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IOT Based Solar Panel Fault Monitoring And Control By Using Wi-Fi Modem

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Research Article

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Abstract-

For solar power plants to provide the most electricity, they must be monitored. This aids in recovering efficient power production from power plants while keeping an eye out for problems that might impair solar performance, such as damaged solar panels, connections, dust buildup on panels that reduces output, and other similar problems. In order to identify problem locations, this project proposes a hardware design for a smart grid home gateway that combines a smart home network with solar system integration for PV. Thus, we suggest an Internet of Things (IoT)-based automated solar power monitoring system that enables automatic solar power monitoring from any location over the internet. This project uses an Arduino-based system that incorporates PT, CT, and LDR sensors to measure parameters and keep an eye on the solar panel. By comparing the voltage recorded by the panel with the intensity of the LDR sensor, the fault has been identified. Our technology continuously checks the solar panel and sends the power output to the Internet of Things system.
Keywords: Light Dependent Resistance (LDR), Internet of Things (IOT), and fault system.

I.INTRODUCTION

The amount of electricity generated by solar sources has steadily increased over the last several decades. Research on solar panels with higher efficiency has kept pace with this development. The current record efficiency is 44.7%, which is defined as the ratio of incoming solar energy to the highest possible output power. There is a well-established interest in the surrounding equipment in addition to research on solar panels. Power inverters, which transform dc energy from solar panels to ac grid output, are a component of these systems. Since any losses would impact the whole system's efficiency, the efficiency issues with solar panels inevitably influence the entire system. The field of photovoltaic (PV) inverters has advanced recently to distributed inverter systems, in which each panel is linked to a tiny inverter module. This is advantageous since the energy harvest may be increased by locally optimizing each panel. This not only increases efficiency but also makes it possible to test each solar panel separately. These new capabilities open up new avenues for solar panel health monitoring. Fault detection is a method that is now the subject of ongoing study. The goal of fault detection is to quickly identify damaged and defective solar panels. Solar panels inherently deteriorate, and measuring the rate of deterioration over time is interesting.

Il. RELATEDWORK

An intelligent system that offers real-time solar panel monitoring and defect detection is being developed by Kian Jazayeri et al. Making use of artificial neural network technologies Yuji Higuchi et al. provide a number of defect classification techniques that make use of string measuring device data from remote, continuous solar power panel monitoring. In order to provide a precise and prompt warning system of dangerous circumstances, Moath Alsafasfeh et al. are concentrating on developing a framework for automated fault detection in a solar energy system using thermal imaging. Shaik Ayesh et al. describe how to use Wireless Sensor Networks (WSN) to monitor the output and performance of individual photovoltaic (PV) panels in a PV plant. Radu The creation of a workable defect detection method for online deployment of photovoltaic (PV) systems is presented by Platon et al. Field data from a PV system in Canada were used to develop and test the method. Vinicius C. Ferreira et al. provide a method for automatic failure detection and diagnosis (FDD) on solar-powered Wireless Mesh Networks (WMNs) that use machine learning methods. A straightforward technique for identifying such problems is presented by Y. Stauffer et al. Adding two electric power sensors to an existing PV system is all that is needed for the suggested solution. A novel kind of photovoltaic (PV) array connection is presented by Yanli Liu et al.: the CTCT structure (complex-total-cross-tied array). We can locate the PV cells with Hot Spot in the array of CTCT-type PV cells by adding a certain number of current sensors and comparing the current.

III. DESIGNOFTHE3GDATALOGGER FORSOLARPHOTOVOLTAIC MONITORING

A. Generaldescription

In order to monitor the SAPV system, a new wireless monitoring system and a basic distribution of electrical

and environmental sensors are required. system. The new datalogger monitors electrical and climatic characteristics; information is saved on two separate servers, one of which is a dedicated server housed inside the university and the other is a cloud server, which is a free storage platform. Data is sent over 3G. Any computer or device with an internet connection may watch the SAPV system.

