(1)https://drive.google.com/file/d/1RhaiYY2akuVrzaqkKD0Zz5ulv1bT723w/view?usp=sharing

Summary

This research paper discusses how predictive maintenance (PdM) can be used to improve manufacturing processes by predicting when machines might fail, allowing for timely repairs and reduced downtime.

Why Predictive Maintenance?

Traditional maintenance methods either wait for machines to break (unplanned) or replace parts too early (preventive).

PdM offers a smarter alternative — it monitors machine health and predicts failures in advance.

This can reduce costs, improve productivity, and increase the lifespan of machine components.

Focus of the Study:

The paper focuses on two key parts of a machine: the cutting tool and the spindle motor.

These are essential in machining processes and are prone to wear and failure over time.

How AI Is Used:

AI and machine learning models are trained using sensor data collected from machines.

For the cutting tool, Support Vector Machine (SVM) models are used to classify wear levels as normal, warning, or failure.

For the spindle motor bearings, Recurrent Neural Networks (RNNs) and Convolutional Neural Networks (CNNs) are used to detect faults based on vibration signals.

Data and Testing:

Real data was collected from milling and bearing tests where sensors measured vibration, sound, and temperature.

The AI models were trained on this data and tested for accuracy.

CNN using frequency-domain data gave the best results (98% accuracy) in detecting bearing faults.

(2) https://drive.google.com/file/d/152sxw1rLA0OofiTcqSe-HW2pqcj8MT8g/view?usp=drive_link

Summary

This paper presents a machine learning (ML)-based approach to predictive maintenance (PdM), focusing on aircraft engines. The goal is to reduce unplanned downtime, improve reliability, and optimize maintenance schedules using sensor data and ML algorithms.

Key Points:

1. Background

- Traditional maintenance (scheduled or reactive) is often costly and inefficient.
- Predictive maintenance solves this by predicting equipment failures in advance, using real-time data.
- ML combined with the Industrial Internet of Things (IIoT) enables this predictive capability.

2. Objectives

- Build an ML model to predict Time-To-Failure (TTF) for equipment.
- Use IIoT to collect real-time data from machines (like aircraft engines).
- Propose a practical PdM framework that companies can use.

3. Literature Insights

- Predictive maintenance use has grown steadily and is expected to keep increasing.
- It provides major cost savings compared to preventive maintenance.
- A 5-step workflow is suggested: collect data → clean it → extract features → train model → deploy model.

4. IoT Architecture

- Sensors collect raw signals (e.g., temperature, pressure).
- These signals are digitized and stored in a database or cloud.
- Edge and fog computing are used to process data locally or regionally for faster response.
- Cloud computing handles larger, more complex analysis.

5. Methodology

- Data is collected using a microcontroller-based system.
- Models like Random Forest, SARIMA, and LSTM are used to analyze the data and predict failures.
- LSTM performed better than SARIMA in this case.

6. Case Study: Aircraft Engine TTF Prediction

- The team used real-world engine run-to-failure data.
- Sensor data from over 100 engines was processed using Python and Pandas.
- Features like rolling mean and standard deviation were extracted from each sensor's data.

7. Results

- Random Forest performed best, predicting engine failure within ±28 cycles of actual failure.
- The model helps send early warnings and supports decision-making for maintenance planning.
- Alerts can be sent via messages or emails to technicians.

(3) https://drive.google.com/file/d/14eRo__w0ZR11LnAMK0dFqon5pOIHEQb2/view?usp=sharing

Summary

This paper presents a machine learning-based predictive maintenance system that uses sensor data to predict equipment failures in manufacturing settings. The goal is to reduce unexpected downtime, lower maintenance costs, and improve productivity.

Key Points:

1. Background

- Traditional maintenance is either reactive (after breakdown) or scheduled (at fixed intervals), which can be inefficient.

- Predictive maintenance (PdM) uses live sensor data and historical patterns to predict when a machine is likely to fail.
- This approach helps schedule maintenance only when needed, saving time and costs.

2. Proposed Solution

- A web-based application is built to monitor sensor data from manufacturing machines (specifically a tubing machine).
- The application predicts the possibility of machine downtime using machine learning models.

3. Machine Learning Techniques Used

- The authors collected and preprocessed sensor data (e.g., temperature, pressure, machine speed).
- They trained several models using classification and regression algorithms.
- A Long Short-Term Memory (LSTM) neural network model was also implemented for better prediction due to its ability to remember patterns over time.

4. Dataset

Key parameters from the machine included:

- Ejection Percentage
- Extruder Pressure
- Machine Speed
- Input Raw Material
- Heating Zone Temperatures

5. Results

- The trained model could predict when the machine was likely to fail based on past patterns in the sensor data.
- LSTM performed well due to its ability to capture time-based dependencies in the data.