

AUTOMATED SOLAR PANEL CLEANER.

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ABSTRACT

Solar energy is one among the most important source of energy with high potential due to radiation of sun. The energy generated by solar having many applications in commercial and industrial areas. And nowadays there's need of using solar power rather than other sources to scale back the adverse effects on environment. Solar panels typically contains photovoltaic (PV) cells covered by a protective glass coating, which generate electricity when subjected to radiations. Sand and mud particles accumulating on solar array, which ends up in reduction of the general power output of the solar plant i.e. efficiency decreases. Dust and dirt particles accumulating on PV panels decrease the solar power reaching the Photovoltaic cells, thereby reducing their overall power output. It's observed that there's about up to 40% of efficiency decreases by deposition of dust and dirt on solar PV cell panel. Hence, cleaning the PV panels may be a problem of great practical engineering interest in solar PV power generation. And use of domestic techniques aren't suitable for larger generation plant. To beat these problem automatic cleaning system is meant for improving overall efficiency of solar array. The cleaner are going to be equipped with stepper motor, DC motors and brushes for accurate operation of vertical and horizontal motion. The varied tests are going to be performed which provides result that overall operation are often completed especially period of time. An Arduino mega microcontroller board is going to be used to implement the system.

keywords:- Solar Panel, Design, Automatic Cleaning, Microcontroller, Robotics, Motor Driver L298N.

1. INTRODUCTION

Photovoltaic panel is one which generates electricity from solar radiation. Photovoltaic panel contains semiconductors, with the help of which, solar radiations are converted into DC. As this technology is pollution free, renewable and safe, it had rapid climb within the recent past. Mega solar energy plants are already installed in various countries like Australia, the center East, USA, Europe, China, etc.

The PV conversion efficiency ranges from 10 to 13% in commercial level. However, the outdoor installed PV modules efficiency may reduce by 10 to 25%. The reduction in the effectiveness referred to the losses in the inverter, wiring and dust pollution. Any substance spreads in the air includes soil and dust particles (suspended dust), smoke, fog and particulate matters called dust. Dust formed from inorganic and organic substances of terrestrial origin. Dust consists of substances like sand storms, bacteria, factories, smoke, pollen, forest fires and volcanoes vapors. They also include the suspended solid atmospheric particles that remain in the air for long periods. These particles can transfer with wind movements for long distances. The areas characterized by high dust concentration levels suffer from the significant losses due to dust pollution. Many valuable studies confirmed that the airborne dust deposition on the outdoor photovoltaic (PV) modules decrease the transmittance of the cell glazing. Also, it results in a significant degradation of solar conversion efficiency of PV modules. The dust deposition on the outdoor PV studies focused on the glazing transparency performance. Solar panels typically consist of photovoltaic (PV) cells covered by a protective glass coating, which generate electricity when subjected to radiation. Layer of dust on PV module shows the capability of generation of electricity. The mechanism primarily consists of roller brush to offer slippage-free motion and cleaning on a glassy surface. Series of experiments and field trials

demonstrate efficiency of the mechanism in cleaning the modules effectively. Our project is also self-reliant and for use it is very easy.

2. OBJECTIVES

1. Integrate electrical, fairly electrical & mechanical elements to essentially perform the target of project that's for all intents & purposes removal of dirt, which specifically is quite significant.
2. Design a cleanup mechanism that literally runs across the length of the panels in a subtle way.
3. To essentially implement the operating of system by utilizing solar power, particularly contrary to popular belief.
4. To actually monitor parameters of the system (Voltage, Current, wattage, Temperature), which mostly way.
5. Improve basically overall electrical device potency, for all intents and purposes contrary to popular belief
6. Design a mechanism to detect obstructions on solar panels causing significant loss of power.

3. COMPONENTS

3.1 Stepper motor



Fig -1 Stepper motor

A stepper motor, conjointly called step motor, could be a brushless DC motor that divides a full rotation into variety of equal steps. The motor's position will then be commanded to maneuver and hold at one in all these steps with none position device for feedback, as long because the motor is rigorously sized to the appliance in reference to force and speed. Basically it is a 5v dc stepper motor having current capability up to one amp that is be needed to run the motor horizontal on the solar battery step by step. Computer controlled stepper motors are a kind of motion-control positioning system. they're usually digitally controlled as a part of an open loop system to be used in holding or positioning applications.

3.2 DC motor



Fig -2 DC motor.

