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Lora-Based Solar Energy Monitoring System Using ESP32 Micro Controller

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ABSTRACT: Global energy demands are expected to rise much higher in the future due to the fast-expanding global economy. The cost of energy is predicted to increase, which will have an impact on economic growth. By using effective Energy Management Systems, the energy demand can be decreased (EMS). Since wireless communication technology has advanced so much in the past ten years, sensor networks can only use wireless communication protocols.Evaluation and the best management of the operational state via a remote monitoring system are needed in the event of unstable renewable energy sources and photovoltaic power generation. Many radio-based wireless protocols have been used and implemented as a result of current trends since short-range radio transmission is affordable, secure, and widely accessible. As a result, the goal of this project is to develop and deploy a LoRa-based wireless sensor network for a traditional energy monitoring system that is capable of driving primarily variables like solar energy.

KEYWORDS: Solar Panel, 12V Battery,Voltage Sensors, ESP32 controller, LoRa Tx & LoRa Rx, LCD Display.

I. INTRODUCTION

The response to COP21 has led to the construction of numerous renewable energy facilities worldwide constructed using traditional fossil fuel-based power-producing facilities. Due to unpredictable environmental variables, such as the weather, renewable energy sources have fluctuating production and are challenging to run on a set timetable.By gathering, examining, and responding to information about the continuous power generation status, the power generating system can be managed more steadily. The accumulated data also gives us the advantage of forecasting future power generation and ensuring optimal maintenance. The grid's increased flexibility and reliability are also a result of this improved stability.

The implementation strategies to efficiently build an IoT-based open hardware and software platform-based energy monitoring system for low-cost system construction. And a low-cost solution without a telco base station is used to implement the LoRa-supporting low-powerlong-distance network. Due to its simplicity, low development costs, and wide range of applications, the monitoring system suggested in this study can be used with the IoT system for future energy. With chip manufacturers spending extensively in the market, the IoT business is bringing a lot of technology and solutions to the market, expanding it exponentially.It is feasible to more reliably manage the power generating system by collecting, analyzing, and responding to continuous power generation status information, and the accumulated data provides an advantage of anticipating future power generation and optimal maintenance.In case of unstable photovoltaic power generation, analysis and optimal maintenance of operation status through a remote monitoring system are required. In this paper, we describe the implementation of a monitoring system for renewable energy generation facilities with the system architecture, implementation method, and analysis program. We use various open IoT platforms such as Arduino, Raspberry Pi, and low-cost LoRa networks. In the future, we will carry out research results on the performance analysis and improvement solutions after operating on the testbed site for a long time.The use of renewable energy plants is in greater demand around the world. The main reasons for the increase in the installation of renewable energy power plantsinclude reducing air pollution and producing no greenhouse gas emissions from fossil fuels, creating economic development, and protecting of the environment.

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Monitoring of these power plants requires human effort if monitored manually. As humans are prone to make mistakes and would be difficult to monitor several power plants, electronic devices such as sensors and microcontrollers are used to collect data and help in remote monitoring.

Lora-Based Solar Energy Monitoring System

LoRa (Long Range) is a low-power wireless communication technology that allows long-range communication with low power consumption. It is commonly used in Internet of Things (IoT) applications such as smart agriculture, smart cities, and asset tracking.

A LoRa-based solar monitoring system can be used to monitor the performance of solar panels in real time. The system consists of a LoRa transmitter, a solar panel, and a LoRa receiver. The solar panel converts sunlight into electrical energy, which is used to power the transmitter. The transmitter sends data about the solar panel's performance to the receiver over a long-range LoRa connection.

The data collected bythe system can include parameters such as solar panel voltage, current, power output, and temperature. This data can be used to monitor the performance of the solar panel and detect any issues or problems that may arise.

The use of a LoRa-based system for solar monitoring offers several advantages over traditional monitoring methods. First, it allows for real-time monitoring of solar panel performance, which can help to identify and address issues as they arise. Second, it is a low-power solution that can be powered by the solar panel itself,eliminating the need for external power sources or wiring. Finally, it offers long-range communication, allowing for the monitoring of solar panels in remote locations.

