

# Automatic Solar Panel Cleaning System

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**Abstract:** Solar power is mainly harnessed from photovoltaic (PV) panels which are arranged in multiple arrays in a solar farm or solar system. Though, power generation from PV solar system is characterized by uncertain efficiency, many countries with high insolation prefer solar as an alternative way of generating clean energy. However, the efficiency of energy generated from PV panels is affected by the accumulation of dust and debris, even on one panel in an array. This condition leads to the need for regular cleaning of the surface of PV panels. Current labor-based cleaning methods for photovoltaic arrays are costly in time, water and energy usage as well as lacking in automation capabilities. To overcome this problem, a fully automatic solar panel cleaning system with/without water is proposed. Hence, in this paper, the design of a robot for automated cleaning of the surface of PV panel is presented. The design utilizes an Arduino controller system to control the robot movement during the cleaning process. In addition, it is equipped with two rough sponge and a water pump system that can be used to clean dust or debris found on PV panel surfaces. The efficiency of the PV panels before and after the cleaning process is also observed.

**Keywords:** Arduino nano, Bluetooth Module, PV Panel, Brush.

## I. INTRODUCTION

In a solar energy system, photovoltaic (PV) solar panel provides DC electricity from the continuous flow of energy from the sun. MPPT method based on Fuzzy logic controller is presented in to produce maximum energy from PV system. Once the installment of solar panels has been completed, the fuel is free. The operating cost of the system is very low when compared to other energy production methods. However, solar energy is CO<sub>2</sub> free renewable energy source, the routine maintenance of solar panel is required. The particles of dust on the solar panel come mainly from urban and industrial products. SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>, CaMg (CO<sub>3</sub>)<sub>2</sub>, Ca (OH)<sub>2</sub>, CaO and CaCO<sub>3</sub> are some sorts of dust particles found on the solar panel. Dust Accumulation on the surface of solar panel has serious impact on the system's efficiency. It is estimated that, about 50% of system's efficiency can be reduced and almost 15% power losses can be occurred in dry areas. Therefore, it is essential to keep solar panel's surface clean as much as possible.

