Usable ubiquitous computing in next-generation conference rooms: design, evaluation, and architecture

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Summary

In the UbiComp 2005 workshop "Ubiquitous computing in next generation conference rooms" we learned that usability is one of the primary challenges in these spaces. Nearly all "smart" rooms, though they often have interesting and effective functionality, are very difficult to simply walk in and use. Most such rooms have resident experts who keep the room's systems functioning, and who often must be available on an everyday basis to enable the meeting technologies. The systems in these rooms are designed for and assume the presence of these human "wizards"; they are seldom designed with usability in mind. In addition, people don't know what to expect in these rooms; as yet there is no technology standard for next-generation conference rooms.

The challenge here is to strike an effective balance between usability and new kinds of functionality (such as multiple displays, new interfaces, rich media systems, new uploading/access/security systems, robust mobile integration, to name just a few of the functions we saw in last year's workshop). So, this year, we propose a workshop to focus more specifically on how the design of next-generation conference rooms can support usability: the tasks facing the real people who use these rooms daily.

Usability in ubiquitous computing has been the topic of several papers and workshops [5, 6, 21, 22, 23, 25]. Focusing on usability in next-generation conference rooms lets us bring to bear some of the insights from this prior work in a delineated application space. In addition the workshop will be informed by the most recent usability research in ubiquitous computing, rich media, context-aware mobile systems, multiple display environments, and interactive physical environments. We also are vitally concerned with how usability in smart environments tracks (or doesn't) across cultures.

Conference room research has been and remains a focal point for some of the most interesting and applied work in ubiquitous computing. It is also an area where there are many real-world applications and daily opportunities for user feed-back: in short, a rich area for exploring usable ubiquitous computing. We see a rich opportunity to draw together researchers not only from conference room research but also from areas such as interactive furniture/smart environments, rich media, social computing, remote conferencing, and mobile devices for a lively exchange of ideas on usability in applied ubicomp systems for conference rooms.

Keywords: Usability, usable ubiquitous computing, smart conference rooms, mobile devices, meeting support, rich media, context-aware computing, collaboration, knowledge management, multimedia, tele-conferencing, active learning, interactive furniture.

1 Description and themes of the workshop

Usable ubiquitous computing is almost an oxymoron. In particular, in smart conference rooms, arguably one of the most complex of work environments, applications of ubicomp technologies have been far from user-friendly.

Next-generation conference rooms are often designed to anticipate the onslaught of new rich media presentation and ideation systems. Throughout the past couple of decades, many researchers have attempted to reinvent the conference room, aiming at shared online or visual/virtual spaces, smart tables or walls, media support and tele-conferencing systems of varying complexity [1, 4, 27]. Current research in high-end room systems often features a multiplicity of thin, bright display screens (both large and small), along with interactive whiteboards, robotic cameras, and smart remote conferencing systems [7, 8, 14, 15, 26]. Added into the mix one can find a variety of meeting capture and metadata management systems, automatic or not, focused on capturing different aspects of meetings in different media: to the Web, to one's PDA or phone, or to a company database [20]. Smart spaces and interactive furniture design projects have shown systems embedded in tables, podiums, walls, chairs and even floors and lighting [16, 19, 24].

Exploiting the capabilities of all these technologies in one room, however, is a daunting task. For example, faced with three or more display screens, all but a few presenters are likely to opt for simply replicating the same image on all of them. Even more daunting is the design challenge: how to choose which capabilities are vital to particular tasks, or for a particular room, or are well suited to a particular culture. The task becomes complicated since such conference rooms are often used for distributed meeting where all end-points differ.

At the same time, creating engaging meeting experiences can increase both knowledge transfer and knowledge retention [17]. The incorporation of media-rich engagement strategies in meetings creates a need to provide meeting participants with appropriate tools for managing these media. Finally, many factors will make distributed meetings more frequent: globalization, rising cost of transports, not to mention epidemics or terrorism which sometimes freeze travel.

Research in areas such as context-aware computing, interactive furniture/smart environments, and mobile devices is moving rapidly. People expect to find the adaptable ease of use that they get from their personal devices in all the technology they encounter.

We are confident that a lively and useful discussion will be engendered by bringing lessons learned from recent ubicomp research in usability, multimedia applications, and social software to ongoing research in conference rooms systems. Although both usability and conference room technology have been a rich area for research for a number of years, applied usability for smart rooms has not been specifically addressed in the UbiComp community as a workshop.

This workshop combines some of the themes of past UbiComp workshops such as "Ubiquitous Display Environments" (2004), "Interactive Tables and Walls" (2002) and the "UbiSys" systems support series (2003 – 2004) with the usability focus of the workshops "User-Centered Evaluation of Ubiquitous Computing Applications" (2002) and "Evaluation Methods for Ubiquitous Computing" (2001). Usability is an applied focus for integrating architecture and tangible media, information design and display, and mobile and computer-mediated communications in the design of the next-generation conference room.

