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Failure Diagnosis in Photovoltaic Systems based on power losses

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ABSTRACT: Solar energy is a non-conventional, pollution-free source of energy, therefore renewable energy systems are quickly becoming the most efficient way to create power. The Photovoltaic (PV) monitoring system is created in this study to identify system problems automatically. The light sensor, temperature sensor, voltage sensor, and current sensor are used to create a photovoltaic (PV) data monitoring system, which is then processed using an Arduino Uno controller. The voltage is measured using a voltage sensor module that works on the voltage divider principle, the current is measured using an ACS712 current sensor module, and the temperature is measured using a temperature sensor that reads the photovoltaic cell parameters and sends them to the microcontroller to process, monitor, and detect faults in the system. This project is being simulated with Proteus ISIS. The purpose of this system is to collect data from many sensors in order to measure solar panel properties.Solar energy has a broad spectrum, and its strength fluctuates depending on the time of day and geographic location.

KEY WORDS: *Photovoltaic PV, Arduino Uno, Proteus ISIS,ACS712, NTC*

I.INTRODUCTION

The quantity of sunlight incident on solar panels to create power is referred to as solar energy. Photovoltaic devices are another name for solar electric gadgets. Throughout the world, millions of PV on-grid and PV off-grid systems are deployed for residential and industrial usage. These photovoltaic (PV) installations are also located in dusty, arid, and inaccessible areas. The energy generation varies according to the effects of the environment and changes in the atmosphere. As a result, a system will never offer data in real time. Solar (PV) systems should be regularly monitored and reviewed in order to ensure smooth, safe operation and greater performance. This system's primary duty is to collect data from many sensors in order to measure solar panel properties. The purpose of this study is to provide a more efficient, cost-effective, and trustworthy monitoring system for popular small-scale installations. Finally, centralised PV system monitoring lowers system operating and maintenance costs.

II. LITERATURE REVIEW

1] [Real Time Fault Detection in Photovoltaic Systems; Mohamed Hassan Ali, Abdelhamid Rabhi, Ahmed El hajjaji, 2016] Fixing a normal and a fault threshold for each fault will define the fault diagnosis. The Euclidean norm between ideal and normal measurement, or between ideal and fault mode measurement, is used to compute these thresholds. By computing the exact threshold ranges of defects, the suggested method identifies them. The diagnosis approach given here is based on an accurate two-diode photovoltaic module model, and it allows for the calculation of the typical normalcy and failure thresholds in five scenarios.A comparison of an ideal predicted power with measured performance is used to find faults. This technique does a good job at fault detection and identification.

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2] [Automatic supervision and fault detection of PV systems based on power losses analysis; A. Chouder, S. Silvestre 2010] Monitoring data in real-world working settings, taking into account ambient irradiance and module temperature change, and allowing real-time modelling of PV system behaviour. Thermal capture losses (Lct) and miscellaneous capture losses (Mcl) are two new power loss indicators (Lcm) It is based on a study of power losses that has been given.The Matlab-based programme provides parameter extraction approaches for calculating primary PV system parameters from monitoring data in real-world situations while accounting for ambient irradiance. As a result of the aforesaid research, we can define an automated solar PV system supervision by analysing the relevant voltage and current losses. Such a system will aid in improving the PV system's efficiency.

III. BLOCK DIAGRAM

The Arduino UNO microprocessor is directly incorporated with current, voltage, and temperature sensors in this system for solar photovoltaic monitoring. Figure 1 depicts the structure of the photovoltaic data monitoring system.

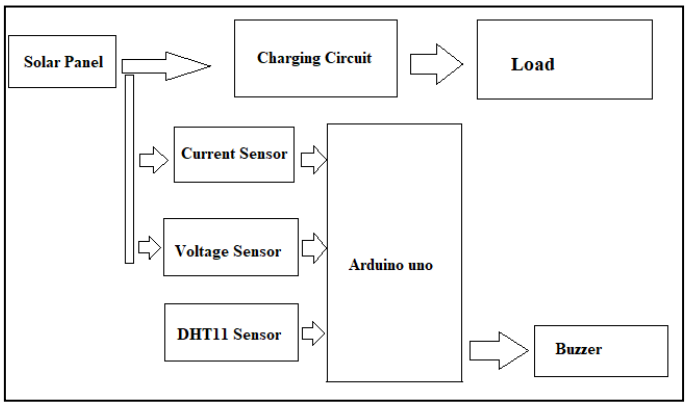

Figure- 1: Block Diagram

The current sensor measures the current flowing through the solar PV system, the voltage sensor measures the voltage in the system, and the temperature sensor measures temperature with an electrical output proportional to the temperature (in 0C). The DHT11 temperature sensor is used in the Temperature Sensor module. When the voltage falls below a threshold value, a fault is detected in the PV system.

