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DEVELOPMENT OF A SMART SOLAR POWER MONITORING SYSTEM USING IOT ARCHITECTURE

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ABSTRACT: Promising new technology called the Internet of Things (IoT), solar power installations may be able to run much more smoothly. Right now, we're living through this period. Improved efficiency and monitoring capabilities can be achieved by solar facilities by incorporating IoT into their management systems. This involves measuring the quantity of dust that is accumulated on solar panels to ensure the energy production is ideal, as dust can change the amount of sunlight that reaches the cells and, therefore, the power generation. Thanks to the IoT, a centralized controller can keep tabs on loads and panels, checking that all sensors are properly connected and that panels are in the ideal positions. This technology is changing the game for solar power plant management and maintenance by providing real-time visibility into critical parameters like voltage, current, and sunlight to all parties involved.
KEYWORDS: Internet of things (IOT), Solar power, Remote monitoring, Solar panel.

1. INTRODUCTION

Connected devices that can communicate with one another and the cloud through the revolutionary Internet of Things (IoT) eliminate the need for human intervention in many everyday tasks. This interconnected system of communication modules, processors, and sensors is revolutionizing several industries and everyday life by facilitating remote administration, data exchange, and real-time responsiveness. The Internet of Things plays a vital role in solar power monitoring systems as it constantly tracks the panels that are exposed to sunlight and adapts to variations in radiation caused by factors such as time, location, and weather. This integration maximizes the efficiency of solar energy output while overcoming the obstacles presented by finite energy supplies.

Renewable energy sources such as solar, wind, and wave power are gaining prominence due to the increasing demand for energy and the depletion of nonrenewable resources such as coal and fossil fuels. The photovoltaic effect converts sunlight into electricity; this process is known as solar power. Solar power is a subset of renewable energy. Facilities may be able to better monitor energy production, predict future outputs, and alert stakeholders to potential issues by integrating IoT technology with solar power systems. The bigger objective of sustainable energy management is advanced, emissions are decreased, and system reliability is increased, all thanks to this real-time data.

Solar power monitoring solutions built on the Internet of Things (IoT) also provide other benefits, such as improved security and easier operations. The system provides stakeholders with visibility into important elements such as voltage, current, and UV exposure since centralized controllers supervise each panel and sensor. The Internet of Things (IoT) guarantees optimal performance with minimal human involvement by automating processes and generating timely alerts. A future where renewable energy and technology coexist to fulfill the world's power demands is within reach, thanks to this innovative method, which benefits communities and individual houses while driving larger-scale efforts toward sustainable energy solutions.

2. LITERATURE SURVEY

Real Time Monitoring of Solar PV Parameter Using IoT This research primarily aims to shed light on a system design that monitors SPV parameters in real time over the IoT. The temperature, current, and voltage of the panels are among the critical components of a solar photovoltaic (SPV) system that sensors detect. The SPV's power output is the most crucial number. The Node MCU Esp8266 allows for the transmission of these variables to the cloud. A mobile app for Android is used to collect data from the cloud. A comprehensive app was built using Android Studio to monitor the current, output voltage, temperature, and power of solar cells in real time. Laboratory testing is conducted on the SPV component of the system.

IoT Enabled Solar Power Monitoring System To optimize energy collection and consumption, the present research shows the most efficient technique for tracking dust accumulation on solar panels. This indicates that the amount of energy that reaches the solar cell is the single most important factor in determining the electricity that the solar panel produces. Also displayed is the current health of the solar panels and whether or not the loads on the batteries are sufficient to power the electrical gadget or panels. The devices that keep tabs on the loads and panels are in constant contact with the central controller, which is linked to each panel individually. With the use of IoT technology, data can be sent from various devices and displays to the cloud, which opens up a world of possibilities. It is also possible for a remote user to see the linked devices' settings. Various variables, such as solar light, temperature, current, and voltage, can have their present, historical, and average values shown using a graphical user interface (GUI). The manager checks if all the conditions are satisfied and gives the user a heads up if they aren't. This particular device is known as the Node MCU.

