

Engineering Social Awareness in Work Environments

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Abstract. A growing interest is seen for designing intelligent environments that support personally meaningful, sociable and rich everyday experiences. In this paper we describe an intelligent, large screen display called *Panorama* that is aimed at supporting and enhancing social awareness within an academic work environment. *Panorama* is not intended to provide instrumental or other productivity related information. Rather, the goal of *Panorama* is to enhance social awareness by providing interpersonal and rich information related to co-workers and their everyday interactions in the department. A two-phase assessment of *Panorama* showed to promote curiosity and interest in exploring different activities in the environment.

1. Introduction

Ambient intelligence, ubiquitous and pervasive computing technologies have primarily focused on the productivity and efficiency side of work environments. We believe that these technologies could be used for designing smart environments that enhance social and interpersonal relationships amongst co-workers. The issue of supporting social connections between co-workers is especially important in big organizations, where, sometimes, social awareness is neglected in the tension of heavy workloads, time clashes, a lack of social encounters between employees, and a lack of suitable platforms for establishing connections [1]. There is a deficit in the current understandings of social awareness of non-work activities and how technologies can be designed to support these. In this paper we introduce a large, artistically inspired display called *Panorama*, for the staff room of our computer science department. *Panorama* supports asynchronous, mixed initiative interaction between co-workers focusing mainly on non-critical and non-work related information and activities. *Panorama* attempts to mediate information about co-workers in an engaging manner to enhance social awareness within the department.

Approaches for designing smart and intelligent environments within office and work settings keep users out of the ‘awareness loop’, i.e. technology generates (using sensing techniques) information about users and their environment and represents it in meaningful ways. In our approach, *Panorama* views co-workers as the integral and

active part of the environment and utilizes different intentional and unintentional social acts for generating awareness.

Panorama utilizes two main design concepts: Self-Reflections and Casual Encounters. Self-Reflections are explicit, user-initiated interactions that allow co-workers to contribute their personal and non-critical information to the ongoing activities of the overall environment. Casual Encounters are implicit, system initiated interactions, in which Panorama collects information about the ongoing activities within the department and offers resources of potential interest from the environment.

In the rest of the paper, we will first describe some background work on technologically supported social awareness and our own conceptualization of social awareness. Next, we introduce the Panorama system and the mechanisms it uses to support social awareness. In the end we discuss the validity of our approach through a two-phase assessment of Panorama.

2. Social Awareness & Intelligent Environments

The notion of ‘awareness’ can be seen as an important aspect of intelligent environments. In past research, awareness is applied in two ways: system-oriented and people-oriented [13].

In *system-oriented* awareness, smart artifact or environment takes technology-initiated decisions based on the historical information and data. The focus here is on objectively observable cues and information from the environment e.g. availability, presence or geographical positions. Secondly, the importance is given to the productivity side of work. In some recent examples, awareness is supported through indications of the presence of colleagues, physical positioning, information about their daily schedules and office calendars [e.g. 3, 10, 14].

In *people-oriented* awareness, the focus is user-centric, in the sense that the system intelligence is used in a way that empowers users to make mature and responsible decisions. In some recent examples of people-oriented awareness, technology is used to provide information about workloads by representing email transactions within an office building [11], to give indications about the mood of an office setting [13] and to give indications of different activities in an office [12].

To our observation, in the system-oriented awareness the user is kept out of the ‘awareness loop’. By awareness loop we mean a cycle of capturing, processing and representing the awareness information about a physical and *lived* environment. Placing our research in the line of people-oriented awareness, we believe that for enhancing social awareness, users should be seen as active contributors of awareness information. Within the social contexts social awareness is generated by different social acts of users and not solely by the technology. Technology should be used as an infrastructure to support social awareness between users.

2.1 Conceptualizing Social Awareness in Intelligent Systems

Social awareness is a very subtle aspect of our overall awareness, which can be accessed only ‘indirectly’ through a granular understanding of space, mediators,

human conduct and culture [1]. Social awareness can only be felt; it cannot be seen or measured in a precise manner. To be aware of somebody we need to feel his or her presence in a somewhat temporary and subtle way. Because, if their presence is too apparent then we tend to take them for granted. Social awareness can be seen as a conscious feeling of belonging, relatedness, and care prompted by the environment. This sort of conceptualization leads to a reflective approach, which suggests that an intelligent awareness technology should allow users to reflect on a three-way relationship of: “how I see myself”, “how I see others” and “how others see me” [7].

