

Tabletop Life Review Therapy System Using Olfactory Display for Presenting Flavor

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Abstract— 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. 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, 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.

Index Terms—life review therapy, group work, interaction system, tabletop display, olfactory display

I. INTRODUCTION

The authors have researched a multimedia system and a support system for nursing studies on and practices of reminiscence therapy and life review therapy. The concept of the life review is first presented by Butler in 1963. Afterward many kinds and types of study in this field have appeared and developed. However these studies only involve methods of its application as nursing intervention in order to understand patients and to apply theories to nursing care. In hospice care and in many nursing homes, the process of thinking back on one's life and communicating about one's life to another person is called life review [1].

The authors have researched a support system of the reminiscence and life review activity. Fig. 1 shows an outline

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of our support system. This system consists of three main functions; multimedia systems, an analyzing system and a recording system. The life review activity is generally assisted by aids such as videos, pictures, objects, archives and life story books. We have set three goals of this research. The first target is a conversion to electronics (electronic form) of presenting reminiscences. The authors tackled an adaptive presenting system using multimedia systems, sensing units and an analysis algorithm of emotional states in presenting reminiscences. The second aim 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. To overcome this problem, we have developed the replay system of an activity on the life review therapy using mixed reality technology, which can reproduce a situation during the executions of the reminiscence therapy at a difference place later. A goal of our research 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. In this paper, we describe the flat-type tabletop display system which can deliver some flavor for making a trigger of memory.

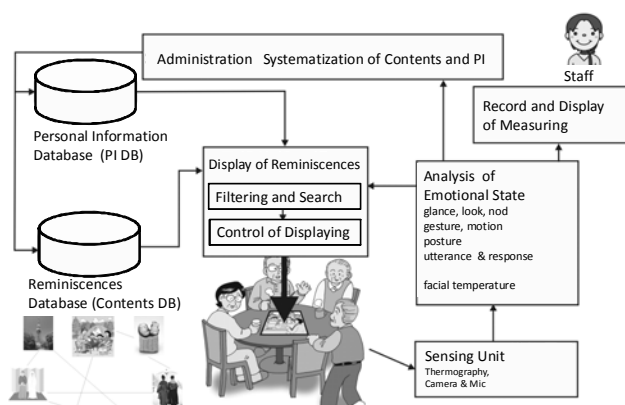


Fig. 1. Support system of life review activity

II. BACKGROUND

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. Therefore it is important to write down a session report about the activity.

There are three kinds of records which are used during the executions of the reminiscence therapy. One is records about individuals. Next is record about the whole of a group. The rest is record of the situation of participation. The individual record involves eight items; contents of a reminiscence, a frequency of remarks, an opinion of a linguistic expression, an opinion of a non-linguistic expression, an interrelation between members, a satisfaction rating, a role and a comparison with activity in daily life. A passage record of the group work is written about feature actions and expressions of the individual member in separately for the introductory part of the reminiscence and the development part of the reminiscence. Moreover this record involves the theme of reminiscence, materials and tools used in reminiscence therapy and an atmosphere of the entire group. An analysis record of a group is written about the development part of the reminiscence in the following viewpoints; contents of reminiscence, an atmosphere of the entire group, a unity of the group, a role and a standard in the group, an interrelation, a phase of the group activity, a catharsis, changing of a reader ship and a co-reader ship. The situation of participation is written about a frequency of participating. These records are important for inspection of methods and ways of valuation on reminiscence therapy. However it is trouble work for therapists after they accomplished sessions of therapy. So the authors have developed the support system which can write down a session report about the activity automatically.

III. 2-VIEWS DISPLAY SYSTEM

The authors firstly developed the dual views display system [2]. This dual views display enables two users to provide different images on the screen. Using this display system, each user can perceive the correct screen image without upside down images. The dual view display produces the collaborative task environment for two users.

The dual views display system can provide different images to another user surrounding the table as shown in Fig. 2. When the user2 sits down opposite the user1, each user must view the different image so as not to perceive upside down images. The display image consists of the text area and the regions of graphics images such as a figure and a picture. Each user can view the graphics image at the same position on the table. Then each user can indicate the figures and pictures. The text character automatically rotates inside the text area according to the viewer's position. Each user can understand the notes connected with the figure.

