IOT -Based Industrial Parameter Monitoring and Control System Using LoRa Module

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Abstract - Monitoring and controlling contemporary cycles, engines, equipment, and devices is crucial for gathering important data and information. This focuses on regulated admittance for increased efficiency. Remote communication solutions are often confined to simple applications due to slow speeds, long distances, and security concerns. LoRa technology enables high-quality connectivity and security for monitoring and controlling industrial applications. LoRa is used to convey monitored and regulated data. Data may be visible in both the control and production units. We have included graphical representations of the data in Thing speak and a mobile app for clarity. We created code to evaluate the accuracy of a machine learning method using three parameters.

Key Words: Domestic and Industrial Automation, Internet of Things, LoRaWAN, Low Power Consumption, Sensor Node.

1. INTRODUCTION

The Internet of Things (IoT) refers to a network of uniquely identified computing devices, machines, animals, and humans. The Internet of Things (IoT) emerged from a convergence of long-standing technologies. These technologies encompass electromechanical systems, the internet, and wireless automation. Implementing IoT-based automation is becoming increasingly popular. Automation is a developing technology that requires study and input from companies, academics, and experts. LoRaWAN, or Long Range Wireless Area Network, is a cutting-edge technology that is both efficient and user-friendly.

LoRaWAN technology enables remote control and monitoring of appliances, machinery, and agricultural pumps using internet of things and LoRa modules. This system allows wireless management of electrical characteristics such as voltage, current, and power, as well as mechanical parameters likes temperature and switching, utilizing LoRa technology. The LoRa system has a range of 0 KM to 50 KM without internet, allowing for a vast network with IoT applications. The system includes two transceivers: a LoRa module and an IoT server that may be located anywhere in the system. Internet appliances can be simply controlled and monitored. This approach addresses real-time monitoring issues for home, industrial, and agricultural systems. However, it is important to ensure that current techniques are used wisely to conserve resources. Recently, IoT installations have used several communication methods for controlling and monitoring purposes. RFID, Zigbee, WSN, and cellular networks (GSM, 3G, 4G, VoLTE) are among the technologies involved. Monitoring applications with these technologies have several downsides, including lower energy efficiency, greater costs, and limited communication range. Figure 1 compares communication systems based on their range and data transmission rates.

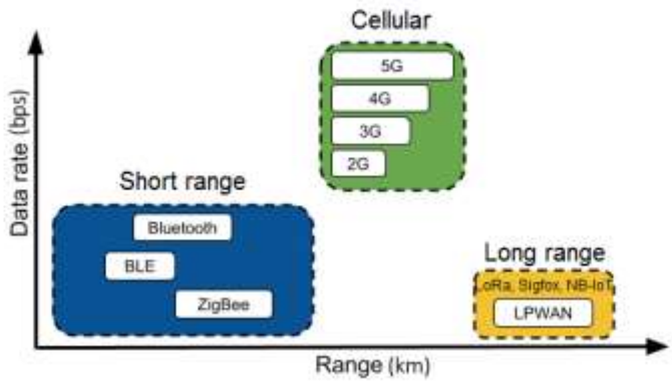

Fig.-1: Comparison of Different Communication Technologies for Communication Range and Data Transfer Rate

2. Proposed System

The proposed IoT-based appliance control and monitoring system utilizes LoRaWAN technology. LoRaWAN is a Long-Range Wide Area Network that allows for wireless data transmission and reception over long distances, resulting in increased efficiency, lower costs, and less maintenance. IoT is ideal for controlling appliances, but has drawbacks that may be mitigated by employing a LoRa module. In this system, LoRa modules employ transceivers to transmit and receive data, while a microcontroller responds to user commands and activates the relay system. This long-range technology wirelessly sends data up to 20KM to 100KM, depending on bandwidth. Figure 1.1 depicts a block diagram of an IoT appliance control and monitoring system utilizing LoRaWAN technology.

