IOT Based Solar Panel Cleaning Robot

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Abstract- **The present invention discloses an Internet of Things (IoT) Based Solar Panel Cleaning Robot, aimed at enhancing the efficiency and performance of solar panels by implementing an automated cleaning system. The system utilizes cutting-edge technology, including IoT modules, sensors, and controllers, to detect and remove dust and specks from solar panels. The automated cleaning process is triggered based on predefined parameters, improving power output and reducing the need for manual intervention. The burgeoning demand for sustainable energy sources has intensified the focus on solar power systems, underscoring the necessity for optimizing the efficiency of solar panels. One critical factor affecting the performance of solar panels is the accumulation of dust and particulate matter on their surfaces. Manual cleaning processes are labor-intensive, time consuming, and often impractical, especially in large-scale solar power plants. In response to this challenge, we present an innovative solution: an Internet of Things (IoT)-Enabled Solar Panel Cleaning Robotic System.**

Index Term-IOT, Solar Panel, WiFi Robot, Controller.

I. INTRODUCTION

As the world advances towards the industry 4.0 revolutions, automation has become a vital support system for several organizations. Solar panel farms in most tropical countries have a great deal of dirt and dust. One of the numerous factors that impact the efficiency of solar panels is the presence of dirt and dust on panels, which may reduce the amount of energy generated in plants. Using IOT module for solar power systems containing a Wi-Fi module. It helps our efforts to restore dependable electricity from solar power plant by keeping a watch out for issue dust accumulation that affects output, and other variables that might affect solar energy production. Consequently, we present an internet of things (IOT)-based automated solar panel cleaning Robot system that allows to clean the solar panel periodically.

We deploy a system based on a IOT module to monitor the functioning of the solar panel array. This solar panel monitoring system maintains a continual check on the panels and transmits information about their power production to an internet of things (IOT). Here, we transfer solar power parameters to the IOT WiFi server via the internet using WiFi Robot app. A streamlined user interface enables us to display this value to the user and trigger an alert if the output unexpectedly drops. An automated cleaning process will activate when output parameters fall below a particular threshold. In order to increase the efficiency of power production, frequent cleaning is necessary. The wiped clean the dust automatically at specified intervals. The system utilizes a controller circuit to driven dc motors to clean the panel. Across various areas and varying particle sizes due to local conditions, specific dust forms can be washed. However, owing to the question of usability of panels, washing solar panels are not straightforward. Solar Panel modules are found in environments with extreme temperatures such as in desert zones, and it is risky and hard to touch manually, too, to clean the solar panels. With solar panels, the glass may be permanently impaired, and its toughness may also be reduced. Therefore, a program that can clean the panel array automatically is a safer way to create. Since the dust density sensitivity is the main parameter in the solar panel module's electrical parameter, the automated cleaning mechanism is needed to extract the dust particle layer from the solar panel surface to boost performance.

II. NEED OF PROJECT

Because the cost of electricity is growing and fossil fuels have an environmental impact, environmentally friendly energy sources are needed. The key form of solar electricity is used primarily by the reflection of sun rays on solar panels. Dust deposition on a single panel reduces their energy output. Therefore, the

surface of the panel must be kept clear. Present work-based solar panel cleaning processes are expensive in terms of time, water and energy usage and are deficient in automation. Therefore, we will create an automated cleaner that can quickly travel onto the panel glass surface to increase performance.

- Design a solar panel cleaning system which can increase the efficiency of solar panels.
- Increase the use of solar panels.
- Make the cleaning of solar panels simple and automated.
- Minimize human intervention.
- A cleaning system that does not affect the quality of the original solar panel.
- An environmentally friendly cleaning system.

III. LITERATURE REVIEW

Literature Survey

Solar energy is the future of power generation due to its renewability nature. It has gained a wide acceptance across the world. Many research works are going on to harness the maximum power from sunlight, but few of the main hindrances in harnessing maximum power are dust accumulation on solar panels and air pollution, which cuts solar cell energy output by over 25% - 40% in some portions of globe in which one among tropical countries like India. This proposed paper describes the implementation of a Smart Solar panel cleaning system with primary focus on making use of Internet of things (IoT) technology. This enables dust monitoring capability, advanced analysis and system control which prompts to increase the total efficiency of the solar PV panel.[1]

In these days, the world is heading to use endless power sources like solar power, wind power etc. In order to gain energy from these resources we need some devices that convert this natural power to electricity or fuel. However, these devices like solar panels or generators need maintenance and sometimes special conditions to work these conditions are not neutrally available all the time. Our project comes to break the challenges which are faced by one of these devices which is solar panels. The main challenge for this device is dirt and dust or any climate condition so our role is to make it efficient whatever the weather is.[2]

Solid particles impair the performance of the photovoltaic (PV) modules. The results in power losses that lower the system's efficiency also decrease the life expectancy of the panel. An Internet of Things (IoT) based system was made to monitor, detect dust accumulation, and a cleaning system that would automatically wipe the dust on the surface of the PV solar panels. Using a specific dust sensor, it detects and monitor the amount of dust in the panel. As the dust accumulated reaches its limit, the cleaning system triggers automatically. The ambient temperature was monitored using the temperature and humidity sensor. The data will be received via internet using the Blynk app. The system will address the panel's dust accumulation problem as it was considered one of the biggest problems globally regarding solar energy reproduction.[3]

The internet is the exciting field in which the Wireless Sensor and Actuator Networks (WSAN) and ubiquitous application systems reach. The internet of things (IIOT) [4].