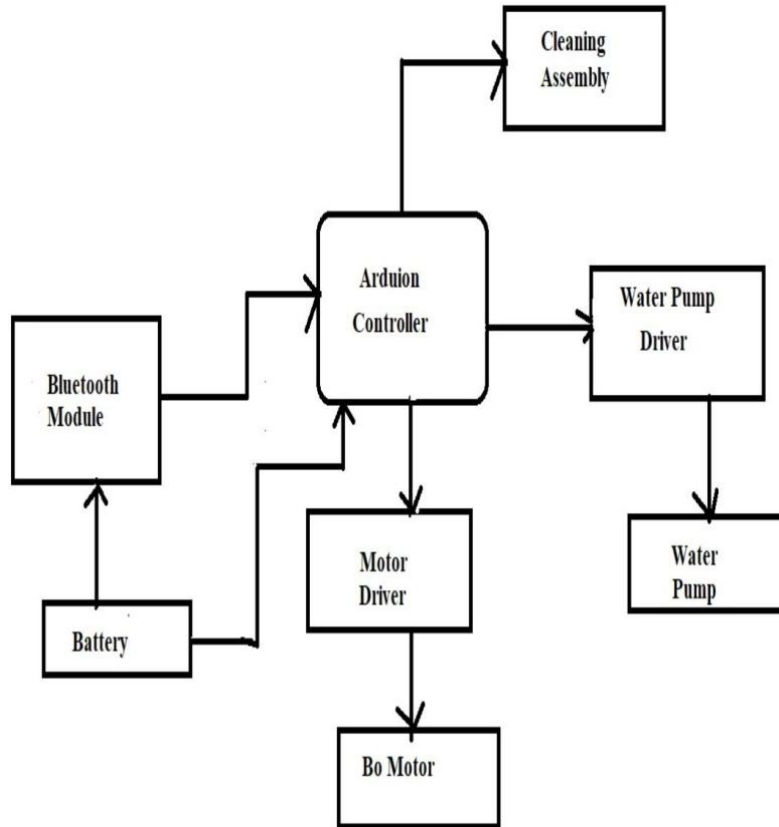
## II. METHODOLOGY

### 2.1 Block Diagram

The major heart of this project is the Arduino nano module controller unit. The Arduino-nano module controller unit controls the movement of the BO motor based on the input given by the . It also determines the time to pump water to the brushes during the cleaning process. In this system, an ultrasonic sensor detects the movement distance of the proposed robot. The built-in cleaning device in the robot consists of static brushes, placed at the front and the backside of the robot, a water pump, and a water tank. Water is supplied to the brushes from the water tanks via a dedicated water pump, whose function is to pump the water at a suitable pressure.

The solar panel cleaner robot makes use of a water tank with motorized pump along with 4x DC motors to achieve vehicle motion using caterpillar wheel motion. The robotic vehicle is built over a metal chassis with a controller circuitry operated over RF wireless remote. A remote controller is used to wirelessly transmit control movement data to the robotic vehicle. The controller receives the data and operates the wheel motors in desired directions to achieve the desired movement. The front brush is fixed to the main chassis front and operated by a geared DC motor. The front

panel also has an integrated water pipe that is used to drive water for cleaning using a dc pump to the front of the brush. The system thus allows for easy solar panel cleaning using wireless control.

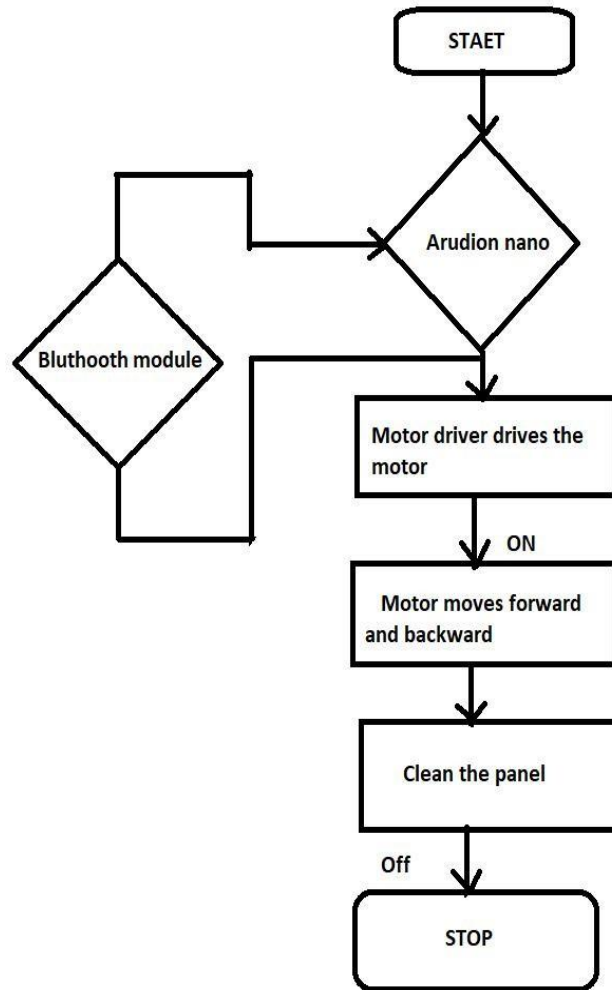


**Fig.1: System Block Diagram**

**2.2 Prototype of Hardware**

1. Aurdino nano Module
2. Bluetooth HC 05
3. Motor Driver L293D
4. Regulator 7805
5. Pump
6. Battery
7. BO Motor
8. Heat Sink
9. Two-wheel-drive (WD)
10. Water tank
11. Brushes

