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DESIGN AND DEVELOPMENT OF SOLAR PANEL CLEANING SYSTEM

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Abstract: The solar panel works, when sunlight imparts on surface of solar panel. Amount of light that impart on solar panel is directly proportional to the energy generated through it. More the light that imparts more is the power generation. Due to the upwards angle of solar panels, there is lot of collection of dust and bird excreta. This reduces the amount of light that impact on the panel and reduces the panel output hence efficiency gets decreased. The solar panel manufacturers and installers claimed about the projected energy figures that based on the optimum performance of clean solar panel. Due to increasing the dirt on solar panel that can adversely affect the panel’s ability to achieve desired output. This is a big challenge in this area; so it is necessary and important to clean the solar panel in order to protect and get more power output. So we have designed and developed the automatic machine which will clean the solar panel and improve the panel efficiency & thus reducing the human effort. This low cost solutions very useful in the sector of non conventional energy.

Keywords – Solar system, solar cleaning system, robotics solution for solar cleaning, non conventional energy.

I INTRODUCTION

Most of the industrial applications use the solar (PV) panels as an electrical power source instead of relying on the generators or the ordinary sources for electricity. The most important part of these systems is solar panel where the solar energy is converted to electricity. As this is one of the easy ways of generation of electricity, Photovoltaic panel production has increased globally in response to the growing demand for solar energy. This has become a solution for environmental degradation due to fossil fuels. There are many factors that affect PV power efficiency, such as birds excreta, dust and dirt. The main factor that affects a PV panel’s efficiency is dust, which can reduce its efficiency by up to 25-30%, depending on the environment.

Though the bird dropping and dirt is not making a big issue, it can be seen that the efficiency of solar panel decreases by 15-20%. So cleaning the solar panels in a frequent period is necessary for getting same output for longer time.

Cleaning the solar panels is normally done by

manual washing which is tedious and also expensive in terms of the labor involved and time. In practice cleaning Today’s World is using the Solar Energy for electricity generation widely. This Solar energy is mainly used by different Industries, Power Plants (which work on solar energy to generate electricity) in bulk.

Along with the other issues that reduces performance and efficiency of the power generation, one of the main issues that can be highlighted is the performance and efficiency of solar panel.

Challenges

Inclination of panel:

Solar panels are located on roof of buildings. The roof of building has inclination by an angle of 20-30 degree. That makes robot unstable while operation. When water is sprayed over surface of panel robot faces difficulties and has chances to slip over panel. Unequal gaps present between row and column of solar panels:

Equal gap between solar panels is not maintained properly while setting. So this creates problem for propagation of robot from one panel to other. So this was also the criteria to make the robot flexible.

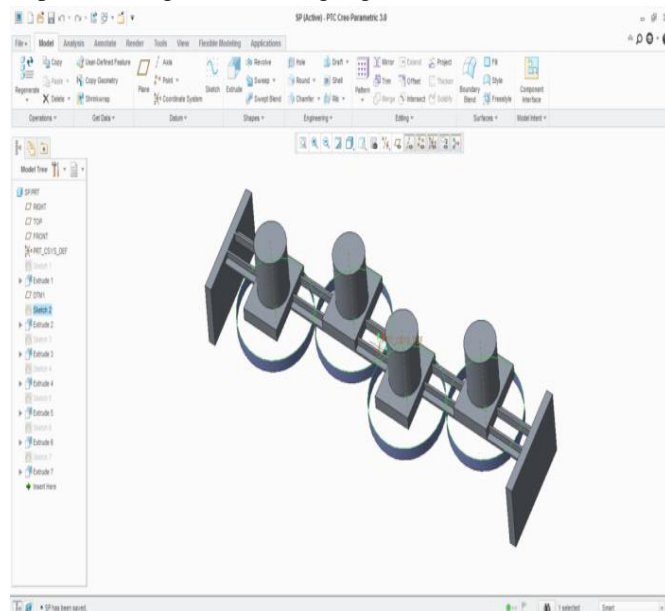
II STUDY AREAS

Use of solar panel is carried at various places and for various applications since 19th Century. At that time level of pollution in environment is much less compared with today. So cleaning solar panels was not main issue. Also the cleaning process wasn't carried in frequent manner. The cleaning carried at that time is by manually. One operator cleans the solar panel with help of water, cleaning material like liquid soap or detergent and piece of cloth. This method was time consuming and also gives less satisfactory cleaning results. Further the cleaning is carried out using wiper. This process takes less time and better cooling than previous method. But these methods were working fine for the environmental condition at that time.

As the evolution of technology has happened tremendously since last two decades, the amount of pollution of environment is increased in considerable manner. This affects the solar panel efficiency by the deposition of dust on solar panels. As manual cleaning by piece of cloth or wiper cannot give satisfactory results, nowadays semi-automatic and automatic cleaning systems have been developed. These automatic systems give very high performance than the manual cleaning operations. It also saves time & efforts in considerable manner.

