UBIQUITOUS COMPUTING: THE IMPACT ON FUTURE INTERACTION PARADIGMS AND HCI RESEARCH

Gregory D. Abowd

GVU Center & College of Computing
Georgia Institute of Technology
Atlanta, GA 30332-0280 USA
+1 404 894-7512
abowd@cc.gatech.edu

Bill N. Schilit

FX Palo Alto Laboratory
3400 Hillview Avenue, Bldg 4
Palo Alto, CA 94304 USA
+1 408 813 7220
schilit@pal.xerox.com

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INTRODUCTION

As we look to the future of computing, and particularly to the future of HCI research, the vision of ubiquitous computing emerges as a principal theme. The focus of this workshop is applications-centered research in ubiquitous computing. We define ubiquitous computing as the attempt to break the pattern of traditional relationships between users and computational services by extending the computational interface into the user's environment. Over the past few years researchers in wireless networking and distributed systems have worked to build infrastructures supporting mobile and ubiquitous computing. Infrastructure research is, of course, necessary for the advancement of ubiquitous computing, but we must also examine higher-level issues such as the kinds of tasks and interaction patterns that emerge as the user is allowed to break away from the desktop.

We can compare the emergence of wearable computing with that of ubiquitous computing. Both share the mission of having the interface to computational resources follow the user, as opposed to the desktop paradigm of the user following the interface. Whereas wearable computing takes the approach of attaching computation to the user, the approach in ubiquitous computing is to provide computational services in those parts of the environment that the user naturally encounters. There is, therefore, a contrast in emphasis but a common goal of augmenting the capabilities of people as we perform tasks in everyday life

The purpose of this workshop is to assemble a community of HCI researchers with particular interest in the impact of ubiquitous computing from an applications perspective.

WORKSHOP GOALS

The goals of this workshop are:

- increase awareness within the HCI community of the various centers for research in ubiquitous computing, with a particular focus on applications-centered research;
- better articulate and understand the goals of ubiquitous computing, especially as it influences a shift in interaction paradigms in single- and multi-user applications;
- develop a set of evaluation criteria that researchers can use to judge the impact of individual research efforts; and
- identify major research themes of ubiquitous computing of interest to the HCI community that will direct research and applications for the next 10-15 years.

RESEARCH ISSUES

A major goal of this workshop is to heighten our own awareness as a community of what work has been done already and how an understanding of that work can direct future efforts. The organizers will draft a survey article on ubiquitous computing prior to the workshop and all participants will receive this draft. Our preliminary work has identified these major topic areas

Scaleable Interfaces

As the number of devices we interact with increases, so too does the complexity of the task of providing similar computational services for each device. It is inconvenient to provide similar yet isolated services on multiple devices. For example, take the task of scheduling. Scheduling services are available on desktop platforms and personal digital assistants and soon will be available with phone interfaces. However, most of these scheduling services work in isolation, meaning that in order to keep each service in synch with the others requires extra effort by the user. A scaleable interface to a scheduling service would provide a unified service with multiple device interfaces. The challenge in this case is to provide programming capability to enable radically different interaction methods with the same underlying data and service.

Ubiquitous software services

A scaleable interface is only one part of what we call a ubiquitous software service, a service that actively searches out the user at convenient and salient times. Users interact with a variety of services (e.g., e-mail, scheduling, contact management) and there are some obvious connections between the information that each service manipulates. Furthermore, this set of services is constantly subject to change. How can we provide ways to

integrate the behavior of these different services without requiring additional programming effort by both the designer of a service and the end user? And how does this new paradigm of ubiquitous software services affect our everyday lives?

Ubiquitous information

The success of the Web shows the power of ubiquitous access for creating, publishing, manipulating, and consuming information. There are two areas of interest here. First, what application areas are enabled by ubiquitous information access? What impact, for example, does it have on education or health care or collaborative research? Second, how can we distinguish different applications? One possibility is to separate them based on access privileges to the information, ranging from personal access for individuals taking notes for their own use, trusted access for colleagues within a work group or within a family unit, or global access intended for public consumption.

Support for Automated Capture and Access

Much of our life in business and academia is spent listening to and recording, more or less accurately, the events that surround us. It is often desirable to recount those past events but our imperfect recording practices make this difficult. Several researchers have investigated the use of ubiquitous computing technology to support this general problem or recording, or capturing, experiences to facilitate later access to that information. Apart from the interesting question of which technologies best support automated capture and access, we want to investigate how different application areas (business meetings versus the classroom, for example) are impacted by these capabilities. In terms of technology, affordable digital audio and video will soon allow us to realize applications using personalized vision.

Context-aware computing

As mobility increases, it becomes possible to customize the interface in accordance with the user's changing physical context. An obvious part of the physical context is location and orientation, and many researchers have investigated both infrastructure and applications that benefit location-aware computing. There is much more, however, to a user's context (time, mood, history) that can be observed and used to better tailor and adapt computational services to better suit user needs.

Technology

What infrastructure is out there today and available to researchers interested in applying it to everyday problems? What technology is emerging but which should be commonplace within 10-15 years? How much does it cost us to experiment with ubiquitous technology today?

These themes are not necessarily the exact themes that will be discussed at the workshop, as that will be dictated by the position papers and desires of the group.

NOVEL USE OF TECHNOLOGY

To assist in the capture of important discussions, we are hosting the workshop in a new classroom within the College of Computing at Georgia Tech. This classroom is a venue for research in ubiquitous computing in education, the Classroom 2000 project, under the supervision of Gregory Abowd and his Future Computing Environments (FCE) Group. Use of the capture/access utilities developed for Classroom 2000 will assist rapporteurs in summarizing discussions. The results of our discussions will be made available to the general research community after the workshop.

We also encourage participants to bring working prototypes of their own research that can be tested live to support this workshop endeavor. This will help further support our own beliefs that we can only truly understand the impact of ubiquitous computing technology in our everyday lives by experiencing it in everyday tasks.

ORGANIZERS' BACKGROUND

Gregory D. Abowd

Dr. Abowd is an Assistant Professor in the College of Computing and the GVU Center at Georgia Tech. In April 1995, he initiated a research group in Future Computing Environments. The purpose of the group is to design and prototype experimental systems that apply mobile and ubiquitous computing technology for various everyday application domains. His group has worked on a number of experimental systems; further informeation can be found at http://www.cc.gatech.edu/fce. Prior to coming to Georgia Tech in August 1994, Dr. Abowd held postdoctoral appointments with the Software Engineering Institute and Computer Science Department at Carnegie Mellon University and with the Human-Computer Interaction Group at the University of York in England. Dr. Abowd received a D.Phil. in Computation from the University of Oxford in 1991.

Bill N. Schilit

Dr. Schilit is a Senior Research Scientist at FX Palo Alto Laboratory in California. At FX PAL his research focuses on ubiquitous information access: recording, reviewing, retrieving, and reusing information anytime, anyplace. Previously, Bill was a Member of the technical staff at AT&T's Bell Labs where he led the TeleWeb project. TeleWeb examines application and system level issues of providing loosely connected access to the World Wide Web. In 1995 Bill received a Ph.D. degree from Columbia University for studies in location-dependent computing. His thesis research was performed at Xerox PARC where he worked on the Ubiquitous Computing initiative as a student intern and visiting scientist.