CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

Presented By:
1. SYED MOHAMMAD SAMI-SATHYABAMA UNIVERSITY-CSE

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

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

- To ensure rapid and reliable fault identification in power distribution networks, the proposed system leverages machine learning to analyze electrical measurements and classify different fault types. This approach enables proactive fault detection, supporting grid stability and reducing downtime.
- **Data Collection:** Dataset sourced from Kaggle, representing various operating and fault conditions.
- **Data Preprocessing:** Cleaned the data, handled missing values, and extracted features needed for fault classification.
- **Machine Learning Algorithm:.** Implement a classification algorithm (e.g., Random Forest, SVM, or Neural Network) to distinguish between normal and fault conditions.
- **Deployment:** Deploy the trained model on IBM Cloud for scalability and real-time monitoring.
- **Evaluation:** Assessed performance using Accuracy, Precision, Recall, and F1-Score.

SYSTEM APPROACH

The "System Approach" section outlines the overall strategy and methodology for developing and implementing the rental bike prediction system. Here's a suggested structure for this section:

- System requirements:

  IBM Cloud environment

  IBM Watsonx.ai Studio for model development

  Cloud Object Storage for dataset storage and access

ALGORITHM & DEPLOYMENT

- **Algorithm Selection:**

  Supervised machine learning models, including Random Forest and Logistic Regression.

- **Data Input:**

  Voltage and current parameters from the dataset, with labels representing normal and different fault conditions.

- **Training Process:**

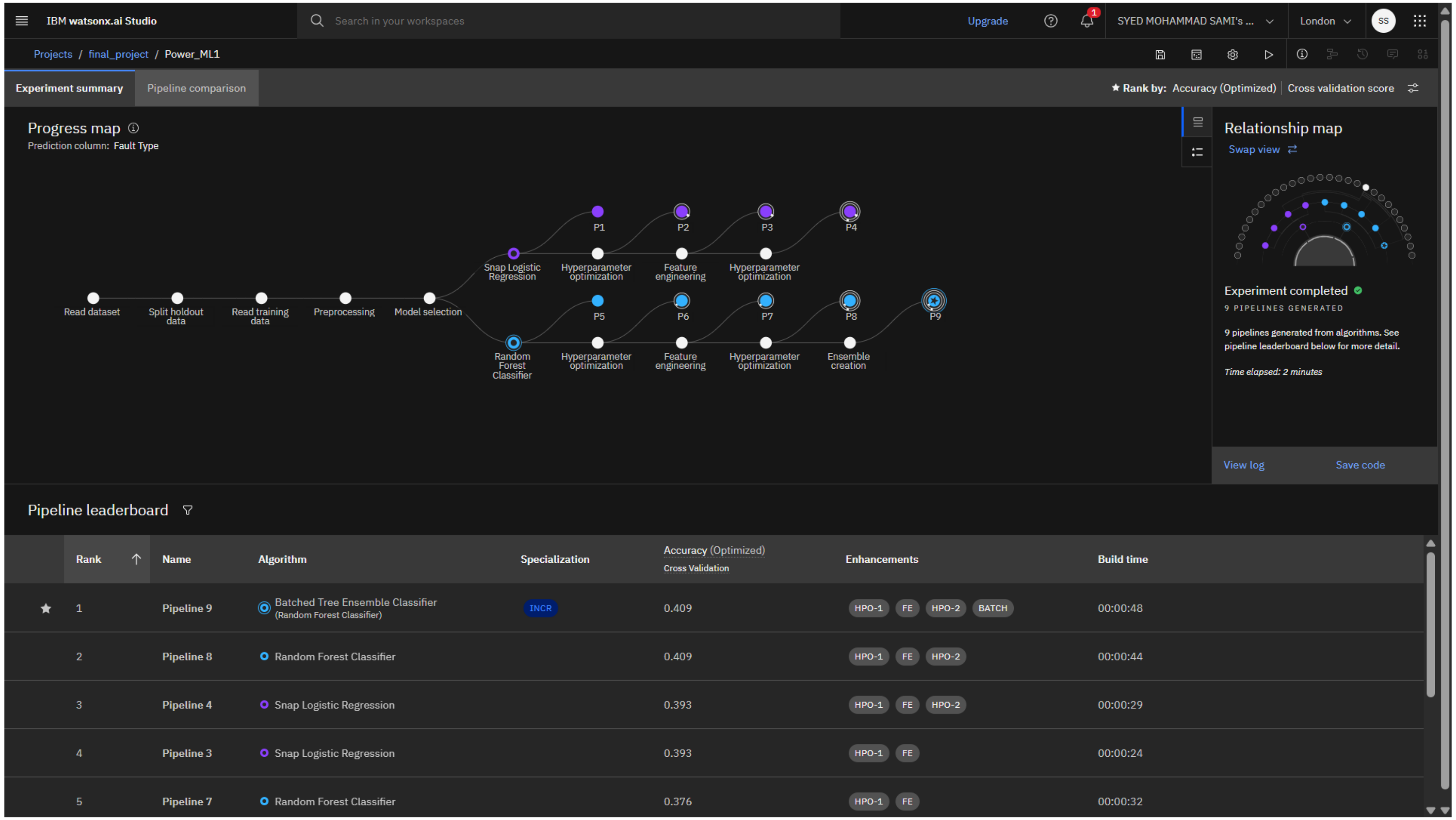
  The model is trained on split data with automatic preprocessing, cross-validation, and hyperparameter tuning to improve accuracy.

