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LINE FAULT DETECTION AND ALERT SYSTEM USING IOT

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Abstract— **This paper proposes an IOT based fault line detection and alert system designed to provide rapid response and precise localization of faults in electrical distribution systems. The system aims to enhance the efficiency of fault management, minimize downtime, and reduce accidents caused by electrical faults. The system utilizes sensors installed along the distribution lines to continuously monitor parameters such as voltage, current, and temperature. When a fault occurs, the sensors detect deviations from normal operating conditions and immediately trigger an alert .The alert is transmitted to the Kerala State Electricity Board (KSEB) in real-time, enabling swift notification of the fault occurrence. This ensures that KSEB personnel can promptly initiate the necessary actions to address the issue, minimizing downtime and restoring power supply to affected areas quickly. Furthermore, the system incorporates GPS technology to accurately pinpoint the location of the fault. This information is relayed to the line maintenance personnel, enabling them to precisely locate the faulted section of the distribution line without time-consuming manual inspection. By facilitating fast response times and accurate fault localization, the proposed system significantly reduces the risk of accidents and enhances overall safety. Additionally, the system's proactive approach to fault detection helps prevent potential equipment damage and costly repairs, leading to improved reliability and efficiency of the electrical distribution network**

I. INTRODUCTION

Electricity has become an essential aspect of our daily lives. Supply of electricity is mainly is mainly done through power line transmission system. There arise a lot of problems due to the disruption in the power line .Fault of power line is common This occurred due to various reasons such as falling of trees , thunder, heavy wind, rain etc. the electric power grid is extremely vulnerable to a veriety of natural and malicious physical events. To detect faulty transmission lines, many electric power transmission companies have relied primarily on circuit indicators. Several of these issues are addressed by line fault detection and alert system using IOT. It helps in faster fault localization accurate fault diagnosis .Cost savings due to condition based maintenance rather than periodic maintenance and so on. These applications have strict requirements such as delivering a large amount of highly reliable data quickly. The design of cost effective and reliable network architecture with a fast response time is critical to the success of this application. The network must be capable transporting sensitive data to and from the transmission grid such as transmission line status and control data.

As a result of the fault of power line there arise a lot of problems such as disruption in the power supply to the households, industries and other firms. Along with that the faulty line will result in the death of animals and other organism when come in contact with the faulty line, along with those children, elderly people when unknowingly touches the fault line will cause the death of people .This all occurs due to the fault of the powerline. In the current scenario when the fault occurs, the people residing near the place where the fault occurs will inform the KSEB when the power supply is delayed. But it will take more time. Sometimes the people are hesitated to inform KSEB and they think that others will inform about it, the wait long time to see whether the power supply is interrupted due to any maintenance purpose or is this occur due to power cut or not. So the informing procedure took a lot of time. And it will increase the chances of risk.

The Power line Fault Detection and Alert System utilizing IoT is a cutting-edge solution designed to enhance the efficiency and reliability of transmission grids. By incorporating two current sensors strategically placed on transmission poles, the system continuously monitors current values. These values are then compared in real-time to detect any discrepancies, indicative of a fault occurrence. Upon detecting a fault, the system triggers an alert via a GSM module, promptly notifying designated recipients. This proactive approach not only minimizes downtime but also aids in swiftly addressing potential hazards, ensuring the seamless operation of the grid. Here in this technology, whenever the powerline fault occurred the current sensor will sense the current , if there is no current the microcontroller will sent the alert through GSM module to the KSEB which include the information regarding the location of the pole where the fault occur. This technology is a fast and accurate. So the lineman doesn’t need to wander through the particular location to find the place where the fault occurred, as this technology provides the location of pole where the line fault is detected. As it is a fast process so it reduces the chances of accidents due to electric shock and along with that it enables the power supply quickly.

II. LITERATURE SURVEY

A. OVERHEAD LINE FAULT DETECTION USING GSM TECHNOLOGY

Priya A Gulbhile , Jitendra R Rana ,Bapu T Deshmukh -Jawaharlal Nehru Engineering College, Aurangabad, Maharashtra, India. International Conference on Innovative Mechanism for Industry Application (ICIMIA 2017).

