

DeskPanel

A Proximity-Based Information Panel for Locally Mobile Staff

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ABSTRACT

DeskPanel is a proximity-based information panel helping locally mobile people to quickly get an overview of centrally stored information, such as e-mails and tasks. According to user trials, DeskPanel has the potential of being a useful tool for mobile staff. This paper outlines the rationale, design, implementation and user trial of the system.

Keywords

Local mobility, Mobile devices, Ubiquitous computing

1. INTRODUCTION

Personal Digital Assistants (PDAs) are currently going through a rapid development phase. While initially being used exclusively as digital calendars, the potential of these devices seems obvious as manufacturers incorporate applications such as e-mail clients, web browsers and offline document readers. However, these applications suffer from some major drawbacks, including the difficulty to rapidly overview information. For example, in order to check new messages (email, fax, internet news, etc.) the user has to launch several applications, which is very time consuming. This may not be optimal for stressed people who spend their working day running between meetings.

In this paper, we present one possible solution to this problem, the DeskPanel system. DeskPanel is a proximity-based information panel designed to provide easy overview of selected information to locally mobile staff in organizations. An organization can contain several publicly available panels integrated into the

environment, just like whiteboards are used today. DeskPanel shows centrally stored information to the person that passes by. Built upon the premise of short-range ad-hoc network technologies such as Bluetooth being built into most devices in the near future, DeskPanel uses the short-range limitations of these technologies to create new types of proximity-based services for its users.

The structure of the paper is as follows: First, we describe the DeskPanel system – its interface, use, and implementation. Some preliminary user trials are presented next, followed by related work. Finally, we present a discussion and concluding remarks.

2. DESKPANEL

DeskPanel is a proximity-based information panel, created to increase the accessibility of information in organizations. In this section we will describe the use, architecture and implementation of DeskPanel.

When people are locally mobile (Bellotti and Bly 1996, Bergqvist et al. 1999), they have certain waypoints they use to collect information. Typical examples include service desks, the local receptionist, coworkers, and of course their own office space. Finding important information can be a matter of being at the right place at the right time, or regularly visiting all places during the day to get updated.

To aid people in accessing their information, we present proximity-based information panels. These are flat-screen monitors integrated in the office environment, either hung to a wall or placed in an office window. When a person comes within the proximity of the screen, it displays information based on the person's customized profile.

Proximity-based information panels consist of four different components (see figure 1 below): (1) a screen, (2) a small, networked computer system, (3) a radio transceiver, and (4) a portable trigger carried by the people that want to use the system. Triggers are small, portable devices that are used to identify a person to the information panel. Since the triggers vary in size, they can be attached to a person's handheld computer, mobile phone or even a key ring.

The use of an information panel can be automatic, manual or both depending on the type of trigger being used. Triggers can be manual, automatic or controllable. Examples of triggers are a manual "car alarm" with a button, automatic mobile phone connection through Bluetooth, and a controllable connection ("automatic connection on/off") using a PDA with wireless LAN.

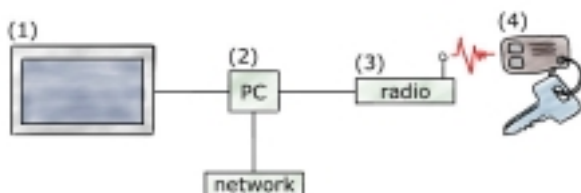


Figure 1: The components of Proximity-Based Information Panels.

2.1 Scenario

The following scenario is used to illustrate the kind of information accessibility DeskPanel seeks to accomplish:

John arrives late this morning. He quickly rushes up the stairs to his office. He knows the budget meeting began ten minutes ago, and that he's also been waiting for an email from the local support personnel regarding his

broken laptop. After saying hi to the receptionist, John passes by a DeskPanel screen currently showing a movie of an aquarium on the wall.

