Proactive Displays & The Experience UbiComp Project

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ABSTRACT
The proliferation of sensing and display technologies creates opportunities for *proactive displays* that can sense and respond appropriately to the people and activities taking place in their vicinity. A conference provides an ideal context in which to explore the use of proactive displays, as attendees come together for the purpose of *mutual revelation*, eager both to learn more about others and what others are doing and to tell others about themselves and what they are doing. We will deploy a suite of proactive display applications that can aid and abet this desire for mutual revelation in the context of a paper presentation session, a demonstration and poster session, and informal break areas at the conference.

Keywords
Ubiquitous computing, proactive computing, human-computer interaction, computer-supported cooperative work, social computing, community computing, RFID, public displays, ambient displays.

INTRODUCTION
Computer displays are proliferating, as the technology advances and the costs decrease, showing up in an increasing variety of physical contexts, such as airports and train stations, retail stores and even billboards along the roads [Barrows, 2002]. At the same time, sensing technologies are also proliferating, from sophisticated multi-purpose sensors [Kahn, *et al.*, 1999, Gellersen, *et al.*, 2003] to rather simple radio frequency identification (RFID) tags and associated readers. We have begun to explore how these two trends may converge to create opportunities for *proactive displays* that can sense their context – nearby objects, people and/or activities – and respond with appropriate content.

Any proactive display application must address a number of research challenges:

- What *contexts* are most amenable to the successful deployment of a proactive display?
- What kinds of *content* are best suited to the context(s) in which the displays are situated?
- What levels of *interaction* are most appropriate to the content and context of use?

People are increasingly concerned about the privacy of their digital information, and their concerns are being magnified by the proliferation of sensing technologies [cf. Chai & Shim, 2003]. Thus, proactive display applications must represent a compelling value proposition in order to succeed, providing enough benefit to overcome concerns about the use of digital information in physical contexts beyond the desktop. We believe that a conference provides a setting in which such value propositions can be articulated and demonstrated

Conference attendees typically share the goal of *mutual revelation*: seeking to learn more about others and their work, as well as being open to opportunities to tell others about themselves and their own work. Attendees also routinely reveal some information about themselves – such as their names and the institutions with which they are affiliated – through conference registration forms before the conference and badges they wear at the conference. We seek to facilitate the process of mutual revelation using technology, while minimizing disruption or deviation from common practices of conference attendees.

The International Conference on Ubiquitous Computing is particularly well-suited for a deployment of proactive display applications, where attendees' familiarity with sensing technologies is likely to reduce the fear of the unknown, and increase their openness to participating in experiments with this kind of technology.

COMMON INFRASTRUCTURE
All of the applications we will deploy at UbiComp 2003 share a common infrastructure.

RFID Tags & Readers
Conference attendees will receive, as part of the registration packets they receive onsite, passive RFID tags that they can insert into their regular conference badges. Printed information about the information associated with the tag, the applications deployed at the conference, and the privacy policy regarding any information collected throughout the conference, will be included with the packets (and available via all online registration pages). Each proactive display installation will have at least one RFID tag reader associated with it, to allow it to sense the tags worn by the conference attendees nearby. Our current system utilizes

the Alien Technology 915 MHz readers and tags. We may make provision for the inclusion of other sensing technology and/or communication protocols, such as Bluetooth [cf. Want, *et al.*, 2002].

Application Clients & Servers

The RFID reader for each application will be connected to a local computer, which will run the application and access a server containing both profile information about the attendees as well as other sources of content that might be shown on the proactive display. The profiles will reside on a central server so that any updates made during the conference can be propagated immediately to the different client applications. Each application client will provide the capability for an administrator to stop the application, in case of unexpected and unwanted behavior.

Profile Creation & Maintenance

Conference attendees will be given the option to opt-in to any / all of the proactive display applications by creating profiles during the registration process. No information will be used in proactive display applications unless an attendee provides explicit consent to use that information. Attendees will be also be given the option of creating or modifying their profiles during the conference at a computer adjacent to the conference registration table, and at one or more kiosks in the Demonstration & Posters area of the conference.

PROACTIVE DISPLAY APPLICATIONS FOR UBICOMP

We plan to deploy three applications at the conference: *AutoSpeakerID*, which displays the picture, name and affiliation of a person asking a question at the microphone during a question & answer period following a paper or panel presentation; *Ticket2Talk*, which displays explicitly specified content (a "ticket to talk" [Sacks, 1992]) for any single person as he or she approaches a proactive display in the coffee break area; and *Neighborhood Window*, which displays a visualization of implicit or "discovered" content (from explicitly provided homepage information) for a group of people who are in the neighborhood of a proactive display in an informal, open area at the conference. These applications are described in more detail in the sections below.