The three phase parameter i.e. voltage of overhead line will get continuously sensed using phase voltage sense section. Once the fault takes place in overhead line, voltage and current values deviates from their nominal ranges. The faults like all series & shunt faults get detected & classified here. During occurrence of any series & shunt faults, voltage get sensed and respective signals are given to microcontroller. . Relay is connected for detecting fault in fault display section. Relay is operated by micro-controller and switched after the occurrence of faulty condition. Microcontroller programing is done on the basis of characteristics conditions of overhead line voltages on occurrence of fault. The type of fault gets analyzed by microcontroller. If the fault gets occurred wireless technology GSM (global system for mobile communication) is used to send SMS to a responsible person on mobile. Type of fault will display on fault display section. Simultaneously fault will clear. The fault clearing system uses various protection devices such as relays and circuit breakers to detect and clear the fault. The three phase voltage sensed is continuously given to microcontroller. The implemented system completely meets the demand of low cost by using the microcontroller and mobile communication technology with the aim to detect the abnormality and fault occurred in the overhead electric line. The implemented system design mainly concentrates on overhead electric power lines. It provides the way to detect all series and shunt fault on transmission and distribution lines. Voltage of the line will get continuously sensed using phase voltage sense section. During the occurrence of any series and shunt fault on the three phase line, voltages get sensed and respective proportional signals are given to microcontroller. The type of fault is detected by microcontroller. . If the fault gets occurred wireless technology GSM (global system for mobile communication) is used to send SMS to a responsible person on mobile. Type of fault is gets displayed on fault display LED section. Simultaneously fault is get isolated using circuit breakers to provide proper protection to the overall system, especially against shunt faults

B.REVIEW ON FAULT DETECTION AND CLASSIFICATION IN TRANSMISSION LINE USING MACHINE LEARNING METHOD.

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2023 International Conference on control, communication and computing (ICCC).

A basic methodology of fault analysis using any ML methods. The transmission line is model led based on the real system parameters and the environmental conditions for fault analysis. The fault is generated in the system. A, B, C, and G are used to represent the three phases and the ground. For feature extraction, the data gained from fault production is employed. A ML model is trained and tested .Basic Methodology for Fault. Analysis using the features that were gathered and it then accurately categorizes the fault. A large transient current is generated in the system when a fault occurs. This current waveform exhibits higher frequency over a brief period of time .With the help of this data extraction, we could get the features required for ML model .For the detection, classification, and estimation of fault location at any random position on a transmission line for both type of low and high fault impedances, Bikash et al [19] used Wavelet Packet Entropy (WPE) and an Radial Basis Function Neural Network (RBFNN). RBFNN’s output layer outputs for classification and estimation of fault location, while its input layer has 12 inputs. The activation function has been proposed to be the Gaussian radial basis function. About 98% of faults were correctly classified. However, one of the single line (A-G) faults had an accuracy of roughly 93%, and for other faults as well, the accuracy varied from fault to fault .P Balakrishnan et al [13] introduced a DWT based algorithm for overhead lines. DWT was employed with ‘db6’ as the mother wavelet. A ground threshold value served as the basis for the classification procedure. Issues can be discovered by receiving fault information along the entire transmission system, from the regional terminal end to the initial terminal end. All eleven categories of TL faults were detected, classified, and located using DWT to identify the signal, extract the detail coefficient, and then locate the faults. The threshold value used for classification varies with different systems. Shahriar et al [20] offered an unsupervised framework based on a Capsule Network (CN) for identifying and categorizing TL defects. It was done using a sparse filtering extension to CN. By actively learning the critical defect characteristics the capsule network with sparse filtering (CNSF) improves model performance without needing a substantial amount of information. The proposed technique acquires cycle post-fault three-phase data and decodes it into a single image, which is the feed of the considered CNSF model. Four distinct topologies were used to support the proposed CNSF model’s efficacy. But it was not consistent in the analysis because of the diversity in transmission line topologies, system parameters, and operating conditions .Daniel et al [21] studied a fault selection system for double-circuit transmission lines using various learning techniques. The suggested method preprocesses the transmission line’s raw data using the Discrete Fourier Transform (DFT) before feeding it to the learning algorithm, which uses a training period to identify and categories any faults. Then, using simulations, the effectiveness of various machine learning algorithms was numerically compared. In the comparison, an accuracy of 98.47% was found to be achieved by an artificial neural network (ANN). The ANN method’s short comings include its inability to produce results that can be explained and its lack of robustness to noisy measurements. Pathomthat et al [22] analyzed faults in a transmission line and high voltage capacitor banks using DWT. The finding showed that when compared to failures occurring in a capacitor bank, the features of system parameters in the event of transmission line faults are distinct. DWT was also used to resolve the disagreement between system characteristics incases when failures occurred in both a single capacitor bank and two capacitor banks linked in a back-to-back topology. But the method cannot be applied to complex networks. Nguyen et al [23] created a hybrid approach based on machine learning (ML) techniques to recognize, categories.

