

A Review Paper on Different Type of Fault Detection Techniques for a Three Phase Voltage Source

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Abstract –The research in the type of electrical source has been very fast in the recent decade. Many conventional and non-conventional source of energy are getting the huge interest of the researchers. Irrespective of the type of the source, faults will always be present in the system. The number of transmission lines are increasing day by day, and it creates a more probability of fault in the system. For clearing the transmission line faults, the detection of fault should be done first. In this paper different types of fault detection techniques for a three phase system is reviewed. In this paper, ANN based fault detection technique is also discussed in details. Further an improvement in the existing fault detection technique is also proposed.

Key Words: artificial neural network, transmission line fault, fault detection, etc.

1.INTRODUCTION

As the demand of the electricity is increasing day by day to different sectors like household, commercial, etc., The occurrence of the fault shows changes in the current. If the fault is of short circuit type, the current will increase abnormally. If the fault is of type open circuit, the current drops to almost zero.

In a three phase systems, the faults may occur in between the phase line and the ground or among the phases. Faults are generally categorizing as line to ground fault or line to ground fault. The occurrence of the fault in the power system causes instability and it causes many serious damages in the faulted devices and their interconnected healthy devices. Stability is an important concern in the management and the planning of the power system [1]. It has been observed that the faults are less transients at the lower voltage and it is more transients at the higher voltage [2]. There may be the various cause of the faults for example lightning, swinging wires, temporary contact with the other objects, etc. As the demand of non-renewable sources is increasing day by day, the main focus now lies on the conversion of the renewable resources into the electrical energy [3]. In the subsequent section, this paper discusses the different type of fault detection techniques to be used. Fault detection occurs regularly . Timely detection of the fault and the protection of the attached healthy devices are very essential [4]

2. Types of transmission line faults

The transmission line is a very important part of any power system. During the last decade, the power requirement has been increasing tremendously transmission lines play an important role in accomplishing the supply and demand. As

the number of the transmission lines is increasing day by day the losses are also increasing simultaneously. In a three phase line, the type of fault can be of two types

1. Line to Line fault
2. Line to Ground fault

In many context, the type of fault are categorized into four types.

- 1.Line-Ground
- 2.Line- Line
- 3.Double line-Ground
- 4.Three Phase

Whenever the fault occurs, the fault current increases rapidly and the voltage comes down. The percentage occurrence of these fault is mentioned in the table below [10]

Fault Category	Occurrence (%)
Line-Ground	85
Line-Line	8
Double line-Ground	5
Three Phase	>2

Some researchers [11] has also classified the overhead transmiision line as shown in the figure below

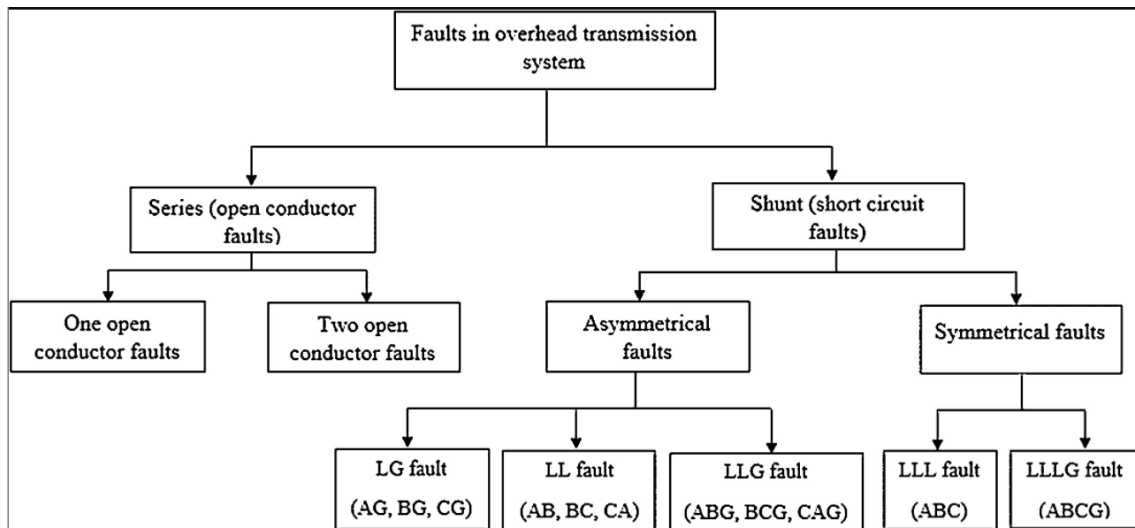


Figure 1 Different types of faults

3. Fault detection techniques

Different protection based on the modern relays are proposed that detect the fault in the correct phase and then protect them [5]. From the last 20 years, a huge development has been seen in the field of fault detection and the classification in the field of power system [6]. In industries, the continuous power interruption leads to the economic loss in the industry sector therefore, the primary task must be detecting the faults in the power system [7]. In the past, various methods like visual inspection, hit and trial have been used for the fault identification and the switching for their protection [8]. With the Industry 4.0, many different type of techniques have been introduced in the recent years. These techniques have been found to be the more and quality and time efficient.

