Tabletop Display System Connected with Olfactory Display

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Abstract

An olfactory display is a device that delivers smells to the nose. It provides us with special effects, for exa mple to emit smell as if you were there or to give a trigger for reminding us of memories. The author s have developed a tabletop display system connecte d with the olfactory display.

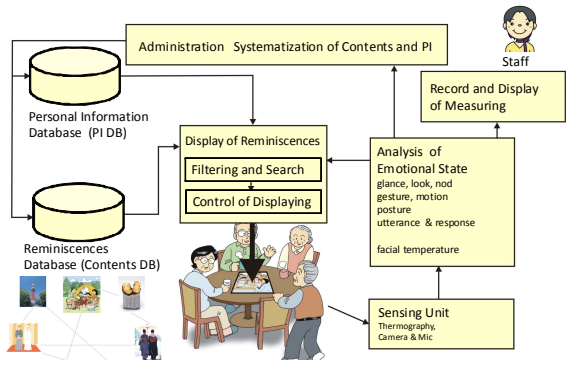

Fig. 1. Cooperative work of life review activity.

1. Introduction

The authors have researched multimedia system and support system for nursing studies on and practices of reminiscence therapy and life review therapy. The concept of the life review is presented by Butler in 1963. The process of thinking back on one's life and communicating about one's life to another person is called life review[1)]. A therapist must keep a record of sessions for inspection of methods and ways of valuation on reminiscence and life review therapy, but it is trouble for the therapist to record. The aim of research is to develop the support system which can automatically give an optimum topic and write down a session report about the activity. This life review is often assisted by aids such as videos, pictures, objects, archives and life story books, as shown in Fig. 1, in order to make an opportunity of talking. We want to develop an omni-directional display system for cooperative activity on a round table to enable all-around viewing and unification of media contents by an electronic form. There is a famous episode concerning the memory. It is called as Proustian effects. This effect is mentioned on the Proust's novel as an episode that a story teller reminds his old memory when he dipped a madeleine in tea. So many scientists research why smells trigger the memory. The authors pay attention to the relation between smells and memory although the reason is not evident yet. Then we have tried to add an olfactory display to the multimedia system so that the smells become a trigger of reminding buried memories.

2. Life Review Activity

The life review activity has been defined as the vocal or silent recall of events in a person's life, either alone, or with another person or group of people. This life review therapy consists of three phases. The life review activity is generally assisted by aids such as videos, pictures, objects, archives and life story books. The first phase is to prepare these aids and to plan activities of the therapy. The second phase is the main part of an activity on a group work. In this phase, the activity of thinking back on one's life and communicating about one's life to another person is performed and a therapist writes down a record of this activity simultaneously with the progress of an activity of the therapy. The last phase is an evaluation. This phase is to examine the process and outcomes of life review therapy using the record of an activity.

The frame of the analysis in the reminiscence therapy is the following element; nonverbal behavior, verbal behavior, an element related to function of the

reminiscence, an element related to kind of memory and interpersonal relatedness in the group and so on. There is sense in continuing and making good use of progresses and results of the reminiscence in a group on the actual spot in hospice care. On the reminiscence therapy and life review therapy, it is one of the important things to analyze the sessions after the activity for an effective therapy. Moreover, it is necessary for therapists to make the best use of analyzing results and records about the sessions of life review activities in order to make progress of their technique on progressing the sessions. In addition, it is useful also to show trainees the site and the situation of a reminiscence activity for bringing up young or new therapists on training. So the authors have developed the replay system which can reconstruct sessions of the reminiscence activity.

The authors have researched a support system of the reminiscence and life review activity. Fig. 1 shows an outline of our support system. This system consists of three main functions; multimedia systems, an analyzing system and a recording system. We have set three goals of this research. One of the goals is to construct an automatic generating system of reports about life review activities. A therapist must keep a record of sessions for inspection of methods and ways of valuation on reminiscence and life review therapy, but it is trouble for the therapist to record. To overcome this problem, we have developed the support system which can automatically write down a session report about the activity. The other target is a conversion to electronics (electronic form) of presenting reminiscences. The life review activity is generally assisted by aids such as videos, pictures, objects, archives and life story books. The authors tackled an adaptive presenting system using multimedia systems, sensing units and an analysis algorithm of emotional states in presenting reminiscences. The aim which is described in this paper is to build an automatic review system of an activity of the reminiscence therapy. Because it is important to review the sessions after the activity for an effective therapy on this activity of therapy. In addition, the record of the sessions of life review activities is made the best use in order to make progress of technique on progressing the sessions and to bring up young or new therapists on training.

