Overview of Smart Tower Technology for Transmission lines

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Abstract— Many electricity transmission companies across the world and Ghana in particular are continuously looking for ways to utilize modern technologies, in order to improve reliability of power supply to consumers. These transmission companies manly depend on circuit indicators (FCIs) to assist in locating exact spots within their transmission lines where power fault had arisen. In this project, fault in the transmission line is identified. This will ensure a shorter response time for technical crew to correct these faults and thus help save transformers from damage and ruins. The system uses a current transformer, a voltage transformer, Microcontroller, connector, and a LCD. The Values is shown in the LCD. In assumption, the time required to find a fault is significantly reduced, as the system routinely and accurately provides correct fault location information.

Keywords— *Fault Location, GSM Module, Transmission Line,*

1. INTRODUCTION

Over the years, technology has transformed our world. Technology a fault in electrical apparatus is well-defined as a defect in its electrical circuit due to which the current is redirect from the future path. The fault impedance being low, the fault currents are comparatively high. During the faults, the power flow is redirect with regard to the fault and the supply to the adjacent zone is affected. Voltages become unstable. It is necessary to notice the fault as early as possible that is why a kit is being made using arduino to make its process quicker. It will detect following major faults and will give trip indication to relay over current fault, undercurrent fault, and Phase Failure faults.

Hence forth it finds its claim at various medical hospitals, industries and places where high fortification is needed for saving the expensive equipment's connected to the main line. The main benefit of this circuit is that any usual skilled worker can use this circuit and can know the type of fault.

Many electric power transmission companies have firstly depend on circuit indicators to detect faulty section of their transmission lines. But there are still challenges in detecting the exact location of these faults.

While fault indicator technology has provided a reliable means to locate permanent faults, the technical team and patrol teams still has to physically locate and check the devices for stretched hours to detect faulty sections of their transmission lines.

2. LITERATURE REVIEW

In the past decades, there has been a rapid development in the power grid all over the world which lastly led to the installation of a huge number of new transmission and distribution lines. Also, the introduction of new marketing ideas such as deregulation has increased the necessity for consistent and continuous supply of electric power to the end users who are very sensitive to power outages.

One of the most significant factors that delay the continuous supply of electricity and power is a fault in the power system any irregular flow of current in a power system's apparatuses is called a fault in the power system. These faults cannot be totally avoided then a portion of these faults also occur due to natural motives which are way beyond the control of manhood. Hence, it is very important to have a well-coordinated protection system that detects any kind of irregular flow of current in the power system, finds the type of fault and then precisely locates the position of the fault in the power system. The faults are usually taken care of by devices that detect the incidence of a fault and finally isolate the faulted section from the rest of the power system. Hence some of the significant experiments for the continuous supply of power are detection, grouping and location of faults can be of various types namely transient, symmetric or asymmetric faults and the fault detection process for each of these faults is absolutely single in the sense, there is no one common fault location method for all these types of faults. The High Voltage Transmission Lines (that transmit the power generated at the generating plant to the high voltage substations) are more disposed to the happening of a fault than the local distribution lines (that transmit the power from the substation to the commercial and housing clienteles) because there is no insulation around the transmission line cables unlike the

distribution lines.

The motive for the incidence of a fault on a transmission line can be due to some details such as a temporary tree contact, a bird or an animal contact or due to other natural reasons such as thunderstorms or lightning. Most of the research done in the field of protective relaying of power systems focusses on transmission line fault protection due to the fact that transmission lines are comparatively very long and can run through various geographical terrain and hence it can take anything from a few minutes to several hours to physically check the line for faults The involuntary position of faults can greatly enhance the systems reliability because the earlier we restore power, the more money and appreciated time we save.

3. TYPES OF FAULTS

Power system's faults may be characterized as shunt faults or series faults. The most common type of shunt faults is **Single Line-to-ground faults** (SLG). This type of fault happens when one conductor falls to the ground or gets into contacts with the neutral wire. It could also be the consequence of falling trees in a rainy storm. This type could be signified as shown in Fig 1. Below

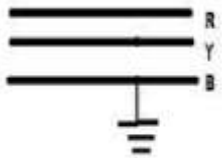


Figure 1: Single Line to ground fault

The second most happening 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 upended on one transmission line and touching the other, or if a tree branch happens to fall on top of two power transmission lines. This type could be signified as shown in the Fig. 2 underneath.

