

Interaction Between Small Size Device and Large Screen in Public Space

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Abstract. We propose a simple way to interact with a large screen which is situated in a public space by using a small size device. In order to get the connection information easily, we use QR-Code to provide connection information such as IP address, position information and password to users. When users are connected to the large screen, the system will provide a part of the large screen to a user as his personal space at right in front of him, so that the user can display the information in his PDA and manage the information on the large screen. The user can exchange the data with the large screen and the other users through the personal space on the large screen. We keep developing the prototype system according to this approach.

Keywords: Ubiquitous, Interaction, Large screen display, Public space, PDA, QR-Code.

1 Introduction

Small size devices such as cell-phones and PDAs (Personal Digital Assistant) are handy to carry. By utilizing wireless network such as WiFi and Bluetooth, users should have the capability to connect to the internet and handle information anywhere and anytime. For example, users can manage their schedule or access the internet with their cell-phone or PDA. Users can also send a mail or even can shop by accessing the internet. However, a small size device has a small size display. It cannot display much information on one screen, which forces users to switch the pages all the times. On the other hand, a large screen can be useful to provide information to users in public space. Currently, large screens are becoming ubiquitous and being used in public spaces such as subway stations, shopping malls, book stores, etc. It will be useful if we could use the large screen in public space with a small size device. In this paper, we will describe how to interact with a large screen in public space by using a small size device.

Our goal is to build a system where a PDA can be used as an input device to operate data on a large screen display in public space. We suppose that we have a wall-sized screen and a small size device which can connect to the internet. Our system provides a limited space to a user as his personal screen area on the large screen, thus the user can display the information in his PDA on the large screen. Users can exchange the information in a simple way with a drag & drop interface on the large screen. Our system also supports a multi-user environment. Therefore, users can

operate information with other users, such as exchanging data with each other through the large screen.

2 System Overview

This section describes the overview of our system. To start using the system, users have to connect with the large screen server. We use the QR-Code [9] to provide connection information to users. When a user is connected to the large screen, the user is given a personal screen area by the system. Thus the user has the capability to interact with the large screen through the personal screen area. The user can also operate the data freely with the drag & drop interface on the personal and the public screen area.

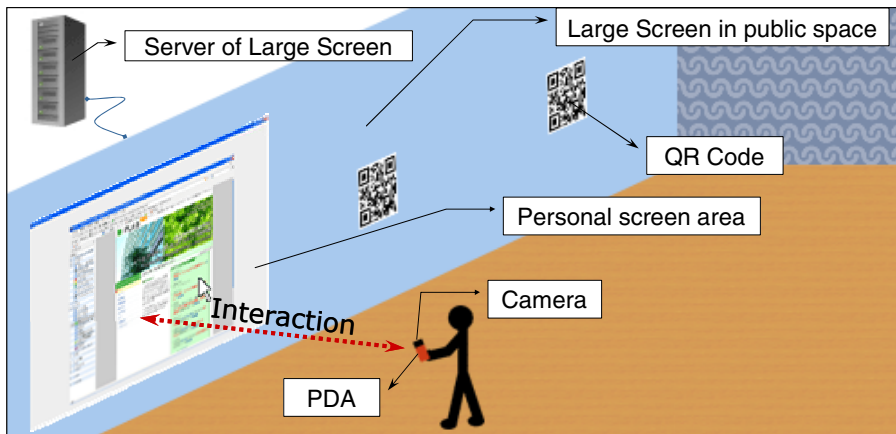


Fig. 1. System overview

2.1 Connection

We assume a large screen is situated in a public space, and users near the large screen can access the internet through the wireless network environment. Many users who are physically near the large screen will be in same network through the wireless network and may use the large screen at the same time. In order for a user to reserve a physical part of this screen and open a personal area adapted to his needs, all he has to do is to read a QR-code positioned at a particular screen space. A QR-Code is a kind of two-dimensional bar code that is easy to read by analyzing the image. Each QR-Code contains three pieces of information allowing users to connect to reserve the personal screen area. The first piece of information is the server's IP address, the second piece is the coordinates on the screen of the part that the user wants to use; the last one is the password required for the connection. This protocol follows the ShownPass technique [6], since users who are not physically near the large screen cannot obtain the password for the connection.

A user could take a picture of the QR-Code with the camera embedded in his PDA and analyze the picture to get the connection information, then send the position information and the password back to the server with the IP address of his PDA in the same format to the server in charge of distributing a space on the large screen. A personal screen area will be ready for the user right in front of him, and user can start using his PDA as an input device to operate on the large screen.

