Interaction Design for the Disappearing Computer

Norbert Streitz

AMBIENTE – Workspaces of the Future
Fraunhofer IPSI
64293 Darmstadt Germany
streitz@ipsi.fraunhofer.de
http://www.ipsi.fraunhofer.de/ambiente

Abstract. This invited talk starts out with a review of the previously developed Roomware® concept and sample prototypes as an approach for designing new forms of interaction and collaboration in future work environments. This is followed by presenting the EU-funded proactive initiative "The Disappearing Computer" (DC), a cluster of 17 related projects designing new people-friendly environments in which the "computer-as-we-know-it" has no role. Finally, a specific example of the DC-initiative is presented, the project "Ambient Agoras: Dynamic Information Clouds in a Hybrid World". It aims at transforming places into social marketplaces ('agoras') of ideas and information, providing situated services and feeling of the place ('genius loci') by creating new social architectural spaces. This is achieved by developing combinations of ambient displays and mobile devices that require and provide new forms of natural and intuitive interaction.

1 Roomware®: Beyond Desktop PCs and WIMP Interaction

The introduction of information technology has caused a shift away from the real objects we were and still are used to in our physical environment as the sources of information towards desktop computers as the interfaces to information that is now (re)presented in a digital format in virtual environments. Associated with this shift is a style of interacting with information that is known as WIMP – windows, icons, mouse (or menus), and pointers; and, of course, not to forget the keyboard. In this paper, I argue for returning to the real world as the starting point for designing future information and collaboration environments. The goal is to design environments that exploit the affordances provided by real objects but at the same make use of the potential of computer-based support that is available via the virtual world. Taking the best of both worlds requires an integration of real and virtual worlds resulting in hybrid worlds.

Since 1997, we have developed a new approach for the design of work environments where the “world around us” is the interface to information and for the cooperation of people [4]. In this approach, the computer as a device disappears and is almost “invisible” (see also “The Disappearing Computer” in the next section) but its functionality is ubiquitously available via new forms of interacting with information. The environments consist of what we call “roomware” components. We define

E. Aarts et al. (Eds.): EUSAI 2003, LNCS 2875, pp. 351–355, 2003.

Roomware® [6] as the result of integrating information and communication technology in room elements such as doors, walls, and furniture [www.roomware.de]. Thus, the roomware approach moves beyond the limits of standard desktop environments on several dimensions.

At the beginning of these efforts, we designed and built a testbed called i-LAND [4],[5] with a range of different roomware components as, e.g., the DynaWall, the InteracTable, the ConnecTables, and the CommChairs. There are two generations of Roomware components; the second one was developed in the context of the R&D consortium "Future Office Dynamics". We also developed the dedicated software infrastructure BEACH [6],[10] and applications on top of it as, for example, MagNets, BeachMap, PalmBeach [3], and the Passage mechanism [1] in order to exploit the full potential of roomware. Furthermore, we used non-speech audio in order to provide sound augmentation for the different types of interaction and collaboration [2].

The *DynaWall* is an interactive electronic wall, representing a touch-sensitive vertical information display and interaction device that is 4.50 m wide and 1.10 m high. The availability of sufficient display space enables teams to display and to interact with large information structures collaboratively in new ways. Two or more persons can either work individually in parallel or they share the entire display space. The size of the DynaWall provides challenges as well as opportunities for new forms of human-computer interaction that are provided by the BEACH software.

The *InteracTable* is an interactive table for informal group discussion and planned cooperation. It is 90 cm high with a display size of 63 cm x 110 cm. The horizontal workspace is realized with a touch-sensitive plasma-display that is integrated into the tabletop. People can use pens and fingers for gesture-based interaction with information objects. Using BEACH, they can create and annotate information objects that can also be shuffled and rotated to accommodate different view orientations around the table.

The *CommChair* combines the mobility and comfort of armchairs with the functionality of a pen-based computer. It has an independent power supply and is connected to all other roomware components via a wireless network. The BEACH software provides a private workspace for personal notes and a public workspace that allows moving them to other roomware components, for example to the DynaWall. Using the CommChair, one can interact remotely with all objects displayed on the DynaWall.

