



A REVIEW ON AUTOMATIC SOLAR PANEL CLEANING SYSTEM

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ABSTRACT:-Power generation from renewable sources has grown rapidly in recent years, due to increasing energy demand just as the ecological and financial worries with petroleum derivatives Photovoltaic (PV) is one of the sustainable power sources with the best future projection. The sun based PV modules are for the most part utilized in dusty conditions which is the situation in tropical nations like India. The residue gets collected on the front surface of the module and squares the occurrence light from the sun. It decreases the force age capacity of the module. And also effects on efficiency of system To address this issue: a fully automated, cost worthy and efficient system needs to be invented.

Keywords: -Photovoltaic, Ultrasonic Sensor, Motor Driver

I. INTRODUCTION

Power generation from renewable sources has grown drastically in recent years, due to increasing energy demand as well as the natural and monetary worries with petroleum products. Photovoltaic (PV) is one of the sustainable power sources with the best future projection as it has provisions like straightforward establishment, high unwavering quality, low upkeep cost because of nonappearance of moving parts and zero fuel cost. Sun oriented photovoltaic energy is saddled from sun powered radiation; for a mono glasslike sunlight based PV board under standard test condition, it is seen that solitary 15-18% of sun based radiation is used to deliver power .Achieving most extreme productivity has been a test and this proficiency changes because of a few components like: lower irradiance; higher air mass; higher temperature; paying little heed to this, sun based radiation is neglected to be tackled because of aggregation of unfamiliar particles like residue, bird fertilizer, snow, and numerous other. Large scale PV systems are immensely affected by dust deposition on solar panels. Conventionally, the panels are cleaned with water and the process is labor intensive and is proven to be expensive in large scale PV system Accumulation of dust particle increases the temperature of solar panel up to 10% resulting decrease in net output power To address this issue: a fully automated, cost worthy and efficient system needs to be invented.



II. LITERATURE REVIEW

Many research studied the effect of dust and other impurities on the solar panel and much experiments have been carried out to clear up this troubles. Under are a few theories and researches which can be related to this mission.

1. 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 filter sand 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. 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.

2. Electrostatics cleaning:-Electrostatics 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. 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 level and activates the system in to 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 larger systems elsewhere.

3. Ali Omar Mohamed, Abdulazez Hasan et al.-, considered the southern area of Libya which usually carries the dust and sand in the period from February to May, which is also called as seasonal wind. So the small particles of the sand, trees, debris and droppings of birds are accumulated on the PV model surface, which yield a shading sunlight on the modules. Here the area of study divided as rural desert, where the amount of solar irradiance is large over the year. Thus it inspires to adopt the clean energy resource on desert region. Hence a framework of weekly cleaning on PV modules throughout the period involves the experimental set up and a simultaneous measuring is implemented in maximum operating voltage and dc currents on each module for both before and after washing modules. Weekly water washing is carried out through periods of February to May in order to evaluate performance of PV panels. So the maximum current and voltage is measured at the terminal using the digital multi-meter device, before and after washing in order to gain the maximum power at the operating point generated by PV module.

III. SYSTEM DEVELOPMENT

3.1 Block diagram -It consist of two ultrasonic sensor, motor driver, DC motor, cleaning brush, high pressure air pump, driving wheels and main part is microcontroller PIC18F458.

Ultrasonic Sensor:-Ultrasonic sensor is used for this project. Here we used the TWO US sensors, both are for detection of solar panel surface. We used HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has

two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that,

$$\text{Distance} = \text{Speed} \times \text{Time}$$

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module.

Relay and Relay Driver:-A Relay is an Electromagnetic Switch which is useful if you want to use low voltage. Circuit to switch ON & OFF a light Bulb or anything which is connected to 230v main Supply.

PIC18F458:-Whenever Ultrasonic sensor senses the panel surface, then it sends signal to microcontroller. After that microcontroller send signal to relay through relay driver to operate the motor as well as high pressure air pump.

High Pressure Air Pump:-An high pressure air pump is a pneumatic device that converts power into the Potential energy stored in pressurized air,use to spray high pressure air on the panels to clean the dust present on the panels.

