

Predictive Fault Detection and Localisation in Electrical Distribution Networks Using Machine Learning and Streamlit

Ansh Honna Baswaraj

Department of Electrical and Electronics Engineering, Rajarajeswari College of Engineering, Bengaluru, Karnataka, India

Jeevan M

Department of Electrical and Electronics Engineering, Rajarajeswari College of Engineering, Bengaluru, Karnataka, India

Veena Patil

Department of Electrical and Electronics Engineering, Rajarajeswari College of Engineering, Bengaluru, Karnataka, India

Lakshya Yogendranath

Department of Electrical and Electronics Engineering, Rajarajeswari College of Engineering, Bengaluru, Karnataka, India

Kiruthika K

Professor, Department of Electrical and Electronics Engineering, Rajarajeswari College of Engineering, Bengaluru, Karnataka, India

Abstract:

Electrical distribution networks are essential for reliable power delivery, and timely identification of abnormal operating conditions is crucial for maintaining system reliability. This paper presents a software-based machine learning approach for predictive fault detection and analysis in electrical distribution networks, integrated with a Streamlit-based interactive application. The proposed system uses six electrical parameters, namely phase currents I_a , I_b , I_c and phase voltages V_a , V_b , V_c , as input features. The developed framework performs two classification tasks: binary fault detection to distinguish between fault and no-fault conditions, and multi-class fault classification to identify six operating/fault categories, including Phase AG, Phase BC, Phase ABC, Phase ABG, and Phase ABCG. Five machine learning algorithms—Random Forest, Decision Tree, XGBoost, Logistic Regression, and Support Vector Machine (SVM)—are trained and comparatively evaluated using a 70:30 training and testing split. Performance is assessed using accuracy, precision, recall, F1-score, sensitivity, and specificity. The system further employs ensemble majority voting during prediction to obtain a consolidated fault detection and classification result. A Streamlit-based frontend provides interactive data visualization, model comparison, evaluation results, and prediction capabilities. The proposed software framework demonstrates the applicability of machine learning and interactive analytics for efficient, accessible, and data-driven electrical fault analysis.

Keywords:

Electrical Distribution Networks, Fault Detection, Fault Classification, Machine Learning, Random Forest, XGBoost, SVM, Streamlit.