International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 04 | Apr 2019 www.irjet.net p-ISSN: 2395-0072

Solar Panel Cleaning System with Inbuilt Power Supply

Pratiksha Mahore[1], Priyanka Thakare[2], Reeba Mohammad Aslam[3], Ashwini Dhawale[4], Dr. N. N. Khalsa[5]

[1-5]*Electronics and Telecommunication Department, PRMIT&R, Badnera, Maharashtra, India*

Abstract - *Growing interest in renewable energy has lead the solar photovoltaic (PV) industry to expand notably in the last decade. In the year 2014 a staggering a 3.03-million gigawatt hours of electricity was produced in the European Union covering 3 percent of the total electricity demand. Because Photovoltaic energy is an accessible technology, it has become a popular investment for companies as well as for residential users. We have designed and built an automated self-cleaning solar panel. The panel detects the presence of an obstruction shading a cell, and actuates a cleaning mechanism that cleans off the obstruction and, therefore, restores the panel to normal capacity. To power the cleaning mechanism, we built our own power supplies which are supplied by a 8V battery. When required, this battery is charged by solar power when the cleaning mechanism is idle.*

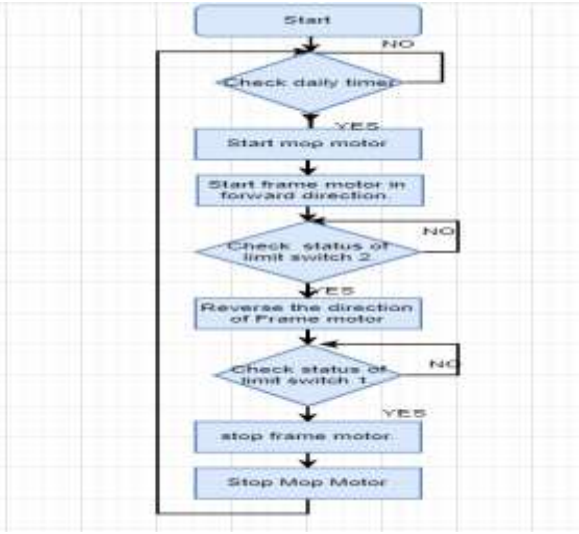
Key Words: **Dust, photovoltaic module, automated cleaning system.**

1. INTRODUCTION

The purpose of this project is to design and develop the cleaning solar panels automatically 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 will focus for more of a smaller scale, as in the case of residential use. There will be several considerations taken when we will design 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. Because of this, cleaning these solar panels would 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 depend upon rainfall to clean the panels, but water usage, for self-cleaning, in these areas may be limited as well. Also, there need 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. 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. The adverse impact of soiling (dust deposition) on solar collectors, and the mitigation of the related energy

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 labour is presented.

2. METHODOLOGY



3. CONCLUSION

The Designed system successfully detects presence of soiling or dust on the PV panel by measuring the output power and will be able to operate the cleaning mechanism. The cleaning mechanism will also respond successfully by two limit switches which were able to change direction of rotation of motors. The system can be applicable at any plant, it should guarantee a zero pressure on the PV cells and easy to control and maintain. Unfortunately, the disadvantage is that it need to be installed manually to the next array. Rainy region could create a problem for this design, because rain creates mud, and mud is hard to clean by using brushes only.

WORKING:

The working of this designed system is described below.

In accordance with the dimensions of the flat plate panel the solar panel cleaning system consists of brush driven by DC motors and actions of brushes is controlled by signal generated by Arduino.
2. The frame carrying this cleaning brush is moved along the length of the solar panel in vertical direction of 11ft and vice-versa, which results in mopping action on the solar panel cleaning the panels. This frame is also consists of DC motors which will produced the rotational motion which is converted into linear motion through rack system. This action is also controlled by signal generated by Arduino.
3. The shifting of frame from one solar panel array to another solar panel array is also carried out using gear motors.
4. The frame is shifted in horizontal direction of 9ft cleaning 3 sets of solar panel arrays.
5. All this cleaning actions will consume a time of 300sec for mopping action for both movements of cleaning system in horizontal direction and vertical directions.
6. Once one array of the solar panel is cleaned, it moves to another array and hence the cleaning process gets repeats.

FUTURE SCOPE:

Some new technologies for dry cleaning of PV modules have come to the market in recent years.

Drone cleaning system The 'SolarBrush' drone recently devel oped by Aerial Power (Germany/UK) is equipped with a brus h that sweeps dry dust and dirt from the surface of the PV m odules.

This contrasts with the mechanized options of other cleaning devices, which run the risk of damaging surfaces by applying forces from wheels and suction cups.

It is easy to transport and requires few staff.

The system cleans an entire solar PV system, using pre-programmed flight paths.

Up to eight different drones can be distributed over the PV sy stem by a single person.

The drone can move along a PV module row with an angle up to 35°. High voltage based cleaning system The TAFT robots from Taft Instruments use a high AC voltage electric fi eld to move dust and dirt away from the PV modules. The ro bot clamps to the edges
of the module using motor driven rollers like a semi-automated system.

Electronics inside the device generate a high AC voltage that is applied to conduct- tors close to the PV module surface.

The charged particles oscillate along the field line. As the rob ot moves over the PV module, dust is pushed towards the ed ges where it eventually falls off.

The robot uses infrared through optical beam sensors to de-test the limits of motion. It requires no maintenance or exter nal power. PV cells supply the power for the robot. As it does not require significant energy story-
age, it runs only when the sun shines. This cleaning method may damage PV modules, particularly in the case of thin film modules without bypass diodes where single cells could be s haded and hot spots generated.

The inverters should be switched off during cleaning to avoi d module damage.

A prototype ultrasonic cleaning system has been de- eloped. The device removes dust from the PV modules by creating a vacuum cavity within the me-
dim (air or/and water) during the rarefaction cycle [16]. No devices using this technology are on the market yet

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