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A Smart Manufacturing Cell with Distributed Intelligence

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Abstract

This paper presents a novel approach to implementing a smart manufacturing cell with distributed intelligence in the context of Industry 4.0. The system uses holons to model digital twins for a manufacturing cell and a Graph Node Network for production routing. The Graph Node Network allows dynamic generation of production routes for different parts. For prototyping, Robotic Operating System (ROS 2) is used, which provides a convenient way of representing individual digital twins (in the form of "nodes") for different equipment in the system. It also enabled us to create a decentralised and distributed architecture. The nodes are connected via Data Distribution Service, which utilises a publish/subscribe method for communications. The paper demonstrated a flexible, extensible, and fault-tolerant manufacturing cell that is geared toward a high-mix and low-volume production scenario.

Keywords: Smart Manufacturing; Digital Twin; ROS2; Distributed Intelligence; Holons, Production routing.