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Internet of Things Based Monitoring and Cleaning of Dirt and Dust in Solar Panel

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Abstract:
The goal of the work carried out here is to make life better for people who use solar panels. It provides an open and honest dust and speck removal system that makes use of cutting edge technology that has improved performance with less cost and scalability. By implementing this method, the cleaning system provides greater power output than a dirty solar panel. By implementing this method, the number of people needed to clean solar panels can be reduced. This module automatically cleaning and washing solar panels. Manual washing of solar panels is a difficult and time consuming task. In this method, a timer system is introduced and that uses water and wipers to clean solar panels. The solar panels can be monitored using Internet of Things (IoT) technology. Sensors and microcontroller will undoubtedly handle system management. This module sends the customer a notification message about the various processes that have been run. This module can be made transportable so that it can be deployed in a variety of functions and settings.

Keywords: IoT, Solar Panel, Sensors.

Introduction

The utilization of solar energy through photovoltaic (PV) panels has emerged as a promising solution to meet the ever-growing demand for sustainable and renewable energy sources. However, the efficiency and performance of solar panels are significantly influenced by external factors such as dust, debris, and environmental conditions. Accumulation of dust and specks on the surface of solar panels can obstruct sunlight absorption, leading to reduced power output and efficiency. To address this challenge, the development of an efficient and reliable cleaning system for solar panels is imperative. Traditional manual cleaning methods are labour-intensive, time-consuming, and often inefficient, necessitating the need for automated solutions that can optimize cleaning processes while minimizing human intervention.

In response to this need, the Smart IoT Based Solar Panel Cleaning System aims to revolutionize solar panel maintenance by leveraging cutting-edge technology and IoT integration. By automating the cleaning process, this system not only enhances the efficiency and performance of solar panels but also offers cost-effective and scalable solutions for both residential and commercial applications. This work seeks to introduce a comprehensive cleaning system that not only improves the performance of solar panels but also ensures transparency, reliability, and convenience for users. Through the utilization of IoT technology, users can remotely monitor and control the cleaning operations, thereby enhancing usability and accessibility.

Literature Survey

In their work, Writer [1] elucidates the process of preparing for a tailored, low-power, self-sufficient Industrial Internet of Things (IoT) controller that is specifically designed to clean photovoltaic (PV) boards. The controller, which is distinct from the control treatment of the mechanical device, has been designed to enable remote monitoring via the Internet.

The author in reference [3] elucidates that the impact of destruction or deposition is a crucial examination in the utilization of photovoltaic or PV technology. In reference [3], the author presents a methodology for achieving autonomous operation of a robotic vehicle through the use of photovoltaic technology for cleaning purposes. The Digital Robot Experimentation System is employed to showcase a PV control terminal, with the Robotic Operating System (ROS) being utilized for vehicle control calculations. This text presents specialized information about mapping, restriction, establishment of means, and avoidance of acquisition.

The author(4) initiates the discussion by pressing the adverse impact of residue accumulation on solar panels, which significantly reduces t effectiveness of the factory. To address this issue, the author proposes the preface of a cleaning robot to enhance the performance of solar panels. The challenges faced by inventors in the conservation of solar panels are having an impact on the possessors of solar energy systems.

In their study, the authors [5] analyse crucial duties related to the performance outcomes, awareness, and mitigation of power issues arising from accumulation on a solar panel. The electrical characteristics of photovoltaic systems, namely voltage and current, are analysed for shading caused by the accumulation of dirt and debris. The act of shielding oneself from pollutants is categorized into two distinct forms: vulnerable shielding, such as protection against air pollution, and hard shielding, which occurs when a solid material, such as accumulated debris, obstructs sunlight. The outcome illustrates that the PV component is influenced by subtle colour variations in the present, while the voltage remains consistent with previous measurements. The performance of a photovoltaic (PV) module in challenging shading conditions is contingent upon the extent of shading, whether it affects only a few cells or the entire array of cells within the module.

The study conducted by the author (6) examines the being assessments on the influence of residue testament on the performance photovoltaic panels, specifically in the environment of PV. Likewise, the study identifies certain challenges that need to be addressed in o to further probe this area. The disquisition into the state of education has been divided into two distinct phases. The first phase encompass an analysis of exploration conducted between the 1960s and the 1990s. The alternate phase involves an assessment of exploration conducted after the 1990s. A offer table has been developed to prop in determining the applicable cleaning and conservation schedule for photovoltaic structures grounded on the prevailing climatic and environmental factors, given the cornucopia of information on insurance content. We will address the resolution of this matter by examining the techniques employed for the elimination of dirt through the utilization of the Internet of Things (IoT).

