Computation for the Corridor: Ubiquitous Computing Systems for Social Spaces

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Abstract. This position paper motivates the need for ubiquitous computing systems to act as social mediators within organizations, and proposes that such systems be situated in the various shared public spaces of the workplace. We present a set of design challenges towards making such systems a reality, and describe our early efforts towards these goals.

1 Introduction

It is often heard that conversations started "around the water cooler" lead to some of the most interesting and memorable social interactions at work. Indeed, as first shown by Whittaker et al [9], unplanned, face-to-face social interactions, such as all-familiar water cooler conversations, play several important roles within organizations. Such interactions have been found to foster the formation and strengthening of social connections, and to the casual exchange of information that spawns collaborations and enables effective coordination[1]. At the organizational level, these social interactions have also been found to facilitate the global dissemination of ideas and knowledge, and to foster a sense of workplace culture, collective identity and solidarity. [2]

While some of these interactions arise from workers explicitly seeking advice from, or to coordinate with, their colleagues, many of these interactions are purely coincidental, made possible by having nearby offices, sharing a corridor, or otherwise just seeing each other frequently. In particular, Kraut and Egido [4] found physical proximity between workers' offices to be a strong predictor of project collaborations within a large research organization, regardless of workers' organizational separation or similarity of research interests. They attributed their findings to the frequency of lightweight, high-quality face-to-face interactions researchers had with one another when they were located nearby. Other studies have demonstrated the difficulties that arise from a lack of such face-to-face encounters. In particular, collaborations across multi-site organizations or with external organizations have been found to be often much more taxing, error-prone, time-consuming and less rewarding than local interactions[1].

Despite the degree to which the physical layout and placement of workers in the workplace determines workers' social interactions, and consequently their professional lives, these aspects are among the factors in the workplace for which workers are most often given the least degree of control, and which change the least frequently. Large workplaces today are often layed out along organizational boundaries, with conference rooms, lounges and kitchenettes allocated to each "group". This means that workers in a given group generally tend to only meet a small number of people, usually whom they already know well, in these spaces.

Moreover, the static nature of workplace layout causes the possibility for an individual to meet someone new to decrease, the longer they remain at their particular location. This tends to result in social balkanization within organizations, characterized by a lack of awareness of the members of one's organization outside of one's immediate workgroup.

If the aforementioned public spaces that serve as the setting for most informal face-to-face interactions in the workplace today could also be made to connect others who were not physically nearby, they could play a much more effective role in preventing organizational balkanization. Our goal, thus, has been to apply ubiqutious computing technology to design systems for these spaces that broaden and diversify the face-to-face social interactions that take place therein, and to expand the capacity of these spaces to bring people together.

2 Designing for Social Spaces

We have categorized what we have identified as the major challenges for ubicomp social computing systems in three general categories: social, interaction, and integration. We summarize each of these areas briefly below:

Social - Ubicomp systems for social spaces should provide a means by which people can meet and socialize opportunistically, much as shared public spaces do. Secondly, these systems should support promoting users' lightweight awareness of each other across spaces, such as by supporting "drop-ins" or mutual inter-space eavesdropping[1]. In addition to real-time interaction facilities, such systems should raise the general awareness of others in the organization, which could be useful for providing background context for conversation. Such systems could also incorporate information about workers' areas of interests, expertise and knowledge needs (such as from an enterprise knowledge management tool) to proactively inspire interactions among people who could most benefit from a collaboration.

Interaction - The second set of challenges concern making such systems in these spaces usable and useful from an HCI-perspective. Unlike software for the desktop, these systems should support short, transient interactions (lasting on the order of seconds to minutes), to support the high-traffic nature of many of these public spaces. This requires the system to have minimal user start-up overhead, and easy navigability. To provide a positive user experience for interpersonal communications, these systems should convey high-bandwidth, rich experiences of remote spaces and users, to allow users to perceive remote social situations and remote users' body language. Important other considerations include allowing users to easily indicate when they do not wish to socialize or to interact with others, or to have their status be communicated.

In many situations, users will be in the space to perform some task (such as making coffee, sending faxes, etc.) and thus systems in these spaces should support peripheral engagement at-a-distance, while letting users perform their primary task(s). For example, a spoken-language interface may alleviate the need for users to use their hands to interact with a system installed in a tea kitchen.