When John passes by the screen, the PDA in his hand sends an identification code to the DeskPanel. The movie fades away and a picture of John appears (see figure 2). He notices a message from his co-worker Bob that the meeting has been moved to a different location. A quick glance at the headers of incoming emails (also displayed on screen) shows that he has not received an email regarding the laptop yet. John quickly runs to the new meeting location.

When the meeting is finished, John and his colleagues are on their way to lunch. Even though they are discussing an important topic, John gets a chance to take a quick glance at another DeskPanel on their way out to find out that his laptop computer has returned from service.



Figure 2: John, on his way to the meeting

In the above scenario, the DeskPanel is used for three different purposes:

- Reaching mobile people. One of John's co-workers wanted to alert him that the meeting room had changed, but could not reach him.
- Keeping up-to-date with events. John used DeskPanel to automatically poll his mail account for changes.
- Non-interruptive access. John was able to check for new messages while keeping a dialog with one of his co-workers.

We will now describe how the DeskPanel interface is operated and configured from a user's perspective.

2.2 Interfaces and use

The main interface of DeskPanel consists of a number of “information elements.” These are graphical components used to display information to the person that is currently within the proximity of the DeskPanel. Examples of information elements are a picture of a person, a view of unread emails and Intranet news. These three elements are shown in figure 3 below.

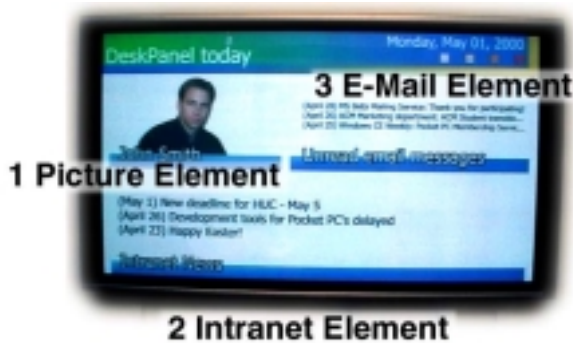


Figure 3: The DeskPanel interface.

In order to get the DeskPanel to recognize and show individual information for each person, a simple web configuration program was built (as seen in figure 4). Here the user can register his device ID, choose which information elements that should be displayed and alter the screen coordinates of these elements.

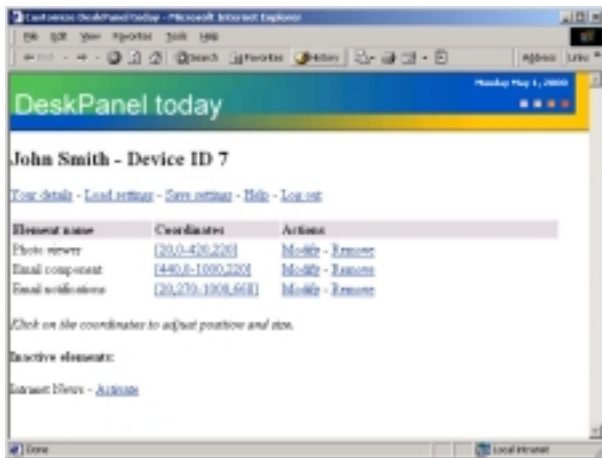


Figure 4: The web-based configuration system.

All information elements have their own properties, and each element contains its own customization interface available from the main configuration program (see figure 4 above). Since each element has a unique look and custom properties, configuring the elements require specific instructions that vary depending on their type.

Each information element can in turn contain additional elements. An example of this is the “Photo Viewer” (see

figure 5), which lets a person show his picture as an ID on the screen when she passes by. The Photo Viewer element configuration lets the user specify both what “sub-elements” to show (picture, name) and also enables uploading both primary image and alpha channel if available. The “Photo Viewer” is thereby an “information element” that has a number of properties that can be set, including information on what “sub-elements” to show.

