Public Viewing of 200-Inch Glasses-Free 3D Display System

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1. Introduction

Current research on ultra-realistic communication is expected to help make our daily lives more enjoyable and convenient. This research is being applied to the development of systems for enjoying 3D television programs in home living rooms (3D broadcasting) and communicating as if we are actually there with people in remote locations (more natural tele-communication). Applications such as medical training systems, cyber museums, 3D digital signage, and more are expected to emerge from this research. To realize the practical applications of this research goal, NICT has decided to tackle glasses-free 3D display systems. In this research project, we developed a prototype of a large glasses-free 3D display system, called REI, and set it up on the third floor of the Knowledge Capital located next to Osaka Station last spring. In this paper, we give an overview of the prototype system.

2. 200-inch glasses-free 3D display system

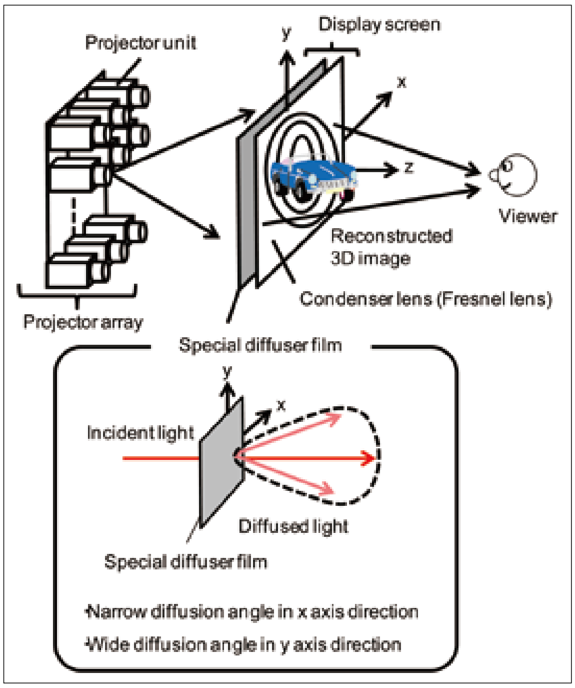
2.1 Configuration

NICT has developed a large size glasses-free 3D display using a projector array[1]. This display is configured with a special display screen and projector array, as illustrated in Figure 1. The projector array consists of several small high-definition projectors called “projector units” arranged horizontally and vertically as shown in the figure. The display screen combines a film featuring special diffusion characteristics with a condenser lens. This enables images from multiple projector units to be superimposed on the screen. The diffuser film has a wide diffusion angle in the vertical direction and a small diffusion angle in the horizontal direction. As illustrated in Figure 2, incident light rays on the screen go straight and are gathered onto the viewer's eyes by the condenser lens. A viewer can see the image from one projector unit on the left eye and in the same way can see a different image from a neighboring projector unit on the right eye. These diffusion characteristics result in a system that can produce different images at various horizontal angles, enabling a viewer to observe parallax images according to his/her horizontal position.

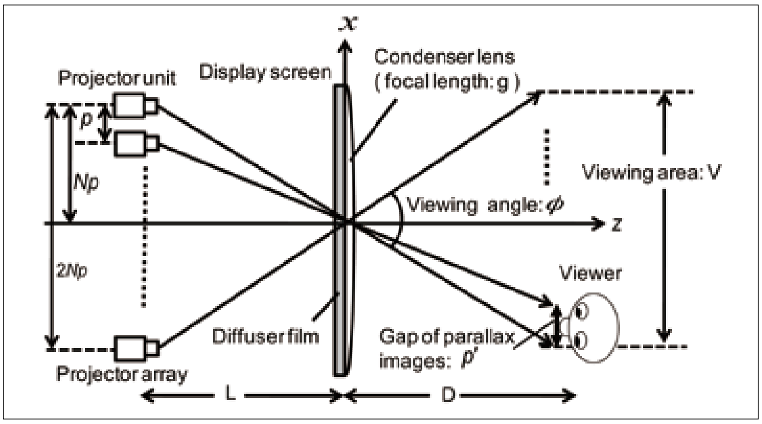
2.2 Specifications

Based on the above architecture, we developed a 200-inch glasses-free display with the system parameters listed in Table 1. The ideal gap of parallax images is less than the size of a pupil, making it difficult to create a practical 3D system. The gap of the parallax images in our previous system, which was used to display 3D images with natural motion parallax, was 29.4 mm[2]. However, in the current system, we set the interval of parallax images to 22.8 mm, which is approximately one third the interpupillary distance, so as to enhance smooth motion parallax in 3D

