

Abstract

In modern industrial environments, ensuring the continuous operation of machinery is crucial to optimizing productivity, reducing downtime, and minimizing operational costs. Traditional maintenance practices, such as reactive and preventive maintenance, often result in either unplanned downtime or unnecessary maintenance tasks, both of which can be costly. This paper presents the design and implementation of a **Machine Predictive Maintenance System (MPMS)** that leverages data-driven techniques, particularly machine learning and sensor-based monitoring, to predict equipment failures before they occur, enabling proactive maintenance actions. The proposed MPMS integrates various technologies, including Internet of Things (IoT) sensors, data analytics, and predictive modeling algorithms, to collect real-time data from machines and analyze it for patterns indicative of potential failures. Using historical failure data and sensor signals, machine learning algorithms such as regression, classification, and time-series forecasting are employed to build predictive models that forecast the remaining useful life (RUL) of critical components. By identifying anomalies in the system, the MPMS can alert maintenance teams to the likelihood of failure, allowing for timely intervention. This system's key features include real-time monitoring, anomaly detection, failure prediction, and the provision of actionable insights for decision-making. Additionally, the framework can be adapted to different types of industrial machinery across various sectors, making it a versatile solution for improving asset management and operational efficiency. The results of implementing the MPMS in several industrial case studies demonstrate significant improvements in maintenance scheduling, cost reduction, and machine uptime. The predictive maintenance model minimizes unexpected downtimes, enhances productivity, and ensures the longevity of equipment. This research highlights the potential of AI and IoT technologies in revolutionizing maintenance practices in industrial settings, pushing towards more autonomous, efficient, and sustainable operations. **Key words:** Predictive Maintenance, Industrial IoT, Machine Learning, Anomaly Detection, Remaining Useful Life, Data Analytics, Asset Management, Failure Prediction, Industry 4.0.