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A framework for presentation and use of everyday interaction histories

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Abstract　Ubiquitous computing environments allow us to collect and store a large number of interaction histories about events, objects, and people over a long period of time. Our study aims at helping people access such possibly large and complex, inherently temporal information. Our research goal is to address an issue of how to select, summarize, and present such interaction histories. In this paper, we first present a framework for incremental information presentation on demand in accessing such interaction histories. We then describe three roles of interaction histories we have identified: serving as physical cues, content cues, and social cues. We argue that such cues are helpful for decision-making in-situ. The paper concludes with a discussion of how to design an effective presentation for three cues in-situ based on the incremental information presentation framework.

1 Introduction

Ubiquitous computing implies not only ubiquity of computation in space but also ubiquity in time. Ubiquity of computation over a long period of time would allow us to access past events in a real world which we are currently not able to[1, 4].

Interaction histories accumulated and presented physically in a real environment guide our actions in our everyday life [3, 5]. For example, footprints left in a mountain help trekkers decide which path to take.

Although useful, such interaction histories are of course not in an ideal form of information presentation. They are neither persistent nor consistent, and become accessible to people only when activities leave perceivable physical traces. You cannot tell which restaurant is most popular during the day after all the customers are gone in the evening. Moreover, such vestiges, as a representation of physical interaction histories, are intuitive but often tell us no more than the existence of the events. If one is interested in knowing more about what has been happening, for instance, wanting to know who walked in that direction and why by looking at footprints in a mountain, we need to rely on other methods of obtaining information.

The goal of our research is to collect interaction histories in a real world, and present them in the site in a way that allows people to access the "right" interaction history information at the "right" time in the "right" level of detail. Our previous work [2] has explored how to present information in a real world, which poses both a design and a technical challenge to find the right balance between being informative and being obtrusive. Information presented in a real world is perceivable by a large number of people. Not all of them will find the information relevant to them. On one hand, we need to make people aware of the existence of the potentially useful interaction histories. On the other hand, we do not want to disturb people by presenting information that is not necessary or relevant to most of them. We have proposed a framework of incrementally presenting information to address this issue.

This paper further investigates the research issue by focusing on the role of interaction histories. We have identified three roles of interaction histories: serving as physical cues, serving as content cues, and serving as social cues. We describe what we mean by the three roles of interaction histories, and illustrate them with scenarios of how people would use such information in a real world setting.

2 A Framework for Incremental Information Presentation through a Real Environment

In [2], we have proposed a framework for incremental information presentation within a real environment to address the issue of finding the right balance between being informative and being obtrusive. This section briefly describes the framework.

A cognitive model of users who are to obtain information in a real world can be illustrated in following three steps.

Step 1: *to become aware of:* one becomes aware of the existence of information

Step 2: *to identify:* one identifies what the information is about

Step 3: *to examine:* one examines more details of the information

These three steps are not discrete activities but progress continuously. The process may not always proceeds step by step. In each step, a user pays an attention to the "targeted" information from the standpoint of interests and needs. If the user decides that he/she would like to know more about the information, the user's cognitive process progresses to the next step.

When a user becomes aware of the information, he/she might ignore the information if he/she does not feel a need for it. Even if he/she is interested, once he/she identifies what the information is, he/she may not need to further examine the details.

In each step, users require different information from other steps. Following three levels of information presentation correspond to the three steps described above.

Level 1: presenting the existence of information

Level 2: presenting the identification of information

Level 3: presenting the details of information

Each step requires different representation of information from the other steps because a user's contexts of information needs are different from each other. We examined requirements for each level in terms of the four spectra: push vs. pull, real vs. virtual, abstract vs. concrete, and social vs. personal. We consider that the system which presents information through a real environment should present information as follows at level 1.

- by pushing information for users to become aware of it. (*push*)
- by presenting information as a part of an environment so that users would be able to pay an attention easily. (*real*)
- by presenting information using abstract representations to let users grasp the information at a glance. (*abstract*)
- by presenting the same information equally to any users to provide socially sharable experience. (*social*)

In contrast, as the users' cognitive process progresses to step 2 and 3, users might come to realize their needs for the information clearer. Thus, the system should present interaction history information in the following manner at level 2 and 3.

- by letting users pull necessary information depending on their needs. (*pull*)
- by presenting information only to those who request it. (*virtual*)
- by presenting concrete information to those users. (*concrete*)
- by personalizing ways of viewing to help them develop better understanding of the information. (*personal*)

The framework has been developed for users to access interaction history information more naturally based on their needs and interests.

3 Three roles of interaction histories

The goal of our research is to support users make decisions-in-situ by presenting the right interaction history information at the right time at the right levels of detail. The framework presented in the previous section helps us to identify the right levels of detail. We have further explored the research issue by focusing on the issue of what is the right interaction history information that users would be benefited from.

