SAION - Selective Audio Image Reproduction System Using Multiple Hyper Directional Loudspeakers

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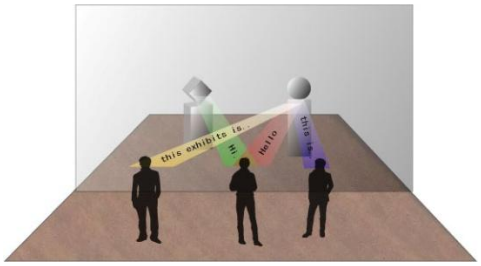

Figure 1: SAION

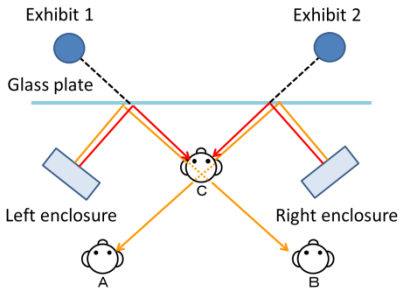

Figure 2(a): Overhead view

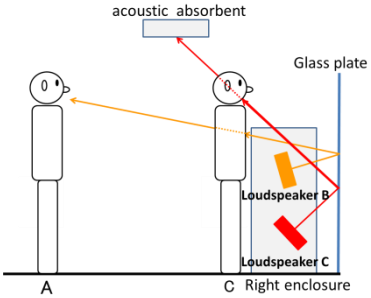

Figure 2(b): Right view

1. Introduction

In museums, auditory information provides a greater understanding of exhibits to visitors. In these days, there are museum guidance systems presenting auditory information to viewers at particular positions such as hyper directional loudspeakers on ceilings above exhibits or mobile audio devices. However, sounds are presented from the ceiling or the devices, not from exhibits. Hence auditory information and exhibits are seldom associated together spatially.

There have been a few studies focusing on spatial combination of auditory information and exhibits. "Sonal Shooter [Nakagaki et al., 2011]" is the hand-held device that can present auditory information from real exhibits. A viewer holds the device containing a hyper directional loudspeaker and aims exhibits to reflect sound on exhibits. However, the system presents sound from only one direction and holding device is a burden of the viewer. In this paper we propose "SAION" (Selective Audio Image reproductiON), the system which can present auditory information from multiple directions to local positions using multiple hyper directional loudspeakers. Figure 1 is the overview of the system. Since the system presents directional sounds with spatial consistency, viewers can experience sound field around exhibits with spatial understanding and select sound fields just by changing their positions without any devices. In addition, selecting auditory information around exhibits appropriately, the system can reconstruct sophisticated sound field.

2. System Overview

The core design concept of SAION is that audio images are put on real objects and viewers can change the sounds by walking around exhibits. As shown in Figure 2(a), we set two exhibits and two enclosures across a glass plate. Hyper Directional Loudspeakers (HDLs) reflect sounds on a glass plate from axisymmetric position of exhibits. The design can give audio images on exhibits without setting any loudspeakers around exhibits.

By presenting directional sounds from multiple directions, the system can overlay multiple audio images on one exhibit. Figure 2(b) shows the example of the right view of the system and the right enclosure. Each enclosure contains two HDLs vertically inclined at varying angles. The viewer standing at a point distant from the exhibit can hear the sound from HDL B inclined at low angle and cannot hear the sound from HDL C inclined at high angle because the sound from HDL C is absorbed by acoustic absorbent attached on the ceiling. On the other hand, the viewer standing at a point near the exhibit can hear the sound from HDL C and cannot hear the sound from HDL B because the sound is absorbed by stomach area of the viewer. Therefore, the viewers can hear different sounds from the same exhibit just coming closer to the exhibit or backing away from the exhibit.

3. Implementation

First, we set two exhibits inside a room the wall of which is a large glass plate and set two operators around each exhibit. Second, we attach microphones to the operators and collect the voices of the operators talking about abstract of exhibits. The system presents the sounds to viewers outside the room at positions A and B in Figure 2(a) in real time. Only viewers at particular positions can hear voices about abstracts of the exhibits as if the voices pass through a glass plate. In addition, we recorded detail system sounds of exhibits previously and the system presents the sounds to viewers at position C in figure 2(a). The viewers standing at C can hear the detail sound of exhibit 2 from the right-hand side and the detail sound of exhibit 1 from the left-hand side separately. Therefore, viewers standing at a point distant from the exhibits can hear abstract information and viewers standing at a point near the exhibits can hear detail information. It should be added that short people such as children can hear abstract information at a point near the exhibits. The fact suggests that the system can present different sounds to short people and tall people individually.

We held a demonstration of the system. During the demonstration, appropriate sounds selected from the noisy room were reconstructed outside the room with spatial consistency. As a result, every viewer could rapidly understand which exhibits emitted sounds. Hearing reconstructed sound field, viewers became interested in exhibits and got in the room.

References

Nakagaki. K and Kakehi.Y: SonalShooter: A Spatial Augmented Reality System Using Handheld Directional Speaker with Camera, ACM SIGGRAPH2011, Posters

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