And find electrical defects on transmission lines. First, characteristics from the current or voltage signals were extracted using the WT approach. Eleven coefficients were created by decomposing the extracted signals. The data of various fault kinds were transformed to an RGB image, and these coefficients were calculated according to the energy level.

c. TRANSMISSION LINE FAULT DETECTION BY USING ARDUINO

Venugopal Reddy,N Sai Deep .Satyabama Instituite of Science and Technology Deemed University.

The voltage, fire, short, open circuit sensors are attached to both Arduino and transmissions lines maintaining the connection between them, meanwhile the Arduino is connected to RPS and the LCD, buzzer, GSM are connected to Arduino completing the circuit. When supply is given to the circuit, if there is any problem in the circuit like high voltage or low voltage the voltage sensor comes in to work and indicates the Arduino which sends signal to LCD to display that there is a short circuit at a specific area and also the buzzer will be alerted. Same process will be continued for all the sensors, if there is a fire at any of the transmission lines the fire sensor comes in to work, if there is any open and short circuit respective sensors come in to work .The set up or field device consists of 2 major components, GSM and microcontroller. The over voltage sensor, fire sensor, short circuit and open circuit sensors are attached to both microcontroller and transmissions lines maintaining the connection between them, meanwhile the Arduino is connected to RPS and the LCD, buzzer, GSM are connected to Arduino completing the circuit. When supply is given to the circuit, if there is any fault in the circuit like high voltage or over voltage the voltage sensor comes in to work and indicates the Arduino which sends signal to lcd to display that there is a short circuit at a specific area and also the buzzer will be alerted, and GSM sends SMS to mobile .Same process will be continued for all the sensors, if there is a fire at any of the transmission lines the fire sensor comes in to work, if there is any open and short circuit respective sensors come in to work. In this process it can detect four types of faults they are: over voltage fault, fire fault, short circuit fault and open circuit fault.

III. PROPOSED SYSTEM

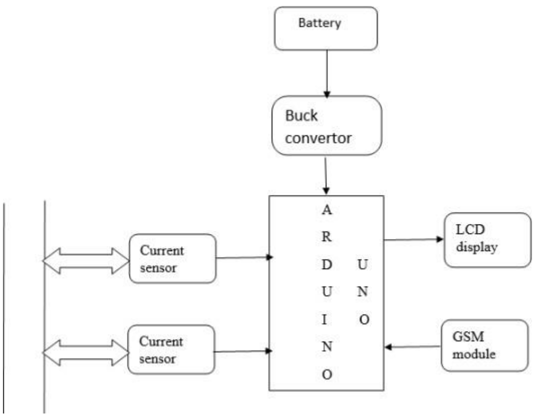

Figure 1-Block diagram

IV. CIRCUIT DIAGRAM

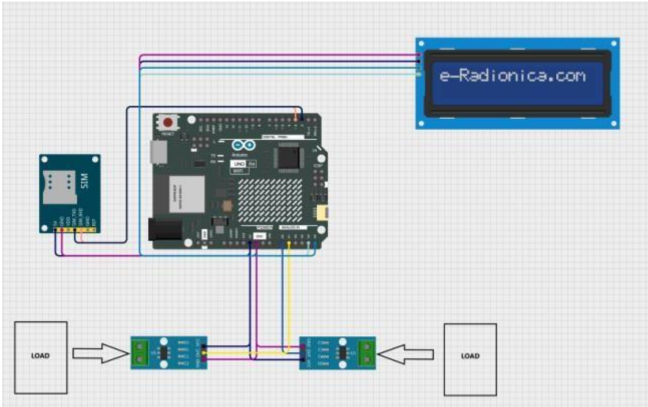

Figure 2-Circuit Diagram

V. WORKING

Fault of power line is common and it occur due to various reasons such as falling of tree, rainfall, thunder etc. It cannot reduce the fault rate. But we can reduce the effect of fault. Hence by using line fault detection and alert system it can give timely awareness, provide real time visualization and alerting and data acquisition. here using two current sensors, ACS712. These two current sensors has 3 pin points gnd ,vcc, vout. The vout of one current sensor is connected to the A0 pin and the vout of the second current sensor is connected to the A1 pin of the microcontroller. These current sensors are used to sense the presence of current in the transmission line. The output of current sensor is fed as the analog input to the Arduino uno microcontroller.

