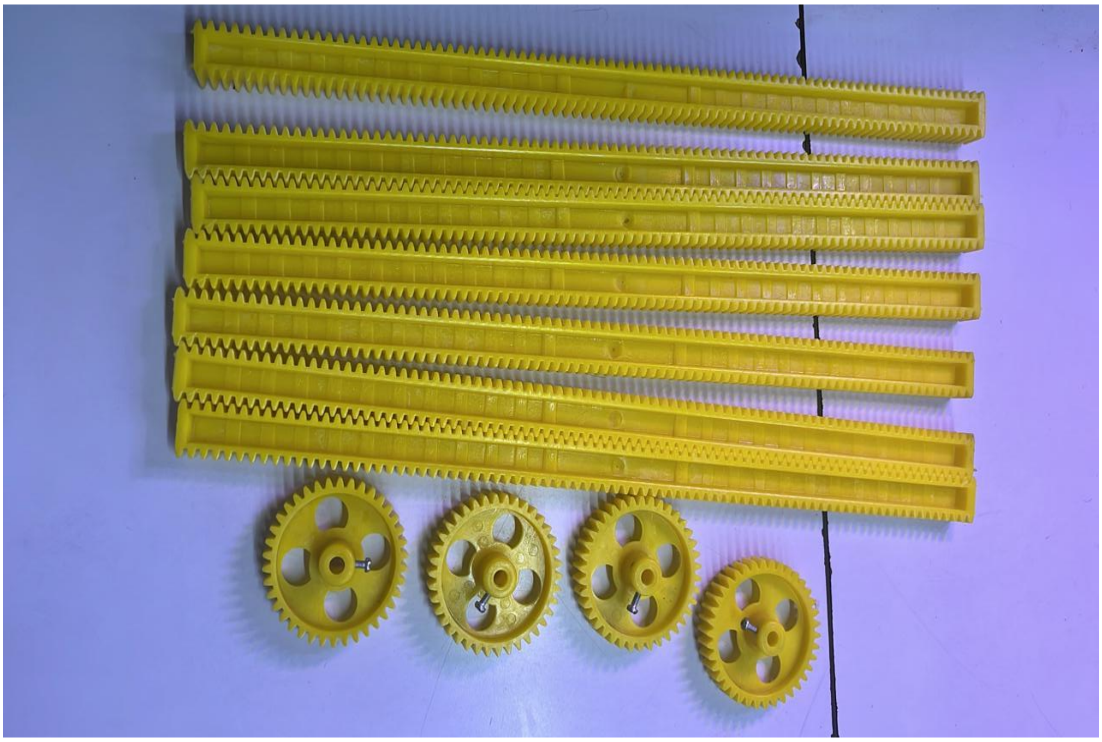

Fig.7 Rack and Pinion

5.1.4 Sliders and motor jacket

We used a hollow pipe piece of mild steel with a for the jacket, and the motor is put in it after performing facing operation on some motors and fixing it in the jacket. For the slider, we used one long steel pipe within a short hollow steel pipe piece and then welded the jacket to that piece.

Fig.8 Slider and motor jack

5.1.5 Motor

To ensure that the system could move down the length of the panel, the motor used to power the gadget had to be able to generate the necessary torque. The anticipated weight of the system and the estimated driving power required to drive the brushes across the panel were used in the calculations. Torque and horsepower were calculated and utilized as the primary factor for selecting a motor. Other criteria included the required power, which required the motor to be able to operate using a small 12-volt battery, and size, which required the motor to be compact enough to fit on the device without weighing it down. The calculations revealed that the motor needed to be capable of producing 7kg-cm of torque at 30 rpm. A 12-volt small metallic geared DC motor was chosen as the motor.

Fig.9 Motor

5.2 Cleaning system selection

The cleaning subsystem is made up of components that will remove dust and dirt from the solar panel. The cleaning system must be able to clean an array of solar panels efficiently and effectively while using little to no water. To keep the solar system working at peak efficiency, it must be able to run twice a week.

