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Solar Panel Hybrid Cleaning System

T. Senthamarai[1], S. Ida Princy[1], M. Vasuki[1], A. S. Vigneshwar[2]

[1]Final Year Student, Electrical and Electronics Engineering, Ramco Institute of Technology, Rajapalyam, Tamil Nadu, India

[2]Assistant Professor, Electrical and Electronics Engineering, Ramco Institute of Technology, Rajapalyam, Tamil Nadu, India

ABSTRACT

Electrical energy consumption is increasing per annum. The generation of energy from renewable sources is gaining more popularity because the traditional methods of power generation aren't environmentally friendly and therefore the source of fossil fuel are depleting at an alarming rate. Energy generation using photovoltaic panel could be a good energy source because of its simplicity in installation and operation. It's evident that for obtaining the utmost output from the panels, ample amount of sunlight should fall on the surface of the panels. For this reason, the solar panels in homes and are placed in an open area on the roof. But this makes them liable to dust particles in air. These dust particles are carried by the wind and gets settled on the surface of the panels, obstructing the day light falling on the PV cells. Hence, the dust accumulation and dirt on the panel surface, the efficiency of the panel degrades to a comprehensible number. The output power reduces the output by 50% if the module isn't cleaned for a month. This amounts to a major loss within the output of the panels which affects the load connected to the PV system. So to order to clean the dust accumulation on the panel, an automatic cleaning system has been designed, which senses the dust on the panel and also cleans the module. To handle this issue: a completely automated, cost worthy and efficient system must to be invented. This paper presents the design and fabrication process of a prototype ready to clean the panel surface.

Keywords – Electrical Energy, Renewable Source, Photovoltaic Panel, Cleaning System, and Prototype

I. INTRODUCTION

The sum emits energy at a very extremely large rate hence there's abundant availability of solar energy in the nature. If all solar power may be converted into usable forms, it would be more enough to provide the world's energy demand. However, this can be inconceivable due to conditions within the atmosphere like effect of clouds, dust and temperature. Solar energy can be converted to more usable energy forms by using solar panel. There's unprecedented interest in renewable energy, particularly solar energy, which provides electricity without giving rise to any CO2 emission. Of the various alternatives, photovoltaic method of extracting power from solar power are considered has promising toward meeting

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the continuously increasing demand for energy. The efficiency of solar panel is proscribed due natural conditions so it is pretty much essential to require care of parameters like dust, humidity and temperature. During this regard the work has been preoccupied to check the efficiency of solar panel with and without dust collected on that. The developed project includes design and to implementation of microcontroller based dust cleaning system. The most aim of the project is provide automatic dust cleaning mechanism for the solar panel.

Traditionally cleaning system was done manually. The manual cleaning has disadvantage like risk of staff accidents and damage of the panels, movement difficulties, poor maintenance etc. The automated dust cleaning system of solar panels has taken to come across the difficulties arise within the traditional cleaning and also produces an good, non-abrasive cleaning and avoids the irregularities within the productivity because of the deposition of dust. The studies taken out to evaluate the efficiency of solar panel for dust collected on that for a period of time. The efficiency of solar panel for dust collected on that for a period of time. The efficiency of solar panel also calculated after cleaning the surface for in unspecified time in the future sooner or later, one week and a month. And at last comparing both the efficiencies it's 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. EXISTING SYSTEM

As accumulation of dust on the PV panel reduced its transmittance which results in the reduction of the power output, thus resulting in loss of power generation. At a point of time density of dust increases to level where power output declines to the extent which is not able to support its vital functions. At present, PV panels can be cleaned manually and automatically. Over time, manual cleaning is more costly compared to automatic cleaning.

The purpose of this project is to develop an automatic self-cleaning mechanism for cleaning the solar panel so that the process can become more reliable and fast, thus increasing the power output of the solar power plant. Various technologies being developed around the world for self-cleaning of solar panels are listed below.

A. Heliotex Technology

Heliotex is an automatic cleaning system that washes and rinses solar panel surfaces. The cleaning system can be programmed whenever it is necessary, depending on the environment. It does not require any further attention except the replacement of the water filters and the occasional refilling of the soap concentrate. It contains a five-gallon reservoir for soap, which does not cause any damage to the solar panels and roofing materials. The Heliotex system sources the water from the residence via a hose or pipe connected to the pump and attached to nozzles on the solar panel surface without causing rubbing. The Heliotex system can be installed for any size or number of solar panels. The cost of installation for the Heliotex is US $ 2,258.00 to cover 50 PV Panels.