Objectives

- Enhance solar panel performance by up to 32% through automated dust and speck removal, ensuring optimal power output and efficiency.
- Minimize labour costs associated with manual cleaning methods by implementing a cost-effective automated system, thus offering a more economical solution for solar panel maintenance.

- Enable remote monitoring and control via IOT technology, providing users with easy access to manage the cleaning process through a dedicated Android application. Additionally, design the system to be easily scalable and adaptable to various settings, ensuring versatility and widespread applicability.

Proposed Methodology

Begin by analyzing the efficiency of solar panels through the measurement of current and voltage using appropriate sensors. By passing a light source to simulate varying light conditions and observe the response of the solar panels. Implement a feedback mechanism where low efficiency conditions are detected by observing a dim glow in the light source.

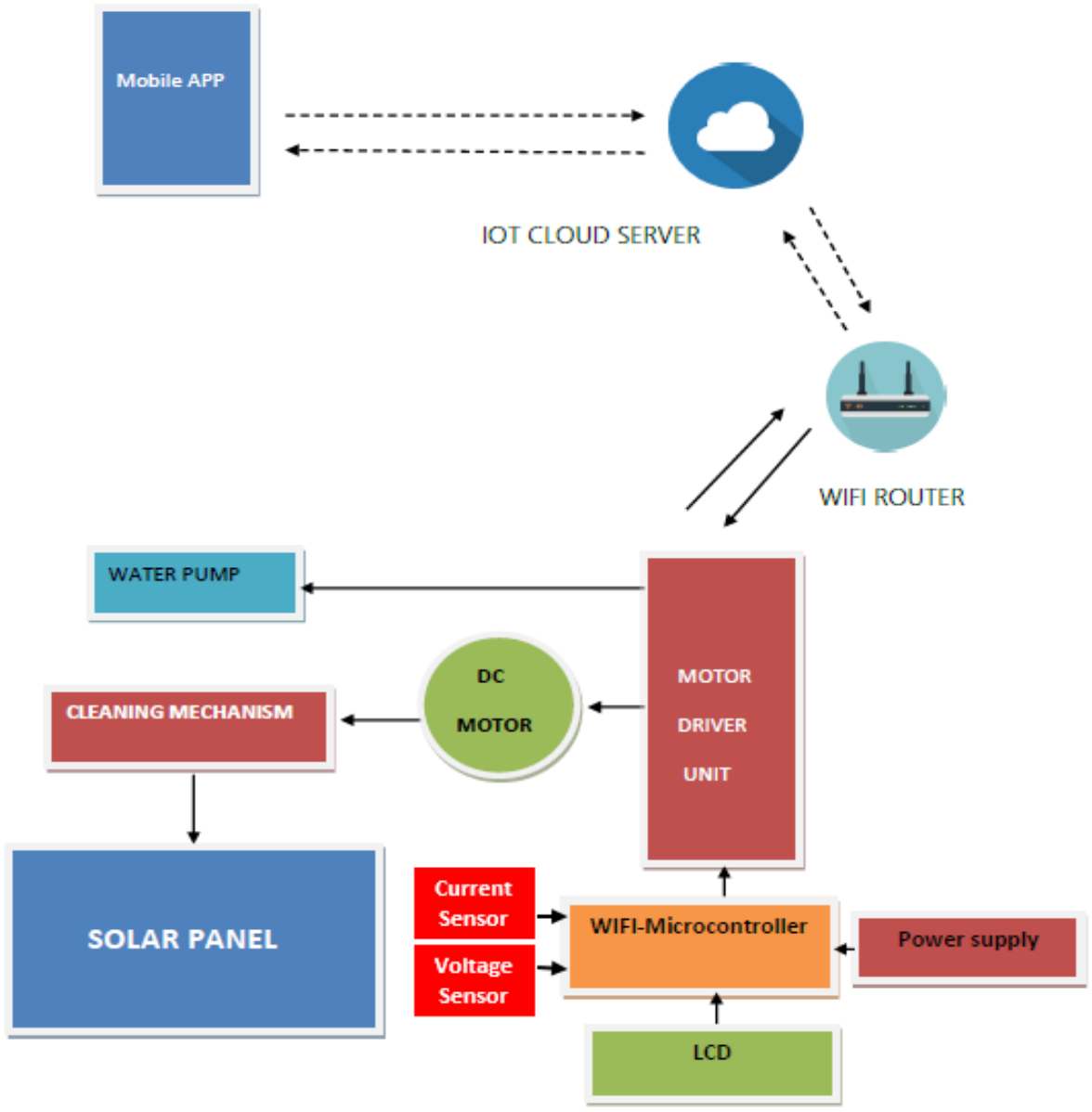

Fig.1.1 Block diagram

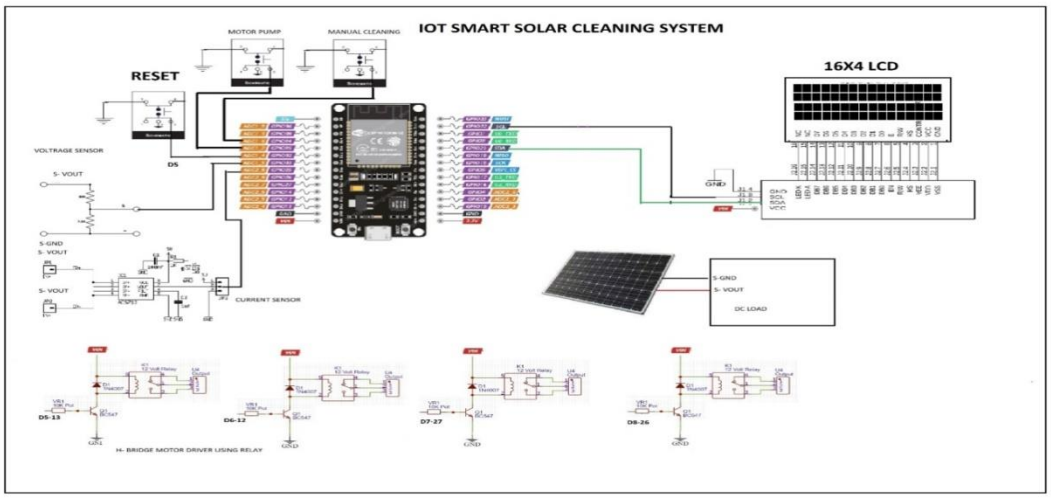

Fig.1.2 Circuit diagram

The above circuit diagram shows the IOT connected with solar cleaning system. Various parts of the circuit have been described.

