CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION USING IBM WATSON AI

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OUTLINE

- Problem Statement
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PROBLEM STATEMENT

- In large-scale power systems, identifying the type of fault in real-time is critical to avoid equipment damage, outages, and economic losses. Traditional fault detection systems struggle with accuracy due to environmental, mechanical, and system load variability

PROPOSED SOLUTION

- **Multivariate Data Integration**: Combine electrical parameters (Voltage, Current, Load) with environmental (Temperature, Wind Speed, Weather) and operational factors (Component Health, Maintenance Logs) for holistic fault prediction.
- **Labelled Fault Classification**: Use supervised learning to categorize faults (e.g., LLG, LL, LLLG) based on historical data labeled with real-world fault types.
- **Data Cleaning & Preprocessing**: Handle missing values, scale features, and encode categorical variables to prepare a robust training dataset.
- **Model Selection via Watson AutoAI**: Leverage IBM Watson's AutoAI to explore multiple models (Random Forest, XGBoost, Logistic Regression) and choose the best-performing one automatically.
- **Cloud-Based Training & Storage**: Use IBM Watson Studio for scalable training and IBM Cloud Object Storage for secure data handling.
- **Deployment as a Web Service**: Publish the trained model using Watson Machine Learning deployment for real-time REST API integration into grid monitoring systems.
- **Real-Time Predictions**: Enable utilities to input current system values and instantly receive the predicted fault type via the deployed model.
- **Visualization Dashboard**: Integrate model outputs into a dashboard (e.g., using IBM Cognos or custom HTML/JS) for engineers to monitor faults in real time.
- **Automated Alerts**: Use output from the model to trigger automated alert systems for rapid response during critical faults.

