Interactive Semi-Public Displays to Support Local Mobility in Working Environments

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ABSTRACT
This paper proposes semi-public displays as a universal way for publicizing internal information and collaborative working in an office environment without loosing other traditional means. In particular, the semi-public displays will be able to display community oriented information as well as private information in a personalized way. Moreover, these semipublic boards will be provided with communication and interaction features for enabling people to perform remote collaboration among colleagues (as a shared working space) through heterogeneous devices (PDAs, desktops and other public displays) in a user-centered, natural interaction approach.

Keywords
Mobile computing, working environments, heterogeneous devices, public displays.

INTRODUCTION
In future working environments, the amount of information and its management will be increasingly huge. In this context, a key issue for future (and current) organizations is the efficient management of information and its opportunistic communication to the right people at the right moment. Today, internal communication, public or private, is delivered in organizations by different means (email, whiteboards, intranet, messaging, paper, etc). The fact that information is delivered to people from such different sources (see figure 1), in most of the cases leads to communication losses (since people have to consult several types of information sources to be actually informed).

The type of interactions expected in such kind of environments should be focused on the understanding of the real intentions of the users when pursuing their goals rather than in the physical characteristics and affordances

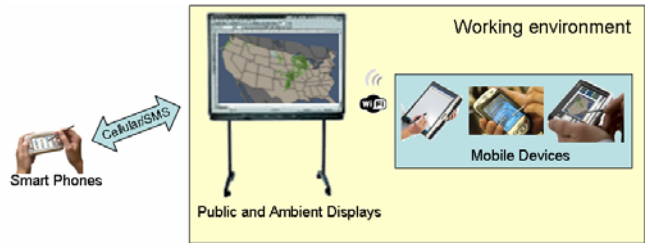

Figure 1. Heterogeneous Devices in Working Environments.

of the currently available devices and services (see figure 2), due to the applications receive input events from devices, services and users; present their state using different types of devices (e.g., smart phones, tablet PC, PDAs, etc.); and adapt to changes in the environment.

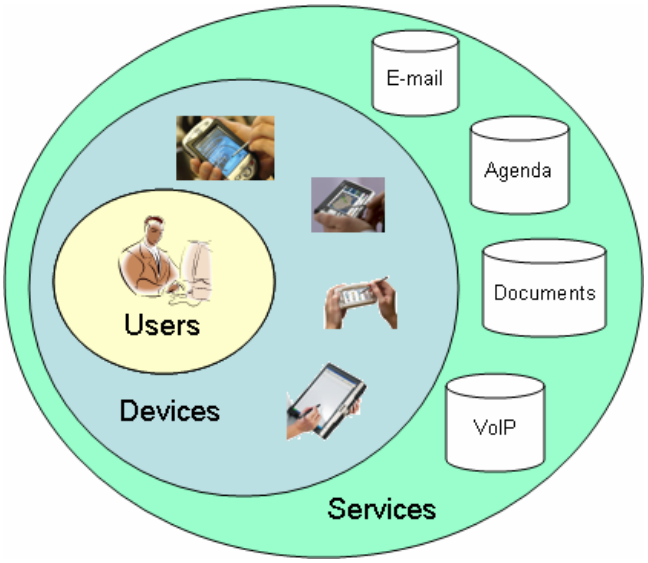

Figure 2. User Interaction among Heterogeneous Devices and Services.

In this sense, any research activity should position the user in the center of the action while maintaining the technology in the background [1]. The kind of interactions that people execute in such environments comprise most of their basic activities such as communicating, working, learning, entertaining and socializing among others. All these activities are usually carried out by different individuals following specific behavioral routines and tasks.

These activities conditions where people move between buildings or offices in a local environment correspond to what has been referred to as local mobility [2]. Local mobility occupies the intermediate space between collaborating together over distance on the one hand and collaborating face-to-face in a office or a control room on the other [3].

Case study analysis have proved their efficiency to explore in more detail communication artifacts of common use and better understand their current uses, thus understanding the main useful characteristics and limitations and enabling us to envision innovative uses of interactive technology devices [4].

In this paper we propose to create an AmI environment in a working scenario, putting an especial interest on the needs of technological support for local mobility. Local mobility poses new challenges for the design of computer support for mobility, and especially for user interaction [5]. The proposed scenario will be then validated (as future work) following the method described in the methodology section.

MOBILE COLLABORATION IN WORKING ENVIRONMENTS

In offices informal interactions are the most important instrument for communication and coordination between staff members.

