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Performance Improvement of Solar Panel and Design of Parameters Monitoring

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ABSTRACT

We are providing the transparency in cleaning system by using the most newly invented technology, which provide a better performance, integrity, consistency, cost-effective and scalable solution for the removal of dust and speck. The presented cleaning system provides more energy output compared to the dust accumulated solar PV. Also, this system reduces manpower for cleaning of solar panel. This is automatic solar panel cleaning system with Digitalised monitoring Using IOT. By using voltage sensor and temperature sensor we are majoring the voltage and temperature, the solar PV monitoring system has been integrated with a wireless platform that comprises of data acquisition, data processing and data transmission from various sensors through wireless data transmission. If any solar plate is damage it will give low voltage and can be easily detect in our mobile app which can be replace easily. This is the main aim of our project.

Keywords: *Solar PV, Sensors, Data Acquisition, Data Processing, Data Transmission.*

Introduction

Since the need for solar energy has risen around the globe, the development of an ad- vanced monitoring method has become an urgent necessity. Due to various environmental factors such as soiling, temperature, irradiance etc., the operation and functionality of solar PV systems can be affected. Thus, the accuracy and performance of the solar PV system can be improved by employing an efficient solar PV monitoring system.

Monitoring is the process of observing and recording the parameters from the solar PV power plant in real-time. An efficient monitoring technology of the solar PV system improves the performance efficiency as it provides updated information and executes the preventive measures if any flaws are found. The monitoring of the solar PV power plant is performed either at the module, string, or system level. The monitoring of the solar PV at the system level provides information about the system exclusively. The monitoring technology related to panels and strings helps in identifying the root cause of the problem precisely.

Fig1 Solar cleaning system

Every panel and string needs to be monitored for the overall efficiency improvement of a solar PV power plant, as even a change in the output from a single panel can affect the efficiency of the entire system. Henceforth, numerous monitoring methods have been introduced in recent decades. There has been a change of trend from wired to wireless monitoring systems in the past decade.

If the solar panel is not cleaned regularly, then the dust in environment accumulates on surface of the solar panel and decreases Efficiency.

To address this issue: a fully automated, cost worthy and efficient system needs to be developed. This system seems to be implemented on solar panels present in Large Scale. This project is developed for the betterment of the solar panel users.

The presented cleaning and Monitoring system provides more energy output compared to the dust accumulated solar panel. Also, this system reduces the manpower required for cleaning of solar panel and Helps in efficiently Monitoring of panel.

Proposed Methodology

1.Design Of Parameters Monitoring Of Solar Panel

A comprehensive review of various data processing and data transmission modules for a solar PV monitoring system has been performed which gives an insight into its implementation, design, specifications, used software, and limitations. In our project, we are using Node MCU ESP8266 for data processing and data transmission.

Voltage sensor would be connected to each and every solar panel to determine the voltages. Voltage sensors are connected to Node MCU. Then the collected data would be send to Node MCU ESP8266.Which will then upload the data to blynk app server by using WiFi and we would be able to monitor the data.
We have temperature sensor connected to our node MCU to measure the temperature of surroundings. If the temperature of surroundings go above certain set level then the efficiency of solar panel get reduced which is undesirable For more efficiency we have to cool down the solar panel for that we have implemented sprinkler system in our project. Which ultimately reduces the temperature and

