Interaction with multiple devices in hospitals

Thomas Riisgaard Hansen
Center for Pervasive Healthcare
Department of Computer Science, University of Aarhus
Aabogade 34, DK8200
Aarhus N, Denmark
thomasr@daimi.au.dk

ABSTRACT

In this workshop paper I will present three projects we have been working on in which we address how to interact with pervasive computers in a hospital setting. I will for each project give a brief overview and shortly discuss some of the interaction issues we have worked with concerning multi-device interaction. Finally I will conclude by relating these findings to the overall theme of the workshop: seamful or seamless interaction

INTRODUCTION

Starting from the real world

One of the main reasons for having more than one computer or device is that a single device is not always able to provide a good fit to all possible tasks. Even though a PC is able to support a wide variety of tasks it clearly also has its limitation e.g. when it comes to collaboration, mobility or when the user is working with something physical and the digital world is not the primary focus.

To support collaboration new devices are introduced that either provides each user with a separate display, or large displays and shared surfaces that allows several user to interact with shared material or a combination. To support mobility a lot of devices already exists e.g. mobile phones and PDAs.

However, how to computer support people that actually primarily work with physical material is still an open and active research question. E.g. how do you computer support the work done by emergency works, firefighters, soldiers, landscape architects, biologists, artists and surgeons? In these peoples daily work they have to deal with the physical world, something that can't be put into a computer, but where a device or computer specialized to the task can play an important supporting role.

To drive the research in multiple device interaction forward it is important to find good scenarios that can provide real world goal and justification for the development of the technology. One way of coming up with scenarios is to brainstorm e.g. on what a smart system for dragging digital material back and forth between devices could be used for. This approach normally leads to scenarios know from the inventor's everyday, a typical scenario that comes out of this approach is how to use multiple devices in meetings or conferences.

Another approach, which I will advocate in this paper, is to look for work practices where one device is not sufficient, but where there is a clear need for multiple devices. To look for work practices that involves mobility, collaboration and/or working with/in the physical world.

One device is not enough in hospitals

We have for some years been working on developing information technology within hospitals. In a hospital we have highly mobile workers that have to collaborate. With the introduction of the electronic patient record in the majority of hospitals in Denmark a virtual space has been added to the physical space, in which medical work previously took place. Finding technical solutions that supports both the work done in the physical and the digital world is not trivial.

A small portable device that supports mobility well has limited interaction possibilities when the doctor or nurse have to work with large patient records whereas stationary PCs with large displays requires the nurse or doctor to move to these terminal to access the digital information. Using stationary computers creates a gap both spatial and temporal between the work done in the physical world and the work done in the digital world. And even though there exist a lot of other devices many of them has similar problems.

Another interesting situation within hospitals is how to access digital information during surgeries. During a surgery the main surgeon is limited from doing any form of interaction with digital systems. S/he has to remain next to the patient, her/his hands are normally in use and s/he has to remain sterile. At the same time the operating theatre is a highly collaborative place with normally 4-8 people present. Again a standard computer might not provide the best solution.

In the following I will briefly describe three projects we have been working on. In the projects we have tried to address some of the interaction issues mentioned above. However, in this paper I will focus on some of the issues we have encountered in medical work relating to interaction among multiple devices.

PROJECT 1: ACTIVE THEATRE

Brief overview

The main challenge we are addressing in the ActiveTheatre project is to look at what kind of digital material that might be relevant to access during an operation in the operating theatre and how this can be done with the restriction on the interaction mentioned above. In the project we have been collaborating closely with doctors and nurses from a local hospital. A goal from the beginning has been to not just support access of digital material by the surgeon operating, but also the possibility to create digital material while operating.

Figure 1: Evaluation of the ActiveTheatre Project

Based on several workshops we have developed a prototype where we use different new interaction techniques e.g. speech input and zoomable interfaces. Figure 1 is from the evaluation of this prototype. Some of our findings are described in details in [1].

Issues, multiple devices

Multiple users

Because the operating theatre is a highly collaborative environment we have at several occasions discussed how best to support this multi-user scenario. Should each surgeon, nurse and anesthetic be provided with a personal display, should we supply a shared display or should it be a combination?

We have e.g. discussed if it would be beneficial to let the surgeon have a head mounted display, but the problem with this approach is that the display is private and not shared by others. We have also discussed the scenario where each participant has its own display and is able to push information to a common display. One of the problems with a shared display is that the participants are centered on the patient and some of them will be facing away from a public display. Figure 2 shows a typical setup during an operation. We have still not been able to find a perfect solution, but we are exploring different possibilities.

Figure 2: This figure is from an operating theatre and shows the setup and the collaboration taking place

Moving out of the operating theatre

After an operation the surgeons and nurses sometimes need to check up on something relating to the operation or they have to finish the entry in the journal on a computer in another location. Moving the session from the operating theatre to another location is another area where we have discussed multiple devices. Current practice is e.g. to take a sticker with the persons cpr-number (social security number) and bring that with you from the operation theatre to the next location, where the cpr-number is typed into a computer and used to find the same data again.

In the ActiveTheatre project we have worked with the idea of a palette metaphor where some of the data gathered and used in the operating theatre can be carried with you as a palette.

PROJECT 2: AWARE PHONE

Introduction

The question we wanted to address in the AWARE project was how to reduce the number of unwanted interruptions that we observed arose when distributed co-workers had to collaborate. The project was again based on extensive field work and a set of workshops with doctors and nurses. A scenario in the AWARE project was e.g. that a young and less experienced doctor would treat a patient and wanted to consult a more experienced doctor about the case. However, the young doctor had no knowledge about which of the more experienced doctor were nearby or least busy.