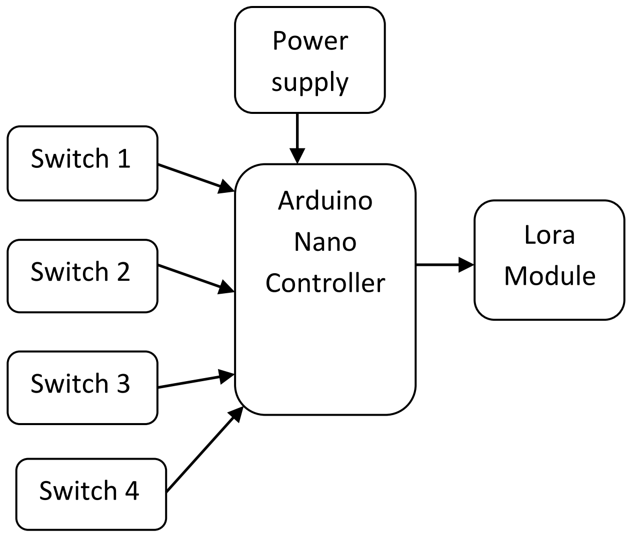

Fig.-2: Transmitter Block Diagram

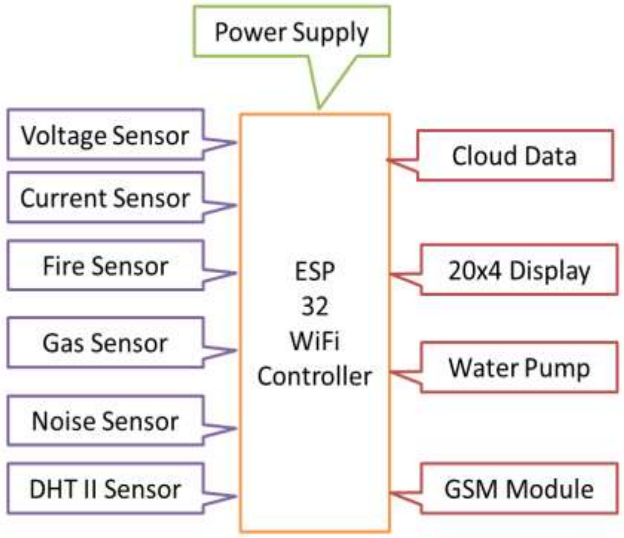

Fig.-4: System Design & Architecture

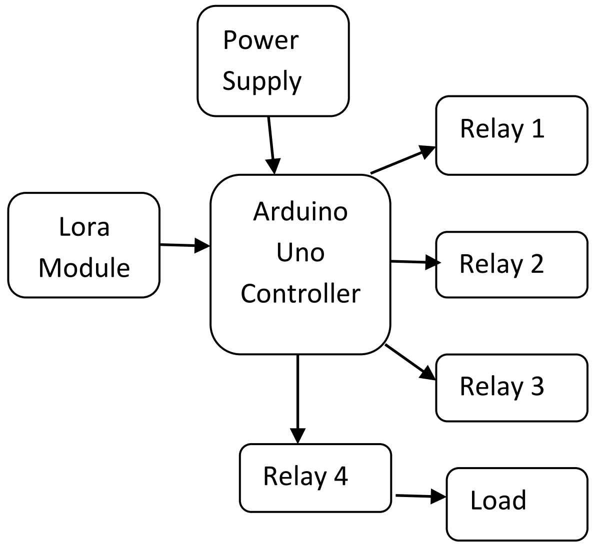

Fig.-3: Receiver Block Diagram

The block has three primary components: an IoT server, a LoRa module, a microcontroller, and magnetic relays. IoT servers provide connectivity between transmitters and receivers. The LoRa module enables wireless long-distance communication between the controlling site and the server at no cost. The user sends a command to the server, which reads it and performs the requested function. Feedback is sent to the user. The system consists of two parts: a transmitter and a receiver coupled to an IoT server. Relays are electromagnetic switches that create and break circuits. The circuit uses sensors to detect flaws and automatically trip the circuit if they occur.

3. RESULT AND DISCUSSION

The LoRa-based Industrial Automation system with NodeMCU, MQ135 sensor, DHT11 sensor, and relay provides cost-effective and efficient load control based on real-time sensor data. The system offers precise and fast information on air pollution, temperature, and humidity, and adjusts loads accordingly.