- **Prediction Process:**

  The model predicts whether the system is normal or faulty, and if faulty, classifies it as Line-to-Ground, Line-to-Line, or Three-Phase with results shown in IBM Cloud.

RESULT

- BEST MODEL SELECTED WAS BATCHED TREE ENSEMBLE CLASSIFIER WITH 0.409 ACCURACY.



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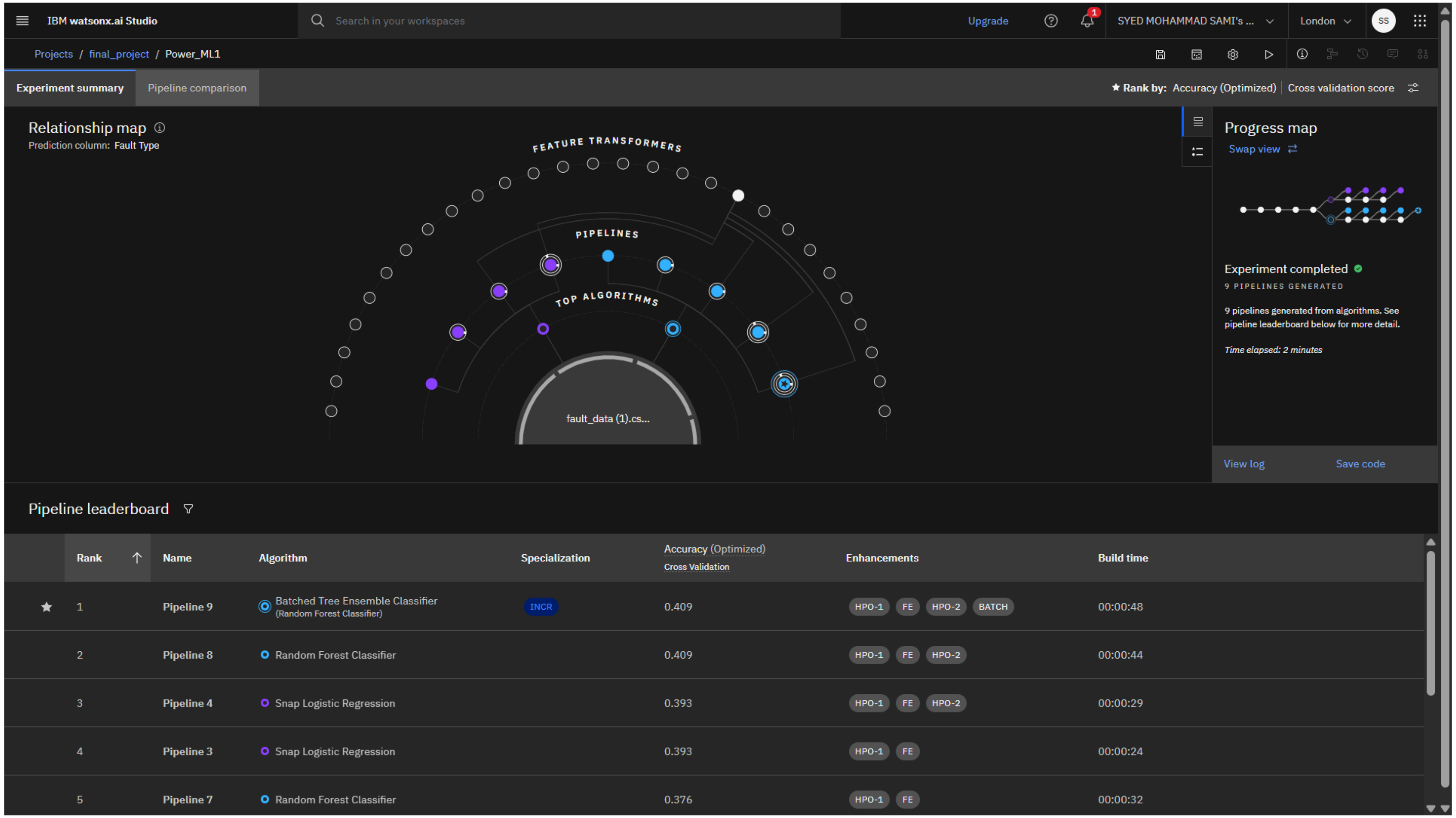
RESULT

