Chapter 12
Pervasive Computing Applications, Technologies, and Challenges for E–Health

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ABSTRACT

The pervasive computing paradigm offers many tools to facilitate health care applications. It allows more robust local and remote monitoring applications, because of many personal acquired contexts that can be used to provide better specialized health services, such as emergency, elderly care, etc. This chapter provides an overview of pervasive environments for eHealth applications. The most common applications and some technologies used to provide pervasive computing environment to collect information for the eHealth applications will be described. Some challenge issues that need research and discussion will be presented, such as security, use of context, user acceptance and performance requirements.

INTRODUCTION

The vision of a pervasive environment is characterized by the use of tiny sensors and other computational devices embedded into everyday objects, working invisibly in the background, collecting information about the environment and the users, and reacting to provide full integration of the user and the environment. Most healthcare applications do not yet behave that way, so there are almost no genuine pervasive computing applications in healthcare today.

Healthcare applications allow the monitoring of people’s health through the use of diverse medical sensors in and on the body and the interconnection of these sensors with a monitoring system. In a hospital environment, the patients, nowadays, are still connected to the monitoring systems using sensors installed over the body and are connected to machines by cables, causing much discomfort.
The pervasive computing paradigm offers many ways to facilitate the monitoring of people, allowing them to move freely while they are monitored by health professionals. Remote monitoring (an aspect of telemedicine) can verify vital signs such as heart rate and pressure, cerebral functioning, etc. This remote monitoring, together with the technologies of pervasive computing, allows the interaction of the environment and its computational resources with the monitored people, supplying means of local interaction in cases of emergency and situations where there are no other people around. So, doctors and medical staff can interact with patients’ medical devices to provide help within a shorter timeframe, which can save lives and avoid more damages.

Amongst the new used technologies inside a pervasive computing environment are Wireless Sensors Networks (WSN) (Akyildiz et al, 2002), Body Area Networks (BAN) (Li et al, 2007), and Network Robotics (Moraes et al, 2009; Coelho et al, 2009) that consists of a multitude of networked robots and other devices capable of interacting with the environment through the use of perception and action for the performance of tasks. These technologies offer ways to detect patient’s situation contexts (through the acquisition of vital signs, movement, localization, etc). Beyond collecting data, these technologies allow the interaction with medical equipment located in the BAN, through remote access systems, for example, insulin injectors.

The objective of this chapter is to provide an overview of new technologies that can be used to provide better services for eHealth applications in a pervasive environment.

This chapter is divided into more four sections. The second section presents some eHealth applications, and discusses how those applications can be applied to pervasive environments. In the third section, some technologies used to allow pervasive computing environments to collect information for eHealth applications are reviewed, such as sensor networks (and its applications for BAN), network robotics and remote access. The fourth section is devoted to discussing challenges related to pervasive environments in the context of eHealth applications, such as security and privacy, context and activity awareness, user acceptance, applications performance requirements and network performance requirements. Finally, the fifth section concludes this chapter.

**E HEALTH APPLICATIONS**

Accordingly to Bednarcikova et al (2008), eHealth stands for “medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies” (p. 283).

Health informatics (eHealth) applications encompass a range of services, such as Electronic Medical Records, Telemedicine, Telepresence and m-Health (mobile Health). Many of them use Electronic Health Records (EHR), which refers to an individual patient’s medical record in digital format. EHR may be composed of Electronic Medical Records (EMRs) from many sources, e.g., hospitals and doctors’ offices.

In this section we present some eHealth applications and how they can be integrated into pervasive environments.

**Telemedicine and Remote Patient Monitoring**

Medical telemetry systems, also known as Telemedicine (Liszka et al, 2004) is the use of communications and information technology to deliver clinical care. It can be more cost-effective and convenient for patients, and it is especially attractive for healthcare delivery to remote or underserved populations (Jurik & Weaver, 2008). It has the purpose of consulting, and sometimes remote medical procedures or examinations.

In a pervasive environment, the remote examination could be integrated with many local
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