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Smart PV Solar System: A Review

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Abstract: *The monitoring and maintenance of the solar system poses an important problem in installation and using of solar panels. To increase the efficiency of the solar panels and to optimize the usage it is necessary to clean the system regularly. Along with cleaning the system it is also essential to cool the system as an overheated system results into reduced power generation. This overheating could result into power loss and could generate less energy which reduces the overall performance of the system. The proposed system takes these problems into consideration and provides a system which not only cleans the system but also monitors the temperature to cool down the system when necessary.*
Automating this system saves the valuable time and provides a regular and more thorough cleaning to the solar plates. This automated system also encourages the users to convert into using the solar energy as they don't have to clean and cool the system manually which at times could be tedious. This whole system also conserves the water which is used for both cleaning and cooling by merging both the functionalities together. This system is a step towards the sustainable future.

Keywords: Solar panels, cleaning, cooling, maintenance

I. INTRODUCTION

The problem definition of our proposed system is Solar plate Optimization and this system focuses on improving the solar panel performance by cleaning, cooling and monitoring the solar plates. The world is moving towards the better future rapidly and in doing so we need an undepletable and renewable energy source to meet our energy requirements. One such energy resource is solar energy which is available to us in abundant. A lot of institutions and households have started using the solar energy to fulfil their energy requirements but the amount of people using this energy resource is not what it should be. A lot of people still refuse to use the solar energy and the main reason behind this is the cost of maintain the solar panels.

Solar panels need to be cleaned regularly. It is recommended that we should clean the solar plates around four times a year. And the main problem behind this is the location where the solar plates are installed. The solar plates are mainly installed in the rooftops and other such areas where the human and animal interaction is minimum and sunshine is in abundant. This pose the problem while cleaning them as the place is dangerous to climb and may lead to accident and severe injuries.

The solar plates are mode to absorb the solar rays and convert them into the electrical energy but if the plates are not cooled regularly then this leads to heating problems. This heating problem reduces the efficiency of the solar panels and produces less energy as compared the solar panel which is been cooled down regularly. Manually cooling the solar panels is not only tedious but also quite difficult. The automated system which could cool down the solar panel is much needed to make the task of cooling easy and efficient.

We could combine the cleaning system and the cooling system to optimize the maintainence of the system. The proposed system uses the water to clean the dirt off the solar panels and similarly regulate regulate the temperature of the solar panel as well.

II. LITERATURE REVIEW

1. " Athena: A Mobile Based Application for Women's Safety with GPS Tracking and Police Notification for Rizal":
Women's security and safety is an important concern in today's world and this study aims to develop a mobile based application to track the location of the woman using the application through global positioning system and providing real-time SMS notifications to the concerned authorities.This system is very similar to our system where we track the

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live location coordinates of the students and notify the teachers and parents in case of irregularities. This research helped us a lot to get better insight into the problem and design our system.

2. " GPS-based Location Tracking System via Android Device":
GPS is probably one of the most important technological inventions. It has made our life a lot easier, and this study aims to develop a GPS-based Location Tracking System using an Android device. This concept has tremendous scope and applications in a lot of different sectors. We used this study to get the insight of our location tracking module of our system. Also, the concept of using an android device to perform calculations on the GPS data helped gave us the option of developing this system as an android application or web application.

3. " Web Based Students' Attendance System (Wsas)":
This study is very similar to ours as both the systems work on the similar background of monitoring the student's attendance using a web application. We used this study to design the notification module of our system where we sent the email notification to the parents in case the student is absent for a fixed number of sessions.

