**CHAPTER 1**

**INTRODUCTION**

* 1. **GENERAL**

The power transmission network is the most vital link in the country's energy system because it carries massive quantities of power from generators to substations at high voltages. The modern power system network is a complex network that needs a high-speed, accurate, and reliable system of protection. Faults in the power system are inevitable, and there are usually higher overhead line (OL) failures connected to other major components. They not only influence the system's reliability, but also have a widespread effect on end-users. Additionally, as the configurations become more complex, the complexity of protecting transmission line configurations increases, predicting faults (type and location) with considerable accuracy, therefore, improves the system's operational reliability and stability and helps prevent colossal power failure. With 85%-87% of failures occurring on distribution lines, power quality has become a major concern in power system engineering in recent years. Faults in power systems may arise due to various reasons but these faults must be predicted and cleared ASAP if not it may sometimes result in the blackout of the complete systems following which it affects the customer although plenty of necessary protection devices are employed for the detection of faults. Still, it is necessary to predict the line faults in advance to overcome the above-said problems.

Digital technology was introduced with the introduction of a smart grid enabling the installation of sensors along with the transmission lines that can capture live fault data because they present the useful data that can be used to detect abnormalities in transmission lines. A substantial amount of heterogeneous data continuously collected by the growing number of distributed low-cost and high-quality sensors, such as Remote Terminal Units (RTU), Phasor Measurement Units (PMU), and smart meters, along with those generated by other measuring devices is required for the operational control and performance analysis of smart grids. Conventional time-domain techniques are inefficient in computational terms and will not meet real-time application specifications. Application of machine learning algorithms on the transmission line for fault detection, classification and location identification has been explored during this research. We can learn without direct programming from the data and, once exposed to new data, can respond independently.

Most researchers believe that the approach of machine learning (ML) like artificial neural networks (ANN), decision trees (DT), deep learning models, etc. is capable of providing relevant  information on safety in power systems. With the introduction of the smart grid, the operation, monitoring, and regulation of the power system network is becoming smarter and supported by machines. In line with the fundamental goals and point of view of the power system network, recognition of line fault patterns and clearance of faults must be done more intelligently, judiciously, and automatically, with less intrusion from the operator. The boundless extent of power systems network and application requires improving suitable fault classification techniques in transmission systems, increasing system efficiency, and avoiding significant damage. The paper analyses the scientific literature and summarizes the most relevant approaches which will be applied in power transmission systems to fault identification methodologies.

* 1. **OBJECTIVES**

The Objectives of our project are as follows

1. To studying in detail, monitor and analyze real-time data flow in Supervisory control and data acquisition (SCADA) network.
2. To simulate events like line faults, line maintenance and collecting relevant data.
3. To detect and thwart various incoming cyber attacks such as man-in-the-middle and remote tripping commands, etc.
4. To apply various Machine Learning Techniques (MLTs) on the collected data to generate inferences.