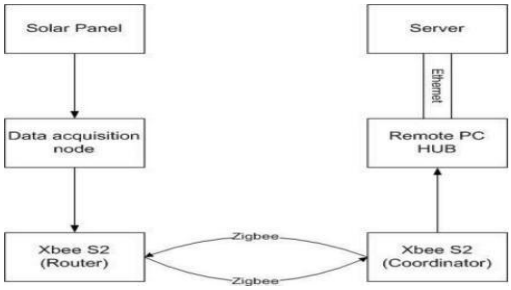
B. Hardware

The Arduino TM UNO board served as the foundation for the preceding datalogger since it is more reliable, affordable, and has a development community than other open-source platforms. López-Vargas et al. [19] added hardware enhancement to an ad-hoc PCB (Printed Circuit Board) because it did not cover all the functionalities for PV monitoring alone. This included (a) a bidirectional I2C™ bus and (b) sensors signal conditioning, which included the integration of electronic elements for filtering transmission systems at a low cost. This gadget runs on an external 5VDC/1A power source and can withstand temperatures between 10°C and 60°C and relative humidity levels between 10% RH and 90% RH (non-condensing).

IV. EXISTINGMETHOD

Radio frequency (RF) transceivers, sensors, microcontrollers, and power sources make up a wireless sensor network (WSN). Low-cost, low-power, multipurpose sensor nodes are the result of recent developments in wireless sensor networking technology. Sensor nodes allow for both data processing and environmental sensing. Monitoring of various surroundings is made possible by instruments equipped with a range of sensors, including those for temperature, humidity, and the detection of volatile compounds. They can communicate with external users and network with other sensor systems. Sensor networks are used in many different fields, such as safety management, automated on-site tracking of costly commodities, smart buildings and roadways, environmental monitoring, wireless data collecting, machine monitoring and maintenance, and many more. The application layer, transport layer, network layer, data link layer, physical layer, power management plane, mobility management plane, and task management plane make up a generic WSN protocol. ZigBee and Bluetooth are currently the two primary technologies available for WSN. Both use the 2.4 GHz Industrial Scientific and Medical (ISM) band, which offers global interoperability, massive spectrum allotment, and license-free operations. Broadband generally expands with frequency, enabling larger data speeds; however, power needs also rise and transmission distances decrease significantly.

V.



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VI. PROPOSEDSYSTEM

According to the Internet of Things' vision, commonplace things will be embraced by the internet as it expands into the physical world. The Internet of Things (IoT) makes it possible to sense and/or control objects remotely using already-existing network infrastructure. This opens up possibilities for the seamless integration of the physical world into computer-based systems, which not only reduces the need for human intervention but also improves efficiency, accuracy, and economic benefit. Solar towns, smart villages, micro grids, solar street lights, and more are just a few of the many uses for this technology. As During this time, the growth rate of renewable energy was quicker than it has ever been. The online display of solar energy's power consumption as a renewable energy source and the identification of solar panel defects are both included in the proposed system. The suggested solution uses the Internet of Things to monitor solar energy. A solar panel aids in the battery's energy storage. Batteries contain energy that electrical equipment may consume. The Arduino is linked to a

battery. The sensor data are read using an Arduino microcontroller. The Arduino is connected to a voltage divider and current sensor. Circuit for Acquiring Current and Voltage An Arduino's analog inputs have a 5V measurement range. To assist shield the Arduino from short circuits or unanticipated voltage spikes, you should utilize resistors even when connecting to a 5V circuit. The voltage being monitored is lowered to a level that the Arduino can read using a potential divider made up of the two resistors. The voltage divider circuit is seen in Fig. The voltage circuit is reduced to 5V using a 10kohm and 100kohm register. This circuit is constructed using a breadboard. The voltage is provided via the Arduino's analog pin. worth. In fact, this increases the range that is usable. Vout = (R2 / (R1 + R2) is the formula used to determine values in a potential divider. * Vin volts the circuit's maximum input voltage: 5.0 / (R2 / (R1 + R2)) volts is Vmax. We will utilize an ACS 712 Hall Effect current sensor (30 A) to detect the current. The analog output of the ACS 712 is 66mV/A, and it measures both positive and negative 30Amps. The current values are provided by this current sensor. The suggested power calculation method makes use of such values. A DC bulb is regarded as a load in this configuration. The battery is regarded as the power source. The Arduino is connected to the sensor's other pins.