5.3 Control system and coding

5.3.1 Role of control system

The control subsystem's objective is to guarantee that all mechanical components move efficiently. Most significantly, the control system must be configured in such a way that our prototype can constantly clean from one side of the solar panel array to the other. The control system, in particular, is in charge of how quickly this operation is completed. The time of operation comprises both the time elapsed from acceleration to cruising speed from rest until deceleration to a stop and the time between cycles. To control how quickly the equipment travels, a microcontroller must be constructed.
A long-term goal for future projects is to create a user interface that allows the user to control how frequently the device cleans the panels. This necessitates more programming. However, it is hoped that it may be integrated into the existing control system. Whatever controller is chosen, it must be capable of meeting both objectives.

5.3.2 Available control systems

There are numerous programmable controller options available to us, with the Arduino Mega or the Raspberry Pi 2 Model B+ being the best options for the project. Both are comparable in terms of specifications and price, as shown in Table 2 below; nonetheless, each is advantageous in various scenarios. The Raspberry Pi is a fully working computer that is superior in terms of software; it has more RAM and gr The primary challenges with control subsystems are the controller's cost and ability to eater agility in managing various network connections. While the Arduino works better as pure hardware. It is more physically resilient and will not be damaged if the device is not powered down improperly. Furthermore, the Arduino will not need the same number of libraries to be installed to begin operation. Lastly, our group is more accustomed to working in C than with Python on a Linux-based operating system. Ultimately, an Arduino-based system was chosen as the microcontroller since the extra computing power seen in a Raspberry Pi now would not be fully utilised.

5.3.3 Control System Description

The complete motor control system consists of the DC motor, L298N H-bridge controller, 12V Deep Cycle Lead Acid battery and OSEPP Uno R3 Plus. The DC motor acts as the load, the battery as the power source, the OSEPP as the microcontroller, and the L292N H-bridge as a power converter. A diagram of all the interconnections can be seen below.

On the H-bridge motor controller one row of three terminal pins is used to control one motor. For our project, the EA pin accesses a PWM interface and 11 and 12 will control the DC motor direction. Pins 11, 12, and EA were connected to the digital pins 8. 9, and 11 on the OSEPP Uno.

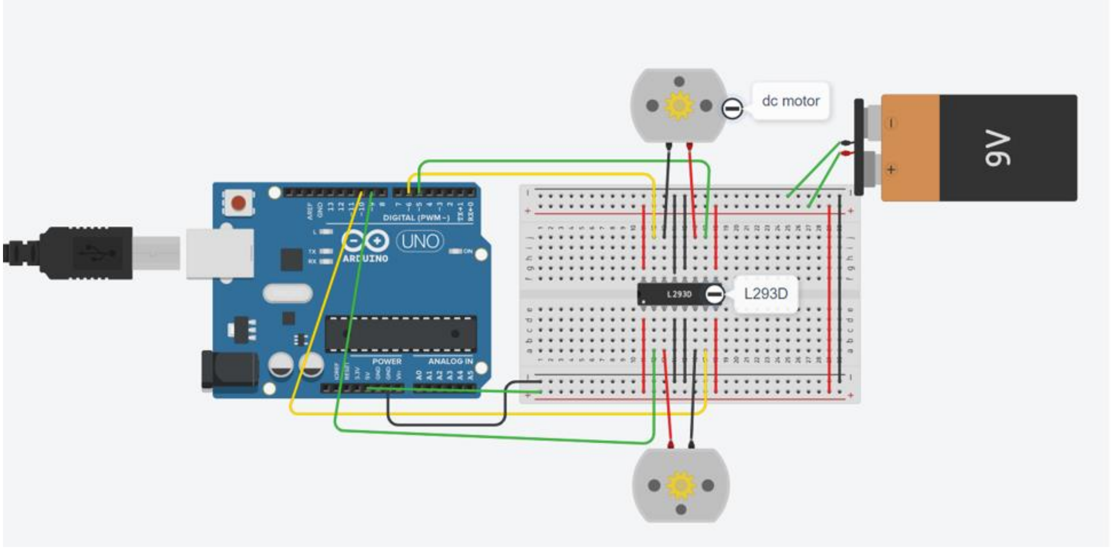

Fig.10 Control System

5.3.4 Description of Arduino

An Arduino uno microcontroller was chosen for controlling DC motors. It has several pins in it. PWM pins are connected with the L298 motor drivers to control speed and to reverse the direction of operation. There are two L298 motor drivers to be operated by Arduino. The Arduino works on the 12v or 5v input voltage.