IV. HARDWARE COMPONENTS

A. ARDUINO

A computer, another Arduino UNO board, or other microcontrollers may all be communicated with using the Arduino Uno. On digital pins 0 (RX) and 1 (TX), the ATmega328 supports UART TTL (5V) serial connection (TX). This serial connection is channelled through USB by an ATmega16U2 on the board, which appears to software on the PC as a virtual com port. There is no need for an extra driver because the 16U2 firmware utilises normal USB COM drivers. On Windows, however, a.inf file is necessary. A serial monitor is included in the Arduino Software (IDE), allowing simple textual data to be transferred to and from the device. When data is transferred via the USB-to-serial chip and USB connection to the computer, the RX and TX LEDs on the board will flash (but not for serial communication on pins 0 and 1). On any of the Unos, a Software Serial library permits serial communication.

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Figure- 2: ARDUINO UNO

B. **Voltage Sensor Module:**

The quantity of voltage in a system is calculated and monitored using a voltage sensor. The AC voltage and DC voltage parameters may both be determined using this module. This sensor's input is changeable voltage, and the module produces exact output. The resistance point pressure idea is used in this module.

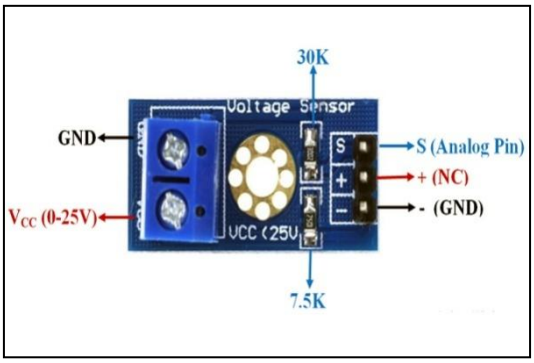

Figure- 3: Voltage Sensor Module

C. **Current Sensor Module*:***

In industrial, commercial, and communications applications, the Allegro ACS712 delivers cost-effective and accurate AC or DC current sensing solutions. Motor control, load detection and management, switched-mode power supply, and overcurrent fault prevention are some of the applications. The gadget is made up of a linear Hall sensor circuit with a copper conduction route near the die's surface that is precise and low-offset.The magnetic field generated by the applied current flowing via this copper conduction line is measured by the integrated Hall IC and transformed into a proportional voltage. The magnetic signal is kept near to the Hall transducer, which improves device accuracy. The low-offset, chopper-stabilized BiCMOS Hall IC, which is configured for precision after packing, provides a precise, proportional voltage.

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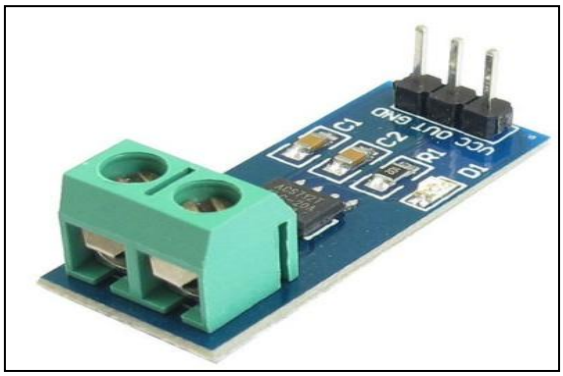

Figure- 4: Current Sensor Module

D. **Solar Panel:**

A photovoltaic (PV) module is referred to as a solar panel in everyday speech. A PV module is a photovoltaic cell assembly that is installed in a framework for installation. Photovoltaic cells create direct current electricity by utilising sunlight as a source of energy. A PV Panel is a grouping of PV modules, while an Array is a collection of panels. Solar power is supplied to electrical devices through photovoltaic arrays. The majority of modules rely on thin-film or wafer-based crystalline silicon cells. Mechanical and moisture damage must be avoided by cells. The majority of modules are stiff, however there are those that are semi-flexible and based on thin-film cells.

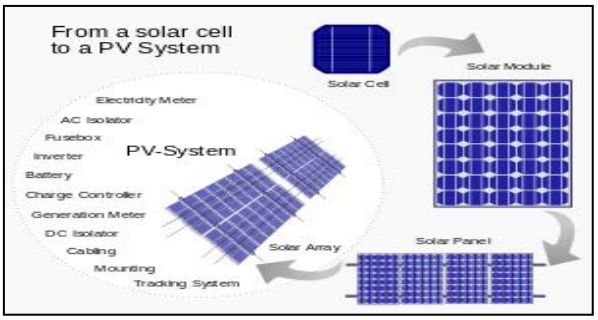

Figure-5: Solar Panel

D. **Temperature & Humidity Sensor:**

The DHT11 digital temperature and humidity sensor is a composite sensor with a calibrated digital temperature and humidity signal output. Application of a specific digital module collecting technology as well as temperature and humidity sensor technology to provide high dependability and long-term stability of the product. A resistive sense of wet components and NTC temperature measuring devices are included in the sensor, which is coupled to a high-performance 8-bit microprocessor.

