IRO Journal on Sustainable Wireless Systems (ISSN: 2582-3167)
www.irojournals.com/irosws/

Automatic Pole Line Fault Detection System Using LoRa

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Abstract

One of the a major threat for the electricians are climbing the electric poles to identify the faults. To avoid such cause this research aims to develop a promising method to identify the faults without climbing the poles. The portion of the electrical cable that connects the transformer to the customers is the main emphasis of this proposed work. These errors must be found and fixed as soon as possible because they directly affect the clients to do this, discrete units made up of a number of voltage and current sensors are placed at certain locations along the power line. If a failure occurs on the line, it may be determined using sensor values. The transmitter is mounted to the pole wires for continuous monitoring. If any issues are found, they are reported through GSM to the closest Electricity Board office. The research utilises the LoRa device after they have reached the desired area to find the faulty pole line and to safeguard their safety as they climb. The proposed design has developed a protype for the fault monitoring of particular area in Coimbatore and has also developed an IoT module application interface using Blynk app to convey the detected faults to the nearby electricity board. The proposed design reduces the number of casualties caused and the time required in conveying the faults to the EB. In future the suggested method could be further improved to automatically detect the pole line faults of the complete district.

Keywords: Monitoring, GSM, LoRa, Fault Detection

DOI: https://doi.org/10.36548/jsws.2023.2.002
Received: 31.04.2023, received in revised form: 31.05.2023, accepted: 09.06.2023, published: 19.06.2023

1. Introduction

Electricity takes an important role in our daily lives. There is complex network of power sources, so transmission line faults can happen naturally. To find the defects on high-voltage HT lines, conventional techniques are still employed, such as sending a technical team to the location. An automated pole line fault detection system is used to identify a gearbox line failure in order to solve this problem. Transmission lines must be found and fixed as soon as possible in order to maintain system reliability because they are more prone to failure due to exposure to the environment. The microprocessor of the relay stores the code needed to communicate with different relays, trip the circuit breaker, and display the relay position. The load is connected to the relay, which is used to make sure that the circuit is shut off when there is a problem. The control room receives information about the fault at the end. The UNO sends all necessary information to the circuit.

2. Literature Review

In this paper, George and et al. present that as a consequence of the increased need for improved reliability and dependability in power distribution, researchers' interest has been sparked and the pursuit of cutting-edge technologies for fault detection and location determination at medium and high voltage levels has been reignited. The goal is to construct and implement a low-cost IoT platform based on LoRaWAN for monitoring distribution networks. [1]

In this paper, Jignesh Gohil and et al. introduce the idea of "fog computing," which uses a cloud computing architecture with a layer of hierarchy to process the initial data and accelerate decision-making to find and detect pole line faults. [2]

In this paper, Ranjit Singh, Sarban Singh, and et al. describe how a defect sensing circuit, control switching, and optimisation are all integrated into a standard, straightforward construction and operation system in this project, from which the proposed system's entire approach is derived. [3]

In this paper, Bindhu V. and et al. are all about cutting back on manual labour. We provide a method that pinpoints troublesome poles in the network by measuring changes in current and voltage at each node and calculating the separation between the station and the problematic node. [4]

3. Methodology

The block diagram in Fig.1.1 consists of a power supply, ATMEGA328 microcontroller, potential transformer, current measurement, relay, load, LoRa, and LCD.

