

INFORMATICS INSTITUTE OF TECHNOLOGY

In Collaboration with



*The University of Westminster, Coat of Arms*

**Industrial Predictive Maintenance Utilizing Hybrid Machine  
Learning**

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## ABSTRACT

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Predictive maintenance is an essential strategy for minimizing unplanned downtime, reducing maintenance costs and improving operational efficiency in industrial environments. Traditional maintenance approaches often lack the ability to accurately anticipate failures, leading to inefficiencies. This research introduces a hybrid predictive maintenance system that combines **Random Forest** models for interpretable fault classification with **Artificial Neural Networks** for precise failure prediction and repair time estimation. By integrating multi-sensor data fusion and explainable AI techniques, the system provides actionable and transparent maintenance recommendation.

The proposed framework simultaneously predicts fault conditions, maintenance triggers and repair times, enabling more effective and timely maintenance decisions – with **85.5%** accuracy . A real-time web dashboard supports deployment by delivering prompt alerts to users. This solution optimizes maintenance scheduling and resource management, reducing unnecessary downtime and spare parts inventory. The system was validated through extensive testing and comparison with existing methods, demonstrating improved performance. Future enhancements will focus on edge computing, mobile compatibility and autonomous diagnostics. Overall, this work advances predictive maintenance by offering a scalable, interpretable and real-time framework suitable for industrial applications.

**Keywords:** Predictive Maintenance, Random Forest, Artificial Neural Networks, Explainable AI, Fault Classification

**Subject Descriptors:**

- Computing methodologies → Machine Learning → Supervised Learning → Neural Networks
- Artificial Intelligence → Edge AI → multi-agent systems