AutoSpeakerID

After a paper presentation during UbiComp (and other conferences), people often approach a microphone stand in the audience to ask questions about the work described in the presentation. Everyone in the audience knows who the presenter is, but don't always know much about the person asking the question. A diligent session chair may remind the questioner to state his or her name & affiliation, but this is often not the case, and even when encouraged to identify themselves, questioners' names or affiliations may not be heard clearly by others in the audience (especially if the questioner is hurrying to get to his or her question).

Since conference attendees ought to be prepared to state their name and affiliations, verbally, anytime they rise to ask a question during a paper (or panel) presentation, we propose to augment this common practice by using a proactive display as a visual aid. An RFID reader at the microphone stand will identify the RFID tag worn by the person approaching the microphone, and communicate this to the AutoSpeakerID application which will, in turn, display a picture of the person, along with his or her name and affiliation, on a display near the front of the room.

Those who do not wish to have their profile information displayed when they approach a microphone stand can either opt out of participating at registration time or at any point during the conference using a kiosk in the registration area, or may simply either remove the RFID tag from their badge or leave their badge at their seat when they go to ask the question. They may also, of course, choose to "game" the system by wearing another person's tag.

We are, with this application and the others, very eager to learn whether, how and why people participate in the system.

Ticket2Talk

A paper / panel presentation session is a rather formal context in which to deploy a proactive display. We also have applications we plan to deploy in more informal contexts, such as a break area or a demo or poster session.

One such application is Ticket2Talk, which will run on a large plasma display – in a portrait mode orientation [cf. Churchill, *et al.*, 2003] – and cycle through visual content explicitly contributed by attendees that represent "tickets to talk": some visual marker for a topic about which the attendee would be happy to talk with someone. This may be a research poster the attendee is presenting at this, or another, conference, the cover of a recently published book, a picture of a favorite pet, vacation spot or piece of art.

The ticket to talk will be displayed in the central region of the screen, with a picture and name of the attendee who posted the ticket to talk appearing at the top, and a collection of thumbnail pictures & names of other people whose RFID tags have been detected near the display appearing in a row at the bottom. Each image will be selected for display based on a priority determined by both the recency of the attendee's badge being detected (higher priority for more recently sighted badges) and the recency of the attendee's ticket having been shown (higher priority for less recently displayed tickets). Images will be displayed for a preset interval, probably in the range of 5 to 10 seconds. There will also be a time limit on the duration for which a ticket might be in the queue of potential content to display: although we want to focus on content for those currently gathered nearby, we also might maintain a small amount of "history" about people who have passed by recently.

We will deploy this proactive display next to a table used for a coffee urn during a break. The serial nature of the movement of people through the line will correspond to the sequencing of tickets, providing each person who comes through the line – who has chosen to participate – an opportunity to both learn more about those nearby in the line and allow those same people to learn more about him or her.

The goal of this application (and Neighborhood Window) is to provide opportunities for conversation for attendees who do not already know each other. However, we also want to ensure *plausible ignoreability*, i.e., no one should feel compelled to strike up conversation with a fellow attendee who happens to be nearby. By cycling through content, one can simply notice the stream of tickets, without acting on any particular one. Even if the opportunity for direct conversation is not taken, we expect that the displays will contribute to raising the level of awareness about other attendees' interests – helping people learn things about their colleagues that they may later choose to act on (e.g., at a demonstration or poster session, or the conference reception).

Neighborhood Window

Another context in which we plan to explore the utility of proactive displays in a conference setting is the demonstration and poster session. Attendees often mill about such a session, forming ad-hoc groups as they cluster around a demonstration or poster of interest. The Neighborhood Window application will display a visualization of interests of those in its vicinity, based on the collection of words found on their respective homepages.

Although we could simply run the Ticket2Talk application on a display in the demonstration and poster session, we want to take advantage of this context to explore other dimensions of proactive display applications (and people's experience with them). Neighborhood Window utilizes *implicit* or latent profile information that can be attained through attendees' explicit profiles, and generates visualizations of this content based on the group that is nearby.

