CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

Presented By:
1. Jagan Palaparthi-Raghu Engineering college-Datascience

edunet
foundation

OUTLINE

- **Problem Statement** (Should not include solution)
- **Proposed System/Solution**
- **System Development Approach** (Technology Used)
- **Algorithm & Deployment**
- **Result (Output Image)**
- **Conclusion**
- **Future Scope**
- **References**

PROBLEM STATEMENT

- Example: In modern power distribution systems, ensuring grid stability and reliability is critically dependent on the rapid and accurate detection of faults. Power system faults, such as **line-to-ground**, **line-to-line**, and **three-phase faults**, can cause severe disruptions, equipment damage, and widespread outages if not identified and addressed promptly.
- This project aims to develop a machine learning-based approach to **automatically detect and classify various types of electrical faults** using real-time measurement data. By leveraging electrical parameters such as **voltage and current phasors**, the proposed system should be capable of distinguishing between **normal operating conditions** and **abnormal fault conditions** in the distribution network.
- The ultimate objective is to enhance fault diagnosis capabilities to enable **faster protective actions**, reduce downtime, and improve the **operational efficiency and resilience** of the power grid.

PROPOSED SOLUTION

- The system uses machine learning to detect and classify faults in a power distribution network based on voltage and current phasor data.
- Data Collection:
  Gather phasor data under normal and fault conditions from simulations or sensors.
- Data Preprocessing:
  Clean and normalize the data; extract key features relevant to fault types.
- Modeling:
  Train a classification model (e.g., Random Forest or Neural Network) to distinguish between normal, line-to-ground, line-to-line, and three-phase faults.
- Deployment:
  Implement the model in a real-time monitoring system for fault identification.
- Evaluation:
  Use metrics like accuracy, precision, and recall to evaluate model performance.
- Result:
  The system effectively classifies different fault types, enabling faster response and improving grid stability.

SYSTEM APPROACH

The "System Approach" section outlines the overall strategy and methodology for developing and implementing the fau

- **System requirements**
  - A computer system with a minimum of 8GB RAM, i5 or Ryzen 5 processor, and 64-bit OS
  - Internet connection for accessing data and libraries
  - Simulation tools (e.g., MATLAB, PSCAD) or sensors for data generation
- **Libraries required to build the model**
  - NumPy and Pandas – for data manipulation
  - Matplotlib or Seaborn – for data visualization
  - Scikit-learn – for machine learning models (e.g., Random Forest, SVM)
  - TensorFlow or PyTorch – if deep learning models are used
  - SciPy – for signal processing tasks (if needed)

ALGORITHM & DEPLOYMENT

- In the Algorithm section, describe the machine learning algorithm chosen for classifying faults in the power distribution system. Here's an example structure for this section:
- **Algorithm Selection:**
  Provide a brief overview of the chosen algorithm (e.g., classification models like Random Forest, SVM, or a Neural Network) and justify its selection based on the problem statement and nature of phasor data.
- **Data Input:**
  Specify the input features used by the algorithm, such as voltage and current phasors, phase angles, and frequency deviations during both normal and faulty conditions.
- **Training Process:**
  Explain how the algorithm is trained using labeled data from fault simulations or historical system records. Highlight any specific techniques or considerations, such as data normalization, cross-validation, or hyperparameter tuning.
- **Prediction Process:**
  Detail how the trained algorithm identifies the fault type (e.g., line-to-ground, line-to-line, three-phase) using real-time input phasor data. Mention any real-time preprocessing done before classification.

RESULT

- The developed machine learning model successfully detects and classifies different types of faults—such as line-to-ground, line-to-line, and three-phase faults—with high accuracy.
- The system was tested using labeled phasor data under both normal and fault conditions. It demonstrated strong performance in identifying fault types in real-time, with minimal false classifications.
- The results confirm that the proposed approach can significantly reduce fault detection time and improve the reliability and stability of the power distribution network.

CONCLUSION

- This project successfully demonstrated the application of machine learning techniques for detecting and classifying different types of faults in a power distribution system using voltage and current phasor data.
- By leveraging classification algorithms and real-time data inputs, the system can accurately identify fault types such as line-to-ground, line-to-line, and three-phase faults. The approach enhances the speed and reliability of fault diagnosis, which is essential for maintaining grid stability.
- Overall, the model provides a promising foundation for intelligent power grid monitoring systems and opens avenues for further enhancement using deep learning and real-time deployment in smart grid environments.

FUTURE SCOPE

- The model can be further enhanced in the following ways:
- **IoT Integration:** Use real-time data from smart sensors for faster fault detection.
- **Deep Learning:** Apply CNNs or LSTMs for better accuracy in complex fault patterns.
- **Smart Grid Deployment:** Scale the system for automated fault response in smart grids.
- **Multi-Fault Detection:** Extend the model to detect and classify multiple faults simultaneously.
- **Live Monitoring:** Add dashboards for real-time visualization and quick decision-making.

REFERENCES

- Kundur, P. *Power System Stability and Control*. McGraw-Hill, 1994.
- Abur, A., & Exposito, A. G. *Power System State Estimation*. CRC Press, 2004.
- Scikit-learn Documentation – https://scikit-learn.org
- TensorFlow Documentation – https://www.tensorflow.org
- Open Power System Data – https://data.open-power-system-data.org
- IEEE papers on power system fault detection using machine learning

IBM CERTIFICATIONS

Getting Started with Artificial Intelligence
IBM SkillsBuild

IBM

In recognition of the commitment to achieve professional excellence

JAGAN Palaparthi

Has successfully satisfied the requirements for:

Getting Started with Artificial Intelligence

Issued on: Jul 20, 2025
Issued by: IBM SkillsBuild

Verify: https://www.credly.com/badges/023e3e89-c201-439c-bdc7-6b9493342d68

IBM

IBM CERTIFICATIONS

Journey to Cloud: Envisioning Your Solution

IBM SkillsBuild

In recognition of the commitment to achieve professional excellence

JAGAN Palaparthi

Has successfully satisfied the requirements for:

Journey to Cloud: Envisioning Your Solution

Issued on: Jul 20, 2025

Issued by: IBM SkillsBuild

Verify: https://www.credly.com/badges/db33f2b6-6edc-486d-9e76-61f39a36aa42

IBM CERTIFICATIONS

IBM **SkillsBuild** Completion Certificate

This certificate is presented to

JAGAN Palaparthi

for the completion of

Lab: Retrieval Augmented Generation with LangChain

(ALM-COURSE_3824998)

According to the Adobe Learning Manager system of record

Completion date: 24 Jul 2025 (GMT) **Learning hours:** 20 mins

THANK YOU