The generation, transmission, and distribution of electrical energy involve many operational losses. The losses in generation technically but distribution and transmission losses cannot be precisely quantified with the sending end information. This illustrates the involvement of nontechnical parametersin the transmission and distribution of electricity. Moreover, technical losses occur naturally and are caused because of power dissipation in transmission lines, transformers, and other power system components.

This requires a lot of human power and it is difficult to visit the installation place every time. Hence remote monitoring is much needed. But most of the agencies don't employ remote monitoring of solar installations. One of the main reasons is because of lack of cellular service at remote locations. In this paper, the LoRa long-ranging technology is used for remote monitoring of photovoltaic solar power plants. LoRa is an alternative wireless network solution that emerged in the field of IoT. It is low power and wide area network with low power consumption and a long transmission range.

Technical losses in transmission and Distribution are computed with the information about the total load and the total energy bill. The system prevents the illegal usage of electricity. At this point of technologicaldevelopment,the problem of illegal usage of electricity. Can be solved without any human control. The implementation of this system will save large amounts of electricity, and thereby electricity will be available for more consumersthan earlier, in the highly populated country as India, and China. Power theft can be defined as the usage the electrical power without any legal contract with the supplier.

In recent days power theft, whichcauses a lot of loss to electricity boardsis the biggest problem, In countries like India, these situations are more often, if we can prevent thesethefts, we can save a lot of power. To detect an unauthorized tapping on distribution lines electrical power theft detection system is used. The distribution network of the electrical power supply system is the main implementation part of this system.

In moderately developing nationsthe development of the nation's power sector provides one of the most importantinputs. The consumption of electricity in India is increasing at a much faster rate. The electrical power system is been divided into generation, transmission & distribution. Losses in the transmission system are much lower than losses onthe distribution side and also faults are not frequent onthe distribution side. Most of the losses are caused by faults and theft in the distribution system. Protection systems are designed to identify the location of faults and isolate only the faulted section in order not to damage the whole equipment in the power system.

Overall, a LoRa-based solar monitoring system is a cost-effective and reliable solution for monitoring the performance of solar panels, ensuring maximum efficiency and productivity.

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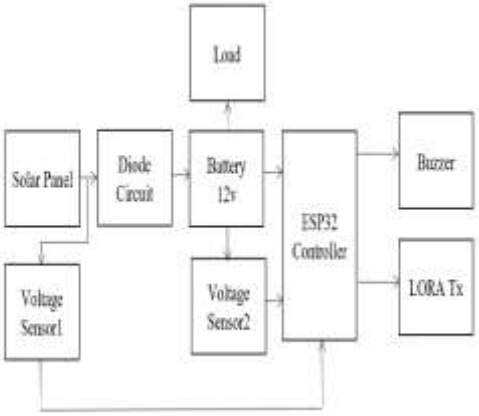
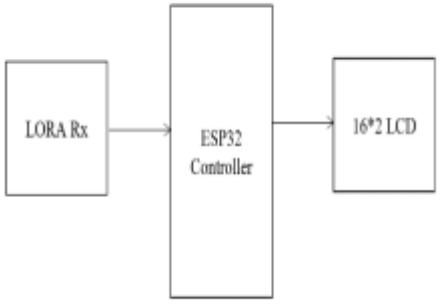


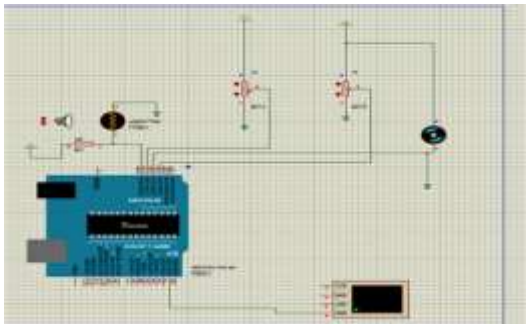
BLOCK DIAGRAM

TRANSMITTER EXPERIMENTATION

The functions of a LoRa-based solar energy monitoring system using an Esp32 controller are depicted in the diagram above. The solar panel absorbs sunlight and stores this as energy. The Voltage Sensor1 is used to measure the absorbed energy. The stored energy in the form of sunlight is transferred from the solar panel to the forward diode. The diode's job here is to stop the backflow of energy.The diode provides energy to the 12V battery. Here also Voltage Sensor2 is used to monitor the same energy. And the energy is sent to the ESP32 Microcontroller, which processes energy parameters including solar panel voltage, current, power output, and temperature. If the incoming energy from the solar panel exceeds the threshold, then the buzzing sound will be heard. Otherwise, the energy will flow through the LoRa Transmitter(Tx) (Tx). The LoRa Receiver (Rx) receives energy from the LoRa transmitter (Tx) and sends it to the ESP32 Processor, which processes the energy and displays the value on the LCD.



