Research Paper E-ISSN NO : 2455-295X | VOLUME : 9 | ISSUE : 6 | SPECIAL ISSUE JUNE-2023

FAULT ANALYSIS IN LOW TENSION TRANSMISSION LINE USING ELCB WITH IOT BASED SMART SYSTEM

DR M YUVARAJU	ASSISTANT PROFESSOR, DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, ANNA UNIVERSITY REGIONAL CAMPUS COIMBATORE, INDIA-639113
S ANUSH KUMAR	STUDENT, DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, ANNA UNIVERSITY REGIONAL CAMPUS COIMBATORE, INDIA-639113
A ATCHAYA	STUDENT, DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, ANNA UNIVERSITY REGIONAL CAMPUS COIMBATORE, INDIA-639113
U GOKULNATH	STUDENT, DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, ANNA UNIVERSITY REGIONAL CAMPUS COIMBATORE, INDIA-639113
M KEERTHANA	STUDENT, DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, ANNA UNIVERSITY REGIONAL CAMPUS COIMBATORE, INDIA-639113
V M SUBIYA	STUDENT, DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, ANNA UNIVERSITY REGIONAL CAMPUS COIMBATORE, INDIA-639113

ABSTRACT:

Fault analysis in transmission line is a very focusing issue in power system engineering to clear fault in short time and re-establish power system as quickly as possible on very minimum interruption. However, the fault detection that interrupts the transmission line is itself challenging task to investigate fault as well as improving the reliability of the system. The transmission line is the most important parameters that connect the whole power system in power transmission. Fault location technique in transmission line is the most important part of the power system. Low tension transmission lines are an essential component in the distribution of electrical power to consumer. However, faults in low tension transmission line can lead to power outages, equipment damage, and even fire hazards. Therefore, early detection and isolation of faults are critical to ensure continuous power supply and prevent accidents. The proposed system utilizes ELCB to detect ground faults and IoT sensors to monitor voltage and current levels, power consumption, and other parameters. Real time data collected by the IoT sensors are analyzed by the system to detect any abnormality and to isolate the faulty section of the line promptly. IOT system also sends alert messages to the maintenance team to initiate the process.

KEYWORDS:

ELCB, FAULT IN TRANSMISSION LINE, FAULT LOCATION, IOT, LOW TENSION TRANSMISSION LINE, TRANSFORMER.

INTRODUCTION

Low tension transmission lines are an essential component in the distribution of the electrical power to consumers. Fault detection and isolation are crucial to ensure uninterrupted power supply and prevent accident. As long as the fault is detected in transmission line in short duration, it provides a good service for protecting the apparatus as well as an open way for disconnecting the part where this incident happened at fault, and with the help of this, it gives safe way to the system from any damages. So it is needed to detect the fault otherwise due to fault it causes any disturbance which further tough time to the interconnected system that based on limitations.

PROJECT DESCRIPTION

MATERIALS

The materials used in this project to detect transmission line fault is ELCB and current sensor. The various insulators used in transmission line are Pin insulator, Suspension insulator, Strain insulator, Stay insulator and Shackle insulator.

The components used in transmission lines are Transmission line, towers, Insulator, Relays and isolators.

RELAYS

A relay is mostly used in the protection of transmission line when the fault occurs. The function of the relay is to sense or accept information from some sensing device and feed it into control circuit. The sensing devices in conjunction with relays are called pilot devices. Pilot devices can sense or detect variables like current, voltage, over-load, pressure, frequency, temperature, etc. The relay is used in post pole for protecting the people when the low tension transmission line gets damage.

EARTH LEAKAGE CIRCUIT BREAKER

Current leakage from any electrical installation may results in insulation failure of the electric circuits. So it

must be properly detected and prevented to avoid electric shock if anyone touches the installation. The Earth leakage circuit breaker detects the earth leakage current and trips the power supply. The ELCB interrupts the power supply when it senses a leakage current exceeding the predetermined limit.