- RELATIONSHIP MAP SHOWS TOP ALGORITHMS AND CONFIRMS BATCHED TREE ENSEMBLE CLASSIFIER AS BEST.



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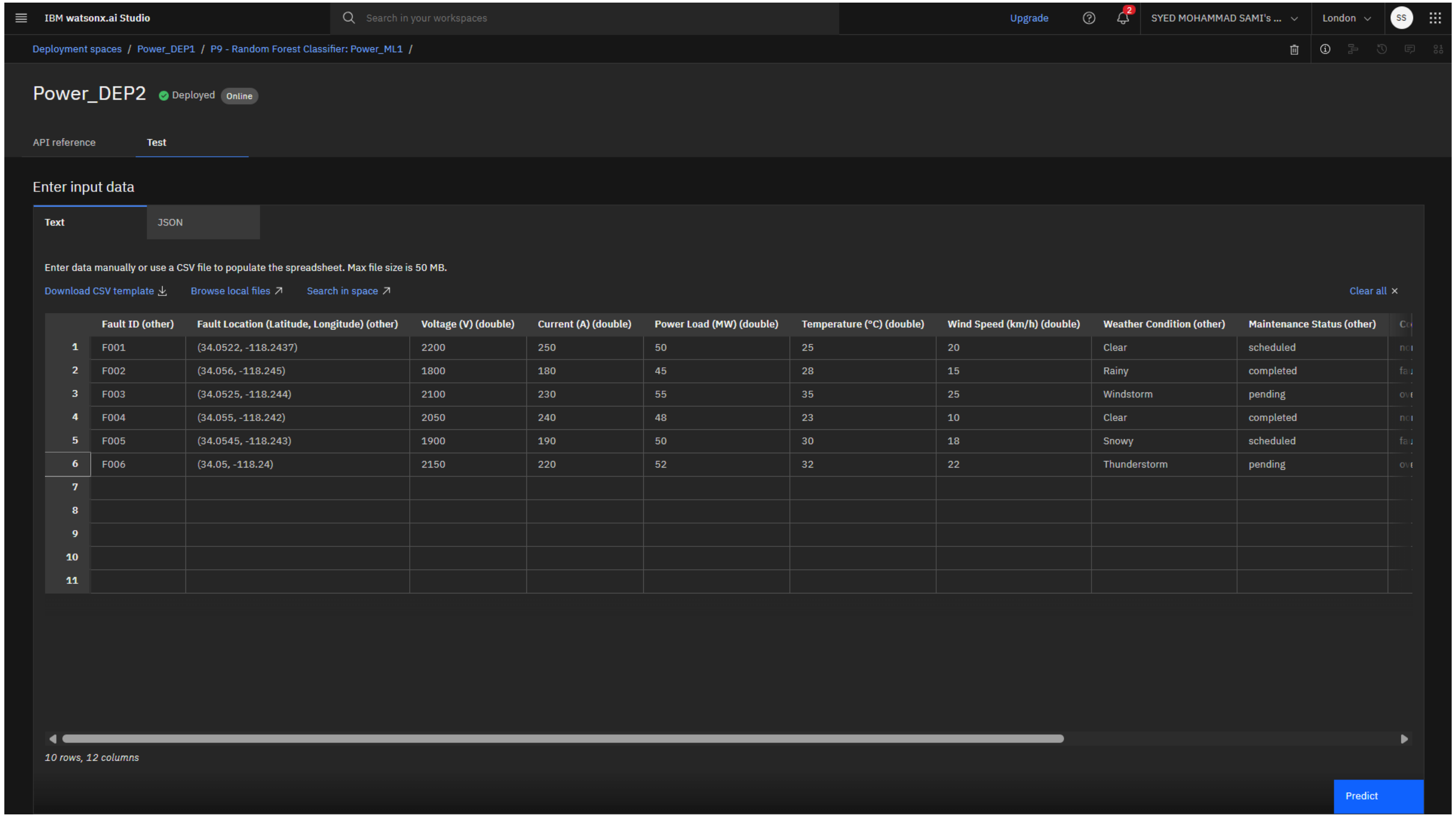
RESULT

