Short paper: Tree-shaded screen:
A Propeller type screen for Public Art

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Abstract

Tree-shaded screen is a novel artwork for the public space. One can also think of it as a novel virtual reality system. The artwork consists of a surround couch, a column, and a propeller with six blades. When we sit down on the couch, we can see the propeller above. A high reflective screen material on the propeller's blades brightly reflects the images that are projected by two projectors. The display uses human's afterimages to form a complete continuous display. This artwork is like a short resting place for people, a metaphor for a mother tree that shades many creatures in nature. This artwork was designed for an installation in the Haneda airport, which is the biggest airport in Japan. We use birds as a metaphor of airplanes. Birds' behavior animation is projected on the propellers. The birds behavior is synchronized with a flight timetable of the Haneda airport. The couch looks like a bird's nest made from a new material. We exhibited the tree-shaded screen at an open-campus and evaluated it. We will exhibit this artwork in the Haneda airpot in October 2009.

Categories and Subject Descriptors (according to ACM CCS): IJ.5 [ARTS AND HUMANITIES]: Arts, fine and performing—H.5.2 [User Interfaces]: Interaction styles / Screen design—I.3.7 [Three-Dimensional Graphics and Realism]: Virtual reality—

1. Introduction

Traditionally, virtual reality technology is confined to a room, mostly in a dark place, used by specialized technicians. However, recent technology like augmented technology enables us to bring VR technology to outdoor environment. We proposed that a suitable application to use VR technology outside of a room is in the field of public art. We want to create a new genre called **Digital Public Art**, which combines media technology with a public art [DPA04]. Digital Public Art has three essential aspects, the spatiality of the environment, the tangibility of objects, and the sensation of participation. A water drops display is one of digital public art examples [EITOKU06]. We focus on pursuing novel artistic expressions by extending these aspects by applying leading-edge media technology.

We will have an exhibition at the Haneda airport in Tokyo Japan. This airport typically serves about 65 million passengers in a year. The exhibition, called "Kuuki No Minato" or "Air-Harbor" will be held from October 9th to November 3rd 2009. Similar public art exhibition was shown in the Heathrow airport. Goldsmiths, University of London and BAA (airport company) have collaborated to create a contemporary art and design project named the Goldsmiths/BAA Expo Award [BAA]. An artist group TROIKA have installed an artworks named CLOUD [TROIKA] in the Heathrow airport as a public art with technology. This kind of project is in an art field, however this paper discusses both art and technological aspects of a public art exhibition.

The purpose of this study is to propose a novel type virtual reality system: tree-shaded screen for the public space. The tree-shaded screen has a round figured couch and a propeller. Human's afterimages perceives the images shown on the propeller's blade as one continuous screen. We want to clarify whether it has an affordance to sit down and to see

above and it is suitable for the public space. By installing this display in a semi-public space, we could evaluate the tree-shaded screen.

2. Concept and Design

2.1. Concept of Tree-shaded Screen

In a tree, there are a lot of animals and insects gathering from various places. The concept of this artwork is to make a public space for sharing and resting like many creatures gather around a mother tree in nature. It is also like an island and a bird's nest. Birds are flying to a tree, resting, and fly off. People will gather to this artwork, take a rest, and communicate with each other.

This artwork was designed to be installed in a real public space, the Haneda airport. We use birds as a metaphor of airplanes. Birds are visualized as airplanes that are taking off from an airport. Birds are flying from a point to another point. The birds' behavior is synchronized with a flight timetable of the Haneda airport. People who come to the Haneda airport will be see a bird that indicates the airplane their partner on aboard. Figure 1 shows an image of Tree-shaded screen in the public space. People can relax on a chair and see above. The display is projected by two projectors and bird's behavior are visualized.
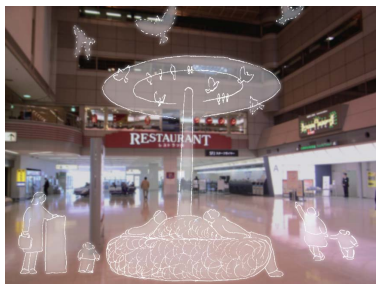

Figure 1: *Image of Tree-shaded screen in the public space*

2.2. Design of Tree-shaded Screen

Tree-shaded screen consists of a round figured couch, a column and a propeller as a kind of bench in a public space. We can sit down on the couch that looks like a nest of bird made with a new material, which lead us to see above. We can see the propeller above our place on which art contents are projected. A high reflective screen material is put on the propellers and two projectors are project images on it. A high reflective projection technology is reported that it is useful for the head up display (HUD) [NOJIMA08]. Tree-shaded screen is not a head up display, but the mechanism is similar. Human persistence of vision is used for the display. The propeller rotates and the projectors located under the couch project images onto the propeler. We can see image only on the propeller. However, we can see whole image by afterimages.

