

All-Around Display for Video Avatar in Real World

Hiroyuki Maeda Kazuhiko Hirose

Department of Mechano-Informatics
Graduate School of Information Science
and Technology, The University of Tokyo
7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656, Japan
{maeda, kazu}@cyber.rcast.u-tokyo.ac.jp

Jun Yamashita Koichi Hirota Michitaka Hirose

Research Center for Advanced Science
and Technology, The University of Tokyo
4-6-1 Komaba, Meguro-ku, Tokyo 153-8904, Japan
{jun, hirota, hirose}@cyber.rcast.u-tokyo.ac.jp

Abstract

This paper describes the methodology and prototype for an all-around display system for video avatar presentation in the real world. This system enables us to reconstruct a video avatar which users can look at from all around, by spinning a flat panel display which has a small viewing angle and changing the image on the display panel depending on the display's orientation.

Keywords: all-around display, video avatar, telepresence, real world oriented

1. Introduction

In previous studies, the application of a video avatar in remote communication has been investigated[1]. Also, many methods of capturing the human figure have been proposed for the reconstruction of high-quality 3D video avatars[2, 3]. Most of these studies were aimed at using video avatars in virtual space. However, to increase the reality of video avatars in communication, a video avatar should be able to be displayed and show movement in the real world.

In "Office of the Future"[4], the concept of reconstructing a virtual environment in the real world is presented. In this approach, scenes and people from remote locations are projected onto the walls of an office. A drawback of this approach is that it is difficult to present a full 3D avatar that can be viewed from all around. In most communication in the real world, the spatial relationship of participants changes freely and dynamically; each participant may stand, sit, or move to any position. To realize such a relationship in communication with a video avatar in the real world, it is an essential requirement of the video avatar that it can be viewed from any direction. Therefore, limitations on the possible view points of the video avatar are undesirable.

There have been some studies which have aimed to develop all-around displays, such as the multiplex hologram and the volumetric display[5]. A multiplex hologram is a cylindrical system. It can be viewed from all around and can play a short movie by rotating the cylindrical hologram, but it cannot play a long or real-time movie at present be-

cause it is difficult to update the interference fringes of the hologram dynamically. Also, volumetric display is based on the method of reconstructing a 3D image by scanning a volume using a 2D display device. This method has difficulty in presenting a non transparent image; if this type of display is used for avatar presentation, the back of the avatar, that faces away from a viewer, is also visible.

In this paper, we propose a new approach to the realization of an all-around display system that is suitable for video avatar presentation in the real world, and report the implementation of a prototype system.

2. Concepts and System Design

The fundamental principle of our method is the spinning of a display panel that has a small viewing angle. Because of the effect of the viewing angle, an observer can view a displayed image only when the spinning display exactly faces in the observer's direction. By changing the image on the display panel depending on the orientation of the spinning display, different images are presented to viewers at different orientations. For example, if the image on the display panel is changed every 45 degrees, different images will be shown in eight directions. By displaying images of a person that were captured from eight directions, so that each image can be seen from the same orientation from which it was taken, an approximately accurate view of the person can be seen from any direction(see Figure 1).

In the presentation of a movie, since the image for each direction is updated once during each rotation of the display, the maximum updating rate of the movie is equal to the frequency of rotation.

Our approach is fundamentally different from the idea of generating a 3D image by scanning a volume using a 2D display device; our approach is based on the concept of simulating the change of image according to the change of view point by switching the image that is viewable from the relevant view point.

3. Prototype and Implementation

Figure 2(a) shows a prototype of our system. This prototype is about 400[mm] in height. We use a Tablet PC(PC-TB7005T, NEC) as the display panel; the PC is equipped

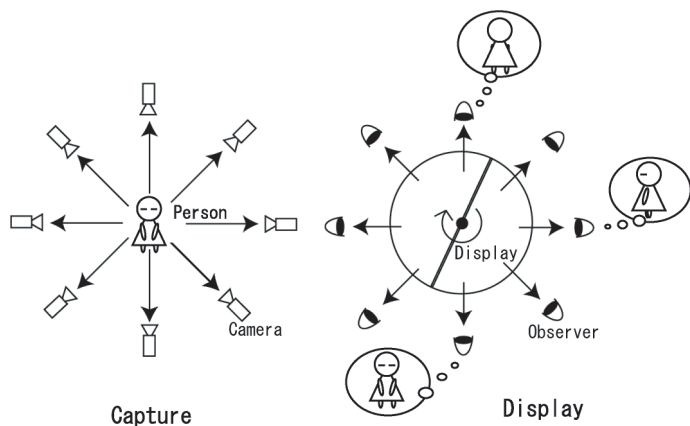


Figure 1. System Design

with a 10.4 inch TFT LCD of XGA resolution, and the refresh rate was set to 60[Hz]. To reduce the viewing angle of the LCD, we installed a privacy filter on the surface of the LCD, and consequently, the image on the display panel becomes completely invisible when an observer's viewing angle is more than ± 23 degrees. A stepping motor was used to spin the display.

Also, in the experiment discussed below, avatar images that were taken by using a surround-camera system with 18 cameras are used. These images are loaded into the memory in advance of presentation and are displayed and changed by DirectX API.

Generally, the updating rate of the image on the display panel f [Hz], the rotational frequency F [rps], and the number of directions for showing different images n , have the relationship: $f = Fn$. We tested the cases with the following conditions: $f=60$ and $n=9$, and $f=40$ and $n=6$. The rotational frequency in both cases is about 6.67[rps]. Under both of these conditions, we carried out an experiment in which we played a movie of a video avatar that was about 1 minute long, and through this experiment, we confirmed that we can see the video avatar from all around. Figure 2(b) shows a frame taken while the system is in operation.

In the case of $n=9$, we can achieve an image with a more natural appearance than in the case of $n=6$. We consider that this is because of the difference between the images of adjacent directions and the angle at which each image is shown. The difference between the images of adjacent directions in the case of $n=9$ is smaller than in the case of $n=6$, and hence the viewer observes a smoother change of images when he or she moves. Also, the larger the number of directions shown, the smaller the angle between adjacent images. In the case of $n=9$, the viewed image changes every $360^\circ/9=40$ degrees, and in the case of $n=6$, it changes every 60 degrees. Hence the viewed image changes according to the observer's movements more sensitively.

On the other hand, it becomes clear that the viewing angle of the privacy filter is not sufficiently small and therefore, images for other directions are sometimes slightly visible. Also, in our implementation, the image updating rate of the tablet PC is a bottle neck; since the maximum updating rate of the image is the same as the refresh rate of the display panel, the number of directions which can be shown



Figure 2. a)Prototype System; b)View of System in Operation

and the rotation frequency are limited.

4. Conclusion

As we stated in the introduction, our purpose is to realize a real-time video avatar for use in the real world. In this paper, as a first step toward this goal, a method of displaying an all-around image of a video avatar was proposed and an implementation of a prototype was discussed.

In our future work, we intend to realize real-time communication using the avatar. For the implementation of this communication, real-time capturing and transfer systems, and the means to support users' interactions with the avatar, must be developed. Also, it is our intention to develop a larger display which is capable of displaying life-sized images of a human.

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