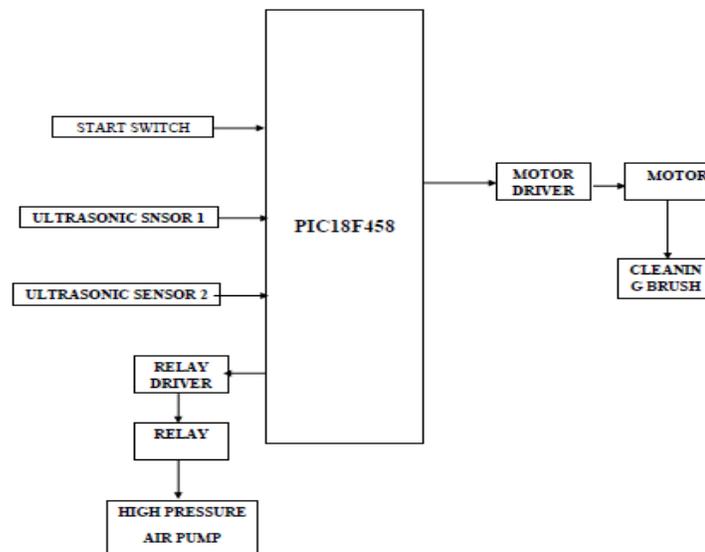


Fig 3.1 Block diagram of Proposed System

DC MOTOR:-It is use to provide forward and reverse motion to the robot. The motion of the motor depends on feedback of DC motor (used for motion of cleaning brush) and ultrasonic sensor. The controlling of this motor is achieved with the help of microcontroller i.e. automatically.

Cleaning Brush:-It is a nylon fiber brush driven by axle of DC motor to clean the dust and debris present on the solar panel; it is rotated in the direction of the robot axle.

3.2 Circuit diagram

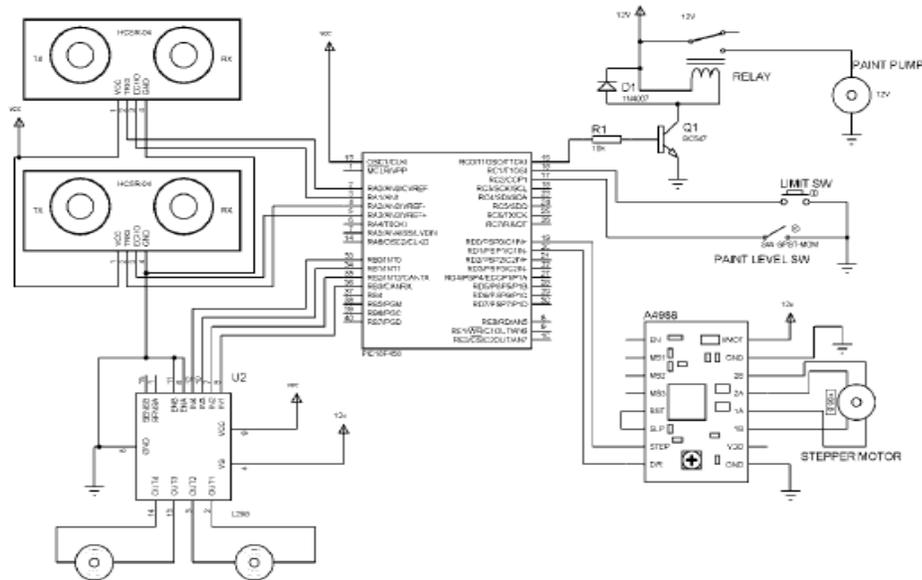


Fig 3.2 Circuit diagram of Proposed System

Filtering unit:-Filter circuits which are usually capacitors acting as a surge arrester always follow the rectifier unit. This capacitor is additionally called as a decoupling capacitor or a bypassing capacitor, is utilized not exclusively to „short“ the wave with recurrence of 120Hz to ground yet additionally to pass on the recurrence of the DC to show up at the yield. A heap resistor R1 (330ohm) is associated so a reference to the ground is kept up with. C1R1 is for bypassing swells. C2R2 is utilized as a low pass channel, for example it passes just low recurrence signals and sidesteps high frequency signals. The load resistor should be 1% to 2.5% of the load.

Voltage Regulators:-In this project we use IC7805, because Microcontroller requires 5v dc supply for its operation. In this, 78 denoted the positive value and 05 denotes 5 volt rating. The primary purpose of a regulator is to rectifier and filter circuit in providing a constant DC voltage to the device.

Step1: Load resistance:

Output Voltage required = 5V,

$$VO = I \times RL \dots\dots\dots (1)$$

Assume max. Load current Idc = 500mA,

Thus, $RL = VO / I = 5 / 500mA = 10\Omega$

Step2: Regulator IC:

If the 5V O/P voltage required so choose IC7805

Step3: I/P Voltage required:

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$$V_{in} = V_D + V_O \dots \dots \dots (2)$$

The Drop out voltage of 7805 is 2.5V thus,

$$V_{in} = 2.5 + 5 = 7.5V$$

Select $V_{in} = 7.5V$

Step4: Selection of Rectifier & filter Capacitor:

Now, filter Capacitance.

The voltage required at I/P of 7805 = 7.5V

$$V_c = di/dt \dots \dots \dots (3)$$

Consider, $di = I_{dc} = 500mA$ & $dt =$ charging & discharging time of Capacitor = T.

Let's,

Mains frequency = 50Hz.

$$\text{Thus, } dt = T = 1/f = 1/50 = 0.02 = 20\text{mSec.}$$

So, from equation (3)

$$V_c = 500mA/50 * 0.02\text{sec} = 25V$$

Choose Capacitor with 100uF, 25V for filtration.