Figure 1. Usability nightmare: multiple screens (five screens of various sizes and shapes, including a podium screen) for using rich media in a conference room. What goes where? How can such a complex environment be designed for maximum usability? Is this design viable across cultures?

2 Workshop activities and goals

The aim of this workshop is to bring together researchers and practitioners working in a variety of disciplines that impact design, technology implementation, and especially the usability and evaluation of next-generation conference rooms. We expect a highly interactive atmosphere to encourage a lively discussion and exchange of ideas.

Activities:

One function of this workshop is to collect "lessons learned" in usability from smart conference room research to date, and develop a shared definition of ongoing research areas going forward. We'll begin with brief reviews of and remarks on salient research; a few lightning demos; discussions (alternating between breakout teams to identify and classify areas of interest, and larger whole-group discussions) and finally proceed to a collation of ideas, charting a roadmap for continued research. The session will also provide a quick "state of the art" overview to participants.

Focus will be on discussion and idea sharing, rather than presentation. However, to establish a basis for conversation, the first part of the workshop will be a round-robin introductory session (a couple of minutes per participant), immediately followed by a subset of invited panels, demonstrations and/or (very) short talks on workshop sub-topics, which will serve as provocations and points of departure for later discussion. The scope of interest includes but is not limited to (in no particular order):

- Usability design in next-generation conference rooms
- Social requirements for formal and informal meetings

- Using ubiquitous displays: multiple screens and media
- Interactive furnishings and smart environments
- Designing across cultural and linguistic barriers
- Learning from prototypes and experimental systems
- Meeting space design and physical form for smart objects
- Context-aware systems for conference rooms
- Meeting capture and data access
- Security, authentication, data handling, and privacy
- Appropriate design and evaluation techniques

Goals:

- Develop a better shared understanding of how people can usefully interact with the technologies at the intersection of ubicomp, rich media, and smart conference rooms
- Create interesting and unique documents on our topic, including a workshop report with sub-sections devoted to the primary themes and, we hope, a collaborative report to be published in an appropriate journal.
- Assess interest/appropriateness for creating an ongoing set of collaborations and/or workshops around usable ubiquitous computing. Though many conferences address related issues (multimedia, CSCW, CHI, ubiquitous computing, etc.) no event specifically focuses on usability in ubiquitous computing as applied to the new generation of smart conference rooms and the many related research issues.

3 Organizers of the workshop

We are a deliberately diverse group, drawing from industry and academia, and from several disciplines (computer science, electrical engineering, business systems, social software, and interactive architecture/design) and cultures (Japan, Thailand, US, France, Germany). All of us have been working in aspects of ubiquitous computing for many years.

- Maribeth Back (Senior research scientist, FXPAL, Palo Alto, CA, USA) currently heads the Usable Smart Environments project at FXPAL, focused on smart conference rooms. She has expertise in prototyping augmented realities and physical design for embedded systems with complex sensors [2, 3, 18]. As a senior researcher at Xerox PARC she worked on a number of ubicomp/smart environment systems as well as embedded-systems projects at MIT Media Lab and Harvard GSD.

- Saadi Lahlou is a social psychologist who heads the Laboratory of Design for Cognition at EDF R&D, a user laboratory in a large end-user organization where many meetings have been systematically recorded in order to push the state of the art and foster dissemination [3, 14]. He is the coordinator of the rufae (research on user-friendly augmented environments) network: www.rufae.net.

- Rafael Ballagas is a research assistant and a computer science PhD candidate in the Media Computing Group at RWTH Aachen University. His research focuses on rapid prototyping tools to enable user-centered iterative design for ubiquitous computing environments, such as the Aachen Media Space (a next generation meeting space). Recent projects include exploring how mobile phones can be used as personal servers, and as input devices to coordinate novel meeting interactions.

- Surapong Lertsithichai is an instructor and researcher at the Faculty of Architecture, Silpakorn University in Bangkok, Thailand. His research projects focuses on the integration of tangible user interfaces in architectural spaces in scales ranging from a remote robotic avatar, room display management, interactive podium, and immersive conferencing environment [3, 7, 31]

- Jeffrey Huang is Associate Professor of Architecture and Digital Media at the Harvard University Graduate School of Design. His research focuses on the design of augmented spaces for learning, meeting, brainstorming and other types of everyday social activities. Recent projects include the Swisshouse in Boston, Team Learning Module (TLM), Digital Agora in Washington DC, and Smart Store in Helsinki. [9, 10]

- Masatomi Inagaki, Fuji Xerox, Japan, is an corporate technology planner in ubiquitous technology area. Currently, his work is focused on designing next-generation workplaces for effective and creative collaboration. He has an MS in system design and management from MIT.

