Wide Area Fault Location in Transmission Line using Differential Protection Strategy

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***Abstract*: The Electric Power System is divided into many different sections. One of which is the transmission system,where power is transmitted from generating stations and substations via transmission lines into consumers. Both methods could encounter various types of malfunctions is usually referred to as a "Fault". Fault is simply defined as a number of undesirable but unavoidable incidents can temporarily disturb the stable condition of the power system that occurs when the insulation of the system fails at any point. A smart GSM based fault detection and location system was used to adequately and accurately indicate and locate the fault had occurred. This will ensure a shorter response time for technical crew to rectify these faults and thus help save transformers from damage and disasters. The system uses a current transformer, a voltage transformer, PIC 16F877 Microcontroller, RS-232 connector, and a GSM modem. The system automatically detects faults, analyses and classifies these faults and then, calculates the fault distance from the control room using an impedance-based algorithm method. Finally, the fault information is transmitted to the control room. In conclusion, the time required to locate a fault is drastically reduced, as the system automatically and accurately provides accurate fault location information. By using this project, we can detect the faults of three phase transmission lines one can monitor the Temperature, Voltage, Current by means of GSM modem by sending message.**

Keywords: Transmission line, fault detection, GSM technology, automatic fault detection.

1.INTRODUCTION

The transmission line conductors have resistances and inductances distributed uniformly along the length of the line. Traveling wave fault location methods are usually more suitable for applicationto long lines. A representation of an overhead transmission line by means of a numberof pi-sections has been implemented using Matlap inwhich the properties of the electric field in a capacitance and the properties of the magneticfield in an inductance have been taken into account and these elements are connected withlossless wires.Transmission lines cannot be analyzed with lumped parameters, when the length of the line isconsiderable compared to the wavelength of the signal applied to the line. Power transmissionlines, which operate at 50-Hz and are more than 80-km long, are considered to have distributedparameters. These lines have the properties of voltage and current waves that travel on the linewith finite speed of propagation. Traveling wave methods for transmission lines fault locationhave been reported since a long time. Subsequent developments employ high speed digital Recording technology by using the traveling wave transients created by the fault. It is well known that when a fault occurs in overhead transmission lines systems, the abrupt changes in voltage and current at the point of the fault generate high frequency electromagnetic impulses called traveling waves which propagate along the transmission line in both directions away from the fault point.

In power transmission systems, the majority of voltage and current signal distortions are caused by faults. Faults that occur in power transmission lines can cause an interruption of power supply. The time required to locate a fault is drastically reduced, as the system automatically and accurately provides accurate fault location information. This will ensure a shorter response time for technical crew to rectify these faults and thus help save transformers from damage and disasters. A smart GSM based fault detection and location system was used to adequately and accurately indicate and locate where fault had occurred. The system uses a current transformer, a voltage transformer, PIC 16F877 Microcontroller, RS-232 connector, and a GSM modem. The system automatically detects faults, analyses and classifies these faults and then, calculates the fault distance from the control room using an impedance-based algorithm method. Finally the fault information is transmitted to the control room. The project presents design and implementation of a distributed monitoring and centralized control system. The master slave communication with the Modbus protocol is implemented. Also using wireless technology GSM, SMS is send to a responsible person on mobile. GSM module has made an attractive option for wireless communication applications. The GSM network provides reliable communication quality with nationwide coverage. Short message service (SMS) has now become the most widely used service based upon GSM standard. At the same time the decreasing cost of GSM devices such as mobile phones and the GSM SMS provides a unique address (SIM card number) to the remote control unit and commands can be transmitted in the wireless communication network.

There are many courses of faults in power transmission leading to power outages, if not properly managed.

Notable among them includes:

- Faults at the power generation station
- Damage to power transmission lines (tree falling on lines)
- Faults at the substations or parts of distribution subsystem
- Lightening

Types of transmission line faults:

Power system's faults may be categorized as shunt faults or series faults.

