International Journal Of Engineering Research And Development
e- ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com
Volume 21, Issue 3 (March 2025), PP 32-37

Solar power monitoring system using IOT

Dr Amar Kumar Dey[a], Mrs Ekta Tamrakar[b], Dinkey Banchhor[c], Dimple Gayakwad[d], Shweta Tiwari[e]

[a] *Associate professor, Department of Electronics and Telecom, BIT Durg, 490006, Chhattisgarh, India*
[b] *Assistant professor, Department of Electronics and Telecom, BIT Durg, 490006, Chhattisgarh, India*
[c] *Student, Department of Electronics and Telecom, BIT Durg, 490006, Chhattisgarh, India*
[d] *Student, Department of Electronics and Telecom, BIT Durg, 490006, Chhattisgarh, India*
[e] *Student, Department of Electronics and Telecom, BIT Durg, 490006, Chhattisgarh, India*

Abstract
The non-renewable power resources are dwindling, the usage of renewable resources for generating energy is developing. Nowadays sun power is an outstanding option for utilizing natural belongings and we can also say that solar panel gathers sun power, and then converts that power into electric strength and stores it in a battery this power we will use on every occasion we wished. Proper here the usage of tracking, which offers easy facts about numerous solar parameters, fault detection, and related energy loss. And we design to monitor the performance of a solar system in real-time. The system measures five critical parameters, namely, current, voltage, power, solar panel temperature, and light intensity continuously. The systems hardware consists of a microcontroller unit (ESP32), current and voltage sensors, a temperature sensor, a light intensity sensor, and an LCD display. This ensures that the system is continuously monitored, and any issues are detected and addressed promptly, enhancing the efficiency of the solar power system.

Keyword: IOT; ESP32; LM35;solar panel

Date of Submission: 27-02-2025 Date of acceptance: 06-03-2025

I. Introduction

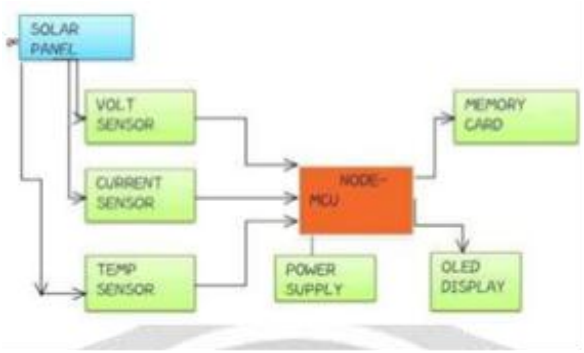
Solar power is one of the types of renewable energy sources prioritized for investment, development and use in Vietnam in particular and globally in general. Solar power systems exist in three main forms: independent solar power (off-grid system), solar power connected to the national grid (on-grid system) and combined solar power (hybrid system) [1]. The monitoring of solar power plant is needed to obtain optimum output power. This efficient output power plants while monitoring for connections, accumulation of dust or any other fault in solar panels affects the solar performance by lowering by output IOT based solar Power monitoring system allows solar monitoring over the cloud and check whether there is a problem in solar panel connection by lowering Output to find the problem occurs in solar panel.[2].

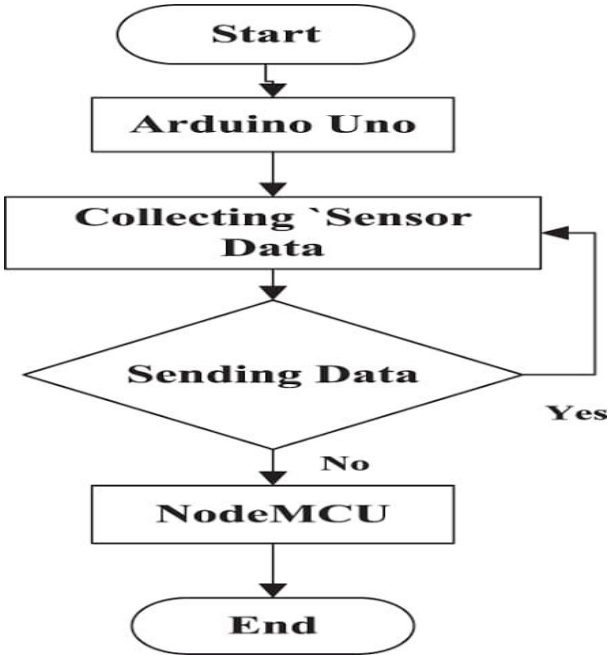
In our modern era, where technological solutions are often sought for complex problems, the integration of Internet of Things (IoT) techniques offers a promising avenue. IoT, with its ability to connect, monitor, and analyze, can play a transformative role in enhancing solar panel efficiency and fault detection. Addressing these specific challenges, this review takes a comprehensive look at the utilization of IoT-facilitated remote IV tracing mechanisms. It further examines their vital contribution to the ambitious vision of cultivating Smart Cities, thereby driving a sustainable and green urban evolution [3]. Solar Panel has a huge effect on our world. It can help our environment to be better without using other power generation plants that can harm the environment, but solar power plant needs to be cleaned at least every 3 days. It generally depends on the country for example in the Middle East, it needs to be cleaned every day so it will cost so much. There are a lot of techniques for cleaning the solar panels like Solar panel that cleans itself automatically and remotely in order to maintain a high level of efficiency of the solar panel [4].