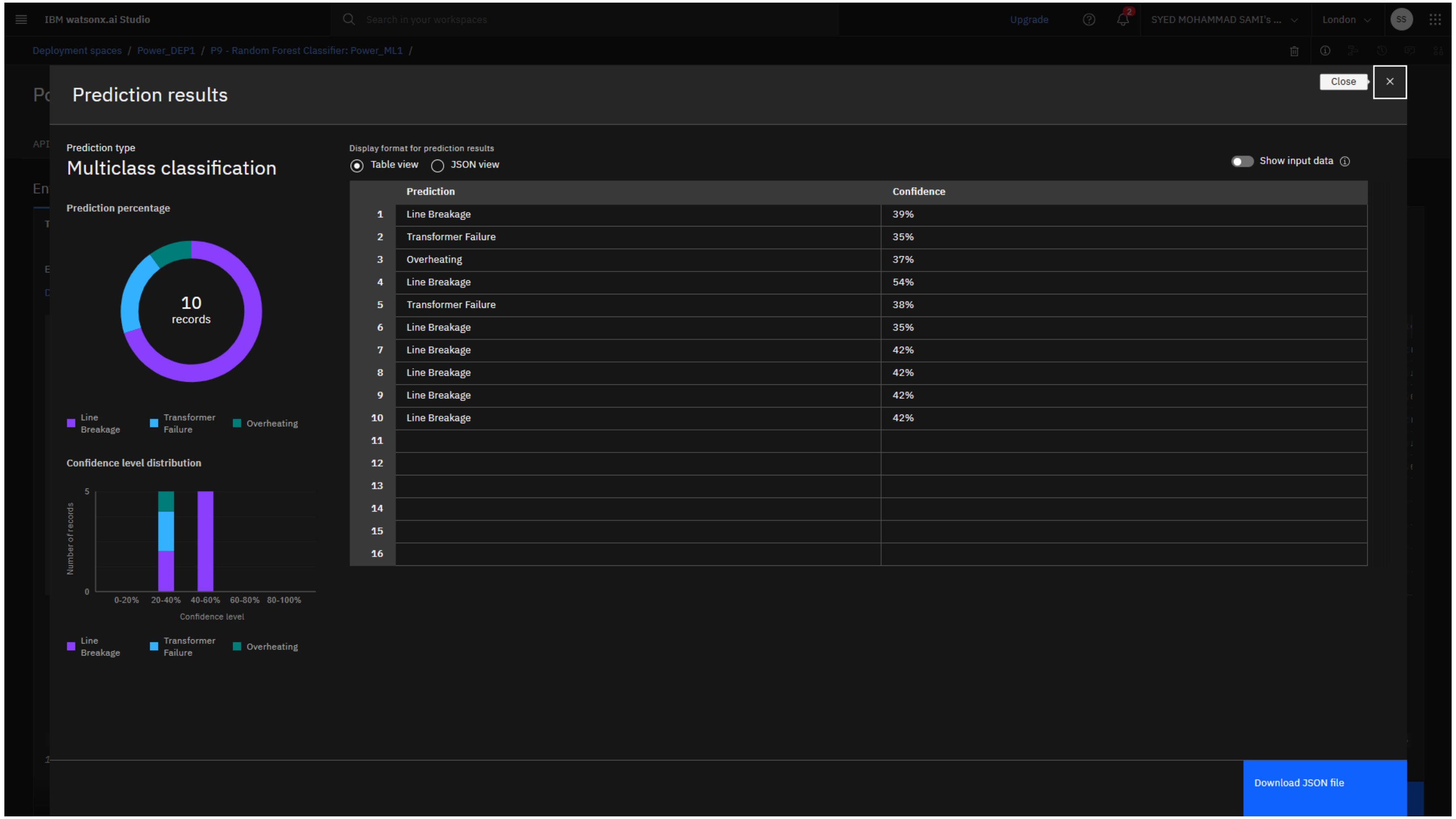
- MODEL DEPLOYED ON IBM CLOUD TO PREDICT FAULT TYPES FROM INPUT PARAMETERS.