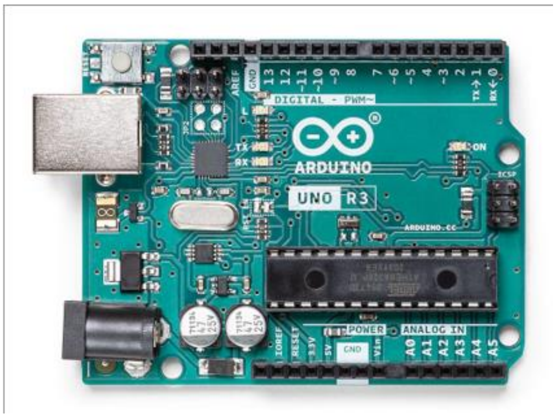

Fig.11 Aurdino

5.3.5 Code for Arduino kit

```
//MOTOR1 PINS

int ena = 5;

int in1 = 6;

int in2 = 7;

//MOTOR 2 PINS

int in3 = 8;

int in4 = 9;

int enb = 10;

void setup() {

  pinMode(ena, OUTPUT);
```

```
  pinMode(in1, OUTPUT);

  pinMode(in2, OUTPUT);

  pinMode(enb, OUTPUT);

  pinMode(in3, OUTPUT);

  pinMode(in4, OUTPUT);

}

void loop() {

  //MOTOR_A CLOCKWISE MAX SPEED

  digitalWrite(in1,HIGH);

  digitalWrite(in2,LOW);

  analogWrite(ena, 255);

  delay(2665);

  //MOTOR_B CLOCKWISE MAX SPEED

  digitalWrite(in3,HIGH);

  digitalWrite(in4,LOW);

  analogWrite(enb, 255);

  delay(2665);

  //MOTOR_A COUNTERCLOCKWISE MAX SPEED

  digitalWrite(in1,LOW);

  digitalWrite(in2,HIGH);
```

```
analogWrite(ena, 255);

delay(2665);

//MOTOR_B COUNTERCLOCKWISE MAX SPEED

digitalWrite(in3,LOW);

digitalWrite(in4,HIGH);

analogWrite(enb, 255);

delay(2665);
```

CHAPTER 06

COST ESTIMATION

Chapter 6

COST ESTIMATION

Sr no.	**Name**	**Cost (in rs)**
1.	Rack and pinion	1800-2000
2.	Motors (2)	200 per piece
3.	Arduino	450
4.	Motor drive	130
5.	Battery (33 watt)	250
6.	Brush	700-800
7.	Manufacturing Cost	2000

Table 1. Cost Estimation

CHAPTER 07

RESULTS

Chapter 7

RESULTS

We performed a short experiment in time lapse of 15-20 min at 1.10pm IST we measured the solar panel Voltage (open circuit voltage) and current (short circuit current) which was 23V and 2.07amp.