Results and Discussions

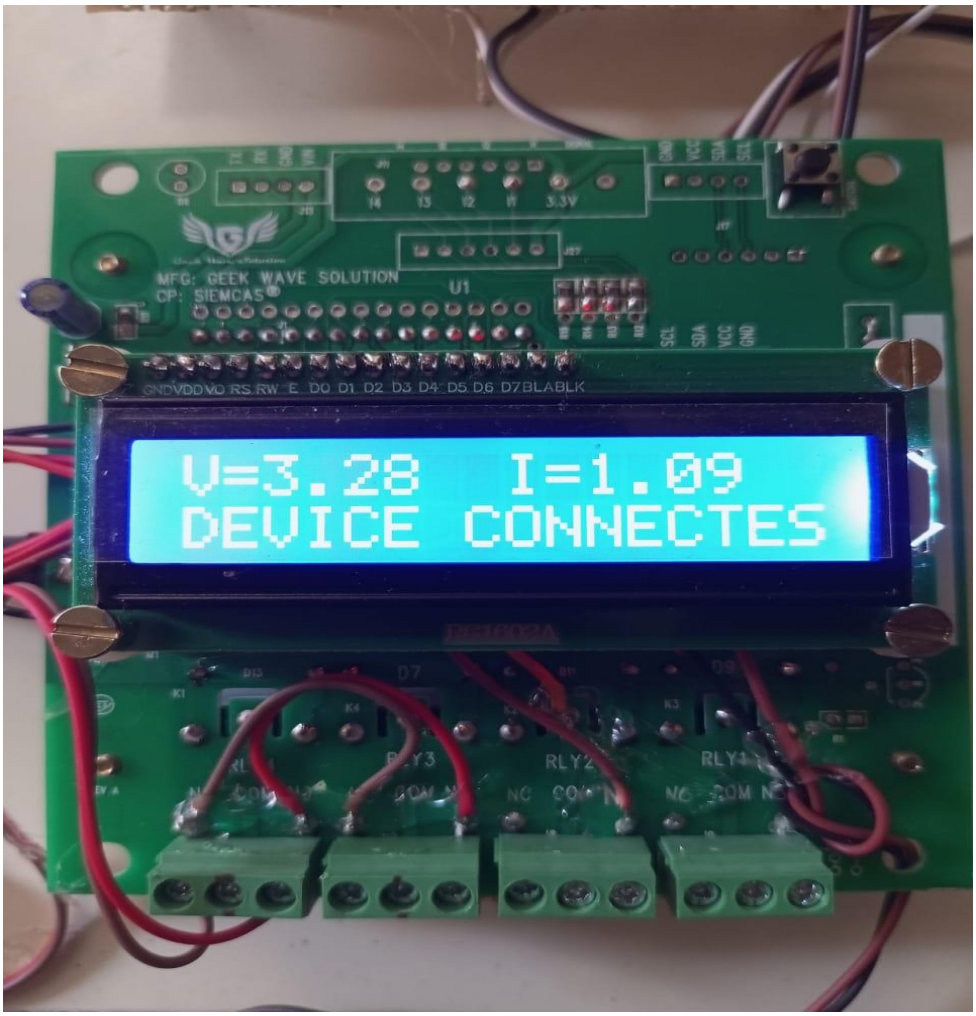

Fig.1.3 Prototype Model

The prototype model of IOT based solar cleaning system. The various functions including voltage and current measurement and pumps switching on and off.