Fig. 1. Heliotex Cleaning Technology

B. Electrostatic Cleaning

Electrostatic cleaning technology is named "Harvesting Electricity". This cleaning technology was first developed by scientists to solve the problem

of dust deposits on the surfaces of PVs located on Mars. This technology can also be used in dry dusty areas on Earth. Electrostatic charge material is used on a transparent plastic sheet or glass that covers the solar panels. Sensors monitor dust levels and activate the system into cleaning mode.

The dust is shaken off the solar panels when an electrically charged wave breaks over the surface material. This is not a safe way for home owners who are using solar panels because the panel shakes which may loosen its connection to the roof and it could fall down and cause injury. However, it is an effective solution for large systems elsewhere. The structure of the panels is strong and flexible to avoid breakage that may be caused by shaking.

In two minutes this system can remove up to 90% of dust from the surfaces of the PV panels by sending an electrical dust deterring wave which causes the dust to fall off onto the ground. However, this system is not going to remove dust when it gets wet, or if it is in a moist environment. The movement of the wave mechanism requires only a small amount of electricity which makes it a power efficient system however at present; the worldwide usage of the harvesting system is only 4%.

Fig. 2. Electrostatic Cleaning Technology

III. PROPOSED SYSTEM

Solar energy is the most abundant source of energy for all the form of life on the planet Earth. It is also the basic sources of energy except Nuclear Energy, but the solar technology has not matured to the extent of the conventional sources of energy. It faces lots of challenges such as high cost, erratic and unpredictable in nature, need for storage and low efficiency. This project aims at increasing the efficiency of solar power plants by solving the problem of accumulation of dust on the surface of solar panel which leads to reduction in plant output an overall plant efficiency. It proposes to develop a solar panel cleaning system which could remove the accumulated dust on its surface on a regular basis and maintain the solar power plant output, the system is and automatic system which could move vertical on the surface of solar panels by using geared dc motor and use dry methods for cleaning such as rotating cylindrical brush and water pumping system keeping in mind the limited availability of water in areas where such plants are mainly located. This project also aims to reduce the human involvement in the process of solar panel cleaning as it is a very hazardous environment for them in scorching sun.

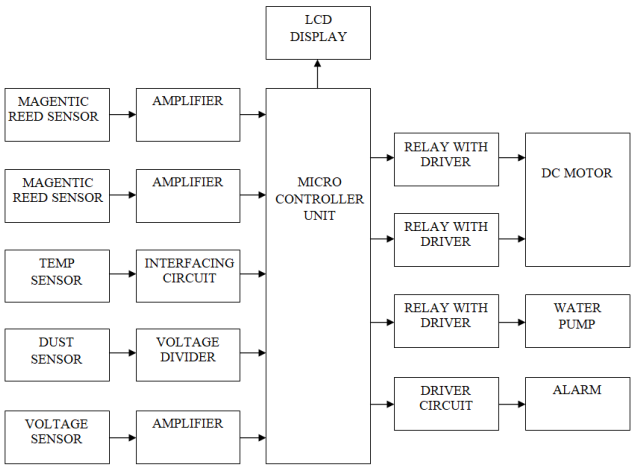

Fig. 3. Block Diagram

Working Principle

Microcontroller is the main unit of this process. The only device can monitor and control the sensor parameters and actuators. Here, we are selecting a PIC type microcontroller unit. The controller has some quite features when comparing with the basic type of controller. The controller has internal erasable program memory, analog to digital conversion and pulse width generation.

Magnetic reed sensor is nothing but a magnetic activated switch which is used to control the motor distance. The reed sensors are placed at both end of frame when motor reaches the particular end the sensor will notify controller and stop the motor. The switch needs a magnetic field to activate itself. Pair of magnets will be placed at the both end of sliding frame.

Dust sensor is used to determine the level of dust which is surrounded a panel. The sensor is constructed by using light depend resistor and voltage divider circuit will give an analog output to read value accurately. Controller internal analog to digital conversion circuit will convert the voltage level into digital.

Solar panel output voltage is feed backed to the controller to identify the generation voltage. The voltage divider circuit will protect the controller from higher voltage reading. Controller collects all sensor parameters and activates the motor when the values are abnormal. Water pump will sprinkle the water to the panel and the brush will clean a water as well as dust which are located in panel.

LCD display is display the ongoing condition of the controller and buzzer circuit will be intimate to the user about the cleaning process is activated or not.

