PROJECT TITLE

Smart Maintenance: Predicting Machine Failures Using AI (Predictive Maintenance of Industrial Machinery)

Presented By:

1. Sri Kumar Muppidi – Malla Reddy College Of Engineering-CSE-DS

Github Link:- https://www.linkedin.com/in/srikumar-muppidi-3724192a6

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OUTLINE

- **Problem Statement**
- **Proposed System/Solution**
- **System Development Approach** (Technology Used)
- **Algorithm & Deployment**
- **Result (Output Image)**
- **Conclusion**
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- **References**

PROBLEM STATEMENT

In today’s industrial environment, unexpected machine breakdowns can cause serious disruptions, leading to costly downtime and delays. Often, maintenance is done only after a problem occurs, which means issues like tool wear, overheating, or power faults aren’t caught early. This reactive approach not only wastes resources but also affects overall efficiency. There’s a growing need for a smarter system that can monitor machines in real time, understand patterns in sensor data, and predict failures before they happen—helping industries take action before it’s too late.

PROPOSED SOLUTION

The system is designed to predict machinery failures in advance using machine learning and cloud deployment.

Dataset Source:

- The predictive model is trained on the publicly available Kaggle Predictive Maintenance dataset, which includes real-world sensor data.

Data Collection & Preprocessing:

- Use historical sensor readings such as air temperature, process temperature, rotational speed, torque, and tool wear.
- Clean the data, handle missing values, and perform feature scaling and encoding.

Model Development:

- Train a classification model (Random Forest) to detect and classify machine failure types.

Deployment Platform:

- The entire system is developed and deployed on IBM Cloud Lite using IBM Watson Studio for model training, evaluation, and serving.

Output:

- Real-time prediction of machine failure types to enable timely maintenance decisions.

SYSTEM APPROACH

System Requirements:

- Sensor data (temperature, vibration, etc.)
- IBM Cloud Lite environment

Libraries/Tools Required:

- IBM Watsonx.ai Studio
- Runtime

ALGORITHM & DEPLOYMENT

Algorithm Selection:

- Random Forest / XGBoost / SVM for failure classification

Data Input:

- Real-time operational data (air temperature, process temperature, torque, tool wear, etc.)

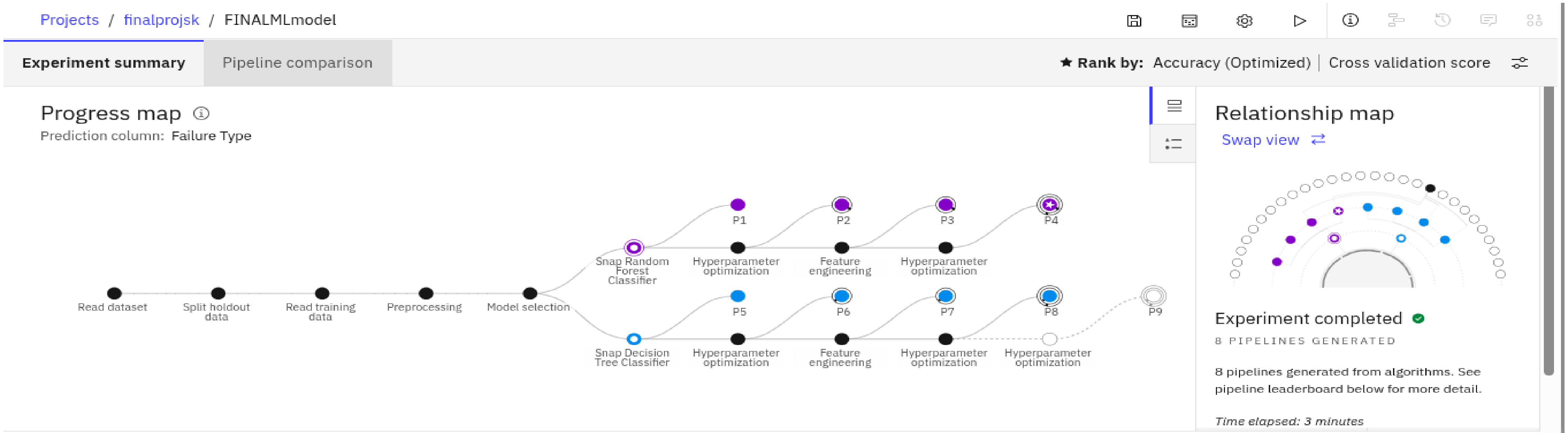
Training Process:

- Dataset split into training and test sets
- Feature scaling and encoding
- Hyperparameter tuning via cross-validation

Deployment:

- Trained model is deployed on IBM Cloud as an API
- Real-time data can be passed for predictions

RESULT



Pipeline leaderboard

	Rank	Name	Algorithm	Specialization	Accuracy (Optimized) Cross Validation	Enhancements	Build time
★	1	Pipeline 4	Snap Random Forest Classifier		0.995	HPO-1 FE HPO-2	00:00:44
	2	Pipeline 3	Snap Random Forest Classifier		0.995	HPO-1 FE	00:00:35
	3	Pipeline 8	Snap Decision Tree Classifier		0.994	HPO-1 FE HPO-2	00:00:29
	4	Pipeline 2	Snap Random Forest Classifier		0.994	HPO-1	00:00:10

