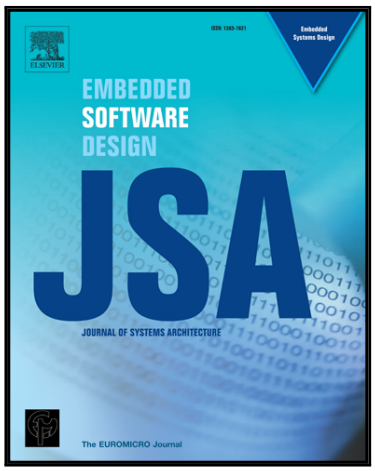

Automatic machine status prediction in the era of industry 4.0: Case study of machines in a spring factory

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Automatic machine status prediction in the era of industry 4.0: Case study of machines in a spring factory

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Abstract—Recent technological developments have fueled a shift toward the computerization and automation of factories; i.e., Industry 4.0. Unfortunately, many small- and medium-sized factories cannot afford the sensor-embedded machines, cloud system, or high-performance computers required for Industry 4.0. Furthermore, the simple production processes in smaller factories do not require the level of precision found in large factories. In this study, we explored the idea of using inexpensive add-on triaxial sensors for the monitoring of machinery. We developed a dimensionality reduction method with low computational overhead to extract key information from the collected data as well as a neural network to enable automatic analysis of the obtained data. Finally, we performed an experiment at an actual spring factory to demonstrate the validity of the proposed algorithm. The system outlined in this work is meant to bring Industry 4.0 implementations within grasp of small to medium sized factories, by eliminating the need for sensors-embedded machines and high-performance computers.

Keywords—Industy 4.0, neural networks, triaxial accelerometer, fault detection

1. Introduction

The success of Industry 4.0 [36] in Germany has prompted other countries to follow suit. Unfortunately, many small and medium enterprises (SMEs) in Taiwan are hindered by the costs and complexity of computerizing and automating factories. This is largely due to the fact that most SMEs still use conventional machines that lack the sensors required for data collection. In this study, we developed an add-on triaxial sensor system to assist in monitoring the operational status of machines on the factory floor without incurring heavy costs.

Accelerometers are used for gesture recognition [26][43], posture recognition [2][24], and sleep detection [8][9]. Most of the algorithms used with these devices involve three steps: (1) collecting and processing data to facilitate feature extraction, (2) reducing feature dimensionality, and (3) detecting the operating status of machinery by using various artificial intelligent models (AI models). Signals collected by accelerometers are converted into a variety of digital features, which are then sorted

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