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Investigating Flaws and Limitations in Transformer Models: A Critical Analysis and Proposed Solutions

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Abstract– Electricity is one of the greatest inventions of mankind. Our culture has advanced to the point that everything is done with the help of electricity.Our existence will not be possible without electricity.This source of energy is reached to every mankind with the help of Transformers, but most often due to some wear and tear, wires in the utility pole gets broken.People without their knowledge somehow get in contact with the broken wire. Due to this many people die due to electric shock. Injury or killing of someone by electric shock is known as electrocution. Drawing a physical link from this , a model is developed which detects this fault in the utility pole and sends a message to the respective Electric Office.

Keywords: Electricity, Electrocution, Transformers, Wireless Sensor Network (WSN).

1.INTRODUCTION

Are climatic conditions responsible for people's death ? Probably Yes. The electricity which we use in our home travels way long back. Transformers play a vital role in electrical power distribution systems; they are critical components in electrical power systems, responsible for the transmission and distribution of electricity across various sectors.

This paper mainly focuses on street and distribution transformers. Both distribution and street transformers play a vital role in power supply.

Distribution Transformers are typically found at a service drop, which is the point where cables that carry power from subterranean power lines or utility poles reach a customer's property. The purpose of the street transformer is to lower the voltage so that our household electronics are not impacted.

During the rainy season, faults often occur in street transformers because wire in it gets weakened due to wear and tear so by this it cannot withstand natural external force. Thus, there is a higher possibility of breaking lines and short circuits during

thunderstorms and strong winds. Transformers and even entire feeders may trip as a result of these broken wires and short circuits. Due to shock, broken wires may pose a serious risk to human life.

The Main Objective of this paper is to put forth possible solutions for the above problem.

2.RELATED WORKS

This section reviews existing literature of the challenges and methodologies associated with detecting the flaws of a transformer model.

"Design and implementation smart transformer based on Iot"[1]Here in this paper it is only based on saving the cost of the model but there is no enhancement of GPS for the location status (where the problem has occurred)So in our transformer model we have GPS possible to find the track of the location of the problem in a transformer.

"Iot-based smart transformer monitoring system with raspberry Pi"[2]here in this paper it speaks about the catastrophic failure protection as the main focus of the paper but as of now there are many devices to detect the catastrophic failure.now in our paper we are using LoRa board to detect and send the location of the defect. This shows that it's more time saving and efficient.

"Design on Iot based real time transformer performance monitoring system for enhancing the safety measures"[3] here in this paper we can observe that they have given a clear cut information about real-time RSS here they have used Nearest Neighbors(NN) algorithm,K-NearestNeighbors(KNN) algorithm but in our paper we have used LoRa board comes under WSN for telecommunications which is far more faster than all those above mentioned algorithms.

"The smart transformer"[4]here in this paper mainly focuses on only finding the deflect or flaws and there is no proper clear cut solution mentioned here. We are designing the model to detect and solve the problem in any sort of case.we even use contractors to solve the problem found by the model.now in our paper we have solved the issue practically.

"Monitoring of three-phase distribution power transformer based on the internet of things(iot) and SCADA"[5]here in this paper it uses only three phase distribution but we uses any sort of distribution here they have also used wifi to find the locations but there are many locations till now we don't have internet facilities but our proposed system even works in remote areas.

3.PROPOSED SYSTEM

To address this problem we have proposed two models, in which one model will be placed in a distribution transformer and another model will be placed in a street transformer. The model in the street transformer is responsible for identifying current flow in the wire and sending a signal to the model in the distribution transformer regarding the wire break. The Distribution transformer model obtains that information

from the street transformer model and cuts the current flow, this ensures that people nearby are safe. Model in the street transformer also sends a message to the nearby Electric Board regarding the issue in the street transformer which helps them to identify problematic street transformers more quicker.In the upcoming passage we will represent the street transformer as a utility pole.

In order to thoroughly examine the shortcomings and constraints of transformer models, we have designed a model that suggested remedies. The following is the structure of the methodology:

3.1.UTILITY POLE BOARD

The Street transformer model has many components, including an Arduino microcontroller, power supply, Lora board (Transmitter), Two module relay, Voltage and current sensor.

The Arduino mirocontroller is powered with a step down transformer which converts high voltage into low voltage, this makes it suitable to function as we wanted.

This same power is sent to the rectifier and regulator in order to convert AC to DC current and also to provide constant supply. Then this is given as input to voltage and current sensor , which helps in calculating the current and the voltage value.

The Arduino board checks for wire break with help of the output from current and voltage sensor. If it detects the wire break then it sends the signal to the Lora board (Receiver) present in the distribution transformer model.

When the wire breaks , eventually power supply to the components also breaks to solve this issue, two module relays come into play. When wire breaks , backup power to the model is provided with the help of battery.The power provided by the battery is enough for the model to work for a certain period of time.

A message is delivered to the electric board and a signal is transmitted to the distribution transformer model during this time.

3.2.DISTRIBUTION TRANSFORMER BOARD

Model present in distribution transformer is made of components such as Arduino Microcontroller, Contractor, GSM & GPRS module, Lora Board (Receiver), LCD Panel, Rectifier, Regulator and Amplifier

Initially a step down transformer is used to step down the voltage, that is it converts high voltage to low voltage,which can be further used by other components present in the model.The output of this is then sent to Rectifier, Regulator and Amplifier

Rectifiers are necessary for changing the mains supply's AC power into a format that allows electronic equipment and devices, which in this case, DC power to function.When input voltage, load, or other variables change, a regulator is a circuit or device that keeps the output voltage or current level constant,which helps in protecting other electrical components in the circuit.