A Research of IoT based Solar Panel Tracking System Order for solar thermal collectors and photovoltaic cells to collaborate with the sun, a "sun-based framework" is necessary. A variety of large-scale research projects that adhere to ecological responsibility should be carefully considered, together with an effective strategy and reliable control mechanism, in light of the potential benefits they may bring. The phrase "Internet of Things" (IoT) indicates that a new age of processing innovation is starting right now. The IoT functions as a cloud-based "universal global neural network" that links numerous seemingly unconnected components. In response to this emerging threat, new sensor network and radio frequency identification (RFID) devices will be created. Complex technologies may connect and interact more easily with one another, with infrastructure, with things, and with environments thanks to the Internet of Things (IoT), a collection of frameworks and strategically placed devices. The investigation raises many concerns regarding the efficacy of solar panel monitoring modules enabled by the Internet of Things (IoT) as a technique of converting solar radiation into electricity.

Solar photovoltaic remote monitoring system using IOT Affordable green energy equipment is a product of technological progress. This has led to a dramatic uptick in the installation of solar photovoltaic systems. Among these installations, backup power sources make up a considerable portion. A large number of these are situated in challenging environments, such high-rise buildings or isolated, desolate areas. In order to keep an eye on these establishments from afar, cutting-edge innovation dependent on wide-area networks is essential. The research's integrated solar PV monitoring system, which is based on the Internet of Things (IoT), transmits data from the production site to the internet using a low-cost microcontroller and GPRS module. This paves the way for remote data examination from any location. We can keep track of all data at pre-set intervals and get the most recent information on the installation in this way. Furthermore, it will aid in preserving the system's integrity and detecting any deficiencies.

Solar energy analytics using internet of things There is currently a lack of regulation and significant localization in the solar energy environment. Current networking technologies in India make it difficult to conduct a comprehensive evaluation of the solar energy generated by the fifty or so solar power facilities in the country. It is now possible, because to advancements in sensor technology, that solar energy systems will be connected to the cloud or internet through the Internet of Things. Connecting these technologies to the cloud allows for easy evaluation of their effectiveness, productivity, and efficiency. Additionally, errors and faults can be more easily identified with the help of Big Data software technologies. Once the solar energy projects that are already known go live, people from all around the globe will have access to them. In order to carry out analytical tasks that will increase the efficiency of solar energy, this research project aims to create a practical and realistic technique of connecting solar-powered devices to the cloud.

3. SYSTEM ANALYSIS

EXISTING SYSTEM

Give an illustration of a solar panel monitoring system that makes use of the Internet of Things. There is built-in monitoring for temperature, voltage, and current on PV panels and PCUs. One can utilize mathematical formulas to acquire power. A solar panel and sensors can exchange data with this prototype device thanks to the Node Mcu Esp8266. The voltage displayed on the screen is generated by a voltage sensor that is integrated into a voltage divider circuit. A current-detecting circuit measures the current, while a temperature sensor measures the temperature. The data is transmitted to a remote computer via node mcu, a Wi-Fi gateway that transmits data to the cloud. Customers have the option to access their cloud information using a mobile application.

DRAWBACKS

Multitude of technological hurdles must be surmounted in order to remotely monitor solar photovoltaic projects. It is essential, for instance, to guarantee that the real data from the solar system is constantly synchronized with the panel voltage, current, and temperature monitoring.

PROPOSED SYSTEM

Method for monitoring solar output that makes use of the Internet of Things is proposed as a remedy. When light from the sun hits solar panels, it is converted into electricity by solar cells. We make use of an Arduino, among other things. The properties of voltage and current can be discovered through the use of sensors. Data about voltage and current can be seen on the LCD screen. Connected to the display's instruments is an IoT device, which enables remote parameter monitoring over a network.

BENEFITS

1. The voltage and current are shown on an LCD panel through the use of Internet of Things technology. We may verify the findings by linking our phone to a Wi-Fi network; the sensors have a Wi-Fi module.

2. Our phone is set to update itself if there is a change in the numbers or data. The efficiency of solar panels can be monitored with the use of Internet of Things technology. In the case that an issue arises, it can be resolved promptly.

BLOCK DIAGRAM

Fig1. Block Diagram of Propsed Method

HARDWARE TOOLS

- ARDUINO UNO
- SOLAR PANEL
- CURRENT SENSOR
- LCD
- WIFI (ESP8266)
- RPS (POWER SUPPLY)

ARDUINO UNO:

The Arduino Uno has become the platform's most beloved variant. The term "Ardunoid" is often used to characterize this specific board. For those just starting out with Arduino, the Uno is a fantastic and widely used board. Rev3 (or R3), the most recent version of the Arduino Uno, is covered in the part that follows.