3. Activity Replay System

The authors have been developing a replay system of sessions on the reminiscence activity using functions of ARToolKit. On a session of the activity in the life review therapy, a therapist executes an activity using pictures on the round table. Fig. 2 shows the brief illustration of the life review therapy. As shown in Fig. 2(a), there are two markers or more on the table. One is a fixed marker for datums. Others are movable markers for the object recognition. These markers are attached on the pictures (In Fig. 2(a), the markers are drawn only for the simplification). At the session of the activity in the life review therapy, a therapist and participants move and rotate a picture on the table. As the result, it is important for object recognition to track the maker which is attached on a picture as shown in Fig. 2(a). At the same time, a camera shots a marker as a datum point and a picture. The system program calculates and records the position and motion of a picture on the table. As shown in Fig. 2(b), the positions and the attitudes of virtual markers are calculated using coordinate transformation equation. Therefore a 3D graphics generator can overlay CG (Computer Graphics) objects on the virtual markers. Then you will see a computer generated 3D object overlaying the invisible marker which is the same position of an actual marker at recording. At the reconstructing part, a virtual object, *i.e.*, a picture used at the session, is overlapped on the scene which is captured by a camera. Using this reconstruction system, therapists can review their executed sessions of reminiscence activities for improving their capability. At the different time or place, trainees can acquire a technique of session progressing on life review therapy using the situation actually executed.

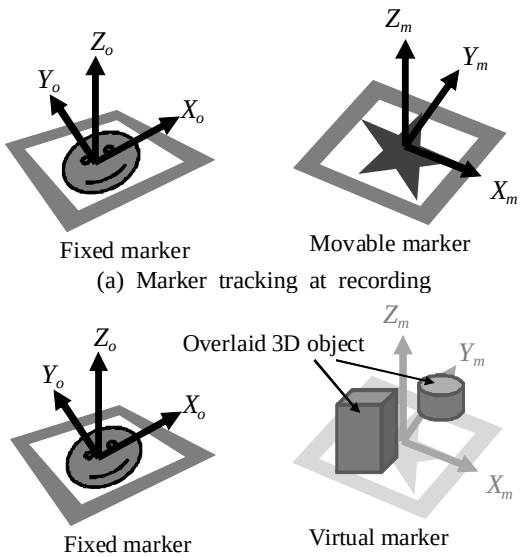

Fig. 2. Marker tracking at recording and replay.

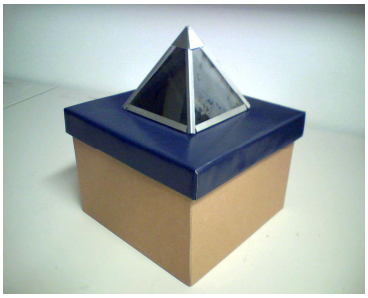

Fig. 3. Display system KNB-10.

Fig. 4. Display system KNX-30.

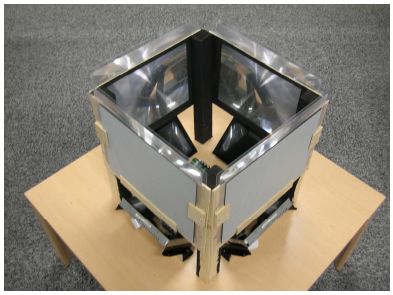

Fig. 5. Display system KNX-35.

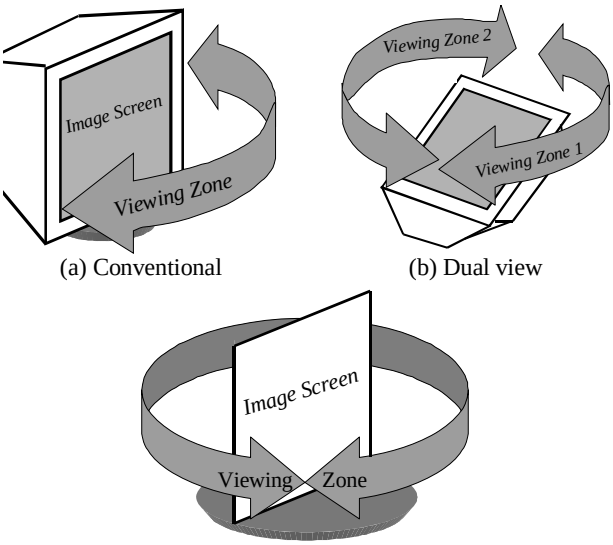

Fig. 6. Viewing zones of our display systems.

