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(published jointly with Novática*)

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Presentation

Ambient Intelligence today

Julio Abascal-González, Alberto Lafuente-Rojo, Yang Cai, and Tom Gross

Ambient Intelligence (AmI) is a techno-scientific proposal aimed at creating "intelligent" environments which adapt to the needs, tastes, and interests of the people who live within those environments, and help them carry out all kinds of tasks related to their daily life, work, leisure, etc.

The technology that will support these environments has been in the works for several years: wired and wireless networks, mobile and ubiquitous computing, new interaction devices, wearable modules, sensor networks, energy-efficient systems, etc. Nevertheless, a number of challenges are still to be met: miniaturization, autonomy, security, reliability, etc.

Ambient Intelligence will offer intelligent services based on techniques such as automatic learning, language, gesture and even mood recognition, adaptable and intelligent

interfaces, etc. These techniques, though currently in active development, still need to be improved and adapted to the requirements of this new discipline.

The European Union has made a special effort in defining the technological objectives of AmI and in focusing R&D workforces in order to meet AmI goals. The EU has also managed to transmit the AmI concept through the description of a series of theoretical scenarios which show how Ambient Intelligence can bring advanced services to people.

In the European Union, AmI objectives have been established through a number of reports and calls for projects. Although there has been a great deal of progress in the field, the feasibility of the proposed goals is open to question. Now might be a good time to analyse the AmI outlook, the progress made, and the work yet to be done. Any analysis

The Guest Editors

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Tom Gross is an Associate Professor, chair of Computer-Supported Cooperative Work (CSCW), and Vice-Dean at the Faculty of Media of the *Bauhaus-Universität Weimar*, Germany, and head of the Cooperative Media Lab (CML). His research interests include Computer-Supported Cooperative Work (CSCW), Human-Computer Interaction (HCI), and Ubiquitous Computing environments. In these areas he has published numerous articles in journals, conference proceedings, books, and book chapters. He has participated and coordinated activities in various national and international research projects on the concepts, implementations, and evaluation of cooperative applications and environments for teams and online communities for more than ten years now, and has been teaching at various universities around Europe. He is a member of the IFIPTC.13 on HCI and a member of the Steering Committee of CSCW of the GI; as well as sitting on programme and organization committees of various CSCW and HCI conferences (e.g. conference co-chair ACM GROUP 2007, and conference and programme committee chair of Mensch & Computer 2007). Before joining *Bauhaus-Universität* he has been visiting associate professor at the RWTH Aachen in Germany, senior researcher at the Fraunhofer FIT, and assistant professor at the *Johannes Kepler Universität* (JKU) Linz in Austria. He holds a diploma and a doctorate degree in Applied Computer Science from the JKU Linz, Austria. <tom.gross@medien.uni-weimar.de>.

of AmI requires a critical approach which will pinpoint past errors and help avoid future frustrations.

This monographic issue on Ambient Intelligence aims to provide an overview of the discipline, introducing the scope of application, the system support required, and the new concepts created around it.

Firstly, an introductory paper authored by the guest editors presents the motivations that they believe may lead to a world of AmI systems, together with a description of the historical evolution of the supporting technology and the problems to be solved. The reader will also find some basic bibliographical references.

Next, *Xavier Alamán-Roldán*, *Francisco Ballesteros-Cámara*, *José Bravo-Rodríguez*, and *Diego Fernandez-Aparicio*, of the universities Autónoma de Madrid, Rey Juan Carlos, and de Castilla La Mancha, describe several examples of projects for home-oriented AmI environments currently being carried out in Spain. Since these developments use current technologies, they could become a reality in the near future.

The telecommunication company's point of view is introduced by *Rodrigo González-Martínez*, from Telefónica Investigación y Desarrollo (TID or Telefonica R&D). The paper describes the business opportunities for a telecommunications provider in the AmI area. The technologies to be enabled by the telecommunication provider are described in the context of the Digital Home. TID's contribution through European projects is also referred to.

Zigor Salvador-Artola and several authors from the universities of the Basque Country, Seville, and Zaragoza

focus on heterogeneity and how to deal with the concomitant complexity through a middleware abstraction layer that enables a unified representation of context. They also analyse the state-of-the-art in technologies for the acquisition of contextual information, in particular location technologies and sensor networks.

The development of intelligent environments is dealt with by *Erwin Aitenbichler*, *Fernando Lyardet*, and *Max Mühlhäuser* of the University of Darmstadt (Germany). In their paper, within the scope of the project Mundo, they present a software development process including common services and tools for the systematic development of applications for intelligent environments.

Artur Lugmayr, of the University of Technology of Tampere (Finland), introduces the concept of Ambient Media as an evolution of the classic communication media in a world of ubiquitous technology.