Automation reduces manual involvement, maximizes resource utilization, and improves energy efficiency. The system's LoRa wireless communication technology ensures safe and reliable data transfer over long distances, making it suitable for industrial and home automation applications. The system's low-cost sensors and wireless communication technologies provide a cost-effective option for real-time load control.

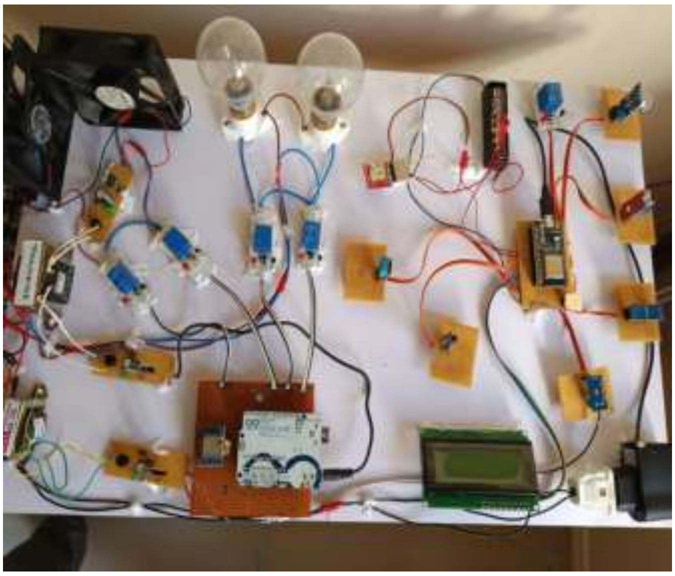

Fig.-5: Hardware of The Proposed System

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We successfully constructed and tested a LoRa-based industrial automation system including NodeMCU, MQ135 sensor, DHT11 sensor, and relay for load control. The system monitors temperature, humidity, and gas concentration in an industrial context, controlling the load depending on sensor data.

Fig.-6: Results of The Proposed System

The system was tested under various situations, with the following results:

Fig.-7: Results of Voltage & Current

Fig.-8: Results of Humidity & Gas

Fig.-9: Results of Temperature & Noise

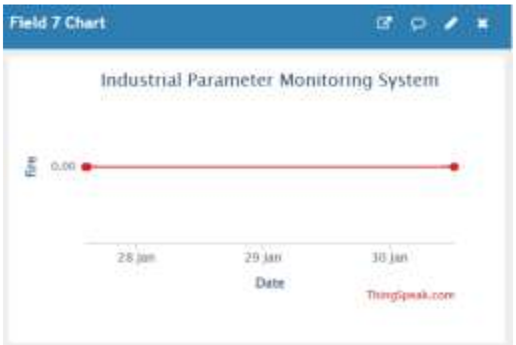

Fig.-10: Results of Fire

Sensor readings: The temperature, humidity, and gas concentration sensors provided precise and dependable data, allowing for continuous monitoring. Load control: Sensor readings were used to control the load on the relay. For instance, the fan was activated when the temperature surpassed a safe threshold, but the load was switched off when the gas concentration exceeded the same limit.
LoRa communication between nodes was successful, resulting in sensor data transmission to other nodes and gateways across large distances.

The system was developed with minimal power consumption and optimized for long battery life. The system can run on battery power for extended durations, eliminating the need for regular recharges. The system's load management ensured a safe industrial environment.

4. CONCLUSIONS

The suggested LoRa-based Industrial Automation system has potential to enhance the efficiency and sustainability of industrial and home automation applications. The system's automation reduces manual involvement, resulting in improved resource utilization and energy efficiency.

Industry automation technologies use platforms to link gadgets and make homes smarter and easier to use. We accomplished accuracy by using static IP addresses and a state function to determine device status. In conclusion, home automation combining internet of things and LoRa technology via an Android app is both user-friendly and affordable. The research indicates that this model has a success rate of around 95%. Future development on this technology will focus on lowering installation costs and reducing power usage.

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