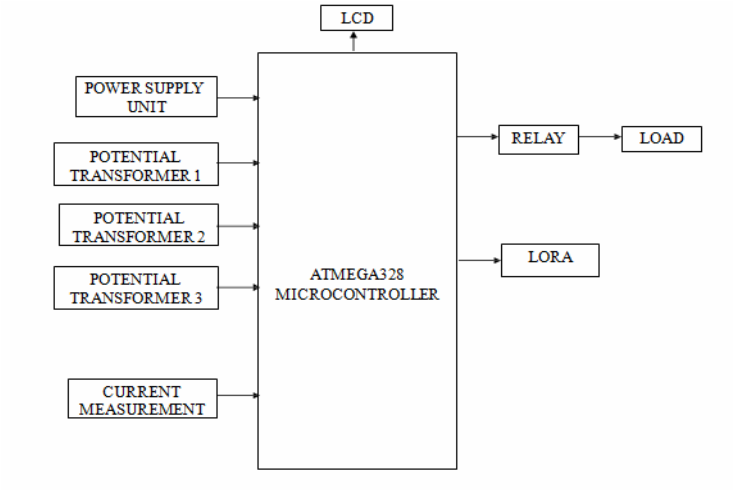

Figure 1. Block Diagram for Pole Line [ref: 11,12]

The load has a connection to the three-phase transformer. The value of the current and the voltage are sent to the microcontroller that is fixed to receive the information about the current and the voltage. If any fault occurs the microcontroller sends the information to the LCD, The LoRa device will receive the microcontroller's fault. When a limit is reached, the LoRa alerts the worker through a buzzer and a message via the GSM module.

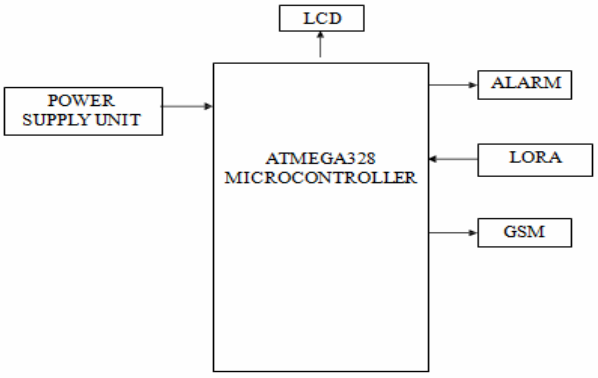

Figure 2. Block Diagram for LoRA Device [ref:11,12]

The block diagram in Fig.1.2, It consists of an ATMEGA328 microcontroller, a power supply, an alarm, LoRa, GSM, and an LCD. Through the LoRa module, the microcontroller's discovered fault is transmitted to the LoRa device. When a limit is reached, the LoRa device alerts the worker through a buzzer and a message via the GSM module. Based on the above methodology [11,12] employing a micro controller and the LoRaWAN the proposed method has devised a prototype and the user interface of the pole line fault detection for a particular area in Coimbatore.

3.1 Hardware Components

A. ARDUINO UNO

The ATmega328 is a microcontroller featuring an AVR, an 8-bit CPU, 32KB of internal flash memory, and 1KB of EEPROM. Because of this property, the microcontroller can continue to store data and generate output even if its power source is shut off. There is a 2KB static random access memory (SRAM) on the ATmega328 as well. We'll talk about other features eventually. The ATmega328 is currently the most well-liked device available due to its wide range of features. A genuine timer counter with a separate oscillator, quick performance, low power consumption, and advanced RISC architecture are just a few benefits. A few characteristics include six PWM pins, a serial USART that can be programmed, a software programming lock, and a throughput of 20 MIPS. We'll go deep into the ATmega328 later on in this section.

B. LCD

A substance that possesses both liquid and crystal properties is used to create liquid crystal displays (LCDs). The molecules move nearly like they are in a liquid, but instead of having a melting point, they have a range of temperatures where they cluster together into an organized crystal-like form. The LCD display has two panels of glass placed by liquid crystal layers. An inside surface of the glass plate covered transparent electrode determines the character, symbol, or pattern that will be displayed.

C. LoRa DEVICE

The Ra-02 addresses the problem that conventional wireless designs do not take into account distance, anti-interference, and power consumption by providing suitable FSK remote modulation and demodulation that may be completed rapidly. It is the best choice for

applications involving networking. Ra-02 is packaged as an SMD and is easily produced with standard SMT tools. A connection mode with high reliability is advantageous to customers.

