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DESIGN AND DEVELOPMENT OF SOLAR PANEL CLEANING MACHINE

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Abstract - About 60% to 70% of the energy demand of the country is met by fuel wood and agriculture residues. Solar energy is a renewable source of energy, which has a great potential and it is radiated by the sun. Renewable energy is important to replace the using of electric energy generated by petroleum. Solar power has become a source of renewable energy and solar energy application should be enhanced. The solar PV modules are generally employed in dusty environments which are the case tropical countries like India. The dust gets accumulated on the front surface of the module and blocks the incident light from the sun. It reduces the power generation capacity of the module. The power output reduces as much as by 50% if the module is not cleaned for a month. The cleaning system has been designed cleans the module by controlling the motorized chain sprocket arrangement. To remove the dust in the PV modules to improving the power efficiency.

Keywords- *Solar Panel, Automated Cleaning Machine, Wiper, Roller Brush, Water Sprinkles*

I. INTRODUCTION

The sun emits energy at an extremely large rate hence there is abundant availability of solar energy in the nature. If all solar energy could be converted into usable forms, it would be more enough to supply the world's energy demand. However, this is not possible because of conditions in the atmosphere such as effect of clouds, dust and temperature. Solar energy can be converted to more usable energy forms through solar panel. There is unprecedented interest in renewable energy, particularly solar energy, which provides electricity without giving rise to any carbon dioxide emission. Of the many alternatives, photovoltaic method of extracting power from solar energy have been considered has promising toward meeting the continuously increasing demand for energy. The efficiency of solar panel is limited due natural conditions so it is very much essential to take care of parameters like dust, humidity and temperature. In this regard the work has been taken up to study the efficiency of solar panel with and without dust collected on it. The developed project includes design and to implementation of microcontroller based dust cleaning system.

Traditionally cleaning system was done manually. The manual cleaning has disadvantages like risk of staff accidents and damage of the panels, movement difficulties, poor

maintenance etc. The automatic dust cleaning system of solar panels has taken to overcome the difficulties arise in the traditional cleaning and also produces an effective, non- abrasive cleaning and avoids the irregularities in the productivity due to the deposition of dust . The studies carried out to evaluate the efficiency of solar panel for dust collected on it for one day, one week and a month. The efficiency of solar panel also calculated after cleaning the surface for one day, one week and a month. And finally comparing both the efficiencies it is proved that solar panel efficiency increases considerably. Thus the developed model enhances the solar panel performance. Various source of energy like coal, gas, hydro, nuclear, renewable, diesel and their some of them are going to be exhausted within few years.

II. LITERATURE REVIEW

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 on 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. This paper aims to eradicate that drawback by designing and installing an automatic solar panel cleaning system.

The solar PV modules are generally employed in dusty environments which is the case in tropical countries like India. The dust gets accumulated on the front surface of the module and blocks the incident light from the sun. It reduces the power generation capacity of the module. The power output reduces as much as by 50% if the module is not cleaned for a month. In order to regularly clean the dust, an automatic cleaning system has been designed, which senses the dust on the solar panel and also cleans the module automatically.

II. OBJECTIVE AND METHODOLOGY

To overcome these unwanted effects we have to Design and Development of Solar panel cleaning machine which have following objectives:

- To clean the solar panel effectively.
- To make the system automated using Adriano.
- To avoid the manual work.
- To avoid dust associated problems on solar panels
- To remove Sticky Dust by adding water sprayer

The cleaning unit moves on the central spline in a back and forth motion. The cylindrical Brush mounted on the cleaning unit rotates in the clockwise direction. The cleaning unit along with the rotating brush moves along the central spline towards the bottom of the panel. Along the entire path, it forces the dust to move in the direction of the motion of the cleaning unit and finally blows it away at the edge of the panel. Once the cleaning unit reaches the lower end of it, it again returns back. Once it reaches the top of the spline, the cleaning unit stops there. Then the locomotion units come into action and release the suction cup which keeps the system in rest. Then the wheels move in the direction parallel to the edge of the solar panel until it reaches the part of the panel that is not cleaned. Then the suction cups are again engaged to make the system still. After this the cleaning unit again comes into action and the process keeps on going until the entire array is cleaned. Once one array of the solar panel is cleaned, it is moves to another array.

V. DESIGN

For final product designing we made 3D model in Solid works Software, in which we made different individual components and finally we made assembly of different components.