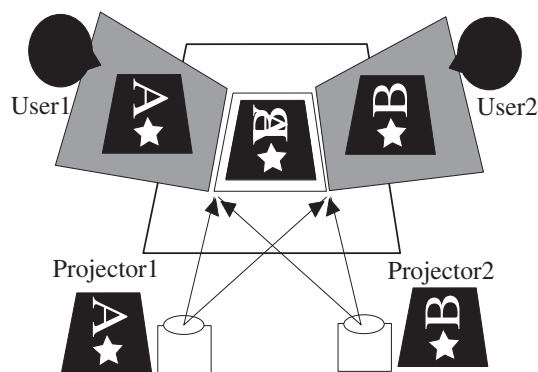


Fig. 2 Desktop dual views display

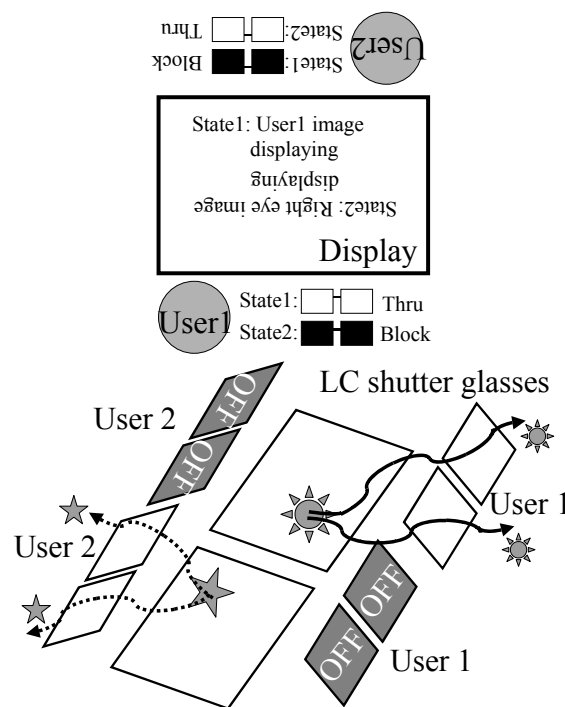


Fig. 3 Special glasses required display system

We developed the prototype display system which consists of a conventional glasses displaying system. This system

requires viewers to wear special glasses to see images. As shown in Fig. 3, the developed display KNX-130 is constituted of a liquid crystal(LC) shutter glasses. A time sharing method by LC shutter has realized the image separation for both users. This use value is the display system can provide different images to another user surrounding the table. When the user-2 sits down opposite the user-1, each user must view the different image so as not to perceive upside down images. This display can provide unique images for both users. Fig. 4 shows the appearance of trial display system.