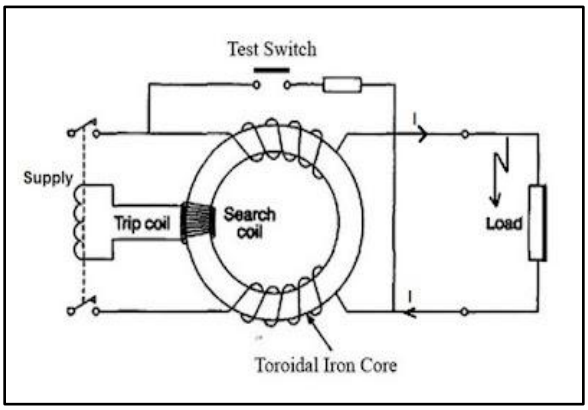


FIG1: ELCB

IOT

An IOT in transmission lines can be developed to detect the unused current. This system can be designed using sensor, microcontrollers and other components that can be connected to transmission lines.

I) SENSOR INSTALLATION

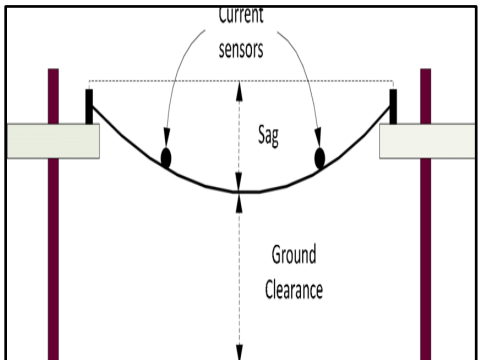


FIG2: CURRENT SENSOR

Sensors are installed on the transmission line to monitor the current. The sensor is placed at specific location and connected to a microcontroller.

II) DATA PROCESSING

The microcontroller reads the data from the sensors and the processors it using an algorithm to detect the unused current.

III) COMMUNICATION

The microcontroller communicates the information to a cloud-based server or on-premise server using IOT protocols such as MQTT and HTTP.

IV) ALERT SYSTEM

The server senses the alert to the concerned authority if unused current is detected.

V) MAINTENANCE AND MONITORING

Regular maintenance and monitoring of the system to ensure its optimum performance.

POWER TRANSMISSION

Power transmission lines are used to connect power stations and substations, and for connections between substations, in order to efficiently transmit large amounts of electricity at high voltage without loss, and therefore play a crucial role in providing electricity.

TRANSMISSION LINES

Transmission lines use either alternating current (AC) or direct current (DC). The voltage level is changed with transformers. The voltage is stepped up for transmission, then reduced for local distribution. The low tension lines are used for household purposes and high tension line are used in industries.

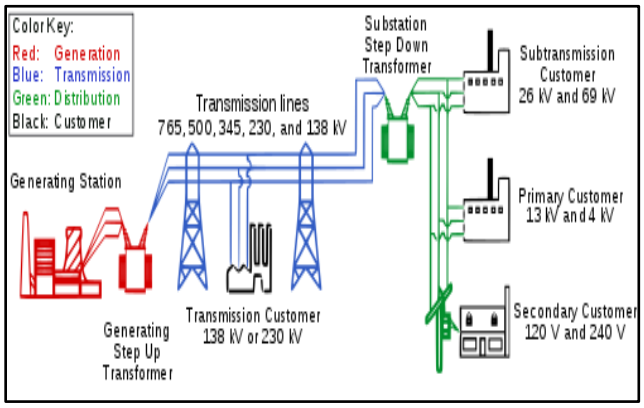


FIG3: DISTRIBUTION SYSTEM

LOW TENSION (LT) LINES

A low tension line can be considered as the line that has an operating voltage till 1000 volt which is 1Kv. At the distribution substation, the voltage is stepped down to 400 V (for 3phase) or 230V (for 1 phase) using step down transformers. The distribution lines are drawn along the roads and service connections to the consumers are tapped off from the distributors. It uses 3 phase, 4 wire system single phase loads are connected between one phase wire and one neutral wire.

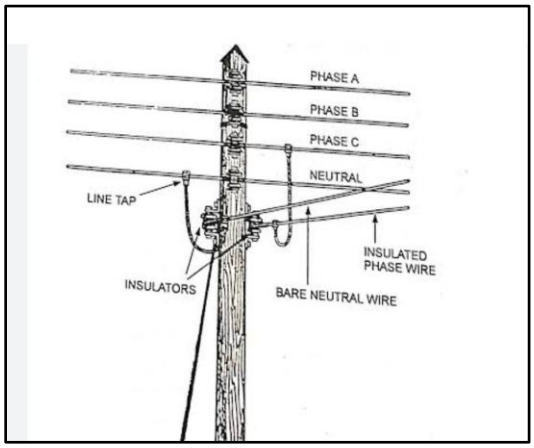


FIG4: LOW TENSION (LT)LINES

HIGH TENSION (HT) LINES

High tension (HT) transmission line delivers electricity long distance. The high voltage is required to reduce the amount of energy lost during the distance .It is a delta connection network. High tension lines are directly connected to substation. The voltage can range from 69,000 to 76,0000 volts and stepped down at substation before being distributed to the local power grid. It's essential for reliable transmission of electrical energy.

