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Design And Development of Solar Panel Cleaning Machine

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Abstract -*The solar panel is work by allowing the light into solar cells. The more light that impact on a panel, the result more power it will be generate. Due to the upwards angle of solar panels, they are more liable to a build up the dust and bird dropping. The dirt which is not clean with just rain. This is reducing the same amount of light impact on the panel and reducing panel output. The solar panel manufacturers and installers are claimed about the projected energy figures that based on the optimum performance of clean solar panel. Due to build up the dirt on solar panel, that can adversely affect the panel's ability to meet that projected figures. So it is necessary and important to clean the solar panel in order to protect and get more power output. So we are design and develop the automatic machine which is clean the solar panel and improve the panel efficiency.*

Keywords: *Solar panel, Cleaner, Automatic machine, Roller brush, Water sprinkle, wiper*

I. INTRODUCTION

The purpose of this project was to design and develop the cleaning solar panels automatically in order to increase the efficiency and energy output from these panels. It is shown that panel efficiency may be reduced by up to 5% to 10% from build up dust particles alone. Adding in other factors such as falling leaves, bird dropping and water streaking, the efficiency of these panels can be further reduced to as much as 10 – 30%. Some studies linked about reduction in output. In the case of a commercial installation, this would be a significantly higher cost. For this project, we focused for more of a smaller scale, as in the case of residential use.

There were several considerations taken when designing this system. Firstly, in the case of residential use, solar panels are usually placed on the roof or terrace to receive the maximum amount of sunlight. As a result of this, cleaning these solar panels would be result in the home owner climbing up on to the roof to clean the panels, which can be very hazardous or risky. The other option would be to hire a company to do it for them.

The system being designed should be automatic to prevent having to climb up onto the roof or terrace and allowing for the solar panels to be cleaned by others. Another factor taken into consideration was that solar panels tend to be placed in areas where there is a lot of sunshine and very little rain. Therefore, we would not be depend upon rainfall to clean the panels, but water usage, for self-cleaning, in these areas may be limited as well. Also, there needed to be a way of determining when to clean the solar panel since having it cleaned all the time would be equally a waste of power or energy. Additionally, we could not depend on there being a reduction of power from the panels as a method of determining when it should be cleaned since a whole cloudy day would also result in a reduction in absorption of solar rays.[1]

The accumulation of dirt on solar panels ("soiling") can have a significant impact on the performance of PV systems in regions where rainfall is limited for a dry season of several months. This effect is magnified where rainfall is absent in the peak-solar summer months, such as in California and the Southwest region of the United States. This paper describes the effects of soiling on energy production for large grid-connected systems in the US and presents a model for predicting soiling losses.

[2] The adverse impact of soiling (dust deposition) on solar collectors, and the mitigation of the related energy yield losses, are the main scopes of this paper. While soiling related losses have been studied more extensively for flat-plate photovoltaic (PV) panels, this study focuses primarily on the impact of dust accumulation on concentrated photovoltaic (CPV) and concentrated solar power (CSP) systems. We report on different methods used for cleaning solar collectors: (i) natural cleaning by rain and snowfall, (ii) manual cleaning by water and detergent, and (iii) an emerging method of dust removal by electrodynamic screens (EDS). Development of EDS technology as an automated, low-cost dust removal method which does not require any water or manual labor is presented.

[4] Vast majority of the large scale solar sites are built in desert environments, benefiting the high radiation. At the same stroke, these sites suffer from frequent dust storms and production losses associated with soiling. Current manual cleaning solutions are not effective nor scalable, and require thousands of liters of water which are scarce resources in these geographies. In fact, according to the World Resources Institute, 79% of new energy instillations will be built in arid regions already suffering from water stress. To keep solar panels clean and optimal, 2-3 liters of water are

needed for washing each panel, that's over 15 Billion litters every year for the current installed base only. In that rate, India is expected to exhaust all available water by 2050.To maximize solar park energy output without the expense and negative ecological impact of manual and water-based cleaning, Ecoppia created the "E4".

[5] Our solar panel cleaning systems are the industry's finest, and make maximizing production from your home solar panels a breeze. Heliotex cleans solar panels like no other company, offering state-of-the-art automatic systems that configure for your specific soiling environment and feature security fasteners and other anti-theft devices. The cleaner your system the more efficient it will be. Why climb up on your rooftop and risk falls and damage to your equipment when our solar panel cleaners can do the work for you? Our products are available for both residential and commercial use, and once your cleaning system is installed you'll wonder why you didn't do so sooner. If you've gone solar, you owe it to yourself to learn more about the great line of products available to you at Heliotex. We offer free quotes and professional installation, so call today! Keeping your solar panels clean does not have to be a difficult proposition. In fact it couldn't be easier when you install a cleaning system from Heliotex. Since our inception in 2008 we have become an industry leader through the residential and commercial cleaning systems we have developed.

[6] The goal of Project SPACE is to create an automated solar panel cleaner that will address the adverse impact of soiling on commercial photovoltaic cells. Specifically, we hoped to create a device that increases the maximum power output of a soiled panel by 10% (recovering the amount of power lost) while still costing under $500 and operating for up to 7.0 years.