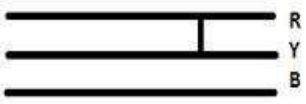
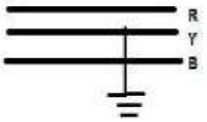


Figure 2: Two line to line faults

The third type of shunt fault is the Double Line-to-Ground fault (DLG) in fig. 3 below. This can be a result of a tree falling on two of the power lines, or other causes.

The fourth and the real type of fault is the balanced three phase (Fig. 4), which can occur by a contact



between the three power lines in many different forms.

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.

Figure 3: double line-to-ground fault

FAULT OCCURRENCE

There are many courses of faults in power transmission leading to power outages if not properly managed. Notable among them includes:

Figure 4:-Balanced fault

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

Type of Fault	*Percentage Occurrences*	*Severity Level*
L-G	70-74%	Minor(less)
LL	12-14%	More
LL-G	16-18%	More
LLL	2-4%	Highly Severe

Table 1:-Occurrences and severity level of Fault

IV. FAULT LOCATION METHOD

Considerable investigation 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 planned by updating the fault current. A brief summary of the algorithmic methodologies has been presented in the following section:

4.1 Impedance and Other Fundamental Frequency Component Based Methods for Detecting Faults on Transmission Lines: - The distance of fault from the primary distribution bus is predictable by impedance based technique. Voltage and current values measured at one end or both ends of the line are compulsory in this method. The process uses mathematical equations to estimate the fault location**.**

Suggested a technique that used the vital 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. Never the less, they still considered the line to be fully reordered, and was only good for line-to-ground faults.

Projected a 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 statistics about the network topology and its electrical parameters. In particular on 11kV networks, application of the method was a problematic. It was difficult to obtain reliable statistical approximations, and also time consuming due to iterative process and need to know the fault type before specific equation could be functional.

4.2 High Frequency Components and Travelling Wave Based Methods:-

This method was commonly based on the reflection and transmission of the fault engendered by travelling waves on the faulted power network. Although in this technique fault can be located with high accurateness, the enactment is complex and more expensive than the application of impedance based methods. This is because it needs too many added apparatus such as the GPS system, fault transient detectors and diagnostic software. Furthermore, due to the complex configurations of distribution systems, the configuration or the sites to install the fault transient detectors become very difficult.

4.3 Knowledge-Based Method:-

The third category is knowledge-based method. This method can be divided into three groups:

a. Artificial intelligence and statistical analysis based methods

b. Distributed device based methods

c. Hybrid methods

4.4 Artificial Intelligence (AI) and Statistical Analysis Based Methods :-

There are several artificial intelligent methods such as Artificial Neural network (ANN), Fuzzy Logic (FL), Expert System (ES) and Genetic Algorithm (GA). These methods can help operatives or engineers to do much laborious work. By using these methods, the time factor is considerably reduced and human mistakes are avoided. Therefore, many investigators used AI based methods in transmission system fault localities.

Developed a fault location method for multi-ring distribution systems using neural network. They used the feeder fault voltage, circuit breaker status, real power of feeders during the normal condition, and real power of feeders during short circuit, etc. to train the neural network.

4.5 Distributed Device Based Methods:-

Another type of knowledge-based technique is distributed device based methods for locating fault presented a mathematical approach that located faults based on installed voltage sensors' information and the network's topological construction. The relation of the voltage sensors with sections was formulated as a matrix. The other matrix was constructed based on the topological relation between sections and nodes in an electric network. Through some matrix maneuvers, all faulted sections could be originate.

4.6 Hybrid Methods:-

Almost all of the above methods locate faults based on one algorithm, such as the fault distance calculation or operated protective device's status analysis. Some have investigated the use of hybrid methods that locate faults based on more than one algorithm to achieve a more precise estimation of the faulted section.