There are various types of fault analysis methods starting from the analytical or artificial intelligence based or statistical approach based. Many methods are based on model while there are many methods that does not need models. Without model techniques are based on the historical system data. Fault analysis methods can be categorize into three categories [9].

1. Model based approach
2. Hardware based approach
3. History based approach

Model based approach: it is meant to deploy a model based on the understanding of law of physics that govern the system. These model based approach can be further classified into qualitative and quantitative method.

Hardware based approach: In this method, a small scale model of the similar system is built using the same scaled down excitations.

History based approach: In this approach a model is not build as compare to the previous two approaches. The main idea of the history based is generating the model of the process based on the historical data and then using this model for the real time process.

4. Previous work done on classification of faults

N Rosle et al [12], in his research paper has mentioned that transmission line need protection from the faults. In his research work, they have used the Artificial Neural Network based fault detector to detect and classify the faults. Two types of test has been performed to get the effectiveness of finding the location. The model that has used in his research work is shown below

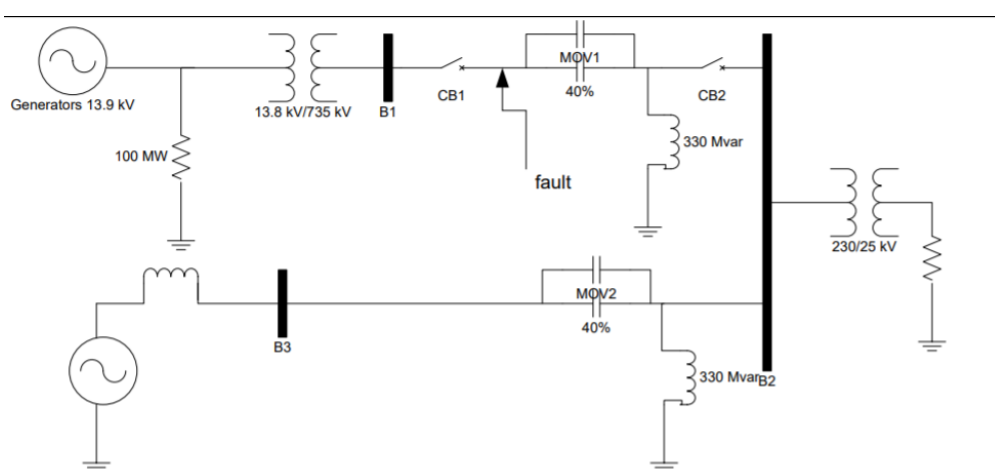


Figure 2 Model used in N Rosle. research paper

Following logic has been used to trained the Neural network. Here four states of the faulty states has been used Fault summarization is shown in the table below

Category/ Test Number	Fault Condition	Fault resistance (Ω)	Length of transmission line (km)	Symbol	Code To detect fault
1	Single line to ground	0.001	300	F1	[0;1]
2	Single line to ground	30	100	F2	[1;0]
3	Three phase to ground	0.001	300	F3	[0;0;1]
4	Three phase to ground	30	100	F4	[0;1;1]

Figure 3 Fault summarization

Sahilbhai Vhora et al. [13] in his research paper has developed a micro-controller based fault detection technique using Arduino platform. The waveform of the current and voltage were obtained from the MATLAB. The block diagram of the proposed model is shown in the figure below

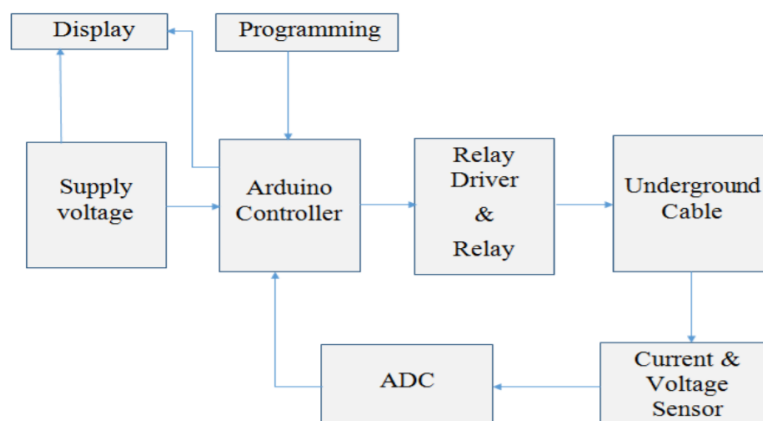


Figure 4 Block diagram of micro-controller based fault detection and isolation system

Atmega328p based micro-controller development board called Arduino has been used as the brain of the overall system. The load has been connected to this board via relay module. Relay module isolates the high voltage side from the low voltage side. Current and voltage sensor has been used with the load cable to measure the voltage and the current. The micro-controller has been programmed in such a way when the voltage and current level of the load comes under the fault condition, the micro-controller sends a signal to the relay module to break the contact with the main supply.

