AUTOMATED SELF CLEANING SOLAR PANEL

Dr. Kumar Shubham[1] , Ms. Prachi Agarwal[2] , Ms.Tanya Sarkar[3]

[1]Associate Professor, Delhi Technical Campus, Greater Noida
[2]Assistant Professor , Delhi Technical Campus, Greater Noida
[3] Undergraduate Student , Delhi Technical Campus, Greater Noida

Abstract

Solar energy is a renewable source of energy .It is a beneficial source for all energy crisis. The only disadvantage of solar PV modules is that these modules are generally employed in tropical areas with high temperature conditions and these areas are mostly of dusty terrain. The dust gets absorbed on the front surface of the module then blocks the incident light from the sun which results in reducing the power generation capacity of the module. The power output reduced mechanism by 50% if for a month the module is not cleaned. The cleaning system has been designed cleans the module by controlling the microcontroller programming. The panel helps in detecting the presence of any obstruction and starts a cleaning mechanism. This mechanism cleans off the obstruction and helps in restoring the panel to normal capacity. For power we are using 12V battery supply. This battery gets charged by the solar power itself when the cleaning mechanism is idle.

1. Introduction

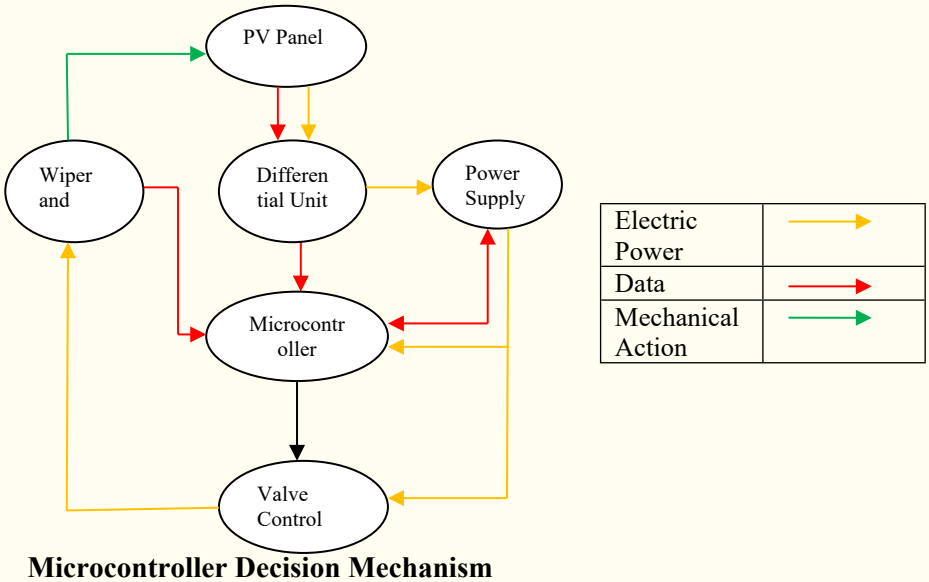
There is a great demand in improving the efficiency of solar power generation. The energy produced by solar PV cells varies with spectral content, the availability of sun's irradiance and other factors like environmental, climatic, system performance. The current solar panels setup results in a major loss of power when any unwanted obstructions occur on the panels surface. The obstruction causing power loss. To address this current issue, we have successfully monitored an automated self-cleaning solar panel. The panel helps in detecting the blockage with a unit called Differential Measurement Unit .It takes the decision from the Microcontroller unit whether to clean the panel .For cleaning the panel there is SPRAY AND WIPE OFF DUST Mechanism. Our purpose to reduce the loss of power is unique and it is easy to handle.