Single line-to-ground fault:

The most common type of shunt faults is Single Line-to-ground faults (SLG). This type of fault occurs when one conductor falls to the ground or gets into contacts with the neutral wire. It could also be the result of falling trees in a rainy storm. This type could be represented as shown in Fig 1 below

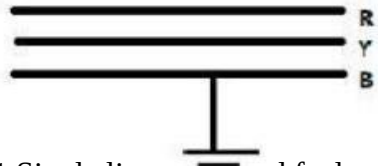


Fig1.Single line to ground fault

Double line-to-line fault:

The second most occurring type of shunt faults is the Line-to-Line fault (LL). This is said to occur when two transmission lines are short-circuited. As in the case of a large bird standing on one transmission line and touching the other, or if a tree branch happens to fall on top of two power transmission lines.

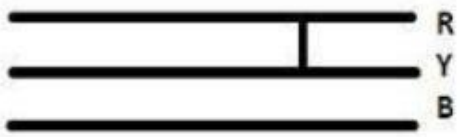


Fig2.Line to line fault

Double line-to-ground fault:

The third type of shunt fault is the Double Line-to-Ground fault (DLG) in figure below. This can be a result of a tree falling on two of the power lines, or other cause.

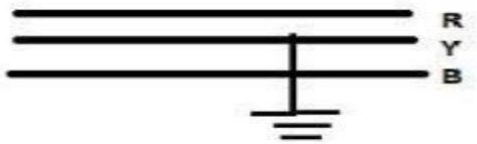


Fig3.Doubleline- to- ground fault

Balance three phase:

The fourth and the real type of fault is the balanced three phase, which can occur by a contact between the three power lines in many different forms.

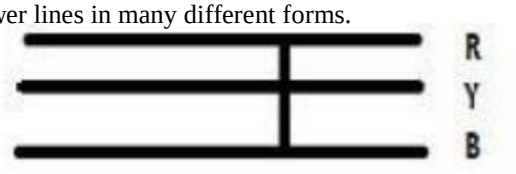


Fig.4 Balance three phase fault

II. PROPOSED METHOD FOR DETECTION AND LOCATION OF FAULT

Considerable research has been carried out in the area of fault diagnosis methods, particularly to radial distribution systems. These methods uses various algorithmic approaches, where the fault location is iteratively calculated by updating the fault current

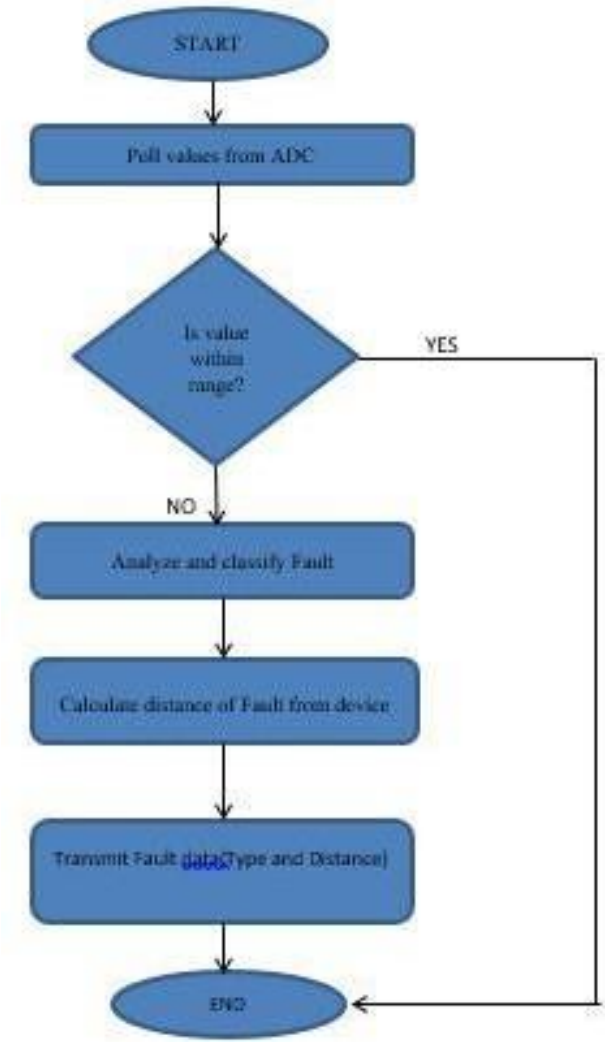


Fig.5 Flowchart of proposed approach

1. Impedance And Fundamental Frequency Component Based Methods
2. High Frequency Components and Travelling Wave Based Methods
3. Knowledge-Based Method

