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Solar Power Plant Monitoring and Cleaning System

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Abstract -This paper focusses on instant monitoring of a renewable energy system that is solar power plant, by keeping track on its parameters the voltage from solar panel is abstracted and converted within a range with the help of voltage sensor which is sustainable to the microcontroller. The monitoring platform is based on current and voltage measurement of each solar panel. The related values are measured with the developed sensing circuits and are processed by ATmega 328p microcontroller. The processed parameters are then stored on IoT cloud and smart data analysis is offered by UBIDOTS. By proper interpretation of data over cloud, cleansing process can be initiated by giving command manually through Blynk application.

Key Words: **Renewable Energy System, Monitoring, smart Data analyse, cleansing**

1.INTRODUCTION

In the recent times, as the world is moving towards 4.0 INDUSTRY REVOLUTION automation has become a vital pillar of industries. Industry 4.0 focus on creating smart environment in manufacturing process, it is a cyber physical system where machine communicates with machine. In solar power generation plants, lakhs of solar panels are arranged in form of multiple arrays. The solar panel farms are generally situated in dirt and dust areas which is mostly in case of tropical countries. The performance of solar panels depends on various factors, the power generated by farms can decrease if there is dust and dirt on panels and this is the main factor for reduction. Solar power plants NodeMcu is a microcontroller with wifi module in built in it .need to be monitored for optimum power output. This helps help us to bringing back efficient power output from power plants while monitoring for faulty solar panels connections, and dust accumulated on panels lowering output and other such issues affecting solar performance. So here we present an automated IOT based solar power monitoring system that allows for automated solar power monitoring from anywhere across the globe over the internet. We use nodemcu controller-based system to monitor solar panel parameters. This solar power monitor system contineous monitors the solar panel and transmits the power output to IOT system over the internet. Here we use IOT ubidots to transmit solar power parameters over the internet to IOT ubidots server. With the help of effective GUI, we can display this parameter to user and generate alert about the output fall. When the output parameters fall beyond a preset threshold, the automated cleansing system comes into play. One can generally assume a reduction of about 40-50%,if the panels are not cleaned properly for 1-2 months .So to overcome this problem and to increase the efficiency of power production cleaning of module on regular basis is necessary .To clean the dust ,an automatic cleaner is developed , which will clean the panels on regular interval of time .The mechanism is based on controller control circuit based on DC motors which is to clean the panels .The paper provides you with the idea of optimization of efficiency with the help of automated cleaner for the solar panels .

2. METHODOLOGY

Working of a purposed system consist of two part

1. Working of solar panel monitor

2. Working of solar panel cleaner

2.1WORKING OF SOLAR PANEL MONITOR

Practically implemented solar panels are arranged in number of arrays, our target is to have a track on the efficiency of these individual arrays, and to generate an alert, once the efficiency falls beyond certain value. Each array is connected to a hardware which keeps a track on efficiency. This hardware contains a voltage sensor, Current sensor, and a temperature sensor. With help of voltage and Current sensor, we are able to measure the amount of voltage and Current generated by a particular array. DHT 11 helps us to obtain both temperature as well as humidity of its environment, and hence helps the user for better analyzing the data. Fetching the data from sensors and further ALU operations for obtaining the parameters essential for monitoring efficiency is done with the help of programing. The code is written in languages supported by Aurduino IDE (C and C++) which later is dump in the NodeMcu. NodeMcu is a microcontroller with wifi module in built in it. Since we are introducing IoT in solar power plants, all this data is collected and simultaneously sent on the cloud storage with help of NodeMcu.

