



AN EFFECTIVE P-V CLEANING ROBOT TO ALLEVIATE PARTIAL SHADING PROBLEMS

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Abstract

With increasing costs of electricity and concern for the environmental impact of fossil fuels, implementation of eco-friendly energy sources like solar power are rising. The main technique for harnessing solar power is with arrays made up of photovoltaic (PV) Panels. Addition of dust and debris on even one panel in an array reduces their efficiency in energy generation considerably and emphasizes the essential to keep the photo voltaic panel surface as clean as possible. Current labor-based cleaning system for photovoltaic arrays are costly in time, water and energy usage and lack of automation capabilities. In this paper a novel design is offered for the first ever human portable robotic cleaning system for photovoltaic panels which can clean and maneuver on the glass surface of a PV array at varying angles from horizontal to vertical. A fully automated and intelligent photo voltaic (PV) cleaning robot is suggested to alleviate partial shading in PV panel. In order to move the robot vertical manner in PV panel, IR sensor based technique is used. In order to move the robot in horizontal axis, it is fitted with dc gear motor to remove the dust particles in PV panel efficiently. Moreover panel to panel jump is done effectively by appropriate control of DC gear motor using relay driver unit. The above tasks can be achieved through microcontrollers, relays, dc gear motors and sensors.

Keywords: Photo Voltaic Panel, PV Cleaning System, IR Sensor, DC Gear Motor, Sensor, Microcontroller and Relay System.

1. INTRODUCTION

Photovoltaic array installations are becoming more predominant around the world. Each of these solar parks has an expected lifetime of 20 – 25 years, and it is important role to maximize the power generating potential during daily service. The addition of dust particles and debris on the surface of photovoltaic (PV) panels harmfully affects the performance the same way as if on a cloudy day. This is especially problematic in dry and dusty environments, [1-2]. There is an essential for an automated cleaning solution to this problem which can service large ground based solar arrays up to an operating park of 22,000 panels (20,000 square meters). An effective robotic device can service such large scale parks for cleaning and built in auto inspection for panels whilst saving power and cleaning water when compared to human crews and current hardware alternatives. A photovoltaic cell is an electronic device that converts solar energy into electricity by flow of electrons between two layers of semiconductors. In order for the PV cells to function at maximum efficiency without energy loss, the panel's surfaces need to be clean and allow free entrance of photons. Both dirt and clouds block out the sun and have the same effect on decreasing energy generated. Cloudy conditions block absorption and can reduce the effectiveness of the panels by 20% - 30% as seen in Figure 1. Water for cleaning panels can also profit

efficiency because most crystalline silicone solar cells have better current-voltage characteristics at lower temperatures. The water being sprayed by the robot cools the panels while cleaning which can further increase efficiency of the array by up to 15% [3]. When the cleaning system is combined with auto-inspection features, the automated choice is clearly superior to old cleaning alternatives. The most significant benefit of a robotized solution for the cleaning of photovoltaic panels is the improved speed, thoroughness, and repeatability with which the system will operate when compared with current methods.

A fully automated and intelligent photo voltaic (PV) cleaning robot is offered to alleviate partial shading (such as Dust particles) in PV panel. In order to move the robot vertical manner in PV panel, IR sensor based technique is used. In order to move the robot in horizontal axis, it is fitted by dc gear motor to remove the dust particles in PV panel effectively [4]. Moreover panel to panel jump is done effectively by appropriate control of DC gear motor using relay driver unit. The above task can achieve through microcontrollers, relays, dc gear motors, and sensors.

2. EXISTING SYSTEM

Glass is already porous by nature. It has little divots you can't see with your naked eye. If you use any sort of soap or a squeegee for that matter, it's going to end up filling those pores and you'll get dirt, soap particles, anything stuck. Your glass is ultimately going to haze over time [5]. Utilizing man power for cleaning solar panel of very large size is a time consuming and tedious process. Also it includes increasing number of workers and wages.



Figure :1 Cleaning via manpower

2.1 Using Machinery

In this system a special type of machine is used to clean the photo voltaic (PV) array panel effectively. It can be achieved by using smart

cleaning robot which is used to reduce the man power,time consumption etc.The figure 2 shows that mechanism machinery system is used.