In the first iteration of the project we augmented the mobile phone carried around by must doctors with an intelligent phone book where we printed information about the different doctors' and nurses' personal status, location and activity based on calendar/booking information. Figure 3 is a picture of the prototype.

Figure 3: The AWARE phone prototype

In the second iteration we extended the system to a more generalized architecture that supported multiple clients and available clues. The project is described in [2].

Issues, multiple devices

Awareness information on public displays

The information about other peoples activity could be access from different devices since the system was based on a centralized server solution and was in that sense a multi-device system. However, a more interesting research question we found was how to deal with awareness information on public displays.

Each participant had its own list of people or resources this person would like to be aware about. The scenario we worked with was what happened in the situation with a shared display in the operating theatre. The surgeons were no longer able to access their awareness list on the phone, but there were still a need for monitoring the awareness list during an operating. Should the awareness list on the public device be a merge of all the participants' lists or should there be some contacts that were public and some contacts that were private? We are still working on this question about how to merge personal information when moving to a shared display.

PROJECT 3: MIXED INTERACTION SPACES (MIXIS)

Introduction

The aim of the last project is to address the limited interaction possibilities on mobile devices. Even though this project is inspired by the problem about how doctors and nurses are able to access complex data on mobile devices the scope of the project is broader and many of its ideas have been explored outside the hospital context.

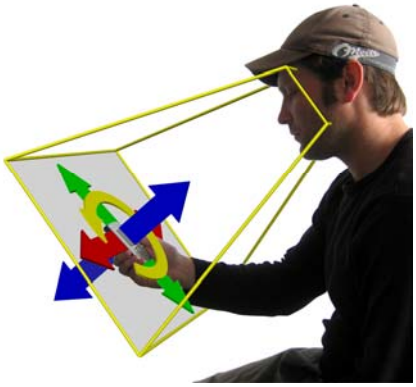

Figure 4: The Mixed Interaction Space with face tracking

The idea behind the project is to used the camera most mobile devices have embedded to track the location and rotation of the mobile device in relation to a fixed-point. We have used different algorithms that are able to track the device based on its distance and rotation from a printed or hand drawn circle or the device's position relative to a users face. From this tracking system we get a 4 D vector about the devices position relative to the fixed-point. We have used this vector as input in a set of different applications. Figure 4 shows the interaction space. Because we are only able to track the device's position when the camera is able to see the person's face the interaction space has the shape of a pyramid.

Figure 5: Mixis used to drag, rotate and zoom picture on a large wall display

We have developed a set of applications on the mobile device e.g. the ImageZoomViewer application where the user can pan and zoom on a subway map or on a x-ray picture by moving the mobile device in the interaction space. Another application is Drozo we use to drag, scale and rotate an image on a large wall display with the mobile device (figure 5), or the Multi-Cursor application where

multiple mobile devices is used to control multiple cursors on a shared display. Our findings are described in [3, 4, 5].

Issues relating to multiple devices

The Car Radio Metaphor

One interesting use scenario of Mixis is what we have called the car radio metaphor. The idea is that to manipulate a device in your environment you move close to the device and use the mobile device as the input panel. If you e.g. want to change the picture in an interactive picture frame you move your mobile device close to the picture frame and use the mobile device to select the picture. It works the same way as the car radios where you can remove the front panel to prevent theft. You carry around the front panel (the mobile device) in your pocket and plug it into (or connect it to) any device you want to manipulate. That way you have your own personal interface with you everywhere.

Another example of this is our multi-user version of Mixis. With the application BlueMix a mobile phone can be connected to a shared display and used as a mouse by moving the phone in the interaction space. Another user can add another mouse pointer by connecting his or her phone to the system etc.

SEAMFUL AND SEAMLESS

Based on the projects presented would seamful or seamless best describe the interaction? I do not think the question can be answered in one dimension.

Common ground dimension

From one perspective it is important to have seamless interaction that allows the user to operate on multiple devices without having to learn different applications for each device or having to configure synchronization and communication protocol when moving data or sessions between devices. Some successful application e.g. the Apple iPod partly succeed because it was really easy to download songs, play it on your computer and move it to your mobile device.

Diversity dimension

However, there is another dimension that recognizes that devices are different and should be treated as different. One of the reasons for having different devices is that they support different work and social situations and having the device support the work situation, but the software being the same is not a good solution. E.g. in the AWARE project moving from a personal to a public display had some clear issues about how to display these awareness information on a collaborate display. Mixis is another example where the possibility to actually move the mobile device is the cornerstone of the interaction technique. When it comes to using the diversity dimension seamful interaction is much more important.

To conclude I do think multi-device setups have to have both dimensions. A common ground dimension in which seamless interaction is a goal in making transition between devices transparent and a diversity dimension that takes into account that devices are different and are used in different settings, that these differences should be used as an advantage to design seamful systems. A design challenge is to keep an eye on both dimension and finding a good balance.

BIOGRAPHY

Thomas Riisgaard Hansen is a PhD student at department of Computer Science at Aarhus University in Denmark. He has for several years been working on human computer interaction issues with focus on pervasive technology for medical settings. He is currently visiting University of California at Berkeley, but will be back in Aarhus this August. He has been coordinating the AWARE project, the Active Theatre project and the Mixis project. He has been publishing several papers within the area of Human Computer Interaction. More information available at http://www.daimi.au.dk/~thomasr/

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