RECEIVER SIMULATION



SOFTWARE SIMULATION

GRAPHICAL REPRESENTATION

GRAFANA SOFTWARE USER INTERFACE

II. CONCLUSION

The number of electrical parameters was trackedusing the proposed approach. This comprises the PV system's voltage, current, and power. The LoRa node uses LoRa communication technology to gather, process, and send the data to the server through the LoRa gateway. Data is stored and shown using the Grafana IoT database and dashboard, respectively. Values are displayed in real-time using the Grafana IoT display dashboard, which has remote control capabilities. Also, it contains plug-ins that can remotely operate important system components. Additionally, the system included an LED control system that enables remote component and observation monitoring.This system was created and developed using a variety of low-cost parts. Moreover, all of the software builds, including the firmware and codes, are downloaded from the GitHub open-source code site.

REFERENCES

[1]. M Yuvaraju, P M Benson Mansingh Book Chapter titled “A Secure Data Sharing Scheme based on Blockchain for Industrial Internet of Things using Consensus Algorithm” for the book “Industry 4.0: Analytics and Case

Studies", Taylor & Francis Group,UK, Chapter 8, 1st edition, January 2021, eBook ISBN: 9781003048855. (SCI)

[2]. P M Benson Mansingh, T Joby Titus, G Sekar Book Chapter titled "Vehicle collision avoidance system using Li-Fi" for the book "IOT Applications Computing", IntechOpen Ltd. London, January 2022, ISBN 9781839686900. (SCI)

[3]. P. M. B. Mansingh, T. J. Titus, G. Sekar and A. Shankar, "IoT based Noise Detector with Automatic Recording System," 2021, IEEE, 5th International Conference on Computing Methodologies and Communication (ICCMC), 2021, pp. 466-468, doi:10.1109/ICCMC51019.2021.9418394.

[4]. M. Yuvaraju, P. M. Benson Mansingh and G. Sekar, "A Li-Fi Based Collision Avoidance System For Vehicles Using Visible Light Communication," 2021, IEEE, 7th International Conference on Electrical Energy Systems (ICEES), 2021, pp. 114-116, doi:10.1109/ICEES51510.2021.9383736.

[5]. P M Benson Mansingh, T Joby Titus, M Yuvaraju "BER Analysis Of Channel Coding Techniques For 5G Networks", IOP: Materials Science and Engineering 932(1), February 2020. (SCI)

[6]. RP M Benson Mansingh, "Application of Internet of Things on the Healthcare Field Using Convolutional Neural Network Processing", Journal of Healthcare Engineering, Hindawi, Volume 2022, Article ID 1892123, doi: https://doi.org/10.1155/2022/1892123.

[7]. P. Papageorgas, D. Piromalis, K. Antonakoglou, G. Vikas, D. Tseles and K.G. Arvanitis(2013), "Smart Solar Panels: In-situ monitoring of photovoltaic panels based on wired and wireless sensor networks", International Conference on Advancements in Renewable Energy and Clean Environment.

[8]. Bruno Ando, Salvatore Baglio, Antonio Pistorio(2015), "Sentinella: Smart monitoring of photovoltaic system atpanellevel", IEEE Transaction on Instrumentation and Measurement.

[9]. Zhang Mingtao, Du Weida, Xie Dongzhou, and Peng Hong, "Distributedphotovoltaic powergeneration monitoring system based on an embedded platform", Foreign Electronic Measurement Technology.

[10]. Farihah Shariff, Nasrudin Abd Rahim, and Hew Woori Ping, "Zigbee-based data acquisition system for online monitoring of the grid-connected photovoltaic system", Expert Systems with Applications.