TransWall

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1. Introduction

Nowadays, imagining modern buildings without glass is difficult, and glass walls can be found almost everywhere around us. Glass has been one of the most valued materials owing to its transparency. Glass walls' transparency in modern architecture involves two contradictory characteristics: visual continuity and spatial discontinuity. Even though we can see everything through a glass wall, we can hardly hear the sound and cannot touch anything on the opposite side of the wall. Although a glass wall facilitates interpersonal communications beyond a partition, it simultaneously blocks deeper interactions. Can the glass wall be made into an even richer communication medium?

What would it be like to embed the type of transparent display seen in the movie *Avatar* in a large glass wall? People can face one another and touch objects on the screen to enjoy gaming. Furthermore, what if a glass wall can transmit the sound or touch from a user to the other side? We propose a concept called "TransWall," which allows interpersonal multimodal interactions through a glass wall.

2. Implementation

The concept of TransWall can be best realized by means of a large, transparent, OLED (organic light-emitting diode) display. Samsung Electronics demonstrated a transparent OLED display for a laptop[1] in 2010; however, obtaining a large panel for our research was difficult. As a result, we built a 32" see-through display wall by sandwiching a thin holographic screen film between two sheets of 3-mm plexiglass. Two video projectors were installed above the user's head 90 cm away from the center of the screen. Two videos were precisely keystoned and aligned so that the resulting images on TransWall were clearer and the occlusion problems that the user's body caused were reduced. We added 32" infrared touch sensor frames (NIB320A) on both sides of the display panel (Figure 1-a).

TransWall is not only a video display but also an audio display. We attached a surface transducer (COM-10975) on the plexiglass sheet and two microphones on both of the touch sensor frames so that TransWall could simultaneously propagate the sound of media sources and transmit the user's voice to the other side of the wall. TransWall also provides users with vibrotactile feedback using the same surface transducer. People could feel a vibrotactile stimulus of approximately 80 Hz from the surface transducer very well, but could barely recognize a vibrotactile stimulus of greater than 400 Hz. Therefore, we set the surface transducer's frequency range to under 400 Hz for the vibrotactile feedback channel and to over 400 Hz for the sound propagation channel. As a result, users could see, hear, or even touch other people through the glass wall.

Figure 1. (a) Sectional view of TransWall and (b) users playing the game "Chromatic rubber band"

3. Application

Users stand face-to-face when using TransWall. This position is substantially distinct from that of general interactive tabletops or shared wall displays. Consequently, people can collaborate with one another in a more natural way. TransWall is touch-sensitive on both sides, so two users can touch the same spot simultaneously without any physical interference. Based on these ideas, we designed a few gaming applications, which are given below.

(a) Chromatic rubber band

Two players can select the color of their balls. If their fingers approach one another and are close enough, the colored balls create a flexible rubber band line that is filled with gradient colors. By moving fingers on TransWall, players can draw something together using beautiful color patterns (Figure 1-b).

(b) Talk-through

The brighter a pixel is on TransWall, the more opaque it appears. Two players create a transparent hole by simultaneously touching one another on TransWall. The size of the hole is proportional to the distance between the two fingers. The bigger the size of the hole, the louder the volume of the conversation that the players hear through the wall will be.

(c) Flip and spell

Players have two-dimensional arrays of alphabet puzzle pieces and they present a reversed image on both sides. An alphabet piece flips when a player touches it. Players are allowed to flip the pieces as quickly as possible. If a player has some linearly juxtaposed alphabets in the same direction and the series of alphabets make a word, then he/she scores points.

(d) Pat-a-cake

We designed a touch-based rhythm game to exploit the advantage of the two-sided touch interaction. Most notes can be touched from a specific side, but both players must simultaneously tap the remaining ones. The game requires a sense of rhythm and good teamwork among players.

4. Future prospect

What about installing TransWall as a sterile wall in a hospital? TransWall would allow patients to interact with family and friends without the risk of being infected or spreading infections.

References

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