Universal Access to Groupware with Multimodal Interfaces

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Abstract

Universal Access aims to improve usability of software by coping with a diversity in human abilities, skills, requirements, and preferences of the target user group, diversity in users' tasks, and diversity in contexts of use. In this paper we suggest multimodal interfaces for the universal access to groupware. Multimodal interfaces are multi-sensory, multi-channel, and allow multi-tasking—and, therefore, they make computing more accessible for diverse user groups. We present a broad range of multimodal interfaces for groupware, and discuss how their multimodality improves universal access.

1 Introduction

Universal Access departs from a perspective that 'recognises, respects, values, and attempts to accommodate a very wide range of human abilities, skills, requirements, and preferences in the design of computer-based products and operating environments' and it tries to cope with a diversity in the target user group, the users' tasks, and the contexts of use. In order to provide universal access the products and services are often designed to change their look-and-feel according to the respective user and the respective context of use (Stephanidis & Savidis, 2001). System that perform changes automatically are often referred to as adaptive; whereas, systems that allow the user to change parameters and adapt their behaviour accordingly are called adaptable (Oppermann & Rashev, 1997).

Multimodal interfaces have the 'potential to greatly expand the accessibility of computing to diverse nonspecialist users' and they will 'increase the accessibility of computing for users of different ages, skill levels, cognitive styles, sensory and motor impairments, native languages, or even temporary illnesses' (Oviatt & Cohen, 2000). They focus on the user rather than the technology. They are 'multi-sensory' (i.e., they utilise multiple sensory modalities), 'multi-channel' (i.e., they utilise multiple channels, on the same or different modalities), and 'multi-tasking' (i.e., they allow users to perform several tasks at the same time) (Buxton, 1994).

In this paper we present a range of multimodal interfaces for groupware. Their specific purpose is to support mutual information of the members of distributed work groups; they capture information about users and artefacts in the electronic world and in the physical world, and they present the information to the interested and authorised users in the electronic and in the physical world. They are highly adaptable to the respective user, tasks, and context of use and they are multi-sensory and allow multi-tasking. After a brief introduction of the underlying open awareness information environment, we will present a range of multimodal interfaces we designed and developed. We will discuss how their multimodality improves universal access and summarise the paper in the conclusions.

2 Multimodal Interfaces

The multimodal interfaces were designed and developed to capture and present information in distributed workgroups; they are multi-sensory and address the visual sense (e.g., the TowerWorld, AwarenessMaps, the mobile client), the auditive sense (e.g., the AudioSpace), or multiple senses at the same time (e.g., ambient interfaces). The multimodal interfaces were used to improve the accessibility of an open awareness information environment (details about the open awareness information environment, called Theatre of Work Enabling Relationships (TOWER), can be found in (Prinz et al., 2002)). Subsequently we will describe some of the multimodal interfaces combined with TOWER.

2.1 Visual Interfaces

Several visual interfaces were designed and developed. For instance, the *TowerWorld* is a 3D multi-user world, which consists of a stage that is dynamically created based on shared information spaces or the content of document management systems. The stage is generated and adapted according to rules and semantic mappings that can be specified by users. Various attributes of the documents can be visualised (e.g., the type, size, frequency of manipulations, creator). These attributes can be mapped to the TowerWorld (e.g., the size, shape, colour, position, clustering of the cubicles). The stage of the TowerWorld is populated with avatars representing users and their current activities as symbolic actions such as automatic navigation through the TowerWorld and gestures. Figure 1 shows a screenshot of a TowerWorld.

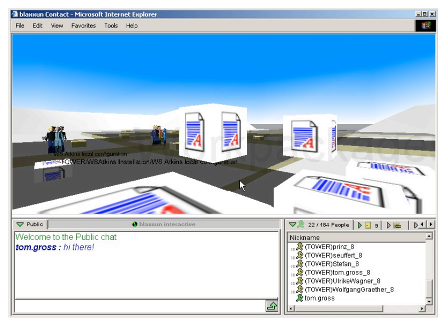

Figure 1. TowerWorld.

AwarenessMaps have been designed to enrich shared information spaces with information about activities of users and changes to documents. Shared information spaces are often nested repositories that can contain various kinds of information such as documents, URLs, results of Web searches, and threaded discussions. AwarenessMaps provide users with up-to-the-minute information on members of the respective shared workspace (PeopleMap) as well as its structure and the contents (DocumentMap). The *PeopleMap* shows an array of pictures of users with recent activities. The pictures are displayed in the order of the actuality of the represented user's last activity and fade out over time. The *DocumentMap* provides a schematic overview of the nested structure of a shared workspace consisting of folders, sub-folders, and documents. The structure is mapped into an array of nested rectangles. The mapping is based on space-filling algorithms for the visualization of hierarchical information structures from Johnson and Shneiderman (1991). In our visualization each rectangle represents an individual document; the bounding rectangles represent the folders containing it (cf. the example in Figure 2). The layout of the DocumentMap is recalculated and redrawn, whenever the underlying structure of the shared workspace changes. Documents are represented in light blue colour; for recently manipulated documents the associated rectangle changes to dark blue. Similar to the PeopleMap the colour changes back to light blue after some time.

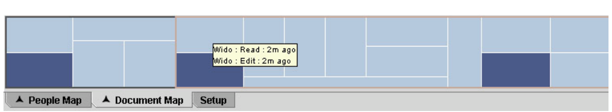

Figure 2. DocumentMap.

