Chapter 9

Wireless Sensor Networks
Advances for Ubiquitous Computing

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ABSTRACT

Wireless Sensor Networks (WSN) have considerably evolved in recent years. Their main focus has been always restricted to the extraction of information from the environment, but only data collected by the network has been considered. All internal operations and challenges encountered in achieving the requirements assigned to the data have been ignored. However, the advances in the area of WSN, allowing their operation in scenarios under different conditions, make us believe that they are sufficiently mature and optimized to solve problems in other related areas. So, considering the WSN as an ideal laboratory to find solutions to several problems in wireless networks, this Chapter discusses how the advances of these networks may be useful to help the development and creation of smart environments, essential to make ubiquitous computing part of our everyday life.

INTRODUCTION

Wireless Sensor Networks (WSN) are usually defined just as a source of collected data specific to a particular environment, such as temperature, pressure, light, etc. Assuming this statement is not false, the initial research that motivated WSN development had as the main interest the use of this technology for the support of military operations, which were set up, basically, from simple tasks, such as collection and dissemination of data to a destination. Their goal was usually able to identify the presence of enemies in hostile territories and make explorations of unknown environments.

However, in recent years, WSN have been the focus of various researchers, who have tried to solve
problems from the energy of sensor nodes to the discovery of new scenarios and applications that can benefit from the use of such network. The research boosted the state of the art in the area of WSN, what makes us conclude that the improvements achieved during the search for solutions to these problems are sufficiently mature and optimized that can be useful to solve problems in other related areas.

So, if we consider the innovations achieved in the area of WSN and identify its operation scenarios as case studies to assess the main challenges of wireless communication networks, we can say that WSN is an ideal laboratory to find solutions to several problems in wireless networks. Some of these problems are only emerging in the new network architectures, as in the paradigm of ubiquitous computing, also known as Internet of Things. Factors such as high mobility of nodes, high level of congestion and dynamism of the nodes, severe restrictions imposed to the computing devices and the need to operate according to the requirements of Quality of Service (QoS) are some examples of the various problems encountered during the design and operation of the WSN as these new wireless networks paradigm.

This chapter describes how the experience gained through studies and research in the area of WSN may be useful in helping the development of this new computing paradigm known as ubiquitous computing. We discuss the Mark Weiser’s vision of ubiquitous computing and the main challenges encountered so that it can become a reality. Then, we present WSN and the main components that make the intelligent sensors. In the following section, we discuss the main features in the design of WSN and how the experiences in developing these networks can be useful for the creation of ubiquitous computing systems. Finally, we present our observations on what remains to be done for WSN may be, not just a tool for data collection to feed the ubiquitous systems, but an active component that can contribute to all potential these new systems promise to improve in our everyday life.

**UBIQUITOUS COMPUTING**

Since its idealization in 1991, we would like to reach the level of technological development necessary to make the Mark Weiser’s vision a reality. His vision is known as the ubiquitous computing, which can be characterized by the total immersion of computational capacity in people’s lives. However, according to Davies and Gellersen (2002), only when we reach the level of pervasiveness enough for the ubiquitous computing be an integral part of our everyday life, is that we have made this vision a reality.

The main feature of this new computational paradigm is the change in the way of interactions between human and computers. For ubiquitous computing, computational intelligence can be found not only in computers as we know today, but also embedded in a variety of common objects we use in our everyday life. This immersion will allow the creation of smart environments, providing us services and computational intelligence at anytime and anywhere (Weiser, 1991).

Based on the theoretical foundation derived from this new computing paradigm, there is the need that research had driven to find for new technologies capable of ensuring the correct deployment of the devices in the environment, which can be transparent to users, and can operate together, in a coordinated and distributed way.

This subject has required that researchers find in other existing technologies, solutions capable of supplying the needs of the new applications to be implemented in these new ubiquitous environments. This need has resulted, in addition to the advantages and benefits of these technologies, in problems from every new concept that was incorporated in this paradigm. Some examples of the technologies ubiquitous computing have sustained is the distributed, embedded and real
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