A successful design should operate without the use of water. This will help solar panel arrays achieve a production output closer to their maximum potential and save companies on costs associated energy generation. The current apparatus utilizes a brush cleaning system that cleans on set cleaning cycles. The device uses the combination of a gear train (with 48 pitch Delran gears) and a 12V DC motor to spin both a 5.00 foot long, 0.25 inch diameter vacuum brush shaft and drive two sets of two wheels. The power source for the drive train is a 12V deep cycle lead-acid battery. Our light weight design eliminates water usage during cleaning and reduces the potential dangers stemming from manual labour. Our design's retail price was estimated to be around $700 with a payback period of less than 3.5 years. To date, we have created a device that improves the efficiency of soiled solar panels by 3.5%after two runs over the solar panel. We hope that our final design will continue to expand the growth of solar energy globally.

II. NEEDS OF AUTOMATIC PANEL CLEANER

Due to growing costs of electricity and concern the environmental impact of fossil fuels, eco-friendly energy sources are necessary to implement. The main method for utilize solar power are mostly depends on the Solar panels by absorbing sun rays.

Accumulation of dust on even one panel reduces their efficiency in energy generation. That is why we need to keep the panel's surface as clean as possible. Current labour based cleaning methods for Solar panels are costly in time, water and energy usage and lack automation methods. So we have to develop automatic cleaning machine which can clean and easily move on the glass surface of panels which helps in improvement of efficiency.

III. MAIN COMPONENTS OF AUTOMATIC PANEL CLEANER

Main components are used in this machine for automatic panel cleaner includes following components.

1. DC motor
2. Roller brush
3. Wiper blade
4. Water sprayer
5. Battery

IV. BLOCK DIAGRAM OF AUTOMATIC SOLAR PANEL CLEANING MACHINE

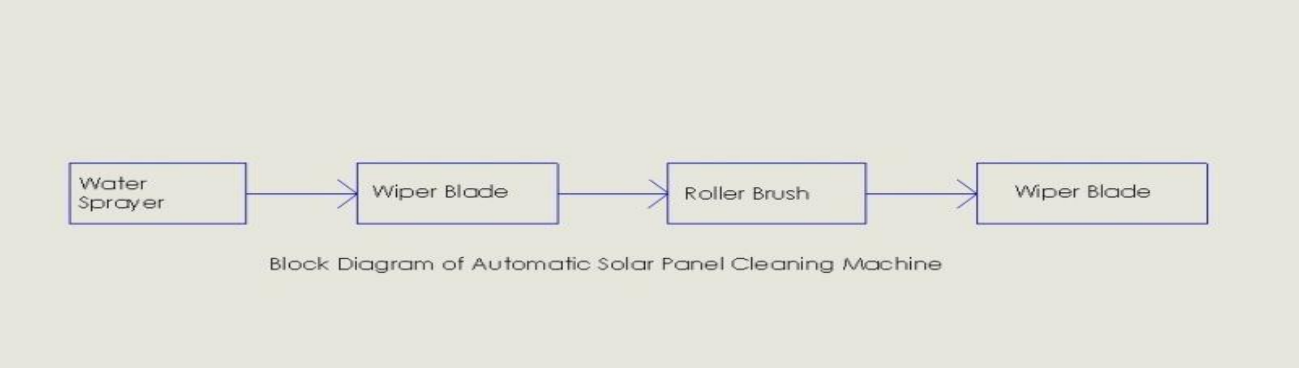


Figure.1. Block Diagram

Steps for Automatic operation

1) The trolley is motorized with a DC motor to provide lateral motion to the system. The trolleys can be controlled by battery.
2) On the top of the trolley, Water sprayer which is used to clean small particle of dirt by spraying water.
3) We attached roller brush with soft material and roller brush is rotates through shaft, followed by wiper which is clean the dust, leaves, etc.
4) After that wiper again clean the water particle which remains on the surface.