The *ConnecTable* is a modular version of the CommChair and can be used in different positions: either sitting in front of it on a regular chair or using it in a stand-up position as a high desk. Its particular name, ConnecTable, results from the functionality that its workspace area can be easily extended by "connecting" several ConnecTables [9]. The coupling of the individual displays resulting in a common shared workspace is achieved by simply moving the ConnecTables together in physical space which is detected by sensors. No additional login or typing of IP addresses is needed.

The *"Passage"* mechanism [1] provides an intuitive way for the physical transportation of virtual information structures using arbitrary physical objects, so called

"Passengers". The assignment is done via a simple gesture moving the information object to (and for retrieval from) the "virtual" part of the so called "Bridge" that is activated by placing the Passenger object on the physical part of the Bridge. No electronic tagging is needed. Passengers can be viewed as "physical bookmarks" into the virtual world.

The cooperative hypermedia environment *BEACH* [6],[10] provides new, intuitive forms of human-computer interaction based on using only fingers and pens and new ways of cooperative sharing for multiple device interaction. It provides a modeless user-interface allowing to scribble and to gesture (for commands) without having to switch modes. The incremental gesture recognition detects the type of input and provides feedback via different colors or sounds.

The context of these development is our more comprehensive notion of so called Cooperative Buildings that we introduced some time ago [4]. We used the term “building” (and not “spaces”) in order to emphasize that the starting point of the design should be the real, architectural environment. By calling it a “cooperative” building, we wanted to indicate that the building serves the purpose of cooperation and communication. At the same time, it is also “cooperative” towards its users, inhabitants, and visitors by employing active, attentive and adaptive components. This is to say that the building does not only provide facilities but it can also (re)act “on its own” after having identified certain conditions. It is part of our vision that it will adapt to changing situations and provide context-aware information and services. Our roomware components are examples of the major constituents of these cooperative buildings.

2 The Disappearing Computer

"The Disappearing Computer" (DC) [www.disappearing-computer.net] is an EU-funded proactive initiative of the Future and Emerging Technologies (FET) activity of the Information Society Technologies (IST) research program. The goal of the DC-initiative is to explore how everyday life can be supported and enhanced through the use of collections of interacting smart artefacts. Together, these artefacts will form new people-friendly environments in which the “computer-as-we-know-it” has no role. There are three main objectives:

1. Developing new tools and methods for the embedding of computation in everyday objects so as to create artefacts.
2. Research on how new functionality and new use can emerge from collections of interacting artefacts.
3. Ensuring that people's experience of these environments is both coherent and engaging in space and time.

These objectives are addressed with a cluster of 17 related projects under the umbrella theme of the DC-initiative. The cluster is complemented by a variety of support activities provided by the DC-Network and coordinated by the DC Steering Group, an elected representation of all projects.

3 Ambient Agoras

"Ambient Agoras: Dynamic Information Clouds in a Hybrid World" is a project of the “Disappearing Computer" initiative [www.ambient-agoras.org]. It addresses the office environment as an integrated organisation located in a physical environment and having particular information needs both at the collective level of the organisation, and at the personal level of the worker.

This project promotes an approach of designing interactions in physical environments using augmented (smart) physical artefacts and corresponding software to support collaboration, social awareness, and to enhance the quality of life in the working environment. Ambient Agoras combines a set of interaction design objectives (mental disappearance of computing devices, communicating awareness and atmospheres) with sensing technologies, smart artefacts (walls, tables, ambient displays, and mobile devices) and the functionality of artefacts working together. "Ambient Agoras" aims at transforming places into social marketplaces of ideas and information ('agoras') and provides situated services, place-relevant information, and feeling of the place ('genius loci'). It adds a layer of information-based services to the place and provides the environment with 'memory' accessible to users. This is achieved by providing better affordances and information processing to existing places and objects. In this way, it aims at creating a social architectural space [8] that facilitates novel interactions and experiences by augmenting existing architectural spaces.

We designed and realized a set of different smart artefacts that function not only as independent artefacts but also in combination [7],[8]. Examples are the Hello.Wall and the ViewPort. The *Hello.Wall* is a large (1.80 m x 2.00 m) ambient display with sensing technology. We use changes in light patterns for conveying information about different states of people and of the physical as well as the virtual environment in an office building as, e.g., atmospheres. The *ViewPort* is a handheld compact artefact with a pen-based interactive display and provided with sensing technology and a wireless network. It can be used as a personal, a temporarily personal or public device for creating and visualizing information. It provides also the functionality of visualizing information “transmitted” from other artefacts that do not have displays of their own and are "borrowing" this display as, e.g., the Hello.Wall. A more recent application is the combination and coupling of two Hello.Walls at distributed locations.