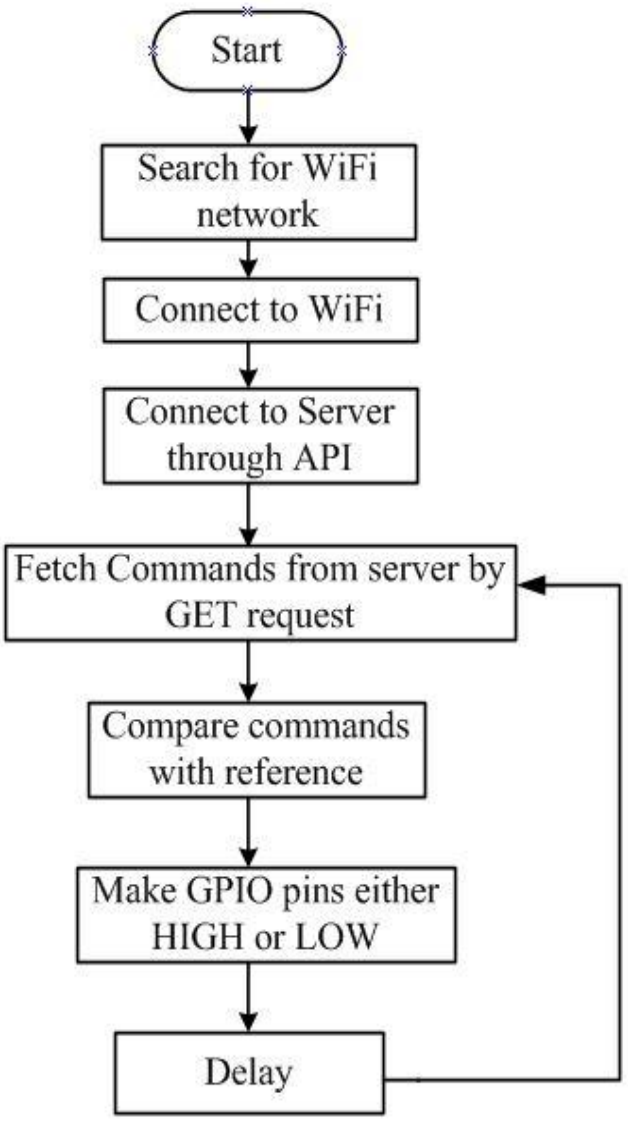


Fig.2: Flowchart of Node MCUESP8266

increses the efficiency.

In case if we see low voltge on our dashboard of blynk app this can be due to two reasons. First, due to more dust are accumulated on the plate which ultimately affecting the generating voltage. Secondly, that the solar panel is defective.

We will check whether our plate is defective or not. We will use our sprinkler system and compare the value of voltage before and after if there is no improvement then we will conclude that panel is defective and which can be replace easily.

