IJARETY

International Journalof Advanced Research in Education and TechnologY(IJARETY)

Volume 11, Issue 3, May-June 2024

Impact Factor: 7.394

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INNO SPACE SJIF Scientific Journal Impact Factor

doi cross ref

निस्केयर NISCAIR

International Journal of Advanced Research in Education and TechnologY(IJARETY)

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Referred Journal |

|| Volume 11, Issue 3, May-June 2024 ||

DOI:10.15680/IJARETY.2024.1103017

An IoT Enabled Smart Fault Detection and Monitoring in Power Distribution System Using Self Healing Technology

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ABSTRACT: This work portrays the performance of Distribution Transformer in the distribution line. It is an embedded system used to monitor and regulate different parameters that directly affects the transformer and its line. Different sensors are used for monitoring current, voltage, temperature, oil level. According to the result of these sensors, microcontroller takes action. A smart IoT based fault detection system, frequently and accurately indicates the location and the type of fault had occurred in Distribution Transformer and Transmission line. This system automatically detects faults, analysis and classifies these faults and then, calculates the fault distance from the control room using Impedance Based Algorithm Method (IBMA). Finally, the fault information is transmitted to the control room via IoT technology and the system uses several sensors like temperature-RTD, Thermocouples, ultrasonic- to check oil level, voltage and current sensor to measure different parameters. The measured parameters are updated in IoT and displayed inLCD. This will ensure the shorter response time fortechnical crew to rectify these faults and thus help have transformers from damage and disaster.

KEYWORDS: Real-Time Fault Detection, Early fault, Remote Monitoring and Control

I.INTRODUCTION

The reliability and stability of power distribution systems are fundamental to modern society's functioning. The increasing complexity and expansiveness of these networks demand innovative solutions for fault detection and real-time monitoring to ensure uninterrupted power supply. Addressing this need, this study introduces an efficient LoRa-enabled Smart Fault Detection and Monitoring Platform for Power Distribution Systems utilizing self-powered IoT devices. The platform's primary objective is to detect various types of faults within the distribution network, including line-to-line, line-to-ground, double line-to-ground, and overload faults. The platform's primary objective is to detect various types of faults withinthe distribution network, including line-to-line, line-to- ground, double line-to-ground, and overload faults. Beyondfault detection, it continuously monitors crucial parameters such as oil condition, temperature, voltage, and current values, providing a comprehensive view of the system's health. At its core, the system leverages self-powered IoT devices, enabling autonomous functionality and reducing reliance on external power sources.

Distribution transformers are one of the most important equipment in power network. Because of, the large number of transformers distributed over a wide areain power electric systems, the data acquisition and condition monitoring are an important issue. This paper presents design and implementation of a mobile embedded system and a novel software to monitor and diagnose condition of transformers, by record key operation indictors of a distribution transformer like loadcurrents, transformer oil, ambient temperatures and voltage of three phases. The proposed on-line monitoringsystem integrates a Global Service Mobile (GSM) Modem, with standalone single chip microcontroller and sensor packages. Data of operation condition of transformer receives in form of SMS (Short Message Service) and will be save in computer server. Using the suggested online monitoring system will help utility operators to keep transformers in service for longer of time.

This project is about design and implementation of a mobile embedded system to monitor and record key parameters of

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a distribution transformer like load currents, oil level and ambient temperature. The idea of on-linemonitoring system integrates a global service mobile (GSM) Modem, with a standalone single chip microcontroller and different sensors. It is installed at the distribution transformer site and the above parameters are recorded using the analog to digital converter (ADC) of theembedded system. The obtained parameters are processed and recorded in the system memory. If any abnormality or an emergency situation occurs the system sends SMS (short message service) messages to the mobile phones containinginformation about the abnormality according to some predefined instructions programmed in the microcontroller. This mobile system will help the transformers to operate smoothly and identify problems before any catastrophic failure.

