

FORTH-ICS internal RTD Programme 'Ambient Intelligence and Smart Environments'

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Abstract. This paper introduces the horizontal, interdisciplinary, cross-thematic RTD Programme in the field of Ambient Intelligence which has recently been initiated by the Institute of Computer Science of the Foundation for Research and Technology – Hellas, aiming to contribute towards the creation and provision of pioneering human-centric AmI technologies and smart environments.

Keywords: Ambient Intelligence, Smart Environments

1 Introduction

Ambient Intelligence (AmI) envisages a future where the environment is populated by several interoperating embedded devices of different size and capabilities, which are interweaved into “the fabric of everyday life” and are indistinguishable from it [1]. In such “smart” spaces, the way that people interact with the environment in order to perform everyday tasks is expected to radically change, shifting towards natural, user-friendly and proactive interactions. In this emerging, highly interconnected and sensing-capable world, great opportunities for improving everyone’s quality of life arise, but, at the same time, key human rights such as privacy, safety and security are expected to face unprecedented challenges. As a result, Ambient Intelligence constitutes a particularly complex, multifaceted and demanding scientific domain, requiring the seamless integration and fusion of natural, social, formal and applied sciences, putting numerous challenges in several distinct research fields. In this context, the Institute of Computer Science of the Foundation for Research and Technology – Hellas (FORTH-ICS) has recently initiated a long-term horizontal interdisciplinary Ambient Intelligence RTD Programme [2] aiming to develop pioneering human-centric AmI technologies and Smart Environments, capable of “understanding” and fulfilling individual human needs.

2 FORTH-ICS AmI Programme

The Programme's overall vision is to positively contribute towards the improvement of quality of life for everyone by actively participating in the process of creating, shaping, applying and safeguarding AmI technologies. The Programme is mainly concerned with three grand challenges that future AmI environments will face:

- (a) **Fusion of Purpose:** Smart Environments of tomorrow, except the obvious fusion of technologies, will also be characterized by fusion of purpose. AmI technologies hold the promise of fulfilling any need anywhere, eventually allowing any place to serve any kind of purpose (e.g., work, learn, play).
- (b) **Universal Access:** An absolute prerequisite for supporting any type of interaction in smart environments is universal access, i.e., the ability of all people to access AmI technologies at a physical, sensory and cognitive level. In other words, AmI technologies should be aware of the vast diversity of the human factor and be able to recognize, understand and eventually adapt to its various manifestations.
- (c) **Conflict:** Up to now, AmI environments are mostly considered as "single-minded" entities, with well-defined, homogeneous and coherent goals. As we move from smaller to larger spaces, the number of people and AmI resources residing in them increases - and people do not always have common requirements, goals or intentions. Additionally, it is very likely that different co-existing AmI environments will also have different goals. This means that conflicts will inevitably arise at all levels. These conflicts have to be effectively handled to avoid negative impact on the proper function of the environments per se, but most importantly, on the well-being of their inhabitants.

The AmI Programme has been structured into several interrelated tasks addressing important dimensions of the required research and development efforts. These include: specification of usage scenarios, hardware components and systems architecture, middleware, communications and resource management, memory and context management, reasoning mechanisms, sensing modules and sensor fusion, actuators and control, user interfaces, applications design and systems testing and evaluation. Additionally, horizontal issues related to safety and security, are also considered. Three related distinct spaces have been set up in the premises of FORTH-ICS, while a novel large-scale facility is currently under construction.

The AmI Sandbox. A laboratory space of about 100m² comprising six rooms, aiming to provide researchers the opportunity to bring along and share their know-how and resources in order to obtain hands-on experience and experiment in a highly flexible setting (see Fig. 1, left). In this space, various AmI technologies and applications are installed, integrated and demonstrated, and multiple ideas and solutions are cooperatively developed, studied and tested.



Fig. 1. (left/top) AmI Sandbox computer room; (left/bottom) AmI Sandbox main room; (right) Smart office prototype environment.

Smart office prototype. A prototype environment [3] exhibiting the concept of Ambient Intelligence in a typical office environment (see Fig. 1, right). The goal is to showcase the potential impact of related technologies in everyday activities and the expected paradigm shift in the way that people will perceive and interact with information and communication technologies (ICT) in the future.

“Portable” exhibition space. A modular two-room exhibition space of about 50m² (under development - see Fig. 2, left) that can be taken apart, shipped and reassembled in exhibitions. It comprises interactive exhibits integrating AmI technologies developed in the context of the AmI Programme. All exhibits have cultural content related to Ancient Greek history and follow an edutainment/infotainment approach combining entertainment with education and information provision.

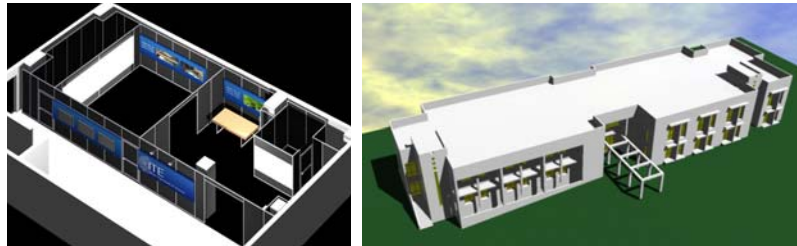


Fig. 2. (left) 3D rendering of the exhibition space; (right) Digital maquette of ICS-FORTH AmI Facility (currently under construction).

AmI Facility. An Ambient Intelligence Facility (currently under construction) that will occupy a two-floor building of 3.000m², comprising simulated AmI-augmented environments and their support spaces, laboratory spaces, staff offices and public spaces (see Fig. 2, right). The Facility is intended to primarily address the application domains of housing, education, work, health, entertainment, commerce, culture and agriculture. The simulated environments constitute full-scale replicas of their real-life counterparts (e.g., the home “simulator” is a residence expanding on two floors). Representative users will be invited to “inhabit” and use these spaces for limited time periods. The term “simulators” is employed since (a) these spaces will be integrated in the overall AmI facility; (b) they will be constantly monitored through various

sensors, observation and logging mechanisms; and (c) they will comprise a mix of fully-functional products and several experimental prototypes. The envisioned flexibility and large diversity of the supported simulated environments will allow both vertical research in specific application domains, and horizontal cross-thematic research, investigating the interplay among heterogeneous smart spaces, and related ways for providing seamless interactive experiences.

3 AmI Programme Present & Future

The set-up phase of the Programme, currently about to be completed, comprised three basic objectives: (a) creating the required infrastructure (both in terms of software and hardware) that would allow for the development of and experimentation with AmI technologies; (b) establishing interdisciplinary work teams and setting up appropriate processes for achieving sustainable and fruitful collaborative efforts; and (c) developing prototypes of applications and services for various domains, in order to acquire first-hand experience, technical and scientific know-how. A number of R&D results have been produced, including hardware components and software methods and tools (e.g., various sensors, computer vision components, middleware, reasoning engine), innovative AmI applications (e.g., AmI games, multi-touch applications, collaborative office applications, cultural applications), and new concept prototypes (e.g., sensor-based interactive “kiosk”, eco-friendly smart coffee table). The next phase will extend the Project’s scope as follows:

- (i) based on the substantial experience gained through the first phase, a research, development and deployment roadmap will be established detailing how the ICS-FORTH AmI Programme will pursue its vision and goals;
- (ii) multidisciplinary collaborative teams will be established that will run parallel coordinated research and development activities;
- (iii) the large-scale ICS-FORTH AmI Facility will be fully developed and deployed.

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