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Ubiquitous Computing and Ambient Intelligence: New Challenges for Computing

J.UCS Special Issue

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The IST Advisory Group (ISTAG) of the European Union had a vision of "Ambient Intelligence" (AmI) in 1999. It refers to "an exciting new paradigm of information technology, in which people are empowered through a digital environment that is aware of their presence and context sensitive, adaptive and responsive to their needs, habits, gestures and emotions". In AmI the technology will become invisible, embedded, present whenever we need it, enabled by simple interactions, attuned to all our senses and adaptive to users and contexts (Scenarios for Ambient Intelligence). AmI proposes a shift in computing from the traditional computer to a whole set of devices placed around us providing users with an intelligent background.

AmI involves three key technologies: Ubiquitous Computing integrating microprocessors into everyday objects; Ubiquitous Communication, which allows these objects to communicate with each other and with users; and finally, Natural Interfaces, which allows interacting with the environment in an easier and more personalized way. This special issue is aimed to join research efforts in these three technologies, although emphasis will be placed on the first one, which emerges directly from the seminal vision of Mark Weiser in the Xerox Lab.

Nine papers have been selected to represent this area of research. The first one, *"Development of Ambient Intelligence Applications using Components and Aspects"* by Fuentes *et al.* focuses on applying aspect technologies to components in order to improve AmI application modularization. Their work presents the benefits of aspect technologies with regard to reusability and adaptability, by showing the limitations of a well-known component-based AmI middleware platform named PCOM.

"Quality of Privacy (QoP) for the Design of Ubiquitous Healthcare Applications" by Tentori *et al.* describes a workplace study conducted in a hospital, aimed at understanding the privacy issues that hospital workers might face in a pervasive computing environment. From the results of the study the authors propose

the concept of Quality of Privacy (QoP) and software architecture to support it. The design of a location-aware hospital application is used to illustrate how the architecture assists designers in the development of privacy-aware ubiquitous computing systems.

"Visualization Services in a Conference Context: An Approach by RFID Technology" by Bravo *et al.* presents a context aware application in a conference site based on the identification process using RFID. This proposal is based on the "ws" concepts (who, when, where & what). Three environments are modelled applying the "who" to the "when" and "where" to reach the "what". In this sense certain services are offered to the conference attendees, some of which are characteristics of this technology and others are the result of a context aware application, the visualization service named "Mosaics of Information".

"A Mechanism for Solving Conflicts in Ambient Intelligent Environments" by Haya *et al*. deals with the conflicts that may appear when the state of a device in an Intelligent Environment is modified. These problems are not as much of sharing of resources as of a conflict of orders coming from different agents. This coexistence must deal also with the desire of privacy of the different users over their personal information such as where they are, what their preferences are or to whom this information should be available.

"EMI^{2}lets: A Reflective Framework for Enabling AmI" by López de Ipiña *et al.* The *EMI^{2}lets* platform aims to transform mobile devices into universal remote controllers of the smart objects (everyday objects augmented with computing devices) that sorround us. An *EMI^{2}let* is a piece of software associated to an smart object which can be discovered, downloaded and executed in a communication technology and computing platform (PC, PDA, mobile) agnostic manner.

"Context-Aware QoS Provision for Mobile Ad-hoc Network –based Ambient Intelligent Environments" by F.J. Villanueva *et al.* introduces the use of mobile ad-hoc networks for large environments, such as hospitals, government buildings, office and industrial buildings, etc. It is also defined an information gathering mechanism in order to provide a context aware QoS framework, relaxing some restrictions that are inherited from traditional ad-hoc networks scenarios with a particular adaptative QoS architecture oriented to provide context-aware quality of service to the traffic generated in a smart-building network.

"*A Modular Architecture for Nodes in Wireless Sensor Networks*" by Portilla *et al*. presents a study of the problems in data acquisition and control on wireless sensor networks. Particularly, when there are many applications that demand the use of many nodes, even hundreds or thousands. They propose a modular architecture for the nodes, composed of four layers: communication, processing, power supply and sensing. The purpose is to minimize the redesign effort as well as to make the node flexible and adaptable to many different applications.

"Secure Service Discovery based on Trust Management for ad-hoc Networks" by Campo *et al.* proposes a service discovery protocol with security features, the Secure Pervasive Discovery Protocol. It is a fully distributed protocol in which services offered by devices can be discovered by others, without a central server, providing location of trusted services, as well as protection of confidential information, secure communications, or access control.

"Information and Hybrid Architecture Model of the OCP Contextual Information Management System" by Nieto *et al.* describes a middleware which provides support for management of contextual information and merging of information from different sources. The approach consists of a model of contextual information which is based on Semantic Web derived technologies and a description of the structured merging in the form of decision rules.

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