An Autonomous Robot Cleaner For Solar Panel Systems

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Abstract- *Solar energy, being a noteworthy wellspring of sustainable power source, is significant in satisfying future energy need. To ensure efficient operation of photovoltaic panels, it is fundamental that the system presents proper cleaning operation to all obstructed materials that may impede the solar light-based radiation. The amassing of dirt or particles like residue, water, sand and greenery on the outer surface of the solarbased photovoltaic panel deter or divert light vitality from achieving the solar oriented cells. This is a noteworthy issue since the light obstruction materials play as resistance that diminishes the performance of solar photovoltaic. The target of this study is to delineate innovation of robotics technology for cleaning photovoltaic boards. The proposed strategy screens the power generation and cleans the photovoltaic surface when required progressively on mobile app. The enhancements accomplished by the unique structure and the created model confirmed the common sense of the proposed design.*

Keywords- Materials and Methods, Motor Driver

I. INTRODUCTION

The power generated by using conventional methods is a costly process and has a harmful effect on the environment that steer the attention towards utilizing and developing the renewable and sustainable energy sources. The most common renewable energy is solarbased energy. It has gotten a huge attention from researchers and industrial sectors for several reasons like: inconstancy of crude oil prices, awareness of environment friendly power sources, backing of local government by creating rules and policies for supporting renewable energy sector, low prices of PV panels. The ability of glass cover of the solar system to break through the sunlight radiation across the collector surface would determine the efficiency of solar systems.

The solar system utilizes solar cell to generate electricity by converting sun energy radiation. The system involves four components, namely: panels, battery, charge controller unit and load. Regularly fixed on rooftops and wired by an inverter into a building, solar PV board changes over the direct current generated by solar cells into electric current. The deposition and accumulation of dirt and residue particles called as soiling highly degrades the energy production. Residue deposition and dirtying of the board glass is one of the serious issues in the quickly extending solar powered vitality advertise particularly in situations that experience the ill effects of residue, airborne particles and moistness which results in changes in board's electrical qualities. The amassing of residue particles break down the performance of solar powered cells and results in measurable misfortunes in the produced power because of the sun irradiance dispersing consequences for the surface of the solar board. The efficiency of solar based panels subsidence radically when a little segment is obstructed by fallen trash or a film of residue and precipitation is found to have practically no cleaning impact. Cleaning of solarbased boards after the installing on the top of a building is troublesome as residue particles do not enable the sunoriented radiations to enter in the board appropriately causing a decrease in conversation productivity of the board and prompting expanded charging time of the batteries.

II. RELATED WORK

Materials and Methods

Fundamentally, robots are designed in such technique that they lessen human intercession from work escalated and unsafe work environment. The cleaning robot for PV panel with Android bolstered block diagram consists of three elements, namely: input, processor and output as shown in Figure 1. The primary element of the project is input mechanism, which includes each of the Android control switch unit, IP camera, sensors of voltage and current. This info information and data later send to the second element, which is a processor advancement (type Wemos D1 ESP8266 based microcontroller) that integrated by using the Arduino IDE. The last element is the output source consists of DC-motor for controlling robot movement, media server for sending video from the IP camera to the android apps, and Bluetooth module integrate with android apps to test the level of both voltage and current. A camera is appended at the forehead of the robot to register and show the perspective on

the climates on the representative's screen for powerful perception, identification and speedy investigation. In this improvement procedure Hardware prerequisite for the advancement of the project are appeared Table 1 and 2.

Motor Driver

Motor driver will control is used to control motion of a motor and its direction by feeding current accordingly. Output of a motor driver is in digital form so it uses PWM (Pulse Width Modulation) to control speed of a motor. Motor Driver are basically current amplifiers followed input signals. It can also drive inductive loads such as relays, solenoids, transformer etc.

Here we use the motor driver to control the movement of the robot's wheels. We use five motors for the control of the robot's wheels and fiber cloth operation. Fiber cloth is used for the cleaning of solar panel. We can control the movement of the wheels using motor driver. Which is essential for the efficient working of the robot.

