
CAPSTONE PROJECT

PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY

Presented By:

1. Nishtha Garg- Meerut Institute of Engineering & Technology- (CSE)

OUTLINE

- **Problem Statement**
- **Proposed System/Solution**
- **System Development Approach**
- **Algorithm & Deployment**
- **Result**
- **Conclusion**
- **Future Scope**
- **References**

PROBLEM STATEMENT

Industrial machinery is prone to unexpected failures that lead to unplanned downtime, increased maintenance costs, and reduced operational efficiency. Traditional reactive maintenance approaches are inefficient and costly. To address this issue, we aim to develop a **predictive maintenance model** that can accurately anticipate machine failures **before they occur**, using real-time sensor data. The objective is to build a **classification model** capable of identifying the **type of failure**—such as tool wear, heat dissipation issues, or power failure—by analyzing historical and live operational data. This solution will enable proactive maintenance strategies, thereby minimizing machine downtime and optimizing overall productivity.

PROPOSED SOLUTION

- To proactively detect and classify potential machine failures, we propose the development of a data-driven machine learning system using sensor data collected from industrial machinery. The proposed solution involves the following components:

- **Key Components:**

- 1. Data Collection:**

Use the Kaggle dataset on the type of failures.

- 2. Data Preprocessing:**

Clean data, handle missing values, create time-based features, label failure types, and normalize the dataset.

- 3. Model Training:**

Train supervised classification models (e.g., Random Forest, XGBoost, LSTM) to predict failure types using labeled data.

- 4. Model Evaluation:**

Use metrics like accuracy, precision, recall, and F1-score to evaluate performance on test data.

SYSTEM APPROACH

Industrial machines often fail unexpectedly, leading to downtime and costly repairs. The objective is to build a **predictive maintenance system** that uses sensor data to detect failure patterns and predict the **type of failure** in advance, enabling timely maintenance.

- System Requirements:

Service	Purpose
IBM Watson Studio	Develop notebooks, process data, and train ML models
IBM Cloud Object Storage	Store sensor data, logs, and model files
IBM Watson Machine Learning	Deploy models as REST APIs and manage deployments

ALGORITHM & DEPLOYMENT

- **Algorithm Selection:**

Random Forest Classifier, (Support Vector Machine (SVM))

- **Data Input:**

Air Temperature, Process Temperature, Rotational Speed, Torque, Tool Wear, Target measurements from the dataset.

- **Training Process:**

Supervised Learning using the labelled failure types.

- **Prediction Process:**

Model deployed on IBM Watson Studio with API endpoint for real-time predictions.

RESULT

Service Details - IBM Cloud

IBM watsonx.ai Studio

+

← → ↺

eu-gb.dataplatform.cloud.ibm.com/ml/auto-ml/a7205a43-70a7-415a-b20a-31dffcfb1e97/train?projectid=528f8d7e-4ca9-4e11-8c97-64b4868c248d&context=cpdaas

🔒 Incognito

⋮

IBM watsonx.ai Studio

Search in your workspaces

Upgrade

?

🔔

Nishtha Garg's Account

London

NG

⋮

Projects / PMIM39 / PMIM39_ML

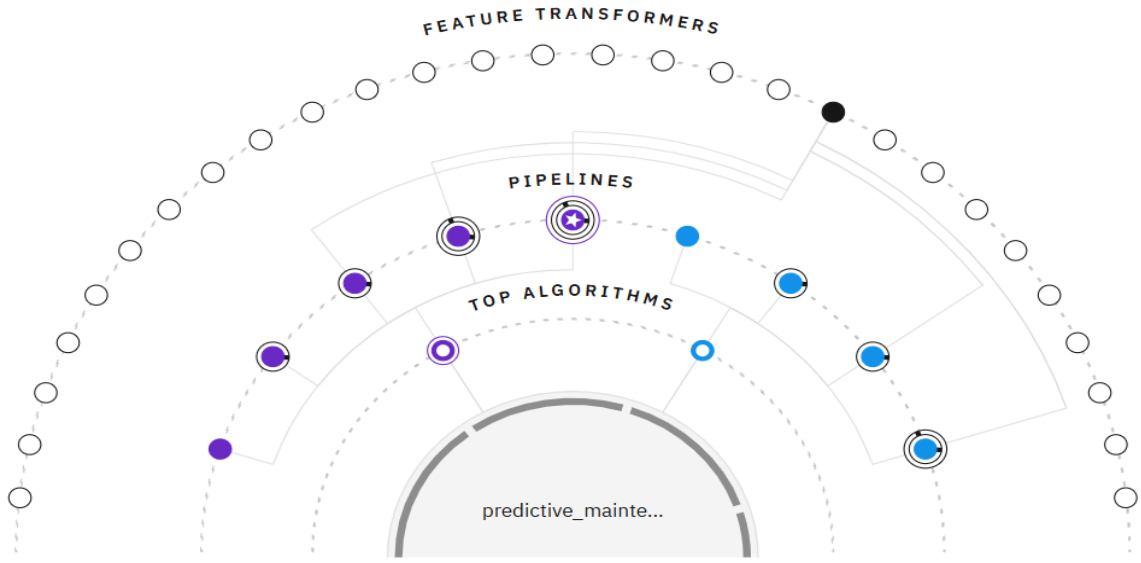
📁 📅 ⚙️ ▶️ ⓘ 📄 🔄 💬 ⋮

Experiment summary

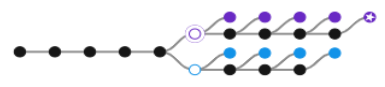
Pipeline comparison

★ Rank by: Accuracy (Optimized) | Cross validation score

Relationship map ⓘ
Prediction column: Failure Type



Progress map
[Swap view](#)



Experiment completed ✓

9 PIPELINES GENERATED

9 pipelines generated from algorithms. See pipeline leaderboard below for more detail.

