iFlashBack: A Wearable Electronic Mnemonics to Retain Episodic Memory Visually Real by Video Aided Rehearsal

Yoji Hirose*
Sony Ericsson Mobile Communications Japan, Inc.

Yasushi Ikei†
Tokyo Metropolitan Institute of Technology

Koichi Hirota‡
The University of Tokyo

Michitaka Hirose§
The University of Tokyo

ABSTRACT

This paper describes a wearable electronic mnemonics, the *i*FlashBack system that promotes human memorization process for the action the user performed in the real-world. The goal of the system is to exploit unlimited capacity of the human brain for storing the variety of information, by assisting memorization using recorded video and related information captured during interaction process to real-world objects. Memorization reinforcement is achieved by drawing attention, promoting rehearsal by flashing a video of interaction, and organizing memory by providing relevant information. The action of the user is captured by a cap-mounted miniature camera, an RFID reader, and arm posture sensors worn by the user. For video-aided rehearsal, a small HMD presents the captured scenes immediately after the user's interaction behavior and/or at appropriate times in the user's activity. We conducted basic experiments to demonstrate our idea. Two memory tasks—to change cup positions within grids and to memorize random dot images—were performed by subjects. The results suggested that the *i*FlashBack system could reinforce memorization of the user's action by motion-controlled video aided rehearsal.

CR Categories: H.5.1 [Information Interfaces and Presentation (e.g., HCI)]: Multimedia Information Systems—Artificial, augmented, and virtual realities; H.1. [Models and Principles]: User/Machine Systems—Human factors

Keywords: memorization aid, video aided rehearsal, motion controlled video, electronic mnemonics

1 INTRODUCTION

Human performs intellectual works using various information materials distributed in the real world. Collecting arbitrary materials timely from such vast distribution is essential for high productivity of the work. So quick access to information materials has been assisted by computers principally in a way that the computer holds information inside and provides interface to that for the users. Sometimes the computer helps the user search outside the computer as a sensor to the real world; in the both cases the computer do provide information when the user requested. This is one approach of computational memory aids where the computer needs to equip efficient dialogue interface for the user to retrieve information. However it is not easy for computers to handle and find information distributed in the real environment.

Another approach is the computational promotion of human memory[1]. Since information is used by the user eventually, the best way is to store it in the human memory. At least a variety of cues stored for the information are very effective for the approach of computational augmentation as well, since they accelerate the dialogue with the computer.

In this paper we introduce the *i*FlashBack, a wearable electronic mnemonics that promotes human memorization process of the user's 3D action to interact with real-world objects. The objects are those the user handles in the everyday work environment, such as books, magazines, papers, business documents, stationeries, information devices and appliances, etc.; these are indispensable for our everyday intellectual activities. Usually we arrange them in the 3D real environment so that we can access them physically and cognitively effortlessly using spatial features. However, as the amount of objects grows enormously, to memorize all of these information media without any assistance becomes very difficult, which limits efficient intellectual production.

The *i*FlashBack provides a memorization aid by a playback of recorded video in order to draw attention and promote rehearsal of the user's action which constitutes one of strong retrieval keys for episodic memory. The interaction of the user to the object is captured by a camera, RFID readers and arm posture sensors attached to the user and the environment. The captured video is played back with potentially relevant information at appropriate times to the user for effective rehearsal (video-aided rehearsal) to promote memorization of the action. The user's action in the real environment observed at his/her eye point is presented visually to the user by an HMD to relive that action twice or more. This flash video of physical interaction reinforces the reality of the episodic memory in his/her mind.

2 WEARABLE ELECTRONIC MNEMONICS

The *i*FlashBack system is depicted in Fig. 1. The system observes the user's behavior handling objects in the real world, and presents cues in the course of action. The cues are built primarily based on the captured interaction records such as visual scenes and sounds the user saw and heard when he/she manipulated the objects. In this form we expect memorization aid works in the two aspects–drawing attention and promoting rehearsal–for enhancing memory retrieval.

Objects handled are labeled and identified by RFID tags or 2D codes that are read by a tag reader or a camera the user wears. The interaction process is segmented based on the tag detections. The cues are presented either during the interaction, immediately after the interaction, and at any adequate time scheduled for optimal rehearsal or when the user prefers reviewing the action.

3 EXPERIMENT ON OBJECT SHIFT MEMORIZATION

A memory test experiment was performed to investigate the effectiveness of a video flashback in promoting memorization of object shift in the work space. Since any specific meaning of a task would affect both the strength and strategy of memorization, a meaningless task was used to reduce those effects so that characteristics of visual presentation forms should be discussed independently from semantic meaning of the task.