1.1 Salient Features

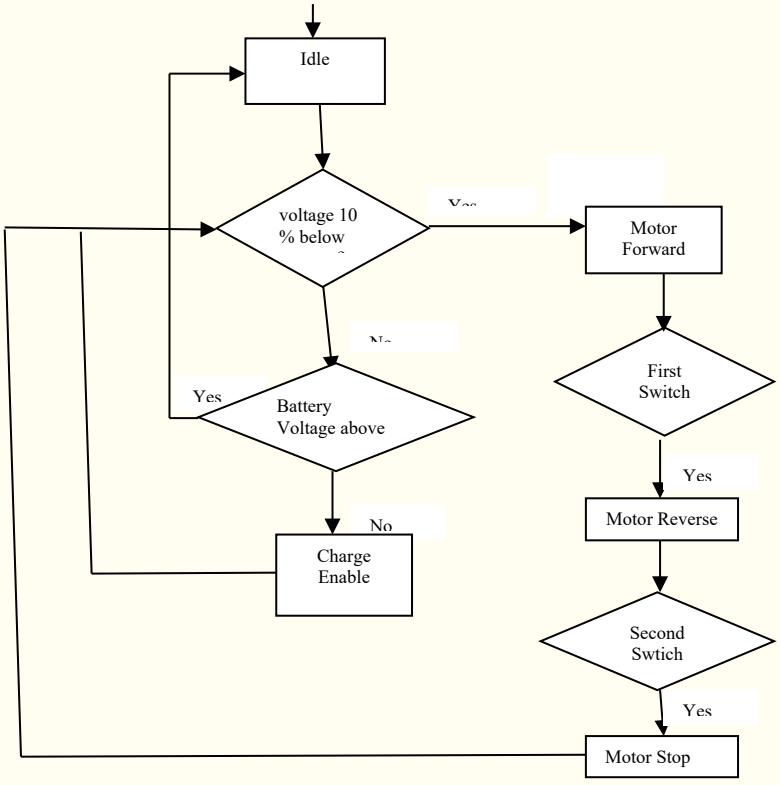
- It enables the cleaning mechanism when required.
- It helps to distinguish between whether the obstruction partially shading the panel or not.
- It helps in charging the battery when the battery is not full and ther is enough sunlight.
- It remains inactive when it is not in either use of charging or cleaning thus saving a lot of power.
- It is one-time installation and cost efficient.
- It is effective wiping system.
- The charging system is suitable with 12V lead acid batteries.

2. Block Diagram

2.1 System Description



Microcontroller Decision Mechanism



3. Operations

The microcontroller is powered from a 3.3V source. Each photovoltaic panel provides difference voltages from the PV Cells which becomes both signal and source of power to the DMU. The DMU using operational amplifiers connects a difference amplifier configuration. Each difference amplifier helps in changing the differential voltage input from a PV cell to a ground reference voltage. This battery going to be charged at 15V. The charger took nominal input voltage of 30V from the solar panel. The input voltage of charger has value than the output voltage. At approximately 28V, the solar panel voltage drops out therefore the charger input voltage is limited to 28V and switching frequency is adjusted to be 50 kHz as supplied by the microcontroller. The inductor current rating needs to be doubled of input current.The main part of the control circuit is a L298N H-Bridge Driver which needs a supply of 5V±5% and 7.2V±0.1V.

To control the water sprinkling , solenoid valve is used. It worked at 12V DC and can also lower down till 6V DC .The N-channel MOSFET connected between the valve and the ground .It will work as a control to open and close the valve. When the voltage greater than 3V DC reach to N-Channel MOSFET causing the valve to open. The valve gets opened for about 2-3 seconds before it is again get closed.The timing of the duration is checked through the microcontroller. A gate driver is used to actuate the valve.

The wiper mechanism comprises of a linear actuator, along the centre of the panel frame, driven by a DC motor, it wipes the PV Panel in a linear motion. At the actuator one wiper bar is connected and stretched on both sides of the PV Panel.Threaded rod's rotation drives the actuator. The dc motor of the wiper is accompanied with wheels on either side which moves on a plastic track. The spray mechanism comprises of pipes along sides of the panel. A sprayer nozzle is present on the pipe for each solar cell. It also has optimal spray angle.The flow of water through the pipes is controlled by the solenoid valve. The water supply is pressurized and connected with a hose.

3.1Costs

CUMMULATIVE COST	2364/-

3.2 Comparison With Existing System

Other projects developed till date have used micro sensors or dust intensity detector sensors which cost more than 25000/- but in my project DMU is used which costs only Rs 200/-.

CONCLUSIONS

The goal of this project is to create an automated solar panel cleaner that is going to reduce the adverse impact of dust on commercial PV cells. The increase in efficiency of a soiled panel by 10% with approximate cost of below 2500/- is very cheap in comparison to the market rate of the product and operating for up to 7 years.

Therefore, a successful design should operate with minimum usage of water requiring only yearly maintenance.

The current apparatus only cleans on set cleaning cycles.Therefore , we are not only improving efficiency of the system , we are working on the design that will expand the solar energy globally.An efficient cleaner is that cleaner that not only help communities by using alternative fuel sources but also provide opportunities globally to harness reliable energy.

REFERENCES

[1] G. Masters, Renewable and Efficient Electric Power Systems, Hoboken, NJ: John Wiley & Sons Inc., 2013.
[2] A. S. Sedra and K. C. Smith, Microelectronic Circuits, 6th ed., New York, New York: Oxford University Press, 2010.
[3] Industries, Semiconductor Components, datasheet, MC34072, 21st ed., 2013.
[4] Texas Instruments Incorporated, datasheet, LM78LXX Series 3-Terminal Positive Regulators, 2013.
[5] Texas Instruments Incorporated, datasheet, LP2950 Series of Adjustable Micro power Voltage Regulators, 2013.
[6]L298 Dual Full-Bridge Driver, datasheet, STMicroelectronics, 2000. Available at: https://www.sparkfun.com/datasheets/Robotics/L298_H_Bridge.pdf.