For manufacturing of any Machine, it requires to firstly making individual parts with desired shape and dimensions containing in Whole machine and then we need to assemble every individual parts with each other to make final machine.

Here, Different View of parts and the materials with dimensions of the parts are Shown for manufacture/ machining them in workshop.

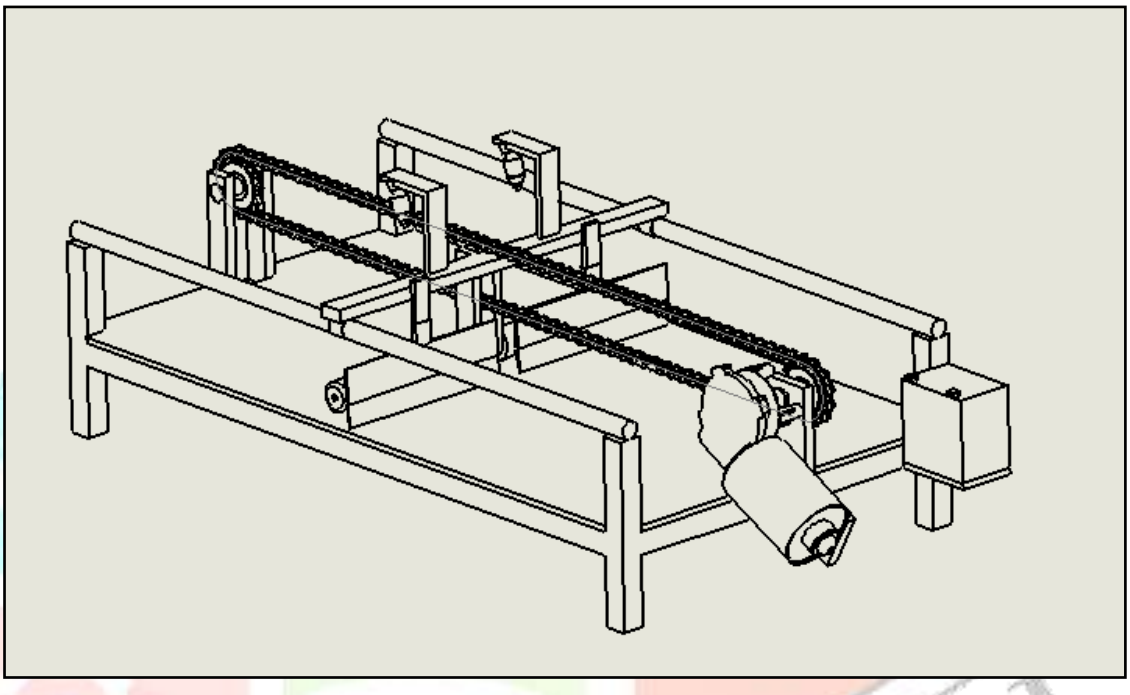

Figure 1 Wire Frame Design

ANALYSIS OF PARTS AND CALCULATION

Different Parts of Mechanism:

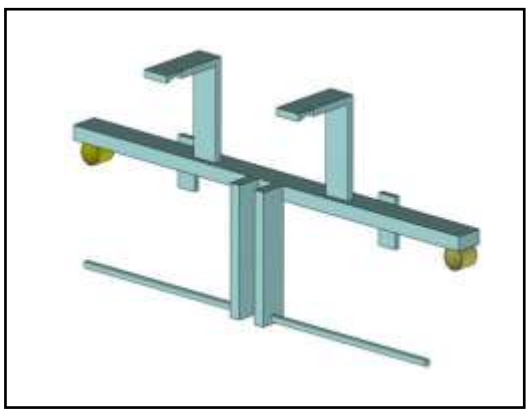

Figure 2 Stand

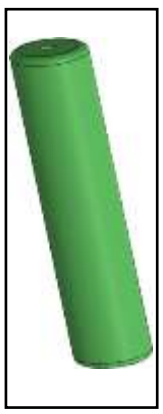

Figure 3 Roller

Figure 4 Nozzle

Figure 5 Sprocket

Design Calculation

- For better design and required output we need to calculate different parameters and find dimensions of the product.

Material of Frame

- Material = C 45 (mild steel)
- Considering factor of safety 1.5
- Yield strength=280 N/mm2
- Tensile stress= 140 N/mm2

Battery specification

- Output Voltage 12V
- Output Ampere: 7 AH
- Output Power: 12*7 = 84 W in one Hour
- Efficiency of a lead acid battery: 50% of usable power: 42W in one hour.

