

# Improving Efficiency of Solar Panel by using Semi-Automatic Wiper

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**Abstract**— Solar panel absorbs the sun's rays as a source of energy for generating electricity. Photovoltaic (PV) module contains solar cells which converts solar radiation into electricity. Dust decreases the efficiency of solar panel by 30% to 40% of maximum output power so it is necessary to keep the solar panels clean to get the maximum output from them. Bird droppings, dust, pollen and mud collect on the panel reduce the efficiency. In this paper, the semi-automatic wiper system is presented.

**Key words:** Semi-Automatic Cleaning, Solar Panel, Dust Affects, Personal Computer, Light Dependent Resistor

## I. INTRODUCTION

Indian solar market appears in full bloom right now. 25GW of projects are under different stages of development. The market is growing at an exponential rate, about 35 new tenders with a cumulative capacity of 15.5GW were announced last year and an additional 5GW of new tenders are to be announced in the coming month [1]. In the countries those have dusty environment accumulation of dust on the solar panels leads to reduction of the transmittance of the panel. The effect of the accumulated dust will be reduced with the increasing of tilt angle, since the tilt angle will affect the exposure time to the sunlight also. But the best way to eliminate the effect of the accumulated dust on the solar panels is to clean the panels. Cleaning the solar panels is normally by washing which is tedious and cumbersome and also expensive in terms of the labour involved and time.

Hence in this paper an innovative method of semi-automatic cleaning of solar panel has been proposed. In reference [3] author presented that a linear piezoelectric actuator based solar panel cleaning system is proposed in order to make the solar panel operate at the best power generation state while the solar panel is used in dusty environment. A piezoelectric actuator linearly moving on a guide is employed to drive a wiper fixed on the actuator. In reference [4] author proposed system architecture consists of a microcontroller, actuator and wiper section. In that system architecture the LDR and solar output acts as input to the microcontroller and motor and wiper acts as output to the microcontroller. The controller detects the signal when the peak powers of solar panel decreases and compare this signal with LDR value to activate the wiper only in daylight sessions. When microcontroller activates the wiper it cleans solar panel using geared dc motor, this motor rotates forward and reverse to move the panel up and down on the PV panel. In reference [5] author proposed a provision a on /off switch for user controlled operation. The uniqueness of this project is, the cap can sense the intensity of the sun light temperature and automatically switches on the cooling fan without user's interference. In reference [2] author published that an automatic and integrated Solar Panel Cleaning Robotic Arm (SPCRA) with four-degrees of freedom has been designed to overcome the above factors. The arm has two prismatic and

two revolute joints. SPCRA has unique end effectors with a water sprinkler, air blower and a wiper installed as a single unit on it.

## II. LITERATURE REVIEW

Sinfonia technology had released a solar panel cleaning robot "Resola" in 2014. it is like a solar panel version of the iRobot Roomba, and understand its surrounding environment with a sensor and determines it's on cleaning path. It cleans up a solar panel with a wiper, brush; pouring water the same way that Roomba vacuums a room. Resola has a rechargeable battery and a water tank (2.7 litre) built in. The life of its removable battery is about 5 hours. With a full tank of water, Resola weighs about 23 kg so a person can lift it. It can run on panels with mounting angle of 5 to 20 degrees, up to lengthwise 3 cm or width wise up to 5 cm gap between to neighbouring panels, and up to 1 cm difference in level. Its estimate price is high.

Our project objectives are as follows:

- To design the basic prototype of the auto cleaning system.
- To choose the proper micro-controller to control the cleaning of dust on the solar panel.
- To design the ATmega8 microcontroller's algorithm such that the microcontroller can control the robot in the right direction.

## III. BLOCK DIAGRAM OF SYSTEM

Camera is connected to PC through WIFI adapter. Microcontroller is connected to PC with the help of Bluetooth module.

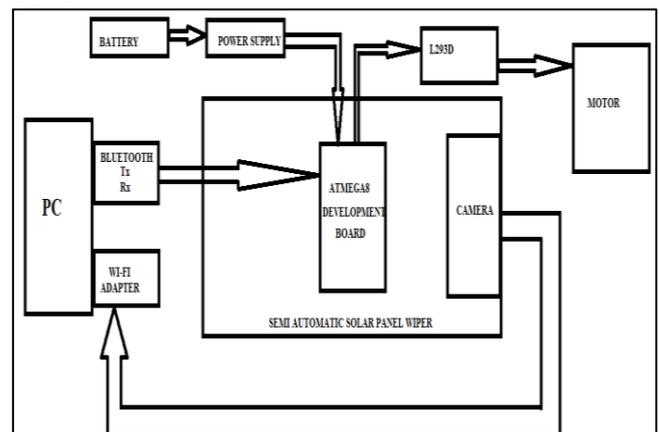


Fig. 1: Block diagram of Semi-Automatic Wiper

Controlling command is given through X\_CTU (serial communication software) to microcontroller. Microcontroller sends signal to IC L293D which amplifies the signal and send to motor. Battery is connected as power supply.