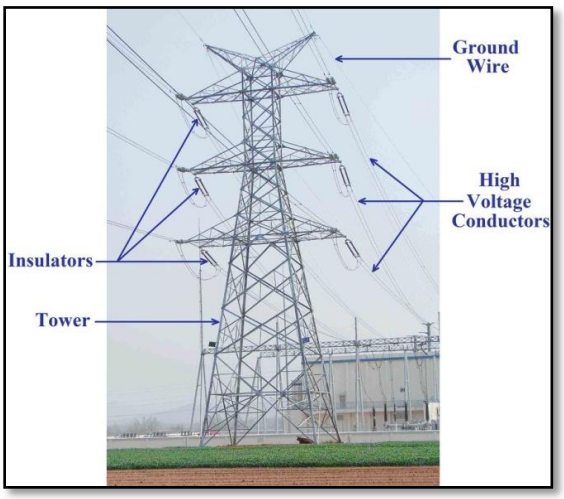


FIG5: HIGH TENSION LINES

FAULTS IN LT LINES

Low tension line damages due to weather condition. The weather factors that typically cause power system faults are Lightning strikes, accumulation of snow on transmission line, Heavy rain, High speed winds, Earthquake, Salt pollution depositing on overhead lines and conductors, Floods and fire adjacent to electrical instrument. Electrical faults are also caused due to human errors like choosing improper rating of equipments or devices, forgetting metallic or electrical conducting components once coupling or maintenance, switching the circuits while below servicing.

DIFFERENT TYPES OF FAULTS

SHORT CIRCUIT FAULT

A short circuit fault is a fault that occurs when there is a direct connection between two conductors of the low tension line. This fault can occur due to insulation breakdown, damage to conductors or equipment failure.

OPEN CIRCUIT FAULT

An open circuit fault is a fault that occurs when there is a break in conductor of a low tension line which results in the circuit being open. This fault can occur due to physical damage to the conductor or equipment failure.

EARTH FAULT

Earth fault occurs when one conductor of low tension line makes contact with ground, which results in a flow of current through the ground. This faults can occur due to insulation breakdown, equipment failure, or accidental damage.

PHASE TO PHASE FAULT

A phase to phase fault occurs when two conductors of the same phase come into contact with each other, resulting in a direct connection. This fault can occurs due to equipment failure, accidental damage or insulation breakdown.

PHASE TO EARTH FAULT

A phase to earth occurs when one conductor of the low tension line makes a contact with earth, resulting in a current flow through the earth. This fault can occur due to equipment failure, accidental damage or insulation breakdown.

SOLUTION

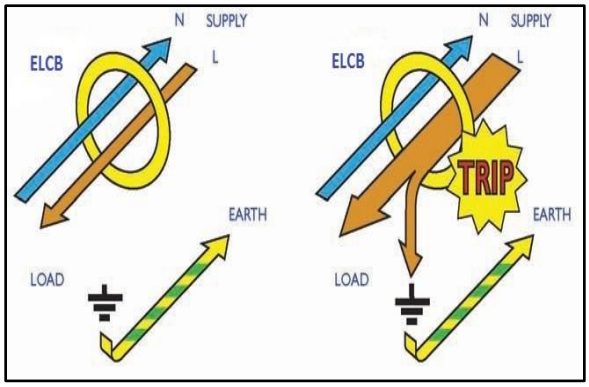


FIG6: TRIP IN LT LINE

Earth leakage circuit breaker is designed to detect leakage and protect against electrical leakage to earth ,which can occur when current flows through a person or a conductive object in contact with the ground. However, if a low tension line falls on a conductive media, such as water or metal, the current will flow through the media to the ground, bypassing the ELCB.