Project Objectives:

1. Design solar power monitoring system using IOT.
2. Increase the uses of solar panels.
3. To obtain efficient output while monitoring for connections, accumulation of dust or any other fault in solar panels.
4. To design the monitoring of solar energy, in which the solar strength enables the storage of the power in a battery.

II. Propose System





2.1 Solar panel (12V)

In this project we use 12V solar panel to measure current, voltage and temperature. These solar panel plays a very crucial role in these setups. It is the main organ of these project.

In the IoT-based solar power monitoring system, a solar panel is used to capture the energy from the sun and convert it into electrical energy.

2.2 NODE MCU ESP32

The Node MCU ESP32 is a low-cost, open-source microcontroller development board based on the ESP32 chip from Espressif. It offers dual-core processing power and integrated Wi-Fi and Bluetooth capabilities, making it suitable for a wide range of IoT applications.

ESP32 can function as a full standalone system or as a slave device to a host MCU, which lessens the burden on the primary application CPU caused by communication stack overhead. Through its SPI and UART interfaces, the ESP32 may connect to other systems and provide Wi-Fi and Bluetooth capability.

2.3 Temperature Sensor (LM35)

A temperature sensor is one of the critical components used to measure the temperature of the solar panel. A temperature sensor is an electronic device that measures temperature and converts it into an electrical signal that can be used for further processing.

LM35 datasheet

Feature	**Description**
Device Type	Precision Temperature Sensor
Temperature Range	-55°C to +150°C
Output Voltage	10 mV/°C (Linearly proportional to Centigrade temperature)
Accuracy	±0.5°C (typical at 25°C)
Supply Voltage (Vcc)	+4V to +30V

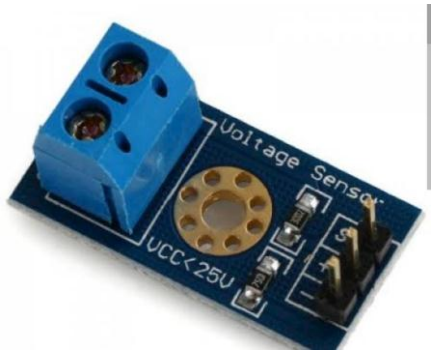
Supply Current (Icc)	60 µA (typical)
Output Impedance	0.1 Ω (typical)
Output Voltage (Vout)	Vout = (Temperature in °C) × 10 mV
Operating Temperature	-55°C to +150°C
Sensor Type	Analog
Package Types	TO-92, TO-220, and others
Response Time (90% step)	500 ms (typical)
Input Voltage	40 mV to 1.5V (minimum at 0°C)

2.4 Voltage sensor

A **voltage sensor** is a device used to measure the electrical potential difference (voltage) between two points in an electric circuit.

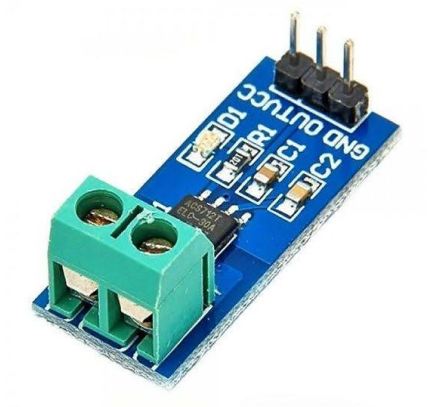
In the IoT-based solar power monitoring system, a voltage sensor is used to measure the voltage output from the solar panel, load, and battery.

These sensors can be used in a variety of applications, including power monitoring, battery management, and other electrical systems where voltage measurement is required.



2.5 Current sensor

A **current sensor** is a device used to measure the amount of electric current flowing through a conductor or circuit. These sensors can measure both AC (alternating current) and DC (direct current). They are essential in various applications, including power monitoring, battery management, and motor control systems.



2.6 LCD display

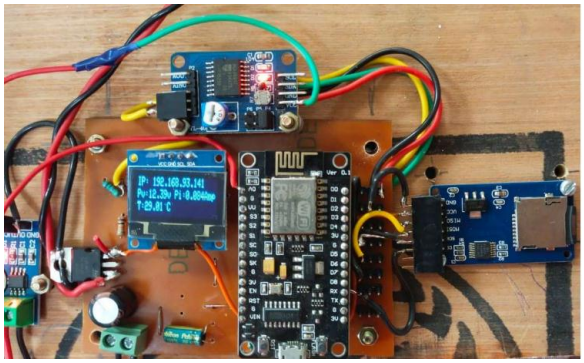
An **LCD (Liquid Crystal Display)** is a type of flat-panel display technology used to show text, images, and videos. LCDs are widely used due to their ability to provide clear images with relatively low power consumption compared to other display technologies like CRTs. They are found in many devices such as televisions, monitors, calculators, smartphones, and embedded systems like microcontrollers.