To design intelligent systems, we conceptualize social awareness as reflections that are supported by ‘cues’ and ‘traces’ of users’ actions in a specific environment. *A trace of human activity is recognized as ‘social’ when it allows someone to acquaint themselves with others without receiving explicitly expressed information about them* [1, p.6]. These cues and traces users leave over the environment make it compelling and emotionally valuable for a new person. When the next person chooses the same environment, he intentionally or unintentionally adds his own cues and traces over to the same environment that eventually would turn the physical settings into a social world. Sometimes, these vague and low-fidelity cues and traces might be valued more than bold and high fidelity cues for community building. [5]

3. Panorama: A Social Awareness System

We have designed an intelligent, asynchronous, large screen display called *Panorama* (Fig. 1). Panorama transforms explicit and implicit inputs from co-workers into an artistic representation to provide information about and an impression of the social environment in the department.

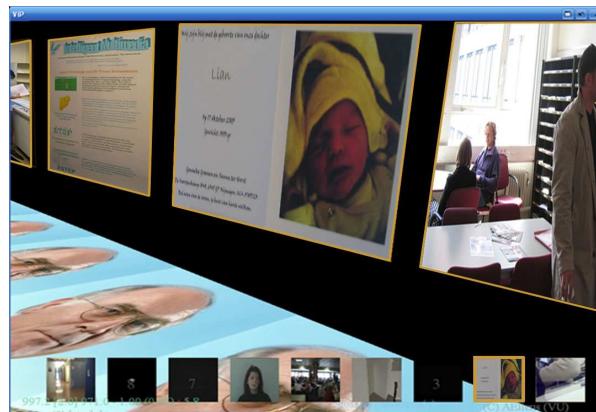


Fig. 1 Panorama representing an ‘Idle’ environment

Panorama is not intended to provide work-schedules, project details, or any other kind of work-related information. Its goal is to allow the co-workers to leave personal, ‘digitalized’ cues and traces onto the environment and help them construct social

awareness within the department. Our intention is to allow asynchronous communication of personal and environmental information in a meaningful way between co-workers by focusing on both: information and impression. The staff room in our department is a common place for many social activities. Most of these are closely related to the routine activities of staff members such as collecting posts, using fax machine, using coffee machine and microwave and having informal chats with co-workers. In addition, the staff room is also used for celebrating different social events like employees' birthday, approval for funding of a new project and so on. By placing Panorama in the staff room, we want the system to provide a starting point for social interaction among co-workers and to (re)kindle interest in exploring different activities in the environment.

Co-workers can electronically submit personal information to Panorama, such as personal announcements or news. Panorama uses motion and sound sensors (placed in the common area of the department) to gather implicit information from the department. It can, for example, adjust its representations based on different real-time activities detected by the sensors and captured still images or real-time video when a specific sensor is triggered. Panorama is an "intelligent" system in the sense that it transforms different types of information into an accordingly artistic and engaging representation, allowing co-workers to playfully manipulate this information (e.g. by waving in front of the camera or by submitting personalized images and messages).

In terms of presentation, Panorama shows a number of different 3D planes on which submitted or recorded images, videos and text are placed. It presents this information in a way that resembles a virtual gallery, i.e. images and videos moving along the wall and floor of the gallery in a continuous cycle. The movement indicates passing of time and it can be dynamically adjusted in speed and direction based on the sensor input. At the bottom of the screen, a number of square images provides streaming previews of the information that is in the system, providing an overview of the information. Panorama also supports scrolling text messages (e.g. news items, personal quotes) on the screen in the similar direction. Next to presenting explicit information, Panorama uses different visual effects such as particles, overlays, shaders and changing background color to implicitly mediate activity and mood in the department.