D. GSM MODULE

This GSM modem is plug and play and has an easy-to-use sequential interface. Simple regulators and PCs can control it with AT commands to send and receive decisions, send SMS, and carry out other GSM tasks. It runs all of its functions through the well-known SIM800 module. Computers and microcontrollers can be connected to the modem using its common RS232 interface. Along with all the other hardware needed for the SIM800 module to operate, the modem also comprises the GSM module.

E. RELAY

Relays are electrically-driven switches. Electricity passing through the relay coil generates a magnetic field that draws a lever and modifies the switch contacts. Because the coil current in a relay may be switched on or off, it has two switch positions and a double throw switch. Relays enable complete independent control of one circuit by another. The relay connects the two circuits using a mechanical and magnetic link rather than an electrical connection. In contrast to the conventional 30 mA for a 12 V relay, the coil of a relay intended for lower voltages can conduct up to 100 mA of current. Since the majority of integrated circuits (ICs) cannot provide this amount of current, a transistor is frequently used to increase the IC current to the higher level needed for the relay coil.

4. Result and Discussion

A. POLE LINE

There are 4 transformers in the kit: one supplies the main power to the kit, which is larger in size, and the other three supply the single-phase power, each representing the three-phase line R Y B. The output of the transformer is connected to the regulator circuit, which has a bridge rectifier, capacitor, trim port, and regulator. Two regulators are used. A 7805 and 7812 5-volt regulator are used in this project, and the 12-volt regulator is used for future purposes. The output of the regulators is connected to the microcontroller. Using the controller, the low and high voltage ranges are established; the low voltage range is 200 volts, and the high voltage range is 240 volts. If the voltage exceeds or decreases beyond this range, the controller operates. 200 volts is referred to as 3 volts, and 240 volts is referred to as 5 volts. So, the controller will

operate accordingly at 3 to 5 volts. The output devices are the relay and the IoT device. A relay is used to make or break the supply while the fault occurs, and the IoT module is used to share information about the pole line. The hand device that is used by the lineman to detect the fault. When this device is shown closer to the pole, it will indicate the condition of the pole. The same controller and battery unit are used for power supply, and an LCD display is used to show the information. The receiver of the LoRa is connected to the controller to receive the information that is shared by the LoRa transmitter, which is located in the pole line. According to the display, the lineman can operate accordingly and clear the fault. The complete status of the pole is displayed on the hand device. Relays consists of two switch positions and a double-throw switch because the coil current can be switched on or off. A bulb holder is connected to the relay circuit for the overcurrent testing.

