Using Spatial Representation to Control Accesses and Interruptions

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ABSTRACT
This paper introduces a visual interface for controlling accesses and interruptions dynamically using a metaphor of icons and regions. As the first implementation of our design concept, we developed a prototype that supports file sharing and text messaging.

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General terms: Design, Human Factors

Keywords: Icons, Communication, Access Control, Interruption Control, Personal Information.

INTRODUCTION
People constantly send, receive, and share information using both pull and push mechanisms. A typical example of pull communications is file sharing. Conversely, text messaging is a common activity involving push communications. In addition, online companies collect personal information without the awareness of their clients. Moreover, advanced devices, such as ubiquitous sensors and displays, will provide additional channels of information transfer.

In this setting, the proper control of accesses and interruptions becomes important. That is:

A) Information senders and publishers need to understand and control what information is outgoing and who can access it.
B) Information receivers and subscribers need to control the information that they choose and when they receive it.

Most people are faced with both problems because they send and receive information. Although many researchers including Neustaedter and Greenberg [3] and Dabbish and Kraut [1] have pointed out the importance of controlling accesses and interruptions, previous solutions are generally domain-specific, and consider either accesses or interruptions.

We designed a user interface to control both accesses and interruptions based on a metaphor of icons, regions, and distances (Figure 1). Using icons and connections between them, it can visualize any pull or push operation, and even an intermediate transfer of information. Each icon represents a person or information. Our interface is independent of the technology that is used for low-level data transfers. The following sections present an overview of our interface design.

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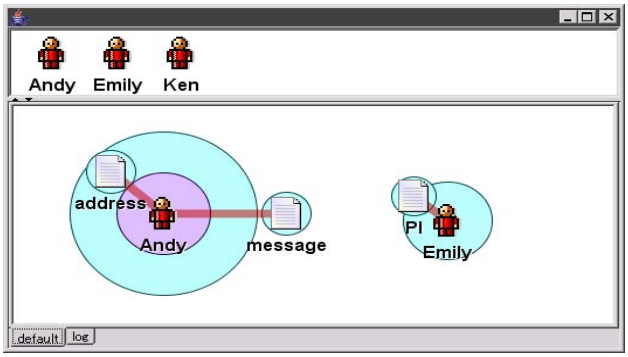


Figure 1: Each icon represents a user or information. A circle represents a region. The upper component is a contact list.

RELATED WORK
Voida et al. [4] developed an interface for file sharing, called "sharing palette", which supports an intermediate sharing modality between traditional push and pull interactions. They listed four design goals based on their investigation of existing file sharing practices:

A) The push/pull distinction
B) The representation of users and groups
C) Notifications of new content
D) The visibility of the sharing state

Although we are interested in more generic information transfers, we started with the same objectives because the four goals are appropriate to almost all systems related to information transfers. We also introduce an additional goal:

E) The dynamic, sophisticated control of accesses and interruptions

The last direction is especially important for a pervasive networking environment, in which users' requirements for accesses and interruptions change constantly depending on the evolving situation.

DISTANCE-BASED REPRESENTATION

Push and pull, groups, notifications, and visibility
Figure 1 shows a screenshot of our prototype. In this interface, the current state of information flow is visualized as a

simple graph that consists of icons and their connections. Each icon symbolizes a user or information, while a connection between a user and information means that the user is currently associated with that information. In addition, users can make icon groups simply by locating them close together (Figure 2-c).

For senders and publishers, a connection means that the information is currently accessible to the user. For example, if Emily drops the icon "Andy" near her "address", the information becomes accessible to him, and then a new connection will appear on both their screens. For receivers and subscribers, a connection notifies them of the arrival of information. For example, if Emily drops an icon that represents her "address" near "Andy", the information is sent to Andy, and then a new connection will appear on both their screens.

In summary, users can send, receive, publish, and subscribe to information using our interface, and then browse the current status in the same interface. An information-centered representation (Figure 2-a) shows which user can access the information; a user-centered representation (Figure 2-b) shows which information is accessible to the user.

(a) (b) (c)

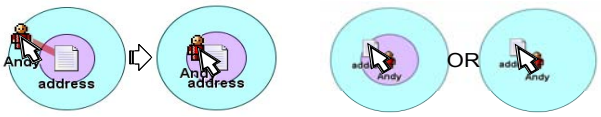
Figure 2. (a) An information-centered representation, (b) a user-centered representation, (c) A group of icons.

Access Control: Putting "Walls" around Information

Users require a permission-control mechanism for maintaining privacy or confidence, especially when publishing information. The permission-control process in our interface is illustrated in Figure 3-a. First, Emily publishes her address with an exclusive region represented as a circle around the information. Then, Andy puts his icon near the region to request permission to access the information. Finally, Emily moves the icon "Andy" into the region to give permission. She can always change the position of any icon and the radius of the circle depending on the evolving requirements. In addition, an icon with multilevel regions may provide more sophisticated mechanisms, such as the distinction between "read-only" and "editable".

Interruption Control: Putting "Walls" around Users

Users require a notification-control mechanism to avoid interruptions, especially when receiving information. The notification-control process in our interface is as described in Figure 3-b. First, Andy surrounds his icon with a personal region. Then, Emily drops her address near his icon. The system produces an aggressive notification such as a popup dialog if and only if the information has been dropped within the region. Therefore, Emily can put the icon outside the region if it is not urgent, so as not to interrupt Andy. He also can change the radius of the circle depending on the evolving requirement. A zero radius means "DO NOT DISTURB".



(a) (b)

Figure 3. Sequences of (a) permission control and (b) notification control.

PROTOTYPE IMPLEMENTATION

Our current prototype software supports files and text messages as transferable information. Because we made our interface less dependent on the implementation of information transfer technologies, it can be applied to other information sources simply by developing plug-in modules. In addition, the main window of our interface is automatically zoomed out while not editing to save screen space.

DISCUSSION

One limitation of our interface design is that it is inadequate for Internet-level use because it currently provides no way to organize huge numbers of people and information. However, we expect it to be effective if used at the intranet-level, involving limited numbers of trusted people, such as friends and colleagues. We plan to conduct a user study to determine whether and how our technique enhances information-transfer activities. The scalability issue is for future work.

Our current implementation supports only simple file sharing and text messaging. Nevertheless, the distance-based representation itself is independent of information form. We are designing other applications of our technique. For example, the collection of personal information by online companies can be visualized properly, just like file sharing, if the privacy policy is written in a machine-readable format. The goal of this work is to integrate the interface so that it can monitor various information transfers around a person, thereby allowing people to control these transfers without considering low-level technologies. Such a concept will be needed in the coming decades, as information forms become increasingly diverse, privacy threats become more serious, and interruption problems become more pervasive.

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