III. PROPOSED METHODOLOGY

- Settled dust particles deposited on the solar panel and its affects throughput of the solar energy conversion. This proposed solar car acts like an autonomous robot and which is generally clean every throughput hazardous particles using Bluetooth based technology.
- When solar car is buildup with microcontroller and which is biased with the mobile phone via Bluetooth. Solar car movements happen with the help of couple of ultrasonic sensors. The solar car is placed top of the solar panel at the time of cleaning.
- It acts like a semi-autonomous robot moved with the help ultrasonic sensor in a structured angle. Mobile based controller sets a forward and reverse mode of operation.
- During this operation, BO motor turns on and the brushes cleaned the solar panel. The cleaning of the dust and hazardous particles removed in a high efficient manner.

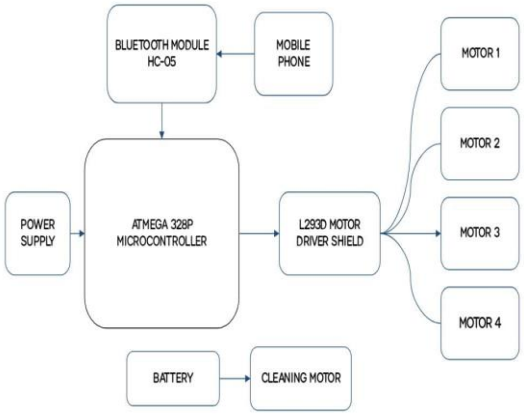

Figure 1. Block Diagram

IV. SYSTEM DESIGN

The solar panel cleaning robot is used for cleaning the solar panel. The motor driver is used to control the movement of the direction of the robot's wheels. Fiber cloth motor is used for controlling the operation of the fiber cloth which helps in cleaning the solar Panel. Bluetooth module (BluetoothRC controller) app is used to give instructions from the user to control the operation of the robot. The instructions are send to the PIC micro controller where the code is written for the operation of the robot.

V. EXPERIMENTAL SETUP

The battery produces 12 V/ 5 V power supply to the regulator that ensures a constant voltage supply through all operational conditions. It regulates voltage during power fluctuations and variations in loads. Then the constant voltage is passed to the PIC microcontroller which is the main brain of the system which is responsible for both computing and communication tasks. It regulates voltage during power fluctuations and variations in loads.

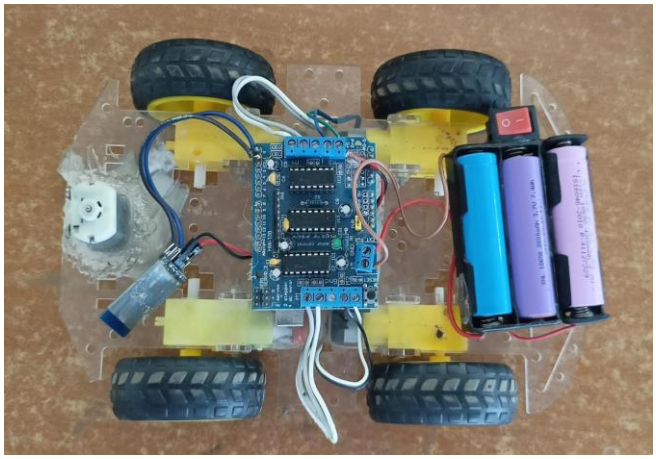

Figure 2. Snapshot Of Proposed Hardware Kit

Then the constant voltage is passed to the PIC microcontroller which is the main brain of the system which is responsible for both computing and communication tasks. In this project we have used Atmega328p microcontroller because of lot specification are there likewise maximum CPU speed is 20 MHZ and maximum I/O pins is 23.

Motor Driver circuits are current amplifiers. They act as a bridge between the controller and the motor in a motor drive. In this project we have used L293D motor driver shield because of lot specification are there likewise Operating Voltage :5V to 12V.Motor controller: L293D driver is capable for connect 4 DC motors or 2 stepper motor.