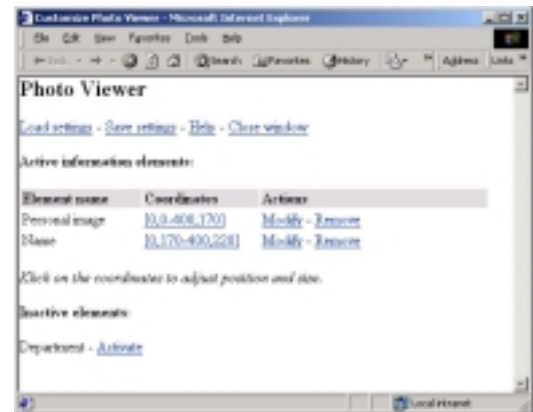


Figure 5: The Photo Viewer configuration screen.

Once configured, the DeskPanel system requires no further interaction from the user. In order to send notification alerts, such as appointment re-scheduling, a person only has to add the prefix “!!” to the subject title of an email sent to a person. This makes the DeskPanel automatically show the item in a separate information element called the task-list element. The task-list is more visible than the e-mail element (different font style and size). Emails prefixed with “--” automatically becomes invisible.

When DeskPanel is idle, the software controlling the screen is running an animation or an image slideshow to show that it’s awaiting user requests. Later, when a person passes by, user identification is sent from the client trigger to the DeskPanel receiver. The system then connects to a central gateway that contains all the necessary user settings and passwords to retrieve the data to be shown. If several users pass by the DeskPanel at the same time, each users data is displayed for a time period of 10 seconds. The necessary passwords to connect to the gateway are protected by encryption.

2.3 Implementation

When implementing DeskPanel we focused on it being interpreted by the user as an “intelligent screen” rather than a complex computer system. Therefore, one of the requirements we made was that the computer system

controlling the screen should be so small that it could be hidden away. If an organization were to implement the DeskPanel on a full-scale basis, the hardware also should be relatively cheap to purchase.

DeskPanel was implemented in Visual C++, which has relatively low demands on hardware. The code base was built and tested on both Windows 2000 and Windows CE, so that DeskPanel could run on a small handheld PC with a built-in VGA controller. Using the handheld alternative, it is possible to pack the system, a wireless network connection and a radio transceiver in a very small package that actually could be hidden behind the screen itself.

Three information elements, “plug-ins”, were created for the first version of DeskPanel. These were the photo viewer, an email component and a task list. The photo viewer shows a picture of the person that comes by, the email component displays all or unread emails, and the task list displays specially marked emails that should be displayed using a larger text font.

Each DeskPanel system communicates with a central gateway using a custom-built protocol. The gateway maintains connections to all company information, such as calendars, emails, and Intranet news. What is elsewhere referred to as “Information Elements” is really dynamic link libraries (DLL's), which run both on the gateway and the DeskPanel system. Since both the gateway and the DeskPanels share the same code base, only one copy of each DLL has to be made. This copy then runs on both the gateway and the DeskPanel, but with different functionality (retrieve data / display data). A picture describing the Proximity-Based Information Panel concept integrated with the office gateway is listed below in figure 6.

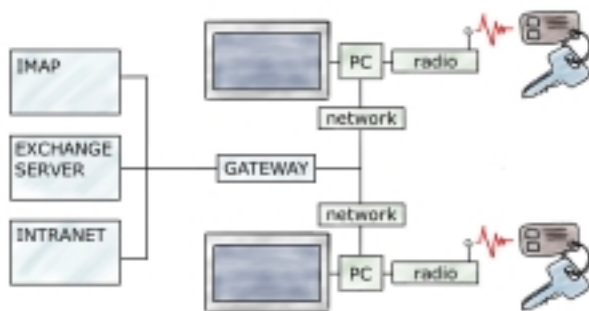


Figure 6 System Components

2.4 Hardware

DeskPanel was built on the premise of Bluetooth being built into every device within the forthcoming year.