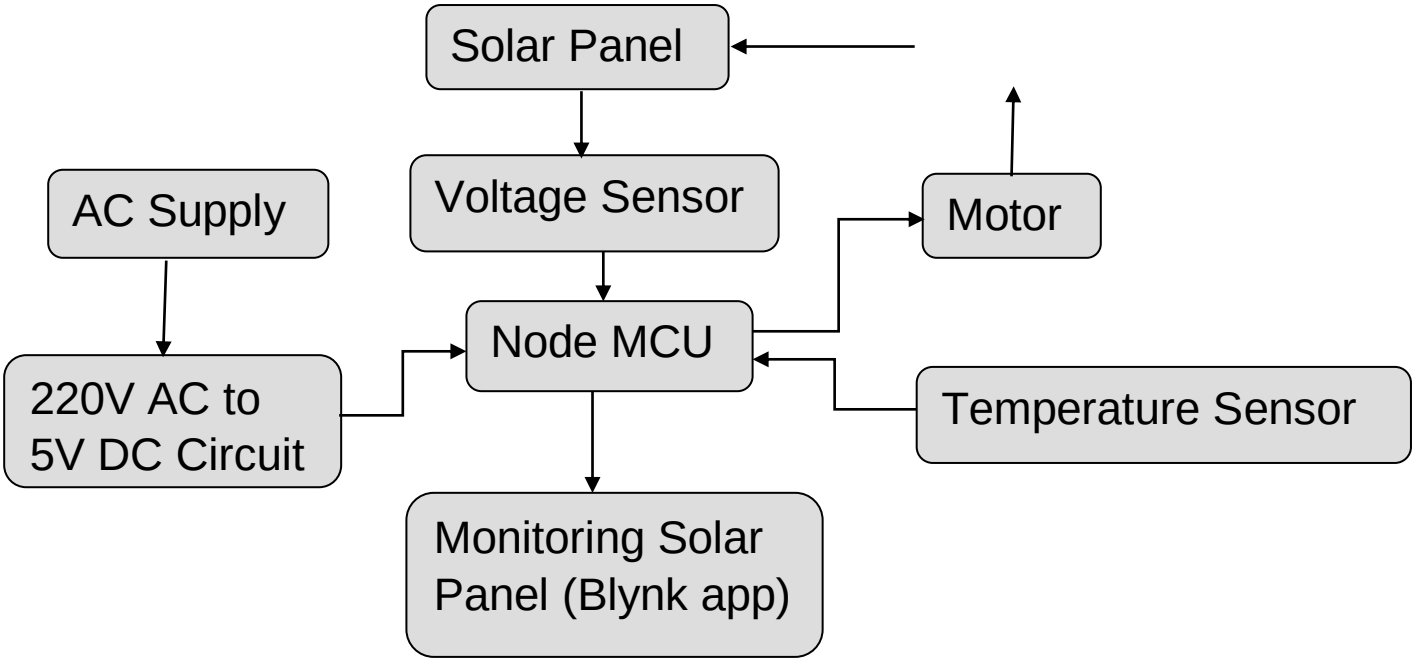


Fig.3: Block Diagram Of Proposed Work

Table1- Connection of Voltage sensors with ESP8266

Sr. No.	Voltage Sensors	ESP8266
1.	Vcc	$3.3V_{IN}$
2.	GND	GND
3.	Data Pin	D5

Table2- Connection of Voltage sensors with ESP8266

Sr. No.	Voltage Sensors	ESP8266
1.	Vcc	$3.3V_{IN}$
2.	GND	GND
3.	Data Pin	D6

Table3- Connection of Voltage sensors with ESP8266

Sr. No.	Voltage Sensors	ESP8266
1.	Vcc	$3.3V_{IN}$
2.	GND	GND
3.	Data Pin	D7

Table4- Connection of Voltage sensors with ESP8266

Sr. No.	Voltage Sensors	ESP8266
1.	Vcc	$3.3V_{IN}$
2.	GND	GND
3.	Data Pin	D8

Table5- Connection of Temperature sensors with ESP8266

Sr. No.	Temperature sensor	ESP8266
1.	Vcc	3V
2.	GND	GND
3.	Data Pin	D4

2.Performance Improvement of Solar Panel

The most widely available energy throughout the world is solar Energy. Within India solar energy industry, there is a general motto of "set it and forget it" with solar energy. This implies that maintenance and regular monitoring is not needed. Yet many things can go wrong to cause the actual performance to deviate from the expected performance. If failures and/or unanticipated degradation issues go undetected, they will lead to reduced energy generation (and associated electricity credits) and/or potential loss of component warranty because of manufacturer turnover. Solar panels are very durable, main warranties last for 15-25 years.

However, to notify the performance of distantly placed solar farm, to minimize the dependence on energy imports, the proper maintenance of solar panels is required. The power generated by the solar panel has to be monitored continuously. Furthermore, to add an automatic cleaning feature, we are Using Internet of Things technology, the power generation can be greatly influenced by means of its performance, monitoring and maintenance and for improving the efficiency by detecting the fault if present.

Cleaning solar panels is important to maximize the amount of light available to turn into electrical power. Making frequent physical inspections can help solar panels absorbing light effectively. If the solar panel is not cleaned regularly, then the dust in environment accumulates on the surface of the solar panel. This dust converts into a thick sticky layer due to morning dewdrops. As a matter of fact, gulf region – especially Saudi Arabia- are facing a lot of dust storms and the solar panels need to be cleaned frequently.

If task is performed manually, it will be very costly and time consuming. Water sprinklers shall be used in the conceived mechanism design to ensure quality of cleaning. To address this issue: a fully automated, cost worthy and efficient system needs to be invented.

This system seems to be implemented on solar panels present in Large Scale. This project is developed for the betterment of the solar panel users. In this project we are designing a cleaning system for a Solar panels, which can be operated automatically and it helps us to clean solar panels without any efforts. This system reduces human efforts, it saves time, it works automatically at a specified time. Overall, it increases the efficiency of the solar Panels.