The *mobile client* called PResence AVailability and Task Awareness client (PRAVTA) is a lightweight and mobile supplement the other interfaces (Gross, 2001). In fact, it allows users to query various types of information about other users such as their presence, availability, or current tasks. Being based on WAP (WAP Forum, 2002), the PRAVTA prototype can be accessed from any mobile device that supports WAP such as mobile phones, palmtops, and SmartPhones. For users who are in their everyday work environment the sensors can capture information about their presence, availability, activities, and so forth. As PRAVTA can be used in any surrounding, the user has the possibility to manually update their status.

2.2 Audio Interfaces

The *AudioSpace* allows users to specify contexts they are interested in and to map SoundScapes to these contexts. Context descriptions consist of various attributes such as persons, artefacts, tools, locations, and so forth. SoundScapes group different sounds that typically coexist in the real world to sound families. These sound families are then associated with contexts. For instance, for a project X a context C_X could be described and a SoundScape S_X (e.g., with beach sounds) could be associated. Now, anytime an event occurs that relates to project X the user can hear sounds from the beach (e.g., seagulls, waves, wind).

For more precise audio notifications, more fine-grained specifications can be created. Single values of attributes of context descriptions (e.g., person P as a member of project X; document D as an artefact belonging to project X) can be associated with specific (e.g., a wind howl for person P; a cry of a dove for document D). Now, anytime an event occurs in which person P is involved, the user can hear the sound of waves; any time document D is involved the user can hear a cry of a dove). Additionally, for either of the two types of events the user hears a basic sound (e.g., a wave sound). So, the user knows from which context the sound origin.

For events with a short duration (e.g., a simply Web access) only a short sound is played. For ongoing events (e.g., the period of a login of person P) the interested user can choose if a sound should be played only at the beginning of the event, or for the whole duration of the event. This last option can be easily changed with a simple on/off-switch. As, there are considerable advantages and trade-offs for both options, this seems to be important. The advantage of a short notification is that the user is not permanently disturbed. The advantage of the on-going notification is that the user does not miss the audio notification, in case she is not in her office when the event starts (e.g., in the printer room, out for lunch).

2.3 Multi-Sensory Interfaces

A range of multi-sensory interfaces was built; they address multiple human sensory modalities and multiple channels, of the same or different modalities at the same time. Examples are a fan, a lamp, and a fish tank. The fan blows air into the face of the user and addresses the haptic sense of the user. The desktop lamp points to the ceiling of an office room and illuminates the ceiling and addresses the visual sense. The fish tank releases bubbles in different intensities. Users can see and hear the bubbles, and their visual and auditory senses are addressed. AwareBots present information in the shape of robots. For instance, the RoboDeNiro AwareBot can lift its hat when another user logs in; it can rotate its body when new email has arrived; and the user can press its arm in order to log into the system. Details about these multi-sensory interfaces and AwareBots as well as about others can be found in (Gross, 2002; Gross, (to appear)).

3 Discussion

The multimodal interfaces presented enhance the accessibility of the open awareness information environment. Several requirements of universal access could be covered with the features of the multimodal interfaces.

Some examples of general requirements are:

- Should cope with *diverse target user groups*: The interfaces presented are multi-sensory and address the visual sense, the auditive sense, or even multiple senses at the same time. Users are free to choose the sense they need or prefer.
- Should cope with *diverse user tasks*: The interfaces presented have different affordances concerning the granularity of the information presented, the timing of the presentation, and the persistency of the information presented. Users can freely map interfaces to specific tasks. So, whenever they perform a certain task, the corresponding interface is selected.
- Should cope with *diverse contexts of use*: The interfaces have different requirements concerning the underlying hardware and its mobility. Many interfaces are presented on the PC, so, they can be used on any PC (desktop or notebook). The mobile interfaces can be used wherever a mobile device with WAP-capability is available.
- Should be *adaptable*: Basically, the interfaces can be tailored by the users and adapt to the changes made by the users. The interfaces allow great freedom in the specification of preferences. The specifications can sometimes be a challenge: they require expertise about the different multimodal interfaces as well as about the user groups and user tasks, they are time-consuming, and depending on the human abilities the users might not be able to handle them. So, we designed a mechanism that allows users to store their specifications in a shared information space. Now users are able to administrate their own specifications or the specifications of colleagues remotely and they can share specifications among groups (so, only one user per group needs to manage the group specifications).

Some examples that are based on more specific requirements for groupware:

- Should *reduce information overload*: The system allows users to choose from a broad range of interfaces. They can choose an interface with the granularity of information needed. Furthermore, we introduced mutual awareness among interfaces—that is, each interface knows what the other interfaces are presenting. By this means it is possible to reduce redundancy (e.g., a user sitting in an office equipped with various ambient interfaces might not want to receive short messages on the mobile phone in this setting).
- Should *reduce disruption*: The interfaces are multi-sensory and can make use of the users' peripheral awareness of information. Subtle changes in the AudioSpace or the ambient interfaces can provide the user with information without disrupting them from their foreground tasks.
- Should *maintain privacy*: The interfaces can be tailored by the user and the mapping of the information to the respective interface is often only known to the user. Another, general approach taken in this open awareness information environment is reciprocity: only the users who share information about themselves are allowed to receive information about other users. This way, lurking, where one user is able to closely monitor other users without having to discover herself, is not possible.

4 Conclusions

Multimodal interfaces have a great potential for improving the universal access to software in general and to groupware in particular. In the past most groupware systems offered only one single interface and style of interaction to all its users and users had to adapt to it in order to be able to get information, to communicate and to cooperate with each other. Today, with multimodal interfaces for groupware users are free to choose the interface they want and need and they can interact with other users, who have the same freedom of choice. In this paper we have presented various multimodal interfaces for capturing and presenting information in an awareness information environment. The benefits of multimodal interfaces for universal access should have become obvious for awareness information environments. Additionally, we think that multimodal interfaces can improve the universal access for many other types of software systems as well.

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