The lcd display is connected to the microcontroller.. The lcd has 4 pin in which the scl pin is connected to the A4 and sda pin is connected to the A5 of the microcontroller and proper vcc and ground is provided. Lcd display is used to provide the real time visualization and accurate display of result of line fault detection and alert system using iot. If the line fault is occurred before pole 1, there is no current entered into the current sensor, that is the current is absent in pole 1 current sensor. Hence it denotes that line fault occurred before pole 1. And the result is visualized in the lcd display. If the current sensor sense the presence of current in pole 1 and the current is absent in pole 2, it denotes that the fault is occurred after pole 1 but before pole 2. Hence the result was line fault occurred before pole 2 and it is visualized as line fault occurred before pole 2. If both current sensors in both poles sense the presence of current, it denotes that there is no line fault and it is displayed in the lcd display.

The gsm module is used to provide the alert information regarding line fault occurrence to the desired recipient in a timely manner. The vin pin of the gsm module is connected to 5v, ground is connected to ground, the tx pin is connected to the pin 2 of Arduino and rx pin is connected to the pin 3 of Arduino. When the line fault is occurred the alert msg was sent to the desired recipient. If line fault is not occurred no alerting occur. If the line fault is occurred before pole 1, that is identified by the absence of current in the current sensor 1. The alert is sent to the desired recipient as line fault occurred before pole 1. If the line fault is occurred after pole 1 but before pole 2 the alert is send as line fault occurred before pole 2. Hence real time and accurate visualization and the alerting of line fault detection and alert system is viewed.

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VI. RESULT

Case 1: NO LINE FAULT

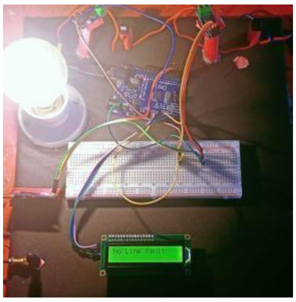

Figure 3 -No line fault

Here the current sensors present in both poles detect the current. That is current is present in two poles. Hence there is no distortion in the current in the transmission line. Thus it indicates that there is no line fault in the transmission line. The power supply does not interfere and all the households connected to the transmission lines get a power supply. As there is no line fault, there is no chance of electric shock accidents. The LCD showcased the result as no line fault occurred. As there is no line fault no alerting will occur.

Case 2: LINE FAULT OCCUR BEFORE POLE 1

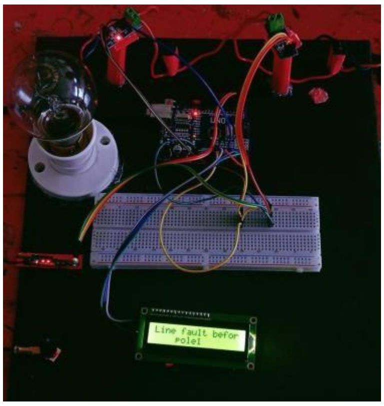

Figure 4 -Line fault before pole 1

In this case, the two current sensors are placed on two poles of the transmission line to sense the presence of current in the corresponding poles. Current is not present in pole 1. That is line fault occurred before pole 1. As line fault is detected before pole 1, no further checking of the current in pole 2 occurs. So it is evident that line fault occurred before pole 1. LCD connected to the Arduino showcased the result as a line fault occurred before pole 1. As line fault has occurred the GSM module sends the alert signal to the desired recipient as line fault occurred before pole1. Hence the lineman can get alerted as soon as the line fault occurs and they can correct the fault as early as possible. Hence avoids the chances of accidents due to electric shocks.

