Aware Community Portals:
Shared Information Appliances for Transitional Spaces

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Abstract

People wish to maintain a level of awareness of timely information and activity of others in a variety of social settings at different times of day. Access to situationally relevant information in the shared environment of the participants provides a means for better exchange, coordination and negotiated order in a community. One approach to enhance community awareness combines sensing of audio/visual context with filtering and display of relevant information in a shared workspace. The challenge is to develop means for lightweight interaction and communication using these 'shared information appliances'.

In this paper, we describe the design of an experimental project that explores such issues within a community environment at the MIT Media Lab. We are investigating peripheral interfaces that can be used in a casual manner in transitional spaces. Such methods can be designed in the context of casual workplace domains, distributed workgroups, and everyday public spaces.

Situated Interaction in Transitional Spaces

To understand the role of shared community appliances and interaction in a public context, we pose a number of questions that may suggest different design approaches. Many such issues are encountered in everyday community appliances which purposely draw attention in public spaces, such as information kiosks in train stations, or an electronic whiteboard in a meeting room. Such appliances tend to be situated in the heart of an area, surrounded by peripheral and transitional spaces, which are typically highly frequented but under-utilized. We are interested in exploring means for enabling brief encounters with contextually relevant information in such transitional spaces.

Why is information about context necessary within a community? One view is that information permits co-ordination and negotiation between community members, clarifying and democratizing their decisions. Another view is that it provides assurances about the social order and one's role in the community. It allows one to stay *in the loop*. Hence transparent public access to situationally relevant information about the community is a desirable goal. The Portholes project [Dourish92] provided distributed awareness via periodic images of others, helping maintain a sense of community. Piazza [Issacs96] supported spontaneous encounters based on shared tasks. We believe shared information in a community space may trigger richer interactions.

Whose needs in the community should the system address? A community is held together partially by spatial proximity, established social orders, and a set shared interests and goals. The question of who belongs in a community could be broadly defined to include its current physical inhabitants, as well as on-line individuals and visitors who may engage in it briefly. Hence shared displays must allow others a level of access, while preserving community standards for privacy and anonymity if desired.

When should a system in transitional space draw attention to itself? An information system that provides continuous alerts or requires active user engagement is distracting. Designing graceful shared systems that coexist with the environment, requires a means to detect when an appropriate interruption is meaningful, based on the context of its participants. [Sawhney 99]

How does interface and modality affect transitional use of space? Many systems tend to utilize high-bandwidth interaction or modalities in a manner that asserts their presence in the environment. We take the converse view that a system, which inhibits the original use of its environment, may have undesirable effects. Hence the presence of the system itself may draw undue attention or distract from the primary social activity of the environment. Lightweight interaction and ambient modalities allow greater cohesion with the environment. Use of human intuitions about social distance [Goffman63], as well as our kinesthetic senses, is underutilized in current systems. We propose using movement and proximity as a *peripheral interface.*

Let's now consider how these questions could be addressed in the design of a shared information appliance for a casual workplace environment such as the 'Garden'.

Social Setting: The Garden Community

The MIT Media Lab is an active research environment and a casual social space inhabited by a diverse group of students and faculty, and frequented by many visitors during the day. The lab has several open spaces for workgroups, and thrives on the interaction among and between such groups to maintain a fluid and social environment. We chose to utilize one such workspace and 'social collective', called the 'Garden' as the primary environment for our exploratory project. The Garden inhabitants are involved in responsive media and interaction research, hence are somewhat more receptive to using prototype HCI systems. The Garden workspace (see figure 1) was recently renovated to further open-up the space and install digital media infrastructure, including computer-controlled lighting, sound, video projections and some cameras (in focused areas). The space consists of clusters of workstations, a large HDTV display, a glass-walled conference room, offices, and an expanded hallway. The Garden hallway faces the entire space and is visible by most people there. This presents a good opportunity to utilize this transitional area for dynamic information display.

Figure 1: The Garden workspace with projected display in the hallway

An existing shared appliance called the Garden-Box, a digital audio jukebox developed at the lab, has been in use here for some time. The system plays MP3 music in the environment, selected via a web-based interface. Shared use of such an appliance requires implicit negotiation among participants regarding the type and volume of music played at different times of day. Continuous use and the kind of music played also serves to define the changing interests of the community and a subtle awareness of others in the space.