This would make it possible to use devices such as mobile phones or key rings as triggers. The trigger would then automatically be detected by the DeskPanel system when it comes within the proximity of the radio transceiver (Bluetooth has a range of 10 meters).

However, at the time of writing Bluetooth is not publicly available, so we had to implement our own short-range radio transceivers with similar functionality. The transceivers we built were custom-made short-range radio transceivers that are connected to the side of a handheld computer (Casio Cassiopeia E-105). The transceivers were previously used in a project called Proxy Lady (Dahlberg et al. 2000), and can be seen in figure 7 below.



Figure 7: A Cassiopeia PDA equipped with a trigger

The radio transceiver is controlled by a custom application built for the Cassiopeia, and is using the serial port to get enough current to run. Once every second the transceiver broadcasts a public ID signal, which is captured by the DeskPanel system to identify the user. The range of our radio transceiver was around 10 meters.

Currently, we are using a laptop computer to run the DeskPanel application and a flat screen to display the user interface. The laptop is fitted with the same type of radio transceiver as the PDA.

3. USER EXPERIENCES

To receive input on DeskPanel we equipped six employees at an international web-consulting firm with radio transceivers that fitted to their current PDAs. Each person had a different role in the organization that ranged from developer to team manager. All participants knew each other before the test period started, and three of them worked in the same project. The local office hosted around 40 people. The office space was located in one oblong floor, with a reception desk at the center and four corridors starting from the reception desk.

We placed one DeskPanel screen at the reception desk in the center of the office building. The two receptionists were already using emails to notify people about incoming events, which would work directly with the DeskPanel system. The reception desk is a place where people pass by several times per day, on their way to a conference room or to search for a colleague. DeskPanel was implemented on an ordinary laptop that was hidden behind the reception desk so that only the screen was visible. The information elements used were the photo viewer, e-mail, and the task-list element.

After having used the system for two weeks, we invited the participants and one of the receptionists to a workshop. To capture the session we used a video camera. The entire workshop was transcribed into text.

3.1 Results

The comments made by the users during the workshop session concerned their actual use experience with DeskPanel together with ideas for improvement. Most users said that they had used the DeskPanel on a daily basis, which also was confirmed by the system log.

Information Elements. All users agreed that a solution that provides a distributed, non-interactive email overview is important. One user commented that he wanted information items that also support to-do lists and distributed calendars, which the others agreed on. All participants positively supported the picture information element. One user mentioned that guests who had come to visit him could see his image and name on screen while he was approaching them, which he claimed increased the value of DeskPanel.

Functionality. One problem one user mentioned was the 10-second cycle period. If several users are in the proximity at the same time it takes too long before his information is presented. Another user had his office just a few meters from DeskPanel. Since his office was so close, DeskPanel triggered his personal information while he was sitting in the office. The user did not consider this behavior of the system to be acceptable.

Added value. All PDA users expressed their feelings for DeskPanel in a positive manner. However, the receptionist mentioned that she did not think that DeskPanel provided any kind of support in her own daily work. Instead, she got additional questions regarding the DeskPanel system from visiting users. She said that this was a negative factor in her work. She also mentioned that the receptionists had not used the special "task list" feature to provide notifications on the DeskPanel except for the first day.

New features. One of the things currently not supported by DeskPanel that was mentioned by several users is the ability to physically locate people within the organization. The receptionist mentioned that she was asked this question a lot.

Trigger. One user mentioned that he always carries his mobile phone within the building, but seldom the PDA. It was simply too large and too heavy. Our test equipment with a PDA and an additional radio transceiver was among all users judged out by being too much to carry in daily work. During the trial period, though, they agreed to bring their PDAs with them all the time.

Privacy. No user mentioned any potential privacy issues using DeskPanel to show personal data on a public display. One person mentioned though that he changed his picture size to a smaller format during the beginning of the evaluation period, since he was not comfortable with the old image.