2.2 Personal Screen Area and Public Screen Area

When the large screen server is displaying the personal screen area to the user, there are two kinds of different areas on the large screen. One is the personal screen area, an area which is given to a user as his personal area that is used by only one user to display personal information of the user. The other one is public screen area, an area outside of personal screen areas used by all of the users to display the common information. As shown in Fig.2 (upper) there are several QR-Codes displayed on the public screen area. In this situation this area is called the public screen area. However, as shown in Fig.2 (lower), since another user opened up a personal screen area by using a QR-Code in the public screen area, the area will become a personal space, and the information which displayed on that area will slip out of this area. So the public screen area is not an absolute public screen area, yet some parts of the public screen area may switch to a personal screen area.

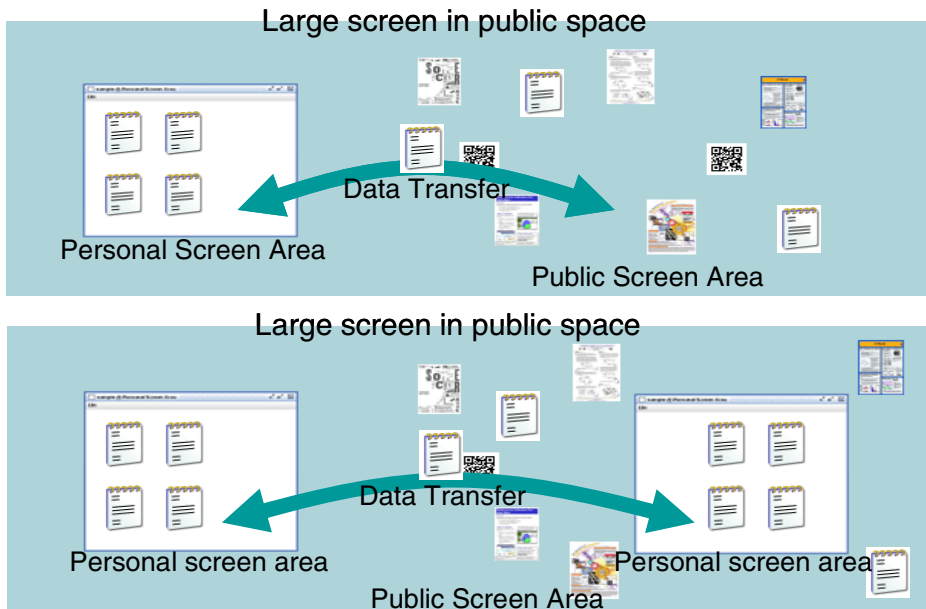


Fig. 2. Personal Screen Area and Public Screen Area

The personal screen area can be used in two ways. First, it can be used as a PDA's extended display. The user can start an applications installed in his PDA. In this case, it will not cause any security problem in general, because all the information is displayed in the personal screen area, and it does not transmit any private information to the large screen server.

Secondly, it can be used as a personal area for using the application on the large screen server. A user can exchange data between the large screen and his PDA with a drag & drop interface. For instance, the user can drag a file on the large screen from the public screen area to his personal screen area to save it on his PDA. Conversely, the user can drag data from his personal screen area to the public screen area. The user can also move his personal screen area to another available position on the screen. We should note that it may cause the security problem in this case.

When the user drags a file from his personal screen area to the public screen area, the system will copy this file from his PDA to the server of the large screen. Everyone who uses this large display has permission to copy this file into his PDA and modify this file. But nobody has the right to delete the file on the public screen area of the large screen directly except the user who published the file. When the user drags the file from the public screen area to his personal screen area again, the system will copy the file to his PDA, and nobody else has permission to copy or modify this file. In fact, a user does not have the permission to operate the data in other user's personal screen area.

This system could be used in many public spaces such as subway stations, shopping malls, book stores, etc. Users can download information such as part-time job information, message from the other users, posters to his PDA or cell-phone. Users can also upload such information from his PDA to the large screen.

3 Prototype System

We have implemented a prototype system that can display the data of the PDA and can browse web pages on the large screen. As the personal screen area, we implemented it as the second way described above that use it as a personal area for using application on the large screen. Our prototype consists of two parts. One is the PDA side, and the other one is the large screen side. These two parts communicate through the wireless network environment.