Anticipated a hybrid method that computed the fault distance using measurements presented at the substation. They used post-fault values of current or voltage to reduce the multiple estimation problems induced by the existence of multiple fault points in the network. To identify the actual fault location, a fault diagnosis procedure was applied to rank the list of multiple potential fault locations. By doing a circuit simulation, the operation of a particular combination of protective devices and the load change pattern during different fault scenarios could be obtained. Then by matching the fault situation to these scenarios, the actual faulted section could be determined.

V. WHICH AREA IT CAN BE APPLIED

- Used in transmission line.
- Used in textile mills.
- Used in food industry.

VI. TYPES OF APPROCHES THAT CAN BE TAKEN

This section highlights the state-of- the art devices that will be needed to implement the system. These devices will provide the much needed attributes for the new

system: robustness, low cost, efficiency, accuracy and low power.

- **Microcontroller**

A microcontroller (MCU) is a small computer on a single integrated circuit (IC) containing a processor core, memory, and programmable input/output peripherals. Program memory is also often included on the chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose claims.

Microcontrollers are used in spontaneously controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, and power tools.

- **The PIC16F877Microcontroller**

Programmable "Intelligent Computer (PIC) is a family of Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1640 originally developed by General Instrument's Microelectronics Division.

The PIC16F877 falls in the mid-range of the PIC family of microcontrollers and finds use in a wide range of applications in diverse fields due to the fact that it is readily accessible. It also has a large numeral of pins (40 pins) with a maximum of three functions per pin which makes it much easier to use as compared to others with restricted pins and a high number of functions per pin. It also has an optimal cost-to-performance ratio.

The above stated desirable characteristic of the PIC16F877 microcontroller coupled with the fact that it has an in-built Analog to Digital Converter and sufficient program memory to store the control algorithm, have largely affected its choice for the design of the automatic fault detection and location system deliberated in this work.

- **The GSM Modem**

A modem (modulator-demodulator) is a device that modulates an analog carrier signal to encode digital information, and also demodulates such a carrier signal to decode the transmitted information. The goal is to produce a signal that can be transmitted easily and decoded to reproduce the original digital data.

The GSM Modem comes with a serial boundary through which the modem can be controlled using attention (AT) command interface. An antenna and a power adapter are provided.

The basic segregation or working of the modem is as follows:

- Voice calls
- Short Message Service(SMS)
- GSM Data calls
- General Packet Radio Services(GPRS)

Which Method Is Convenient (The proposed system.)

The idea of the device designed is that it is used to detect the kind of fault that has occurred in a faulty line. By using arduino the fault is detected by the designed circuit and it also displays on the LCD screen. Apart from that, a relay circuit is also attached to it in order to save the system from being damaged by disconnecting the faulty circuit from the healthy one.

The AVR has an inbuilt ADC circuit which converts analog signal of the supply into digital signals. According to the digital signal fed to the arduino it detects the normal or abnormal conditions. Thus we finally obtain the tripping as well as display of the fault at same time.

VII. PROBLEM STATEMENT

- The problems that we are currently facing is that the distance of short transmission line is minimum 80-100 km.
- When a fault occurs it becomes very difficult to find fault location especially during rainy seasons when the frequency of fault is very high.
- So to find the fault patrolling is very necessary so we have to petrol throughout the transmission towers to find exact location of the fault.
- Sometimes during temporary fault the system gets disconnected completely this interruption is not appropriate.
- To avoid this it is very necessary to identify the temporary fault from the permanent faults.
- To do so we have selected this project so that the exact location of the fault will be sent to the substation as well as on your cell phone.
- The temporary fault will also be identified from the severe fault when the faulty system must be isolated from the healthy one.
- Also the main advantage is that it will also display the exact fault that has occurred so it becomes very convenient and easy after the installation of the kit on transmission tower.

VII. CONCLUSION

By some variations in the circuit one can devise a new shielding system for each individual phase too. It gives a comprehensive and wide application along where high protection is needed for saving the expensive equipment's associated to the main line.

The help of this model one can know what kind of fault has occurred in which phase and also one knows the meticulous working of microcontroller and LCD circuit in

detail. The main advantage of this circuit is that any untrained man can use this circuit and can know the type of fault.

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