We intend to use these comments when we design the next generation of DeskPanel. Among the things that need improvement is the office integration, with full support for both calendar and tasks. We might also look into location awareness, so that each user via a web interface can specify one or more people for which to show their last known location. This would make it possible to see when a person passed by a certain DeskPanel.

4. RELATED WORK

The use of context as a resource for mobile computing, called context awareness has been previously explored (e.g. Want et al. 1995, Schilit et al. 1994). There are several different types of context that an application can use, e.g. location, temperature and light conditions.

The most commonly used type of context is location. By filtering out information based on the current location, a user only has to be concerned with the information that is relevant for her present position. These kinds of systems are often categorized as location dependent systems. Among this type of systems, we find Shopper's Eye (Fano 1998) and Cyber Guide (Abowd et al. 1997).

The DeskPanel is context-aware, in the sense that it is aware of what users that are nearby. However, DeskPanel is not a location dependent service. Location dependent services typically aim to provide the relevant information at the right place. The DeskPanel, on the other hand, is a ubiquitous effort to provide an overview

of relevant information at several places. It does not customize the information depending on location.

Digital whiteboards are computer-driven displays that seek to combine the ease of an ordinary whiteboard with the novel features of a computer-based editing and organizing software. Research in this area ranges from interaction and organizing techniques (e.g. Rekimoto 1998, Pedersen et al. 1993, Gessler 1998), to complex interactive environments that seeks to change the way we think of office environments today (e.g. Mynatt et al. 1999; Streitz et al. 1999). DeskPanel might be a modest step in this direction.

DeskPanel is a non-interactive display that provides centrally stored information (e.g. emails and tasks) in a mobile setting. DeskPanel does not only distribute the same centrally stored information independent of location. It also does so automatically without any interaction requirements from its users.

Digital whiteboard systems have distinct requirements on placement and screen size, and are typically placed in meeting rooms. DeskPanel, on the other hand, should be placed in corridors and other places where the personnel pass by.

Adding DeskPanel functionality to an existing digital whiteboard would be possible, but form factors and location would probably restrict its use. However, adding whiteboard features to DeskPanel using remote manipulation tools (such as those described by Rekimoto 1998) would be possible without sacrificing its current functionality, just by using an "interactive" information element on screen for input.

Ubiquitous computing (Weiser 1991) is a concept that has gained a lot of interest since its introduction about ten years ago. In the concept of ubiquitous computing information technology is described to fade away in the background of the environment. Interfaces should be available everywhere in the environment, ready for interaction when a person needs it.

5. DISCUSSION

In this section we discuss some emerging issues related to the DeskPanel. The topics include both technical aspects as well as aspects on the use of the system.

5.1 Privacy, awareness and disruption

Broadcasting personal information in an organization is a sensitive matter, which should be taken very carefully. Issues regarding privacy, awareness and disruption in everyday work are matters that have to be taken into

account when building public information systems like DeskPanel.

Providing awareness information will always affect privacy, either for the sender or the recipient depending on what type of information is transferred and if the information is shown in public or not. At the same time, the more information being transferred the greater is the risk of privacy threats. Increased awareness may also have the side effect of increased disruption in normal work. The effect awareness has on these two factors has been categorized as "The Dual Tradeoff" by Hudson and Smith (1996).

DeskPanel provides several solutions to keep a high awareness factor, and still respecting both privacy and disruption factors in everyday work. By using manual or controllable (automatic on/off) triggers it is possible to restrict the use of DeskPanel when there are people around. Using these kinds of triggers, DeskPanel also does not have to disrupt ordinary day work since the system can be turned off completely for individual users, and switched on by demand. It is also possible for an e-mail sender to block emails from being displayed on the screen, assuming that she knows how to use the blocking-filter.

Designing with respect to privacy is often easier to overcome by filtering data (e.g. blurring out areas of information). This is a technique can be used when building shared media spaces (e.g. Hudson and Smith 1996). Filtering information in DeskPanel (e.g. blurring the email headers so that they become unreadable) would lose some of the systems usability, but still provide value in that the user gets an awareness of his/her current information stream. This feature is currently not implemented in DeskPanel but would not be hard to realize.