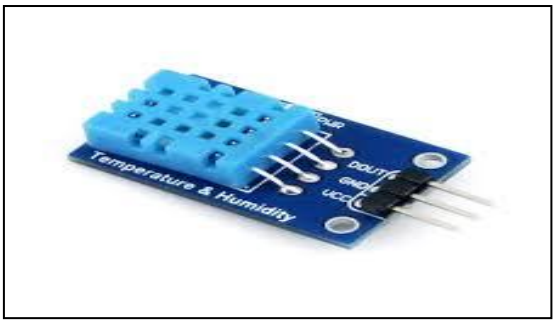

Figure- 6: DHT11

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E. **Buzzer:**

A buzzer is a simple yet effective component that may be used to offer alert functionality to a system. It has a tiny and compact 2-pin construction, making it ideal for usage on a breadboard. Because of the internal oscillating circuit, a sound is created. A DC power supply ranging from 4 to 9 volts can be utilised to power the buzzer. The buzzer is usually connected to a switching circuit that turns it on and off at predetermined times and intervals.

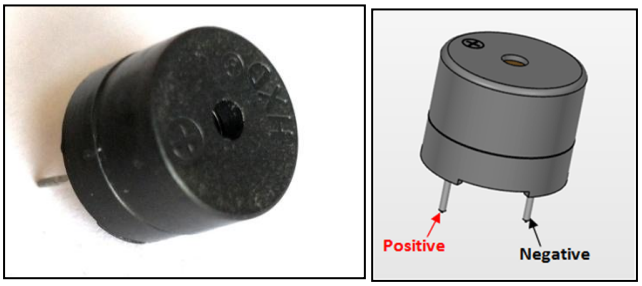

Figure-7: Buzzer

V. SOFTWARE

A. Proteus

The Proteus design suite is a proprietary software product that is primarily used to automate electrical design. The Proteus Design Suite's schematic capture feature is utilised for both design simulation and the design phase of a PCB layout project. As a result, it is a critical component that comes standard with all product configurations. In Proteus, the microcontroller simulation is accomplished by adding a hex or debug file to the microcontroller portion on the schematic. The device, as well as any analogue and digital devices linked to it, is then co-simulated. This makes it suitable for a wide range of project prototype applications, including motor control, temperature control, and user interface design.It's also useful in the general public, and because it doesn't require any infrastructure, it's easy to use as a training or learning program.

B. Arduino *IDE:*

The Arduino IDE is free software that allows you to write and compile code for the Arduino Module. It's official Arduino software, which makes code compilation so simple that even a non-technical person can get their feet wet with the learning process. It operates on the Java Platform and is compatible with operating systems such as MAC, Windows, and Linux. It has built-in functions and commands that are useful for debugging, editing, and compiling code in the environment.

VI.SIMULATION

Below mentioned is the simulation of Failure diagnosis system in Photovoltaic (PV) system.

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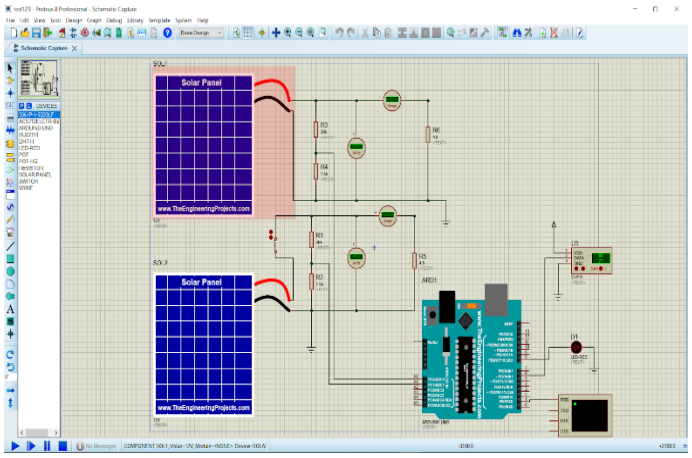

Figure-8: Simulation

VII CONCLUSION

One recommended method of lowering environmental effect is to use Renewable Energy technology. Because of the frequent power outages, it is critical to use renewable energy and keep track of it. The user is guided through the examination of renewable energy use through monitoring. This method is economical.

ACKNOWLEDGMENT

This is our pleasure to present some words of acknowledgement with the joy of successful completion of our project, which is most important part of our syllabus during academic year. Our group is especially thankful to our guide Prof. P. R. Sonawane under whom we did the Project execution and provided much required direction to our project. We are also grateful to our Head of the Department Dr. Prof. M. T. Kolte.

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