3.1 Design Methods

For designing Panorama, we wanted to understand the social dynamics of our department and co-workers' current and aspired practices of being aware of others. We used three complementary methods: Open-ended Observations, Contextual Inquiries and Cultural Probes [6]. The aim of using these ethnographic methods and tools was to get a thorough vision of co-workers' interaction dynamics, including spatial, temporal and socio-political issues within the department. As described in the previous section that social awareness can only be ephemerally observed through rich and personal experiences as conveyed by the users, we adapted our Cultural Probes methodology to focus on the social aspects of an academic department. This helped us going beyond the inspirational fascination of Cultural Probes and developing tangible design concepts.

3.2 “Shared” Initiative Interaction

Panorama supports an interaction model that allows shared control of interaction. By sharing the control between the environment and the co-workers, Panorama exploits explicit interaction (Fig. 2) – allowing co-workers to support their ‘self-reflections’ amongst each other; as well as, implicit interaction (Fig. 3) – utilizing the power of sensor-based proactive environment for expressing ‘casual encounters’.

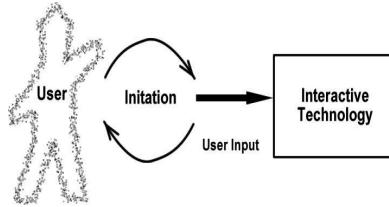


Fig. 2 Explicit Interaction: Conveying Self-Reflections to the co-workers through user inputs.

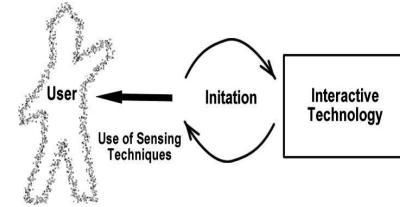


Fig. 3 Implicit Interaction: Use of sensing techniques to convey Casual Encounters amongst the co-workers.

Self Reflections. For addressing the issue of self reflection, explicit user initiated interaction is used. For co-workers this means that they can contribute towards the ongoing activities of the overall environment with their personal and non-critical information or data. The technology serves as a tool that allows co-workers to support their social needs, such as sharing non-work related news (announcing the birth of a new born child), personal achievements (e.g. best paper award), personal interests (e.g. favorite books, favorite conferences), etc. In this case, the technology does not necessarily be passively receiving feeds from users. It in fact filters and alters contents and represents content in a compelling manner.

Casual Encounters. The concept of casual encounters is realized when the technology proactively pushes information about the ongoing activities within the department. Casual encounters provide an added value to the departmental social environment, especially, when during heavy workloads and frequent time-clashes physical interaction between co-workers is not possible. The technology can serve as a mechanism by which co-workers can be socially aware of each other by knowing their presence, social events and relevant non-critical activities within the department. In this case, even though users receive information from the technology, they can actively comprehend the implications of their action (either alone or in groups) upon the technology.

3.3 Representation

By conceptualizing social awareness as reflections of cues and traces of different social acts, it was important for us to consider the *meaning* that we were embedding in Panorama. Our decision of creating a representation for Panorama was based on available resources and on a number of assumptions that we regarded as facilitating social awareness.

The self-reflections (such as objects of personal interests) are represented as a flow of images using particle systems. Since these are used to form a sense of belonging and recognition, these are presented without any form of modification of the actual content. To add an artistic flavor, different particle flows are used to focus viewers' attention. The objects of self-reflections are seen as clues and traces, when interpreted within the departmental context can aid to support social awareness.

The casual encounters are represented as still images or videos generated through sensor-triggered cameras in the staff and printer rooms. To emphasize the fact that casual encounters are important and not necessarily the people involved in them, Panorama uses different level of abstractions to emphasize the peripheral nature of social awareness. This also takes into account the privacy issues that may arise when monitoring people in real-time. The videos captured by Panorama are represented in abstract forms using shaders and particle overlay effects.

The overall mood and activity level in the department is captured using different movement and sound sensors. Inspired by [11], the overall activity level is represented using different visual effects and by adjusting the speed of the information flow. Panorama uses sensor-triggered, transparent particle effects that can be shown at any layer of the Panorama interface. Increased activity level, for example, could generate more particle effects, abstraction and a higher speed of representation. We chose particle effects for their aesthetic richness to stimulate curiosity and to decrease predictability that might evolve into boredom.