5.2 Trigger Technology

A wide variety of small devices will incorporate Bluetooth when it becomes publicly available. IDC forecasts (IDC Report 2000) that more than 400 million devices will be Bluetooth-enabled by 2004. Many cellular phone manufactures have already announced that they will support Bluetooth, which would make them suitable for triggers for DeskPanel.

RF Tags, or transponders, is a technology that is very small and do not require any batteries. The transponder can be so small that it can be fitted into a sticker. When a transceiver sends out an electrical current, the transponder "wakes up" and sends an ID back to the transceiver. This technology is commonly used for

parcel tracking. A user can put a transponder-sticker in her wallet and then forget about it. However, the range seems to be too short for use with DeskPanel, since it today only functions up to 50-100 cm.

Further, the small radio transmitters that are used for car alarms could be used as a pro-active alternative for the DeskPanel. The devices can be constructed to be very small, but need batteries. Hence, it is not possible to transmit an ID constantly, since that would lower the operating time too much. But as a manual trigger it would probably be suitable.

What technology to choose depends on several different aspects. When Bluetooth is a common standard it seems to be a very good solution. On the other hand, there are no Bluetooth devices on the market today. It will probably take several years before everybody's cellular phones are Bluetooth-enabled. The RF solution is very handy, but might have a too short range of operation. The "car-alarm" solution is also very handy, but would have problems with the battery capacity.

5.3 Ubiquitous or Mobile

As mentioned before, ubiquitous computing and mobile computing is very much in contrast to each other. While mobile technology currently is expanding fast, ubiquitous computing has not gained much interest. At least not in the commercial world. We want to stress a couple of reasons for not leaving the concept of ubiquitous computing.

First, mobile computing is not suitable in all situations. The main strength of mobile computing is that the user can reach information or communicate wherever she is located. Most current implementations of mobile computing require the users full intention. Reading mail on a PDA, for instance, is very difficult when walking in a corridor. One of the few solutions that do not require full attention is the cellular phone.

Even though the research in mobile computing is developing quickly there seems to be room for other concepts. Such concepts should be better on handling the problem that a mobile person often have to focus on other things than IT-use. Therefore, there might be a place for ubiquitous computing.

One disadvantage with ubiquitous computing is that it often requires a huge infrastructure at all places in which a user might be located. Large displays should be mounted on the walls, sensors should be installed and so forth. This infrastructure will become very costly if efforts are being put to implement that at all places

where a user might be located. Therefore, our efforts are put into office environments. The two main advantages with these environments are (1) that employees tend to spend a large portion of their time at the office where they work and (2) companies can invest more easily in IT than private consumers can.

One reason for the lack of success for ubiquitous computing might be that most solutions have been fairly expensive. Flat displays, sensors and other types of technology have not been available or been far too expensive to use in most (real) settings. As it seems, the development is now coming to a point where it will be possible to implement ubiquitous computing-inspired systems rather cheaply. The DeskPanel system, for instance, does not have to cost more than a standard PC. The triggers we use are indeed too large and still too expensive, but as other technologies emerge (see 5.2) the triggers will be very cheap as well.

Therefore, we want to argue that ubiquitous computing has a place, not only in research, but also in the commercial world. Some shortcomings with the technology (e.g. price, availability) seem to disappear as technology develops, while some other problems resists. Ubiquitous computing has some advantages where mobile computing does not help much, and vice versa.

6. CONCLUSION

In this paper we have presented DeskPanel, which is a proximity-based information panel. According to preliminary user feedback, proximity based information panels seem to be a useful means to provide mobile office workers with overview of information.

Suggestions for future work include a full evaluation at several sites, which is required to provide more information on its use in the "real world". New triggers need to be investigated, and the functionality of the system can be extended according to the feedback we received from user experiences.

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