Chapter 5

Pervasive and Interactive Use of Multimedia Contents via Multi–Technology Location–Aware Wireless Architectures\(^1\)

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ABSTRACT

Nowadays, due to the increasing demands of the fast-growing Consumer Electronics (CEs) market, more powerful mobile consumer devices are being introduced continuously; thanks to this evolution of CEs technologies, many sophisticated pervasive applications start to be developed and applied to context and location aware scenarios. This chapter explores applications and a real world case-study of pervasive computing by means of a flexible communication architecture well suited for the interactive enjoyment of historical and artistic contents and built on top of a wireless network infrastructure. The designed system and the implemented low cost testbed integrate different communication technologies such as Wi-Fi, Bluetooth, and GPS with the aim of offering, in a transparent and reliable way, a mixed set of different multimedia and Augmented Reality (AR) contents to mobile users equipped with handheld devices. This communication architecture represents a first solid step to provide network support to pervasive context-aware applications pushing the ubiquitous computing paradigm into reality.

INTRODUCTION

In the last few years we witnessed a great advance in mobile devices processing power, miniaturization and extended battery life, making the goal of ubiquitous computing every day more realistic, also thanks to novel networked consumer electronics (NCE) platforms that are capable of supporting different applications such as video streaming, file...
transfer and content delivery. In modern society, computers are ubiquitous and assist in increasing human efficiency and saving time; in particular, two main aspects of the same coin have contributed to the development and implementation of the ubiquitous computing paradigm pushing it into reality: the advancements in technologies and the increased popularity of context-aware applications. The first aspect, consisting in the rapid development of computer technology, has yielded the shrinking of computer size and increasing of processing power; such progress is well realized by wearable computers (Kim, 2003; Starner, 2002); the second one has made context-aware computing more attractive for many groups, research centers and industries (Han et al., 2008; Schilit et al., 2002). In context-aware computing, applications may timely change or adapt their functions, information and user interface depending on the context and client requirements (Kanter, 2002; Rehman et al., 2007).

Taking the vision of ubiquitous computing to another level, we see the development of context-aware ubiquitous systems which take into account a great amount of information before interacting with the environment, and dynamically cater to user needs based on the situation at hand; furthermore, these systems are interconnected by novel mobile wireless and sensing technologies (Machado et al., 2007; Roussos et al., 2005) setting up a new kind of intelligent environment where context-aware applications can search and use services in a transparent and automatic way. Nowadays, many possible wireless networking technologies are available such as wireless local area networks (WLANs) based on the well known IEEE 802.11a/b/g standards or personal area networks (PANs) supporting Bluetooth communication (McDermott-Wells, 2005).

Since context-aware applications necessarily require some kind of mobile wireless communication technology, the transparent integration of different communication standards and equipments has a growing interest in the scientific community; in other words, the current state of mobile communication and consumer electronics can be characterized by the convergence of devices and by the growing need for connecting these devices.

Starting from this existing scenario, the chapter first describes a set of useful localization techniques and services for pervasive computing; then it proposes a real world case-study networking architecture suitable to provide AR and multimedia historical and artistic contents to the visitors of museums or archeological sites equipped with CEs handheld devices. This location-based contents delivery system has been called GITA (Pace et al., 2009) that in Italian language means “trip” with the aim of pointing out the main goal and purpose of the designed application.

The architecture uses a two-level (hard and soft) localization strategy to localize the visitors and to provide them information about what they are viewing, at their level of knowledge, and in their natural language. The soft localization, mainly based on Wi-Fi/GPS and Bluetooth technologies, allows knowing a coarse user’s location in order to select and deliver a set of multimedia contents of potential interest, while a more accurate (hard) localization, based on the use of fiducial markers, is used only to support the provision of AR contents. The system also gives the possibility to the users to have a graphical user interface adapted to their CEs devices (e.g. cellular phones, Smartphones, PDAs, UMPC) and to receive useful AR contents.

In particular, the proposed GITA system differs from the works described in the “State of the art and related works on Location Based Systems and Services” section because it is able to locate users in both indoor and outdoor environments using and combining, at the same time, different technologies (i.e. Wi-Fi, Bluetooth, GPS and Visual Based) in a flexible and transparent way; moreover the proposed system presents the following improvements:
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