IoT developers have well-defined possibilities, issues, obstacles and the technological requirements for IoT, such as radio frequency identification, sensors, actuators, cell telephones, etc. Specific implementations of the IoT were created. The first fold encompasses the different systems that have so far implemented smart technology. The second fold offers a description of the devices and their requirements.[5]

IV. BLOCK DIAGRAM

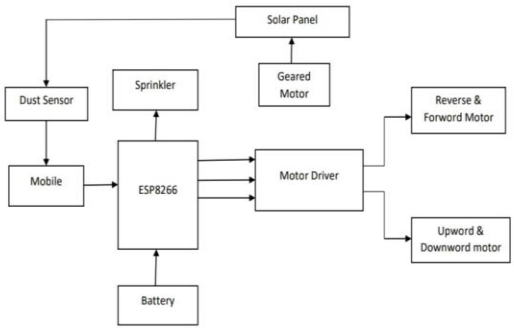


Figure 1.Block diagram

V. WORKING

Dust Detection and Signal Transmission: The operational workflow commences with the ESP8266 dust sensor actively monitoring the solar panel surfaces for dust accumulation. Upon detecting dust, the sensor sends signals to the ESP8266 microcontroller, indicating the need for cleaning.

Microcontroller Processing and Activation: The

microcontroller processes the signals received from the dust sensor, interpreting the extent of dust accumulation. Based on predefined parameters, the microcontroller activates the relay module to engage the DC motors for movement, cleaning brush rotation, and water spraying.

Robotic Movement and Cleaning Process: The activated DC motors drive the movement of the robotic cleaning system, ensuring it covers the entire solar panel surface. Simultaneously, the cleaning brush rotates to mechanically dislodge and remove dust, while the sprinkler nozzle sprays water to soften adhered particles.

WiFi Robot App Control and Monitoring: The WiFi Robot app serves as an interface for users to remotely monitor the cleaning process and exercise manual control if required. Users receive real-time notifications about the system's operations, enhancing transparency and facilitating timely intervention.

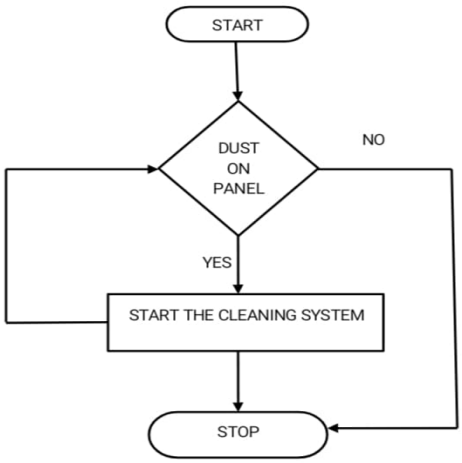
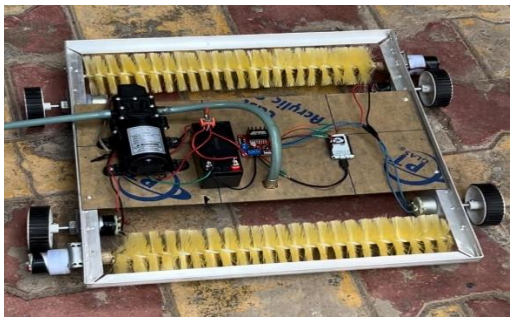


Figure 2.Flowchart

VI. RESULT

Motor are connected to the microcontroller and the robot is made. Fig 3. Shows the system hardware and IOT control screen of the system. This robot via a solar panel is cleaned.



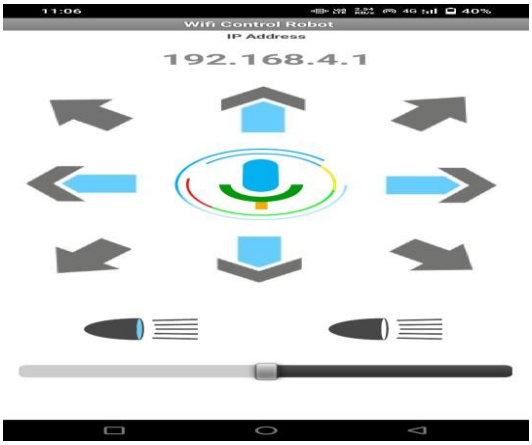


Figure 3. Image of the Hardware set up and IOT control screen.

VII. CONCLUSION

The development of the IoT-Enabled Solar Panel Cleaning Robotic System represents a confluence of technological innovation, environmental stewardship, and economic pragmatism. The evolutionary journey from manual cleaning processes to automated systems, and finally to the integration of IoT technologies, underscores the dynamic nature of solar panel maintenance. The proposed invention transcends the limitations of conventional cleaning methods, offering a scalable, intelligent, and user-friendly solution to the pervasive issue of dust accumulation on solar panels. As the global transition towards sustainable energy intensifies, the IoT-Enabled Solar Panel Cleaning Robotic System stands poised to play a pivotal role in enhancing the efficiency, longevity, and economic feasibility of solar power systems worldwide.

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