Several ways of communication are implicated: personal, post-its, magnets, etc. However, they do not always make the best use of their location.

From that emerges the proposal of using large and ambient displays as communication artifacts. This displays system consist of inserting them in essential locations so that they can be accessed by the staff members. We will center on the affordances for coordination and collaboration that such displays system may involve.

The main potentialities of these kinds of tools consist in their ability for increasing the communication capabilities and thus, improving the social interactions of a specific community, in this scenario: the social network.

For supporting this idea, various innovative technologies will be integrated together in order to provide a natural, easy-of-use, and useful system. The underlying technologies that will support interaction and remote collaboration will include direct manipulation features, videoconference, remote shared working spaces and use of portable devices for enriching the interaction experience on a local mobility environment.

We need to build a robust platform in order to achieve the goal of support local mobility in a rich environment (see Figure 2) like a smart office.

SAMPLE SCENARIO

The creation of scenarios enabled us to generate and communicate design ideas for our system and to better understand the implications of particular design solutions [6].

Next, we present a use scenario in which we envision by means of literature analysis how the support of local mobility in offices may help with the interactions between personnel with their environment in a natural way.

The staff members discuss in the meeting room the next project. To this meeting they could bring information they want to discuss (reports, results, presentations, etc) on their PDA. If they find it appropriate, they will be able to seamlessly display this information on the public screen. However, instead of controlling the slide sequence using a keyboard, the presenter uses his PDA on which the current slide is displayed. In addition to that, all the members of the audience can have an instance of the current slide on their PDA, with the ability to point at things on the actual presentation. After the meeting, participants will be able to take the information that has gone public onto their device if it is relevant for them.

METHODOLOGY

In order to provide adequate support for this scenario we have to understand, from the perspective of those experiencing this situation, what are the challenges and circumstances around the office work. Consequently, for the design of our solution we propose to adopt an empirical approach and based it on a combination of interviews and in situ evaluations. The experience designing this system will give us not just a set of well-grounded requirements but, more important, a good understanding of the phenomenon experienced by those office workers. For this reason we have selected the methodology proposed by [7] and extended by [8] illustrated on Figure 3 and briefly described next.

Initial understanding

The inquiry to derive the design of the system must be oriented towards understanding the needs of the office workers.

We wish to gain knowledge about their experiences in regards to the following main aspects: work fragmentation, communication with colleagues, exchanged artifacts between colleagues, task monitoring, and work mobility.

We plan to elaborate several scenarios of use to illustrate the systems functionality and conduct interviews to inform the scenarios and to envision a preliminary design of the system.

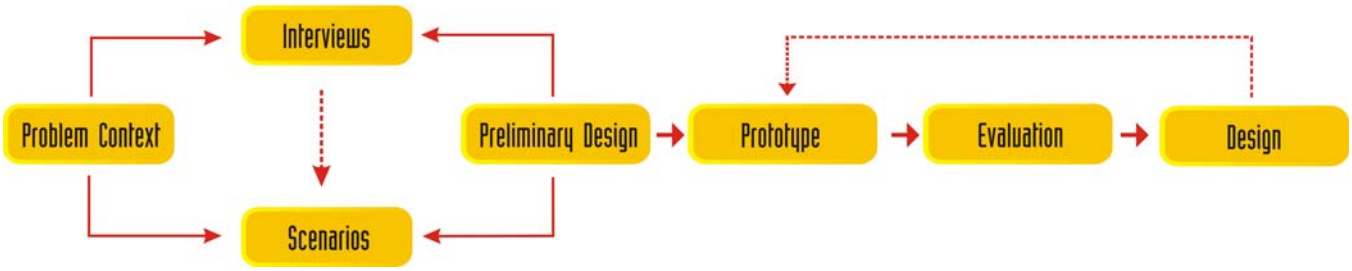

Figure 3. Design methodology for the technological solution.

Preliminary design

Using the literature review and scenarios of use, we design a software architecture for the development of the system.

Prototype

In order to evaluate the design, we will build a prototype of the solution that would be evaluated by potential users.

Results of the prototype evaluation will enable us to improve the design and consolidate a final and more complete solution.

Evaluation

We propose to evaluate a functional prototype by offices workers to gain feedback from all perspectives. For the evaluation we have selected the methodology proposed by [4], because the potential advantages of ubiquitous technologies cannot always be perceived until the users are situated within a new context of interaction. The goal of the evaluation would be to explore the feasibility of the solution as well as its appropriateness for the context of an office. We will expect that participants, while evaluating the prototype, will raise more specific issues that would serve to refine the solution and, in general, the understanding of the challenges they face in their works.