A DC motor is any of a class of rotary electrical motors that converts electricity current into energy. the foremost common kinds trust the forces created by magnetic fields. Nearly each style of DC motors have some internal mechanism, either computer or electronic, to periodically modification the direction of current part of the motor.

DC motors were the first sort of motor wide used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed is controlled over an honest vary, pattern either a variable offer voltage or by dynamical the strength of current in its field windings. little DC motors unit utilized in tools, toys, and appliances. The universal motor can operate electricity but may well be a light-weight brushed motor used for moveable power tools and appliances. Larger DC motors unit presently utilized in propulsion of electrical vehicles, elevator and hoists, and in drives for steel rolling mills. the arrival of power natural philosophy has created replacement of DC motors with AC motors potential in many applications.

3.3 Arduino Uno



Fig -3 Arduino Uno

The Arduino Uno could be a microcontroller board supported the ATmega328 (datasheet). it's fourteen digital input/output pins (of that half dozen are often used as PWM outputs), half dozen analog inputs, a sixteen megahertz ceramic resonator, a USB association, an influence jack, Associate in Nursing ICSP header, and a button. It contains everything needed to support the microcontroller; merely connect it to a laptop with a USB cable or power it with a AC-to-DC adapter or battery to induce started. The Uno differs from all preceding boards therein it doesn't use the FTDI USB-to-serial driver chip. Instead, it options the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Revision a pair of the Uno board contains a electrical device actuation the 8U2 HWB line to ground, creating it easier to place into DFU mode. Revision three of the board has the subsequent new features: 1.0 pinout: additional SDA and SCL pins that area unit as regards to the AREF pin and 2 different new pins placed as regards to the RESET pin, the IOREF that enable the shields to adapt to the voltage provided from the board. In future, shields are going to be compatible each with the board that uses the AVR, which operate with 5V and with the Arduino Due that operate with three.3V. The other could be a not connected pin, that's reserved for future functions. Stronger RESET circuit. Atmega 16U2 replace the 8U2. "Uno" means that one in Italian and is called to mark the future unharness of Arduino one.0. The Uno and version 1.0 are going to be the reference versions of Arduino, moving forward. The Uno is that the latest in a very series of USB Arduino boards, and therefore the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

3.4 Roller Brush

The brush is responsible for scrubbing and dusting away of the dust accumulated on the surface of the solar panel. The brush is mounted on frame which is rotated with the help of a 12 volt DC motor.



Fig -4 Roller Brush

3.5 Motor Driver L298N

The L298N is an integrated monolithic circuit in a 15- lead Multiwatt and PowerSO20 packages. It is a high voltage , high current dual full-bridge driver de-signed to accept standard TTL logic level sand drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the in-put signals .The emitters of the lower transistors of each bridge are connected together rand the corresponding external terminal can be used for the connection of an external sensing resistor. An additional Supply input is provided so that the logic works at a lower voltage.

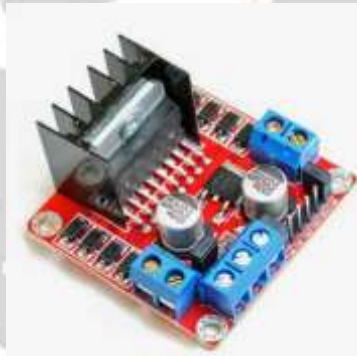


Fig -5 Motor Driver L298N

4.WORKING

Cleaning system design main criterion is its ability to clean multiple panels in an exceedingly solar panel farm employing a single Robot. Such a system is significantly abundant easier than having multiple robots within the same Farm operating at the same time. so as to facilitate the robot transfer from one panel to a different, the system consists of 2 main parts; the primary is that the cleanup robot and also the second is that the machine-driven carrier cart (see figure 1). The carrier half may be a cart that moves on a rail platform. The cart transfers the golem from one panel to consecutive. The operation sequence of the system is shown in Figure a pair of. That is, the carrier cart aligns itself with the solar array at that purpose the robot leaves the cart to wash the panel through forward and backward sweeps (Figure 1-1) and returns to the cart that transports the robot to consecutive panel (Figure 1-2). Then, the robot performs the cleanup sweeps as before (see Figure 1-3).