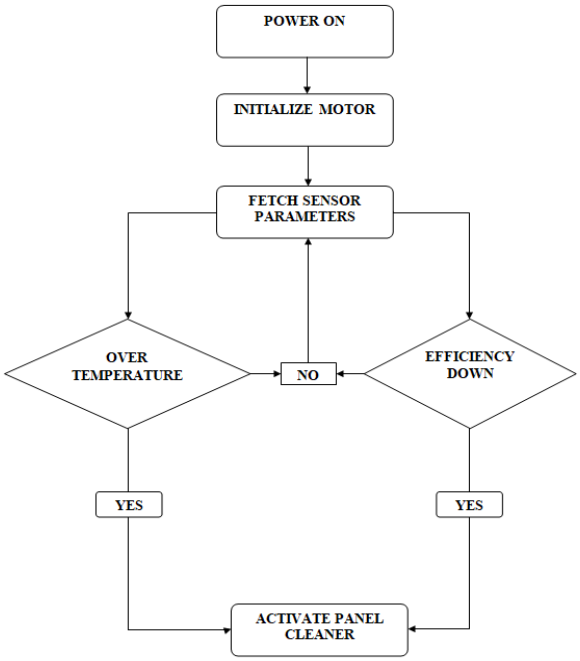

Fig. 4. Flow Diagram

Advantages

- Low cost and Higher efficiency
- Does not require heavy machinery
- Reduce threat to human life
- Manual assistance is not required
- Less weight and portable
- Easy to construct and maintenance
- Fully automated device
- Detect both dust and overheating
- Improves the efficiency of the panel
- Day/Night self-adjustment
- Battery operated device doesn't require external source

IV. RESULTS & DISCUSSIONS

Power ON

When power is given to the controller, it'll take few seconds to power up the internal registers and then initializing liquid crystal display. After initializing controller will print the proposed title on the display and it will visible for a second. After that controller clear the display and execute next command line.

Basic Initialization

After clearing display controller trying to initialize the slider motor by activating relay modules. The relay module helps to drive a motor by using TTL voltage switching. Controller Vex the connection after that start end magnetic reed sensor detects solider beam.

Sensor Parameters

After initializing slider motor controller fetch details from sensors and displayed it. The ATmega328 controller has internal analog to digital conversion register which is used to convert analog voltage to digital. 10bit conversion data is much easier to identify accurate values. Some of simple formulas applied to calculate current voltage and temperature.

Cleaning Process - 1

Whenever the controller detects that voltage comes from solar panel below the set range and the light intensity will higher. Then controller decides some of dust reduce the panel voltage generating efficiency and turn on the cleaning process. The cleaning process contains motor and pump. Controller simply activating motor and pump and wait for the both end reed sensor switches. By using this method controller easily complete one circle of cleaning process. Furthermost alarm will be activated while cleaning is in progress.

Cleaning Process - 2

In case temperature level limit exceed the set range controller again activating the cleaner process. The higher temperature level will affect solar panel life time. Once the process complete controller back to normal range and checks the sensor parameters.

Warning

Once cleaning process is done controller activates the internal timer module and waits for the next processing command. If the sensor parameters reach the abnormal condition within a timer of interval it's consider as abnormal condition and it's require human involvement to resolve the problem. If the problem occur controller activates alarm continuously until back to normal.

Future Scope

In this paper there is a great scope to modify it in different ways like increasing its operation by using surface brush cleaners and spray of waters. This can be modified by sensors. In this project electric supply has been used through power supply, this can be used where it gives max life of cleaning. Arduino programs can be replaced by better and variety of micro-controllers. It can also be controlled by using remote controllers for necessary cleaning actions. Rack system can be replaced by belt drives. Even though our project worked perfectly and was functioning as initially planned, there are still a lot of improvements that can be made to make it more effectively in cleaning.

V. CONCLUSION

Existing automated cleaners mainly focus on large arrays and in general are unsuitable for installing on smaller arrays namely residential roofs. For those with limited space this means that a smaller array only needs to be installed, hence our idea serves as a huge advantage for those smaller sites. Our system can be installed for roof top solar panels. The solar panel cleaning system was first designed taking into consideration the design parameters. Our model was tested and the following observations were made the

rack and pinion mechanism work as it was designed to do. The linear actuator system worked very nicely and was able to achieve the required design parameter. The cleaning action of the brush was good but it failed to scrub the dust which was sticky in nature. The sticky dust need to be remove using hard brush or through mopping action. So as we know prevention is better than curing as a result the cleaning action prevents the primary accumulating surface dust on the solar panel before it becomes too sticky to remove.

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