A Study for Personal Use of the Interactive Large Public Display

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Abstract. In recent years, "digital signage" has been used for large screen displays in public spaces, such as stations or shopping malls. Some display terminals have used digital signage to dispatch information in an interactive format; thus, a user touches an electronic screen to obtain information, such as a map, store location, or advertisement, and receives it freely. Public systems commonly adopt user interfaces with touch panels on display terminals to facilitate interactive information exchange.

On the other hand, the popularity of personal computers and the explosive growth of the Internet now make it possible for users to handle a wide variety of information—regardless of location or time of day. Furthermore, users communicate not only information that may be seen by others but sometimes information not intended to be seen by others. In other words, even information of a highly confidential nature can be accessed anywhere and anytime. The information dissemination which cared about this point is desirable.

In this research, therefore, we will study information security and privacy as it pertains to large touch screens in public places. The goal of this research is to identify the variables associated with user safety when interfacing on large touch screens in public venues; additionally, we will propose a method for designing public space so that users can communicate interactively with reassurance of confidentiality.

Keywords: Information environment design, Public space, Large public display, private information, Reassurance.

1 Introduction

In recent years, "Digital Signage" has emerged where a large-screen display is installed in public spaces like a station or a shopping mall. Some display terminals used by digital signage have not only information dispatched to one direction, but also interactive interface. With such an interface, the user may freely access via touch

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various kinds of information, for example, a map, a store, or an advertisement. Many user interfaces which use touch panel for the display terminal, facilitating an interactive information exchange have been used in public spaces (Figure1).

The spread of personal computers and the explosive growth of the Internet now make it possible for users to access a wide variety of information, regardless of location or time of day. In using the Internet, users communicate both confidential and public information. From this, we see that even information of a highly confidential nature can be accessed and processed anywhere and anytime. Knowledge of the process of such information dissemination over the Internet is useful for those seeking to develop the confidential dissemination of information using public touch screen.

Therefore, in this research, we decided to study information security privacy for large, public touch screens in public spaces. The goal of this research is to clarify the facts regarding the safety of communicating confidential information using a large touch screen in a public space, and to propose the indicator and method or an environmental design of a large screen interface in a public space where users can communicate confidential information with the reassurance that the information will remain private.

Fig. 1. Large public display use image in public space

2 Related Works

The following materials are helpful to understanding this study:

- A comprehensive analysis of the design space that explains mental models and interaction modalities, as well as taxonomy for interactive public displays is presented by Müller et al. [4].
- A preliminary prototype of a personal display, which is deployed in a university context is presented by Böhmer et al. [1].

- A paradigm for measuring whether or not a user has read certain content is presented by Desney et al. [3].
- Two initial user studies investigating factors relevant to user acceptance and usability in the context of a deployed system that provides pedestrian navigation support through a combination of mobile devices and public displays are presented by Müller et al. [5].
- A crossmodal ambient display framework that supports multiple users simultaneously accessing information that contains both public and personal elements is proposed by Cao et al. [2].

A concept for personalized privacy support on large public displays is presented by Röcker et al. [6].

3 Concept

In order to promote the concept that users can safety disseminate information using interactive displays in public displays in public spaces, a design for a "shared terminal" and a "physical environment" must be developed with the user in mind. This research furthers the following three objectives:

- To clarify the characteristics needed to secure confidence in the means by which private information is conveyed by user's of large, public touch interactive displays in public spaces.
- To develop the indicator and method for the design of large, public touch screens in public spaces so users can feel reassurance in communicating information.
- To consider this proposal from two different designs: that of the graphical user interface (GUI) realized by software, and the solid user interface (SUI) realized by a physical component.

4 Proposal Method

We propose how to show private information on the portion of a large public display that is hidden by the body of the user, that is, the portion that is a dead angle to the surrounding people. By using this method, it will be possible to communicate private information securely in a public space. Moreover, it will also be possible to hide confidential information by a user's judgment by showing the user the portion of the display that cannot be seen by others.

However, it is insufficient to ensure safety merely to hide in the shade of user's body. Therefore we propose a method that makes the privacy of communicating information via a public interface more reassuring for the user of such an interface. This method will conceal information according to the level by which the user classifies it by hiding it in the "concealment domain." An image of this proposal is shown in Figure 2.

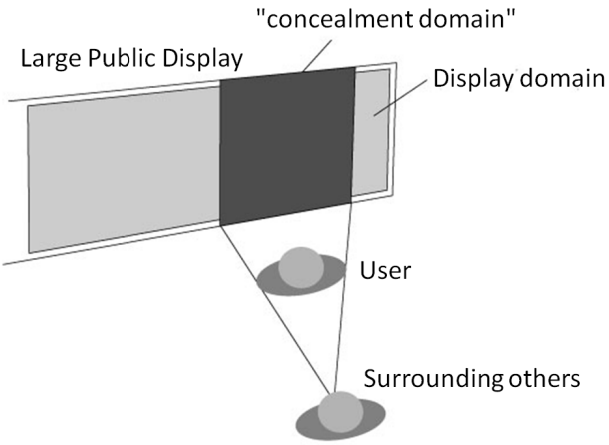

Fig. 2. Concealment domain

Thus, private information will be shielded from public view by being placed on the part of the screen blocked by the user's body. We call this the "concealment domain."

4.1 Theoretical Value of Concealment Domain

We made the trial calculation of the width of the display's concealment domain by realizing the proposal technique. The following conditions were applied to the trial calculation.