II.EXISTING SYSTEM

Distribution transformer is an important component of an electrical distribution system. The distribution transformer distributes electrical energy to low voltage users directly. This paper presents monitoring system of distribution transformer. Which is an embedded system used to monitor and regulate different parameters that directly affects transformer. Different sensors are used for monitoring current, voltage and temperature. According to the interpretation of these sensor microcontroller takes action to maintain constantoperating conditions of transformers. Proposed system is low cost, easy to use capable of monitoring and displaying data using MATLAB.

III.PROPOSED SYSTEM

The proposed system introduces an innovative approach to power distribution network management through an integrated LoRa-enabled Smart Fault Detection and Monitoring Platform. Designed to ensure the uninterrupted operation of power distributionsystems, this platform leverages self-powered IoT devices equipped with advanced fault detection capabilities. By employing LoRa technology, it establishes a robust and scalable communication infrastructure, enabling seamless data transmission over extended distances. The system's core functionality encompasses the detection of multiple fault types viz., line-to-line, line-to-ground, double line-to-ground, andoverload faults while simultaneously monitoring critical parameters such as oil condition, temperature, voltage, and current values in real time. This comprehensive monitoring is complemented by a dual-alert mechanism: a visual interface providing a holistic view of system parameters and an audio alert system that promptly notifies operators in case of critical value breaches. The platform's adaptability, cost-effectiveness, and emphasis on proactive fault detection position it as an efficient and reliable solution for enhancing the resilience and performance of power distribution networks.

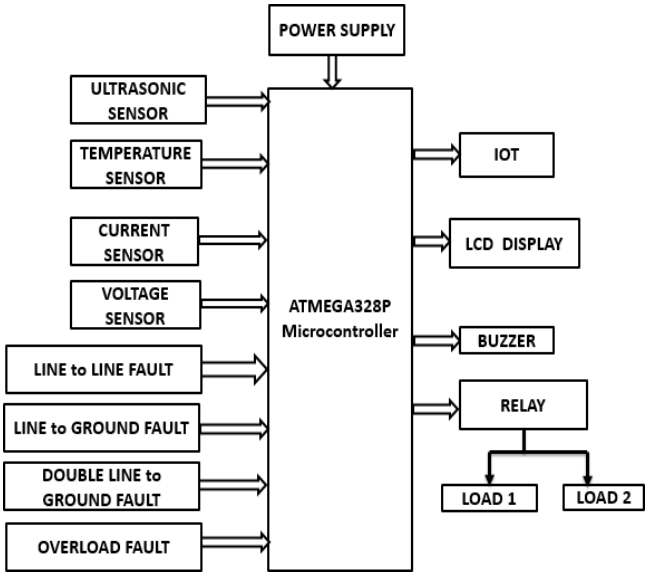

Figure.1. Block Diagram of Proposed System

Measures the oil level within a tank or reservoir in the power distribution system. It emits ultrasonic wavesand measures the time taken for the waves to reflect back,determining the oil level based on the reflection. Monitorsthe voltage levels within the distribution system. Measures the voltage and provides this data for analysis and monitoring purposes.

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Measures the current flowingthrough specific circuits or components. Detects the amount of current passing through and provides this data for monitoring and analysis. Measures the temperature of critical components or areas within the system. Provides real-time temperature readings, ensuring that temperature levels are within safe operating ranges. Serves as a visual interface for presenting real-time measurements. Displays oil level, voltage, current, and temperature values for easy operator monitoring and system status assessment. Facilitates communication between the system and the IoT/cloud platform. Sends the collected data (oil level, voltage, current, temperature) to an IoT platform for remote monitoring and analysis. Notifies operators in case of high sensor values or critical conditions. Activates the buzzer, relay (for potential equipment shutdown), or light to alert operators when any sensor value exceeds predefined thresholds. Provides power to the entire system. Supplies stable and regulated power to all components, ensuring continuous and reliableoperation. Acts as the main controller for data acquisition and communication between sensors, display, alerting mechanisms, and IoT module. Collectsdata from sensors, processes it, and controls the displayand alert mechanisms based on predefined conditions.