III. Methodology

The methodology for developing and implementing this system involves selecting appropriate sensors, microcontrollers, and wireless communication modules, developing data visualization interfaces, generating alerts, and testing the system's functionality. This methodology requires a comprehensive understanding of the principles of solar power systems, sensor technology, microcontroller programming, wireless communication, and data visualization. The methodology for developing the IoT-based solar power monitoring system is a step-by-step process that requires careful planning and execution. It involves selecting appropriate components, developing and integrating these components, and testing the functionality of the system. By following this methodology, it is possible to develop a comprehensive monitoring system capable of improving the efficiency and reliability of solar power systems.

IV. Result

The working model of the proposed system is shown in figure. In this project an IoT based Solar power monitoring system is designed to obtain the maximum output power from the solar panels.
After the conversion of light energy into electricity through solar panels, the current and voltage parameters are recorded using sensors.



V. Conclusion

The solar array voltage generation is one of the most higher solutions for clean energy production by observation and controlling the voltage generated by our planned system we have tendency to might overcome the drawback of earlier proposed system. This technique contains a low operating cost and find its application in remote areas and additionally reduces man power.

The IoT-based solar power monitoring system is an innovative project that provides real-time monitoring and analysis of various parameters of a solar panel. The system has several advantages, including efficient energy management, improved solar panel performance, reduced maintenance costs, and increased system reliability. The software modules of the system include the Blynk mobile application and the computer program. The ESP32 microcontroller acts as a bridge between the hardware components and the software

modules, processing and displaying the collected data. IoT-based solar power monitoring system has many advantages such as efficient energy management, improved solar panel efficiency, reduced maintenance costs and increased reliability.

VI. Future scope

Since the system requires external power supply of 5 volts and 3.3 volts for its operation which can be taken rid of by utilising the power generated by solar panel only. Also, with the help of motor and controlling it is possible to track the sun for better power generation. Apart from that by using various Machine Learning algorithms and model it is possible to make system smart enough to take decision about data and performance.

Dust-based Soiling Challenge: Dust-based soiling remains a significant challenge in solar power generation, particularly in desert regions. Accumulation of dust particles on solar panels obstructs radiation absorption, leading to reduced energy output. Addressing this challenge is crucial for maximizing solar energy yield in such environments.

Smart Cities and Sustainable Urbanization: The application of IoT-based remote IV tracing systems contributes to the development of Smart Cities and supports sustainable urbanization. By enabling efficient monitoring and fault detection in solar power facilities, IoT technology aids in optimizing energy production and consumption in urban areas.

Reliability and Maintenance: Ensuring the reliability and maintenance of solar PV systems is essential for long-term performance. Studies emphasize the importance of using quality components, monitoring critical subassemblies, and conducting RAM analysis to identify and address potential failures. Improving reliability and maintenance practices contributes to stable energy production.

In summary, the integration of IoT technology in solar power plants, particularly in desert regions, has the potential to address challenges like dust-based soiling, enhance energy generation efficiency, and support the development of Smart Cities for sustainable urbanization. Additionally, understanding PV cell types and their efficiencies, optimizing PV system orientation, and implementing effective reliability and maintenance strategies are crucial for advancing solar energy technology and ensuring its long-term success.

References

[1]. Tran Thanh TRANG , Le Thanh TOI , Tran Huu KHOA . Design Of A Real-Time Solar Power Monitoring And Controlling System Using Internet Of Things. VOLUME: 22 | NUMBER: 2 | 2024 |

[2]. Neelanshi S Palkar , Ashish Janwe , Ashlesh Chopde ,Ankit Yadav , Vinit Borkar , Poonam Bhad. SOLAR POWER MONITORING SYSTEM USING IOT. IJARIIE-ISSN(O)-2395-4396 Vol-7 Issue-3 2021.

[3]. Vidhi Rawat , Aya H. Athab , S. K. Joshi , S. Jayasree , Darmesh Dhabaliya , J.Devika. Optimising Solar Energy: An Evaluation of IoT Based Solar Panel Monitoring Systems. E3S Web of Conferences 540, 080 (2024) ICPES 2023.

[4]. Dhanashri Ingole, Maroti Kavale, Tanaji Utane, Amit Pathare. IOT BASED SOLAR PANEL CLEANING SYSTEM. International Research Journal of Modernization in Engineering Technology and Science Volume:05/Issue:05/May-2023.