MDPI

Article

Intelligent Sensors for Real-Time Decision-Making

Tiago Coito [1],*, Bernardo Firme [1], Miguel S. E. Martins [1], Susana M. Vieira [1], João Figueiredo [2] and João M. C. Sousa [1],*

[1]   Department of Mechanical Engineering, Center of Intelligent Systems, IDMEC, University of Lisbon, Instituto Superior Técnico, 1049-001 Lisbon, Portugal; bernardo.firme@tecnico.ulisboa.pt (B.F.); miguelsemartins@tecnico.ulisboa.pt (M.S.E.M.); susana.vieira@tecnico.ulisboa.pt (S.M.V.)

[2]   Department of Mechatronics, IDMEC, University of Évora, 7000-645 Évora, Portugal; jfig@uevora.pt

*   Correspondence: tiagoascoito@tecnico.ulisboa.pt (T.C.); jmsousa@tecnico.ulisboa.pt (J.M.C.S.)

Abstract: The simultaneous integration of information from sensors with business data and how to acquire valuable information can be challenging. This paper proposes the simultaneous integration of information from sensors and business data. The proposal is supported by an industrial implementation, which integrates intelligent sensors and real-time decision-making, using a combination of PLC and PC Platforms in a three-level architecture: cloud-fog-edge. Automatic identification intelligent sensors are used to improve the decision-making of a dynamic scheduling tool. The proposed platform is applied to an industrial use-case in analytical Quality Control (QC) laboratories. The regulatory complexity, the personalized production, and traceability requirements make QC laboratories an interesting use case. We use intelligent sensors for automatic identification to improve the decision-making of a dynamic scheduling tool. Results show how the integration of intelligent sensors can improve the online scheduling of tasks. Estimations from system processing times decreased by over 30%. The proposed solution can be extended to other applications such as predictive maintenance, chemical industry, and other industries where scheduling and rescheduling are critical factors for the production.

Keywords: smart sensors; fog computing; automatic identification; real-time systems; decision-making

1. Introduction

Nowadays, the decreasing sensor prices and the digital transformation are forcing the industry to adopt more flexible data-based solutions. Together, with the continuous growth in mass customization in the new industry 5.0 paradigm, the integration of data towards decision support systems using cost-effective solutions will be even more crucial [1,2]. Information acquired from sensors can be routed to higher levels of decision, improving decision-making. However, there are several challenges. Decision support systems often fail due to insufficient data quality and not due to algorithmic difficulties or the volume of information [3,4]. In scheduling, for instance, data quality problems are in both processing time estimations and business process mappings. These include custom production workflows or resources behaving differently. The missing data often comes from manual time studies, empirical knowledge, and unstructured sources [5]. These lead to inefficient scheduling and productivity losses. However, improvements in data acquisition in complex manufacturing and flexible environments did not receive enough attention in the literature. The simultaneous integration of real-time information from the cloud with sensors in different local architectures and acquiring valuable information can be challenging. The engineered systems must ensure the proper sensors are used and provide relevant data.

Intelligent sensors or smart sensors are distinguished from their non-intelligent counterparts, by their integrated electronics with advanced communication and computational processing capabilities. These include signal enhancements features, the capacity to store