4. Artificial Intelligence (AI) and Statistical Analysis Based Methods
5. Distributed Device Based Methods
6. Hybrid Methods

AUTOMATIC POWER LINE DISCONNECTER

Detecting and locating fault in power line is very necessary for healthy operation of power system. In electrical power line fault often happen many times making the power system unreliable. In this idea using wireless sensor for detecting fault which includes phase to phase, short circuit and mainly line to ground fault in power line for better reliable and best operation of the system is presented. In the proposed idea power line is divided by WNS (wireless sensor network) nodes that could sense the fault condition in power line, display to operator as well as send SMS through GSM modem to service engineer. This idea successfully carefully studies the asymmetrical faults which happen in power line. In Wireless Sensor Network (WNS) current sensor is connected with PIC 16F877A microcontroller converts the analog measured current value into digital form and then transmits the data to the main first node through transceiver. Guidelines calculated in PIC 16F877A microcontroller transmit data to control panel or substation so that immediate action can be done with the help of GSM technology.

Impedance and Fundamental Frequency Component Based Methods

The distance of fault from the primary distribution bus is estimated by impedance based method. Voltage and current values measured at one end or both ends of the line are required in this method. The method uses mathematical equations to estimate the fault location. Suggested a technique that used the fundamental frequency voltages and currents measured at a line terminal before and during the fault. The fault location technique was described by considering a single-phase-to-ground fault on a radial system. Nevertheless, they still considered the line to be fully transposed, and was only good for line-to-ground faults. The proposed method that was based on measurements provided by Intelligent Electronic Devices (IEDs) with built-in oscillography function. This is installed only at the substation level and on a database that stores information about the network topology and its electrical parameters. In particular, on 12kV networks application of the method was a problem.

III. CONSTRUCTION AND WORKING

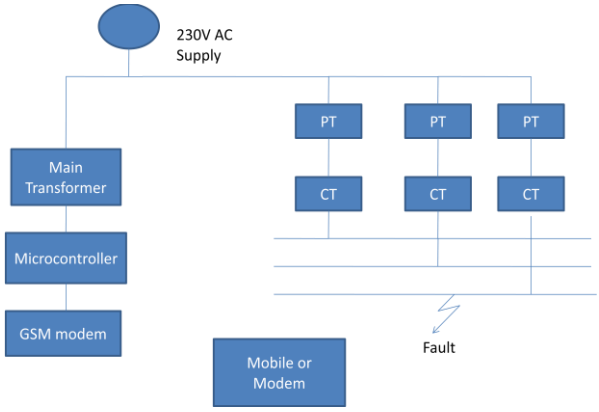


Fig 6. Block diagram Working

The set up or field device consists of 3 major components, instrument transformer (CT and VT), GSM modem and microcontroller. The primaries of the CT and VT which are connected to the line sense the corresponding current and voltage values of the system and feed the output to the ADC of the microcontroller which converts the signal to a digital form in order to be processed by the CPU of the microcontroller

