

## Chapter 1.2

# Wireless Sensor Networks and Systems

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### ABSTRACT

*Sensor networks are one of the most powerful technologies applied to control and supervising systems. They are present in almost all environments, so we can find them in different industrial, medical, security and/or home applications. In addition, the use of wireless technologies applied to sensor networks improves the final system. Examples given are the enlargement of the coverage area and the low deployment costs. Nowadays a combination of both items is used in many common implementations of a wide variety of applications. This chapter is focused on the use of sensor networks applied to disabled and elderly people. We will study the wireless technologies most used for this purpose and we will show a survey with the benefits when they are applied.*

### INTRODUCTION

Since sensors are able to collect data from the environment, sensor networks are used for many application areas. The most well known areas are habitat monitoring, fire detection, motion tracking, reservoir water controlling or intruders controlling

(Xu, 2003). In order to control, monitor, tracking or detect something, a large quantity of sensor nodes that have to be able to detect the event being monitored (light, pressure, sound, heat, humidity, electro-magnetic field, proximity, location, etc.), is needed. Moreover, the data transmission to a base station, in order to take the appropriate action, must be taken into account. Wireless sensor networks have become very useful for our lives

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and they have started to be more and more common between us.

The appearance of micro-sensors has encouraged the development of wireless sensor networks in a wide range of applications due to the benefits given by their small size and the possibility of using them in any place because of the wireless technologies.

First of all, the main advantages are the easy installation and the high reduction of the deployment costs. Moreover, because of its physical architecture, these systems can cover higher extension than the wired ones, providing high scalability and being the perfect solution for open scenarios and natural and forest environments. Furthermore, it is fast and easy to make changes on the network once it has been installed. Their flexibility and adaptability are their main features.

This chapter is going to show and describe several wireless sensor networks that were used for disabled and elderly people. It will not be focused on the sensor or what it is measuring, but on the network of sensors, what types are set up and what benefits give a wireless sensor network to the disabled and elderly people.

## **WIRELESS TECHNOLOGIES**

Four main wireless technologies are applied to wireless sensor networks. Depending on the environment where it is going to be used, the type of use, the infrastructure conditions and/or the coverage extension needed, one of them (or a combination of two of them) can result the best option to develop the system.

Bluetooth is an open specification for wireless networks which is based on radiofrequency. It operates in the Industrial Scientific Medical (ISM) frequency band (2.4 GHz) forming wireless personal area networks (WPAN) (IEEE Std 802.15.1-2005, 2005). It has low energy consumption and its cost is quite low. Bluetooth controls its interference, and the susceptibility

to the interference, by using spread spectrum modulation. It uses a frequency-hopping spread spectrum signaling method (FHSS). Bluetooth was formalized in IEEE 802.15.1 standard in its version 1.2. This technology uses a small area network without infrastructure (piconets). Nodes share a physical channel with a clock and a unique sequence of jumps in the same piconet. In Bluetooth, different channels can coexist. While a master can only belong to one piconet, any other device can belong to several piconets at the same time. This overlap is denominated scatternet (dispersed network), although there are not defined routing capacities among them. This technology appeared to be used for the devices interconnection like computers, mp3, PDAs, etc. at a distance of about 10m, although lasts products in the market achieve 100m. of coverage radius. Furthermore, this coverage range can be longer with higher antenna gain and even longer distances can be gotten using signal repeaters.

ZigBee is a non-profit alliance with more than 100 members, where most of them are semiconductors manufacturers. ZigBee and IEEE 802.15.4 are standards-based protocols that provide the network infrastructure required for wireless sensor network applications (IEEE Std 802.15.4-2006, 2006). IEEE 802.15.4 defines the physical and MAC layers, and ZigBee defines the network and application layers. This technology is focused on creating low-rate wireless personal area networks (LR-WPAN). Its objective is to develop and to implement a low energy consumption and low cost wireless technology. It is presented as a very economic solution for Wireless Sensor Networks. It is also destined towards energy management, automation and remote control applications. ZigBee products work in a wide range of bands. Examples given are 2.4 Ghz, using the modulation OR-QPSK with expansion direct sequence spread spectrum signaling (DSSS), and 868Mhz in Europe or 915Mhz in North America, using the modulation BPSK with expansion DSSS. Its energy consumption is very low; it consumes 20

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