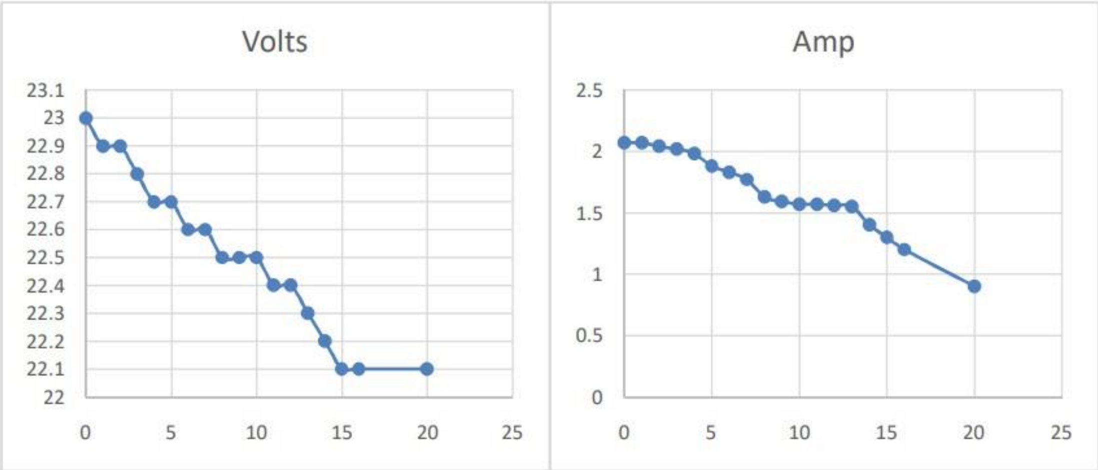

Fig.12 Graph plotted for Talcum Powder as Dust Particle – Volt v/s Weight in Gms & Ampere v/s Weight in Gms

DUST TYPE	BEFORE CLEANING			AFTER CLEANING			EFFICIENCY INCREASE AFTER CLEANING
	V	I	H	V	I	η	
Talcum (in gms)							
10	22.5	1.59	15.3	23.5	2	20.11	4.81
20	22.1	0.9	8	23.4	2.01	20.1	12.1
Fuller earth (in gms)							
15	22	1.84	17.3	23.4	2	20.08	2.78
30	21.4	0.68	6.22	22.9	2.05	20.07	13.85

Table 2. Graph plotted for Talcum Powder as Dust Particle – Volt v/s Weight in Gms & Ampere v/s Weight in Gms

CHAPTER 08

FUTURE SCOPE

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We have tried to make a working model of solar planning mechanism such that it will be budget friendly. For working towards this purpose, we have not included automation in it as it will require more electronics and software part. But we can use artificial intelligence and automation for further advancement in our model to make it better than the current model.

We have used rack and pinion mechanism in our system. In case of extreme dusty environment, blockage may arise in the free movement of the pinion on the rack due to accumulation of dust. Here we can use roller mechanism instead of rack and pinion which is made of metal. It would require more power supply and battery with high torque but it is worth using because it will allow smooth functioning of cleaning even in harsh environment.