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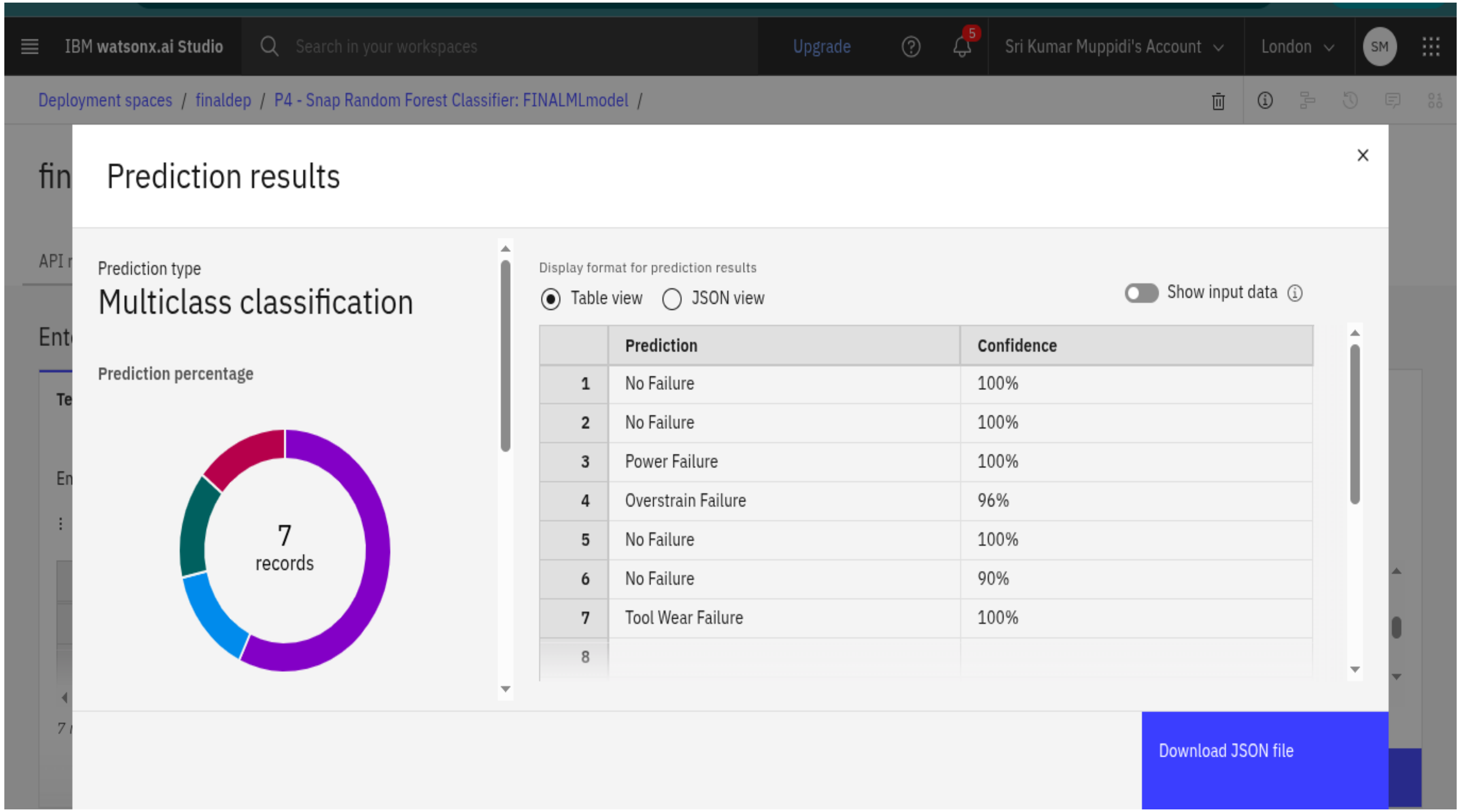
RESULT


IBM watsonx.ai Studio
Search in your workspaces
Upgrade
Sri Kumar Muppidi's Account
London
SM
Deployment spaces / finaldep / P4 - Snap Random Forest Classifier: FINALMLmodel /
Prediction results
Prediction type
Multiclass classification
Prediction percentage
7
records
Display format for prediction results
Table view
JSON view
Show input data
Prediction
Confidence
1 No Failure 100%
2 No Failure 100%
3 Power Failure 100%
4 Overstrain Failure 96%
5 No Failure 100%
6 No Failure 90%
7 Tool Wear Failure 100%
8
Download JSON file

CONCLUSION

The predictive maintenance model effectively anticipates equipment failures, allowing timely interventions. This leads to:

- Reduced machine downtime
- Lower maintenance costs
- Enhanced production efficiency

FUTURE SCOPE

- Integrate deep learning models (e.g., LSTM) for time-series sensor data
- Extend the system to include more types of equipment
- Integrate with IoT platforms for automated alerts
- Improve model with live feedback loop from the factory floor.

REFERENCES

- https://www.kaggle.com/datasets/shivamb/machine-predictive-maintenance-classification
- IBM Cloud Documentation

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THANK YOU