Majid jamil et al. [14] in his research work has proposed a method based on the wavelet transform and the Genetic Algorithm (GA). Discrete wavelet transform has been used to extract the feature of three phase currents. These feature are fed as the input values to the Genetic Algorithm. Depending on the different value of fault resistances and fault inception, the training data for the Genetic algorithm is obtained. As mentioned by the researchers the Genetic algorithm used twenty input and one input to classify the fault. The proposed genetic algorithm based method used normalized inputs and outputs, making it a model that can be used with any system without any change in the parameters. MATLAB has been used for extracting the feature through wavelet transform as well as Genetic Algorithm codes are also written in the MATLAB. The researchers has used the Daubechies mother wavelet of level 4 for analyzing the phase current. The mean of the error is found to be 7% in classifying the fault.

Ahmed M. T. Ibraheem et al. [15], proposes a system for the practical implementation of the overcurrent protection of the three phase transmission line system using Programmable Logic Controller. PLC here is used as a controller to detect the over-current and then isolate the fault by sending the output signal for tripping the coil of the circuit breaker. Display unit is used with the PLC to display the load current and also the alert message. The proposed controller program also cancel of the trip signal of the CB during a definite time of the inrush and stating load current. In addition, an automatic reclosing system for return the CB to the work when the overcurrent is released. PLC-based protection methods cost less, provides greater precision with a safe way of operation when compared with the other protection controller's system. The language that is used is Functional Block Diagram (FBD). Block diagram of the proposed system is shown in the figure below.

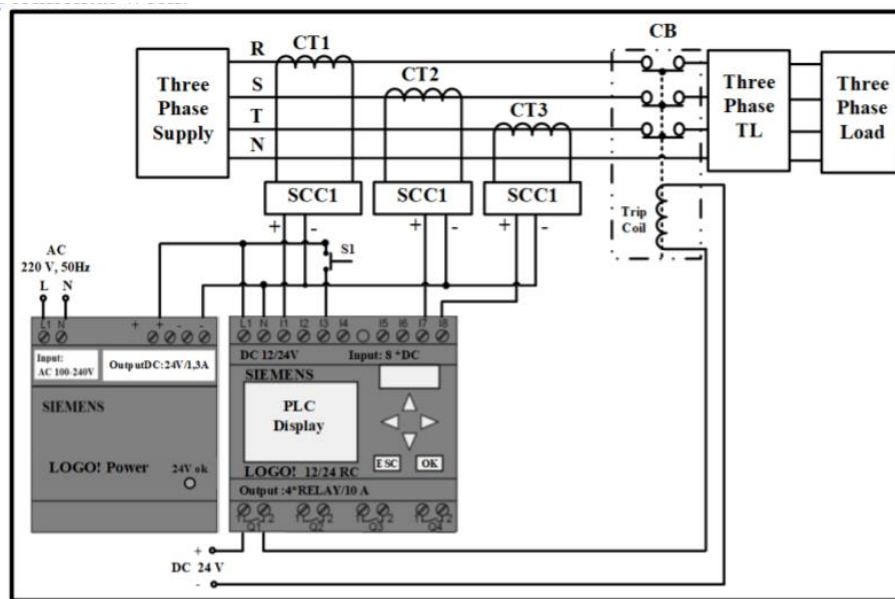


Figure 5 PLC based fault detection and isolation system

M.Sanaye Pasand et al [15]. has mentioned that The usefulness of a new method to fault detection/phase selection algorithm is proved in this research. The technique provided is based on the implementation and application of neurocomputing technologies idea of pattern recognition The paper makes a case for a constructive approach to enhancing the performance of algorithms that are commonly used. The suggested method has been thoroughly tested. Independent fault patterns and promising findings have been discovered through independent testing. acquired. Different system parameters and their effects. The situation is investigated. Numerous studies have revealed that the network can appropriately classify various errors. It works quickly and is unaffected by the environment.

Conclusion

In this review paper, the discussion on the transmission line fault is done. We have seen the different types of fault present in the transmission line system. Line to Line and Line to ground fault has been reviewed. During the fault, the current and voltage on the transmission line changes tremendously. This information is used by various researcher in their model. We have reviewed that many controller has been designed and developed by the researchers, most commonly are micro-controller based, Genetic Algorithm based, Artificial neural network based, PLC based, etc. Artificial Neural Network technique in the recent decade has seen a great development and modern tools and different algorithm based on the comparative study can be used to detect, classify and isolate the fault.

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