

Situated Interaction with Ambient Information: Facilitating Awareness and Communication in Ubiquitous Work Environments

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Abstract

In this paper, we introduce our approach as well as examples of realizations for situated interaction in the context of future work environments. These environments will be populated with a range of smart artefacts. The artefacts and their mutual interaction are designed to facilitate awareness and notification as well as informal communication. They constitute examples of our approach to develop future work environments going not only beyond traditional PC-based work places but also beyond electronic meeting rooms and roomware components previously developed by us. We address a range of spaces in office buildings including semi-public spaces, e.g., in the hallway, the foyer, and the cafeteria. The approach is not restricted to office buildings but can be extended to other types of buildings and spaces. It is part of our vision that we call “Cooperative Buildings”. The artefacts and the software were developed in the EU-funded “Disappearing Computer”-project “Ambient Agoras: Dynamic Information Clouds in a Hybrid Worlds”.

1 Introduction

“Ambient Agoras” is a project that 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 to designing interactions in physical environments using augmented physical artefacts and corresponding software to support collaboration, social awareness, and to enhance the quality of life in the working environment. Ambient Agoras couples a set of interaction design objectives (ambient displays, mental disappearance of computing devices) with sensing technologies, smart artefacts (walls, tables, mobile devices) and the emerging functionality of artefacts working together. This work is an example of our approach to develop future work environments going beyond traditional PC-based work places and electronic meeting rooms as well as the various roomware components previously developed by us (Streitz et al., 2001).

2 The Role of Informal Communication

In our approach we address issues beyond the traditional PC-based working place and the less traditional but in many places already existing electronic meeting room environments. It is also motivated by the increased awareness of and interest in the role of informal communication in innovative work environments. While people acknowledge for quite some time the importance of

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“soft skills” and “social competence”, the value of informal communication for the performance and the creativity of an organization tend to be underestimated. So far, there has been little work on computer-supported augmentation of informal communication. Two trends changed the situation: The trend of putting more emphasis on informal communication and the trend in new technology developments where computer-based support is not only tied to the PC workplace anymore but will be mobile and ubiquitous using a wide range of devices. In this context, computer-based support for informal communication becomes an important topic when designing the workspaces of the future in terms of what we have called “Cooperative Buildings” (Streitz et al., 1998). Informal communication and the associated social interactions involve what may be described as “gossip”. The way people deal with exchanging “soft facts” influences the general climate and atmosphere of the corporate culture. The increase of temporary project teams and nomadic workers with irregular presence in the office building requires compensating for the loss of continuity. Asynchronous and localized communication may help to overcome the anonymity and alleviate socializing for nomadic workers. Though email and telecommunication cover some of these needs, media that convey atmosphere, rumours, and vague news, etc. have to be developed. The question arises how one can support and augment the exchange of informal communication and atmospheric information using information technology. Our proposal is to develop “smart artefacts” with a focus on ambient displays.

3 Ambient Displays

Ambient displays take a broader view of the notion of “display” usually encountered with conventional graphical user interfaces (GUI) found on PCs, notebooks, PDAs and even on interactive walls or tables. Ambient displays also serve the purpose to communicate information but in a different, usually “implicit” way compared to traditional “explicit” GUI displays. This is achieved by making use of the physical environment around us and conveying information via changes in light, sound, movement of objects, smell, etc. For early examples see Wisneski et al. (1998). In the Ambient Agoras project, we decided to use changes of light, in particular 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. In addition to communicating various types of information, we combined this with the goal to contribute also a decorative atmospheric element - called “GossipWall” (see below). As an example of what can be called “informative art”, it serves two purposes at the same time: being a highly decorative spatial artefact and a real time feedback tool for informal processes within a space or a building.

4 Different Zones of Interaction

In addition to developing a new type of ambient display, our goal was also to make the type of information and the way of its communication context-dependent. The service provided by this artefact should be situation-based and depending on the proximity of people passing by. We decided to distinguish among three “zones of interaction” (and their respective modes) dependent on the distance from the GossipWall:

- Ambient Zone
- Notification Zone
- Interactive Zone

This is achieved by integrating sensors into the wall that cover two ranges, which may be adapted according to the surrounding spatial conditions. The sensors allow us to introduce “distance-

dependent semantics”, implying that the distance of an individual in front of the wall defines the kind of information shown and the interaction offered.

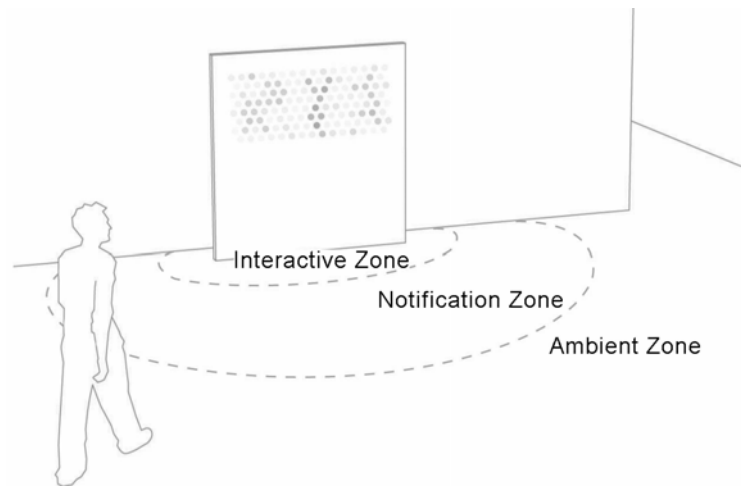


Figure 1: Three Zones of Interaction

Ambient Zone

When people are passing by but are outside the range of the wall’s sensors, they experience the “ambient” mode, i.e. the display shows general information that is defined to be shown independent of the presence of a particular person. The parameters chosen to define the atmosphere will be represented as light patterns. Examples are: the number/ percentage of people still in the building, levels of activities, etc.