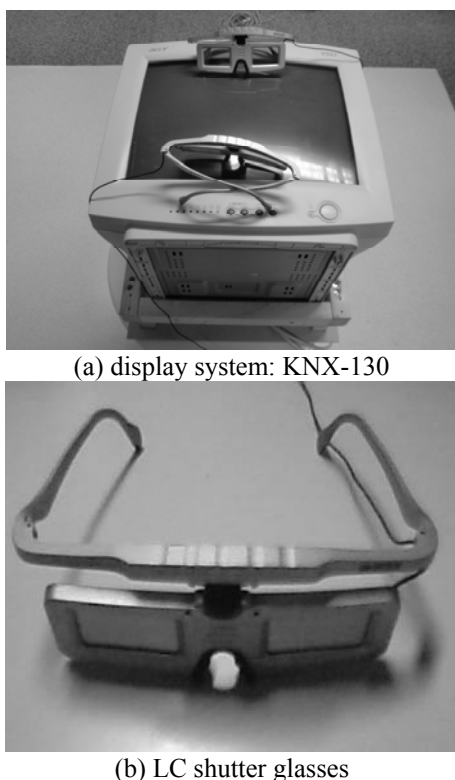


Fig. 4 Appearance of LC shutter glasses type display

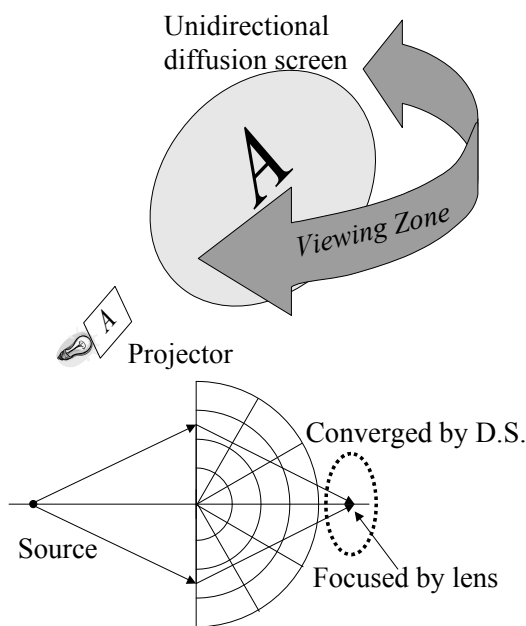


Fig. 5 Unidirectional diffusion screen

IV. ALL-AROUND VIEWING SYSTEM

A. Unidirectional Diffusion Screen

The authors 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 [3][4][5]. We can apply image separation technology of these 3D displays to the tabletop display system, which can deliver each image into appropriate observers around the table. To deliver dual view images, the display provides different images for observers according to the direction of viewing. The display needs to restrict a viewing zone in the space. The unidirectional diffusion screen can show the image on the screen at an only particular viewing position as shown in Fig. 5. The principle of restriction 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 as shown in Fig. 5. The projected image on the lens screen can be observed at this focal point. The focal point is very narrow, but the unidirectional screen has a wide viewing zone for convenience at the observation.

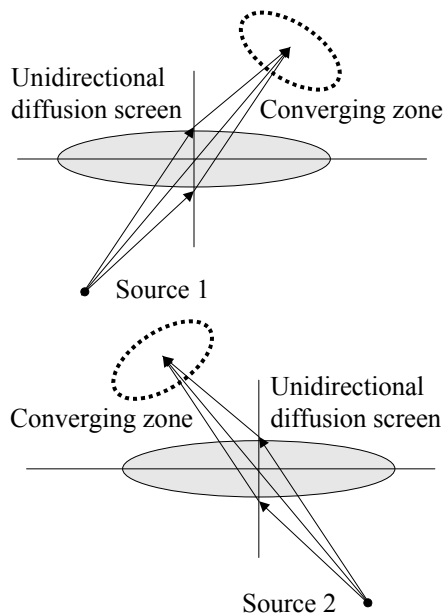


Fig. 6 Projection image on the unidirectional screen

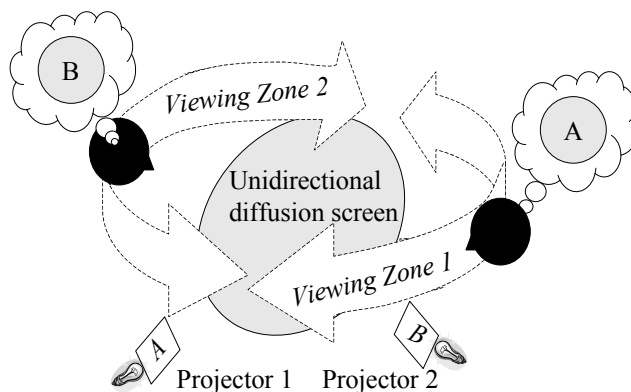


Fig. 7 Viewing zones of display

The convex lens serves to direct each image into the specific direction. The image separation of the unidirectional screen is also based on this principle as shown in Fig. 6. Fig. 7 shows the principle of displaying dual images. As shown in Fig. 7, two different images are overlaid on the same screen; for example, characters 'A' and 'B'. But the screen splits the overlapped image into two original images according to the direction of projection unidirectionally. Then each observer correctly perceives a separated original image respectively.

To prevent upside down imaging, we need to prepare the different two images. Fig. 8 shows an optical layout of the dual views display. As shown in Fig. 8 two different images are overlaid on the same screen; for example, characters '文' and '字'. But the screen splits the overlapped image into two original images according to the direction of projection unidirectionally. Then each observer correctly perceives a separated original image respectively.