3.3 Hard Ware Requirement:-

1. Microcontroller IC AT MEGA 328
2. Regulator IC 7805
3. Resistor
4. Capacitor
5. Transistor BC547
6. Diode (1N4007)
7. Transformer
8. Pushed on switch
9. Oscillator (15.0952 MHz crystal)
10. Ultrasonic Sensors
11. Belt Drive
12. L 293D
13. Relay SPDT Sugarcube
14. DC Motor
15. High Pressure Air Pump
16. Cleaning Brush
17. Rotating Wheels
18. Chassis Board
19. Preset
20. Nut Bolts
21. Iron Body Chasis

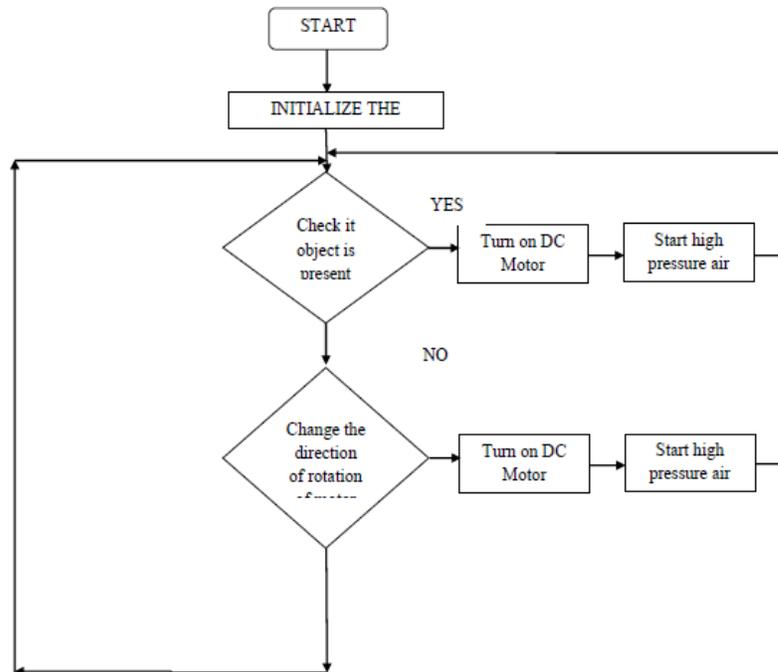


Fig 3.3 Flow chart of Proposed System

We have used arduino software for programming. Arduino is an open source platform used for building electronic projects. The arduino platform has become quite popular with people just starting out with electronics for good reason. The arduino doe snot need a separate piece of hardware (Called a programmer) in order to load new code on to the board. Additionally the arduino IDE uses is a simplified version of C++, making it easier The Arduino Software, it dedicated to providing with the best development tools and technical support. That's why it offers numerous ways we can get the technical support to complete your embedded projects.

3.4 Working Principle of Proposed Hardware –

When supply given to the step down transformer it converts 230 volt into 12 volt. Because electronic components require dc power supply. With the assistance of extension rectifier we changes over the air conditioner supply into dc supply and by utilizing voltage controller IC we manage the voltage into 5 or 12 volt. This stockpile given to transfer, microcontroller IC, LED and all electronic components. The cleaning unit continues on the sun powered board in a to and fro movement. The round and hollow Brush mounted on the cleaning unit turns the clockwise way. The cleaning unit along with the rotating brush moves along the solar panel towards the bottom of the panel. Along the entire path, it forces the dust to move in the direction of the motion of the cleaning unit and finally blows it away at the edge of the panel. Once the cleaning unit reaches the lower end of it, it again returns back. Once it reaches the top of the panel, the cleaning unit stops there. Then the locomotion units come into



action. Then the wheels move in the direction parallel to the edge of the solar panel until it reaches the part of the panel that is not cleaned.

IV. CONCLUSION

It is very important to clean this debris to produce better output. The system is used to eliminate dust and soil related particles on PV boards. This framework complete cleaning work with least human exertion. The misfortunes of the yield influence of the decent sun powered board can be higher relying upon the residue structure. The soil and bird drop make a problem area in the panel, and it can cause brief to fall flat in the board. Cleaning can't eliminate all the soil on the outside of sun based board, yet it can eliminate the external layers of the residue. Cleaning sunlight based board with water expands cleaning effectiveness by eliminating greater part of the soil kept on the board. Contrasting the expenses of cleaning by manual activity and programmed activity the expenses of programmed cleaning is proved to be more economic and significantly less difficult particularly in systems having large number of solar panels. Also frequent periodic cleaning ensures that the solar panel works with a good consistency at all times

By this project we learned following things:-

- Importance of project.
- How to make circuit diagram.
- To make PCB layout on the copper clad.
- Component mounting and soldering.
- How to troubleshoot the fault and clear it.

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