Chapter 18
Ubiquitous Healthcare

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ABSTRACT

We have already moved away from traditional desktop-based computer technologies towards ubiquitous computing environments that progressively exist in our daily activity. This chapter introduces the concept of ubiquitous computing in the domain of healthcare as well as the prevalent technology its implementation depends on. This technology, named context-awareness, and a generic system for its realization are comprehensively described. Furthermore, the authors outline the main services that a context-aware system can provide and concluding they discuss the impact of ubiquitous computing in the healthcare domain. The authors aim at providing an overview of the technological proceedings in this area and through this understanding assist researchers to their brainstorming.

UBIQUITOUS COMPUTING

The future of computing has been painted by many visionaries. It was coined as ubiquitous computing by Mark Weiser; D.A. Norman introduced invisible computing, IBM promotes pervasive computing; Sybase calls it mobile embedded computing; and Sun uses the term Post-PC era (Milojicic et al., 2001). Each one perceives differently this new technological region and as a result focuses on a different aspect of it. The prevailing name is ubiquitous computing even if pervasive computing is also used alternately. A common feature of all these diverse approaches though is the center of gravity is moving now from technology to users and services (Milojicic et al., 2001). All promote the current trend through which communication systems and their components are built aiming to offer services based on the analysis of the context of their users and adapt to the specific preferences of each user. Adaptation is further done

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regarding the potential of the environment through which a user communicates and the situation he finds himself in.

According to M. Weiser (1991), one of the first that introduced the term ubiquitous computing, the most profound technologies are those that disappear. Such a disappearance is a fundamental consequence not only of technology but of human psychology. The main concept of ubiquitous computing is that users will interface with services and computing hardware and software will be transparent (Kumar et al., 2003). The realization of this concept will be supported with multiple devices, either mobile or embedded in almost every type of physical space and device people interact with such as homes, offices, cars, tools, appliances, clothing and various consumer goods - all communicating through increasingly interconnected networks. The functionality is not based on each device separately but on the interaction of all of them. The objective is that devices fit the human environment instead of demanding from humans to enter theirs (Weiser, 1991). This is succeeded by providing relevant information in the right form, at the time and place it is needed. This is the key to customized and personalized information systems that remain invisible until needed (Ley, 2007). Ubiquitous computing has many potential applications, from health and home care to the domain of advertisements (Kohda & Endo, 1996), tourist guides (Cheverst, Davies, & Michell, 2002), real estate brokers (Boddupalli et al., 2003) and intelligent transport systems (Parliamentary Office of Science and Technology, UK, 2006).

Ubiquitous computing is often used interchangeably with two other terms: pervasive computing and ambient intelligence, even if they have a different notion. There is a confusion concerning the way these terms are used and the concept they reflect. In reality, they differ in a sufficient level to be distinct from each other.

Ubiquitous computing is considered to be the integration of mobility and pervasive computing functionality (Lyytinen & Yoo, 2002). Mobile computing expands our capability to be productive and to communicate independently of the device's location. The flaw of mobile computing is that computing device cannot seamlessly and flexibly obtain information about the context in which computing takes place and adjust it accordingly. This deficiency is covered by pervasive computing which is an area with computing devices which are embedded in the natural environment and interact with it. Figure 1, which depicts the difference between ubiquitous and pervasive computing, follows (Lyytinen & Yoo, 2002):

Correspondingly, ubiquitous computing and ambient intelligence (AmI) imply a slightly different focus: ubiquitous highlights the "everywhere" technological features of this new vision whereas ambient focus on populating the environment with smart devices and making information services accessible everywhere. AmI is a term used more in Europe and ubiquitous computing more in USA. It should be noticed that this vision consists not only of the computing part that the term ubiquitous mainly reflects but also the ability for communication, the facility for use and the unobtrusive interfaces. Therefore, the term AmI is preferred in Europe and can be defined as the convergence of three fundamental technologies: ubiquitous computing (including miniaturization of computing capabilities, new materials, sensing technologies), ubiquitous communication and intelligent user-friendly interfaces (Punie, 2003).

Several umbrella projects in leading technological organizations have already worked on and are still exploring ubiquitous computing. Xerox's Palo Alto Research Center (PARC), for example, has been working on pervasive computing applications since the 1980s. Carnegie Mellon University's Human Computer Interaction Institute (HCII) is working on similar research in their *Project Aura*, whose stated goal is "to provide each user with an invisible halo of computing and information services that persists regardless of location." The

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