A DC motor or direct current motor is an electrical machine that transforms electrical energy into mechanical energy.Designed to replace cable connections HC-05 uses serial communication to communicate with the electronics. Usually, it is used to connect small devices like mobile phones using a short-range wireless connection to exchange files. It uses the 2.45GHz frequency band.

S.No	Parameters	Existing system	Proposed system
1	Efficiency	50%	80%
2	Power supply needed	24 V	12 V
3	Cost	High	Low
4	Controller	Not used	Pic

Table. 1 Comparison of proposed system with existing system.

VI. RESULT AND DISCUSSION

The results revealed an improvement in system performance where the produced current was increased from 0.35 to 0.95 A while the efficiency rate was raised up from 35% to 94.95% after robot cleaning.

With more advances of technology, more developed and efficient cleaning methods are taking their way to practical use to reduce the power losses due to dust accumulation on the panel surface.

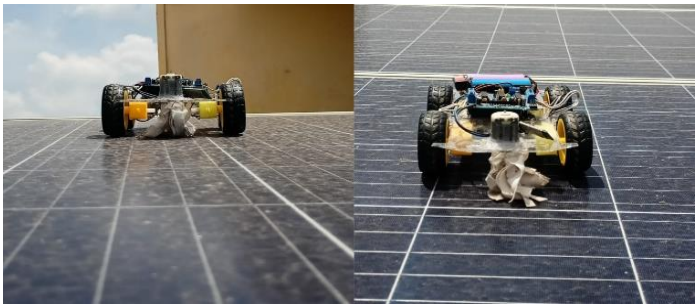

Figure 3. Robot start cleaning process

Now if the passenger loves to extrude the course of the automobile way set up a Bluetooth terminal software and switch on the Bluetooth and pair with the Bluetooth located in the robot. The instructions are send to the PIC microcontroller. The robot will work accordingly to the instructions given by the user. We can give the instructions from the remote mode. So that , hence we achieved the project of automated solar panel cleaning robot.After connecting the Bluetooth device, the passenger can give the following commands given in Table.2

Directions	Commands
Forward	1
Reverse	2
Right	3
Left	4

Table.2 Bluetooth commands

When we give instructions using the Bluetooth terminal app the robot's movement is controlled, the upward key, downward key, right key, left key is used for forward , backward, right, left direction movements respectively. The movement of the robot can be controlled from remote mode.

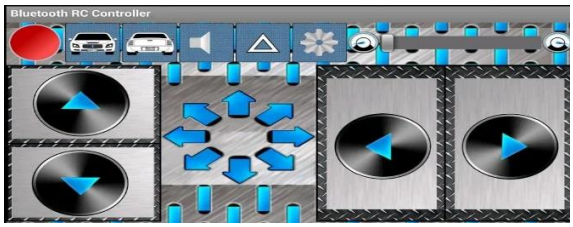

Figure 6 Bluetooth instruction setup

As we developed this project to introduce betterment in the project. Here just increased the efficiency of the project by 30%, we are using low power supply. This project is economical, where this is available for small solar power set up. We are programming this robot using Atmega 328p micro controller. This micro controller here we can send

instructions to this controller by which we can control the operations of the solar panel cleaning robot.

S.No	Parameters	Existing system	Proposed system
1	Efficiency	50%	80%
2	Power supply needed	24 V	12 V
3	Cost	High	Low
4	Controller	Not used	Pic

Table. 3 Comparison of proposed system with existing system.

VII. FUTURE SCOPE

- The device that is developed, reduces the number of workers needed to clean the arrays significantly.
- Further development could be done to optimize the system to be smaller, lighter and easier to assemble in higher volumes and to become more user-friendly.
- The next focus will be on diversifying the robot's functionality by including auto inspection, communication and self-diagnostic features.

VIII. CONCLUSION

The cleaning head is designed to clean while traveling both upwards and downward.The device developed significantly reduces the number of workers needed to clean arrays using limited resources and taking less time.

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