- user's shoulder width: 43.1 cm (Japanese average shoulder width)
- user's surrounding eyesight: 1.0
- user stands 35 cm away from a display (user can reach a display and can hide a screen domain to some extent)

We estimated that a user with surrounding eyesight 1.0 and who can read a 10 to 12 point font can see about 2 m~3 m. Then, we decided to divide the distance from a display into 3 points: 150 cm (clear,) 250 cm (visible), and 350 cm (not much visible).

The results of calculating the concealment domain based on these figures is shown in Table 1. From these results, we estimated that the range of abbreviation of 50–60 cm can be hidden.

Table 1. Width of the concealment domain on a display (trial calculation)

others' distance (cm)	angle with a display(°)			
	90	75	60	45
150	56.22	56.83	59.00	64.33
250	50.12	50.41	51.41	53.74
350	47.89	48.08	48.73	50.20

4.2 Informational Privacy Level and Display

Using only the technique mentioned above, the concealment domain is not only restricted, but the view ability of the rest of the screen greatly depends on the position of a person behind the user (Figure 3).

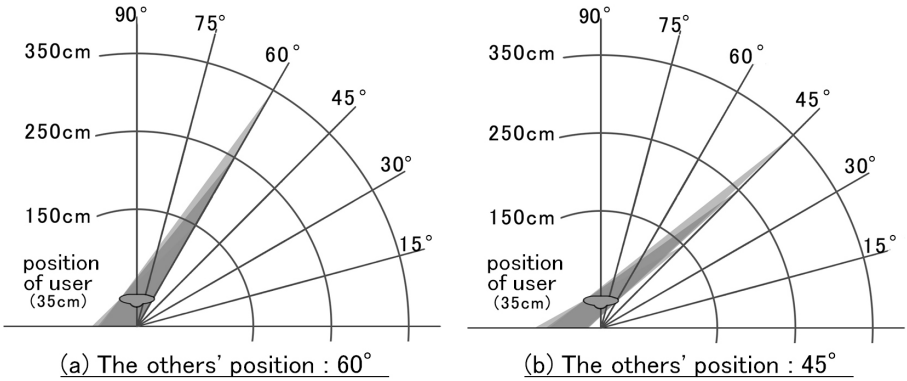

Fig. 3. The relation of the others' position and a concealment domain

In such a case, the two ideas below should be considered.

1. Gradually notify the user of the danger.
2. Hide information according to the privacy level that the user selects beforehand.

1. Gradually notify the user of the danger.

In order to gradually notify the user of the danger, it is necessary to divide the space in front of a display according to distance. Although the method for dividing the domain in front of a public display according to distance and changing an interaction is already proposed by Vogel and others [1], in our proposal, the interaction of the user using the domain before this display is not changed, and the divided domain is used as an index to notify of the user of the danger (Figure 4). According to the distance (domain) from a display, a system notifies the user gradually of the danger.

2. Hide information according to the privacy level that the user selects beforehand.

This method determines what kind of operation the system performs, and when the user's information will emerge from the concealment domain according to the privacy level that the user selects beforehand.

In a high level, contents are automatically moved into the concealment domain so that the user's information must remain within the concealment domain. Where the concealment domain does not exist, or where it does not effectively shield the user's private information, iconifying and minimizing information that appears on the screen

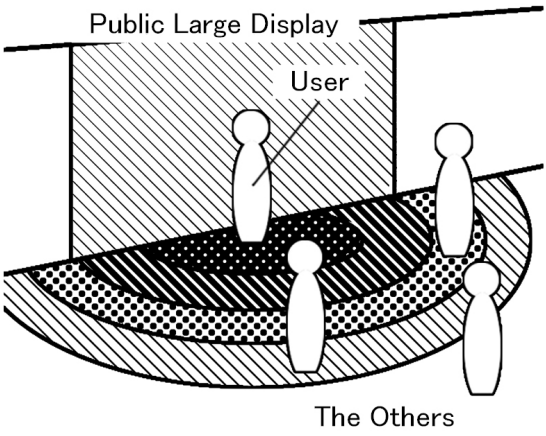

Fig. 4. Domain before display

directly in front of the user can prevent others from reading the contents (Figure. 5). In addition, the high level further protects privacy by hanging a filter that covers contents in the middle to low screen level. Thus, setting opacity in the filter and allowing the user to select the place on the screen where information can be read to some extent balances the competing goals of preserving safety of the information and allowing the user to see the showing information in a public space.

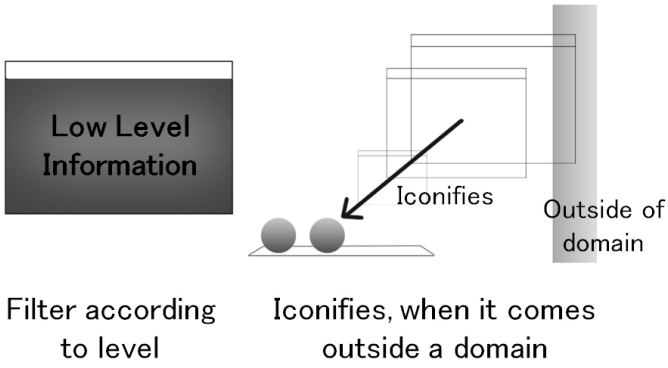

Fig. 5. Display image outside the domain

5 Conclusion

In this paper, in order to communicate private information on a large public display in a public space, we demonstrated how to display information on the concealment domain. From now on, we will investigate how someone's using a large public display in public spaces influences others to look at the display, and how many others do

look. Based on those results, we aim to design a prototype for such a large interactive public display in a public space to maximize the privacy of communicated information.

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