4. Display Systems

To work collaborative tasks on the round table, the authors have developed tabletop display systems as shown in Fig. 3, 4 and 5. An all-around 360 degree viewing display system can be viewed from any direction (*i.e.*, the display has a 360-degree viewing angle). We have ever researched 3D display systems using the polarized glasses and the liquid crystal shutter glasses, the image splitter such as a parallax barrier or a lenticular screen and the holographic optical elements[2)3)4)]. However, a conventional monitor display is viewed from one direction, that is, the display has narrow viewing angle and observers cannot view the screen from the opposite side. Hence we developed a tabletop display system for collaborative tasks cooperated by two users[5)]. This tabletop display can provide different images to two users surrounding the system utilizing the image splitting technologies for displaying a stereoscopic 3D image. The viewing zones of these displays are shown in Fig. 6. But screens on the monitor cannot be viewed correctly by all users from any direction. Thus, conventional display systems enable users not to do collaborative tasks on the round table.

To solve this problem, we developed the 360 degree viewing system. As shown in Fig. 3, our developed a 4-views display system consists of four LCD panels and a square pyramidal optical screen. A layout of display unit is constituted of four panels. And a square pyramid works for generating four virtual screens above original positions of the actual display panels. To enable all-around viewing from four directions, a virtual screen is generated and floating above the top level of an actual display panel. Many techniques have been ever proposed in order to float images and locate pseudo images at different places from original positions. To simplify an optical layout, the authors utilize a grating sheet. The grating sheet provides a diffracted image which is arranged under or above original position. Thus this grating sheet diffracts or scatters a light beam with a designed angle. This interesting phenomenon reminds us of method to shift image positions by a simple optical layout. Meanwhile a floating display generates a touchable virtual image in the air above the table. This 3D technique, frequently used in exhibitions and magic shows, employs a convex lens or concave mirror to form a realistic image close to the observer. This technology typically uses 2D images for dynamic image-floating systems. A floating lens generates tangible virtual image in the air.

This principle of imaging is based on the optics of a convex lens. Note that each lens has two focal points - one on each side of the lens. The lens converges the ray at the focal point. The generated image by the lens screen can be observed at the restricted regions where an observer watches the floating image and the lens on a straight line. The display systems shown in Fig. 4 and 5 utilize this floating image principle of the convex lens. An olfactory display can be attached to these displays for providing environments as if you were there.

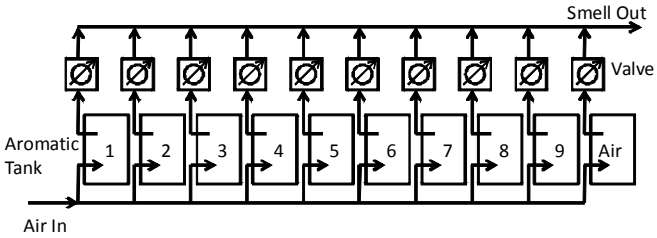

Fig. 7. Air circuit.

Fig. 8. Appearance of olfactory display(KNO-01).

Fig. 9. Olfactory display unit(KNO-115).

5. Olfactory display

Involuntary memory is a concept articulated by the French writer Marcel Proust in his novel "In Search of Lost Time." The most famous example is the "episode of the Madeleine." In this novel the narrator experiences an awakening upon tasting a madeleine dipped in tea. Involuntary memory is a conception of human memory in which cues encountered in everyday life evoke recollections of the past without conscious effort. Thus the smell is implicated with the memory. The authors developed a prototype olfactory display system. Our developed olfactory display system consists of an air blower, ten aromatic tanks and valves as shown in Fig. 7. Airs flow into the aromatic tanks from the blower and smell goes out through the valve. This ten valves system can output nine flavors because one air valve is used for making no smell so as not to block an air flow. Each valve is controlled by a signal from the Windows PC through RS-232C serial interface. Fig. 8 shows an appearance of our developed prototype olfactory display system. Thus the olfactory display is a device that can generate smelled air with a trigger of reminding a forgotten memory, and deliver it to an observer's olfactory organ. Fig. 9 shows the newly developed olfactory display system.

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