Abstract

The concept of smart environment envisions a world in which various kinds of smart devices collaborate towards a common objective. In this context, smart refers to the ability to acquire and apply knowledge autonomously to achieve this objective, while environment refers to the physical world. Therefore, a smart environment can be defined as one that acquires knowledge of its surroundings, and applying it can improve the experience of its inhabitants.

Ubiquitous or pervasive computing will allow this concept of smart environment to become a reality. Usually, ubiquitous computing refers to the use of small, inexpensive devices distributed in the physical world, which are able to communicate with each other and collaboratively solve a problem.

When this communication is performed wirelessly, these devices form a Wireless Sensor Network (WSN). These networks have increasingly attracted attention due to their wide range of applications, ranging from military solutions to home applications.

This thesis focuses on Underwater Wireless Sensor Networks (UWSN) in which, although sharing the same principles as the WSN, the different transmission medium changes their main means of communication from radio to acoustic signals. This change renders both networks different in many aspects such as propagation delay, available bandwidth, energy consumption, etc. In fact, acoustic signals have a propagation speed that is five orders of magnitude lower than radio signals. Therefore, many algorithms and protocols need to be adapted or re-designed.

Since the deployment of these types of networks can be very difficult and expensive, carefully planning the necessary hardware and algorithms is essential. Simulations are a very convenient way of testing different variables before actual deployment. However, this can only be achieved when using accurate models and real parameters that enable the extraction of trustworthy results and conclusions.

This thesis proposes a UWSN ecosystem based on freely available, open source tools. This ecosystem is composed of an energy-harvesting model and a low-cost, low-power underwater wake-up modem model that, alongside existing models, en-

ables the performance of accurate simulations by providing real weather and marine conditions from the location where the target application is to be deployed.

This ecosystem is then successfully applied to the study and evaluation of various transmission protocols when applied on a real application for monitoring an offshore fish-farming facility, which is part of an Spanish research project (CICYT CTM2011-2961-C02-01). Subsequently, by using the energy-harvesting model, the simulation platform is used to determine the energy requirements of the application and to extract the minimum hardware requirements.