

Chapter 32

Mobile Interaction in Real Augmented Environments: Principles, Platforms, Development Processes and Applications

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ABSTRACT

In this chapter the authors describe a real augmented environment and its associated mobile interactions based on wearable computers with appropriate interaction devices that can be either classical computer interaction devices or real objects augmented with computer interfaces called tangible objects. After presenting the main principles, they describe a concrete platform, related MDA development processes and give several applications. These examples are contextual collaborative maintenance of industrial appliances and associated just-in-time mobile learning and nutritional coaching system supporting practice and learning of management of nutritional decisions in relation to specific requirements in health or high-level sport.

INTRODUCTION

As announced by Weiser in 1991 (Weiser, 91), ubiquitous computing (also known as pervasive computing) seems to have taken on concrete form with the massive propagation of mobile and

connected devices (e.g. PDA, Smartphone, etc) and the increasing everyday use of computer resources such as RFID tags (Srivasta, 2005). Since 2001, ubiquitous computing has been considered as integral part of Ambient Intelligence (AmI) (Ambient, 2005), which merges “ubiquitous computing” and “social user interfaces” to adapt

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user interfaces to an environment and task context, thereby creating proactivity. On the other hand, Mixed Reality (Milgram et al., 1995, Renevier et al. 2002) better known as Augmented Reality (AR), which was first described in 1993 by Wellner (Wellner et al., 1993), is also in the process of expansion. AR attempts to merge physical and numerical worlds to facilitate the user's task with new devices and specific interaction techniques (i.e. a physical block controls a numerical block). However, the User Interface used on these new mobile and connected devices is similar to that of a desktop computer and is often inappropriate for mobile users who have to perform several tasks simultaneously (talking with other people, technical equipment maintenance, tourist spot visit, etc). We note that even though these devices can be sensitive to the environment (GPS, RFID tags detection, etc.), they rarely ensure that the user benefits from this contextual knowledge. Thus, we must proactively adapt their behavior without reference to the user as in an Ambient Intelligence Environment (Ambience, 2005). AR devices and techniques can be particularly useful in this respect.

Our aim is to study, through Ubiquitous Computing and Mixed Reality domains, some innovative human computer interfaces (Beaudouin-Lafon, 2000). These interfaces would be appropriate for mobile users working in a collaborative context-aware manner with access to contextual and/or personal precise data in a Computer Augmented Environment within the domains of Augmented Reality and Ubiquitous Computing. Our main concepts are:

- MoUI (Mobile User Interfaces) which are user interfaces for wearable computers,
- CAE (Computer Augmented Environments) in the sense of Mixed Reality and Ubiquitous Computing,
- MOCOCO (MObility, COoperation, COntextualisation) denoting tasks performed collaboratively by several mobile

actors, who have access to precise and contextualized data,

- Proactivity, the transparent user interface adaptation enabled by an Ambient Intelligence Environment.

IMERA PLATFORM

For our studies we defined an IMERA platform (French acronym for Computer Augmented Environment for mobile interaction). This platform consists of a working area and two or three remote workspaces. The working area where different actors are located is a CAE (Computer Augmented Environment). For us this CAE is defined as a working area covered by a WiFi network, able to receive signals from RFID tags, either freely set or integrated into real objects located in this space. This description characterizes our first support for the ambient intelligence environment. Some RFID fixed readers can also be introduced to this area. The actors move freely in this area with their wearable computers where each of them is equipped with a WiFi card and RFID reader allowing them to be connected to the network and to access contextual data through the RFID readers. The WiFi network allows actors to be both connected with one another as well as with back-office systems (database servers, etc) so they can access large amounts of data.

As well as this working area, there are a variety of management and observation workplaces at various distances that complete this platform. For our experiments we have three workplaces in our lab. A management workspace with the TableGate equipment (Figure 1) (David et al., 2003), which is an interactive flat-mounted table supporting Mixed Reality by means of a video projector and a camera able to recognize the physical objects that are placed or are moving on the table. The table is also pressure sensitive and can be used as a touch pad. This lab room is intended to be a central workplace for management

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