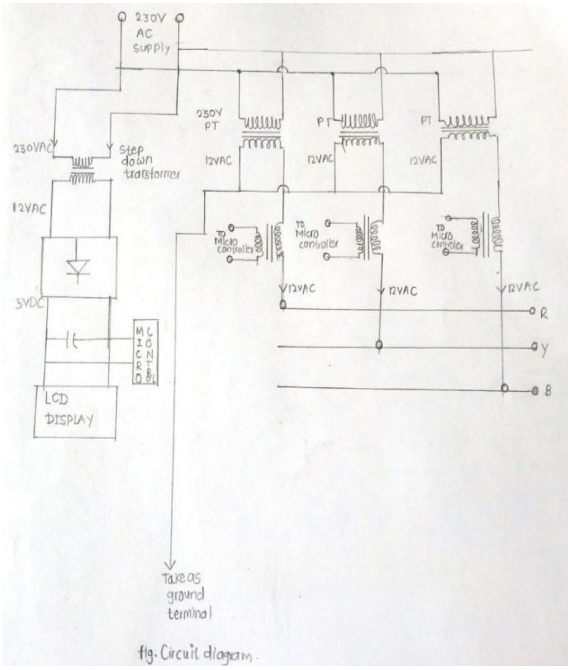


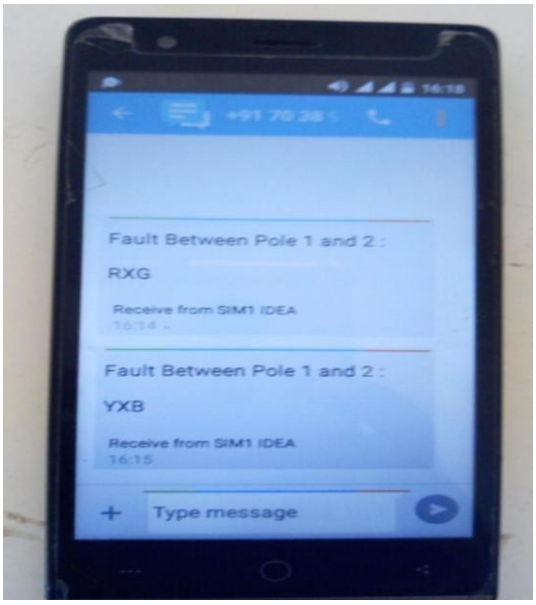
Fig6.Circuit diagram

The microcontroller serves as the central point of the set up. It contains a set of programming codes which have been stored in the EEPROM which enables it to classify the fault type based on the voltage and current values. Based on the program, the microcontroller compares these values to see whether they are within the range required. If the voltage and current values are out of range as compared to the reference, it gives an indication of a fault. The microcontroller also calculates the fault distance, relative to the device based on an impedance-based algorithm and then relays this

information to the modem for transmission. In summary, the microcontroller classifies, calculates the fault distance and relays the information to the modem for transmission via the serial communication interface (SCI) which serves as an interface between the microcontroller and the modem. The RS-232 serves as the connector between the microcontroller's serial communication port and the modem. The device is placed in the boundary of the sectionalized regions in the transmission system and the location of the fault is calculated relative to the position of the device. The unique identity of the SIM card in the GSM modem is used as an address for the device.

IV. RESULT

The analysis of fault detection and location system of transmission line. Whether it is any type of fault that can be detected and located. When fault get occurs on the transmission line the signal is send to the control room or mobile phone through a GSM modem. The message receive on the mobile that is the fault between pole 1 and 2 and the fault which is symmetrical or unsymmetrical like L-G, L-L, L-L-G, L-L-L, L-L-L-G. The signal that appears on the control room or mobile phone is the L*G or any other type of fault occurred on transmission line.



V. CONCLUSION

Here, in this project we have designed a GSM based transmission line monitoring and indication system that sends information of the same to control room via SMS. The implemented system design mainly concentrates on the distribution system. It provides the way to detect the faults such as wastage of energy and power theft. The system continuously monitors various parameters of the system. It also helps to detect the fault at the appropriate time and hence avoids illegal use of electricity. Automatic monitoring, analyzing and recording is done on the PC screen through hyper terminal. The project has continuous monitoring system integrating the GSM communication technology and the microcontroller technology. It also represents the hardware architecture and the software flow. The implementation of the system will save large amount of electricity and thereby electricity will be available for more number of consumers in a highly populated country such as India.

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