Design of motor

- Power of motor = 100 watt, 12V
- Rpm of motor = 100 rpm
- Calculation of power transmitted by shaft,
  P = 2ΠNT / 60 x motor efficiency (60%) **(**Where N=Rpm of motor**)** T=Torque transmitted

- **100 = 2Π*100*T / 60 x (60%)**
  T = 9.549 x 60% N-m
  T = 9549.3 x 60% N-mm
  T = 5729.58 N-mm

Water Pump Specification

- Voltage : 220V
- Nozzle Electric Air Pump
- Power : 130 W Height : 11.5 cm Inflector die : 3 cm Deflate dir : 3 cm

Solar Panel Calculations

- Solar panel: 10/12 watt
  if means it generate 10 watt electricity per hour If we get 6 hours sunrays then it will generate 10x6=60 watt
  It will take at least 6 hour to charge battery of 12 v of 7ah battery Battery charging time calculation (general)
- example: take 100ah battery and if the applied current is 10amp Then battery charging time = 100ah/10 amp =10 hour approx

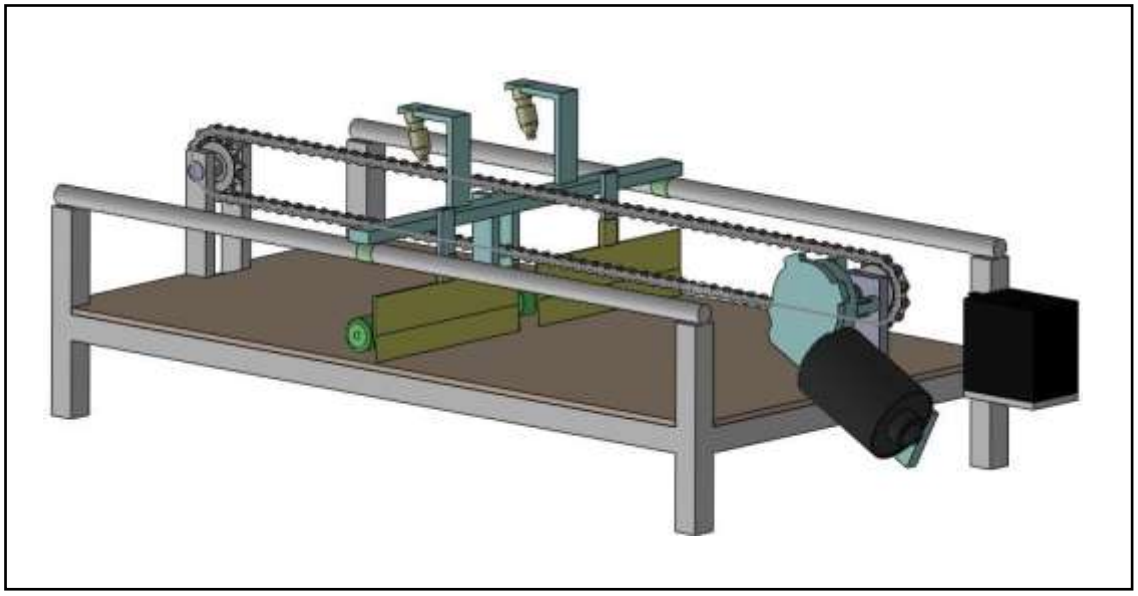

Figure 6 Final Assembly of Solar Cleaning Machine

CONCLUSION

Dust accumulation on PV panels can significantly reduce their power output. While the Geographic region is solar-energy rich, the desert conditions are quite dusty threatening the PV systems power generation potential. The robotic system proposed by me with the help of company is a simple way to tackle this challenge effectively. Although promising results will be obtained. Here we are going to set a new benchmark by using latest technology and replacing the conventional methods of cleaning the solar panels. We are saving water, time and money. In general the technique used by other method explain above total cost of solar panel maintenance goes around 5% of total plant cost annually but cleaning done by robot reduced it by 2%. The robot of this kind can clean the solar farm as and when require very easily without man power thus saving the cost and waste age of water. Further we can add very interesting features in our system like de-ionized water cleaning; camera for inspection and climate based cleaning. The major advantage of this robot is that we can inspect the farm without going on actual site. Also in future we can reduce the weight and can made compact design of the system with the help of booming technology. Also now a day there is increase in use of solar system in industries as well as at homes, thus giving a bright future scope for this system.

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