Normally, users handle the information of the PDA within a normal PDA interface. When they find a large screen (Fig.3 left), users can start a program installed in the PDA to capture the QR-Code (Fig.3 right) and analyze the QR-Code image to get the connection information. Then the program will try to connect with the large screen server by using the connection information.

When the user is connected to the large screen server, the server will display a personal screen area to the user. Currently, we implemented a web browser to access the internet web-site (Fig.4), a file browser is available in personal screen area to display files in the user's PDA (Fig.5).

Users can operate on the large screen by using their PDA as input devices. For instance, users can move their personal cursor on the large screen by touching their PDA's screen. The system can generate particular events on the large screen based on the PDA's events. Users therefore can start some applications to manage information on the large screen.

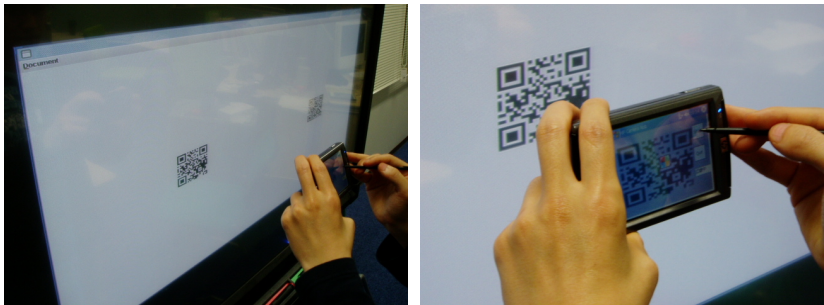


Fig. 3. Display a QR-Code in the usable section to provide the connection information to users (left) and the user capture the QR-Code and analyzing the image to get the connection information (right)

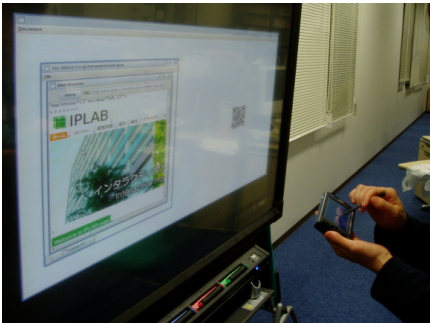


Fig. 4. The large screen will display the personal screen area to the user. The user can open up some applications installed on the large screen.

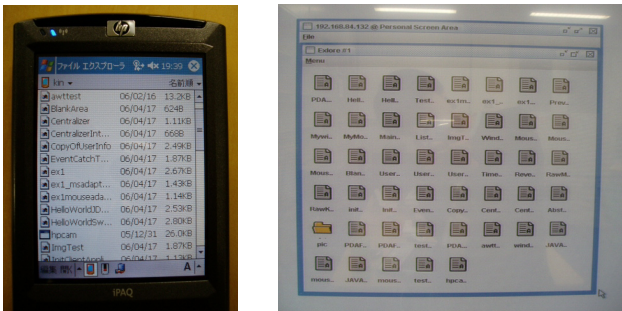


Fig. 5. Files in the PDA (left) and the large screen (right)

When a user operates on a large screen there are two different scales of operation. The first one is related to small-scale operations within a user's personal screen area. The second one is operations at large distances outside a user's personal screen area. To handle small-scale operations, we developed a pointing interface where the user

moves cursor relatively, a user thus can operate on the PDA's surface using a pen the same way as touch-pad on the notebook computers (Fig.6 left). To handle large-scale operations, we developed a pointing interface where the user can point directly on the miniature of the large screen on the PDA, the user therefore can operate on the PDA's surface the same way as touch-panel on the tablet PC (Fig.6. right). Fig.7 shows the two different interfaces for the small-scale operation and the large-scale operation.

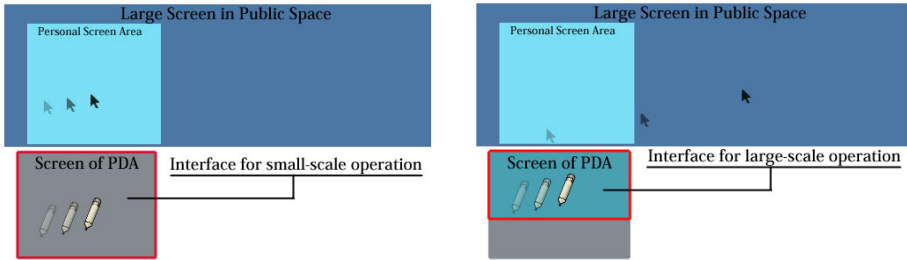


Fig. 6. Interface for small-scale operation (left) & Interface for large-scale operation (right). When the user moves the pen on the interface for small-scale operation the cursor will moves like touch-pad on the notebook. When the user moves the pen on the interface of large-scale operation, the cursor will moves like touch-panel on the tablet PC.