- Kazunori Horikiri, Fuji Xerox, Japan, is an engineer and designer who has expertise in ubiquitous computing and distributed computing. Currently, his work is focused on designing computing-embedded workplaces that enable knowledge workers to achieve effective and creative collaboration.

4 Maximum number of participants

Excellent work often gets done in diverse groups where everyone has a voice; so we would like to cap the workshop at about 22 - 25 participants (including organizers). Both informal queries and the depth of response to last year's workshop lead us to believe that there is considerable interest in the workshop, and we believe that entry will be competitive.

5 Soliciting participation and workshop URL

We will strive to attract diverse viewpoints, including people from different cultures, research areas, and disciplines, while maintaining a cohesive line of inquiry throughout the workshop. We hope to engage people with usability expertise in rich media, personal devices, smart environments, multimedia communication, ubiquitous display systems, social networks and software as well as in mobile and ubiquitous computing systems; and to draw engineers, researchers, and designers from both industry and academia.

To this end we will create a web site describing the workshop and the research areas of likely interest. The site will be linked from each of our organizations' web sites as well as the UbiComp 2006 site. We will distribute flyers at appropriate related conferences and at sites such as university computer science departments. Each of us will email solicitations to our professional lists, inform our colleagues, and issue personal solicitations for position paper submission to people we believe would make significant contributions to the workshop.

The proposed URL is http://www.fxpal.com/UbiComp2006/ .

6 Selecting participants

Selection of workshop participants and presentations will be based on refereed submissions. Authors are invited to submit a 1-2 page position statement describing their interest, experience or ongoing research in the field, and including a brief biography. Position statements should have only one author, and admission to the workshop will be for that person only. Position statements should be sent directly to back@fxpal.com; and will be published on the website.