III. METHODOLOGY

The proposed system is divided into three modules
Cleaning: - The solar panels often accumulate the dirt and debris on its surface which reduces their capacity to absorb the solar rays. This further reduces the efficiency of the system. In order to increase the performance and to increase the power generation it is essential to regularly clean the solar panels and remove the dirt and pollutants which gets accumulated on the surface. This task is often done manually which could be quite tedious at times. Also, the solar panels are often fixed on the higher grounds like the rooftops to better expose them to the sunrays this makes the task of cleaning them even more difficult and accident prone. To avoid it, this system proposes an automated cleaning of the solar panels. This automated cleaning could prove to an excellent addition to the solar panels.
Cooling: - The performance of the solar panels is also dependent on another important factor which is the heat generated. An overheated solar panels often produces less energy than the one at normal temperature. So, in order better utilize the energy producing capability of the system it is necessary to cool down system regularly. This could be done using fans or by sprinkling cool water along the surface of the solar panels. In this study we have decided to use the water as it also cleans the surface thus managing two complex functionalities at once and increase in productivity. Also using the fans to cool down the solar panels uses a lot of energy which ultimately results into wastage of the energy generated.
Monitoring: - Monitoring the physical and environmental aspects of the system results into better understanding of the system and to improve the adaptability of the system. It consists of real-time monitoring of the system and analysis. This real-time monitoring is done by using various sensors which are present in the system and collect the physical factors such as temperature and humidity. Studying these attributes improves the adaptability of the system and better prepares the user to maintain it as per the environmental needs.
The below diagram shows the flow of the system. First of all, the variables are declared for the Arduino program and the pins are connected accordingly. Then the temperature of the system is collected by using a temperature sensor and the collected data is sent to the Arduino to process. Similarly, the humidity and LDR values are collected using the sensors and the values are sent to the Arduino as well. The voltage value of the system is also collected by using the voltage sensor. Then the temperature is compared with the predetermined value which in this case is 37 and if it is greater then, the motor is turned on to cool down the temperature. Then all the collected data is sent from the Arduino to the Wi-fi. Then the data is separated and processed and stored on the cloud for future reference.

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Fig.1 Flowchart of the system.

Algorithm for data processing
step 1: start
step 2: declare required variable
step 3: set the pin mode for pins used
step 4: read the temprature value
step 5: read the humidity value
step 6: read the LDR value
step 7: read the voltage value
step 8: read the current value
step 9: check temprature for on the motar
step 10: send the data from arduino to wifi module
step 11: recive data from arduino
step 12: separate the data
step 13: upload to the cloud
step 1: begin from step 4
step 14: end

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IV. MODELING AND ANALYSIS

Below is the block diagram of the system. It consists of the very base of the system that is the solar panels which are connected with various sensors like LDR sensor, Voltage sensor, Current sensor, Temperature and humidity sensor. All these sensors are connected to the solar panels and they monitor the physical attributes of the system and send the data to the Arduino who process the data and analyze it further. The Arduino along with these sensors is also connected with the power supply (which in this case is a battery). The Arduino is then also connected with the actual actuators of the system such as motor driver. As soon as the Arduino senses that the temperature of the system has risen above the pre-determined temperature then it starts the motor pump which sprinkles the water above the surface of the solar panels effectively cooling it and washing away all the dirt and debris which was accumulated on its surface.

Along with all these components the Arduino is also connected with the Wi-fi module. All the data collected by the sensors is sent to the Wi-fi module where it is separated and further sent to the cloud for storage.