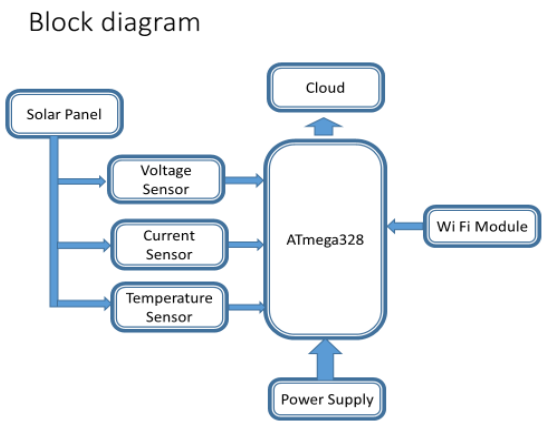

Fig-1: Block diagram of solar panel monitoring system

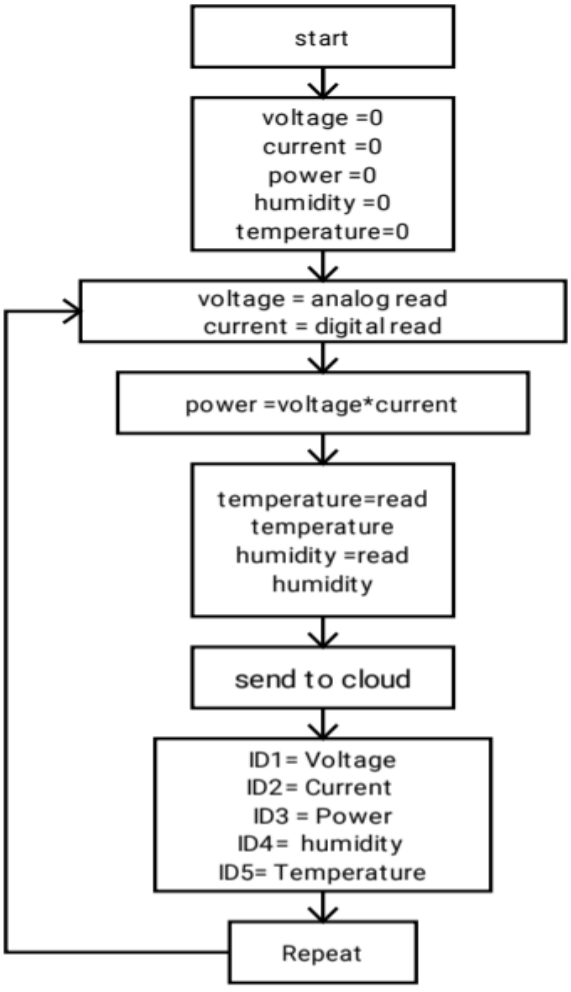

Fig-2: Program flow of solar monitoring system

The IoT platform used is Ubidots. Ubidots turns sensor data into information that matters for business decisions and increases economization of global resources. It also supports interactive, real-time data visualization (widgets). Device friendly APIs provide simple and secure connection for sending and retrieving the data to and from our cloud service in real-time. Further alarms can be set with help of Ubidots platform. The alerts can be in the form of emails, buzzer indicators, voice messages, etc. To successfully track the efficiency is the primary objective, to optimize the efficiency is our secondary objective. For this we have added a cleaner hardware and software both to the solar panels.

2.2 WORKING OF CLEANER

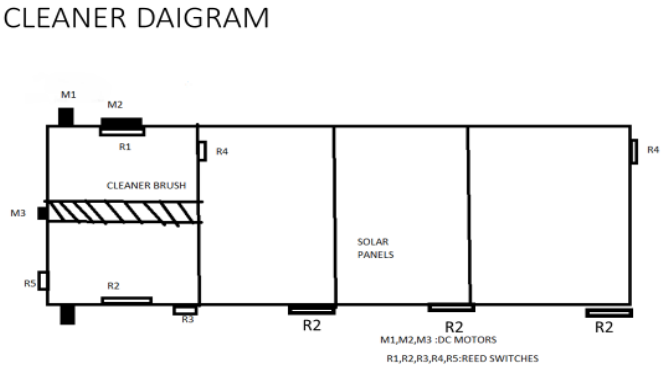

Fig -3: Solar Panel Cleaner Diagram

With respect to the dimensions of the solar plate, the cleaner is being designed and mounted on the solar plant. One of the main component of the cleaning system is brush which is driven by DC motors whereas the actions of brushes is controlled by signal generated Node MCUs are used for each frame to control the cleaning process using Wifi or internet. The command for cleaning action to get started will be received by Node MCU from Blynk app. Brush with soft bristles are used so that it will not affect the transparency of solar panel in long term use. The frame carrying the cleaning brush is moved along the length of solar panel in vertical direction. Simultaneously, this brush will rotate at high speed, for throwing of the dust from the panel. The rotating motion for brush is given to it by motor mounted on panel.

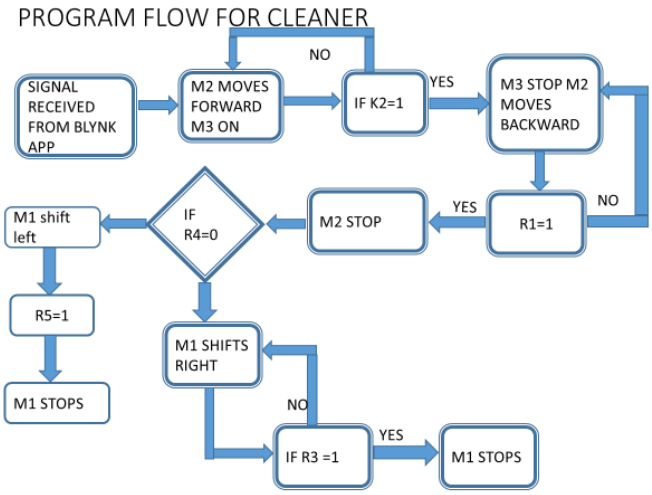

Fig- 4: Program flow for solar panel cleaner

Two DC motors produces rotational motion which is converted into linear motion. The frame with this assembly is mounted on rollers and two of the rollers are having individual motors. Also four rollers accompany the frame for soft movements across the solar panel plate. As soon as the user gets the notification of dropping of efficiency of solar panel, the user can control the cleaning process through Blynk app. On both end of machine, limit switch i.e. Reed switch is mounted which will stop the machine as it will go on the one end of the solar panel array blynk app guided by Node MCU.

