Exploring the Design and Use of Peripheral Displays of Awareness Information

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ABSTRACT

Peripheral displays allow users to monitor an information source while focusing on a separate primary task. In this paper, we present our work investigating what form peripheral displays of awareness information from instant messaging programs may take and the role these displays could have in existing communication practices. We describe several prototypes of tangible, aesthetic displays of awareness information. A focus group involving users of instant messaging software revealed that the awareness information component of the software (such as sounds or flashing windows) is often used to trigger communication through more heavyweight means such as telephone or face-to-face conversation.

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INTRODUCTION

Awareness has been defined as "the state of knowing about the environment in which you exist; about your surroundings, and the presence and activities of others" [10]. Various types of information from different sources can provide a sense of awareness. For example, looking up the Dow Jones Industrial Average can provide someone with an awareness of the nation's economy while glancing at the window can tell one the weather outside. Evidence showing that background awareness for both co-located and distributed groups can increase work productivity and efficiency [6] led researchers in the Computer Supported Cooperative Work (CSCW) community to build systems to support awareness among groups. Dourish and Bly's Portholes [3] project provides awareness for distributed group members through low framerate video. The importance of awareness of the presence and activities of others goes beyond team members of a project group. For example in a domestic environment, family members may want to be aware of each other's whereabouts and activities.

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While awareness information can take many forms, from numerical data to video streams to human observation, there are also various methods of obtaining awareness information. Within the domain of remote presence, one can become aware of the location or activity of another by calling him/her on the phone, sending/reading an email, or watching a video stream of the remote person's location. We classify these methods as "heavyweight" methods in that they usually require the user's full attention, making it difficult to fully concentrate on a separate task at the same time. In contrast, we describe "lightweight" methods of obtaining awareness information as methods that allow monitoring of information and the splitting of attention among one or more other tasks. Examples of these methods, such as glancing at a co-worker's desk, hearing someone's footsteps entering a room, or smelling a familiar cologne, often take advantage of one or more human senses.

The situation may arise where a person cannot directly observe and/or interpret evidence of presence or activity left by others. For example, suppose Bob is a project team member working at home. He would not be able to hear the shuffling of papers of another team member, Charlie, as he walks into his cubicle in the office. Research in providing technological support for abstracting data from a raw stream and presenting it to a user in a lightweight fashion has resulted in the creation of peripheral displays. In the previous example, Bob may have a peripheral display application running in the corner of his desktop at home. When a microphone on Charlie's desk picks up evidence of activity, the application would produce a flashing visual effect on Bob's desktop. As a lightweight method of obtaining and presenting awareness information, peripheral displays can be used to monitor an information source while allowing a user to continue work on a separate primary task. The work described in this paper focuses on the exploration of various forms of tangible peripheral displays of awareness information that operate "off the desktop" and are embedded in everyday physical objects in the user's environment.

The information source for our peripheral displays are instant messaging (IM) applications such as AOL Instant Messenger (AIM) and Yahoo! Messenger. These software programs allow exchanges of short text messages between

distributed users and have become increasingly popular among teenagers and employees in work environments [7]. Features contributing to the success of this technology are the ability to monitor the status of several online "buddies" on a "buddy list", have simultaneous IM conversations with several "buddies" at once, and quickly send messages from one user to another. Some IM applications also provide the user with awareness information. For example, when someone goes online or offline, a sound clip that is either generic or buddy-specific is played to notify the user. While scanning a buddy list, special icons can be placed next to a screenname to denote that the buddy is currently offline.

Despite the lightweight nature of IM software, there are still several constraints on its usability. First, the user must be in front of the computer or within close proximity to be able to receive awareness information from the software. Second, the sounds triggered by buddies going online/offline and upon receiving a message can be distracting to a user working on a separate task while at the computer. The designs of our tangible peripheral displays attempt to address these issues, allowing users to place the displays in any room of the house and by providing more subtle notification cues. We removed the text-messaging capability from the displays to focus solely on awareness and support a greater degree of peripherality. This decision raises several questions regarding the utility of awareness information from IM software. To answer these, we conducted a focus group with IM users to gather feedback on how awareness information from IM software is used, as well as our initial designs of peripheral displays of awareness information from IM software.

The following section discusses previous work in peripheral displays of awareness information. The next section describes the design and implementation of several tangible peripheral displays. The following section discusses feedback received from a focus group we conducted on how awareness information is obtained and interpreted from IM software. We conclude with a summary of our findings and a description of future work on a long-term deployment of these displays in users' homes.