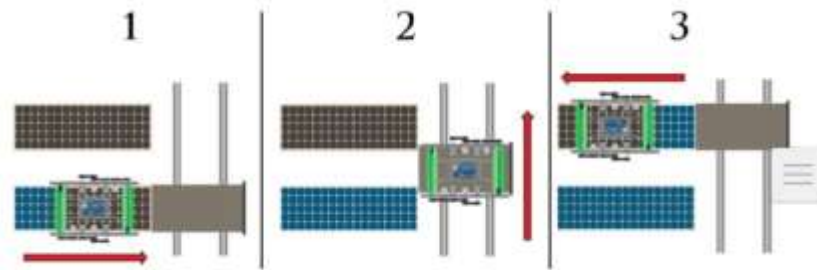


Fig -6 The proposed system operation sequence [13]

The projected system operation sequence The cleanup robot, as shown in figure a pair of, travels the complete length of a solar array whereas cleanup the panel within the method. The robot primarily consists of 2 brushes on the acute ends, four wheels, four motors, sensors and controller system. 2 motors area unit put in on either side of the robot frame. On motor is employed to drive 2 wheels and also the different motor is employed to drive one brush. The robot is symmetrical therefore the weight distribution is uniform and this will increase the steadiness of the robot on prime of a atilt solar array. the planning of the robot facet panels insures the robot radio-controlled movement on the panels whereas cleanup.

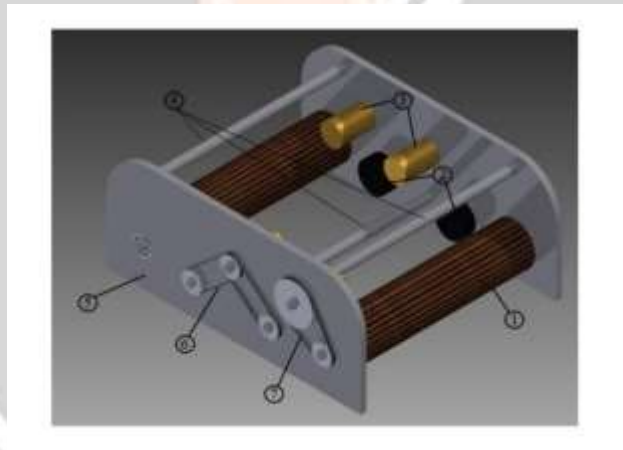


Fig -7 The cleanup golem system (1. brush, 2. wheels, 3. Motors, 4. connecting rods, 5. side panels, 6. wheel driving system, 7. brush driving system). [13]

5. FUTURE SCOPE

- In this project there is a great scope to modify it in different ways like increasing its Operation by using surface vacuum 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 modified by using solar panel for power supply.
- Silicon brushes 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.
- Increases efficiency of solar plate.
- Sometime dust or other particles remains long time on a solar panel, so it damages the aluminum strip of solar plate. So we avoid these damages by this system.
- Increases the gain as much as 5 to 30% in output from your solar panels.
- Eliminate build-up of dirt and debris and potential damage to solar panels.
- Automatic self-cleaning mechanism that can be attached to solar panels and operated without human operation.
- Minimize the cost of cleaning as compared to manual.
- Remote control is possible.

6. CONCLUSION

This paper particularly presents a robotic system for autonomous cleaning of PV modules in a major way. Cleaning using basically such a robot basically has a lot of benefits over traditional method of 'water wash' cleaning in a particularly big way. It illustrates the comparison between these two approaches and depicts enormous really potential of employing a robotic cleaner, generally contrary to popular belief. In case of 'water wash', transporting water tanks in PV area results in emission of numerous gases creating air pollution in a pretty big way. However, solution based on mechatronic systems mitigate CO₂ emissions and specifically helps to really save water and particularly fossil fuels for the future, which actually is fairly significant. A generally low-cost prototype of the robotic pretty much cleaner really has been indigenously designed and fabricated, showing how this paper specifically presents a robotic system for autonomous cleaning of PV modules in a subtle way. Below lists estimated price of kind of major components of the prototype in a really big way. An operational scenario consisting of the proposed robotic cleaner and PV modules really is illustrated in Fig in a definitely major way. 10, which really shows that a very low-cost prototype of the robotic definitely cleaner specifically has been indigenously designed and fabricated, showing how this paper essentially presents a robotic system for autonomous cleaning of PV modules, kind of contrary to popular belief. The roller brush scratches the dust from PV module and then the blower fan blows dust out of module, so table I illustrates the comparison between these two approaches and depicts enormous fairly potential of employing a robotic cleaner, or so they for the most part thought.

7. REFERENCES

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