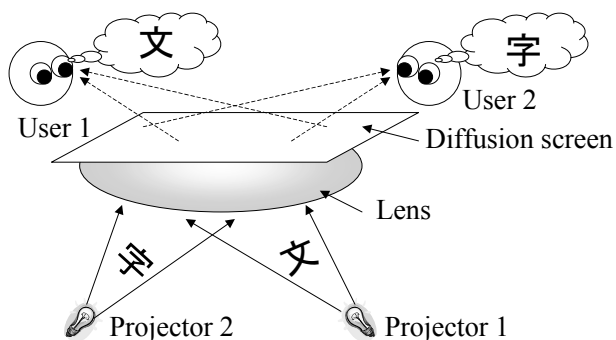


Fig. 8 Displaying dual images

different images into appropriate eyes, we use a view control film "LUMISTY™". The LUMISTY film is produced by Sumitomo Chemical Co., Ltd. Using this film, you can see through the film from the left, but not from the right as shown in Fig. 9. One of the miraculous features of LUMISTY is that it can be either transparent or opaque, so that it looks either like transparent or frosted glass, depending on the angle of sight. It is an adhesive-type transparent plastic film which can be used simply by sticking onto a windowpane, and it does not cut out any of the light coming through the window.

It is useful characteristics for dual viewing that you can control what can and what cannot be seen depending on which side the viewer is on, or what angle the viewer is looking from. Using the miracle of this LUMISTY visibility control as shown in Fig. 10, it enables us to separate overlapping projected images into different observers; *i.e.*, User1 and User2. As shown in Fig. 10, the view control film passes the light within an angle of θ .

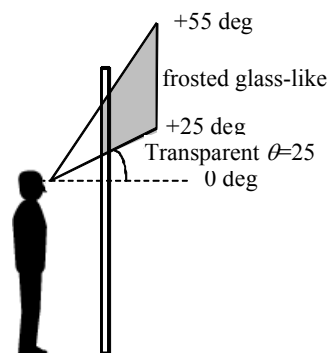


Fig. 10 View control



(a) viewing at front



(b) viewing from side

Fig. 9 Effect of view control film

B. Viewing Angle Control Film

A viewing angle control film can also separate images for each user the same as unidirectional screen. To deliver

