An Ambient Intelligent Prototype for Collaboration

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INTRODUCTION

The development of Web 2.0 has lead to a dramatic shift in the whole Web community. The decentralized and asynchronous applications are becoming prevalent both in Web-based and ubiquitous environments. In Web-based environments, each service (agent, application, Web service, learning object, mobile device, sensor) can be accessed through a single point, usually a Web portal, whereas in a ubiquitous environment, a service is dynamically composed by several agents that need to coordinate and negotiate with the aim of providing the most suitable adaptation for the user. In ubiquitous environments, distributed sensors follow the user's movements and based on either the user's typical tasks or the user's characteristics and preferences (learned from history and features of the context) appropriate adaptations of the interface, ambient features or functionality are made. Instead of having isolated user models for each application, a ubiquitous environment presumes the existence of a community of adaptive applications sharing user information.

In decentralized settings, each player maintains a small, locally created user model/profile, as needed for its own adaptation needs. Each person acts differently and needs to develop his/her own skills in own way. What makes the difference now is the availability of an advanced technology that enables us to rebuild learning and collaboration and make them more interactive, individualized, and adaptive. Nevertheless many difficult research challenges still remain, and much work is still needed if the existing relevant technologies are to be applied for the adaptation purposes in ubiquitous applications and the Semantic Web collaborative environment.

In this article, we explore the impact of ambient intelligence (AmI) on collaborative learning and experimental environments aiming to point out some new and upcoming trends in the professional collaboration on the Web. The article starts with some introductory explanations of both Web-based and ubiquitous environments. In addition, an overview of the relevant research issues is given. These issues represent the key paradigms on which the conceptual design of the AmIART prototype is based, and embrace the following facets: Ambient Intelligence, online experimenting, and personalized adaptation. The main idea of the AmIART prototype is to give users the feeling of being in training laboratories and working with real objects (paintings, artifacts, experimental components). Then, the AmIART prototype for fine art online experimenting is discussed in the sense of e-collaboration. When online experiments are executed in the Semantic Web environment, remote control of experimental instruments is based on knowledge that comes from domain ontologies and process ontologies (semantic-based knowledge systems). For these purposes, we present the ontology ACCADEMI@VINCIANA, as an example of a domain ontology (professional training domain), as well as the ontology GUMO (general user model and context ontology) that consists of a number of classes, predicates and instances aimed at covering all situational states and models of users, systems/devices and environments. In the following section, a collaborative scenario of using the AmiART prototype is given. The last section contains some conclusion remarks.

BACKGROUND

E-collaboration represents the convergence of technologies to allow people to work together. With the technology growing so fast, any technology should be available to meet the ongoing requirements from the field of e-collaboration.

In this section we explore the using of AmI as a developing technology that will increasingly make our physical environment sensitive and responsive to our presence. This section explores the key paradigms being used in the conceptual design of the AmIART prototype organized into the following three research issues: Ambient Intelligence, online experiments, and personalized adaptation.

Ambient Intelligence

The vision of AmI was first proposed by Philips Research in 1999, and was subsequently adopted in 2001 as the leading theme for the Sixth Framework Programme (FP6) on Research in Europe. This is the vision of a world in which technology is integrated into almost everything around us (ISTAG, 2005). AmI technology is intended to be in the service of humans; designed to adapt to the people's needs rather than making people adapt to the technology (Riva, 2005). In addition, this vision may be roughly described as being opposite to virtual reality (VR) (Riva, 2005): *until VR puts people inside a computer generated world, AmI puts the computer inside the human world to help us*.

In much of the general literature on emerging technologies, AmI is not clearly distinguished from earlier concepts such as *pervasive computing* or *ubiquitous computing*. The AmI paradigm builds on three recent key technologies (Alcañiz & Rey, 2005):

- **Ubiquitous computing:** It can be defined as the use of computers everywhere, but in the way that people are not aware of the presence of computers. Ubiquitous computing also means integration of microprocessors into everyday objects like furniture, clothing, white goods, toys, roads, smart materials;
- **Ubiquitous communications:** They enable these everyday objects to communicate with each other as well as with the user by means of *ad-hoc* and *wireless* networking (as recognized ongoing network technologies). Ad-hoc networking is a kind of a "mobile extension" of the Internet in environments with no network infrastructure. It is also a fundamental step towards achieving the goal of uninterrupted ubiquitous communications;
- **Intelligent user interfaces (user adaptive interfaces):** They enable the inhabitants of the AmI environment to control the environment and interact with it in a natural (voice, gestures) and personalized way (preferences, context). Key interface trends include the growth of agent communication languages (ACLs), the introduction of affect into the interface, and the growing focus on awareness and knowledge management. Affective interfaces involve several different aspects like:
  - Recognition of the user's affective state
  - Generation of the computer's affective state
  - Expression of the generated state by the computer

One of the main challenges recognized in ongoing intelligent user interfaces research efforts is building practically "invisible" interfaces (i.e., interfaces built in a human centered manner) through the ontology-based knowledge sharing. Intelligent products with intuitive interfaces will surround people, and both people and products will be always online, and connected by wireless communication technologies (Alcañiz & Rey, 2005).

Online Experimenting

When users work as a geographically distributed group, they communicate through computer-mediated channels like text chat, audio conferencing, video conferencing, application sharing (Faltin, 2004). These channels do not convey non-verbal messages (e.g., facial expressions) as faithfully as direct face-to-face communication. Also it is more difficult to refer to an object on the screen by application sharing than by pointing with a finger at it. This is why we introduce AmI concepts in online experimenting.

Online experiments are based on remotely controlling experiment equipment or software simulations of real experiments built for learning purposes. They enable users to get an experience without leaving their workplace and going to a traditional laboratory.

We distinguish local, remote and virtual experiments (Faltin, 2004):

- In a local experiment, users operate real devices and manipulate and measure real objects while being directly colocated with the devices and objects in the same room.
- In a remote experiment, users and devices are at different locations and the users manipulate the experiment devices through a computer connected (online) to the devices.
- Virtual experiments consist of software simulations of experiments and prerecorded measurements, pictures and videos but do include ma-