

Chapter 21

Integrating Machine Learning With Industrial Automation for Enhanced Predictive Maintenance

Archana Kedar Chaudhari

 <https://orcid.org/0000-0002-3304-1461>

Vishwakarma Institute of Technology, India

ABSTRACT

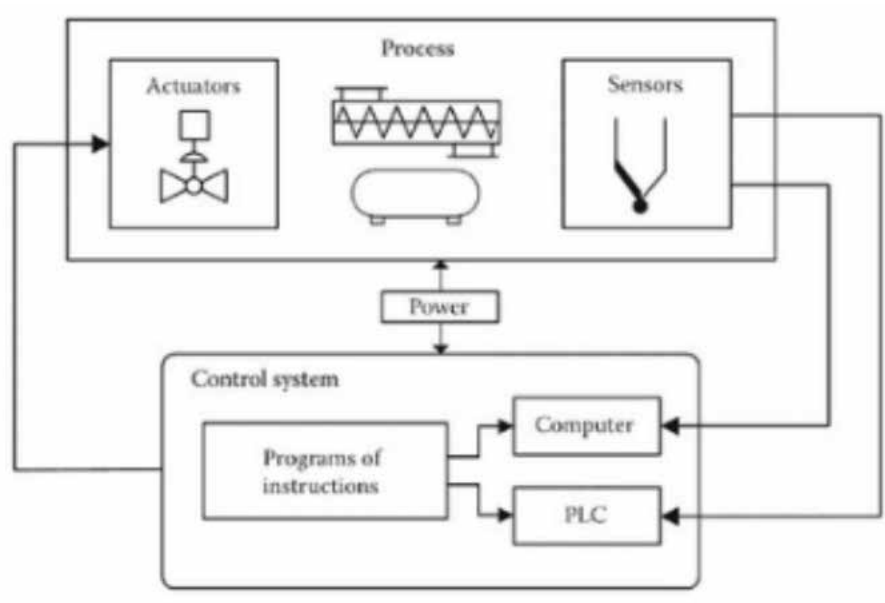
The integration of machine learning with industrial automation is transforming the landscape of predictive maintenance, a critical aspect of modern manufacturing and industrial operations. This research explores the synergies between machine learning algorithms and industrial automation systems. Predictive 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).

DOI: 10.4018/979-8-3693-7974-5.ch021

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).

22 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

www.igi-global.com/chapter/integrating-machine-learning-with-industrial-automation-for-enhanced-predictive-maintenance/376707

Related Content

An Efficient Learning of Neural Networks to Acquire Inverse Kinematics Model

Fusaomi Nagata, Maki K. Habiband Keigo Watanabe (2020). *Advanced Robotics and Intelligent Automation in Manufacturing* (pp. 203-232).

www.irma-international.org/chapter/an-efficient-learning-of-neural-networks-to-acquire-inverse-kinematics-model/244816

Cable-Driven Robots in Physical Rehabilitation: From Theory to Practice

Rogério Sales Gonçalves, Thiago Alves, Giuseppe Carboneand Marco Ceccarelli (2020). *Advanced Robotics and Intelligent Automation in Manufacturing* (pp. 52-96).

www.irma-international.org/chapter/cable-driven-robots-in-physical-rehabilitation/244811

Innovations in Device-to-Device Communication for Mechanical Tool Optimization

P. Sreenivas, Divakar Harekal, T. K. S. Rathish Babu, Sudheer Kumar Battulaand J. Ramya (2025). *Using Computational Intelligence for Sustainable Manufacturing of Advanced Materials* (pp. 511-532).

www.irma-international.org/chapter/innovations-in-device-to-device-communication-for-mechanical-tool-optimization/376708

Designing a Robot for Manufacturing Fiberglass Reinforced Plastic (FRP) Molded Grating

Marcos Vinícius Ramos Carnevaleand Armando Carlos de Pina Filho (2020). *Advanced Robotics and Intelligent Automation in Manufacturing* (pp. 147-184).

www.irma-international.org/chapter/designing-a-robot-for-manufacturing-fiberglass-reinforced-plastic-frp-molded-grating/244814

Strategic Stratified Task Team Model for Excellent QCD Studies

(2024). *Revolutionary Automobile Production Systems for Optimal Quality, Efficiency, and Cost* (pp. 197-226).

www.irma-international.org/chapter/strategic-stratified-task-team-model/347010