Notification Zone

If an individual approaches or passes by close to the wall, the person enters the Notification Zone and the wall will react. The GossipWall changes from a stand-by pattern to a notification pattern. This pattern can be a personal one relevant only for that particular person or a group pattern that is shown to all members of that group when passing by. These patterns can be “secret” and only been known to the people that are notified.

While the notification serves already an important purpose, in many cases there is a need to receive more detailed information. This is achieved by combining an ambient, implicit display with another explicit display. We propose a mechanism that we call “*the principle of borrowing a display*”. In our realization, we use a mobile device called “ViewPort”. The GossipWall borrows the display of the ViewPort and the user has all kind of information “at hand”. This includes information about the meaning of the displayed patterns. Depending on the actual application, the user can interact and also enter data, download (“freeze”) or browse information. See figure 2.

Interaction Zone

The third zone is active, once the person is very close to the GossipWall. In this case, the person can approach the GossipWall and interact with each single *cell* (= independent interactive pixel). This is able to store and communicate information in parallel in combination with mobile devices. This feature allows playful and narrative interactions, which other media don’t supply. There is also a charming element of surprise that may be discovered via single cell interaction.



Figure 2: Interaction at the GossipWall using the ViewPort as a „borrowed display“.

5 Realization: GossipWall and ViewPort

5.1 The GossipWall

The GossipWall is an XL-size (1, 80 m x 2 m) compound artefact with sensing technology. It does not have a standard type of display but is able to “display” or communicate ambient information, i.e., an “ambient display”. It serves the function of “spreading gossip” by providing awareness and notifications to people passing by via patterns, in our case light patterns. Different patterns correspond to different types of information. People can access details via portable M-size artefacts as, e.g., the ViewPort (see below). We call this situation ‘the GossipWall is “borrowing” the display of another artefact for explicitly displaying the information’.

We call the device GossipWall, because our focus is on the atmospheric and non-explicit aspects of communication localized within a building. Since individuals passing by can be recognized, there is a range of interaction opportunities including individual information through mobile artefacts as well as anonymous and public communication.

Each of the 124 cells at the GossipWall contains an LED cluster and a short-range transponder. The light intensity of each cell can be controlled. Since dimming of LEDs is not possible, we developed a control unit using pulse width modulation to change the brightness in 256 steps. To support the interaction among the different components we use two independent RFID systems and a wireless LAN network. People within the notification zone are detected via two RFID long-range readers installed in the lower part of the GossipWall.

Once a person is detected, the identification information is sent to the controlling PC for further processing. Depending on the kind of application, data can be transmitted to the ViewPort via the wireless LAN or distinctive light patterns can be displayed for notification.

Within the interaction zone people can access the information “stored” in each cell by reading the cell’s ID with the ViewPort’s short-range reader. With the received data the ViewPort can access the corresponding information.

5.2 The ViewPort

The ViewPort is a portable M-size compound artefact with a pen-based interactive display and provided with sensing technology. 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 GossipWall.

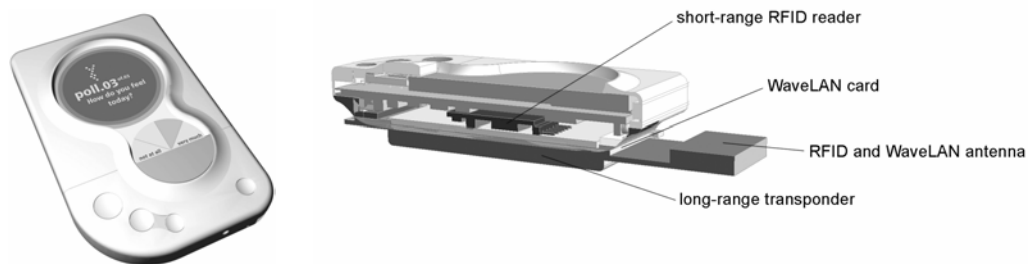


Figure 4: ViewPort with sensing (left) and communication module (right)

The ViewPort is developed on the basis of a Compaq iPAQ 3660 with 32bit RISC Processor, touch-sensitive color display and 64MB RAM. Its functionality is extended by a passive short-range reader unit and a WaveLAN adapter. The integrated RFID reader allows reading ranges up to 100mm. For higher flexibility, the WaveLAN hardware is implemented in a detachable communication module. Additionally, the ViewPort is equipped with a long-range RFID transponder. Thus, the ViewPort can be detected by stationary artefacts, e.g., the GossipWall, while at the same time it can identify nearby artefacts through its own reading unit. The ViewPort is able to offer services that are aware of the context. Sample applications include a GossipWall memory game and a polling functionality that reflects the results of the vote on the GossipWall.

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