Chapter 9
Real-Time Traceability with Sensing in RFID Applications: Design Issues

Ana V. Alejos
University of Vigo, Spain

Iñigo Cuñás
University of Vigo, Spain

José Antonio Gay Fernández
University of Vigo, Spain

Manuel García Sánchez
University of Vigo, Spain

ABSTRACT

Traceability and embedded sensing are analyzed in this chapter by three main approaches: firstly, a Wireless Sensor Network; secondly, a Sensor Area Network; and, finally, a Wireless Identification and Sensing Platform. This chapter presents an introduction to the “RFID F2F” action, and its application to the wine sector briefly describing a wine pilot developed in Spain. The traceability system resulting of the WSN and RFID integration is sketched and concisely described. The current deployment of this pilot is commented. In a second block, this chapter introduces the accomplishment of an RFID tracking through a mesh of individual active radiofrequency (RF) barriers composed by active emitter and receiver nodes/tags that cover only small individual areas. The result is a Sensor Area Network (SAN). Finally, the authors of this chapter discuss the Wireless Identification and Sensing Platform technology. WISP chips have the capabilities of RFID tags compliant with EPC Class-1 Generation-2 standard—but they also support embedded sensing and computing. WISP technology is shown as the next step forward in the design of pervasive devices. The chapter discusses the main features of the emerging computational RFID technologies.

DOI: 10.4018/978-1-4666-1990-6.ch009
INTRODUCTION

Due to the extension of food economy, different proposals appear to improve the quality of the products and the information received by the consumers. Even more, consumers look for specific or differentiated products, with high quality standards and guaranteed origin. Such requirements claim for new traceability systems that could be useful for the producers and distributors (as current traceability standards) but also for the final consumers. Indeed, clients want to know more and more about the goods they are buying.

Passive UHF RFID resulted in an optimal alternative to barcodes for industrial supply-chain tracking applications. By simply applying a cheap and inexpensive electromagnetic label named RFID tag on the product, it is possible to know plenty of information about the goods to be purchased. However, once covered the basic tracking needs, it is desirable to incorporate additional data to the RFID tagged items. To collect data externally to the supply-chain, such as origin production conditions or transport temperature and humidity conditions, sensing devices are needed to be present in the items or surroundings jointly to the RFID tags. The integration of both elements in an embedded sensing RFID network would be an optimal approach for unobtrusive monitoring and traceability, providing more confidence in the product.

Embedded sensing is analyzed in this chapter by three main approaches: firstly, a Wireless Sensor Network; secondly, a Sensor Area Network; and, finally, a Wireless Identification and Sensing Platform. Then, the chapter is structured in three main blocks, one per approach, as follows. A first block is related to the WSN solution. We offer a brief introduction to the “RFID F2F” action, and its application to the wine sector depicting one wine pilot in Spain along with the individuated requirements of a well-performing traceability system. The block diagram of the whole traceability system is sketched and concisely described. Then, the environment where the WSN were deployed is presented and after that, the main elements of the WSN are showed. The propagation model estimated from experimental measurement in the vineyard is used for the deployment of an actual wireless network with sensors to collect data of foil and soil temperature, ambient humidity and solar radiation.

In a second block we discuss the SAN configuration, followed by a block dedicated to the WISP technology. We also discuss other platforms derived from the WISP technology and depict pros and cons of the so-called computational RFID devices. Finally, some conclusions and key terms are presented to close this chapter.

Previous Related Work

The European Action “RFID F2F” is focused on the test of a system to solve the mentioned situation, by using radio frequency identification (RFID) and Wireless Sensor Networks (WSN). Indeed, despite the joint use of such technologies has already been investigated (Catarinucci 2008; Catarinucci 2009; Catarinucci 2010), a global system merging both traceability and sensor data is still missing in literature.

A wireless sensor network was deployed in a vineyard, and the maximum distance between installed nodes is necessary to be previously estimated. Therefore, some propagation studies have been conducted in order to analyze the behavior of such specific radio channel at the frequency band assigned to these wireless networks: 2.4GHz. Propagation studies in rural environments, plantations and cultivated areas should consider the presence of vegetation in the propagation channel and its possible effect on the wireless communication.

Although there are several research works related to propagation under these conditions (LaGrone 1961; Richter 2005) and even an International Telecommunication Union recommendation (ITUR 2007), most of them are focused on a classical master-slave (or base station to mobile