Chapter 21
Integrating Machine Learning With Industrial Automation for Enhanced Predictive Maintenance

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ABSTRACT

The integration of machine learning with industrial automation is transforming the landscape of predictive maintenance, a critical aspect of modern manufacturing and industrial operations. This research explores the synergies between machine learning algorithms and industrial automation systems. Predictive maintenance leverages data-driven insights to anticipate equipment failures, thereby reducing downtime, optimizing maintenance schedules, and enhancing operational efficiency. The core of the research focuses on the application of machine learning techniques to predictive maintenance. The paper outlines the processes of data collection, feature extraction, model training, and validation, highlighting the challenges and solutions associated with each step. The work discusses industrial applications based on machine learning for predictive maintenance. Issues like data integration, scalability and security are discussed along with strategies to overcome the challenges.

1. INTRODUCTION

Industrial automation consists of control systems, computers and information systems and robots used to handle different industrial setup or processes with minimal human intervention. Such systems are specially used in assembly lines, manufacturing industry, logistics and production processes. It utilizes sensors, actuators and industrial robots in certain cases. Fig. 1 presents a scenario of typical industrial automation setup (E4U).

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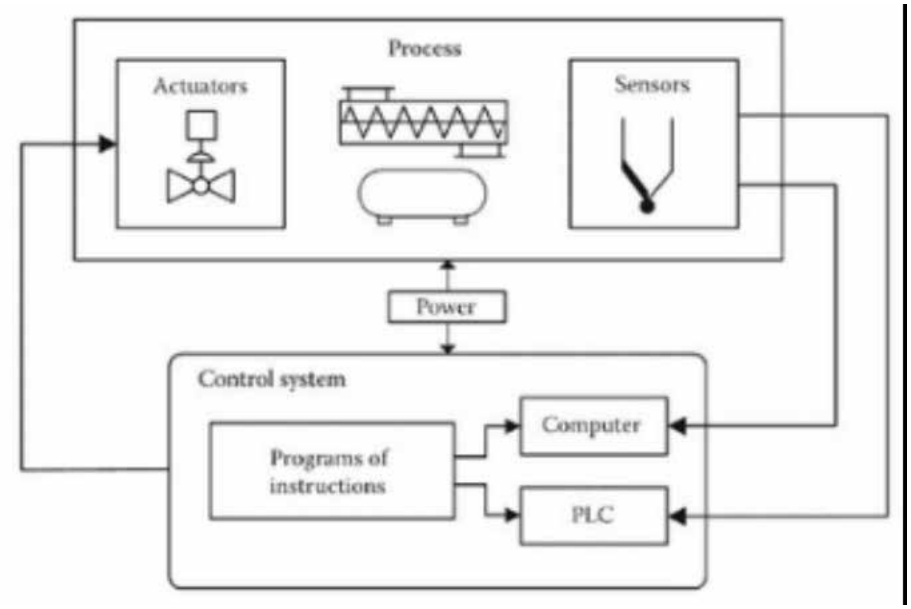
Figure 1. Typical industrial setup (E4U)



Maintenance of the moving parts such as gears and motors in industrial automation is crucial to ensure operational efficiency, minimize downtime and prevent failures. A simple fan if ignored in a process loop or equipment can lead to overheating of a controller and cause a plant to shut down. Lack of maintenance may lead to breakdowns and further result in production delay. Maintenance is needed for all kinds of Industrial systems to guarantee the correct operation from equipments in manufacturing to railway grid or vehicle fleet (Esteben et al. 2022). Almost one-third of all the expenses incurred are assessed to be wasted on improper or unnecessary maintenance. Figure 2 presents the role of maintenance in equipment life extension (Sahli et al. 2021).