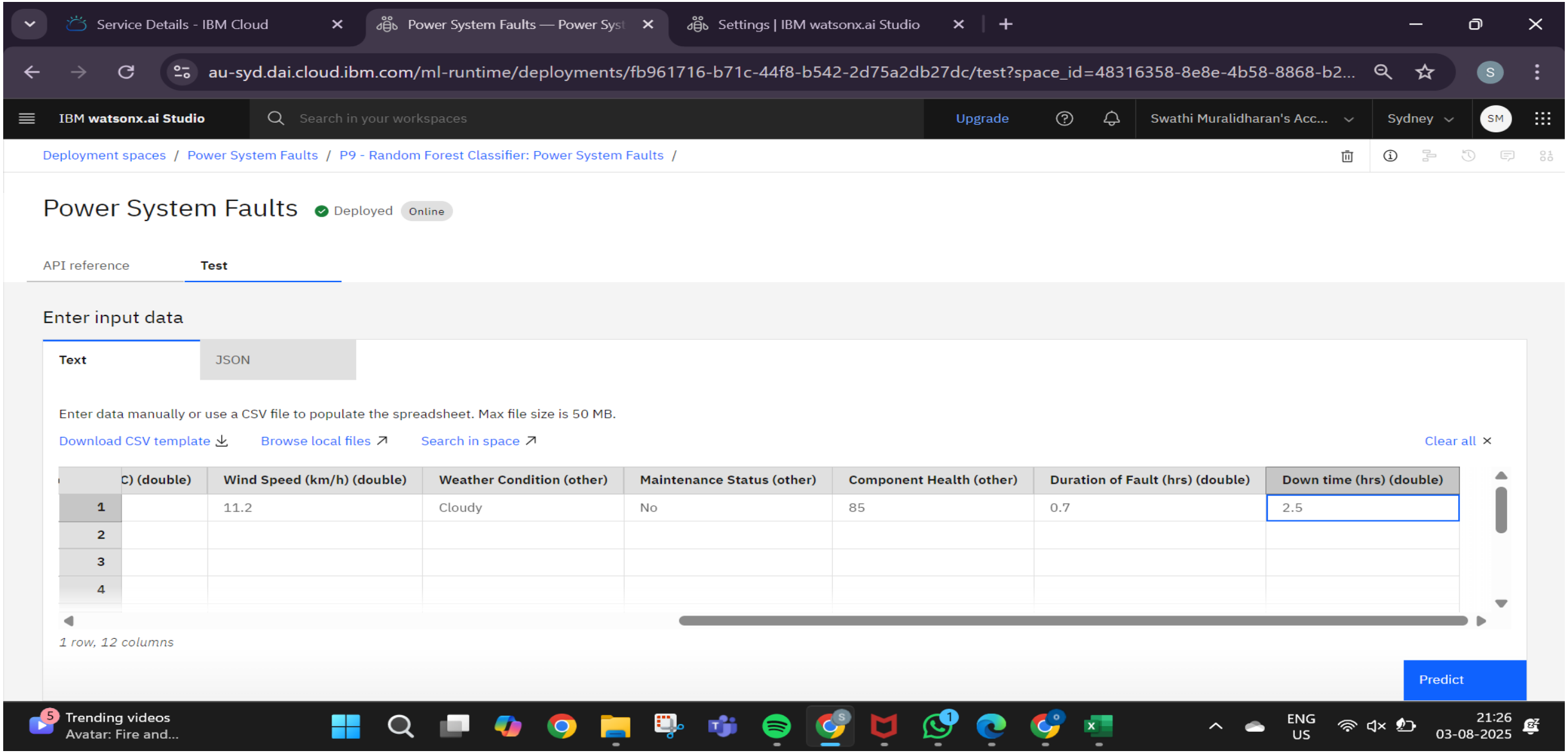
SYSTEM APPROACH

- **System Requirements:**
- IBM Cloud Account
- Watson Studio access
- Python 3.10 runtime with scikit-learn, pandas, matplotlib
- Libraries Used:
- pandas, sklearn, matplotlib, seaborn, joblib

ALGORITHM & DEPLOYMENT

- **Algorithm**: Random Forest Classifier (high accuracy, handles tabular data well)
- **Input Features**:
- Voltage, Current, Power Load
- Temperature, Wind Speed, Weather
- Fault Duration, Component Health
- **Training**: Split 80:20, trained using Watson AutoAI or Jupyter Notebook
- **Deployment**: Model deployed as a web service using Watson ML deployment pipeline

RESULT



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Prediction results

Close

Display format for prediction results

(•) Table view ( ) JSON view

Show input data

	prediction	probability
1	Line Breakage	[0.5641631081481538,0.2700214014355519,0.16581549041629426]
2		
3		
4		
5		
6		
7		
8		
9		
10		

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Prediction results

Display format for prediction results

(•) Table view ( ) JSON view

Show input data

	prediction	probability	Fault ID	Fault Location (Latitude, Lo	Voltage (V)	Current (A)	Power Load (MW)
1	Line Breakage	[0.564163108148153...	1	13.0827, 80.2707	230.4	2.7	95.3
2							
3							
4							
5							
6							
7							
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3 assets

All assets

Asset types

- Data 1
- Experiments 1
- Models 1

All assets

Name	Last modified
P9 - Random Forest Classifier: Power System Faults Machine learning model from AutoAI	17 minutes ago Modified by Service
Power System Faults AutoAI experiment	22 minutes ago Modified by you
fault_data.csv CSV	22 minutes ago Modified by you

CONCLUSION

- This project demonstrates the successful application of AI and cloud technologies to enhance fault detection in power systems. By leveraging IBM Watson Studio, we built a robust model capable of accurately classifying fault types based on electrical, environmental, and operational parameters. The cloud-based deployment ensures real-time access, scalability, and easy integration with existing utility infrastructure. This solution not only improves reliability and response time but also reduces manual diagnostics and maintenance costs. The model's success showcases the transformative impact of AI in critical infrastructure, especially in smart grid and energy sectors

FUTURE SCOPE

- Integrate live sensor streams using IoT
- Add explainability (XAI) for fault traceability
- Extend to predictive maintenance with time-series data
- Apply to regional power grids for anomaly detection

REFERENCES

- IBM Watson Studio Docs
- Kaggle Power Faults Dataset
- IEEE research on smart grid fault classification

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THANK YOU

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