Chapter 7
Smart Gateways for IOT–Factory Integration:
Trends and Use Case

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ABSTRACT

This book chapter proposes a description of smart gateways and cyber-physical systems (CPS) for the industrial internet of things (I-IOT). It also presents a case study where a smart gateway is developed to be used in different types of industrial equipment for the shop floor. The case study is developed under the specifications of different industries in the region of Castelo Branco. It is a proof that the 4th industrial revolution will be the engine for SME innovation, independence of the regions and their financial strength. It is also proof that the cooperation between universities, industries and startups can evolve to break barriers and add value in the improvement of regional industries competitiveness. Topics that will be addressed on the chapter can be used for developers, students, researchers and enthusiasts to learn topics related to I-IOT, such as data acquisitions systems, wired and wireless communication devices and protocols, OPC servers and LabVIEW programming.

INTRODUCTION

Factories are continually changing due to emerging technologies and different ways to process information, from computing and automation systems towards big data and a smart world, to digitising the industry, and create an intelligent and an autonomously network which provides: an increase in the efficiency of manufacturing with a reduction of time, efforts during set-up, re-configuration, a reduction

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of production costs and an increase in production quality. In this field, Industry 4.0 is the current trend of automation and data exchange in manufacturing technologies. It was initially developed by the German government to create a coherent policy framework to maintain industrial competitiveness. Related terms used internationally include Internet of Things, Internet of Services, Industrial Internet, Advanced Manufacturing and Smart Factory (Smit et al., 2016). Now, the introduction of the Internet of Things (IoT) and Services into the manufacturing environment is ushering in a fourth industrial revolution (Kagermann et al., 2013).

This chapter examines challenges to the adoption of the Internet of Things in factory – or Industrial Internet of Things (I-IoT)– to implement new applications and services in more efficient manufacturing systems. Several studies, projects and companies have focused their attention on this new paradigm. The authors present the necessary background by introducing the fourth industrial revolution. Consequently, they provide a survey of the state of the art related to I-IoT and cyber-physical production systems. Some industrial solutions for IoT are also presented –hardware and software solutions– from companies from power systems and automation technology areas. Readers interested in this field could learn which are the benefits of theses factories of the future, and meet the developments of the latest technologies for smart production with Co-Factor –an action supported by the European Commission under its Research & Innovation Program Horizon 2020 (Co-FACTOR project, 2017) –whereby the researchers introduce several projects focus on a new system architecture. Then, this chapter presents development platforms for I-IoT solutions. Moreover, a practical case is described. The main purpose this case –study is to measure vibration on electrical motors from machine factories, and implement predictive maintenance to assess anomalies. To implement the practical case, the authors will use several platforms and technologies: LabVIEW and NI DAQ hardware, Arduino, OPC server, machine learning algorithms and EtherCAT communication protocol. Finally, the authors highlight improvements and some possible directions for future research.

This chapter is organized as follow. First, a background of industrial revolution over the years and how is going toward Industry 4.0. The second section presents a general vision about Cyber-Physical Systems (CPS) and Smart Gateways. The third section describes several available platforms that are useful to implement smart networks in factories and after that, some current European projects towards digitizing industry and diverse development platforms are shown. One case study is also exposed and afterwards the benefits obtained and possible improvements. Finally, future research direction and conclusions are pointed out.

BACKGROUND

Industry has changed since the beginning of the Industrial Revolution and it can be described as the fourth stage of industrialisation or Industry 4.0. Over the years, the industrialisation concept has been changing simultaneously with technological advances.

Industrialisation began with the introduction of mechanical manufacturing equipment at the end of the eighteenth century when water and steam-powered machines like the mechanical loom revolutionised the way goods were made. This first industrial revolution was followed by a second one that began around the turn of the twentieth century and involved electrically-powered mass production of goods based on the division of labour. This was in turn superseded by the third industrial revolution that started during the early 1970's and has continued right up to the present day. This third revolution employed electron-