3. HARDWARE AND SOFTWARE DETAIL

3.1 HARDWARE DETAILS

The purposed system consists of following hardware components.

A. Solar panel
B. Sensors
C. Microcontroller (esp-8266 node mcu)
D. Motor
E. Reed switch

3.1.A .Solar Panel (12V DC)-The term solar panel is use colloquially for a photovoltaic module (PV). PV module is an assembly of photovoltaic cell mounted in frame work for installation. In the photovoltaic cell the source of energy is sunlight and by using this sunlight photovoltaic cell generate electric energy. A collection of PV module is call a PV panel, and a system of panel is an array. Arrays of photovoltaic system supply electricity to electrical equipment. The cells are connected electrically in series, one to another to desired voltage, and then in parallel to increase amperage. The wattage of module is the mathematical product of the voltage and amperage of module.

Fig -5: Solar Panel

3.1.B. Sensors

a. Voltage Sensor- The voltage sensor connect with the solar panel determine and measure the supply of voltage. In voltage sensor, measurement of voltage is based on voltage divider. There are two main type of voltage sensor capacitive type voltage sensor and resistive type voltage sensor. In our project we use capacitive type of voltage sensor.

Fig -6: Voltage sensor

Capacitor comprises of two plate and a non conductor is place is kept between two plate which is term as dielectric. When an ac voltage is provided across this plate, current will start two pass owing to either a attraction or repultion of electron by means of the voltage present on the opposite plate. The field among the plate will create a complete ac circuit with out any hardware connection.

b. current sensor-current sensor is device that detect electric current in a wire which is connected to the solar panel and generate a signal proportional to that current. The generated signal could be analog voltage or a digital output.

Fig-7: Current Sensor

c. Temperature and humidity sensor-The temperature sensor calculates relative humidity by measuring the electrical resistance between two electrodes. The humidity sensing component is a moisture holding substrate with the electrodes applied to the surface in DHT11. The relative humidity is proportional to the change in resistance between the two electrodes .

Fig -8: Temperature sensor (DHT11)

3.1C. Microcontroller –The microcontroller here is nodeMCU , which is an open source software and hardware development environment and it is built around a very expensive system-on -chip called the esp8266. Its firmware is based in the widely used ESP8266-12wifi module. It allows us to program the ESP8266 WiFi module with the simple and powerful programing language .It combines the feature of WiFi and station and microcontroller.