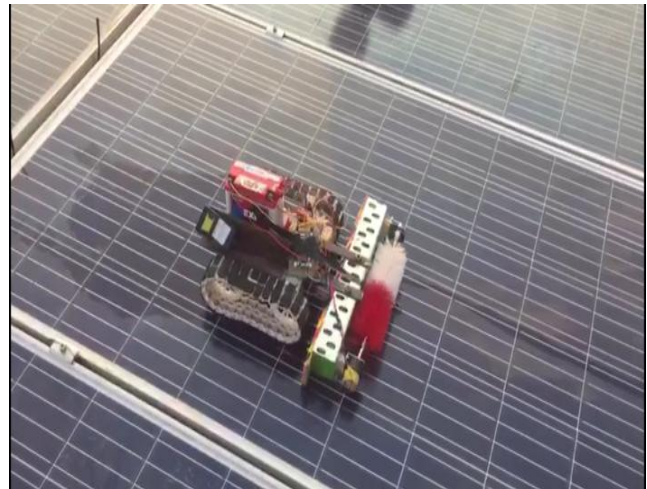
III APPROACH AND METHODOLOGY

Initially, the location of solar panel was studied so that to understand the various problems that company is facing. Also, position of solar panel was one of the important points that is to be considered. Along with this energy production, losses and manpower requirement are also the important things that were highlighted.



Picture 1: Approaching methodology for Solar Panel Cleaning System

Final Design:



Picture 2: Implementation of Solar Panel Cleaning System Components Required

Chassis of Robot:

The chassis of this robot is made up of Aluminium Composite Material. It consists of 4 L-Shaped motor mountings to hold Motors on their proper position. Chassis also provides rugged structure for battery and other electronic component.

Drive Motors:

Motors provide motion to robot for propagation in both forward and reverse direction. Motor runs at 200 RPM on 12 V DC squirrel cage & 7 A battery supply.

Crawler Belt:

It is a belt of flat plate which protects around the set of wheels, tend to move complete body. It has got many connecting links (flat plates) connected together.

Wireless Circuit:

It consists of Arduino and Motor driver chip use to drive the motors. It also consists of play station to Wireless Emitter and Receiver, use to control movement of robots.

Cleaning Mechanism:

It consists of Rotating Nylon brushes, use to remove the dust, after it, nylon sponge is placed use to clean the dust and water from panel. Following these wiper is placed to wipe out water remained after nylon sponge. It ensures that no water and dust is remained on panel.

IV WORKING

With the help of these components and by assembling them, a wireless cleaning robot is made. 12V Battery gives power supply to run motors. Crawling belt is located over wheels of robot. These wheels are attached with motors and receive power from it. With this robot can propagate over solar panel surface. As we can see in design cleaning brush and cleaning sponge cleans solar panel. At last wiper wipes out water from surface of panel and ensures total cleaning.

Performance Analysis

Table 1: Comparison Table for Solar Panel Cleaning System

Month	Current Output (KW)	Expected Output (KW)
JAN	600	650
FEB	650	700
MAR	700	750
APR	1000	1100
MAY	1500	1600
JUN	1400	1500
JUL	1000	1100
AUG	900	950
SEP	900	950
OCT	800	850
NOV	700	750
DEC	700	750

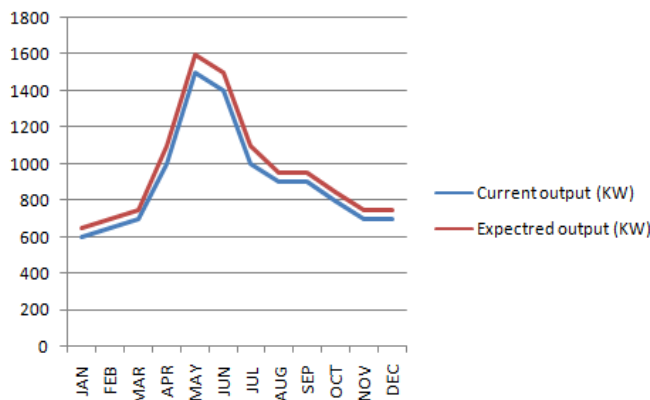


Figure 1: Graphical representation of Output analysis
Table 2: Output analysis of Solar Panel Cleaning System

Sr.No.	Parameter	Current Status	Expected Outcomes
1.	Energy generated in Winter	400-500 unit /day	450-550 unit /day
2.	Energy generated in summer	1000-1200 unit /day	1200-1500 unit /day
3.	Manpower	4 worker	1 operator /robot

Advantages

- 1) Reduced in manpower requirement.
- 2) Efficient & proper cleaning.
- 3) Less consumption of water.

Disadvantages

- 1)Charging of Li-Po battery is required after some time.

V CONCLUSION

Reduction in manpower:

Robot requires less time for cleaning of solar panel in comparison with manual cleaning. It ultimately reduces total time required for cleaning of all panels present on roof of plant buildings.

Efficient cleaning:

As we studied there are many problems in manual cleaning like manual cleaning is unable to clean sticky dust and materials present over surface. This cleaning robot removes those sticky dust and materials.

Increase in Power generation:

This robot gives a cleaned surface after operation in easy way and in less time and effort. As we know, due to dust deposition sun rays cannot reach to surface. On cleaned surface, sunrays impartation increase. So efficiency of panels increases by 10-20%.

Final View:



Picture 3: Final view of Solar Panel Cleaning System

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BIOGRAPHY



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