3.4 Two Levels of Communication

Panorama establishes two levels of communication amongst the co-workers. This results from our two-fold aim of combining specific *information* with overall *impression* to support social awareness within the department.

Panorama provides concrete building blocks of *information* by providing the precise information such as individual announcements, achievements and so on in the form of unaltered images, texts and video streams. This way, self-reflections are mediated as a direct representation of reality, establishing detailed communication of information through the system. The movement and placement of the representation in turn are used to focus co-workers' attention. Although abstracted in part using shader techniques and other visual effects due to privacy concerns and to stimulate curiosity, casual encounters are also examples of this type of explicit communication of information. Both mechanisms aid co-workers for extracting the information about social awareness directly from what they see on-screen.

On the other hand, Panorama provides an *impression* about the overall environment by representing different set of information in certain ways to indicate the activity level within the department. Panorama uses real-time sensor input to gather information regarding overall activity in the department and based on this Panorama changes its representation. As the activity level increases, the speed, overlays and abstractions of different moving objects also increase. This sort of indications of increased activity level is generated through different social acts of the co-workers. Interestingly, for co-workers Panorama provides an indirect way of controlling its representations. This way Panorama may influence co-workers'

working practices. For example, workers can adjust their ways of working after receiving indications about the overall activity level of the department.

4. Assessing Panorama

We mentioned earlier that social awareness is inherently subjective and subtle in nature and it cannot be measured in a precise manner. Methods for evaluating technological aspects of a system may be impractical or unsatisfactory when evaluating systems meant to support subjective and interpersonal aspects [15], such as understanding their social awareness. Previous research [8, 9] has shown that mixed-reality artistic interfaces can better be evaluated using a combination of argumentation ('art criticism') and informal conversation with users.

The challenge for us as designers was to understand to what extent the Panorama system helps co-workers of our department to make sense of the current environment and how this could lead to their desired experiences. We were interested knowing what kind of interpretations and meanings the co-workers construct about Panorama, their subjective understandings of Panorama, their theories of what it is and their metaphors for describing it.

To validate our understanding of social awareness, in the assessment we developed three configurations of Panorama representing three types of environments: idle, live and chaotic. These representations were created mainly to help us get a controlled view of co-workers' interpretations about Panorama.

In the three configurations we supported an increasing amount of information with an increasing number of presentation mechanisms (speed, color, visual effects). The *idle* configuration (Fig.1) provides a constant flow of information, without any extra layers or visual effects. This configuration is the basis for the next two configurations. The *live* configuration provides flashes of attention to self-reflections by moving these on a top layer, and adds particle effects and transparency to images depicting casual encounters. We regarded this configuration as the most useful combination for representing dynamics impressions and detailed information. Finally, the *chaotic* configuration provides increasing speed of movement, added multiple layers of moving objects on top of the *live* configuration, and increased amount and spread of abstract visual effects. We hypothesized that this configuration could be confusing for most users due to the relatively high visual density.

We organized our assessment in two sessions.

1. We installed a working prototype of Panorama in a laboratory setting and invited 8 participants – ranging from senior lectures, to support staff and from PhD researchers to students (see Fig. 4). Without providing any precise information about our assessment we confronted them with 3 different configurations of Panorama for an equal amount of time. During each configuration we asked participants to individually write down answers for questions related to their perceptions and understanding about Panorama, the difference between the 3 configurations and their perceived effects of having Panorama in the staff room. In the later part we asked them to discuss the suitability of Panorama in an

academic department. Through this we sought to understand the social construction of meanings amongst different participants.

2. Next, we installed Panorama in our staff room (Fig. 5). As Panorama is meant to be an active part of the environment in the department, we were interested knowing how Panorama would be welcomed in the staff room. We set up Panorama next to the coffee machine in the staff room and observed what happened. We actively switched between the three configurations so that people would notice and comment on these. In some cases, we questioned people on their thoughts and interpretations, mostly about the way in which the system would affect their life at the department.