In our everyday life, we often face the situation where we need to make decisions. Certain interaction histories might be useful for users who face a certain situation to decide next activities. However, it is difficult to seek necessary interaction histories when interaction histories become massive. Thus, the system which support users' decision-making should enable users to obtain necessary interaction histories easily and quickly.

To explore the issue of what is the "right" interaction history information for users, we have identified three roles of interaction histories for decision-making.

serving as physical cues A physical cue serves to convey information of physical interaction histories. Presentation of a physical cue allows users to have a partial understanding on what was there and what happened there.

serving as content cues A content cue serves to convey contents of objects related to interactions in the past. Presentation of a content cue allows users to deepen an understanding of the object having interacted on the site in the past.

serving as social cues A social cue serves to convey information about people involved in interactions that took place on the site in the past. Presentation of a social cue allows users to deepen

understanding of the people who took interaction.

Let us explain the three roles by using an example.

Suppose you are in a video-store and looking for a movie to rent. You have heard about the movie XYZ, but you do not really know either what the plot is about nor whether it is a good movie or not. So you direct yourself to the shelf where the movie is supposed to be, but there are no copies left. Still you are curious to know more and want to make a decision when the movie will be available.

In this situation, the *physical cue* would tell you the movie was there (i.e. the video-store has that movie); the *content cue* would tell you what the plot is about (according to the standard description provided by the distribution company); the *social cue* would tell you how many people rented that movie (and maybe also what other movies they rented or the comments they made about the movie or other).

Such cues could be generated by using interaction histories of the shelf of the rental video store. A camera recording the activities happening around the shelf might capture the picture of taking and putting of videos. The system which presents cues on the shelf can recognize at which part of the shelf a person took a video and rented it and how frequently the video was rented. These activities might be captured by a pressure sensor fixed at the shelf. Further, combination of the camera and a position sensor that a user carries might capture which user rented which video.

The next section explains how such three different types of interaction histories can be communicated with users based on the framework described in Section 2.

4 Scenarios of Using Three Types of Interaction Histories

In this section, we present scenarios illustrating how interaction histories can be presented to users differently according to the three different roles: serving as physical cues, content cues, or social cues. We use the three levels of incremental information presentation framework as described in Section 2. In producing scenarios, we use a bulletin board on a corridor of a research laboratory as an object-to-think-with.

To illustrate how technical support can be implemented, we use visible and invisible projection techniques which we call HIEI projector. The technical environment consists of HIEI projector that can project the visible and infrared image, and a camera (Figure 1). This setting enables to present three kinds of presentation as follows.

- overlaying information onto the real environment using visible light(Figure 1(a))
- presenting information on the real environment using infrared light(Figure 1(b))
- presenting information onto a handheld computer with an attached infrared camera by presenting infrared marker whose information can be decoded by the handheld computer.(Figure 1(c))

Presentation of different images to users according to level is possible by using the system.

4.1 Presenting Physical Cues

Physical cues derivable out of the interaction histories around the bulletin board include how posters have been put on the board and how frequently they have been replaced. Figure 2 shows an example implementation of the three levels in presenting physical cues.

When the system presents physical cue incrementally in such design, both current notices and past notices come into users' range of choice simultaneously. Users who become aware of the image shown in Figure 2(left) may want to see past notices. Such users can see and browse the summary of notices as shown in Figure 2(center) through a handheld computer with an attached infrared camera. After that, if users chose necessary past posters, they can see them as shown in Figure 2(center) on the handheld computer.

4.2 Presenting Content Cues

Content cues derivable out of the interaction histories around the bulletin board include what conference posters have been put and when. Figure 3 shows an example implementation of the three levels in presenting content cues.

The color of the spot shown in the Figure 3(left) tells users which posters are classified into which categories, so that users who look for posters related to their interests can become aware of such posters by seeing spots. Users who want to narrow down the posters in terms of their contents can filter out the posters by seeing the summary of contents projected by an infrared light. Users who want to obtain more concrete contents which are relevant to the poster can see web pages of the conference presented by the poster. Obtaining details of the content through three levels of content cues enables users to deepen understanding of presented poster.