3.Hardware And Software Details Of Proposed Work

a) Hardware Details

Table 6-Hardware components of proposed work

Sr. No.	Component Name	No. of components	Component Rating
1.	Solar Panel	4	9V
2.	Voltage Detection Sensors	4	0-25 V
3.	Temperature Detection Sensors	1	Operating Voltage= 3.5-5.5V, Operating Current= 0.3Ma
4.	Node MCU ESP8266	1	Operating Voltage= 3.5V
5.	Adaptor	1	I/P: 110-260V AC, 150mA, O/P: 5V, 1A DC
6.	LED	1	5mm dip
7.	Submersible Water Pump	1	3-6V
8.	Multiplexer Modul	1	Operating Voltage=(3.5-6)V
9.	Micro Switch	2	NA

Table 6 provides all the hardware components used in the proposed work along with their ratings.

b) Software Details

We have used the blynk cloud based platform for monitoring various parameters like voltage temprature, humidity and also controlling the pump. We have used gauge for displaying voltages and label for displaying temprature and humidity and sliding button for controlling pump. The data is first collected by all the sensors which is then send to blynk cloud using WiFi of Node MCU once the data is uploaded the data is directly visible on the dashboard.

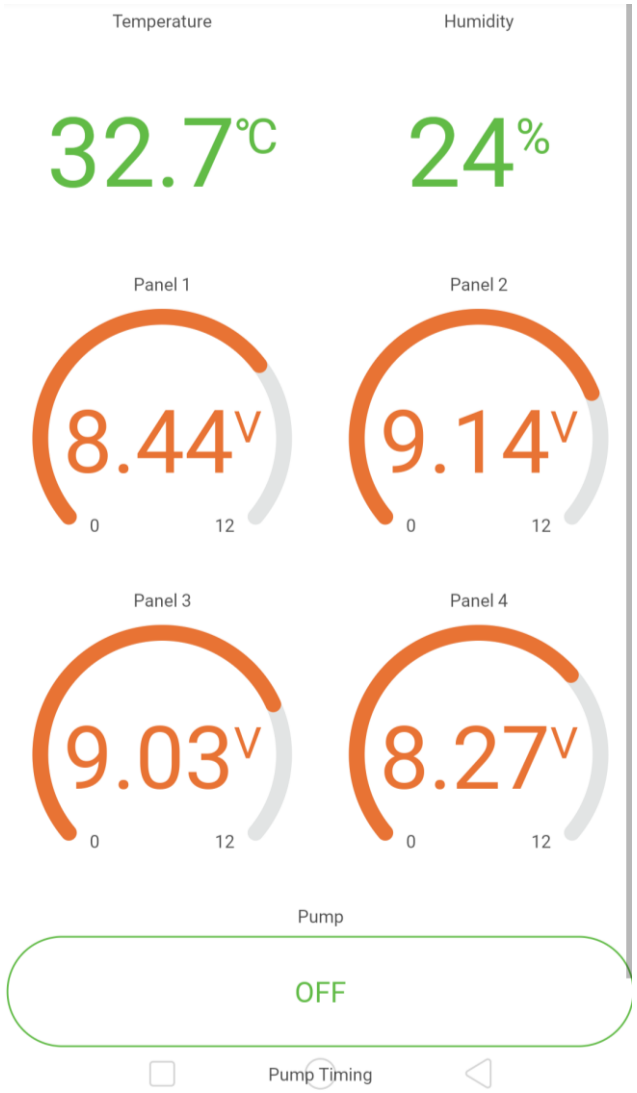


Fig4. Dashboard (Mobile App)