Case 3: LINE FAULT OCCUR BEFORE POLE 2

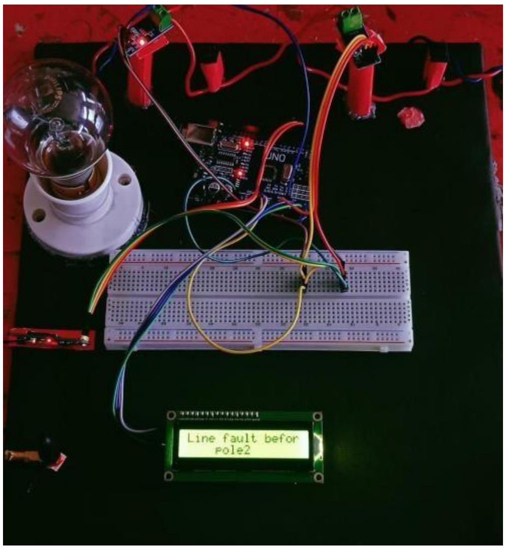

Figure 5-Line fault before pole 2

In this case, the two current sensors are placed in the two poles of the transmission line and sense the presence of current in the corresponding poles. Current is present in pole 1 and it is sensed by the current sensor present in pole 1. The current is absent in pole 2. That is the current sensor placed in pole 2 does not have any current value. This indicates that the current is present in pole 1 but which is absent in pole 2. That is there occurred a fault after pole 1 but before pole 2. That is line fault occurred in the transmission line anywhere in between both poles. This result is showcased in the LCD as a line fault occurred before pole 2. As there is a fault occurs, the GSM module connected to the Arduino Uno microcontroller will send an alert to the desired recipient as a line fault occurred before pole 2. . Hence the lineman can get alerted as soon as the line fault occurs and they can correct the fault as early as possible. Hence avoids the chances of accidents due to electric shocks.

VII. FUTURE SCOPE

In addition to the immediate benefits of a line fault detection and alert system using IoT, there are several future scopes for further enhancement and optimization:

Predictive Maintenance: Implement predictive maintenance algorithms to anticipate potential faults before they occur based on historical data, environmental conditions, and predictive analytics. This proactive approach can further minimize downtime and prevent accidents.

Integration with Smart Grids: Integrate the fault detection system with smart grid technology to enable dynamic rerouting of power and isolation of faulty segments, thus minimizing disruptions and optimizing overall grid performance.

Enhanced Data Analytics: Continuously improve data analytics capabilities to extract actionable insights from the vast amount of sensor data collected. This includes identifying patterns, trends, and anomalies that can inform decision-making and improve system reliability.

Augmented Reality (AR) for Line Maintenance: Develop AR applications to provide line men with real-time visualizations and guidance during maintenance and repair operations. This can streamline workflows, improve accuracy, and enhance worker safety.

Resilience to Cyber Threats: Strengthen cybersecurity measures to protect the IoT devices, communication networks, and data infrastructure from cyber threats and unauthorized access. This is crucial for maintaining the integrity and reliability of the fault detection system.

Energy Storage Integration: Integrate energy storage systems with the fault detection system to provide backup power during outages and emergencies. This can improve grid resilience and support the integration of renewable energy sources.

Community Engagement and Education: Engage with the community to raise awareness about the importance of electrical safety and encourage proactive measures to prevent accidents. Education and outreach programs can complement technological solutions to create a culture of safety and resilience.

By pursuing these future scopes, the fault detection and alert system can evolve into a comprehensive solution that not only detects and addresses faults in real time but also anticipates potential challenges, optimizes grid operations, and promotes a safer and more reliable electrical infrastructure for the future

VIII. CONCLUSION

The implementation of a fault line detection and alert system utilizing IoT technology represents a significant advancement in the management of electrical grid faults, particularly in the context of the Kerala State Electricity Board (KSEB). This innovative system ensures that KSEB is promptly notified whenever a break occurs along the electrical lines, thereby minimizing any delay in initiating necessary actions. With real-time alerts being generated, the system enables swift and efficient response mechanisms, thereby reducing the time consumption involved in identifying and addressing faults. This agility in response is crucial in ensuring the uninterrupted supply of electricity to consumers while also minimizing disruptions and inconveniences.

One of the key benefits of this system is its ability to provide accurate location information regarding the breakage point to line men. Armed with precise details regarding the fault's location, line men can swiftly proceed to the site of the incident, thus expediting the repair and restoration process. By eliminating the need for time-consuming manual inspections to locate faults, the system enhances operational efficiency and enables resources to be allocated more effectively. Additionally, the reduced response time facilitated by the system helps mitigate the potential risks associated with electrical faults, thereby enhancing overall safety standards.

Furthermore, the proactive nature of the fault detection and alert system plays a crucial role in mitigating the occurrence of accidents resulting from electrical faults. By promptly identifying and addressing faults before they escalate into more significant issues, the system helps prevent potential hazards such as electrical fires, equipment damage, and personal injuries. This proactive approach not only safeguards the infrastructure but also protects the well-being of individuals and properties within the vicinity of the electrical grid.

In conclusion, the implementation of a fault line detection and alert system utilizing IoT technology represents a significant leap forward in enhancing the reliability, efficiency, and safety of electrical distribution systems, particularly within the domain of the Kerala State Electricity Board. By providing real-time alerts, precise location information, and enabling swift response actions, the system minimizes downtime, optimizes resource utilization, and reduces the likelihood of accidents. As a result, it contributes to the overall resilience and effectiveness of the electrical grid infrastructure, ultimately benefiting both utility providers and consumers alike.

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