ELCBs work by measuring the current flowing to an electrical device and comparing it to the current returning from the device .If there is a difference (leakage) between the two current, it indicates that some of the current is flowing to the ground and the current sensor gives signal to ELCB for opening the circuit to prevent electric shock or fire.

In case of the low tension line falling on a conductive media, the current is flowing directly to the ground through the media and by passing the ELCB , which only detects current leakage to earth from the electrical device itself .When the phase falls on the conductive media, the ELCB cannot detect the flow of current to earth so IOT is used in low tension transmission line. This current sensor detects the flow of unbalanced current and makes the ELCB to open. Now, the current does not flow from phase to ground.

The ELCB opens when the phase falls on the non conductive media. The IOT based smart sensor is used only when the phase falls on the conductive media.

DISCUSSION

The combination of relays and IOT can improve the reliability, safety, and efficiency of low tension transmission lines. By installing IOT sensors and monitoring system in the power grid, it is now possible to detect and diagnose fault in real –time. The data obtained by the IOT sensors can be analyzed by the relays to detect any abnormalities and attenuate the system's risk

Furthermore, IOT can allow remote control and maintenance of power grids, reducing the need for human intervention ,enhancing safety, and minimizing downtime. The integration of advanced analytic tools, machine learning, and artificial intelligence with the IIT and relay can help in predicting and mitigating potential failures, enabling comprehensive maintenance planning ,and avoiding costly outages.

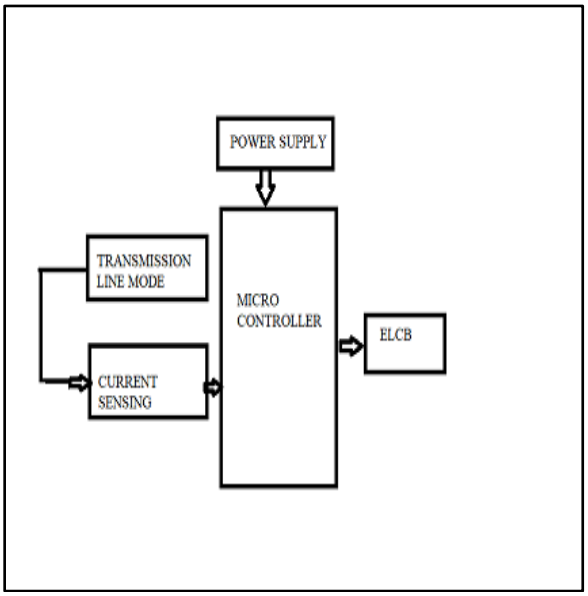
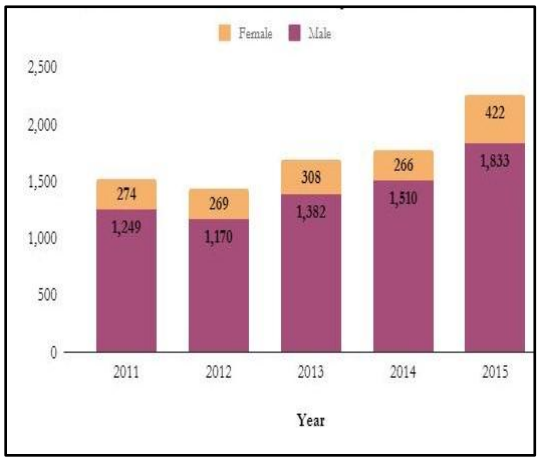


FIG7: BLOCK DIAGRAM OF IOT

RESULT

Incorporating IOT technology into the low tension transmission line can allow the collection and analysis of real-time from the transmission line. This data can help in the early detection of faults, reduce downtime and improve the overall efficiency of the transmission line.