Fig. 4 Session 1 of Panorama assessment
(in laboratory settings)



Fig. 5 Session 2 of Panorama assessment
(in the staff room)

Results: In session 1, participants provided some interesting perspectives on Panorama. It was clear to all participants what Panorama was about. Some described it as, “*it reflects the dynamics at our department*”, “*it demonstrates what's the department in a virtual way*”, “*a lazy way to get information about the department*”, and so on. The participants showed a preference for the “live” environment – the second configuration of Panorama. The “idle” configuration was perceived as too slow when thinking of the dynamics of the department. The “chaotic” configuration, being too dense in presentation left a very little traces and indications of the detailed information about the department but provided a nice impression of a hectic environment in the department. The images of self-reflections as floating overlay objects were appreciated for focusing participants’ attentions. The participants expressed their interest in recognizing people and objects. When an object or person was not recognized, the participants indicated that this would be a starting point for exploration and conversation.

In session 2 the staff members described Panorama as “nice” and “fun”. In this session, we did not explicitly invite anyone. Staff members came to the room to do their routine activities like checking the post, sending fax or having coffee. Panorama initiated curiosity amongst the onlookers. Some comments were made that sparked conversations based on the artifacts and people that were depicted in the system. Both in the still images and the real time videos, most staff members liked that fact that they could see themselves. This resulted in people waiting for their images to come up in the system and manipulating the video recording by for example waving their hands. Panorama performing in its proposed environment, workers who queued for the coffee machine (Fig. 5) glanced at the system and commented aloud on what they

saw. In many cases this resulted in them becoming part of 'the group' of onlookers. Curiosity was observed to be a starting point for interacting with the system, opening up ways to form a bond with the system that enabled the recognition of the information presented on Panorama. Importantly, regular activities in the staff room such as informal meetings with students were not interrupted by Panorama being present. Panorama also provided additional topics for informal talk without imposing or enforcing anything onto the people who were present.

In both sessions participants expressed the need for a higher level of direct interaction with the system, mostly thinking of the interface to be touch-screen. This could allow users to activate their channels of interest, thus filtering the available information. Interestingly, some participants asked if the system would be able to run on their desktops, supporting our proposals for a lightweight version of the system.

5. Discussion: Users in the 'Awareness Loop'

The notion of disappearance, seamlessness and intelligence coined by the ubiquitous computing [17] and ambient intelligence [4] paradigms has been fundamentally based on the technological assumptions of users' activity and intentions. This notion has been criticized for many reasons. First, it assumes the use of specific media and tools for users' seamless interaction with the environment. However, in reality our everyday encounters may involve interaction with many heterogeneous media and tools and we may use, adapt or interweave to support our activities [2]. Their technology-oriented conceptualization of context is very limited and sometime unachievable. Secondly, some of the scenarios of ambient intelligence [4] conceptualize users as 'passive receivers' of information. From the user experience perspective, users contribute as much to the interaction as the technology and the environment does [15]. And, thirdly, when technology becomes a part of our everyday used things like pillows, sofas, tables, etc., affordances of these things also change. Scenarios of ambient intelligence and ubiquitous computing assume that users will use these artifacts in their natural and traditional ways. However, as recently argued [16], affordances of an artifact emerge during the actual practice and use and they cannot be defined in a pre-deterministic ways.

Panorama uses the 'awareness' aspect to support meaningful and valuable experiences by enhancing non-work related social awareness. It extends the current application of intelligence and awareness from people's presence and activities to aspects of care, belonging and community building. Panorama acts as a tool for self-reflection and casual encounters between co-workers. In the two-phase assessment of our installation, we did not pretend to measure social awareness, as such. However, it was clear from the study that Panorama provided ways to encourage co-workers to explore different activities in the department and emphasize their presence by the active contribution of self-reflections. This confirmed our assumptions that community-level awareness can benefit more from the information related to people's values, culture and attitudes [5] then from functional and instrumental information.

6. Future Research

Taking into account the feedback gathered during the two assessment sessions, our future research for Panorama will focus on establishing better interaction mechanisms, dealing with the privacy issues and incorporating the three configurations. In order to provide direct and possibly playful interactions with Panorama we plan to incorporate touch-screen functionality. We are currently investigating the use of advanced shaders techniques to generate abstract and artful effects on real time images and video. This should further promote curiosity and at the same time deal with the privacy issues. The three experimental configurations of Panorama proved to be very useful, hinting on the future use of variable information density and indicating how lively it is at work.

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