Time elapsed: 2 minutes

View log

Save code

Pipeline leaderboard ▾

RESULT

Service Details - IBM Cloud

IBM watsonx.ai Studio

eu-gb.dataplatform.cloud.ibm.com/ml/auto-ml/a7205a43-70a7-415a-b20a-31dffcb1e97/train?projectid=528f8d7e-4ca9-4e11-8c97-64b4868c248d&context=cpdaas

Incognito

IBM watsonx.ai Studio

Search in your workspaces

Upgrade

Nishtha Garg's Account

London

NG

Projects / PMIM39 / PMIM39_ML

Rank by: Accuracy (Optimized) | Cross validation score

Experiment summary

Pipeline comparison

Progress map ⓘ

Prediction column: Failure Type

Read dataset

Split holdout data

Read training data

Preprocessing

Model selection

Snap Random Forest Classifier

Snap Decision Tree Classifier

P1

P6

Hyperparameter optimization

Hyperparameter optimization

Feature engineering

Feature engineering

P2

P7

P3

P8

Hyperparameter optimization

Hyperparameter optimization

P4

P9

Ensemble creation

P5

Relationship map

Swap view ↺

Experiment completed ✓

9 PIPELINES GENERATED

9 pipelines generated from algorithms. See pipeline leaderboard below for more detail.

Time elapsed: 2 minutes

View log

Save code

Pipeline leaderboard ⌵

Type here to search

8:31 PM 8/3/2025 foundation

RESULT

Service Details - IBM Cloud

P5 - Snap Random Forest Classi

eu-gb.dataplatform.cloud.ibm.com/ml-runtime/models/43434171-7653-410c-a6e6-233d66ae4a63?project_id=528f8d7e-4ca9-4e11-8c97-64b4868c248d&context=cpdaas

Incognito

IBM watsonx.ai Studio

Search in your workspaces

Upgrade

Nishtha Garg's Account

London

NG

Projects / PMIM39 / P5 - Snap Random Forest Classifier: PMIM39_ML

Input (1)

Column	Type
Air temperature [K]	double
Process temperature [K]	double
Product ID	other
Rotational speed [rpm]	double
Target	double
Tool wear [min]	double
Torque [Nm]	double
Type	other

About this asset

Name

P5 - Snap Random Forest Classifier:
PMIM39_ML

Description

No description provided.

Asset Details

Type: wml-hybrid_0.1
Model ID: 43434171-7653-41...

Software specification:
[hybrid_0.1](#)

Hybrid pipeline software specifications:
[autoai-kb_rt24.1-py3.11](#)

Tags

Add tags to make assets easier to find.

Last modified
10 seconds ago by Nishtha Garg

Created on
Aug 3, 2025 by Nishtha Garg

CONCLUSION

The predictive maintenance system built on IBM Cloud efficiently combines machine learning with cloud services to forecast equipment failures using sensor data. Leveraging Watson Studio, Cloud Object Storage, and Watson Machine Learning, we developed, trained, and deployed a real-time failure prediction model. The solution reduces downtime, supports proactive maintenance, and offers a scalable, cloud-based foundation for future enhancements like automated alerts and retraining pipelines.

FUTURE SCOPE

The predictive maintenance system built on IBM Cloud has strong potential for future growth and enhancement. With a solid cloud-based foundation, the project can be expanded and optimized in several impactful ways:

- **Incorporate Additional Data Sources:** Integrating environmental data, operator behavior, and real-time third-party APIs can enhance prediction accuracy.
- **Algorithm Optimization:** Advanced techniques like XGBoost, LSTM, and AutoML can improve model performance. Hyperparameter tuning can further refine results.
- **Geographical Expansion:** The system can be scaled to monitor equipment across multiple cities or regions, with localized models and centralized cloud monitoring.
- **Edge Computing Integration:** Deploying models on edge devices using IBM Edge Application Manager can enable real-time, low-latency predictions even in remote locations.
- **Advanced Machine Learning Techniques:** Using anomaly detection, transfer learning, and federated learning can improve adaptability and privacy in distributed environments.

REFERENCES

- Kaggle dataset link – <https://www.kaggle.com/datasets/shivamb/machine-predictive-maintenance-classification>
- IBM Cloud - <https://cloud.ibm.com>
- IBM Watson Studio - <https://cloud.ibm.com/catalog/services/watsonxai-studio>
- IBM Watson Machine Learning
- IBM Cloud Object Storage

In recognition of the commitment to achieve
professional excellence



Nishtha Garg

Has successfully satisfied the requirements for:

Getting Started with Artificial Intelligence



Issued on: Jul 16, 2025

Issued by: IBM SkillsBuild

Verify: <https://www.credly.com/badges/b58a8339-aabe-49e8-a8f9-87a375e607d7>



IBM CERTIFICATIONS

In recognition of the commitment to achieve
professional excellence



Nishtha Garg

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/cd00704b-ed9a-4213-8c36-f6b9fbda860f>



IBM CERTIFICATIONS

IBM **SkillsBuild**

Completion Certificate



This certificate is presented to

Nishtha Garg

for the completion of

**Lab: Retrieval Augmented Generation with
LangChain**

(ALM-COURSE_3824998)

According to the Adobe Learning Manager system of record

Completion date: 23 Jul 2025 (GMT)

Learning hours: 20 mins

**IBM
CERTIFICATIONS**



THANK YOU