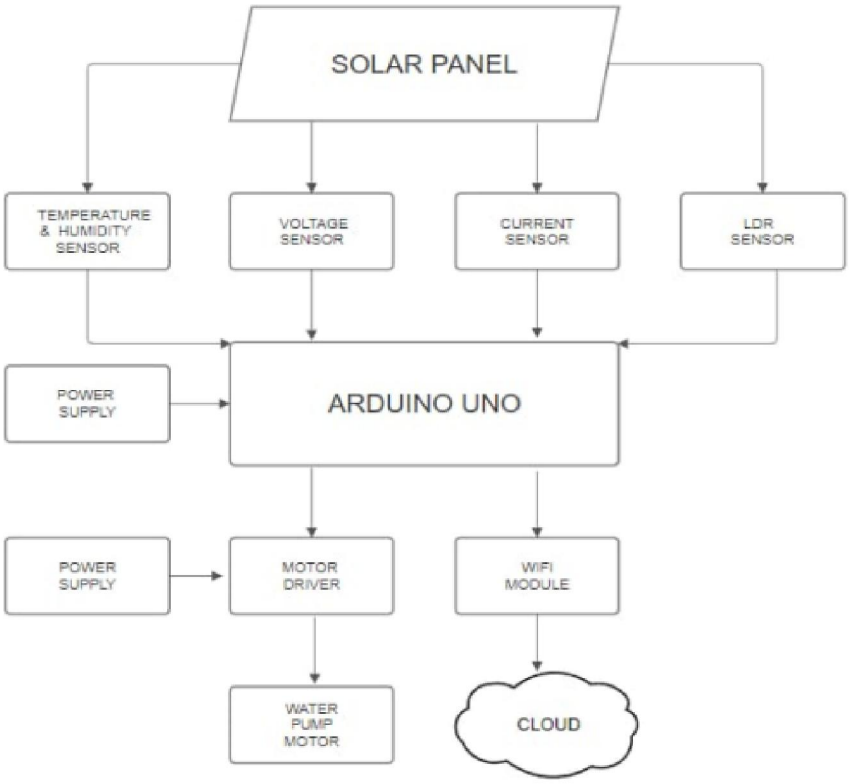

Fig. 2 Block Diagram

Below is the circuit diagram which specifies the Arduino connections. This is how the sensors and actuators are connected with the Arduino. In the circuit there are components like Arduino, sensors, motor driver, motor, esp8266 Wi-fi module, battery and power supply. Working of a circuit is such that sensors will read physical data. Convert it and send it to the Arduino. Arduino will read the data from sensors, process it and perform the task of cooling by turning the pump motor on. All sensors are connected to Vcc and ground of the Arduino. The Arduino is connected to the external power supply. Motor driver is connected with 12v battery for power. The power required for motor is supplied by the motor driver that is 6V. ESP8266 WII Module is connected to external power supply. Ground and receiver pin o module is connected to Arduino ground and transmitter pin respectively.

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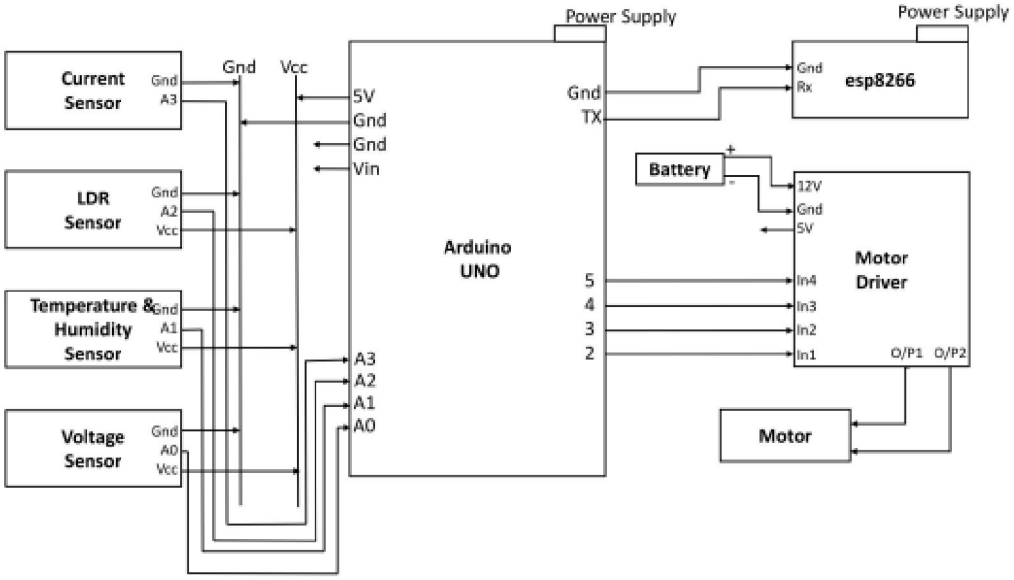

Fig. 3 Circuit Diagram

V. RESULTS AND DISCUSSION

The various sensors used in the system such as temperature humidity sensor, LDR sensor, current and voltage sensor gather the various environmental factors and feed them to the Arduino which then processes the data and pass it to the respective blocks which controls the physical attributes of the system such as pumps which manages the water flow for the cleaning and cooling of the system. The system also consists of the Wi-fi module which is used for collecting the data from the Arduino and passing it to the cloud. The cloud is used to store the collected data only for the monitoring purpose. On the experimental analysis of the system following observations were made

The regular cleaning of the solar panels allows them to better absorb the solar rays by removing the thin film of dust and debris which gets accumulated on the surface of the solar panels.

Monitoring the humidity and temperature of the solar panels allows them to better adapt to the environmental changes.

Automating the cleaning and cooling the solar panels combined with the remote and user-friendly interface for monitoring encourages the user to shift towards the solar energy.

The system also allows the addition of more panels with ease and thus improving the scalability of the system.

VI. CONCLUSION

The Proposed System is designed to make the manual task of cleaning and cooling the system automated. It is divided into three crucial sections. The first one is the cleaning system which cleans the dust and other pollutants from the surface of the solar panels, the second section is the cooling system which cools down the system whenever it overheats and the last section consists the monitoring of the system which monitors the different aspects of the solar panels and keeps the user updated about the condition and performance of the system. This system could be a huge boon to promote the use of solar panels and encourage more people to switch to clean energy.

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