Fig-9: Node MCU

HARDWARE CONNECTION OF SOLAR PANEL MONITORING SYSTREM

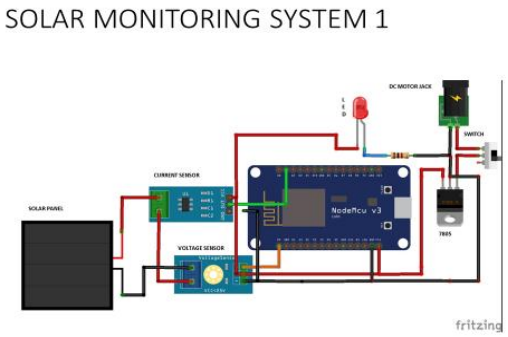

Fig -10: Hardware Connection of solar power monitoring system 1

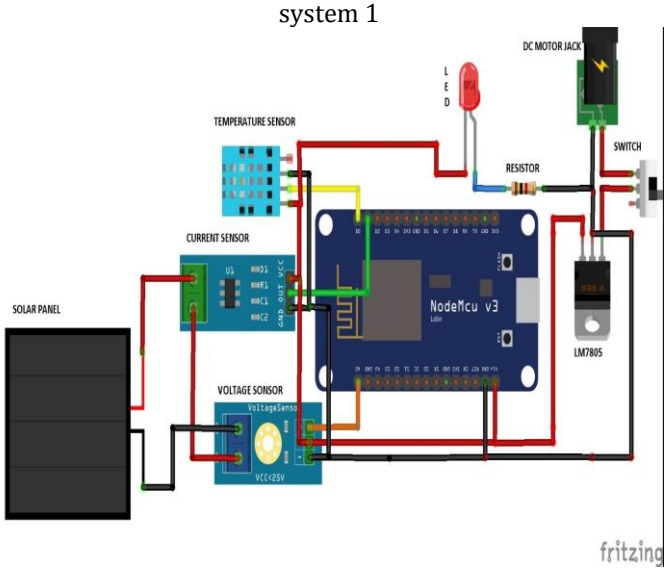

Fig-11: Hardware Connection System 2

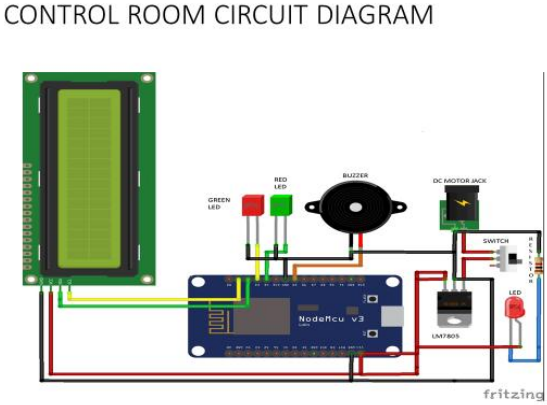

Fig -12: Hardware connection of control room

e. reed switch- Reed switch is an electrical switch, which works on the principle of electromagnetic switching. It is generally made up of a pair of ferromagnetic flexible metal contacts, in a hermetically sealed glass tube. The working of the reed switch is such that, in the absence of magnetic field it remains in its rest position, which is either in short circuit condition or in open circuit condition. Whereas, once a magnetic field is introduced, the switch becomes active. The ferromagnetic metal contacts becomes magnetized resulting into ,either two contacts attracting towards each other representing the closed switch condition or repelling away from each other representing the open switch condition.

f. dc Motor- Dc Motors are defined as the ones which converts the direct current electrical energy into the mechanical energy. The DC motors works on the principle which states, that whenever a current carrying conductor is placed in a magnetic field, a mechanical force is, induced in the current carrying conductor. Further, Fleming's left hand rule gives the idea about the direction of the force that is being experienced by the conductor. The internal components of motor consists of,

1)A pair of stationary permanent magnets, known as stator, which produces the magnetic field.

2)An armature coil with specific number of windings of insulating wire that allows +ssweee2323.the current to flow through it and hence acts as current carrying conductor which is further wrapped around an iron core that concentrates the magnetic field.

3) Commutators that connects the ends of the wire windings.

4) Brushes that connects the rotating coil with the external power supply.

The armature is placed in the magnetic field, in such a way that when current flows through the armature, a force is induced on it, due to the presence of magnetic field and hence converts the electrical energy into mechanical one. The force induced in the two arms of the coil is equal in magnitude but opposite in direction and hence a torque or rotational force, is generated, that rotates the armature conductor mechanically. Accordingly, Fleming's left hand rule comes into play to determine the direction of rotation of motor.

3.2. SOFTWARE DETAILS

A. IOT- An IoT platform is a multiple layer technology that enables straightforward provisioning, management, and automation of connected devices within the Internet of Things. It basically connects the hardware, irrespective diversity , to the cloud by using flexible connectivity options, enterprise-grade security mechanisms, and broad data processing powers. The IoT platform offers to developer ready-to-use features that greatly speed up development of applications for connected devices as well as take care of scalability and cross-device compatibility.

To called an IOT system complete hardware, such as sensors or devices. These sensors and devices collect data from the e perform actions in the environment . A complete IoT system needs connectivity

In this project we use UBIDOTS as a IOT platform. UBIDOTS provide the dashboard on which the complete real time analysis of solar panel is display.

B. Blynk app-blynk is the new platform that allows us to quickly build the interface for controlling and monitoring our project from our ios device. After downloading the Blynk app, we can create a project dashboard and arrange button, slider, graph and other widgets onto the screen. The cleaner is operated by the user by using blynk app.

4. CONCLUSION

The exigency of electricity is rising day by day and traditional sources of energy are not producing enough energy to meet the requirements. We have studied PLC, SCADA, Zigbee, Bluetooth etc. Applications of monitoring system are in Rooftop solar, ground mounted solar, solar cities and many more. The energy is alternatively depends upon the primary parameters like temperature, voltage, current and to keep track on all these parameters on real time IOT played a vital role through ATmega management. Results are displayed on LCD as well as on mobile devices. User will be able to track, monitor and control this panels virtually to maximize electricity generation. Accompanying the monitoring system cleaner is installed in our system to ameliorate efficiency of the system. As we know that prevention is better than curing 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.

5. Result

The purposed system that is solar power plant monitoring system can measure the voltage, current, temperature and humidity . The real time monitoring of all these parameter is done by using the IOT platform. After successful of checking all the current and voltage value the efficiency of the solar panel is calculate . In situation where the efficiency of the solar panel goes beyond certain threshold it is possible to

clean the solar panel with the help of IOT solar panel cleaner machine. Hence , in this manner efficiency of solar panel is increase.

6. REFERENCES

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