Predictive Maintenance System

Using Machine Learning for Early Failure Detection

Executive Summary

- Objective: Predict machine failures before they occur
- Impact: Reduce costs and downtime
- Results: 98.66% accuracy in predictions
- Implementation: Web-based system with REST API
- Status: Deployed and operational

The Problem

Current Challenges:

- Reactive maintenance costs
- Unplanned downtime
- Production losses
- Premature equipment wear

Business Impact:

- High repair costs
- Reduced productivity
- Quality issues
- Safety concerns

Dataset Overview

AI4I 2020 Predictive Maintenance Dataset:

- 10,000 sensor records
- Key variables monitored:
  - Air temperature
  - Process temperature
  - Rotational speed
  - Torque
  - Tool wear

Methodology

Feature Engineering:

- Temperature difference
- Power calculation
- Rolling averages
- Wear rate analysis

Model Selection:

- Random Forest
- Gradient Boosting
- Neural Networks
- Hyperparameter tuning

Results

Model Performance:

- Overall Accuracy: 98.66%
- F1 Score: 0.988
- Precision (Failure): 0.71
- Recall (Failure): 0.79

Key Achievements:

- Early failure detection
- Low false alarm rate
- Real-time predictions

Implementation

System Components:

- Flask REST API
- Machine Learning Model
- Web Interface
- Real-time Predictions

Deployment:

- Cloud hosting on Render
- Continuous Integration
- Automated Testing

Live Demo

Access the live system at:

https://predictive-maintenance-vgzh.onrender.com/

Features:

- Real-time predictions
- Parameter monitoring
- Failure probability estimation
- Health indicators

Future Improvements

Planned Enhancements:

- Real-time monitoring integration
- Mobile application development
- Advanced analytics dashboard
- Automated maintenance scheduling
- Multi-machine monitoring
- Enhanced visualization tools

Thank You!