Ambient Intelligence

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Ambient Intelligence envisions an exciting new paradigm in information technology, in which people are surrounded by a digitally augmented environment. Ubiquitously connected appliances, sensors, actuators, and computers enable a sensitive, adaptive, and responsive era of computing. In 1991, Mark Weiser coined the term ubiquitous computing [1], ambient intelligence became broadly emphasized in the Information Society Technologies' (IST) work programs since 2000 and is still part of the current IST Working Programme 2003-2004 [2].

Research in the field of ambient intelligence is not just a new hype, but has already evolved from first prototypes to mature systems targeting sophisticated challenges, like context-awareness enriched by prediction, networks emerging spontaneously between tiny sensors, or the fusion of virtual and physical objects by means of augmentation and representation. Appealing new application areas bring together research groups from different well-known fields, like – just to mention a few – Human Computer Interaction (HCI), Virtual Reality, Distributed Computing, Mobile and Wireless Networking, Real-Time and Embedded Systems, and Artificial Intelligence.

The driving forces of ambient intelligent systems are questions related to the four dimensions of ambient intelligence: (context) awareness, natural HCI, intelligence, and ubiquitous computing. Sometimes, the requirements are mutually contradictory and questions arise, like: How can intelligence be introduced to computers with small footprints in terms of processing power, battery lifetime and memory? What are the most interesting functional and non-functional (that is, for example reliability, performance, or availability) parameters or properties of a context? How can digital traces gathered from the augmented environment be used for adaptation and machine learning purposes? And, how will the information society deal with the overwhelming amount of additional data in terms of privacy, information overload and information quality assurance?

This special issue is a collection of surveys in the four dimensions of ambient intelligence. Each article presents a different view to ambient intelligence related to the authors' research work and presents well-known Austrian research results. Additionally, every contribution shows the relations to the other dimensions and is meant as an invitation for the Artificial Intelligence community to participate in this very rewarding field.

Mario Pichler et al. give a detailed introduction to context awareness and survey the research in this field by introducing basic terms, different application areas, and the description of commonly used context parameters. Besides sensing the context, interpretation of the context and its uncertainties, and pro-active adaptations require more sophisticated technologies. The authors argue how techniques originating from AI research can be applied to context-awareness, like fuzzy logic or machine learning.

The second contribution focuses on natural HCI. Gerald Kaefer et al. present their selected research project VEGAS, which offers a vivid insight into HCI techniques, for example, in a car race scenario. Besides, the authors give an overview of main aspects of natural HCI, like gesture and speech recognition, where different pattern recognition techniques are used. Furthermore, Brain Computer Interaction (BCI), which is another fascinating area of non-traditional HCI, is described as a part of this survey.

Thomas Grill et al. present a different view to ambient intelligence. In this paper, emphasis is put on agent technology as a field in Artificial Intelligence and its applicability to different challenges and areas of ambient intelligent systems is discussed. Inherently, agents provide beneficial properties, like autonomy, reasoning, learning, and communication facilities. A survey will give an introduction to a variety of ambient systems where agents are already used.

The forth paper presents selected research topics in the field of mobile and ubiquitous computing. Karin Hummel et al. survey mobility modeling, wireless networking while integrating sensors and heterogeneous networks, and mobile information access by means of middleware. The survey on mobility models includes techniques used to derive mobility patterns by analysis of movement traces, like Markov-models and clustering, for example, by means of neural networks. Furthermore, this article presents the authors selected research work on mobility aware space based middleware.

I am looking forward to the next issue on ambient intelligence, which will present exciting summaries on late breaking results and research work from two main conferences in the field taking place in Vienna, April 2004: Pervasive 2004 (http://www.pervasive2004.org/) and CHI 2004 (http://www.chi2004.org/).

References

[1] M. Weiser: The Computer for the Twenty-First Century. Scientific American, September 1991, pp. 94-104.
[2] Information Society Technologies. Working Programme 2003-2004, http://www.cordis.lu/ist/.