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Nested Automation

Dual digital twin + PLC automation enabling flexible, resilient, and easily integrated smart manufacturing.

Researchers at Purdue University have developed Nested Automation, a novel automation system for industrial applications that integrates advanced digital twin technology with traditional Programmable Logic Controllers (PLCs). This innovative system performs mass customization by dynamically adjusting PLC operations to meet varying production demands and material specifications. The system also enhances the management and control of industrial systems by promoting high reliability and system resilience. Numerous solutions exist for industrial control systems, and many companies are addressing the challenges of enhancing system flexibility, resilience, and integration. However, Nested Automation is distinguishable from its competition because of the system's unique dual digital twin system and the ability to seamlessly integrate with existing industrial technologies without disrupting ongoing operations.

Technology Validation:

The proposed technology was tested by setting up a virtualized Programmable Logic Controller (PLC) engine deployed within a Docker container. Several renditions of their experiment demonstrated enhanced operational efficiency and user experience, as well as ease of integration for the system.

Advantages:

-Increases operational flexibility and sustainability

-Resilient and adaptable

-Provides fail-safe operational continuity

-Enables seamless integration with existing industrial infrastructures

-Enhances system resilience through effective redundancy features

Applications:

Technology ID
2024-SEAL-70694

Category
Robotics & Automation/Simulation, Digital Twins, & Industrial Automation
Robotics & Automation/Automation & Control

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-Automotive industry

-Electronics

-Consumer goods production

-Original Equipment Manufacturers (OEMs)

-Energy sector

-Infrastructure and transportation management

-Pharmaceutical and chemical manufacturing

-Smart homes

Publication:

Mikhail M., Sealy W., (2022), Configuration of a PLC Controlled Articulated Robot for Autonomous Vision Inspection Applications, Proceedings of the 20th LACCEI International Multi-Conference for Engineering, Education, and Technology: "Education, Research and Leadership in Post-pandemic Engineering: Resilient, Inclusive and Sustainable Actions", Hybrid Event, Boca Raton, Florida- USA, July 18 - 22, 2022

Alremeithi, K., Almaeeni, H., & Sealy, W. (2024, June). Virtualized Digital Twin (DT) of a Reconfigurable Programmable Logic Controller (PLC). In 2024 6th International Conference on Reconfigurable Mechanisms and Robots (ReMAR) (pp. 349-354). IEEE.

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Intellectual Property:

Provisional-Patent, 2024-07-02, United States

Utility Patent, 2025-07-02, United States

Keywords: Industrial automation systems,Digital twin technology,PLC integration,Smart manufacturing solutions,Industrial IoT,Adaptive control systems,Resilient automation platforms,Real-time process optimization,Manufacturing system flexibility,Virtualized control systems,Production line customization,Fail-safe industrial control,Industrial system resilience,Automated infrastructure management