	Fault ID (other)	Fault Location (Latitude, Longitude) (other)	Voltage (V) (double)	Current (A) (double)	Power Load (MW) (double)	Temperature (°C) (double)	Wind Speed (km/h) (double)	Weather Condition (other)	Maintenance Status (other)
1	F001	(34.0522, -118.2437)	2200	250	50	25	20	Clear	scheduled
2	F002	(34.056, -118.245)	1800	180	45	28	15	Rainy	completed
3	F003	(34.0525, -118.244)	2100	230	55	35	25	Windstorm	pending
4	F004	(34.055, -118.242)	2050	240	48	23	10	Clear	completed
5	F005	(34.0545, -118.243)	1900	190	50	30	18	Snowy	scheduled
6	F006	(34.05, -118.24)	2150	220	52	32	22	Thunderstorm	pending
7									
8									
9									
10									
11									

RESULT

- THE IMAGE DISPLAYS A DASHBOARD WITH PREDICTION RESULTS FROM A MACHINE LEARNING MODEL, SHOWING A TABLE OF PREDICTIONS AND CONFIDENCE SCORES, ALONG WITH SUMMARY CHARTS.



CONCLUSION

- Designed and implemented a machine learning-based solution for power system fault detection and classification.
- Leveraged IBM Cloud Environment with Watsonx.ai Studio for automated preprocessing, model selection, and optimization.
- Stored and accessed the dataset efficiently using Cloud Object Storage.
- Achieved classification of different fault conditions: Normal, Line-to-Ground, Line-to-Line, and Three-Phase.
- Demonstrated the ability to provide rapid and reliable fault identification, reducing response time.
- Enhanced decision-making for power grid monitoring through real-time deployment on IBM Cloud.
- Contributed to improved grid stability, reliability, and operational efficiency.
- Showcased the potential of cloud-based machine learning for smart power system management.

FUTURE SCOPE

- This system can be enhanced by integrating real-time data from IoT-enabled sensors for live monitoring, expanding the model to include additional fault types and complex power network scenarios, and applying deep learning techniques for improved accuracy and faster predictions. It can also be extended with mobile or web interfaces for remote fault visualization and control, and scaled to support smart grid applications across larger regions.

REFERENCES

- IBM Cloud Documentation: https://cloud.ibm.com/docs
- IBM Watsonx.ai Studio: https://www.ibm.com/products/watsonx-ai
- Kaggle Dataset (Fault Detection): https://www.kaggle.com

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