RELATED WORK

Early research used video as an information source for providing awareness information to distributed users. The Media Space project provided collaborators with a live video view of office activity [1]. Later work explored modifications to the fidelity of the video link, as in the Portholes project which provided video snapshots [3]. The Peepholes project provides an even more abstract representation of remote activity in the form of line drawings [4]. An example of awareness devices which operate away from the desktop is the Lumitouch system [2], a tangible interactive peripheral display. When the user touches his/her picture frame, the touch is translated to light over an Internet connection to another picture frame. Another example is Super *Cilia* Skin [8], which translates tactile input into visual output on an array of individual actuators. There are two main distinctions between our work and the previously cited research. First, our displays are designed to leverage off the existing IM user pool, allowing our displays to interact with other commercial IM clients just as if it were an ordinary IM client. Thus, it is not necessary for both users to have a special display for an awareness information link to be established. Second, by having the displays communicate to the user through the familiar "IM status language" of online, offline, away, and idle, we can leverage off the user's previous experience with IM software, preventing the need for users to develop a specific interpersonal language for IM status.

Several other projects have also investigated extending the awareness capabilities of existing IM software. The ConNexus and Awarenex prototypes integrate awareness information, IM, and other communication channels such as email and phone in a single interface, with the Awarenex system providing this functionality on wireless handheld devices [9]. Hubbub is an IM system supporting awareness and opportunistic conversations through the use of earcons [5]. In contrast to these two systems that provide output primarily via traditional computer-generated audio and graphics, our displays focus on having an aesthetic effect by being embedded within physical objects that a user can place in his/her environment.

IMPLEMENTATION

Design of Displays

In this section we describe the design and implementation of several Physical IM Clients, tangible peripheral displays of awareness information. Each physical client is mapped to one or more screennames (or "buddies") on a buddy list. When the IM status of a buddy changes (*e.g.*, online to offline), the physical client notifies the user of this change through images, movement, sound, or a combination of the three. Impacting our designs were 3 design objectives:

Aesthetic appeal: As stated earlier, we aim to provide users with access to awareness information off the desktop so that the user is not restricted to being near a computer. As a result, we embedded our displays in physical objects so that they could be easily set up in various places around a home. In addition to portability within the home, we also aimed to have our displays blend into their environments and draw minimal attention to themselves while operating.

Ease of interpretation: Given the limited space of messages our physical clients can exhibit to the user, we aimed to take advantage of this by avoiding the need to formulate a complex "IM language" that the user would need to learn to be able to interpret the physical client's output. As a result, the various output modes were designed to be as intuitive as possible. This involved making use of icons from IM software and choosing mappings of IM status carefully.

Minimal distraction: A final goal was to minimize the distraction generated when status changes occur. This

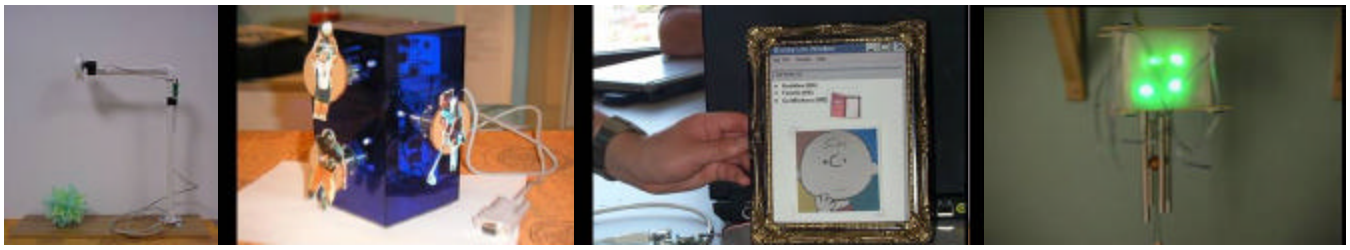

Figure 1: Images of physical clients. From left to right: Expanding Ball, Spinner, IMFrame, Chime

would allow the display to be easily monitored while focusing on a separate task.

With these design criteria in mind, we designed four physical clients (see Figure 1). Upon system startup, an open-source Jabber IM client running on a desktop machine logs on to a commercial AIM or Yahoo! IM server and checks for text and status messages from the mapped buddy. When a message is received, it is relayed to the physical client through a USB cable and/or a serial port. In future work, we intend to make this connection wireless to support improved mobility.

Expanding Ball: The Expanding Ball physical client displays the status of one's buddy by changing the size of a geodesic expanding plastic ball. When the buddy is offline, the ball is in the collapsed state. Upon evidence of activity, a string attached to the top of the ball is pulled by a servomotor, causing the ball to expand to various sizes, depending on the desired status. When a message arrives, the ball expands and contracts several times, creating a pulsating effect.

Spinner: The Spinner physical client is a sculpture that uses motion and light from LEDs to present the status of up to three buddies. The client is a dark blue transparent plastic box with three hobby motors protruding from its sides. Each screenname is represented by a spinning motor and an LED. An image of the respective buddy may be placed on each motor to make the mapping more explicit. The motors spin when the buddy goes online and the absence/presence of the LED light depicts the specific IM status of the buddy.

IMFrame: The IMFrame physical client is a picture frame that uses visual icons to present the status of a buddy. In the center of the frame is a slot for inserting a photo to make the mapping more explicit. The icon directly above the photo depicts the buddy's IM status. Leveraging off the user's possible prior experience with IM software, the icons are taken from existing commercial systems. For example, a closed door indicates the buddy is offline while an open one indicates online status. The icon is changed by a servomotor that rotates an icon wheel attached to the rear of the frame.