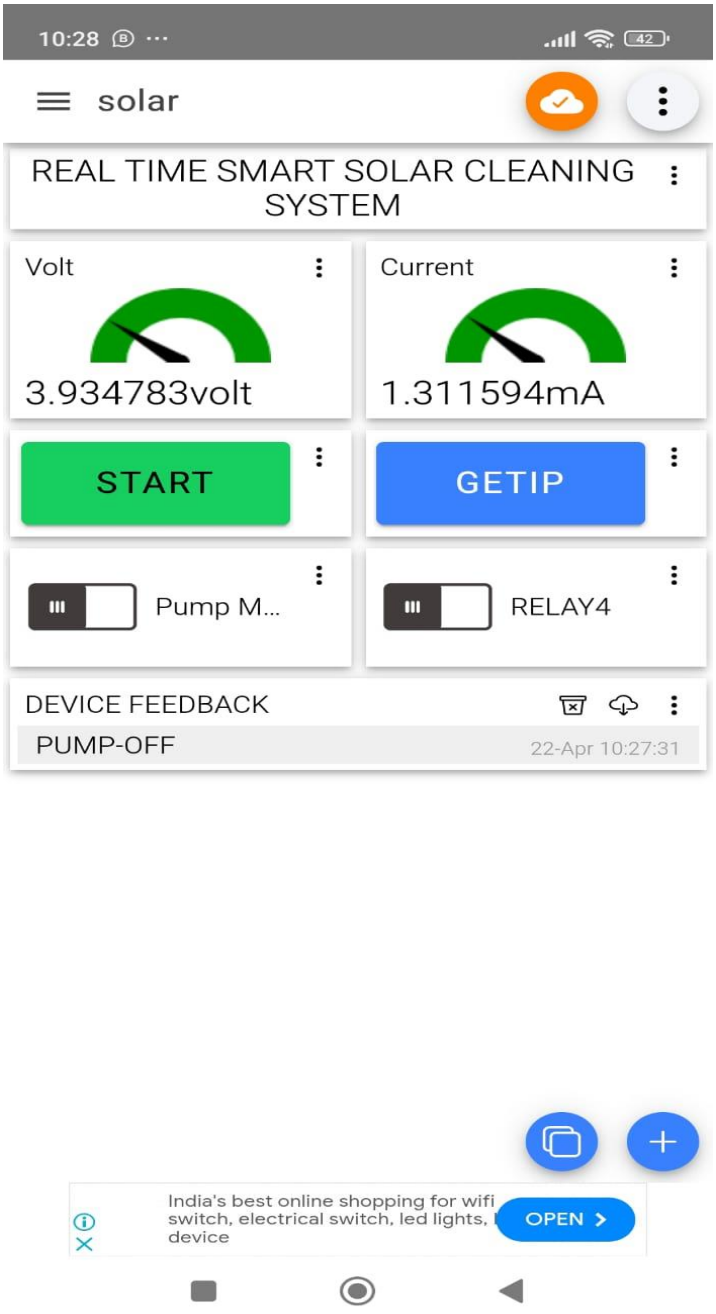

Fig. 1.4: Screen Shot of Mobile Display Output 1

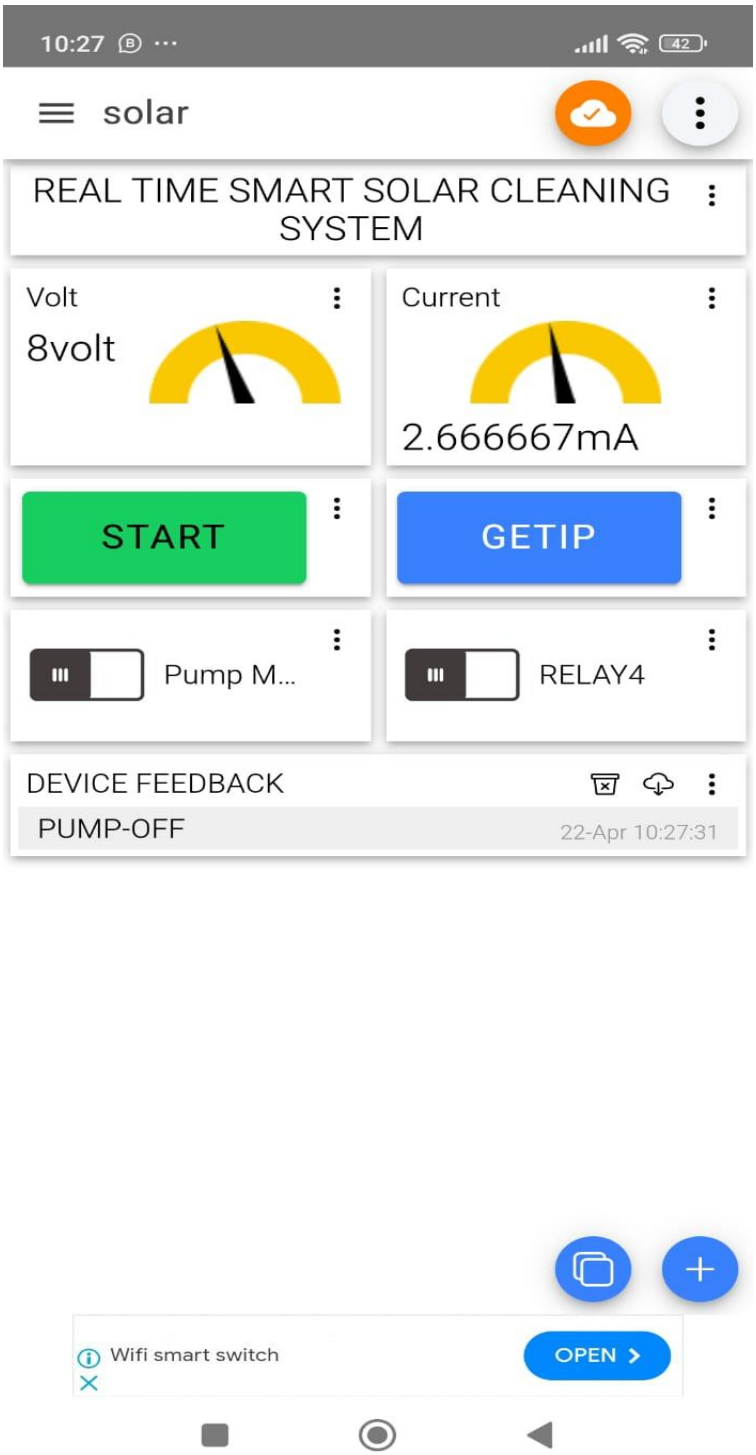

Fig. 1.5: Screen Shot of Mobile Display Output 2

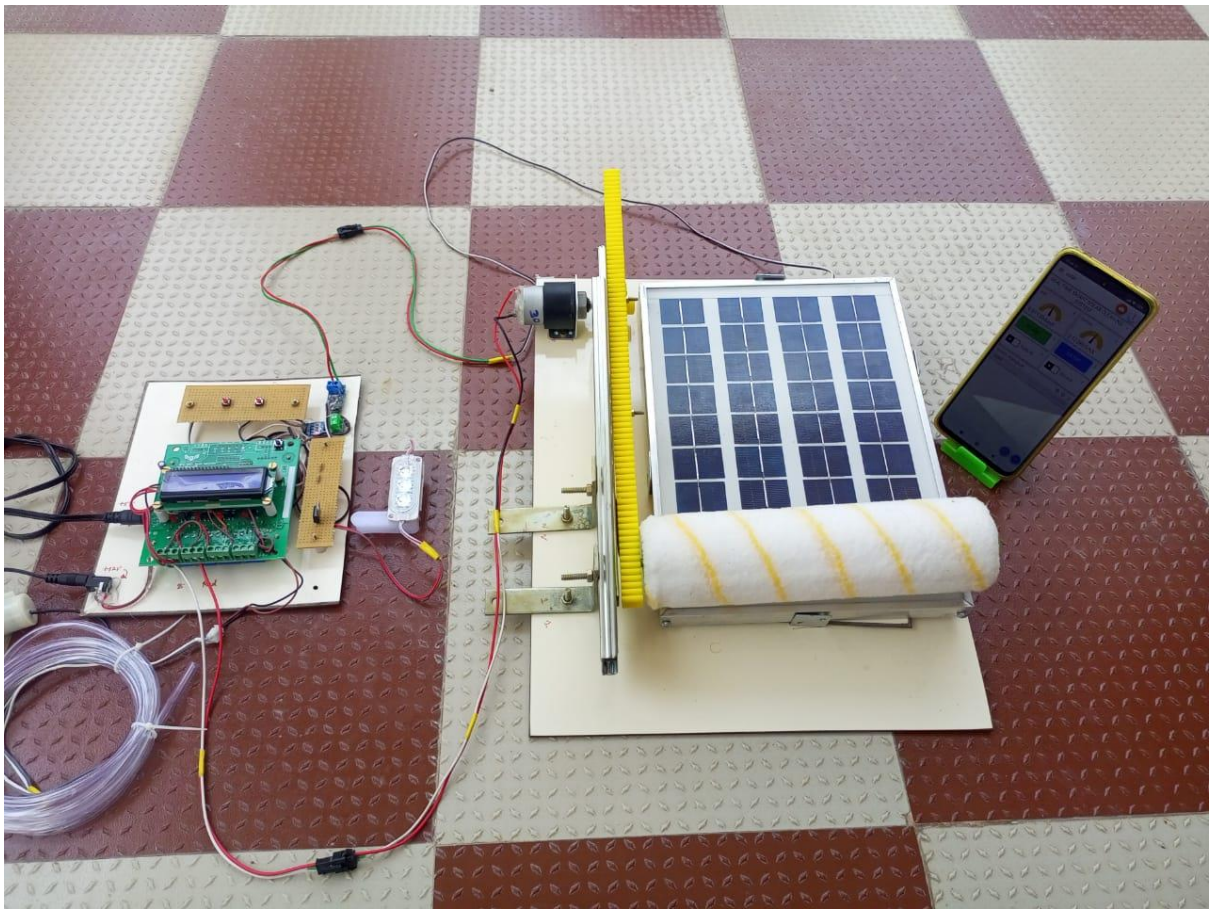

Fig.1.6. Product Module

Conclusion

The limitations of traditional processes for cleaning and maintaining solar panels underscore the importance of innovation and advancement in renewable energy technologies. Manual labour-intensive methods, inconsistent cleaning outcomes, safety concerns, limited accessibility, environmental impact, dependency on weather conditions, and inadequate monitoring and control capabilities highlight the need for more efficient and sustainable solutions. The Smart IoT Based Solar Panel Cleaning System represents a significant step forward in addressing these challenges. By leveraging cutting edge technology such as IoT integration, automated cleaning mechanisms, and real-time monitoring systems, this work offers a comprehensive solution for optimizing the performance and maintenance of solar panels. Through the implementation of advanced sensors, microcontrollers, and communication protocols, users can remotely monitor and control the cleaning process, ensuring timely and efficient maintenance. Moreover, the integration of IoT technology enables data-driven decision making, allowing for proactive maintenance strategies and enhanced performance optimization. By overcoming the limitations of traditional processes, the Smart IoT Based Solar Panel Cleaning System project contributes to the advancement of renewable energy technologies and the transition towards a cleaner, more sustainable energy future. With its potential to improve efficiency, reliability, and sustainability in solar panel maintenance practices, this project embodies the innovative spirit driving progress in the renewable energy sector.

In conclusion, the Smart IoT Based Solar Panel Cleaning System holds promise for revolutionizing solar panel maintenance practices and maximizing the energy generation potential of solar PV systems.

By addressing the limitations of traditional processes, this work paves the way for greater efficiency, reliability, and sustainability in the utilization of solar energy resources.

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