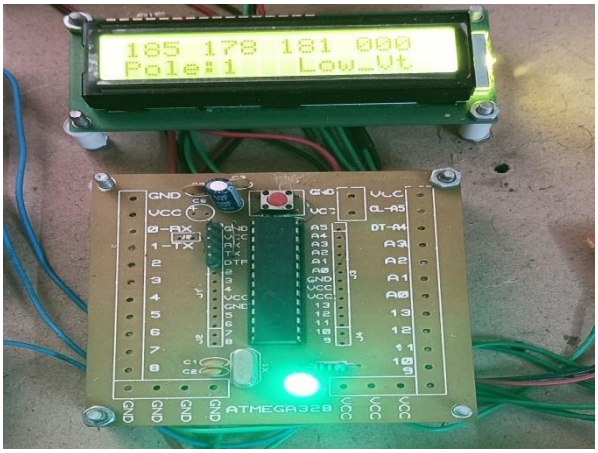

Figure 2.1. Pole Line Output

The figure 2.1 shows the pole

Figure 2.2. Handheld Device Output

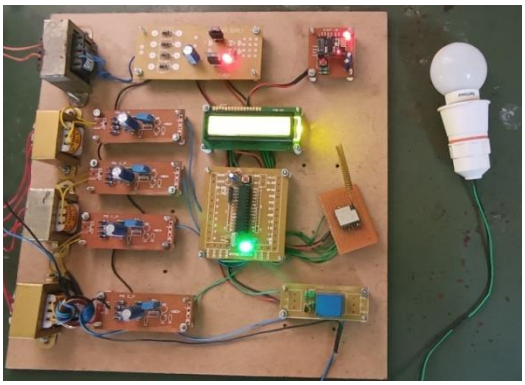

Figure 2.3 Final Setup Output

B. APPLICATION INTERFACE

The devised IOT module is designed using the Arduino IDE and Embedded C the information is shared to the EB office through the application interface. The exact voltage and the current of the poles are regularly updated to the closest electricity board. The application interface for the research is developed using the Blynk application to handle the commuting of faults diagnosed in poles.

Figure 2.4. Application Interface

5. Conclusion

In this research, the technical team can find the HT line issue much more quickly and fix it as soon as possible. Power outages won't occur in this situation for a very long period, and if they do, they can be maintained to a minimum. Here, an uninterrupted power supply from the reputable sub-power station may be given, saving time and causalities. LoRa is being used in this instance as a wireless communication method, greatly simplifying the process. For improved coverage, a LoRa-based WAN that can span a larger area has been suggested.

References

[1] George yodango , Richard musabe, Damien Hanyurwimfura, AbubakardiwaniBakari ,“An Efficient LoRa-Enabled Smart Fault Detection and Monitoring Platform for the Power Distribution System Using Self-Powered IoT ” IEEE Annual India Conference, India,july 7, 2022.

[2] JigneshGohil, ChintanParmar “LoRa based Architecture for Fault Localization in Transmission Lines” International Journal of Computer Applications , Feb 2022.

[3] RanjitSinghSarbanSingh,YanChiewWong,BaljitSingh,Maysam F Abbod “A new fault detection system using wireless communication - assisted with analog relays for grid electrical lamp pole network.”Journal of Theoretical and Applied Information Technology,April 30,2019.

[4] Bindhu V, G. Ranganathan “Effective Automatic Fault Detection in Transmission Lines by Hybrid Model of Authorization and Distance Calculation through Impedance Variation” Journal of Electronics and Informatics,March 27,2021.

[5] Aravind sing rawat ,jagadheswaranrajendran,“Lora (long range) and LoraWAN Technology for Iot application in COVID 19 pandemic” International Conference on Advances in Computing ,Communication & Materials(ICACCM),Nov 2020.

[6] P.Ramachandran, V.Vittal and G.T.Heydt, “Mechanical state estimation or overhead transmission lines with level spans”,IEEE Trans. Power Syst., vol.23, no. 3, pp.908–915, Aug.2008.

[7] S.Gumbo and H. N. Muyingi, “Performance investigation of wireless sensor network for long distance overhead power lines”,IEEE Xplore,December 2008.

[8] Yik-Chung Wu,Long-Fung Cheung,King-Shan Lui,Philip W. T. Pong "Efficient Communication of Sensors Monitoring Overhead Transmission Lines" IEEE Transactions on Smart Grid,September 2012.

[9] S.Gomathi, Dr.M.V.Suganyadevi, Dr.A.Deepak, M.Nithya, R.Vivitha "Photovoltaic based Induction motor speed control Using SEPIC converter", 2020.

[10] Nagarajan, Ramalingam, SivasreeSathishkumar, K.Balasubramani, C.Boobalan"Chopper Fed Speed Control of DC Motor Using PI Controller", Research Gate, May 2016.

[11] https://eudl.eu/pdf/10.4108/eai.14-5-2022.2318875

[12] Mahalakshmi, G., M. Mithunesh, Parithi Adhavan TK, and R. Prasanth. "Automatic Pole Line Fault Detection System using Microcontroller." In 2022 4th International Conference on Inventive Research in Computing Applications (ICIRCA), pp. 42-47. IEEE, 2022.

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