Available online at www.sciencedirect.com
SCIENCE DIRECT®
Signal Processing: *Image Communication* 20 (2005) 927–946
SIGNAL PROCESSING: IMAGE COMMUNICATION
www.elsevier.com/locate/image

intGuide: A platform for context-aware services featuring augmented-reality, based on the outcome of European Research Projects

Athanasios M. Demiris*, Vassilios Vlahakis, Alexandra Makri, Manos Papaioannou, Nicolaos Ioannidis

INTRACOM S.A., Hellenic Telecommunications and Electronics Industry, Greece

Received 11 October 2004; accepted 15 May 2005

Abstract

As people become increasingly acquainted with information technology, they demand continuous availability of services related to their work or leisure. The era of ubiquitous computing announced long ago is currently turning into an everyday reality at an ever-increasing pace. Alongside the evolution of ubiquitous and nomadic computing, the need of people to access vast amounts of information in a comprehensive and efficient way gives rise to the areas of information visualization and augmented-reality. Such technologies allow for the comprehensive presentation of visual information equally addressing the needs of different categories of people.

In the past 5 years, we have been active in a set of European Research Projects addressing the above-mentioned research directions, with the long-term goal to develop a software platform that will enable context-aware services deploying advanced visualization technology in a series of application domains, such as cultural heritage dissemination, interactive television and retail industry. The multitude of the application domains addressed, as well as the multidisciplinary expertise necessary to create a generic platform was successfully addressed in complementary research activities. In this paper, we present the idea of a platform for context-aware services by exploiting advanced visualization technology and subsequently we briefly review the research projects that delivered valuable pieces in the

Abbreviations: API, application programmers' interface; AR, augmented-reality; CDWA, categories for the description of works of art; CIDOC, International Committee for Documentation of the International Council of Museums; DVB, digital video broadcasting; FFT, fast Fourier transform; GIS, geographic information system; GPS/D-GPS, global positioning system/differential global positioning system; GPRS, general packet radio service; IEEE, Institute of Electrical and Electronics Engineers; IST, Information Society Technologies; LAN, local area network; MPEG, moving picture experts group; PDA, portable digital assistant; R/F, radio-frequency; SMIL, synchronized multimedia integration language; UMTS, universal mobile telecommunications system; VRML, virtual reality mark-up language; WLAN, wireless local area network; XML, extended mark-up language; XMT, extensible MPEG-4 textual format

*Corresponding author.

E-mail addresses: dema@intracom.gr (A.M. Demiris), vvla@intracom.gr (V. Vlahakis), almak@intracom.gr (A. Makri), paem@intracom.gr (M. Papaioannou), nioa@intracom.gr (N. Ioannidis).

0923-5965/$ - see front matter
doi:10.1016/j.image.2005.05.007

overall puzzle. Emphasis is put on the practical issues of the implementation and deployment in different application scenarios.

Keywords: Context-aware services; Ubiquitous computing; Augmented-reality; Nomadic devices; Computer vision applications

1. Introduction

Every larger and somehow complex software platform usually requires a set of concrete applications covering parts of the targeted domain before it can materialize. The reason for that is the know-how necessary, which is reflected upon details that will make the platform usable in many areas. The more applications are built prior to constructing a generic platform, the more generic the platform is bound to be. Nevertheless, there is always a tradeoff between the degree of generality and the time-to-market, which dictate a faster pace in the introduction of a platform on the market.

In our case, we were aiming at developing a generic platform delivering, what we called approximately 5 years ago "high-end visually enhanced services". The high-end services would be related to the delivery of information depending on the current location and the personal profile of the end-user. This goal evolved within the past years into a more concrete platform for context-aware services featuring advanced visualization technology. The goal remains the same, namely the delivery of information to the end-users in a visual format easy to comprehend, depending on the context of the users.

Our strategy for collecting the necessary expertise related to context-aware services and gather the experience of applying such services on different application domains, thus verifying the validity of our research and development directions, focused on collaborations with institutes and other companies within Europe having similar research interests, within the framework of European Research Projects mainly in the Information Society Technologies (IST) program of the European Commission. The projects were carefully defined in order to complement each other and always deliver a new aspect necessary to complete the puzzle. In order to avoid extreme diversification, the application domains were restricted to the following three: applications in cultural heritage, sports and interactive television, as well as the retail industry. It is clear that the only common denominator of all these application areas is the generic profile of the end-users, i.e. in all these application domains the end-users originate from a widely spread sample across the population. The selection of these domains was based mainly on the interests of the teams involved in the development process, and also exhibited the important commercial characteristic of spreading across vivid market segments.

In order to implement such a platform, different areas of expertise are necessary. As opposed to other similar attempts, in our case we focus on the aspects related to the visually enhanced information presentation, which introduces the necessity for the inclusion of computer vision technology in the overall framework. In this work, we will present all features addressed by the platform, as well as its architecture. We will focus on the most important aspects (mainly related to the enhanced visualization applications) in each of the research projects that delivered know-how in different parts of the overall platform. At the end we will conclude with the future work planned to further extend the intGuide platform.

2. State-of-the-art in context-aware systems

Context-aware computing is an emerging field. Nevertheless, there are already some commercial systems appearing in the market. One example, which happens to be the outcome of a European research activity, is presented in [1]. The main goal and the major difference to our approach are the creation of a generic framework for context-aware services on the client platform with the focus on