Acknowledgements. The work reported is supported in part by the European Commission (contract IST–2000-25134) as part of the “Disappearing Computer” initiative. Thanks are due to our cooperation partners in the different projects and to Carsten Magerkurth, Christian Müller-Tomfelde, Thorsten Prante, Carsten Röcker, Richard Stenzel, Peter Tandler, Daniel van Alphen, Daniela Plewe, members and all students of the research division AMBIENTE for their contributions in realizing the different components and environments [www.ipsi.fraunhofer.de/ambiente].

References

1. Konomi, S., Müller-Tomfelde, C., Streitz, N. (1999). Passage: Physical Transportation of Digital Information in Cooperative Buildings. In: N. Streitz, J. Siegel, V. Hartkopf, S. Konomi (Eds.), Cooperative Buildings - Integrating Information, Organizations, and Architecture. Proceedings of Second International Workshop (CoBuild'99). Springer LNCS 1670, pp. 45–54
2. Müller-Tomfelde, C., Streitz, N., Steinmetz, R. (2003). Sounds@Work - Auditory Displays for Interaction in Cooperative and Hybrid Environments. In: C. Stephanidis, J. Jacko (Eds.), Human-Computer Interaction: Theory and Practice (Part II). Lawrence Erlbaum Publishers. Mahwah, June 22–27, 2003. pp. 751–755
3. Prante, T., Magerkurth, C., Streitz, N. (2002). Developing CSCW tools for idea finding – Empirical results and implications for design. In: Proceedings of the ACM Conference on Computer Supported Cooperative Work (CSCW 2002) (New Orleans, USA). pp. 106–115
4. Streitz, N. Geißler, 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 the First International Workshop (CoBuild '98). Springer LNCS Vol. 1370, pp. 4–21
5. Streitz, N., Geißler, J., Holmer, T., Konomi, S., Müller-Tomfelde, C., Reischl, W. Rexroth, P., Seitz, P., Steinmetz, R. (1999). i-LAND: an Interactive Landscape for Creativity and Innovation. In: Proceedings of ACM Conference CHI'99 (Pittsburgh, USA). pp. 120–127
6. Streitz, N., Tandler, P., Müller-Tomfelde, C., Konomi, S. (2001). Roomware: Towards the Next Generation of Human-Computer Interaction based on an Integrated Design of Real and Virtual Worlds. In: J. Carroll (Ed.), Human-Computer Interaction in the New Millennium. Addison-Wesley, pp. 553–578
7. Streitz, N., Röcker, C., Prante, Th., Stenzel, R., van Alphen, D. (2003). Situated Interaction with Ambient Information: Facilitating Awareness and Communication in Ubiquitous Work Environments. In: D. Harris, V. Duffy, M. Smith, C. Stephanidis (Eds.), Human-Centred Computing: Cognitive, Social, and Ergonomic Aspects. New Jersey, Lawrence Erlbaum Publishers. Mahwah, June 22–27, 2003. pp. 133–137
8. Streitz, N., Prante, T., Röcker, C., van Alphen, D., Magerkurth, D., Stenzel, R., Plewe, D. (2003). Ambient Displays and Mobile Devices for the Creation of Social Architectural Spaces: Supporting informal communication and social awareness in organizations. In: K. O'Hara, M. Perry, E. Churchill, D. Russell (Eds.), Public and Situated Displays: Social and Interactional Aspects of Shared Display Technologies. Kluwer Publishers (to appear in fall 2003)
9. Tandler, P., Prante, T., Müller-Tomfelde, C., Streitz, N., Steinmetz, R. (2001). ConnecTables: Dynamic Coupling of Displays for the Flexible Creation of Shared Workspaces. In: Proceedings of the 14. Annual ACM Symposium on User Interface Software and Technology (UIST'01), ACM Press (CHI Letters 3 (2)), 2001. pp. 11–20
10. Tandler, P., Streitz, N., Prante, T. (2002). Roomware: Towards Ubiquitous Computers In: IEEE Micro (November/December 2002). pp. 36–47