We attempted to leverage the infrastructure and negotiated social order within the Garden community to propose an on-going design of shared appliances for display of situated information and awareness patterns.

Aware Community Portals: Design Exploration

Design Themes

We set out to explore a number of key themes and issues for designing a shared media appliance that utilizes short-term awareness of visual activity and long-term community interests, Some of these themes were further developed in an early prototype.

Community-Filtered Information Glances

As a fundamental premise for a shared information appliance, it is necessary to ensure that the information shown is based on community interests. Hence a collaborative mechanism must be provided to allow users to select relevant external and internal data for periodic updates as well as timely display. The framework should be extensible to allow users to create and integrate new information services easily. Finally users should be able to view the status of such 'broadcasts' and add or remove them as needed. Examples of such services would include news, weather, traffic, but emphasis would be placed on group information such as scheduled events, internal messages and informal postings.

Figure 2: Transitional Interaction - a weather map triggered by the user walking by vs. a news article shown when the user lingers to browse. Notice a potential design element: shadows of prior viewers, cast on the article could be used to gauge community interest in current stories.

Casual and Transitional Interaction

Although selecting services would require greater involvement, the primary model of everyday usage of the portal assumes peripheral and transitional interaction. It is expected that participants maintain subtle awareness of information naturally placed in their environment and be able to engage with the system with minimal effort. Hence a range of unobtrusive presentation and interaction techniques are explored. One example suggests walking by the display and noticing that the meeting scheduled in the conference room has just been postponed. The interaction here is meant to be brief and situationally relevant. The user may then wish to see who's coming or glance at the recent weather or traffic report for possible delays, without much more effort and then simply walk away.

Temporal Awareness Patterns

People remain aware of the activity around them to maintain continuity and retain a sense of the temporal structure of their environment. By capturing the salient traces of activity over time and abstracting into a useful representation, a system can display the regularities and temporal rhythms in the space over time. For example, one may observe the general presence of people shown on a weekly or daily timeline; that allows one to infer the times when most people are around or whether a previously scheduled event was unattended or postponed. Facial glances or shadows of people looking at particular articles on the projected display can be retained to allow one to gauge people's interest in stories (see a simulated example in figure 2). Long-term patterns provide an understanding of the social order of the space and a means to potentially predict the occurrence of activity at specific times of day. Statistical learning of temporal patterns could allow the system to overlay a representation of future activity on a calendar, timeline or other novel temporal maps of community activities.

Exploratory Prototype

The current prototype consists of a projected video display driven by a graphics-rendering engine on an Alpha workstation, live information provided by servers, and active sensing from networked cameras in the environment. This early version serves as platform for design experiments.

Filtering and Display

A content transcoding server (written in Perl) monitors the system's Internet news sources for new information. *Slashdot.com*, a popular technology web-log, was chosen as one news source of potential interest, as many community members visit the site at least once a day. New content is pulled in as an HTML page, parsed, and relevant information is extracted from nodes in the parse tree. The system uses this information to create a graphic rendering for each news story, optimized for the low resolution and other display constraints of the projection system (see figure 2). This system will be extended to handle a variety of information services and a web-based interface will be provided. The portal display engine, written in ISIS [Agamanolis97] (a programming environment for responsive media), renders graphics and text as a video projection, and manages live information queued from servers. Currently the projection periodically shows information such as clock-time, hourly cartoon-strips, MP3 audio titles from music playing in the Garden-Box, and live data (news and weather) from the transcoding server.

Proximity and Movement as an Interface

To maintain a casual and natural interaction, user intent is inferred as they approach the projected display. A phased approach first displays an 'information glance' when new information arrives. When a person is seen *walking-by* the space, a series of images are shown cycling through, depicting the recent stories in memory. If the person stops to *glance* at the display, a preview of the current story (news headlines or weather map) is shown for a short duration. If the person then continues to glance, the system assumes she wishes to *browse* the article in more detail, hence a sequence of related information is shown (see figure 2). After a person leaves, the display gradually fades away. The timing and duration of *information glances* and previews have to be carefully devised and synchronized with movement to provide fluid presentation and interaction without being overtly distracting or prolonging beyond a user's interest.