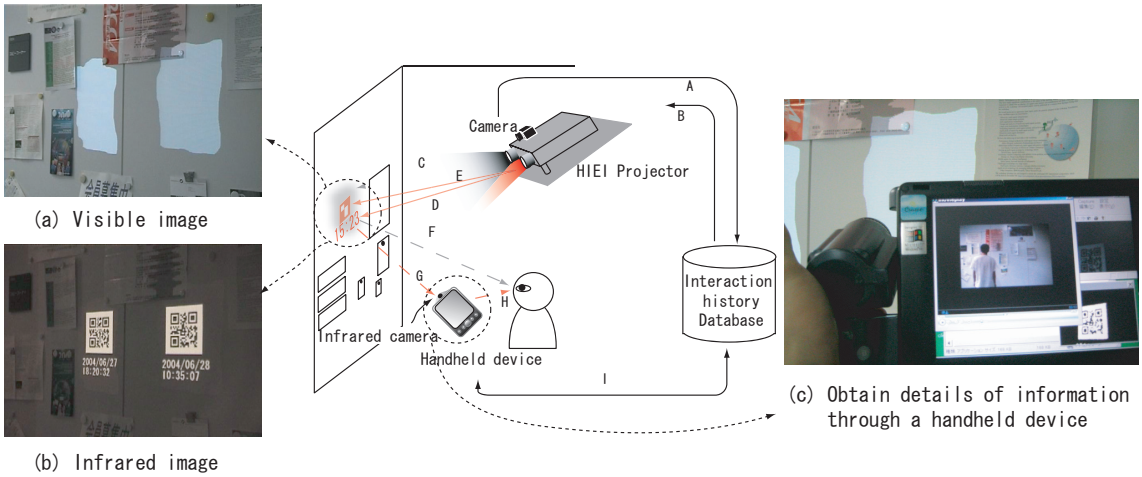

Figure 1: Architecture of the system

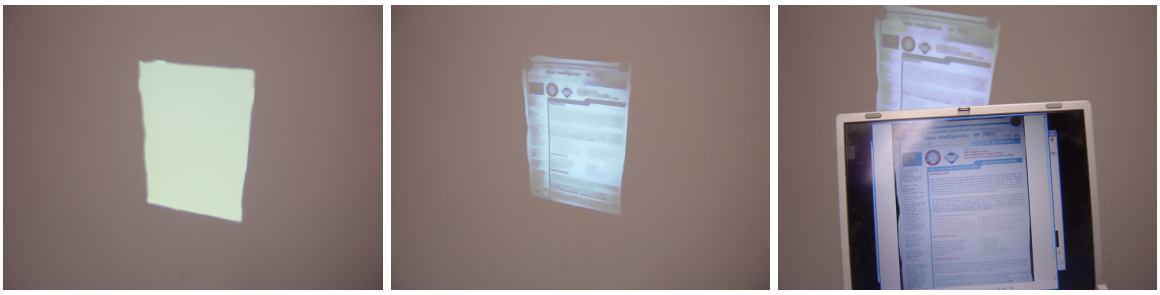

Figure 2: An example of physical cues

4.3 Presentation of social cue

Social cues derivable out of the interaction histories around the bulletin board include how many people have stopped at which posters or which posters have been more popular than others. Figure 4 shows an example of a presented image as social cues.

Such cues enable users to select posters which others frequently accessed and earnestly watched. The image shown in Figure 4(left) indicates that the people have stopped there recently, so that users can become aware of the existence of past browsing by some people. The image shown in Figure 4(center) indicates that the frequency of browsing. Users who become interested in social cues at level 1 can see the frequency of accessing each posters. Finally, users who want to obtain more social cues can obtain actual movies in front of the poster. Therefore, users can obtain details of social cues, such as which part people directed their attention to and to what extent people browsed it earnestly.

Thus, presentation of each cue allows users to incrementally obtain necessary type of cue according to their needs and help them make a decision. Representation of each cue described in this section is just one example of presentation. We will plan to investigate how each cue should be presented at each level.

5 Conclusion

In this paper, we introduced incremental information presentation framework and described three roles of interaction histories we have identified: serving as physical cues, content cues, and social cues. We also illustrate them with scenarios of how people would use such information in a real world setting. To evaluate our framework, we will plan to apply our framework to interaction histories of other domains.

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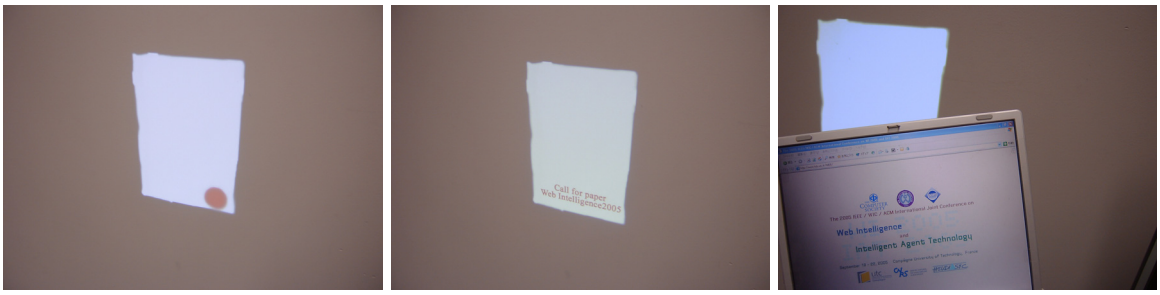

Figure 3: An example of content cues

Figure 4: An example of social cues

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