Fig. 7. Interface for small-scale operation (left) & Interface for large-scale operation (right)

4 Related Work

There are a number of studies on the interaction between a large screen and a small size device. For example the WebWall [5] is a system which enables multi-user communication through a large screen. WebWall allows user to access the web-based applications such as simple sticky notes within small size devices such as mobile phones or PDAs. The ContentCascade [4] is a system which enables the user to download some contents from the public exhibition or displays situated in the public space such as shopping malls, book stores, etc, to the personal devices such as mobile phones. The C-Blink [2] system allows users to control the cursor on a large screen by using a cell-phone with a colored screen. This system is based on a program that

rapidly changes the hue of the phone screen and the user's waving the phone screen in front of the camera mounted above the large screen. The camera tracks the relative position of this signal to control the cursor on the large screen. The "Sweep and Point & Shoot" system [1] allows users to control the cursor on a large screen directly by using a cell-phone. This system keeps taking pictures with the camera embedded on the cell-phone and compares the pictures to determine the relative motion, thus allowing a user to control the cursor on the large screen. The paper [3] describes the interaction with situated displays using mobile phone. They situated displays out side of the office, and visitors are able to use the system in order to download information from the office door display through Bluetooth such as the owner's contact details. The paper [7] allows users to get information from the real world by using a PDA and RFID chips. The paper [8] is a research about how people move from individual to group work through the use of both PDAs and a shared public display. These systems allow users to handle directly the information. However, they do not use any concept of personal screen area. The novelty of our system is the concept of a personal screen area within a multi-users environment.

5 Summary

We have proposed a system to support public space communication by using a large screen in public space and a PDA. In this system, we use QR-Code to provide the connection information to the user. The user runs a program installed in the PDA to capture the QR-Code with the camera embedded in the PDA and to analyze the image to get the connection information. When the user connected to the large screen server, the server displays a personal screen area to the user that the user can manage the information through the personal screen area. We have also described our prototype system. Currently, we have implemented a system that we can control the cursor so that the user can browse the data in his PDA and browse web pages on the large screen. We will focus on the interface and keep on developing the prototype system.

References

1. Rafael Ballagas, Michael Rohs, Jennifer G.Sheridan. Sweep and point and shoot: phonecam-based interaction for large public displays, ACM CHI'05, 2005, pp.1200-1203.
2. Kento Miyaoku, Suguru Higashino, Yoshinobu Tonomura. C-Blink: A hue-Difference-Based Light Signal Marker for large Screen Interaction via Any Mobile Terminal. ACM UIST'04, 2004,pp.147-156.
3. Keith Cheverst, Alan Dix, Daniel Fitton, Chris Kray, Mark Rouncefield, George Saslis-Lagoudakis, Jennifer G. Sheridan. Exploring Mobile Phone Interaction with Situated Displays. PERMID workshop at Pervasive 2005, Munich, PERVASIVE 2005,pp.43-37.
4. Himanshu Raj, R. Gossweiler, D. Milojevic, "ContentCascade Incremental Content Exchange between Public Displays and Personal Devices", in Proc. of the first Annual International Conference on Mobile and Ubiquitous Systems: Networking and Services (MobiQuitous'04), Boston, Massachusetts, USA, pp.374-381, 2004.
5. Ferscha, A. and S. Vogl, Pervasive Web Access via Public Communication Walls: Pervasive Computing, Springer LNCS 2414, Zurich, Switzerland, pp.84-97, 2002.

6. Yuji Ayatsuka, Michimune Kohno, Jun Rekimoto, "Real-World Oriented Access Control Method with a Displayed Password" in Computer Human Interaction (APCHI 2004), LNCS 3101, Jun. 2004, pp.9-29
7. Pasi Valkkynen, Timo Tuomisto: Physical Browsing Research. PERMID workshop at Pervasive 2005, Munich. PERVASIVE 2005,pp.35-38.
8. Greenberg, S., Boyle, M., and Laberg, J., "PDAs and Shared Public Displays: Making Personal Information Public, and Public Information Personal." Personal Technologies, 1999. March. pp.54-64.
9. QR-Code: <http://qrcode.com>