

# Abstract

There are many works related to the design and development of sensor nodes which present several applications. Wireless sensor networks can facilitate and improve some aspects of our daily lives. It is easy to think that if this type of device is so beneficial to us and to our environment, its price should be relatively cheap. But we can see that this is not true. Why these devices are so expensive? Would it be possible to develop devices with the same capabilities and lower prices? How can I make my low-cost sensor nodes?

This dissertation answers these questions and shows some of the many applications that sensor nodes may have. In this dissertation, we propose (and implement in some cases) the development of sensor nodes for environmental monitoring, from low-cost devices. For the implementation of a sensor node and network which joins all these nodes, it is important to know the environment where they will work. Throughout this dissertation, we present the research carried out for the development of sensors in three main application areas.

In the first of these areas, we present multisensor devices developed for environmental monitoring. The application of wireless sensor networks to the environment requires a study of how signals are affected depending on the distance, vegetation, ambient humidity, etc. We focus our developments on the fire detection in rural areas and on the control of pests in vineyards where the early detection of these events generates high economic savings. We also propose the development of a sensor network which will help us to reduce and prevent wolves' attacks and theft in livestock. Finally, within this group, we present a network to detect material anomalies in building and a sensor network which allows us to monitor the elderly or disabled people who move along with a group on a tour or activity.

The second group of applications is related to the monitoring of spaces in indoor environments. For this, we analyze the behavior of wireless signals in different scenarios. These results allowed us to extract a new method for designing wireless networks in indoor environments. Our method allows defining the best location of network devices and sensor nodes indoors saving 15% of the sensors needed.

Finally, we present a study on underwater freshwater communications based on electromagnetic waves, where we analyze the dependency of underwater communications as a function of working frequency, temperature, data transfer rates and modulation.

Related to underwater environment, we present two proposals. First one refers to the implementation of a sensor network for marine farms which allows us to reduce the amount of waste deposited on the seabed and reduce the percentage of wasted food. The second proposal is the development of two oceanographic sensors which allow us to control the amount of food and feces deposited in seabed and the water turbidity control in a very simple and inexpensive way.

All these developments and proposals have been preceded by a comprehensive study on the energy problems in wireless sensor networks. We have also presented several techniques which can be used to prolong the network lifetime and improve its stability.