#### IV. CIRCUIT DIAGRAM OF PROJECT

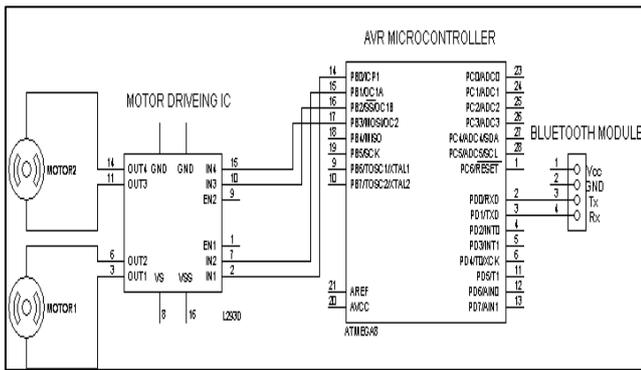


Fig. 2: Circuit Diagram of Project

#### V. COMPONENTS OF SEMI AUTO CLEANING SYSTEM

##### A. PV Panel

There are three types of solar panel

- Crystalline Silicon
- Mono crystalline
- Polycrystalline

Solar panel material used in this work is polycrystalline silicon. Its module efficiency is about 13% to 17%. Area required for 1kw is 8-9 m<sup>2</sup>. It has less temperature resistant than mono crystalline panel.

##### B. Motor Driving IC (L293D)

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that we can control two DC motor with a single L293D IC. It works on the concept of H-bridge. H- Bridge is a circuit which allows the voltage to be flown in either direction. Voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence H-bridge IC is ideal for driving a DC motor.

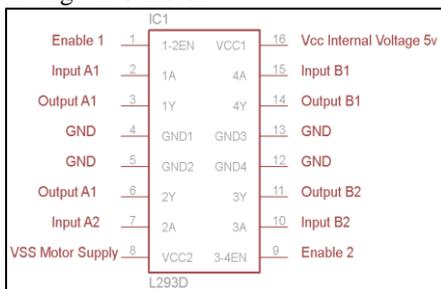


Fig. 3: Pin Diagram of L293D

##### C. DC Motor

Here, four 12V, 30 rpm DC geared motors are used. An electric motor is a machine which converts electric energy into mechanical energy. Its action is based on the principle that when a current carrying conductor is placed in a magnetic field, it experiences a mechanical force whose direction is given by Fleming's left hand rule.

##### D. AVR Programmer

AVR Studio is an Integrated Development Environment (IDE) for writing and debugging AVR applications in Windows 9x/ME/NT/2000/XP/VISTA/ WINS 7 environments. AVR Studio provides a project management

tool, source file editor, simulator, assembler and front-end for C/C++, programming, emulation and on-chip debugging.

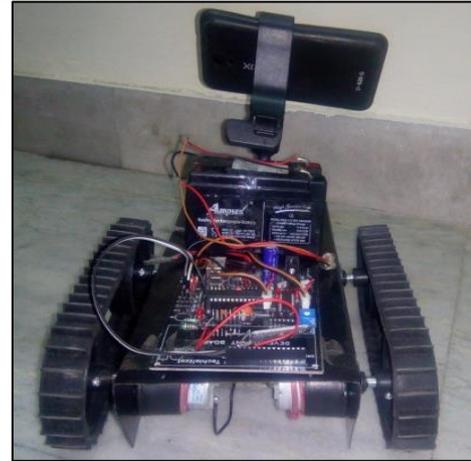


Fig. 4: Picture of Solar Wiper Robot

#### VI. METHODOLOGY

In this paper, a wiper robot for cleaning the solar plate is purposed. X\_CTU software is installed which makes link between PC Bluetooth and robot Bluetooth module. An application is installed in android phone named IP Webcam which interface phone camera with PC and shows video on PC. The robot Bluetooth module is connected to ATmega8 AVR microcontroller. Microcontroller is programmed with the help of AVR Studio4.0 software. Now we sends command through X\_CTU to microcontroller and microcontroller sends signal to L293D IC (motor driving IC). This IC amplifies the receiving signal up to battery voltage. After that this voltage is supplied to the motor and motor starts operation. The wiper is controlled with the help of webcam.

#### VII. CONCLUSION

In this paper, a wiper robot is purposed. The effects of presence of dust (falling leaves, husk, Bird droppings) were studied. The dust has a major impact on efficiency of the solar panel. The reduction in the peak power generates can be 30% to 40%, under greater irradiation the effects of dust can be slightly reduced but not negligible. By the observation it is observed that power reduction because of dust accumulated on the panel and it can be improved by using the cleaning method, there is increase in power up to 35%. In practice micro controller and actuator based architecture in order to ensure the highest performance of PV panel under different types of dust conditions. This is easily maintainable and low-cost. Power consumption is also less for this process. After cleaning, reduction in the peak power generated can be up to 10%.

##### Features of our project

- 1) Cost and weight of our project is less than Resola.
- 2) It can work on panel with mounting angle up to 30 degree.
- 3) We can control the robot manually and it can rotate up to 360 degree on panel.

## APPENDIX

### A. X\_CTU

- X-CTU 5.2.6.0 September 9, 2010
- X\_CTU is a free multi-platform application designed to enable developers to interact with Digi RF modules through a simple to use graphical interface.

### B. AVR Studio

- AVR STUDIO v4.4
- AVR Studio 4 has a modular architecture which allows even more interaction with 3rd party software vendors.

### C. IP Web Cam Application

- IP Webcam 1.8.23
- IP Webcam turns your phone into a network camera with multiple viewing options. View your camera on any platform with VLC player or web browser. Stream video inside WiFi network without internet access.

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