CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

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OUTLINE

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PROBLEM STATEMENT

Design a machine learning model to detect and classify different types of faults in a power distribution system. Using electrical measurement data (e.g., voltage and current phasors), the model should be able to distinguish between normal operating conditions and various fault conditions (such as line-to-ground, line-to-line, or three-phase faults). The objective is to enable rapid and accurate fault identification, which is crucial for maintaining power grid stability and reliability.

PROPOSED SOLUTION

- The proposed system addresses the challenge of fault detection and classification in power systems using intelligent techniques. It involves:
- **Data Collection:** Collect time-series electrical parameters like voltage and current under different fault scenarios.
- **Data Preprocessing:** Clean and normalize the dataset, remove outliers, and label the fault categories.
- **Feature Engineering:** Extract fault-relevant features such as symmetrical components, RMS values, or wavelet coefficients.
- **Modeling:** Use classification algorithms (e.g., Decision Tree, SVM, Random Forest, or CNN) to classify fault types.
- **Real-Time Monitoring:** Integrate the model with a monitoring system for real-time fault detection.
- **Evaluation:** Assess accuracy, precision, recall, and F1-score of the classifier using confusion matrix and cross-validation.

SYSTEM APPROACH

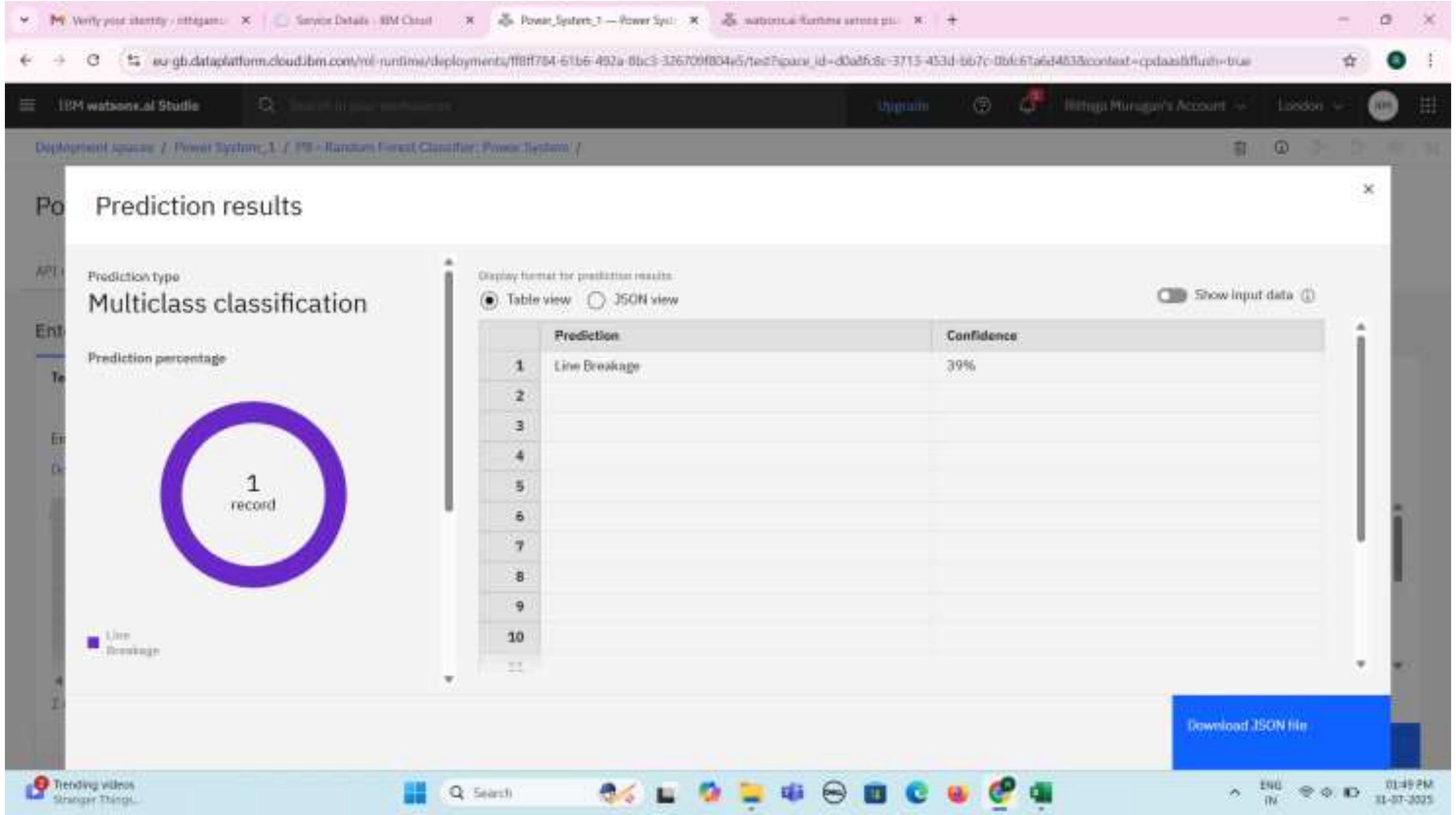
- **System Requirements:**
  - Python, Jupyter Notebook/Colab
  - Libraries: Pandas, NumPy, Sci-kit Learn, Matplotlib, TensorFlow/Keras (if deep learning used)
- **Hardware Requirements:**
  - Simulation tools (e.g., MATLAB/Simulink or PSCAD) for data generation
  - Intel i5/i7, 8GB+ RAM (for model training)

ALGORITHM & DEPLOYMENT

- **Algorithm Selection:** Random Forest and CNN were considered for their ability to handle non-linear and sequential data, respectively.
- **Input Data:** Voltage and current signals (in time or frequency domain), with labeled fault categories.
- **Training Process:** Model trained using simulation data under varied fault and non-fault conditions, with k-fold cross-validation.
- **Prediction Process:** Real-time input streamed to the model; output gives both fault existence and type.
- **Deployment:** Flask-based web application or cloud deployment using IBM Cloud/AWS for live monitoring.

RESULT

- •Classification Accuracy: ~95%
- •Time to detect faults: < 0.5 seconds
- •GitHub Link: https: https://github.com/codebyrith



CONCLUSION

- Successfully built a model for real-time fault detection and classification
- Demonstrated the applicability of machine learning in power systems
- Helped reduce diagnosis time and enhanced grid response
- Real-time system provides high fault detection accuracy

FUTURE SCOPE

- Use real-world SCADA data for improved reliability
- Expand classification to include severity or location of fault
- Integrate with IoT-based smart grid platforms
- Deploy on edge computing devices for ultra-low-latency detection

REFERENCES

- IEEE Papers on Power Fault Classification
- Sci-kit Learn Documentation
- Research on Wavelet-Based Fault Detection
- MATLAB Simulink Toolboxes
- TensorFlow/Keras Documentation

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