The output from the Rectifier, Regulator and Amplifier is then sent to the Arduino microcontroller. The process is used to power the components in the circuit.

The Arduino microcontroller constantly gets data from the Lora Board Receiver, which in turn listens for data from the Lora Board Transmitter present in the Street transformer model.

When Lora Board receives information from the Street transformer model, this information is gathered by Arduino. Later the arduino cuts the current supply from the distribution transformer to street transformer with the help of a contractor. Electromechanical switches called electrical contactors are used in electrical circuits to regulate the flow of electricity.

3.3. DEPICTING INFORMATION

The Informations that are collected by the Model in Distribution Transformer are stored in the database with the help of Application Programming Interface.Basically, it's a set of rules and practices that let different software applications communicate with each other.

API's can be implemented in various technologies depending on the application and preference of the developer.The API technology which we use here is REST, which stands for Representational State Transfer.

Here we store sensor data in the cloud with help of MongoDB and use that information to display on the website, for reference.

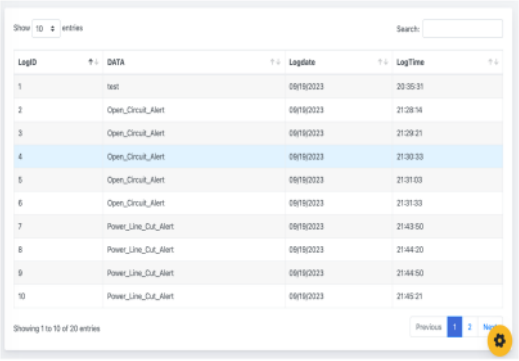


Figure 1 : Log of wire break in street transformers.

This information is posted by the Lora board (Receiver) which is present in the distribution transformer model to our cloud database. To perform this POST request it requires a microcontroller such as an arduino, Lora board transmitter, server endpoint, and GSM module for network connectivity.

The GSM (Global System for Mobile communication) module works by integrating various hardware and software components to enable communication between devices over the GSM network.This allows Lora board to perform requests to our cloud database.

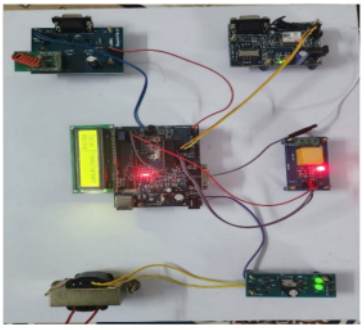
4.CONCLUSION

Existing research papers mainly focused on solving problems in distribution transformers; however, in this paper, we also used utility boards and distribution transformers to convert high voltages to household voltages. Additionally, we used LoRa boards to transmit signals to the appropriate distribution transformers and

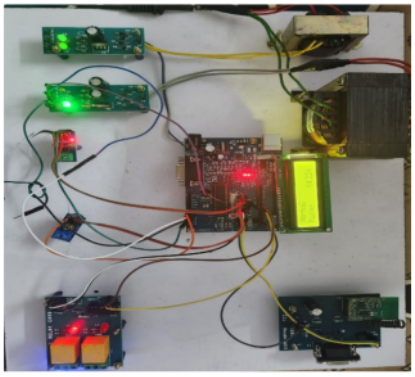
distribution transformers where the problem has occurred.

The distribution transformer model has a contactor, which is responsible to break the current supply when it receives the signal.As a result, the current flow via the street transformer eventually stops. The outcome of our model is as follows :

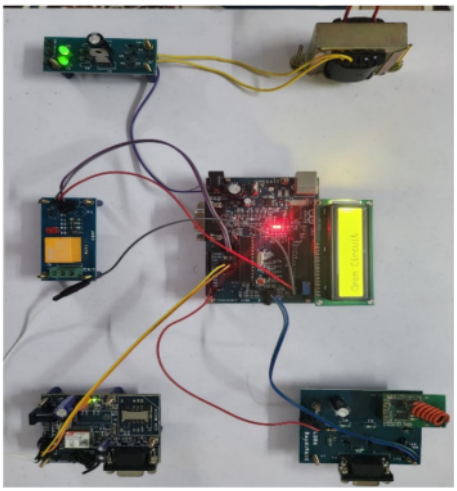
1.Distribution transformer at normal case.



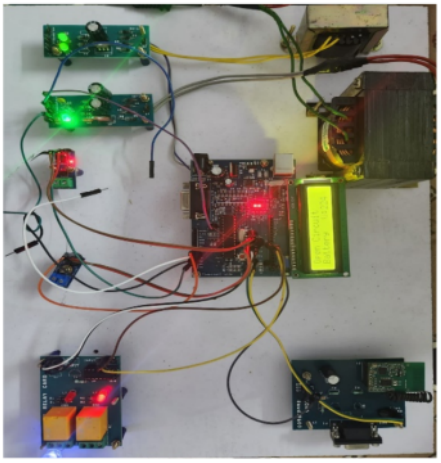
2.Street transformer in normal case.



3.The LCD panel in the Distribution transformer displays 'OPEN CIRCUIT', when a flaw is found in the Street Transformer .



4.Following is the result of LCD panel from Street Transformer



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