V. SOFTWAREANDRESULTDISCUSSION

Any programming language that has a compiler that generates binary machine code may be used to write Arduino applications. For the IR microcontrollers, Atmel offers two development environments: AVR Studio and the more recent Atmel Studio. The Arduino integrated development environment (IDE), a cross-platform Java program, is made available by the Arduino project. It started with the IDE for the Wiring and Processing programming language projects. It is intended to teach artists and other beginners who are not acquainted with software development to programming. In addition to a code editor with features like brace matching, syntax highlighting, and automatic indentation, it offers a straightforward one-click method for building and loading programs into an Arduino board. A "sketch" is a program created using the Arduino IDE. The C and C++ programming languages are supported by the Arduino IDE via unique code organization guidelines. A software library named "Wiring" from the Wiring project is provided by the Arduino IDE and offers several standard input and output methods. Two routines that are built and connected with a program stub main() to create an executable cyclic executive program make up a typical Arduino C/C++ sketch: 1. Setup(): a function that may configure settings and executes once at program startup. 2. loop(): a function that keeps running until the board shuts down. .3. The Arduino IDE uses a program to transform the executable code into a text file in hexadecimal coding after compilation and linking with the GNU toolchain, which is also included with the IDE release. A loader program in the board's firmware then loads the text file into the Arduino board. The project is based on designs for microcontroller boards that use different microcontrollers and are produced by many manufacturers. Various expansion boards (sometimes known as "shields") and other circuits may be interfaced with sets of digital and analog I/O pins provided by these systems. To load software from personal computers, the boards include serial communications ports (some variants also have USB). Regarding programming

Based on the Processing project, the Arduino project offers an integrated development environment (IDE) for microcontrollers that supports the C and C++ programming languages. An Atmel 8-, 16-, or 32-bit AVR microcontroller (but since 2015, microcontrollers from other manufacturers have been used) plus auxiliary parts that allow programming and integration into other circuits easier make up an Arduino board. The Arduino's standard connections, which enable users to attach the CPU board to a range of interchangeable add-on modules called shields, are a crucial feature. Many shields may be stacked and used in parallel since they are independently accessible via an I²C serial bus, while other shields connect directly with the Arduino board via different pins. Numerous boards are both Arduino-derived and Arduino-compatible. Some may be used interchangeably and are functionally identical to an Arduino. In order to make building buggies and tiny robots easier for school-level instruction, many improve the basic Arduino by adding output drivers. Others alter the form factor but are electrically comparable; sometimes, they remain compatible with shields, and other times they do not. Certain variations have differing degrees of compatibility and use entirely different CPUs.

Fig5.2 NormalpanelCondition

crack_detection

```
int temperature;
void setup()
{
   lcd.begin(16, 2);
   lcd.print("panel      ");
   lcd.setCursor(0, 1);
   lcd.print(" monitoring SYSTEM ");
   delay(2000);
   lcd.setCursor(0, 0);
   lcd.print("condition");
   lcd.setCursor(0, 1);
   lcd.print("    000           ");
   delay(2000);
}

void loop()  {

   temperature= analogRead(co)/2;
   lcd.setCursor(0, 1);
   lcd.print("000          ");
   lcd.setCursor(0, 1);
   lcd.print("    ");
   lcd.setCursor(0, 1);
   lcd.print(temperature);

   if(temperature>150)
  {
    lcd.setCursor(0, 0);
   lcd.print("crack detected    ");
    lcd.setCursor(4, 1);
   lcd.print("Need safety    ");
     }
     if(temperature<150)
  {

   lcd.setCursor(0, 0);
   lcd.print(" no issues      ");
    lcd.setCursor(3, 1);
   lcd.print(" Normal        ");
     }


    delay(1000);
}
```

The above fig5.2 shows the arduino controller software when theLDRresistancevalueandpanel outputvoltagebotharehigh or low then no issue condition shows in the LCD display.

The fault calculation algorithm used depends on the type of

the error that takes place. Line to Line (LL), Double Line to Ground (DLG), and Single Line to Ground (SLG) are examples of unsymmetrical faults. The only symmetrical fault in which all phases are in touch with one another is a three-phase fault. The separation With the aid of a fault current, the relay will first identify the kind of problem. algorithm for magnitude detection. The fault impedance is then calculated using the appropriate formula.