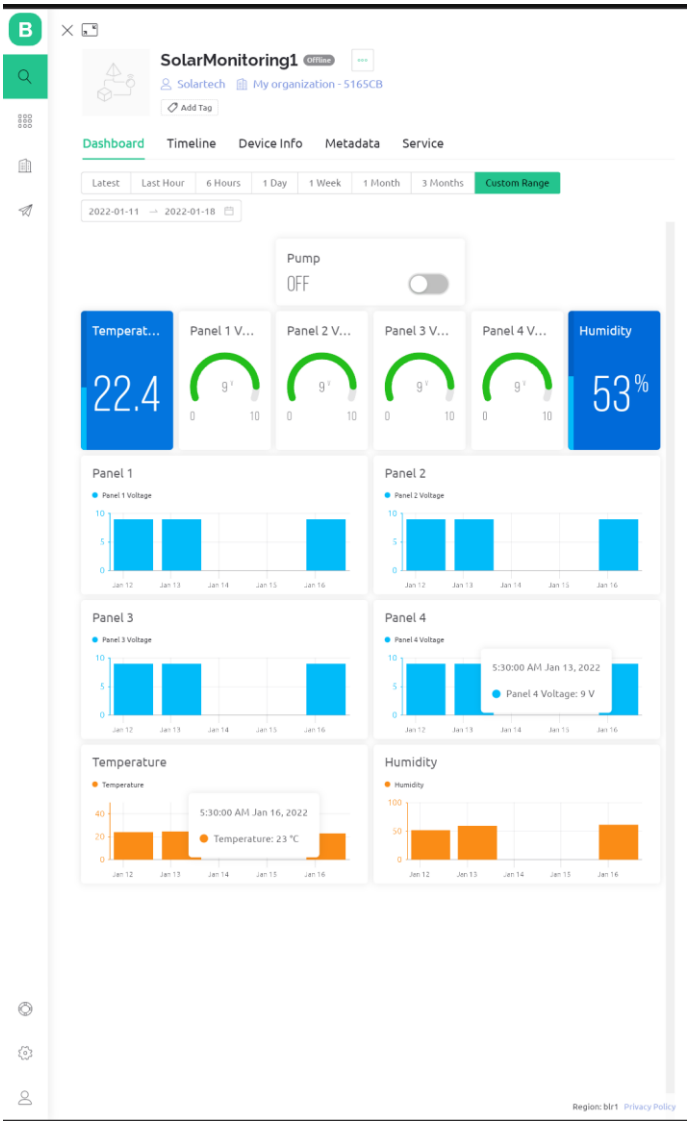


Fig5. Dashboard showing voltage (Laptop App)

Result

	Panel 1	Panel 2	Panel 3	Panel 4
1/02/2022	9.14V	9.04V	9.01V	9.12V
5/02/2022	8.63 V	8.33 V	8.42 V	8.32 V
10/02/2022	8.50V	8.45 V	8.31 V	8.40 V
15/02/2022	8.62 V	8.44 V	8.49V	8.22 V
20/02/2022	8.70 V	8.69 V	8.65 V	8.55 V

Table6: Voltages before cleaning

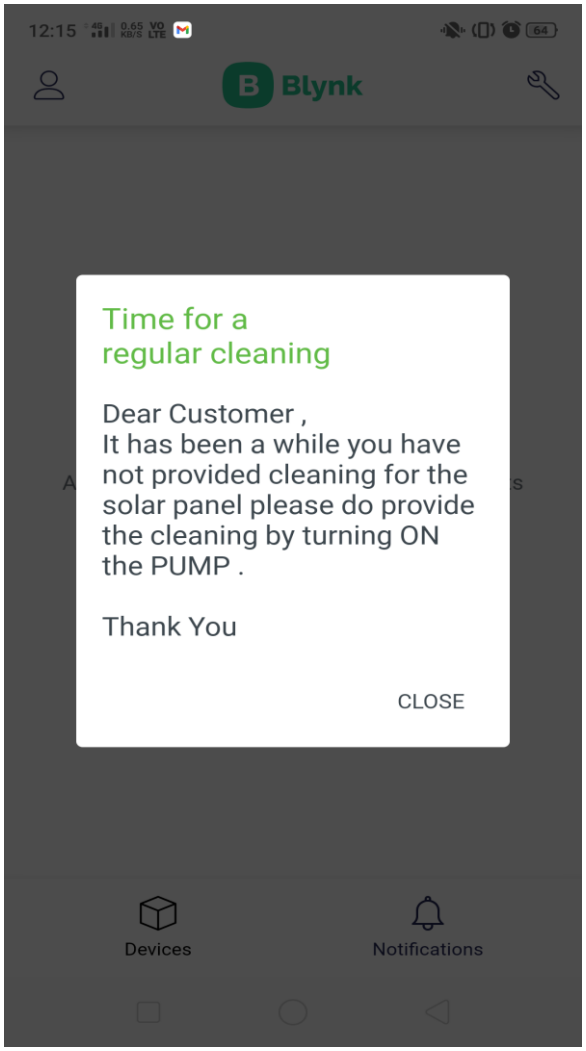
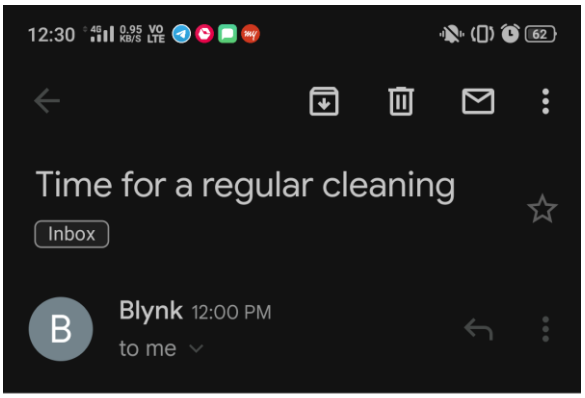