In addition to offering attendees the capability of providing their pictures, names, affiliations and/or tickets to talk, we also offer them the option of providing a link to their homepages in the registration process. An offline application then analyzes the content of their homepages, collecting words and phrases, and constructing a profile vector that can be used to select content that is likely to represent interests shared by those near the display, but not widely shared among the more general population.

For example, two UbiComp attendees approaching the urn may have references to "motes" or "ambient displays" on their homepages, and these phrases may be highlighted in the visualization that depicts people's names, associated words and phrases, and the links between them. Our goal is to provide opportunities for attendees to start topical conversations, or at least become more aware of the interests they share with others in the community.

EVALUATION

Our goal is to introduce technology to bridge the gap between people's digital profiles and their presence in the physical world to enhance the conference experience for all. We are assuming that the applications we have designed will have a positive impact, but we will be carefully assessing the experience at the conference, to see how these applications impact attendees' experience – and why.

We want to allow others to learn from our experience, so that the community as a whole may be able to better design future proactive display applications, and other types of applications that seek to enhance the experience of groups of people using information from digital profiles.

Our plan is to collect data using both qualitative and quantitative methods. Observations and on-site interviews will be conducted throughout the conference. This data will then be coded and evaluated for trends and themes in interaction. A follow-up questionnaire will also be conducted to gauge the impact of the proactive displays on the attendees' overall conference experience, and to identify areas for further research and development.

RELATED WORK

Previous work [Woodruff, *et al.*, 2001] has explored the use of technologies to encourage conversations among small groups during museum visits; we are seeking to broaden the context and scope of people who might engage in conversation, and to use situated, peripheral displays rather than handheld devices. Other researchers have explored the use of ambient displays [Mankoff, *et al.*, 2003; Weiser & Brown, 1997] and other forms of public displays [O'Hara, *et al.*, 2003]. We seek to extend this work through the use of sensing technologies (in this case, RFID) that enable to public displays to be more proactive – responding to the people nearby, as well as other elements of the local context.

GROUPCAST [McCarthy, *et al.*, 2001] is an earlier application that runs on a large display that responds to the people nearby. However, GROUPCAST ran in a corporate environment where all the passersby were members of the same company (indeed, most were members of the same research group within the organization), and had profiles for approximately 20 people. We seek to extend this work by deploying applications in a less restricted context, with a much larger number of people from multiple organizations.

There has also been some other, promising, research into the use of technology to enhance the conference experience for attendees. The Intellibadge system [Kindratenko, *et al.*, 2003] included a suite of visualization applications based on aggregate information collected through active radio frequency (RF) tags worn by approximately 20% of the

attendees of the SC 2002 conference. As an example, one application showed the distribution of interests among the people attending each parallel session (e.g., the number of compiler people vs. middleware people, etc.). Our work explores applications that directly react to the small number of people in the vicinity of the displays, rather than showing more general, aggregate data regarding the overall conference population.

nTAGs (http://www.ntag.com, see also Borovoy, *et al.*, [1998]) are devices that include infrared and radio frequency communication capabilities, as well as a small display and buttons for interaction. These devices have also been deployed at a conference, with a similar goal as our work (creating conversation opportunities and raising mutual awareness among the people attending the conference). We believe that the use of large, situated displays that react to RFID tags embedded in ordinary conference badges worn by attendees fits more closely into existing practices at conferences. Also, showing content that may spark conversations on a peripheral display leaves more room for plausible ignoreability – it is easier to glance at (and ignore) a display on the periphery than to ignore content shown on a display worn by a person in front of you – and thus will engender different types of interactions (and reactions) among the conference attendees.

Yet another approach to enhancing the conference experience is being explored by SpotMe Conference Navigator (http://www.spotme.ch), a handheld device that people can use to detect other devices used by attendees with similar interests. The profiles used by SpotMe contain many of the same elements as the profiles we have designed, but as with the nTags, we believe that using a handheld device is less proactive, and deviates further from existing conference practices, than the use of displays that may show content on the periphery of attention.

One of the reasons we are planning on extensive evaluations during and after the conference is to facilitate our ability to compare experiences with Proactive Displays with experiences with other technologies and approaches at other conferences.

CONCLUSION

We have designed a suite of proactive display applications intended to enhance the conference experience for attendees by providing conversation opportunities and fostering greater awareness among the community. UbiComp 2003, as a community that is exploring the use and implications of new display and sensing technologies, will provide an ideal venue in which to deploy these applications, assess their impact, and further the research agenda in this area.

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