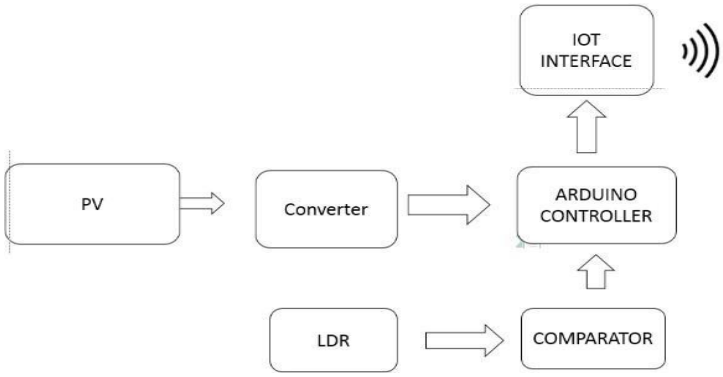
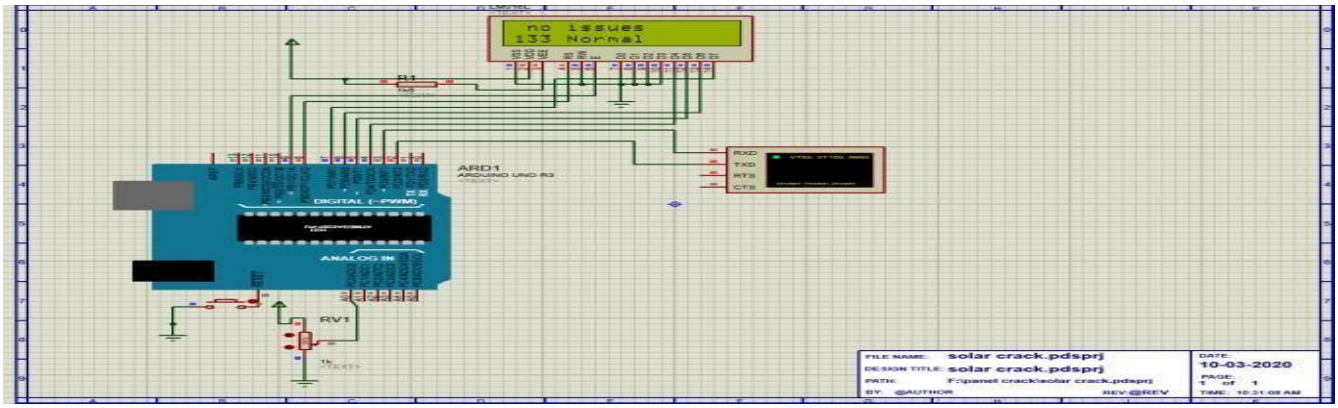
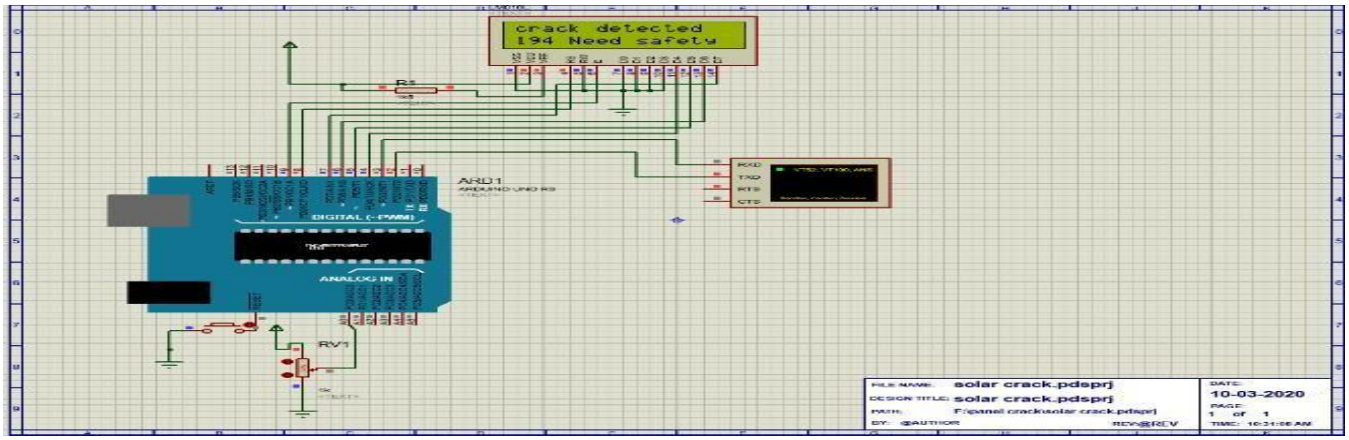


Fig6.1 BlockDiagram

The suggested solution uses the Internet of Things to monitor solar energy. A solar panel aids in the battery's energy storage. Batteries contain energy that electrical equipment may consume.