Integration - Finally, a number of design problems surround the physical embodiment of ubicomp systems for public spaces to make systems fit seamlessly within each of the myriad types of public spaces in the workplace, while supporting the capabilities mentioned above. Additionally, such systems should integrate with existing organizational information infrastructure, in particular, with rele-

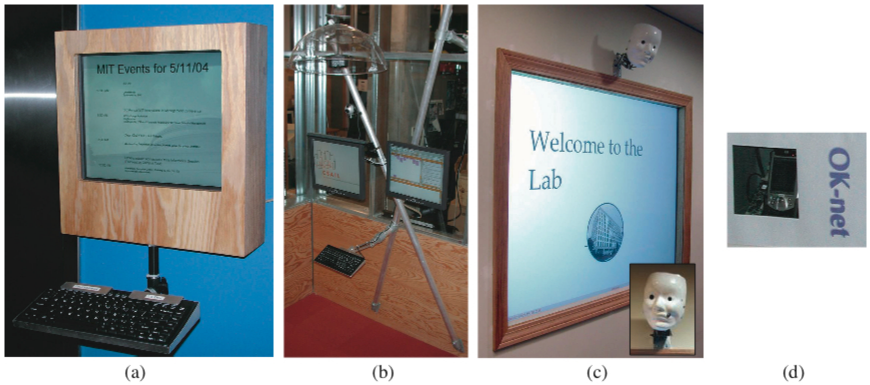

Fig. 1. Four OK-net prototypes (a) OK-net "G" prototype for elevator lobbies, (b) speech-capable "X" prototype (c) "K9" large display prototype with IGOR vision-based gestural mouse control robot, (d) "P" prototype embedded within a wall plate for interaction via mobile devices (exposed for demonstration)

vant communications and collaboration tools already in use within the organization.

3 Oxygen Kiosk network

We have started a project to explore potential solutions to many of the aforementioned challenges by designing and deploying a ubiquitous computing platform for public spaces at our laboratory. Since our intial prototype bore resemblance to information kiosks commonly seen in shopping malls, we chose the name *Oxygen Kiosk* network, or OK-net, after our ubiquitous computing initative, *Oxygen*. As described in the next section, we are also exploring various alternative form factors.

3.1 OK-net Prototypes

The various form factors for the OK-net kiosk fleet currently deployed at our laboratory are illustrated in Fig. 1. While each of the prototypes currently offer users the same services, the means of user interaction differs among them. The G and X prototypes are equipped with touchscreen displays and keyboards for data input; the X prototype additionally supports speech-based multimodal interaction[5] using the Galaxy[7] system. K9 features a 4-by-3-foot rear-projection display and supports gestural interaction at a distance through vision, using a camera embedded in a robotic head[6]. The P prototype, shown in on the right running on an HP iPaq handheld computer, is intended to be embedded within wiring conduits in the hallways of our building and to remain invisible to the user. Users interact with the P kiosks through users' own mobile handhelds, via messages exchanged over the popular short-range wireless communications protocol Bluetooth.

3.2 Applications

OK-net kiosks thus far deployed are running a suite of simple services [8] that offer basic information to lab members about lab current and special events, the directory, and map. Additionally, the system runs a rule-based screen saver called *k:info* [3], that opportunistically selects items for display using sets of heuristics. One set of heuristics bias content selection to more physically distant lab events and members' profiles in an attempt to raise local viewers' awareness of these remote happenings. Additionally, we have experimented with having k:info try to spark local conversations by choosing content that matches the intersection of all nearby users' interest profiles.

We are currently working on a new interface for OK-net which will combine textual information elements with a media-space, that will provide live audio-visual glimpses at users looking at the various items on display. Users will then be able to subsequently initiate conversations with people looking at particular items if they choose. Additionally, we are in the process of incorporating *Awaireness*, our ubicomp based awareness tool, to provide users with information about lab members' current whereabouts.

4 Summary

Although we are far from achieving all of the design goals described above, we have begun exploring various roles that ubiquitous computing technology can play in bringing people together through the the social spaces of the workplace. We hope that our experiments within our own laboratory will yield visible results over the next few years[1].

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