IV. RESULTS

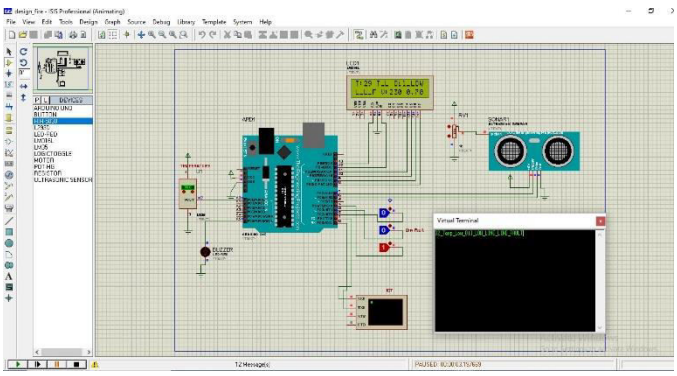

Figure.2.Simulation Result

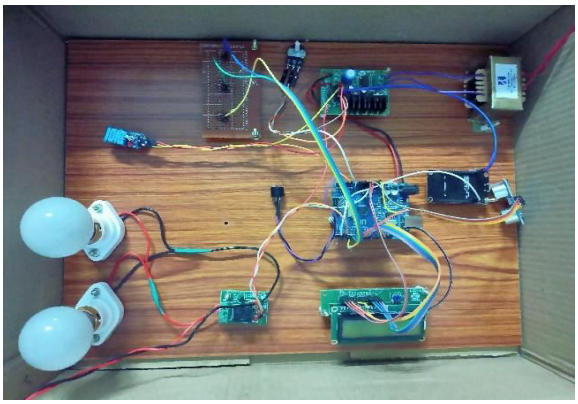

Figure.3.Hardware Model

The development of an efficient LoRa-enabled Smart Fault Detection and Monitoring Platform for Power Distribution Systems utilizing self-powered IoT devices marks a significant stride in enhancingthe reliability and safety of power networks. By adeptly identifying a spectrum of faults—line to line, line to ground, double line to ground, and overload faults—the system ensures a comprehensive approach to fault detection, minimizing potential disruptions and hazards. This platform's multifaceted monitoring capabilities encompassing oil condition, temperature, voltage, and current values reflect its commitment toproactive maintenance and real-time oversight. The amalgamation of these measurements onto a visual interface serves as a comprehensive dashboard for operators, providing a holistic view of the system's health. The adoption of self-powered IoT devices and LoRa technology not only establishes a robust communication infrastructure but also aligns with the scalability and cost-effectiveness essential for modernizing power networks. In platform signifies a paradigm shift towards proactive fault management, poised to elevate the resilience and efficiency of power distribution systems, fostering a safer and morereliable energy infrastructure for the future.

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V.CONCLUSION

In this paper, we have introduced a ground-breaking solution, the "Efficient LoRa-Enabled Smart Fault Detection and Monitoring Platform for the Power Distribution System Using Self-Powered IoT Devices," designed to revolutionize fault detection methodologies in power distribution networks. By leveraging self-powered IoT devices equipped with energy harvesting capabilities and the Long Range (LoRa) communication protocol, this platform offers a sustainable, reliable, and cost-effective approach to monitoring and mitigating faults. The integration of self-powered IoT devices addresses the limitations of traditional monitoring systems, eliminating the dependency on external power sources and significantly extending operational lifespans.

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|| Volume 11, Issue 3, May-June 2024 ||

DOI:10.15680/IJARETY.2024.1103017

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International Journal of Advanced Research in Education and Technology

ISSN: 2394-2975 **Impact Factor: 7.394**

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