The Arduino Uno microcontroller platform is powered by the ATmega328 CPU. The device has a 16-MHz ceramic resonator, six analog inputs, fourteen digital input/output ports (six of which can produce PWM outputs), a power port, a USB connector, a stop button, and an ICSP header. It is easy to begin using it as a microprocessor as it comes with all the necessary components. Simply connect it to a computer or other USB-powered device to charge it.

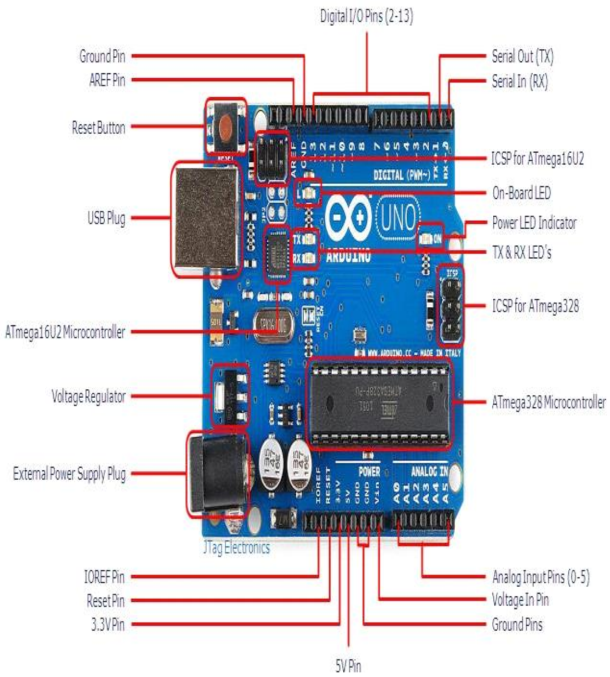

Fig2. Arduino Uno Board

SOLAR PANEL:

Solar energy conversion refers to the process of transforming solar radiation into usable electrical power for buildings and households.

When left alone, the sun can be thought of as a nuclear power plant. Photons, incredibly little units of energy, travel 93 million miles to reach Earth, a journey that takes 8.5 minutes. The amount of solar energy that may be generated per hour is equivalent to one year's worth of global energy use.

Solar power today only supplies 0.5 percent of America's electricity. The cost of making the transition to solar electricity is going down as solar technology improves. Because of this, we should be able to use solar power more effectively.

The International Energy Agency reports that solar power surpassed all other fuels in 2017 in terms of growth. The sun's rays are now the most dynamic energy source. Solar power will be a boon to society in the long run.

Fig3. Solar Panel

CURRENT SENSOR:

The term "current sensor" describes a device that can measure the flow of current and convert it into a voltage that is directly proportional to the current in the studied path. A broad variety of currents and ambient conditions can be handled by each type of monitor.

Fig4. Current Sensor

Measuring the current via a machine shouldn't interfere with its functionality. Given this, the capacity to detect current is crucial for numerous power systems and devices. In the past, electrical circuits could be protected and controlled using current sensing. The capacity to detect current, however, has grown in significance for object monitoring and performance enhancement as technology has progressed. Thus, it is useful to be aware of the total force exerted on the load in many cases.

LCD:

This picture shows a module for electronic displays, sometimes called a liquid crystal display (LCD). You can find the humble 16x2 LCD display module in all sorts of electronic devices and circuits. The performance of these devices is superior to that of competing seven- and multi-segment LEDs.

Fig5. LCD Display

WIFI (ESP8266):

This ESP8266 tutorial will teach you how to use an ESP-01 module to remotely control an LED. Among inexpensive internet-based communication devices, the ESP8266 is both practical and affordable. Using an Arduino to implement it is likewise a breeze. All the knowledge you need to operate any electrical device remotely from anywhere in the globe using the internet is provided in this ESP8266 tutorial.