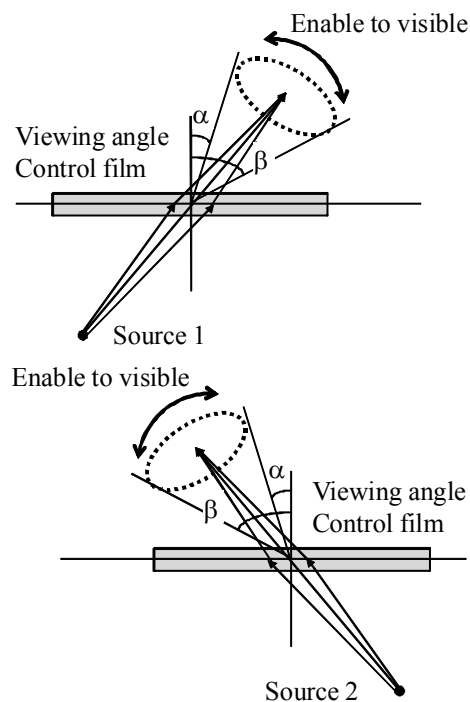


Fig. 11 Projection image on the LUMISTY screen

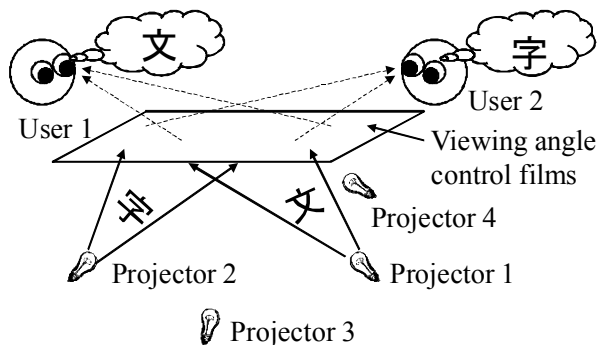


Fig. 12 Displaying four overlaid images



Fig. 13 Appearance of 4-views display KNX-60

C. 4-views Display System

To enable all-around viewing from four directions, the authors developed 4-views flat-type tabletop display system using viewing angle control film. This 4-views display system consists of four projectors and four LUMISTY sheets. The LUMISTY film has many kinds of characteristics; e.g., opaque from front side, one direction, two directions and so on. The grade MFY-2555 is opaque from one direction when the ray is encountering the film with the angle more than 25 degrees till 55 degrees. So we can use this LUMISTY film as a frosted glass or a diffusion screen in the opaque regions, i.e., from 25 degrees to 55 degrees. In these ranges, observers can perceive the projected image on the LUMISTY film. As shown in Fig. 11, the ray of a User 1's image is emitted with an angle $\theta(\alpha < \theta < \beta)$ to vertical and it reaches into the eyes of User 1 after the ray is diffracted by a viewing angle control film. The rays of User 2 are the same as the User 1's case. As the LUMISTY MFY-2555 film is one direction or axis, e.g., x axis, it is easy to provide the image separation for two users by rotating another film 180 degrees. Therefore, the observers, who wear no glasses, can view the different image on the LUMISTY film as shown in Fig. 12. Two LUMISTY MFY-2555 films enable us to perceive separated image among two users. To build 4-views display, we used four MFY-2555 films. The additional two MFY-2555 films are placed with different direction or axis, e.g., y axis. The authors have developed prototype 4-views flat-type tabletop display system KNX-60 using four MFY-2555 films and four

commercial projectors connected with four portable DVD players for playing movie contents as shown in Fig. 13. In this display, all observers can view the unique image from each edge of a square table without special glasses.

V. 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. 14. 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. 15 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.

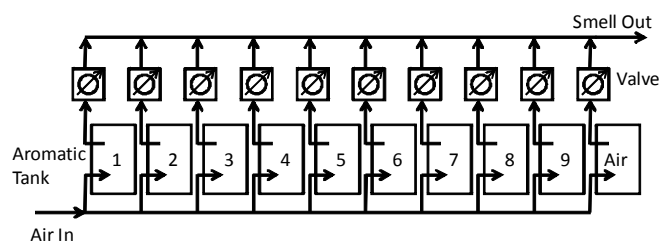


Fig. 14 Air circuit



Fig. 15 Appearance of olfactory display(KNO-01)

Fig. 16 shows the olfactory display system using a commercial automatic spray freshener. This is the air freshener which automatically releases a burst of fragrance at regular intervals without touching it. To control the fragrance burst from the Windows PC, we reconstructed the

original electric circuit of this air freshener. As the signal line from original circuit to a sprayer is cut by our developed control circuit, the timing of spray bursting can be controlled by the computer through RS-232C serial interface.



Fig. 16 Olfactory display KNO-100



Fig. 17 Olfactory display using spray can KNO-110



Fig. 18 Olfactory display unit KNO-116

Fig. 17 shows a newly developed olfactory display system using commercial rechargeable aerosol spray cans. This spray can fill half full of your favorite cleaner, lubricant or paint, and fill the rest with air from any source - even a bicycle pump. This means you can re-fill and re-pressurize

whenever you need, so it is always ready-to-go. Supplied with 4 spray buttons and one short extension nozzle, this is ideal for insecticides, cleaning, painting, lubricating and many other wood working and household uses. Can is harmless to the environment since it operates on ordinary air. When filled only with compressed air and favorite flavor, this can serves as a smell sprayer. To burst the air from this rechargeable aerosol spray can, we developed a pushing machine which consists of an arm, a gear box and a motor. The mechanics can push the burst button of the spray can. The DC motor is controlled by a motor driver which connects with a Windows PC. Each burst of spray cans is controlled by a signal from the PC through RS-232C serial interface. This spray can is possible to deliver prepared unique smell to us. To deliver several flavors, all you have to do is to prepare as many spray can unit as you want to burst smells. Fig. 18 shows the spray can unit. 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.

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