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# A Framework of Virtualized Software Controller for Smart Manufacturing

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**Abstract :** A virtualized software controller is developed in this research to replace traditional hardware control units. This virtualized software controller transfers motion interpolation calculations from the motion control units of end devices to edge computing platforms, thereby reducing the end devices' computational load and hardware requirements and making maintenance and updates easier. The study also applies the concept of microservices, dividing the control system into several small functional modules and then deploy into a cloud data server. This reduces the interdependency among modules and enhances the overall system's flexibility and scalability. Finally, with containerization technology, the system can be deployed and started in a matter of seconds, which is more efficient than traditional virtual machine deployment methods. Furthermore, this virtualized software controller communicates with end control devices via wireless networks, making the placement of production equipment or the redesign of processes more flexible and no longer limited by physical wiring. To handle the large data flow and maintain low-latency transmission, this study integrates 5G technology, fully utilizing its high speed, wide bandwidth, and low latency features to achieve rapid and stable remote machine control. An experimental setup is designed to verify the feasibility and test the performance of this framework. This study designs a smart manufacturing site with a 5G communication architecture, serving as a field for experimental data collection and performance testing. The smart manufacturing site includes one robotic arm, three Computer Numerical Control machine tools, several Input/Output ports, and an edge computing architecture. All machinery information is uploaded to edge computing servers and cloud servers via 5G communication and the Internet of Things framework. After analysis and computation, this information is converted into motion control commands, which are transmitted back to the relevant machinery for motion control through 5G communication. The communication time intervals at each stage are calculated using the C++ chrono library to measure the time difference for each command transmission. The relevant test results will be organized and displayed in the full-text.

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