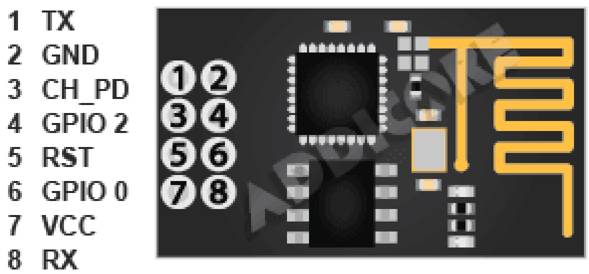

Fig6. Wifi Module

Programming the ESP8266 ESP-01 module, a USB-to-TTL converter is necessary. Also, we'll build a web server in the Arduino IDE so we can control an LED remotely. My previous ESP8266 tutorial is another useful resource for understanding how the ESP-01 Wi-Fi module works, particularly if you have recently bought one. Also shown in the video is how to configure the ESP8266 so that it may communicate with other devices without the need for a USB-to-TTL converter.

RPS:

POWER SUPPLY:

There must be a controlled source of electricity for all digital circuits. Following this post's detailed instructions, you should be able to create a controlled positive supply directly from the source.

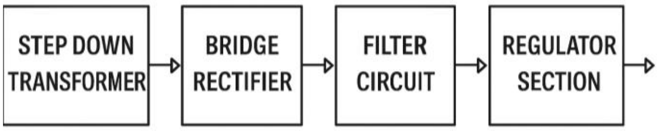

Fig.7 Power Supply flow

4. CONCLUSION

Maintaining voltage and current characteristics and continuously adding fresh data, the proposed solution enables smooth monitoring of the solar photovoltaic system. The ability to perform studies on a daily or monthly basis is made possible by this continuous supervision, which allows for comprehensive research and system evaluation. Guaranteeing the optimal performance and reliability of the solar energy system even in circumstances where the data presented is disputed, monitoring the solar panels running at full capacity provides critical insights to discover and correct any potential problems.

REFERENCES:

[1]. Shailesh Sarswat, Indresh Yadav and Sanjay Kumar Maurya 2019 Real Time Monitoring of Solar PV Parameter Using IoT 9 p 267

[2]. R.L.R. Lokesh Babu, D Rambabu, A. Rajesh Naidu, R. D. Prasad and P. Gopi Krishna 2018 IoT Enabled Solar Power Monitoring System Int. J. Eng. & Tech. 7 p 526

[3]. R. Vignesh and A. Samydurai 2017 Automatic Monitoring and Lifetime Detection of Solar Panels Using Internet of Things Int. J. Inn. Res. in Comp. and Comm. Eng. 5 p 7014

[4]. Subhasri. G and Jeyalakshmi. C 2018 A Research of IoT based Solar Panel Tracking System Adv. In Comp. Sci. Tech. 11 p. 537

[5]. Ankit Kekre and Suresh K. Gawre 2017 Solar Photovoltaic Remote Monitoring System Using IoT Int. Conf. on Recent Innovations in Signal processing and Embedded Systems (RISE) (Bhopal, India) p 27

[6]. M. C. Hottel and B. B. Woertz 1942 Performance of flat plate solar heat collectors Trans. ASME, 64 p 91

[7]. Arduino (2016) overview of an Arduino, retrieved from

[8]. Balbheem Nadpurohit, Roopa Kulkarni, Kadappa Matager, Nagaraj Devar, Rahul Karnawadi and Edmund Carvalho 2017 IoT Enabled Smart Solar PV System Int. J. Inno. Res. in Comp. and Comm. Eng. 5 p 11324

[9]. Manish Katyarmal, Suyash Walkunde, Arvind Sakhare and U.S.Rawandale 2018 Solar power monitoring system using IoT Int. Res. J. Eng. and Tech. 5 p 3431

[10]. B. Vikas Reddy, Sai Preetham Sata, Sateesh Kumar Reddy and Bandi Jaswanth Babu 2016 Solar Energy Analytics Using Internet of Things Int. J. Appl. Eng. Res. 11, p 4803

[11]. T. C. Prakash, Mamatha M and Samala S 2020 An IoT based under weather monitoring system J. Cri. Rev. 7, p 148

[12]. Seena Naik. K and Sudarshan. E 2019 Smart healthcare monitoring system using raspberry Pi on IoT platform ARPN J. Eng. and Appl. Sci. 14, p 4872