Final design

Based on an analysis of the data collected during the evaluation we will identify results both with respect to the system and with respect to being workers that uses heterogeneous devices to work every day. Finally, we plan to redesign and develop the final system using the data collected on the evaluation.

PRELIMINARY DESING AND ARCHITECTURE

Previous work [9] has identified the following aspects as relevant ones to be addressed by context-aware interactive public displays:

- User's Location and Authentication.
- Content Adaptation and Personalization Based on Contextual Information.
- Information Transfer between Heterogeneous Devices.
- Opportunistic Access to Relevant Information.

To allow a seamless interaction between the user and the environment we need: a seamless file transfer between devices to support information exchange with the participants, the ability for collaboration among the staff members that can be done with the creation of a meeting environment with different user policies, this interactions can be enhanced with a screen sharing capability between several devices.

The first milestone of the project was to control a display from different devices; we have started deploying an application for PDAs.

There are a number of technical and design challenges that have to be overcome to be able to run this application among heterogeneous devices.

As illustrated in Figure 4, in order to overcome these challenges we are proposing a multi-layer environment, this enabled us to implement a scalable and loosely-coupled environment in which by means of components we can add new functionality to the system (e.g., new services), integrate new devices (e.g., internet tablets) and other people with whom the staff may want to be connected, such as collaborators or friends.

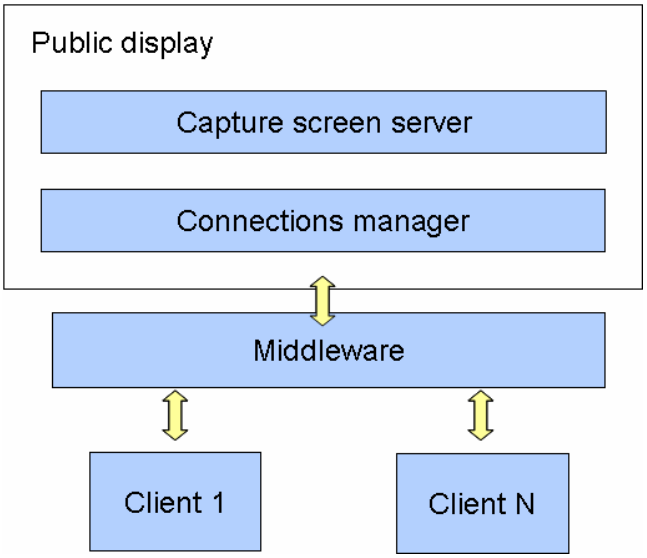

Figure 4. Environment architecture.

The Public Display.- allows the display of the public screen on a handheld device, and being able to remotely share the control of the device with other users.

The Middleware.- is a core layer of the architecture, being the enabling infrastructure that supports the interoperability between components and services defined in the upper layers. It allows services to understand which is the context where they operate and which components and services they can access to. The Middleware allows inserting new services and devices in the system, and removing unused or obsolete ones in an efficient way, defining in such a way the context where the system operates [10, 11].

Communication is a fundamental feature covered by the Middleware, allowing the different modules that compound the working environment to communicate each other and with the outside world through external links, such as Internet. Besides, the middleware will be general enough to support different kind of events in both, fixed and mobile platforms in indoor, outdoor and in the transition to one environment to the other. This will be achieved by means of an infrastructure based on adaptive services with context provisioning that will serves as input information into the adaptive decision algorithms [11].

Since issues such as security and privacy involve the system as a whole, they are managed at this level, both providing it as a service to the upper layers and as an asset for guaranteeing the safety of the system itself.

CONCLUSIONS AND FUTURE WORK

This ongoing research considers that in order to achieve the proposed goal it is very important and necessary to conduct empirical studies in order to identify real use scenarios, involving context aware ubiquitous computing in working environments. The approach will focus on how heterogeneous devices (sensors and mobile computers) can be used as support for local mobility in the office where context awareness influences directly on the personnel. Validation of the system will be carried out by conducting a long-term trial evaluation of the system with a company for a period of one or two months. The system will be deployed at offices and access will be granted to their employees. We expect that those trials will provide additional information to refine our design and will let us to explore some features that could not be understood with our initial understanding.

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