

Use Case: Predictive Maintenance in Manufacturing

Predictive maintenance helps manufacturers reduce machine downtime and maintenance costs by using data analytics to predict equipment failures before they happen.

1. Data

Data Sources

The data used for predictive maintenance is collected from multiple sources:

- IoT Sensors: Temperature, vibration, pressure, humidity, and acoustic sensors attached to machinery.
- Machine Logs: Error logs, warnings, and operational status logs generated by machines.
- Maintenance Records: Historical data on past breakdowns, repairs, and servicing schedules.
- Production Data: Workload, production cycles, and operational efficiency information.
- External Data: Weather conditions, power fluctuations, and supplier-related issues that may affect machine performance.

Data Issues

- Missing Data: Some sensors might fail to record data, leading to gaps in time-series data.
- Noisy Data: Sensor readings can be affected by environmental factors, causing inaccurate values.
- Data Redundancy: Multiple sensors capturing similar parameters can lead to duplication, increasing storage and processing costs.
- Data Drift: Over time, sensor behavior may change due to wear and tear, affecting model accuracy.
- Latency Issues: Real-time data collection may face delays due to network constraints.

Types of Data

- Structured Data:

- Machine ID, sensor readings, and timestamps (stored in relational databases).
- Maintenance history, repair logs, and failure records.

- Unstructured Data:

- Technician reports, audio signals from machines, and images from thermal cameras.

- Time-Series Data:

- Continuous sensor readings over time, critical for detecting anomalies and trends.

2. Problem Statement

Manufacturing companies face unexpected machine failures, leading to unplanned downtime and production losses. Traditional reactive and preventive maintenance approaches are costly and inefficient.

Problem Statement:

Develop a predictive maintenance system using machine learning to analyze real-time sensor data and predict potential failures before they occur. This system should:

- Detect anomalies in machine behavior.
- Identify failure patterns and potential causes.
- Recommend optimal maintenance schedules to reduce downtime and costs.