Figure 3: Visual activity detected using image differencing and thresholding. A sequence of such images provides a trace-like representation that could be overlaid on information or abstracted to indicate overall activity patterns.

A networked video camera mounted on top of the portal provides live video via a server to different processes that analyze the video. A video window on the top-right corner of the display shows the view seen by the camera both as a means of providing interaction feedback and assuring people of the purpose of the camera. Movement is detected via image differencing and thresholding techniques in ISIS; these simple techniques operate in real-time (a temporal representation is shown in figure 3). A face-detection system monitors whether a person is looking at the display and triggers a close-up of the current article. When a person continues to maintain a glance (at the camera), the system shows more detail. A bounding box on the person's face indicates the system is tracking their face and indicates that it recognizes a glancing action (see figure 4).

Figure 4: Detecting a person glancing at an article and stepping closer to see more. By gazing at the camera for a longer duration, a person allows the system to capture his face.

Persistence and Awareness

The portal is designed to allow people to maintain persistence of usage over time and provides a form of awareness of the presence of others during the day. One mechanism is to capture people's faces as they browse articles they are interested in. While glancing at an article if people choose to look directly at the camera (to indicate their interest), a bounding-box on the person's face grows gradually (see figure 4) allowing an opportunity to step back if they don't want their face captured. Once captured their face is shown on a timeline in the left corner associated with the article seen (see figure 5). This provides both an awareness of others who have browsed the article (and been around in that physical space recently) as well as a sense of the general popularity of certain articles. It is important to note that the system currently does not recognize the person whose image is captured (maintaining their anonymity to the system), however in the future such recognition may enable personalization of news content or tracking of user's interests (if they choose to do so).

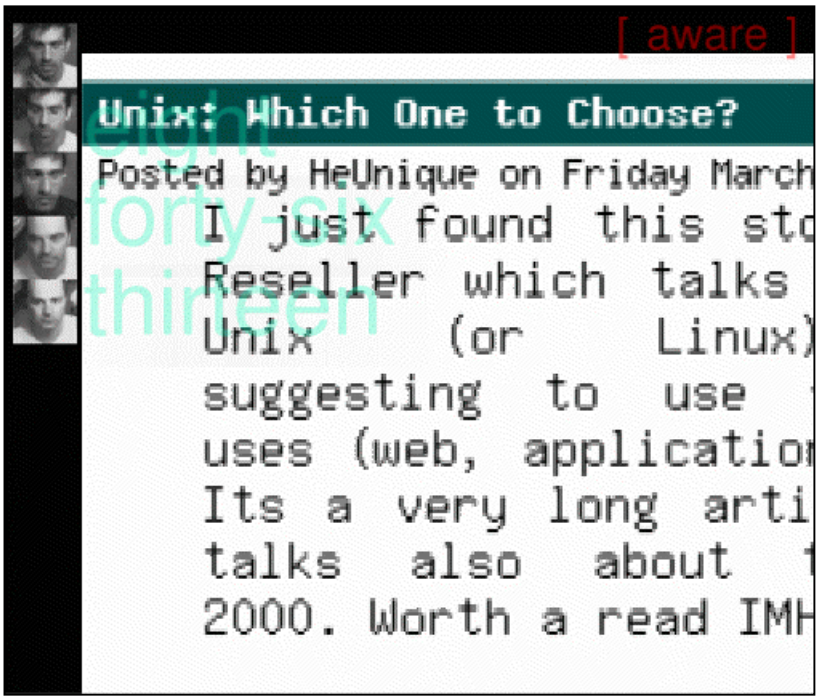

Figure 5: A timeline of faces shown on a portion of the large display indicates people's interests in certain articles and also provides an implicit sense of awareness of whose around during the day (most recent person seen at the bottom).