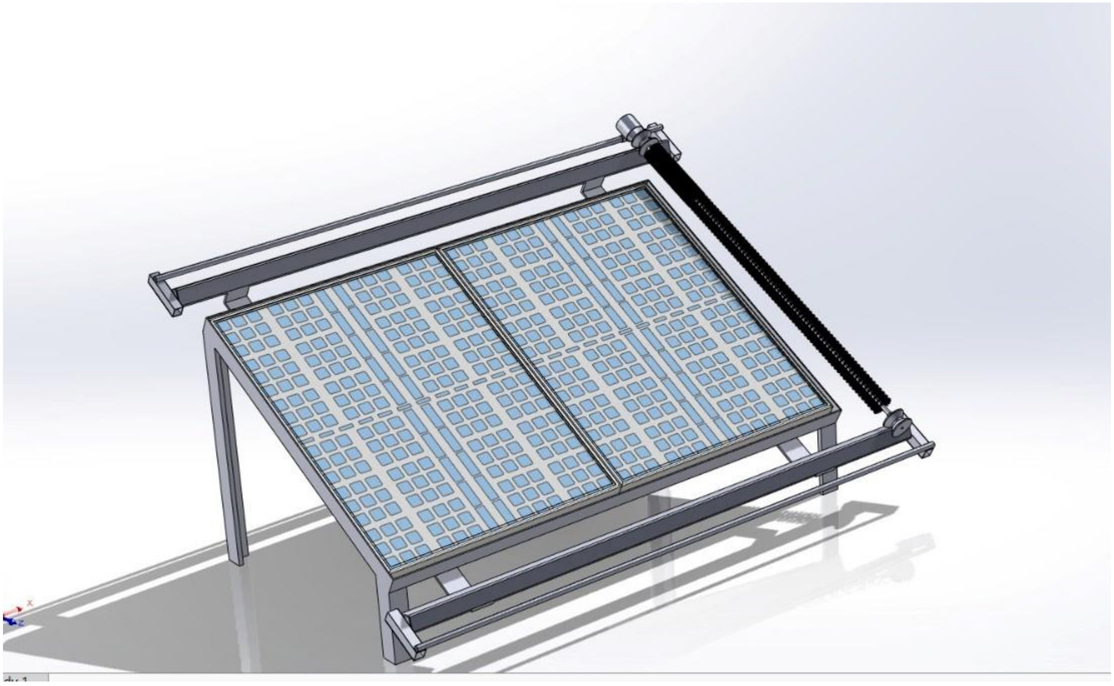

Fig.13 CAD model with roller

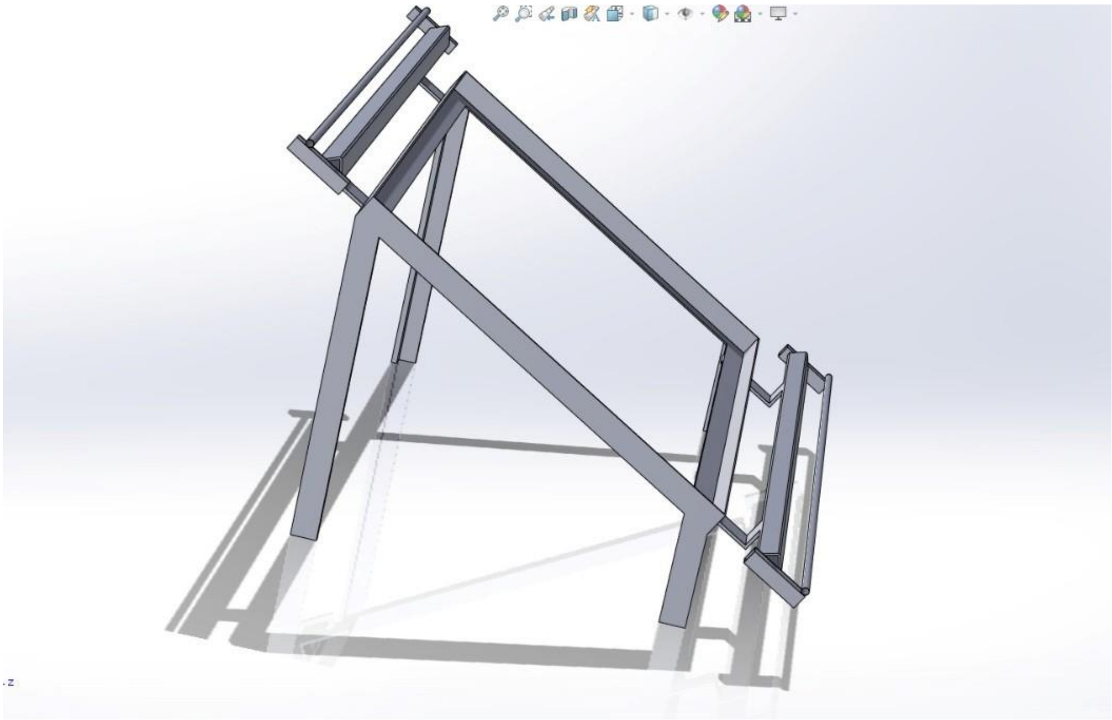

Fig.14 CAD model of frame

Fig.15 CAD model front view

CONCLUSIONS

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The Solar Panel Cleaning System project aimed to bring a better solution for maintaining solar efficiency. The main scope was to develop a machine that can clean a solar panel by a proper control system. This project is a developed prototype to expand on a new and increasing market The project team hit many obstacles along the way.

Our goal was to build an automatic solar panel cleaning system which is efficient to clean various solar panels with the help of automatic robot cleaning system which have minimum contact with solar panel and does not make any disturbance in case of assembling and disassembling the solar panels. With the scope of improvement, the project is done to fulfil all the current demands of solar power plant. The main objective of dust, sand, and cost of labour for cleaning solar plant as it is difficult to clean the solar power plant by few persons. With this solar panel cleaning system percentage reduction in time required for cleaning was observed to be % and reduction in labour cost as compared to other method was 70%

It has solved the problem of traditional way of cleaning by human. Since the capital cost is essential factor while cleaning for solar panel. This system has very least capital cost as compared to other type of cleaner and principal advantages of having automated and easy to control. By undergoing all the discussion and undergoing factors associated with automated solar panel cleaning system, this will be proven to be a great boon for the Indian solar panel power plant.

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