V. DESIGN DATA

1) Motor Selection :-

Motor = 0.5 HP
P = 372.5 WATTS
N = 50 rpm
T = 71270 N.mm
V = 0.0130.83 m/s

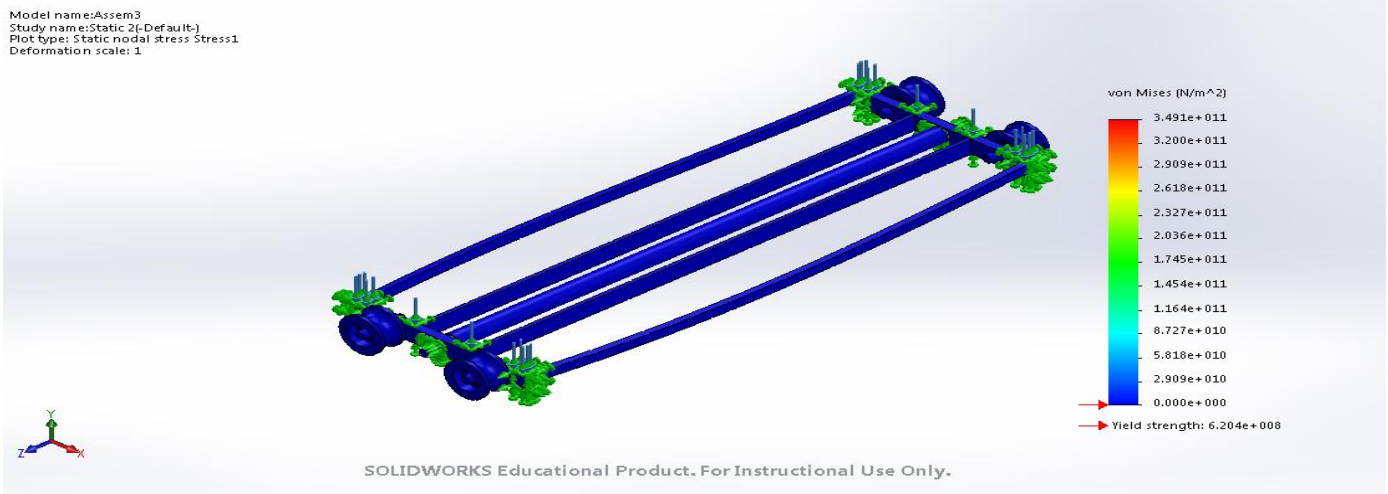
2) Design of shaft:

D = 22 to 25
L = 700 mm

VI. RESULTS

Table 1

Name	Type	Min	Max
Stress1	VON: von Mises Stress	0 N/m^2 Node: 1	3.49062e+011 N/m^2 Node: 33077



Assem3-Static 2-Stress-Stress1

Figure.2. Safety against Stress

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	0 Element: 1	0.545322 Element: 19148

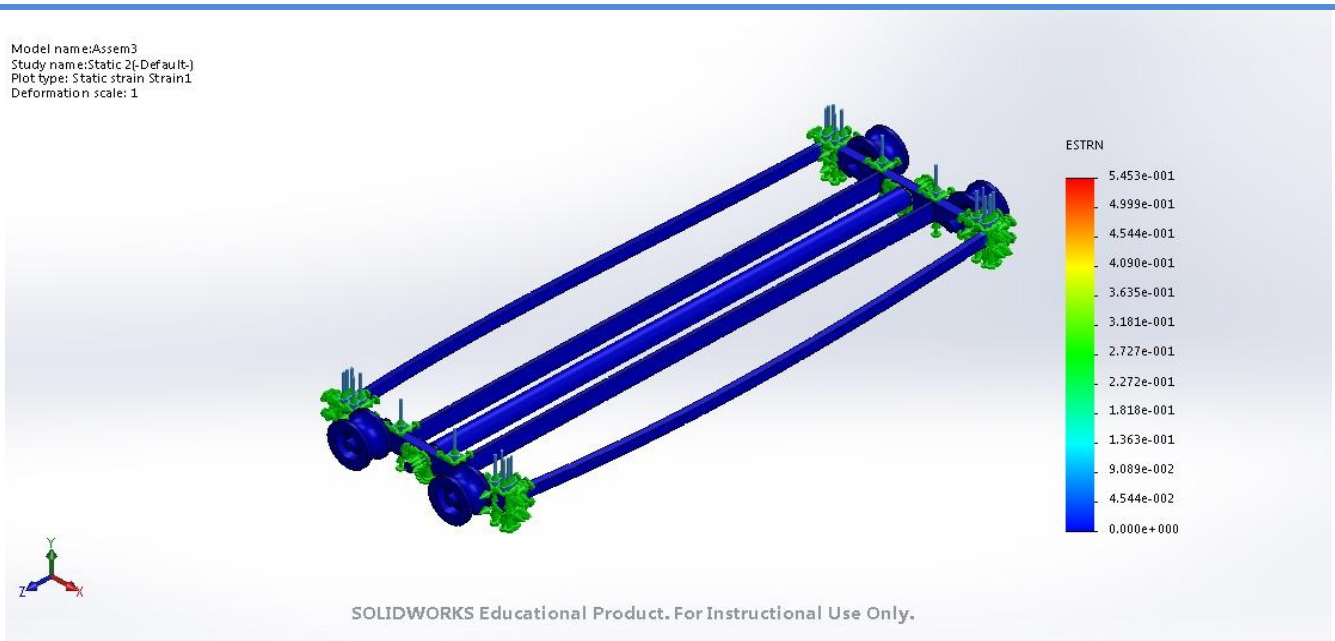


Figure.3.Safety against strain

VII. CONCLUSION

The effects of presence of dust were studied using falling leafs, dust, bird dropping. The dust has a major impact on the efficiency and performance of the solar panel. The reduction in the peak power generates can be up to 10 to 30%. By the observation, it is observed that power reduction due to dust accumulated on the panel and it can be improved by using the cleaning method, there is increase in power and efficiency of solar panel. This is easily maintainable and low of cost. Power consumption is also less for this process. Finally results showed that reduction in the peak power generated. In the future, the machine software can be developed to be smarter, such as that when it cleans any solar panel surface, it will save the information about size, its location and its ledges. We can use solar panel energy instead of individual battery. We can also attach camera for perfect wireless operation.

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