Figure : 2 Machinery System

The above task can achieve through microcontrollers, relays, dc gear motors, and sensors. Polycrystalline material is used for better output performance on various angle position.

2.2 Using Existing Machinery

In this type of existing machinery system which leads to damage and crack on the solar photo voltaic panels due to some technical problems.

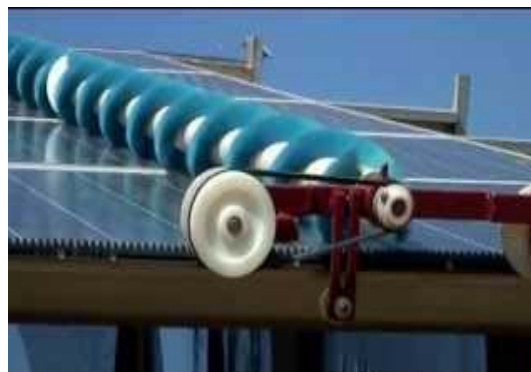


Figure: 3 Cleaning via existing machinery

The above 3 represents cleaning of solar panels using machines. This may lead to cracks and small damages on the panels due to some misoperations of the machine tools. Also careful handling of the equipment is needed.

3. PROPOSED SYSTEM

Smart cleaning robot is necessary to reduce receive of mismatch irradiation or sun light intensity in P-V panel. Complete cleaning is especially important since the obstruction of a single panel with debris affects the energy generation for the entire array [6]. With the help of this proposed system this can be achieved. When compared to existing system this type of

smart cleaning robotic system yields better output performance in all angle positions and gives time consuming is less to clean the panel without using the man power.

The block diagram figure 5 depicts the implementation of an intelligent p-v cleaning robot to mitigate partial shading problem. An efficient robotic device can service such large scale parks for cleaning and built in auto inspection for panels whilst conserving power.



Figure: 4 Robotic System

4. BLOCK DIAGRAM

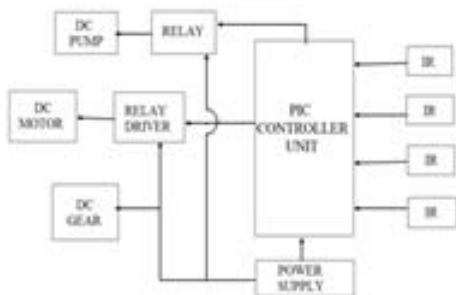


Figure: 5 Block diagram

The block diagram consist of PIC microcontroller, Relay driver circuit, power supply and IR sensor unit. PIC micro controller is used to control all the units provided the command by the user.

Relay is an electromechanical device which act as a switch. Only when the relay is switched on power will be supplied to the DC motor.

The driver circuit is employed to drive the relay. Power supply unit supplies power to microcontroller unit, relay circuit and motor.



Figure: 6 Prototype Model

5. PROTOTYPE MODEL

The figure 6 depicts the prototype model for the entire system. In this prototype consist of controller unit, which is used to control the motor action provided by DC gear setup and power unit supply is employed to enable all the units effectively [7]. For every instant of time water is taken from the reservoir tank and clean the entire photo voltaic panel through smart cleaning robotic system



Figure: 7 Trainer kit

The above figure 7 shown is the experimental model that was developed and successfully satisfied the expectation.

6. CONCLUSION & FUTURE ENHANCEMENT

In this paper smart robotic cleaning system is proposed. Implementation of photovoltaic arrays, a new technique of cleaning and inspection is essential. Complete cleaning is especially important since the obstruction of a single panel with debris affects the energy generation for the entire array. It is extremely important that all cells operate at peak efficiency since they are connected in series. Advances in energy technology should be accompanied by advances for their support, maintenance and inspection devices. This robotized system is used for cleaning photovoltaic panel arrays at large scale solar parks.

This project provides cleaning of PV panels at easier way, allows reduction of man power and portable, which can be carry over instantly. In future there may be even advanced technology robot produced to mitigate partial shading problem. This project helps in improving the efficiency of the photovoltaic panel.

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