Chime: The Chime physical client conveys IM status through movements of a lantern wind chime and colors of LEDs within the lantern. Actuated by a Phidget servomotor, the wind chime rotates when a buddy goes online or sends a text message, producing a calm, soothing sound, notifying the user of a status change. The yellow, blue, and green LEDs within the chime indicate the buddy's status and produce a cycling effect when a text message is received. Upon startup the user can specify a time when the servomotor is disabled. This is intended to serve as an option for the user should he/she find the chime sound to be distracting (*e.g.*, when the user is sleeping).

EVALUATION

Overview and Setup

In addition to developing several prototypes of peripheral displays of awareness information, we also wanted to investigate the impacts of such technological support on existing communication practices. We conducted a focus group with the following objectives:

- To learn how people currently use the awareness information from IM software
- To generate ideas on how people would use (if at all) a tangible peripheral display that only presented awareness information
- To get feedback on our initial peripheral display prototypes

In two separate sessions we interacted with a total of 15 IM users. We started the focus group by getting the participants to agree on a definition of awareness. Once established, we discussed methods of obtaining awareness information and attempted to have the participants distinguish between heavyweight and lightweight methods. We felt that this was necessary to allow the participants to become comfortable with the concepts related to awareness in our discussion. Next, we asked each participant to describe his/her IM usage. Returning to the topic of awareness, we then discussed whether or not the participants made use of the awareness components of instant messaging software. Finally, we discussed our goals of isolating awareness information from IM software and embedding this in a tangible peripheral display. This led to a design review of three of the prototypes discussed in the previous section (Spinner, IMFrame, and Chime).

Results

Participants in both focus group sessions were able to agree on definitions of awareness, defining the state of being aware as knowing "what [others are] doing at the exact time" or "what's going on around you", as well as characteristics which distinguish lightweight methods from heavyweight ones. Participants also mentioned lightweight

methods in which they currently obtain awareness information such as telephone rings, vibrations from cellular phones, and the email arrival notification sounds.

Several users commented on ways in which they used IM applications for obtaining awareness information, particularly via notification sounds. For example, one user would log in and check if he was interested in chatting with someone on his buddy list. If not, he would leave the room and return when he heard that someone had logged in. Another user customized the sound clip played when certain buddies logged in. One user commented on how he turned off the sound and left the computer when he found the sounds distracting. While in the same room, he could monitor his desktop and watched for flashing windows to know when he had a new message. However, the generic notification sounds from IM software were seen as annoying by some users, who would prefer to have a sound that was less distracting. These remarks suggest that IM users are able to abstract awareness information from the software and find this information alone to be useful. In addition, it suggests that there are times when the software is distracting and users make adjustments to be able to monitor the software while focusing on another task.

Another conclusion that can be drawn is that awareness often serves as a cue for initiating conversation through a more heavyweight method. For example, one participant said that if it were late at night, she would see if a buddy was online before calling him/her. Another described how she left her office to call a buddy once she saw him online. She explained how IM and cell phone conversations were not permitted in her workplace so she kept her buddy list on to know when certain people became available. Several participants echoed frustrations with being unable to use IM due to the level of distraction it generates through sounds and flashing windows. These participants favored a method of getting IM awareness information in a more discreet form. We feel that peripheral displays that operate off the desktop and in the background of one's attention such as our designs would address this need.

Feedback regarding our initial designs was mixed. One participant said she would like to put an IMFrame in her house because she can simply remove the picture from one frame and place it in the IMFrame. Some participants felt that the Spinner physical client would stand out too much since it does not resemble an everyday object. Others commented on how they preferred displays that were already integrated into existing objects such as a cell phone, key chain, or wallet. Another participant said she would prefer the ringing of the Chime over the incoming message notification sound from AIM. Several participants mentioned that the design of the Chime stands out among the three designs as the only one capable of producing sound. This makes it possible to receive awareness information from a greater distance than the other designs.

CONCLUSIONS AND FUTURE WORK

In this paper, we reported our work in designing tangible, aesthetic, peripheral displays of instant messaging awareness information. A focus group conducted to discover the utility of such devices revealed that IM users do take advantage of the lightweight awareness information of IM and that this information often causes the user to initiate communication by more heavyweight means.

Future work on this project includes testing the hypothesis that awareness information serves as a cue that triggers communication via heavyweight means. We are preparing to revise our prototypes based on the feedback from our focus groups and to start a four-week deployment of the Chime and IMFrame to 10 participants. The participants will have the physical clients running in their homes during which we will gather data related to their ability to notice changes in IM status through popup surveys that will appear at random times on their desktop throughout the day. This survey will also ask the participant to self-report the number of conversations (via heavyweight means) he/she had with the mapped buddy. In addition to testing this hypothesis, we also hope to learn about the long-term effects of using these peripheral displays by comparing the feeling of connectedness the user feels toward his/her buddy before and after using the displays.

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