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Integrating Cyber-Physical System toward Advance Intelligent Industry: Features, Requirements and Challenges

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Abstract : In response to high levels of competitiveness, industrial systems have evolved to improve productivity. As a consequence, a rapid increase in volume production and simultaneously, a customization process require lower costs, more variety, and accurate quality of products. Reducing time-cycle production, enabling customizability, and ensure continuous quality improvement are key features in advance intelligent industry. In this scenario, customers and producers will be able to participate in the ongoing production life cycle through real-time interaction. To achieve this vision, transparency, predictability, and adaptability are key features that provide the industrial systems the capability to adapt to customer demands modifying the manufacturing process through an autonomous response and acting preventively to avoid errors. The industrial system incorporates a diversified number of components that in advanced industry are expected to be decentralized, end to end communicating, and with the capability to make own decisions through feedback. The evolving process towards advanced intelligent industry defines a set of stages to empower components of intelligence and enhancing efficiency to achieve the decision-making stage. The integrated system follows an industrial cyber-physical system (CPS) architecture whose real-time integration, based on a set of enabler technologies, links the physical and virtual world generating the digital twin (DT). This instance allows incorporating sensor data from real to virtual world and the required transparency for real-time monitoring and control, contributing to address important features of the advanced intelligent industry and simultaneously improve sustainability. Assuming the industrial CPS as the core technology toward the latest advanced intelligent industry stage, this paper reviews and highlights the correlation and contributions of the enabler technologies for the operationalization of each stage in the path toward advanced intelligent industry. From this research, a real-time integration architecture for a cyber-physical system with applications to collaborative robotics is proposed. The required functionalities and issues to endow the industrial system of adaptability are identified.

Keywords : cyber-physical systems, digital twin, sensor data, system integration, virtual model
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