The Arduino is linked to a battery. The sensor data are read using an Arduino microcontroller. The Arduino is connected to a voltage divider and current sensor. Circuit for Acquiring Current and Voltage An Arduino's analog inputs have a 5V measurement range. To assist shield the Arduino from short circuits or unanticipated voltage spikes, you should utilize resistors even when connecting to a 5V circuit.
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RDWAREDISCRIPTION

The Arduino controller, power supply unit, regulator IC, bridge rectifier, LCD display, step-up motor, Wi-Fi module, magnetic relay, and LDR sensor make up the hardware mode. The power supply device provides the input to the Arduino board. By using a regulator integrated circuit (IC) and filtering the 12 volt direct current, the bridge rectifier transformed the 12 volt AC

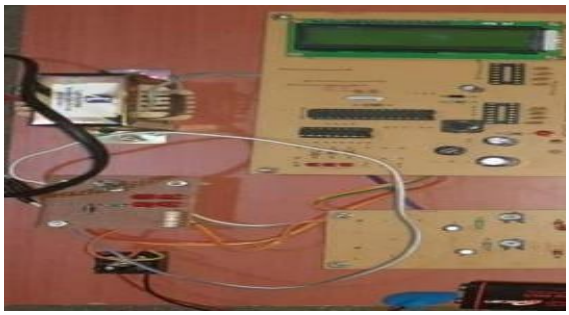


Fig7.1HardwareSetup

a) POWERSUPPLYUNIT

Power supply or DC voltage sources are necessary for the majority of electronic circuits. To provide the DC voltage needed by electronic circuits, one or more batteries are often necessary if the electronic gadget is to be portable. Batteries, however, are not rechargeable and have a limited lifespan. Making a DC voltage source out of the alternating current loss retain line voltage is the answer.

into 12 volt DC and the 12 volt direct current into 5 volts. The Arduino board and wifi model get this 5 volt direct current. The magnetic relay receives a direct current of 12 volts. We must manually adjust the voltage level in the VI measuring equipment. We now lower the voltage and maintain the light intensity as low as possible so that the LCD display shows "no issues." It indicates there isn't a problem with the panel, but when we lower the voltage and maintain a high degree of light intensity, the LCD display says "crack detected need safety." It indicates that there is a panel problem. The suggested solution uses the Internet of Things to monitor solar energy. A solar panel aids in the battery's energy storage. Batteries contain energy that electrical equipment may consume. The Arduino is linked to a battery. The sensor data are read using an Arduino microcontroller. The Arduino is connected to a voltage divider and current sensor. Circuit for Acquiring Current and Voltage An Arduino's analog inputs have a 5V measurement range. To assist shield the Arduino from short circuits or unanticipated voltage spikes, you should utilize resistors even when connecting to a 5V circuit.

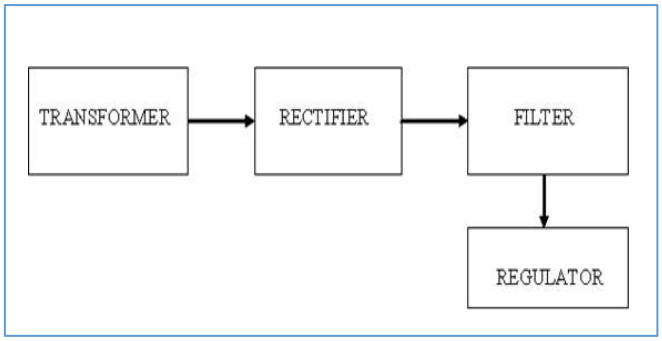


Fig7.2blockdiagramfor powersupplyunit

b) Figure 7.2 displays the AC to DC power supply block diagram, which includes the following:
1. Transformer: Adjusts the voltage of the home line as needed. 2. Rectifier: transforms ac power into dc power.
3. Filter: Create a fluctuating DC voltage by smoothing the pulsing DC voltage. 4. Regulator: Maintain a steady output voltage.

c) ELECTRICALTRNSFORMER

An electrical transformer is a device that converts one voltage of electricity into another. Transformers may be used to change the AC voltage, current, and waveform in circuits. A transformer is a crucial component of electrical devices. Transformer transformation and commutation almost accomplish AC and DC voltage in power supply equipment.

CONCLUSION

Humanity needs renewable energy sources like solar and wind to survive as

traditional means of power production are running out. With the exception of its fluctuating nature and the expense of capturing it, solar energy is a clean and plentiful alternative energy source. The cost of gadgets is rapidly declining due to technical developments. Therefore, all we want is a good, modern monitoring system that can send data to the user whenever and wherever it is required and complete important tasks automatically without human interaction. IOT is the greatest way to monitor solar systems in the face of continuously evolving technologies. Remote monitoring of the solar PV project using IOT

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