Interactive Walls and Handheld Devices – Applications for a Smart Environment

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There is a growing research interest in enhancing and augmenting the interaction with large, stationary displays. One promising approach is to utilize mobile devices that offer richer interaction capabilities than an interactive display. This paper addresses the realization of a text entry system for walls and mobile devices as well as further services that may become available when the handheld also serves as an authentication device.

Introduction

If we regard the prominent features of wall-sized displays and handheld devices, it becomes immediately clear that one device complements the other. For instance, the handheld has a very small and hard to read display that is unsuited for showing most kinds of information, while the wall-sized display's main purpose and strength is obviously to display information to at least one person, probably more. On the other hand, the handheld device usually boasts with a multitude of interaction possibilities with more than one modality: Users can interact with a set of hard-keys, they can operate on the touch display with their fingers or special pens, and for many devices there is even the possibility of using speech (although the recognition- and processing capabilities are usually very limited). The wall, however, offers only limited ways of interacting. If it has a touch surface, the user usually controls a mouse pointer with her/his fingers. This is not practical, especially for large surfaces, since ordinary mouse movements require quite long distances for the fingers to move over the surface. In fact, the dimensions of the wall display are equal to the maximum finger translation on the wall necessary to get the mouse cursor from one corner of the screen to the other – a lot more than what is necessary with a real mouse that implements relative mouse movements and simple acceleration mechanisms.

To overcome this impracticability, researchers have developed several methods to enhance finger input on interactive walls such as the throwing of windows in contrast to dragging them (Streitz et al. 2001, 2002). Also, there is a growing research activity regarding the use of mobile and handheld devices to support the interaction with large displays. Rekimoto et al. (1998), for instance, coined the notion of the handheld device being a "painter's palette" that allowed the user to access user interface components related to the contents of the wall directly on the handheld device. Greenberg et al. (1999) even allowed the user to access most of the information that

was being displayed at a wall directly at the user's personal digital assistant (PDA) in a device-adapted, but coherent way. This idea was later picked up by Magerkurth & Prante (2001) who realized a creativity support tool on a handheld device that seamlessly synchronized with an interactive wall running a complementary software tool.

What these approaches lack, however, is making use of the specific advantages of both of the very different kinds of devices. When a handheld device is utilized to help interacting with a stationary display, it is not sensible to make use of the very limited display capabilities of the PDA, when the wall is so much more superior in displaying information. Therefore, the handheld as an interaction device should be used "blindly" while the relevant information should be perceived directly at the wall (see figure 1).

Figure 1: Entering information with the PDA and perceiving it on the wall.

One domain that can profit greatly by handheld interaction is entering text, because text entry on large, public displays always comes with a disadvantage that becomes relevant with the typical usage of a large display as a media for presenting information in plenary situations, i.e. when more than one person perceives information from the wall: No matter if handwriting recognition or a virtual keyboard is used for entering text, there is always a considerable amount of screen real estate wasted for the interaction of the person working on the text. Thus, moving the text entry to the mobile device effectively preserves the wall's characteristics of a presentation media for multiple persons.

Text entry for wall-sized displays

We are developing a system using a PDA to enter text for large displays. The usage on the PDA differs from traditional handheld text entry mechanisms in that there is no screen-oriented interaction as with virtual keyboards or gesture recognition. The handheld's display is used for controlling four virtual buttons that are large enough to be pressed blindly with the right hand's thumb. In conjunction with the PDA's

hardware buttons one can easily create all the characters of the Alphabet. Figure 2 shows how to blindly interact with the PDA (a Palm V).

Figure 2: Interacting blindly with the mobile device.

Characters are generated by associating anchor-elements (the vocals "A-E-I-O-U" which are mapped to the hardware keys) with the virtual keys that generate the consonants following a specific vocal.

Using this technique, we can avoid having the user watch the PDA's display. Using a serial wired or infrared connection the PDA is linked to the wall where characters generated with the PDA are updated in real-time (see figure 1).

To further augment this connection between handheld and wall we are now exploring to utilize a dictionary/ auto-completion system on the wall's side to further accelerate generating text. In principle, this is similar to text entry methods such as T9 on mobile phones, however, we will again make use of both devices' specific strengths and move this memory and CPU intensive application to the wall (which has no memory and processing constraints as a mobile device has).

User authentication

While text entry is a good example for enriching interactions with mobile devices and interactive walls, using a PDA also offers an additional benefit: It is a personal device that is potentially able to authenticate its user on a public wall by means of infrared or even RF-ID communications. This allows for more advanced services than merely entering text. When a public wall can realize which persons are standing before it, it might grant access to private folders of these users or it might decide to show urgent messages to them. Depending on the rights of these users it might even offer them the possibility to utilize the PDAs that had previously authenticated them to edit what the wall displays to the public, e.g. allowing a service technician to correct a spelling mistake on an interactive poster.

There are many possibilities and many open questions such as privacy control or technical feasibility. We hope to address some of them with you at the UbiComp workshop.

About the authors

Carsten Magerkurth

Carsten studied Cognitive Sciences at the University of Mainz, Germany, where he earned his diploma in 2001. He then joined the AMBIENTE division of Fraunhofer IPSI, where his main research topics include the role of mobile and handheld devices in conjunction with larger systems such as interactive walls. He is Fraunhofer IPSI's representative in the Ladenburger Kolleg "Living in a smart environment" of the Daimler-Benz foundation that deals with the social implications of future UbiComp technologies.

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Peter Tandler is a member of the AMBIENTE division of FhG-IPSI (Integrated Publication and Information Systems Institute) since August 1997. He leads the software development within the BEACH and i-LAND projects.

His research interests are within the areas of synchronous CSCW, integration of virtual and physical environments, new forms of human- and team-computer-interaction for roomware components. Additionally, he is interested in software architecture, programming languages, object-oriented frameworks, and object-oriented design and programming in general. He is currently working on his Ph.D. in the context of application models and software infrastructure for roomware environments.

He studied computer science at the Technical University of Darmstadt, Germany, with education and psychology as additional subjects.

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