Ubiquitous and Mobile Computing– New directions in user system interaction

Matthias Rauterberg
IPO—Center for Research on User-System Interaction
Eindhoven University of Technology (EUT)
Den Dolech 2, NL-5600 MB Eindhoven
Email: rauterberg@ipo.tue.nl

Introduction

By definition, the goal of ubiquitous computing is to make computational devices ubiquitous in the everyday world. Although oft described as making these devices "invisible," most efforts have focused on replication and dissemination. The vision is something like "Computing devices will be everywhere. They will be smaller so that we can carry them around with us and they will be able to communicate back and forth with each other." [1] The end result is that although computational devices are more likely to be seen as ubiquitous, they are far from invisible. Our world is now cluttered with various computational things that vie for our attention.

Ubiquitous computing is an inevitably evolving topic in computing. Many devices, which are already equipped with computers, can be found in our homes or offices. Nevertheless people still use their washing machines and telephones not considering them as a computers. Additionally, growing communication possibilities and the advent of small computers like Personal-Digital-Assistance (PDA) let Mark Weiser's vision come true [1]. In the ubiquitous computing research we consider technology and applications, using PDAs, other mobile devices and extented "dump" machines (like TV) to set up prototypes for the demonstration of ubiquitous computing scenarios.

A common focus shared by researchers in mobile, ubiquitous and wearable computing is the attempt to break away from the traditional desktop computing paradigm. Computational services need to become as mobile as their users. Whether that service mobility is achieved by equipping the user with computational power or by instrumenting the environment, all services need to be extended to take advantage of the constantly changing context in which they are accessed.

Attaining the goals of ubiquitous computing will require a highly sophisticated infrastructure. In the ideal system, a real-time tracking mechanism will derive the locations and operational status of many system components and will use that context to deliver messages more intelligently. Users will be able to choose from among a variety of devices to gain mobile, high-bandwidth access to data and computational resources anywhere on the network. These devices will be intuitive, attractive and responsive. They will automatically adapt their behavior to suit the current user and context.

The wireless communication revolution is bringing fundamental changes to telecommunication and computing. Wide-area cellular systems and wireless LANs promise to make integrated networks a reality and provide fully distributed and ubiquitous mobile computing and communications, thus bringing an end to the tyranny of geography. Furthermore, services for the mobile user are maturing and are poised to change the nature and scope of communication

Recent advances in wireless networks and computer down-sizing technologies have led to the development of the concept of mobile computing. In the near future, millions of mobile users will be equipped with small, powerful and battery-operated palmtops. Through the wireless networks, these portable equipments will become an integrated part of existing distributed computing environments, and mobile users can access to data stored at information servers located at the static portion of the network even while they are on the move. In our increasingly mobile world, the ability to access information on demand at any location can satisfy people's information needs as well as conferring on them a competitive advantage. As such, the potential market for mobile computing applications is estimated to be billions of dollars annually. For example, passengers will access airline schedules, investors will access stock activities, travelers will access weather or traffic conditions.

For wireless computing to be widely accepted, there are two obstacles to be cleared. First, for palmtops that operate on AA batteries, power conservation is a key issue. For an `average user', the power source is expected to last 2 to 3 hours before replacing or recharging becomes necessary. What makes it worse is the predictions by battery experts of the modest improvement in battery capacity of only 20%-30% over the next 5-10 years. Second, the bandwidth of

the wireless channel is also very limited. The bandwidth of a wireless channel can vary from 1.2 Kbps for slow paging channels, through 19.2 Kbps (e.g. Cellular Digital Packet Data) to about 2 Mbps for the wireless LAN. Therefore, mobile computers would frequently be disconnected from the network or be kept in a weak connection status to conserve energy, and transmission be kept at a minimum to avoid channel contention. These two issues pose a great challenge to researchers in the community.
What are the relevant research fields in ubiquitous and mobile computing?

Handheld Devices

Handheld devices like PDAs are a key technology and build the base for many mobile computing and ubiquitous computing projects.

Location

Knowledge about the location of a person or device is useful for many applications in ubiquitous computing. An examples is the routing of phone calls; to provide this service a user has to be located all around a building or area (absolute location). But even relative location, where only devices and persons in the direct proximity are detected (e.g. in a room), could be useful. One example is the ad-hoc meeting, supported by PDAs, where social communication is supported by PDAs. The research in this area focuses on how to get this location information and how to present this information in the background computer system.

Context of use

There is more to context than location - For example, context is also the social situation the user actually was in. In this research area it is worthwhile to find out what sensor information could be useful to detect situations and how applications could profit from this information.

Information Access

The relation between direct and indirect information access is one of the most exciting areas of research in ubiquitous computing. Ubiquitous computing environments give a lot of possibilities to retrieve, to input and to output information, so combining only these possibilities leads to a lot of new challenges for new applications. Different information access scenarios are built to find out how information access works in ubiquitous computing scenarios.

Privacy

When building global communication and network infrastructures and "computerizing" the user as described in ubiquitous computing the question of privacy arises. Technologies like active badges or even GSM mobile phones enable computer systems to track any person using such technologies. These issue of privacy and security as well as individualism is underestimated by current ubiquitous computing proposals and collides with the real world. As a solution we suggest a concept that integrates a personal device (PD) into ubiquitous computing to overcome these problems.

Encryption

New network technologies like infrared or wireless radio communication need encryption technology to ensure security to its users. But available bandwidth of these networks is small and therefore a precious resource. The ongoing research tries to find solutions, based on available and well introduced technologies.

Publications

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