CONCEPTION AND DEVELOPMENT OF SELF-CLEANING ROBOT FOR SOLAR PANEL

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Abstract: As a result of the threat of climatic change and global warming to our planet's future, it has become critical to our future energy needs. Solar energy, as one of the renewable energy sources, plays a critical part in fulfilling our goals' increasing electrical energy demand. Solar panels are one of the most cost effective and low maintenance means of generating electricity because they did not have any moving parts. When undesirable impediments cover the surface of solar panels, they lose a significant amount of power. To maintain the entire system clean and efficient, a water-free solar panel cleaning robot is used. Cleaning brushes, rather than water, are used in this technique. Sensors are used to sense the dust level by examining how much frequency level of dust is present on the solar panel. The complete system is programmed into the controller. The dust level will be displayed on the blynk app once the dust reaches the certain level; it will automatically start to clean the panel. After the solar panel has been cleaned, the voltage and current values of the solar panel are saved in the blynk app in the Android mobile. With the help of IoT the mechanical setup and blynk app are connected via Wi-Fi module. When compared to the standard setup, the power generating efficiency will be improved.
Keywords: Arduino, Brush, DC motor, Dust effects, Power source, Solar panel

I.INTRODUCTION

Robotics is quickly becoming one of the most advanced fields in modern science. Majority of the industrial robots are autonomous as they are required to operate at high speed and with great accuracy. Nowadays, greater sources of renewable energy are available by replacing limited resources of oil and coal with abundant natural resources. The most popular option would be the sunlight energy that is obtained from the solar panel or solar cells. Although the use of solar panel to reduce energy consumption is simple and saves a lot of electricity. Solar panels in highly polluted areas witnessed a substantial loss in efficiency due to atmospheric pollution alone, according to researchers. When these two impacts are combined, a solar panel in a very polluted area that hasn't been cleaned in a month or longer could experience a significant decline in total efficiency. It's critical to note that shadows, snow, extreme temperatures, dirt, and bird droppings have an effect on solar panel efficiency. First of all, there is the accessibility problem. Because photovoltaic panels are often located on hazardous and hard to achieve areas, it may be difficult to manually wash them and it requires time to do it securely. Secondly, cleaning a panel only once a year may not have an important effect on the annual energy output. Especially hiring the manpower for cleaning the PV panel is difficult task now a day. To overcome above problems regular cleaning of panels is required which can be done by robot technology instead of humans. It increases the panel efficiency by cleaning uniformly. The primary aim of the paper is to develop an autonomous and reliable cleaning method without using water and low energy consumption to provide maximum panel efficiency. The developed system will be able to monitor the power production and clean the PV surfaces as soon as required in real time using mobile app.

II. PROBLEMS AND ITS ELUCIDATION

A. Existing System

All other existing system can provide surveillance, and they can move autonomously by sensing the surrounding conditions. There are certain systems which can sense objects and physical things but not the environmental conditions.

B. Drawbacks of Existing System

- ❖ Most systems were designed for cleaning the solar panels which are placed in the water bodies.
- ❖ Large amount of human assistance is necessary; hence labour costs will be expensive.
- ❖ Water and trash utilization are significantly higher with these systems.These robotic devices demanded a large upfront expenditure. So, it is not the best choice for a residential system.

C. Proposed System

The suggested project intends to create a robot that can clean PV panels by employing a cleaning brush that can sense the size of the panels and adjust the robot to clean them. To incorporate IoT technology to the Autonomous robot to monitor and control the cleaning process of the solar PV panels. This paper aims to develop the self-powered, automatic, cost effective and energy efficient robot for cleaning the Solar PV panels. The suggested system is made up of two components: a robot and a Blynk server. Robot performs the cleaning of the Solar PV panel remotely controlled by the blynk app at the receiver end. Blynk was created with the Internet of Things in mind. All communications between the smartphone and hardware are handled by the Blynk server. It's open-source, can easily manage thousands of devices, and can display, store, and visualize sensor data.

III. METHODOLOGY

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 the figure1. The primary element of the paper is input mechanism, which includes each of the Android control switch unit, IR sensor and sensors of voltage and current. This information and data later send to the second element, which is an Arduino Uno microcontroller that integrated by using the Arduino IDE. The last element is the output source consists of DC-motor for controlling robot movement, and Wi-Fi module integrate with android apps to test the level of both voltage and current.

Table 1:
Hardware required for the development of paper

| Hardware Specifications	Quantity
Limit Switch	4
Cleaning Brush	1
Stepper Motor	1
L298N Motor Drive	1

Table 2:
Software required for the development of paper

Software Specification	Software Name
Software code Monitoring cleaning robot	Arduino IDE Blynk app

A limit switch is an electromechanical device that is activated by an object's physical force. Limit switches are used to detect the presence of something such as object. A stepper motor is a brushless DC electric motor that divides a whole rotation into a set of equal steps. The L298N is a type of a motor driver with two H-bridges that allows for controlling the speed and direction of two DC motors simultaneously. The module can supply DC motors with electricity, peak voltages ranging from 5 to 35V and current up to 2A.

According to preliminary collected data and information during the design stage, appropriate elements and software are selected. For the hardware component, the Arduino Uno microcontroller is chosen as system development panel, which play a centric and a crucial role in monitoring other elements function like: motor driver, sensor of voltage and current and cleaning brush. Meanwhile the software component is Arduino software utilized for coding and programming of the system.