References

1) Abowd, Gregory D. "Classroom 2000: An Experiment with the Instrumentation of a Living Educational Environment." *IBM Systems Journal*, Special issue on Pervasive Computing, Volume 38, No. 4, pp. 508-530, October 1999.
2) Back, M., Chow, M., Gold, R., Gorbet, M., Harrison, S., Macdonald, D., Minneman, S. "Designing Interactive Reading Experiences for a Museum Exhibition." IEEE Computer Magazine, Vol. 34, No. 1, January 2001, 1-8.
3) Back, Maribeth, Lertsithichai, S., Chiu, P., Foote, J., Kimber, D., Borezky, J., Liu, Q., Zhao, F., Matsumoto, T., "Rethinking the Podium: An integrated design for tangible control of rich media in next-generation conference rooms." Submitted, UbiComp 2005.
4) Bly, S., Harrison, S. & Irwin, S. (1993). Media Spaces: bringing people together in a video, audio and computing environment. *Communications of the ACM,* 36(1), 28-47.
5) Consolvo, S., M. Walker, "Using the Experience Sampling Method to Evaluate Ubicomp Applications.," *IEEE Pervasive Computing Mobile and Ubiquitous Systems: The Human Experience,*, Vol. 2, No. 2 (Apr-Jun 2003), pp. 24-31, IRS-TR-03-010, Apr. 1, 2003
6) Consolvo, S., L. Arnstein, B. Franza, "User Study Techniques in the Design and Evaluation of a Ubicomp Environment.," *Proceedings of the Fourth International Conference on Ubiquitous Computing*, (September/October 2002), pp. 73-90., IRS-TR-02-018.
7) Foote, Jonathan, Liu, Q., Kimber, D., Chiu, P., and Zhao, F. 2004. Reach Through the Screen: A New Metaphor for Remote Collaboration. Springer Lecture Notes in Computer Science - Advances in Multimedia Information Processing, Proc. PCM 2004 5th Pacific Rim Conference on Multimedia, Tokyo, Japan Aizawa, K., Nakamura, Y., Satoh, S. (Eds.), Vol. 3333, 2005, ISBN 3-540-23985-5, pp 73—80.
8) Fox, Armando, Johanson, B., Hanrahan, P., and Winograd, T. Integrating Information Appliances into an Interactive Space. *IEEE Computer Graphics and Applications* 20:3 (May/June, 2000), 54-65.
9) Huang, J., and Waldvogel, M., The Swisshouse: an Inhabitable Interface for Connecting Nations. Proceedings of Designing Interactive Systems: Processes, Practices, Methods, and Techniques (DIS 2004), Cambridge, MA, USA, 2004, ISBN:1-58113-787-7, pp 195–204.
10) Huang, J., Future Space: A Blueprint for a New Business Architecture, Harvard Business Review, April 2001. VOL. 7, NO 4; ISBN: B00005RZBF; pp. 149-158.
11) Ishii, H., and Ullmer, B. 1997. Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms. In *Proceeding of CHI 97*, ACM Press, 22-27.
12) Jaimes, A. and Miyazaki, J. "Building a smart meeting room: from infrastructure to the video gap (research and open issues)." EMMA '05.
13) Lahlou, Saadi. Cognitive Attractors and Activity-Based Design: Augmented Meeting Rooms. Human Computer Interaction International. 22-27 July . 2005, Las Vegas, NA, USA. Volume 1 - Engineering Psychology, Health and Computer System Design.
14) Lahlou, Saadi, Ballagas, Rafael Tico. Lessons learned in 6 years of operating an augmented room in industrial context. "Ubiquitous computing in next generation conference rooms: interweaving rich media, mobile devices, and smart environments" workshop. Ubicomp 2005, Tokyo, 10 Sept 2005.
15) Liu, Qiong, Zhao, F., Doherty, J, and Kimber, D. An EPIC Enhanced Meeting Environment. Proceedings of ACM Multimedia 2004, ACM Press.
16) Matsushita, M., Iida, M., Ohguro, T., Shirai, Y., Kakehi, Y., Naemura, T. (2004). Lumisight table: a face-to-face collaboration support system that optimizes direction of projected information to each stakeholder. *Proceedings of CSCW '04*, pp. 274-283.
17) Mayer, Richard E. 2001. *Multimedia Learning*. New York: Cambridge University Press.
18) Mynatt, E., M. Back, R. Want, J. Ellis, and M. Baer. "Designing Audio Aura." Proceedings of CHI '98, ACM Press, 566-573.
19) Rekimoto, J., Saitoh, M. (1999). Augmented surfaces: a spatially continuous work space for hybrid computing environments. *Proceedings of CHI '99*, pp. 378-385.
20) Richter, Heather A., Abowd, G., Geyer, W., Fuchs, L., Daijavad, S., and Poltrock, S. "Integrating Meeting Capture and Access within a Collaborative Team Environment," in Proceedings of Ubicomp 2001, Atlanta, GA, 2001.
21) Scholtz, J., S. Consolvo, "Towards a Discipline for Evaluating Ubiquitous Computing Applications," IRS-TR-04-004, Feb. 20, 2004.
22) Scholtz, J., and S. Consolvo. Workshop on User-Centered Evaluation of Ubiquitous Computing Applications. UbiComp 2002.
23) Scholtz, J, and H. Richter. Report from Ubicomp 2001 workshop: evaluation methodologies for ubiquitous computing. ACMSIGCHI Bulletin, Volume 2002 , January-February 2002.
24) Shen, C., Vernier, F., Forlines, C., Ringel, M. (2004). DiamondSpin: an extensible toolkit for around-the-table interaction. *Proceedings of CSCW '04*, pp. 167-174.
25) Smailagic, A., D.P.Siewiorek, J.Anhalt, F.Gemperle, D.Salber, S.Weber, J.Beck, J.Jennings. Towards Context Aware Computing: Experiences and Lessons Learned, IEEE Journal on Intelligent Systems, Vol. 16, No. 3, June 2001
26) Streitz, N., Geisler, J., Holmer, T. 1998. Roomware for Cooperative Buildings: Integrated Design of Architectural Spaces and Information Spaces. In: N. Streitz, S. Konomi, H. Burkhardt, H. (Eds.), Cooperative Buildings - Integrating Information, Organization, and Architecture. Proceedings of CoBuiM '98 (Darmstadt, Germany), Springer LNCS Vol. 1370, pp. 4-21.
27) Stults, R. (1986). Media Space. Systems Concepts Lab Technical Report. Palo Alto, CA: Xerox PARC.
28) Weiser, M. September 1991. The Computer for the 21st Century. *Scientific American,* pp. 94-10.
29) Yoshida., N., Miyazaki, J. "An Automatic and Immediate Metadata Extraction Method by Heterogeneous Sensors for Meeting Video Streams." SAINT 05.
30) Yoshida., N., Miyazaki, J., Wakita, A. : "CandyTop Interface: A Visualization Method with Positive Attention for Growing Multimedia, IEEE Information Visualization 2003 (IV03)..
31) Zhang, Hangjin, Liu, Q., Lertsithichai, S., Liao, C., Kimber, D. 2004. A Presentation Authoring Tool for Media Devices Distributed Environments. Proceedings of 2004 IEEE International Conference on Multimedia and Expo (ICME 2004).