t-Room: Remote Collaboration Apparatus Enhancing Spatio-Temporal Experiences

Keiji Hirata, Katsuhiko Kaji, Yasunori Harada, Naomi Yamashita, Shigemi Aoyagi
NTT Communication Science Laboratories
2-4, Hikaridai, Seika-cho, "Keihanna Science City", Kyoto 619-0237, Japan
{hirata,hara,aoyagi}@brl.ntt.co.jp, {kaji,naomi}@cslab.kecl.ntt.co.jp

ABSTRACT
In this paper, we describe the overall design of the remote collaboration apparatus t-Room and present three applications: playback of a recorded scene using a hand controller, an elevator effect at scene change, and remote golf lessons. These applications are realized by the high controllability and flexibility of the t-Room system, and they can provide the user with a novel type of spatio-temporal experience.

Author Keywords
Presence Disparity, Surrounding Back Screen, Video-Mediated Communication.

ACM Classification Keywords
H5.2 [Information interfaces and presentation]: User Interfaces. - Prototyping.

INTRODUCTION
We are developing the video collaboration system t-Room using shared video screens [2,8]. Our aim is to help users overcome spatial and temporal barriers in collaborative communication and, furthermore, use t-Room as a medium for content production.

Systems employing a shared video screen method include VideoDraw [7], ClearBoard [3], Agora [4], and VideoArms [6]. However, these systems merely project a part of a scene or perspective in a room to the screens of the other rooms, so the reciprocity of perspective [1] does not hold (i.e., the presence-disparity problem occurs [6]). To resolve this problem, t-Room encloses a user space with surrounding large LCD displays showing life-sized images. The enclosed space is shared with other enclosed spaces by overlapping it onto them. Moreover, with this setup, t-Room can preserve the spatial relationships existing between moving people and objects (i.e., spatial cues).

In addition, by introducing recording and playback capabilities of the activities that occur within the entire space, t-Room allows asynchronous communication to overcome temporal barriers, in the manner of e-mail, blogs, telephone answering machines, and video submission sites [5]. In the asynchronous communication, a referencing (e.g., quotations in e-mail and citations in blogs) realized by the recording and playback capabilities plays a significant role for facilitating interactivity across time. So, we expect that the combination of surrounding shared video screens and the recording and playback capabilities may lead to a novel type of spatio-temporal experience that can be used, for example, in content production with non-verbal skills.

T-ROOM ARCHITECTURE
Figure 1 illustrates our method for reproducing face-to-face interaction among persons A, B, and C; we duplicate a space and project remote users' images to surrounding back screens [2]. For each room, we alternatively arrange three screens and three cameras to surround a user, who stands just in front of a screen. The preprocessing denoted by ⊟ and ⊞ in the figure is needed. The function of ⊟ is to extract only the light from real objects in front of the opposite screen and to cancel the light from the screen (visual echo canceller). That of ⊞ is to overlap or superimpose more than two images captured in Rooms 1

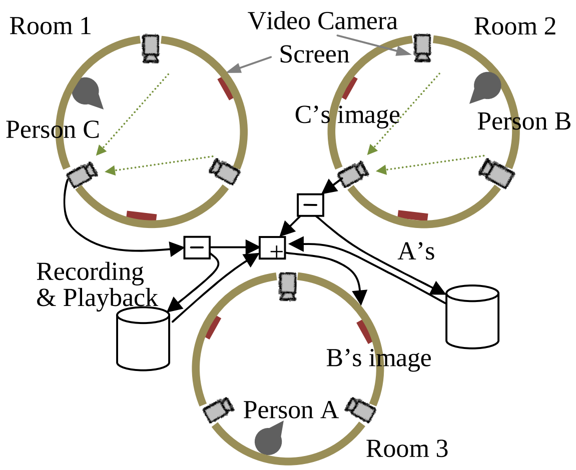

Figure 1: Duplicating space and projecting images to surrounding back screen

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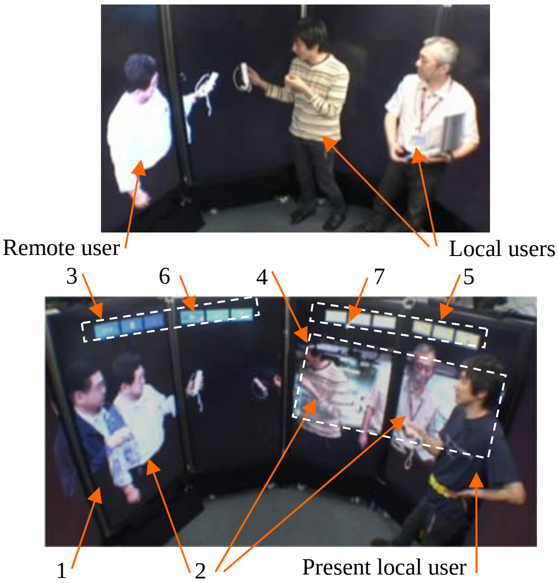

Figure 2: (Top) Recorded scene. (Bottom) Playback with recorded scene using hand controller

and 2 to correctly place images where they should be projected (overlapper). As such, the video camera capturing B is, for example, distributed to Rooms 1 and 3, but detailed illustration of the entire wiring is omitted for simplicity. For recording and playback capability, the output of a visual echo canceller is stored. When later accessed, the stored data is put into an overlapper.

SPATIO-TEMPORAL EXPERIENCES

We present three applications for demonstrating the controllability and flexibility of the t-Room system, each of which supports spatio-temporal experiences. A single t-Room consists of eight 65” LCD panels and eight HDV cameras, which are arranged decagonally.

Playback Using Hand Controllers

Figure 2 shows that users can control playback with hand controllers. In the bottom snapshot of the figure, seven objects are displayed on the screen: 1) present remote user, 2) users in the recorded scene, 3) operation buttons for controlling playback of the recorded scene, 4) video player window, 5) operation buttons for the video player, 6) pointer image of the present local user’s hand controller, and 7) pointer image of the present remote user’s hand controller.

Elevator Effect at Scene Change

We implemented a function of moving the scenes projected on screens upward or downward, which gives users a feeling of movement, as if they were in a transparent elevator car (Figure 3).

Figure 3: Scene movement giving a feeling as if elevator goes downward

Remote Golf Lesson

Figure 4 shows a snapshot of a remote lesson in swing-form as a golf skill. The activities, such as gestures, finger pointing, and body movements by an instructor and a student, as well as playback used at that time, are all recorded for a later playback by someone else.

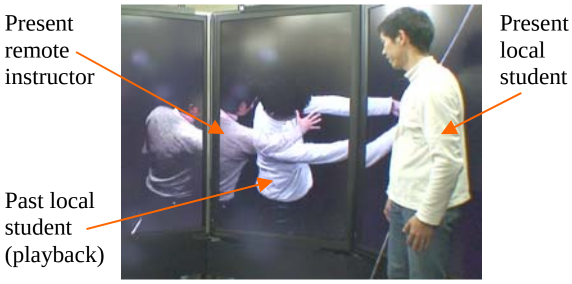

Figure 4: Remote instructor gives a swing-form lesson to the in-place playback of student’s swing

CONCLUDING REMARKS

While building the applications briefly presented in this paper, we conduct experiments and user studies in the t-Room from the viewpoint of CSCW; such studies are involved with the presence-disparity problem, seat position [8], and spatial cues exchanged among moving users. We believe that the results of such experiments and user studies will be reflected in the rich spatio-temporal experiences provided in the t-Room.

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