Blynk software connects the Android to the microcontroller. Cleaning should be done on demand and with the bare minimum of needs. It functions as an auto cleaner mounted on a solar PV panel. Also, it consists of brush, electrical D.C. power for driving the system and the effects of accumulated dust on the solar collector surface will be investigated by analyzing data from sensors and microcontrollers in a dusty environment. Hence, this cleaning system works depending on the electrical power of the PV solar panel in case of dust accumulation.
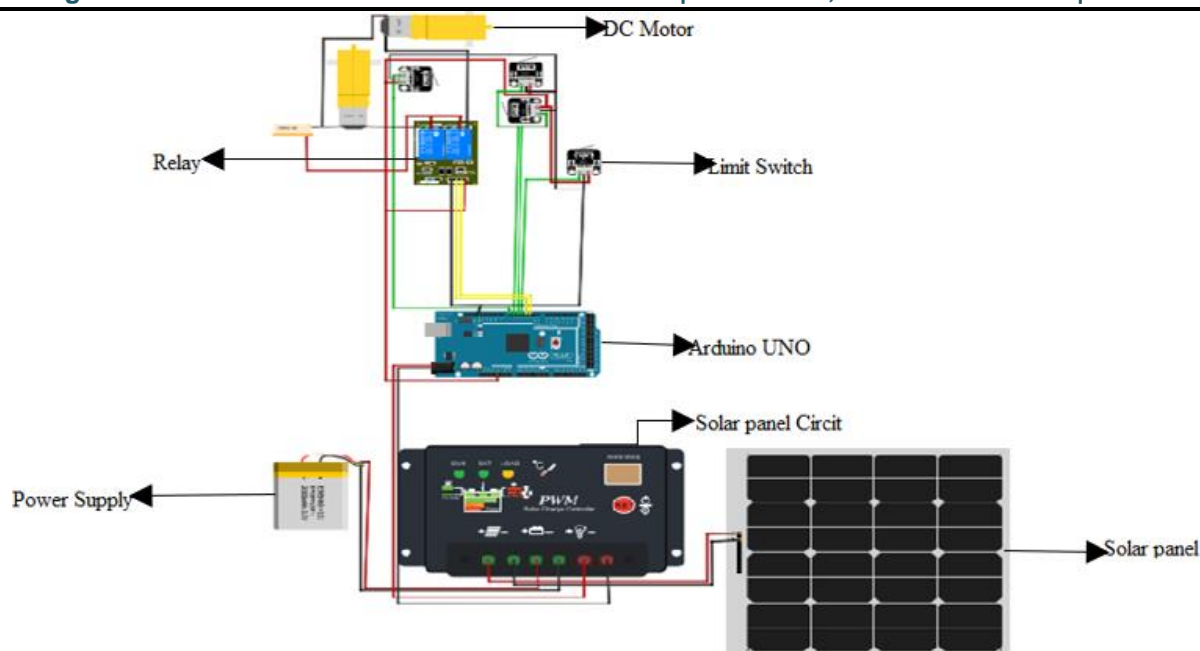
Circuit Diagram of proposed system connection consists of Solar panel, DC motor, Limit switches, Arduino Uno Board and power source as shown in the figure 2.

IV. RESULTS AND DISCUSSION

With the use of an IR sensor, the robot identifies the panel's dimensions and moves the bot accordingly. Mobile robot was tested and approved its suitability in cleaning solar panel where it expressed good mobility and capability of passing over the PV panel effectively completed. The cleaning procedure is carried out by the cleaning robot. The operation involves forward and backward motions along the rail, which are controlled by an Arduino software. The cleaning brush likewise effectively turned and clean the hindrance like residue and dry leaf all through the procedure. The robot is controlled and monitored via the Blynk application. With the help of the blynk application, the wiper on the panel can be adjusted. It has been discovered that when a panel is cleaned manually, the electricity generated is lower than when the panel is cleaned using a robot. The suggested Robot will boost solar energy production for huge solar facilities.

Figure3 depicts the proposed system's connectivity arrangement. It is made up of driving motors, a cleaning brush, and a panel. Figure 4 shows an overview of the blynk app. It enables us to design incredible user interfaces for our projects using various widgets we provide.

V. CONCLUSION

Due to dust collection on the panel, the amount of solar energy produced is reduced. By blowing air across the panel, the proposed Solar PV panel cleaning robot intends to eliminate Cleaning was done using a cylindrical brush. The Blynk app is used to track the robot's movements, and the robot is self-powered by a solar panel and batteries. When compared to manual cleaning, it has been discovered that solar plants have boosted their power generation and production. The manual changing of the robot from one row to the next will be avoided. The suggested system's goal is to solve these issues and improve solar power generation efficiency.

VI. FUTURE SCOPE

The technology that is being developed dramatically reduces the number of people required to clean the arrays. More work might be done to improve the system and make it more efficient. Smaller, lighter, and simpler to construct in large quantities as well as making it more user-friendly. The next point of emphasis will be on adding auto-pilot to the robot's capabilities to broaden its capabilities features of inspection, communication, and self-diagnosis.

VII.REFERENCES

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