Fig6: Cleaning Reminder Notification displayed on users Gmail and Mobile App

	Panel 1	Panel 2	Panel 3	Panel 4
1/02/2022	9.14V	9.04V	9.01V	9.12V
5/02/2022	9.21V	8.89V	9.10V	9.13V
10/02/2022	9.12V	9.14V	9.04V	9.13V
15/02/2022	9.14V	9.13V	8.99V	9.01V
20/02/2022	8.96V	9.01V	9.10V	9.00V

Table7: Voltages After cleaning



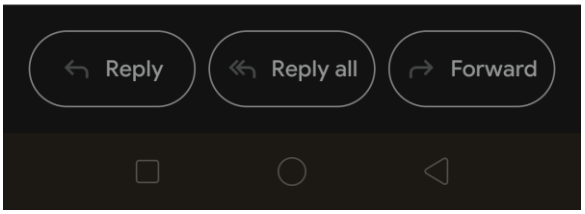


Fig7: Cleaning Reminder Notification displayed on users Gmail and Mobile App

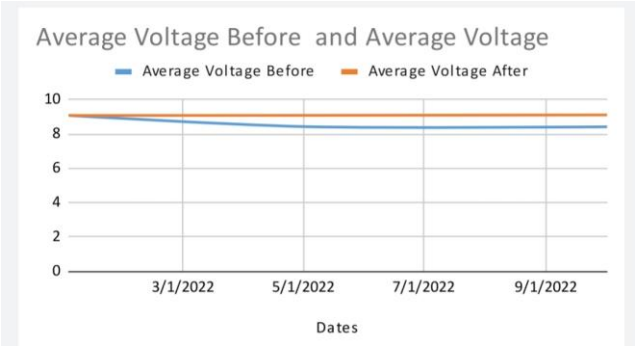


Fig8: Graph showing result

Conclusion

The review outlined a comprehensive exploration of various solar PV monitoring technologies based on the application of data processing modules and transmission protocols. In line with this, the review presented an overview of the monitoring and cleaning system.
Through this system, Users will be able to track, monitor and control these panels virtually to maximize electricity generation. Accompanying the monitoring system cleaner is installed in this system to improve the efficiency of the system. Prevention is better than cure as a result the cleaning action prevents the primary accumulating surface dust on the panels before it hinders the efficiency of panels to a greater extent. The critical analysis, discussion, issues, and recommendations will prove fruitful in sustainable development with regard to clean energy, emission reduction and economic prosperity. Further, the development of an advanced solar PV monitoring system could provide guidelines and encourage solar PV industries and researchers to perform further
research on IoT-based monitoring systems for large-scale solar PV applications.

Additionally, this review could assist in selecting the appropriate monitoring technology for the improvement of efficiency, accuracy, and robustness of solar PV systems towards increasing green technology and achieving decarbonization goals by 2050.

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