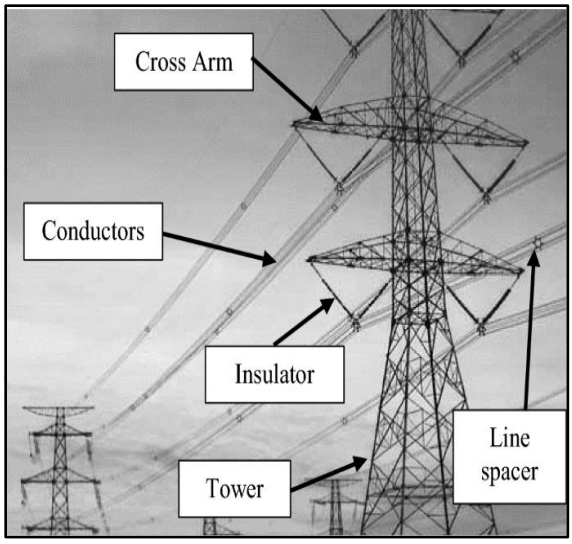


FIG8: YEAR VS DEATH

The graph shows the number of death caused due to electric shock in LT lines. 30 people killed by electrocution everyday in India. According to NCRB data, almost 1.1 lakh people have lost their lives due to electrocution from 2011 to 2020.This translates to nearly 11,000 deaths every year.

So IOT sensors can be installed on low tension transmission line to monitor various parameters like temperature, humidity, voltage and current, which can give an indication of line performance and alert when problems arise.

The implementation of ELCB and IOT can help in reducing maintenance costs, minimize outages, and improve safety for line workers and the general public.

ADVANTAGES

I) ENHANCED SAFETY

ELCB provides protection against electrical shock caused by earth leakage current. IOT based smart systems can quickly identify faults and sense alerts to avoid any danger to people.

II) SMART ENERGY MANAGEMENT

ELCB and IOT enable smart energy management by providing detailed information about energy consumption and demand patterns within the system. This data pave the way for optimized power distribution and potentially lead to energy conservation.

III) EARLY FAULT DETECTION

By using ELCB and IOT in low tension transmission lines, faults can be detected at an early stage. This helps in preventing the damage caused by faults and reduces the downtime of the system.

IV) REAL TIME MONITORING

IoT devices continuously monitor the system, provide real-time insights, and help identify inefficiencies, which can be addressed quickly.

V) REMOTE CONTROL

IOT devices can remotely control the transmission line which means that the system can be managed from the central location. This reduces the need for manual intervention and improves the overall efficiency.

REFERENCES

1. R Navaneetha Krishna, Babugouda RJ, VanneshBM, Md.Shamim,Khan," Transmission Line Fault Monitoring system", JETIR,Vol.6 issue 5,May 2019,ISSN 2349-5162

2. S.Suresh, R.Nagarajan,L.Sakthivel, v.Logesh, C.Mohandass, G. Tamilselvan, Department of Electrical and electronics engineering, Gnanamani college of technology, Namakkal, India" Transmission line fault monitoring and identification system by using internet of Things", International journal of advanced Engineering Reasearch and science (IJAERS), [VOl-4,Issue-4,Apr-2017], ISSN:2349-6495 (p)| 2456-1908.

3. A.Biswas, T.Ekanayake, and B.Doyle," Fault analysis of Transmission Lines using PMU Data," in IEEE Transctions on powerdelivery, Vol.32, no.1, pp.444-453, feb.2017.

4. Moradi and M.Ghasemi," Power system fault Detection and classification using wavelet Multiresolution signal Decomposition," in IEEE Transactions on power Delivery, vol.23, no.3, pp.1061-1070,April 2008.

5. Y.Xian, J.Huang ,and y.Liu," Fault Diagnosis and Fault Location in Transmission lines using wavelet Transform and Data Mining Techniques," in IEEE Transactions on power Delivery, Vol.28, no.2, pp.977-985, April 2013.

6. Benson Mansingh.P.M and Yuvaraju.M," Improved data transmission using Li-Fi technology for home automation application", Journal of Ambient Intelligence and Humanized Computing, vol 12, pp 5581-5588, 2021.

7. Yuvaraju.M, and Divya.M," Residential load forecasting by recurrent neural network on LSTM model", 2020 4th International Conference on Intelligent Computing and Control System (ICICCS), IEEE explore, pp,395-400,2020.

8. Yuvaraju.M and Monika.M," IOT based vehicle parking placing detection using Arduino", International Journal of Engineering Sciences and research Technology (IJESRT), vol.6, no.5, pp,536-542, 2017.

9. Sindhuja.M and Yuvaraju. M,"Congestion control using On – Board Data Units in VANET Scenarios", International Journal of MC Square Scientific Research,vol.7,no.1,pp.1-9,2015.

10. Yuvaraju.M, Naraina.A and Deepika.K," Wireless based on perfunctory fire detection and liberate system", International Research Journal of Engineering and Technology (IRJET), vol.3, no.6, pp.468 a, 2016.