*e-mail: Yoji.Hirose@SonyEricsson.com
†e-mail: ikei@computer.org
‡e-mail: hirota@cyber.r-cast.u-tokyo.ac.jp
§e-mail: hirose@cyber.r-cast.u-tokyo.ac.jp

IEEE Virtual Reality 2005
March 12-16, Bonn, Germany
0-7803-8929-8/05/$20 ©2005 IEEE

Proceedings of the IEEE Virtual Reality 2005 (VR'05)
1087-8270/05 $20.00 © 2005 IEEE

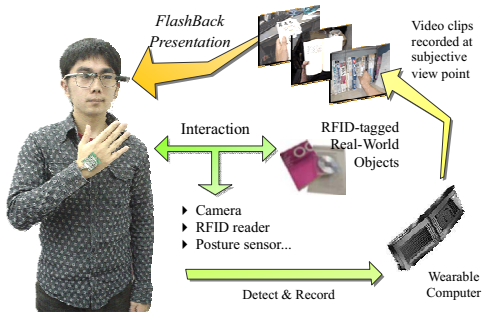

Figure 1: *i*FlashBack system. Interaction scene video is replayed at the HMD to reinforce the visual memory as a retrieval key.

The subject was asked to move an object arranged randomly within a test grid on a table to any position in a grid on the other table and to memorize the object and the two (start/end) places. This task models a general situation found in our daily activity to handle physical information source objects. In this experiment, colored paper cups were used as model objects. The *i*FlashBack system recorded the subject's view and timestamps when the subject picked up a cup and released it. A video clip was extracted immediately based on the timestamp and presented to the subject. This video clip provides the subject the chance of visual rehearsal for his/her action. After five trials, free recall was requested to reproduce the cup shifts.

3.1 Three Video Presentation Forms

Captured video scenes were edited in three ways—Normal, Enhanced, and Still–by a notebook computer in real-time. The outline of video forms is depicted in Figure 2. Normal video is an untouched segment recorded during the transfer of a cup. Enhanced video consists of three parts, a pick-up segment, a walk segment and a release segment. The pick-up section is a slow-motion playback of the first 10 percent segment of Normal video. The frame speed is reduced to a half of real-time. The release section is made from the last 10 percent segment in the same way as the pick-up section. The walk section is a shrunk frame of the middle 80 percent. The frame speed is four times faster and the duration is 20 percent of the original length. The total duration of the Enhanced video is 60 percent of the original. Still (freeze-frame) video is made of two frames extracted from the original. The two frames about 0.2 second before the grasp of a cup and after its release were extracted and given the duration of 30% of the normal video for each frame.

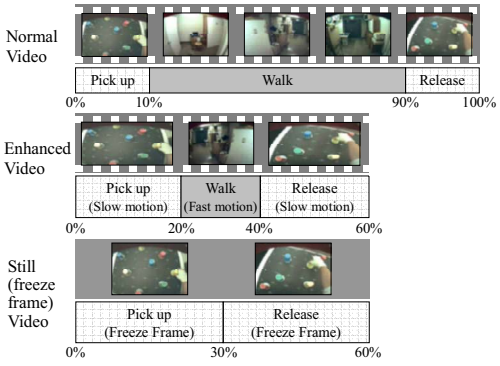

Figure 2: Three video formats. *'Enhanced'* means slow- and fast-motion controlled. *'Still'* consists of two frames.

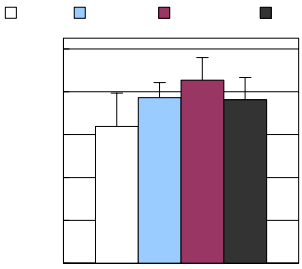

Figure 3: Free recall performance of the cup shift task.

3.2 Results

Figure 3 shows the mean score (with SD in an error-bar) of recall performance for twelve subjects. One hundred marks mean that the subject could perfectly recall and trace back 5-time transfers of cups. A near miss recall (next to the correct answer) scored a half, and a one-end right answer was given a quarter. The score of no flashback ('nOne') was significantly lower than the other three modes with video playback, which indicates that the video flashback-aided rehearsal was effective and it could assist the memorization of the subject. Among three video presentation modes, the Enhanced mode was significantly higher than the Normal- and Still-modes based on the LSD (Least Significant Difference) method ($p < 0.05$). The difference between the Normal- and Still-modes was not significant. This result clearly demonstrated that the subjects could accomplish effective rehearsal using the video flashback specifically with the Enhanced-mode.

Subjective evaluation by a questionnaire was performed after the sessions. The Enhanced mode was the most supported presentation by the subjects. They reported the Enhanced mode gave the easiest view to remember cup positions and directed hand motions while reducing a less important segment of walking although it contributed for showing the continuous action of the user.

4 Conclusion

We have developed the *i*FlashBack system and demonstrated the effectiveness of its video-aided rehearsal in the model task. Another experiment, although not included in this paper, performed on a memory task to recall random dot patterns on pages also indicated remarkable increase in performance with the *i*FlashBack system.

The *i*FlashBack system looks potentially promising in various application areas that involve intellectual production, education and rehabilitation. We will continue to elucidate the characteristics of the video-aided memorization to find more video formats easy to remember for effective rehearsal. Currently, very little is known about the memorizability of digital videos that have recently obtained diverse modification capabilities based on the modern video editing technology.

In addition, the system devices still need more flexible control options to enable versatile applicability to the human actions and objects. The presentation design should permit more flexible timing, caption on the video, and multi-modality displaying.

References

[1] Yasushi Ikei, Yoji Hirose, Koichi Hirota, and Michitaka Hirose. iflashback: A wearable system for reinforcing memorization using interaction records. In *Human-Centred Computing*, volume 3, pages 754–758, 2003.