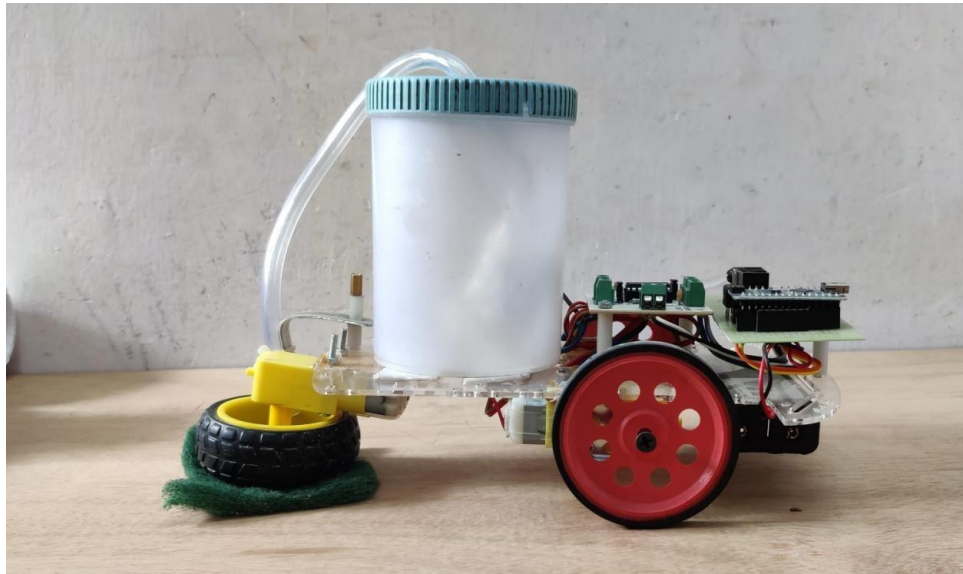
2.3 Flow Diagram of the Proposed System



**Fig. 2: Flow Diagram of System**

This is the system's flow procedure. Every activity happens in order which we control direction forward, backward, left, right to clean the panel with the help of app Arduino Blue Control. we use this app for controlling direction





**Fig 3. Real Implementation of Automatic Solar Panel Cleaner**

### III. EXPECTED RESULTS

The solar panel cleaner robot makes use of a water tank with motorized pump along with 4x DC motors to achieve vehicle motion using caterpillar wheel motion. The robotic vehicle is built over a metal chassis with a controller circuitry operated over RF wireless remote.

A remote controller is used to wirelessly transmit control movement data to the robotic vehicle. The controller receives the data and operates the wheel motors in desired directions to achieve the desired movement. The front brush is fixed to the main chassis front and operated by a geared DC motor. The front panel also has an integrated water pipe that is used to drive water for cleaning using a dc pump to the front of the brush. The system thus allows for easy solar panel cleaning using wireless control.

### IV. APPLICATIONS

1. In all colleges and schools
2. In all small scale industries
3. Large offices and Companies
4. Solar Power Plants
5. In residential houses that uses solar power
6. Commercial sectors

### V. CONCLUSION

This project highlights the effect of dust, dirt, pollen, sea salt and bird droppings on the PV systems' efficiency. Dust has a major impact on the efficiency and performance of the solar panels. The reduction in the peak power generation can be up to 10 to 30%. Power reduction was observed due to dust accumulation on the panels and this can be improved by using robotic cleaning method. It has increased Power generation capacity of the solar panels. Easy maintenance, low cost and less power usage are few advantages of this process. Finally, the reduction in the peak power generation can also be overcome by using this cleaning system.

The device is lightweight because most of its material is made of aluminium. Comparing the costs of cleaning by Manual operation and Automatic operation, the cost for automatic cleaning is proved to be more economic and significantly less cumbersome, particularly, in systems with large number of solar panels. Frequent and periodical cleaning ensures that the solar panels work consistently with a good transmittance at all times

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