Hence with a simple sequence of *movement* and *proximity*, a range of responsive behavior can be provided along with an implicit form of awareness of others over time. Similar approaches are used in distributed virtual environments to automate communicative social behavior between virtual avatars [Cassell99]. Our view is that such social protocols can be used to provide situation dependent behavior between peripheral information 'actors' and humans in a physical space. Previously stored facial images are used in the Piazza system [Issacs96] to show other users browsing the same document on-line, whereas the portal provides awareness of people's interests and activities in a shared physical space over time. As the system has only recently been up and running, we have not conducted formal evaluations. Informal usage shows that people desire better cues (such as audio/visual or text-prompts) to enable them to understand the different modes of the interface and recognize the range of simple behaviors they can utilize to control the interaction. We hope to share our preliminary observations of the system's usage at the workshop.

Research Directions and Design Implications

Interaction with Mobile Devices

As people carry mobile devices like PDAs in their environment, they may be able to implicitly exchange information between the aware portals in these spaces. This may allow them to post personal messages easily or store updated information (news or changes in schedules) they recently glanced on the display. In this manner, humans act as carriers of contextually relevant information between spaces and communities.

Privacy vs. Awareness

By providing more personal information to a shared portal, one may get more relevant information from the system and allow known others to get better awareness, however there is also a greater potential intrusion of ones privacy [Hudson96]. We need to consider negotiated protocols and interfaces that *perceive* and retain the level of privacy one demands in different situations. Abstract representations of visual activity (such as shadow-views [Hudson96]) and our own experiments with garbled audio techniques point to several design approaches.

Transitional Speech

Although visual sensing provides a simple and unobtrusive form of peripheral interaction, it is not easily extensible for complex tasks. One solution is to provide speech-based interaction when the system detects that the user is engaged in more active use of the display. For example, once the user enters *browse* mode, speech recognition activates to listen for commands and the display provides hints regarding the phrases that can be spoken. Examples may include switching topics directly or requesting specific information. Once the user steps back, recognition could be turned off. We recognize that introducing a spoken modality makes the interaction more directed and less peripheral (especially in a public space), however it may provide rapid access to timely information especially for expert users in a rush. This retains the transitional nature of the interaction as we discussed earlier.

Situated Communication

Most communication devices assume binary and absolute modes for interaction. Telephones can disrupt recipients and require a time-limited conversation between parties rather than an on-going awareness. Video and audio-conferencing permit open connections between participants but typically require complete engagement or attention. Communication technology can now be used to create more graceful means for peripheral awareness and background conversation. The awareness portal may act as a link between distributed spaces, and the proximity of individuals in both spaces may trigger gradual awareness and communication.

Classifying and Representing Salient Activity

One must consider the granularity at which audio and visual events must be segmented and classified for meaningful abstraction of activity information. There are several techniques for establishing context from audio/visual scenes [Clarkson98] as well as extracting high-level activities from motion templates [Bobick97]. There should be an emphasis on modeling and representation of activity derived from both audio and visual features of everyday environments.

Design for Diverse Social Settings

We are currently exploring the use of aware information appliances in a casual workplace scenario. However in public environments such as hospitals, airports and train stations, there will be varying modes of interaction, privacy concerns and benefits of access to timely information or awareness of routines. Awareness provides subtle cues about people's availability, rhythms, and regularity of activity (or lack thereof) [Mynatt99]. One's expectations regarding the social and temporal structure of the environment, allows better coordination with others in a workgroup and enhances cognitive well being in a community. Awareness portals placed within elderly communities may provide cognitive support and enhanced mutual awareness within the community or with caretakers and loved ones.

Conclusions

Publicly available information is predominantly accessed through private information appliances. For information of broad community interest, however, it may be more appropriate to integrate the information within the very spaces we occupy [Dourish97]. Providing a platform for shared information access and awareness within a community is a valuable means to support coordination, negotiation and a sense of belonging.

The design of shared information appliances requires consideration of community-driven authoring of content, low-overhead interaction techniques and a framework that takes into account frequent but transitional usage by participants. We have demonstrated an exploratory prototype that provides community-filtered information based on peripheral interaction using visual proximity and motion.

A fluid and situationally sensitive interaction requires appropriate use of modality to the context of use, a protocol for synchronization of information 'actors' with human activity, and sensitivity to privacy norms in the group. Such systems must have an unobtrusive means for sensing user intention and activity patterns while representing timely information relevant to the community.

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