Chapter 5
Experiences in Developing Ubiquitous Applications

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ABSTRACT
Ubiquitous computing aims at making our lives easier by creating smart environments that are able to adequately react according to the context, the user, and the available devices. This chapter describes a set of prototype applications developed for a wide set of ubiquitous computing environments. These applications provide solutions to improve different kinds of environments, such as academic, business, museum and hospital environments. Since wireless networks are a key component in pervasive applications, a careful selection must take place to find which one suits better the characteristics required, depending on the objective of each case. In the authors’ case studies they have mainly concentrated on IEEE 802.11 and Bluetooth technologies. The work has enabled them to translate theoretical concepts to real scenarios, while identifying specific needs in different types of ubiquitous computing applications.

INTRODUCTION
Nowadays our lives increasingly depend on information and communication technologies. People want to be connected anytime, anywhere, and so the use of the Internet through the wide range of mobile devices available in the market is becoming more and more common in our societies, being even indispensable in some cases. Also notice that electronic devices are becoming smaller, and can be integrated into nearly all everyday objects. This leads to the conclusion that pervasive computing and ubiquitous scenarios are becoming a reality.

The concept of ubiquitous computing deals with a world where computational technology and
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services embrace almost everything around us, making many computing devices so naturalized within the environment that people do not even realize that they are using computers (Weiser, 1991). The central concept is to harmonize with users through a digital environment that is aware of their presence and context, being able to provide personalized services according to their needs, besides being capable of anticipating their behavior and responding to their movements. Applications may change or adapt their functions, information and user interface depending on the context and the client's profile (Weiser, 1993).

For this ubiquitous vision to become a reality we must rely on small, hand-held, wireless computing devices that enable the interaction between users and their environments. These devices should offer functionalities that can be described, advertised and discovered by others. Moreover, they are able to inter-operate even though they have not been specifically designed to perform joint tasks. Therefore, thanks to the advanced technology in devices and low power wireless communication systems, consolidating the ubiquitous computing is more evident every day, being a major motivation to research and develop new systems.

Currently there are many companies and research centers actively working on the issue of context-awareness or, more generally, on ubiquitous computing (Baldauf, 2007). In particular, several proposals focus on smart spaces and intelligent environments (Shafer, 1998; Harter, 1999; Kindberg, 2002; Fitton, 2005; Oliver, 2006; Smart-its, 2007), where it is expected that smart devices all around us maintain updated information about their locations, the contexts in which they are being used, along with relevant data about the users. There is no doubt that pervasive computing systems will provide flexible services and unsuspected benefits. However, there are still only a few examples of pervasive computing environments moving out from academic laboratories into our everyday lives. This occurs because their design is still a difficult task, requiring much theoretical and practical work. Moreover, it is complex to define what a real pervasive system should be like. The OneWorld (Grimm, 2004) project builds an architecture that provides an integrated and comprehensive framework for developing pervasive applications. It includes a set of services that help to structure applications and directly simplify the task of coping with constant change.

This chapter describes the research work we have done in the area of pervasive computing to define ubiquitous systems that fit into different types of environments. These systems are prototypes from which more sophisticated versions can be developed when targeting real ubiquitous scenarios. Selected environments include museums where visitors can get personalized and context-aware computing information, spontaneous networks in academic and business scenarios that allow P2P connections to exchange any type of resources, MANETs (Mobile Ad Hoc Networks) that allow an organized team to communicate independently in different situations, and also intelligent hospitals where it is possible to monitor patients automatically. We provided a detailed description of each prototype, including the system architecture as well as application and implementation details.

BACKGROUND

Pervasive computing has been receiving attention from the research community for more than fifteen years. Although new technologies are emerging and the target scenarios are heterogeneous (museums, schools, malls, official departments, hospitals, military), a great number of leading technological organizations are exploring pervasive computing. The most crucial objective is not necessarily to develop new technologies, but finding ways to integrate existing technologies with a wireless infrastructure in real settings.
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