

# Digital Twin Based Process Monitoring Framework and AI-powered Process Planning

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*In this paper, we present a digital twin based process monitoring framework and provide one example of how the AI-powered digital twin can assist to improve process planning. This digital twin based process framework is composed of two layers of networks - local network and cloud network, for data collection, storage, and processing. The online process information from all manufacturing devices in an assembly line has been collected by Raspberry Pis and Industrial PCs. This online processing data has been sent to the local server through the local network. The local server can reorganize and preprocess the data and then upload the process information to a cloud server. The Smart Manufacturing Innovation Platform™ (SMIP) has been applied as the cloud server to save the process information. An online dashboard has been developed to monitor the low-frequency data (for instance, production yield, work in process). The Unity-based digital twin has been developed to visualize the motion of the devices to provide geometrical boundary information for manufacturing safety and maintenance. Besides the use of the digital twin, a deep learning based machining feature identification algorithm has been developed to automate the process plan. The machining feature identifier converts the input CAD model into the improved Dixel Representation (IDR) first and then processes the data using a deep Convolution Neural Network (CNN). The input CAD model can be classified according to the required manufacturing process to assist the design of the process plan. A large synthetic dataset has been used to create the training data. The classification result shows 98.8% accuracy on a modified FeatureNet style dataset, which validates the performance of this technique. The overall framework provides one solution for the industrial digitalization in the manufacturing field and paves the way for a higher level of industrial automation.*

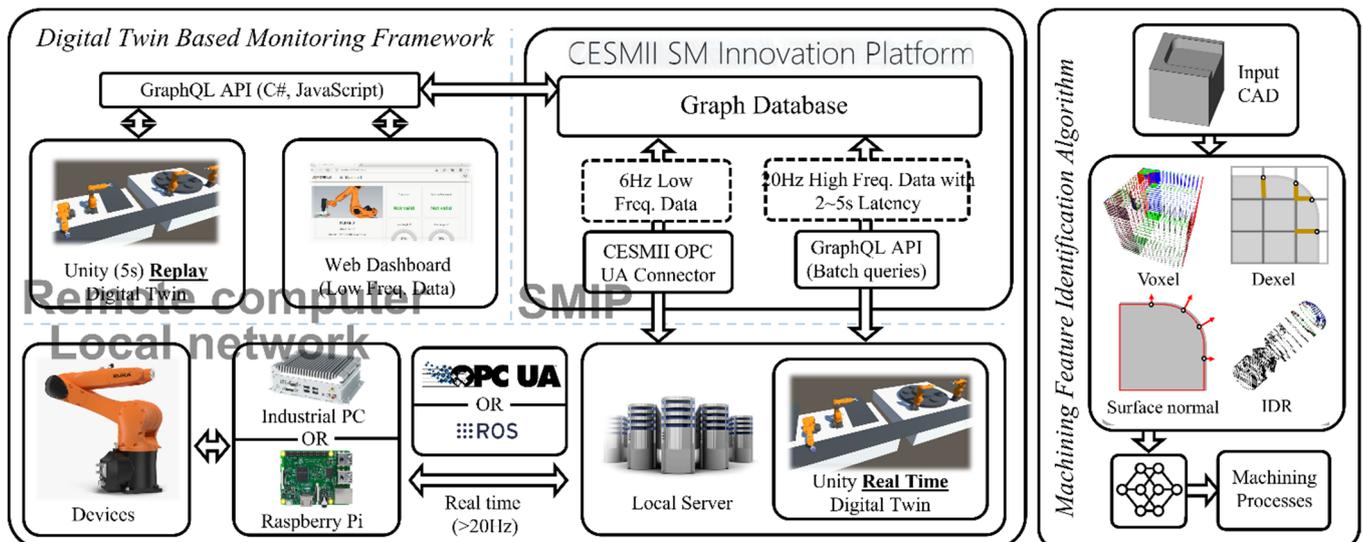


Fig. 1 Digital twin based process monitoring framework and AI-powered process planning