■ **Figure 1: Configuration of 200-inch glasses-free display**



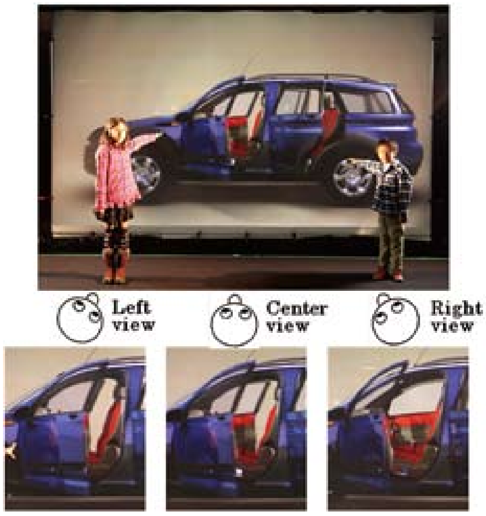
■ **Figure 2: Basic arrangement of the display**



■ **Table 1: Specifications of 3D display**

Image size	200 inches, 16:9
Resolution	1,920 (H) × 1,080 (V) pixels
Frame rate	60 frame/second
Projector units	Almost 200 units
Interval of parallax images	22.8 mm (viewing distance 5.5 m)
Viewing angle	About 40°

■ **Figure 3: Examples of reproduced 3D images**



images. As almost 200 projector units are used for our 200-inch glasses-free display, we set the width of the viewing area to 4 m, which is almost the same size as that of the 200-inch screen. The suitable viewing distance between the screen and the viewer was determined to be 5.5 m. From these parameters, the viewing angle is about 40°. Viewers can still see the 3D images even if they move more than ±2 m in the depth direction.

The on-screen surface resolution of the 3D images is 1,920 pixels horizontally and 1,080 vertically. Moving images can also be displayed at a frame rate of 60 fps.

2.3 Examples of 3D images

Figure 3 shows the image of a vehicle reproduced by 3D computer graphics. The reproduced image as viewed from the left, center, and right are also shown. Viewers can recognize that there is parallax by seeing different images of the car door and the interiors according to the viewing position.

We can also capture multi-view images of actual still objects using a moving high-definition digital camera[3]. The captured images are calibrated and corrected for the perspective of the images. The displayed 3D images of a real scene observed from the left and right sides are shown in Figure 4.

3. Public viewing of the Prototype

3.1 Setup of the prototype

The prototype of our large size glasses-

■ **Figure 4: 3D images of real objects**

free 3D display was set up on the 3rd floor of the Knowledge Capital in Grand Front Osaka next to Osaka Station. The location at which the display is set up is called "the Lab" and is open to the public with the aim of providing exposure to the most advanced technologies. Since Knowledge Capital opened last April, more than 1 million people have visited "the Lab". We planned to show 3D images of cultural properties at "the Lab" because there are many valuable cultural properties in the Kansai region and it is suitable for visitors who wish to explore the rich cultural characteristics of Kansai.

3.2 3D images for public viewing

As a first trial, we obtained 3D images of valuable cultural properties including Standing Juichimen Kannon (Ekadasamukha, eleven-faced Kannon, an important cultural asset) and Gojushoto (small five-storied pagoda, a national treasure) with the cooperation of Kairyuouji temple in Nara and displayed them on the 200-inch glasses-free 3D display. These images were very popular among the many visitors, as shown in Figure 5. Many people visited Kairyuouji temple after viewing these 3D images, and there were reports about Kairyuouji temple in newspapers and on TV.

4. Conclusion

In this report, we gave an overview of a prototype of our 200-inch glasses-free 3D display, developed as part of an ultra-realistic communication research project, and introduced examples of 3D images. The prototype display was set up at "the Lab" attached to the Knowledge Capital located in Grand Front Osaka next to Osaka station. Since the display was opened to the public, many people

■ **Figure 5: Example of cultural properties on display**

have visited and observed glasses-free 3D images that they had never seen before. Consequently, use of the display to promote the many valuable cultural properties in the Kansai region was recognized, and we received a "Knowledge Innovation Award 2013" acknowledging concrete results in "creating new value causing change in the world."

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