Finally, *Mirko Fetter* and *Tom Gross* of the Bauhaus-University of Weimar (Germany) discuss the design of concepts and systems for Ambient Intelligence. They identify three fundamental dimensions in the AmI scenarios: space, time, and connections between users. These dimensions and the interactions between them are analysed with a view to drawing conclusions of practical interest for the design of AmI systems.

We hope that this monograph on the current state of Ambient Intelligence will provide useful information to readers coming into contact with AmI for the first time, and that it will also help open up a space for discussion among readers already familiar with the field.

Useful References on Ambient Intelligence

The following references, along with those included in the articles this monograph consists of, will help our readers to dig deeper into this field.

Books:

- T. Basten, M. Geilen, H. de Groot (Eds.). *Ambient Intelligence: Impact on Embedded System Design*. 2004. ISBN: 978-1-4020-7668-8.
- J. Bravo (Ed.). *Ubiquitous Computing and Ambient Intelligence*. UCLM Publisher, 2006. ISBN: 84-6901744-6.
- J. Bravo, X. Alamán (Eds.). *Ubiquitous Computing and Ambient Intelligence*. Thomson, 2005. ISBN: 84-9732-442-0.
- Y. Cai (Ed.). *Ambient Intelligence for Scientific Discovery. Foundations, Theories, and Systems*. LNAI 3345 Springer, 2005.
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Papers and Reports:

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- M. Lindwer, D. Marculescu, T. Basten, R. Zimmermann, R. Marculescu, S. Jung, E. Cantatore. Ambient Intelligence Visions and Achievements: Linking Abstract Ideas to Real-World Concepts. Proc. of the Conf. on Design, Automation and Test in Europe Vol. I, 2003.
- N. Shadbolt. Ambient Intelligence. IEEE Intelligent Systems. Vol. 18, No. 4, 2003.

URLs:

- Documents on AmI by Philips: <<http://www.research.philips.com/technologies/digsoc/index.html#ambintel>>.
- AmI applications in Health Care: <<http://www.ambientintelligence.org/>>.
- The aware home: intelligent home by Georgia Tech: <<http://www.cc.gatech.edu/fce/ahri>>.
- MIT's Oxygen Project on person-oriented ubiquitous computing: <<http://oxygen.lcs.mit.edu/Overview.html>>.

Events:

- European Conference on Ambient Intelligence. Two editions: Smart Objects & Ambient Intelligence, Oct 05, Grenoble, France, and AmI'07, Nov 07, Darmstadt, Germany A joint conference from two series of previous conferences: the Conference on Smart Objects (sOc) organized in 2001 and 2003 by France Telecom and CNRS in Grenoble, and the European Symposium on Ambient Intelligence (EUSAI) organized in 2003 and 2004 in Eindhoven by Philips and the University of Eindhoven.

- UCAmI International Symposium on Ubiquitous Computing and Ambient Intelligence. Two editions: Sept 07, Zaragoza, and Sept 05, Granada.
- IE 07. 3rd IET International Conference on Intelligent Environments, Ulm (Germany), Sep 07 <<http://www.uni-ulm.de/ie07/>>. IE05 was held in Essex, and IE06 was held in Athens.
- Ambi-sys 2008. First International Conference on Ambient Media and Systems. Quebec (Canada), feb/08.
- USW2005. The First International Workshop on Ubiquitous Smart Worlds. Tamkang University, Taipei, March/2005 <<http://www.takilab.k.dendai.ac.jp/conf/usw/2005/>>.
- AmI.d. Ambient Intelligence Developments. Two editions: sept/06 y sept/07, Sophia-Antipolis. <<http://www.strategiestm.com/conferences/amid/07/index.htm>>.
- Conference on Safeguards in a World of Ambient Intelligence. Organized by the European project SWAMI. Brussels, Mar 06.

Basic Glossary:

- Ubiquitous computing (pervasive computing). A type of distributed computing in which computing resources are not explicitly located or previously determined. A ubiquitous system provides the mechanisms to meet application requirements flexibly according to resource availability at a given time within the execution environment.
- Context information. Logical representation of the knowledge that a system has about its own state.
- Context awareness. Ability of a system or application to automatically integrate environment information in its own behaviour.
- Proactivity. Ability of a system to anticipate answers to foreseeable requests.
- Seamless integration. Ability of a system to integrate and switch heterogeneous components transparently to the application.
- Intelligent environment (*smart space, active space*). A physical space where the available resources are integrated to execute applications that interact with the people in the environment in a way that is deemed smart or intelligent.
- Ambient Intelligence (AmI). A category of applications which exhibit context awareness and proactivity and which interact with people in a natural way to offer highly advanced services.