3. Implementation

3.1. Whole Design

A whole design of Tree-shaded screen is shown in Figure 2. There are six blades. two projectors, and a round figured couch. The radius of the couch is 1,650mm in order to lie face up on the couch. Maximum height of the couch is 1,000mm. Under the couch's center, there are two projectors to project images onto the propeller. The radius of a blade is 1,730mm and the height of the propeller is 3,900mm like a tree size.
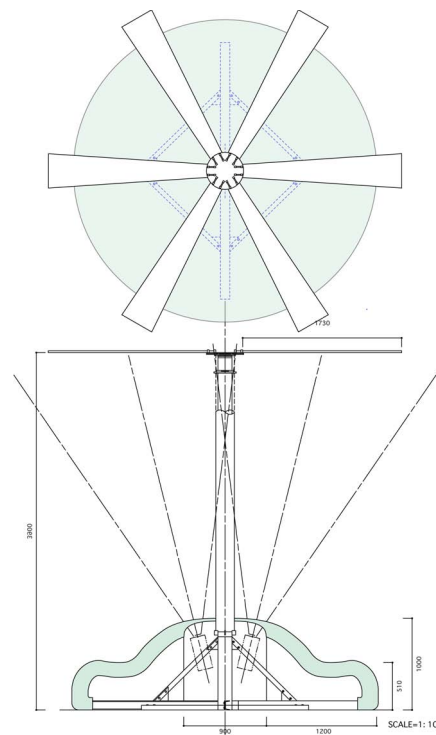

Figure 2: *Design of Hardware*

3.2. Display / Screen

The images on the propeller are projected from under the couch's central core. People who sit down on the couch will see the propeller above. People who walk around Tree-shaded screen will see the propeller at an angle. Thus, we chose a high reflective screen material. It has a screen property shown in Figure 3. This screen is made by micro glass beads and has the following features; 1) High gain (peak gain is about 2.58), 2) Wide view angle (half ratio is about 36 degree), 3) High resolution. Figure 4 shows the result of a screen test. The left propeller in Figure 4 put on a screen and the right is without a screen. Only the left propeller reflects a projector's light.

Propellers are rotated about 1.5 rotations per a second. We determined this speed by two conditions; 1) we can see images, 2) it is not dangerous (not to feel dangerous). The

propeller itself is very light (about 300g) made by two fishing pole and foam polystyrene. Images are adjusted and conducted trapezoidal correction with the propellers by hardware (projector) and software. Thus images are connected smoothly. We used two projectors with 3,000 lm.
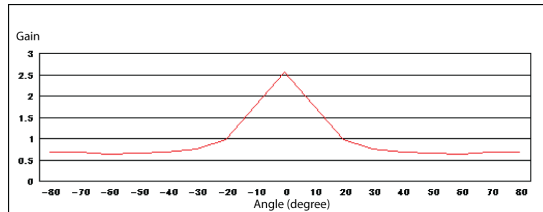

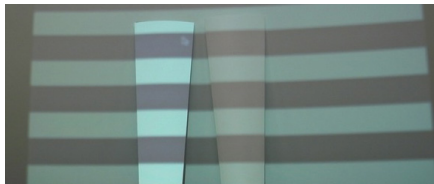**Figure 3:** *Screen property: Relationship between gain and angle*

Figure 4: *Screen test: Comparison with a screen (a left propeller) and without a screen (a right propeller)*

3.3. Couch

We used a wooden chair at the first prototype. However, many people complained about the chair because it was hard and was easy to be tired especially when audiences wanted to see above. Thus we changed a chair material.

Our image of couch is like a bird's nest. We selected a new material (BREATHAIR®from TOYOBO CO., LTd.). It has some special features; 1) High resilience and repelling force, 2) Antibacterial material, 3) Breathability, 4) Aerial and light. It is good for a couch and looks like a nest. We also improve a figure of couch in order to see above spontaneously. In side of the couch, we used cardboard. Cardboard is set up as latticework that is a grid square. BREATHAIR and cardboard are designed to breathe which prevents projectors from overheating. We designed the couch as a round figure. A cross-section of the chair is modeled in order that persons feel comfortable and lie above easily.

3.4. Tree-shaded screen

A whole view of Three-shade screen is shown in Figure 5. People are sitting on the couch and the propeller's show a bird image. Birds' behaviors are visualized on the propellers. There are some birds' behaviors; flying from somewhere, rest on a line, taking off to somewhere. The flight timetable of the Haneda airport is imported to this system. Birds' animation are synchronized with the timetable. In order to notice a bird metaphor as an airplane, we put airlines information on birds such as JAL (Japan Airlines) or ANA (All Nippon Airways). Figure 6 shows this visualization results. The

circle line indicates a stopping point which is a metaphor of an airport. Birds come automatically, and a certain time, bird will taking off.

Figure 5: *Right: Whole view of Tree-shaded screen, Left: The couch made by cardboard and the BREATHAIR*

Figure 6: *Visualization of birds as a metaphor of airplanes*

4. Evaluation

4.1. As a display

We exhibited the tree-shaded screen in an open-campus in the university and evaluated it (Figure 6). The room is a half public space and is bright. The light condition is from 500 lx to 1,000 lx (it depends on the position of the display). As a comparison, a normal office is said to be about 500 lx. In this bright condition, it is easy to see display under the propellers and from the distance of several meters. It can work as a display.

4.2. As a public art

To evaluate Three-shade screen as a public art, we watched the visitors' behavior. In an hour (not during crowded time; from 11:00 to 12:00), 66 people came to see this artwork and 43 people sat on the chair and paid attention to the propeller above. That was 65 percent of people interacted with this artwork. Some people sat on the chair more than 10 minutes. We could observe many couples or friends sit together for a long time. We also observed people could enjoy the exhibition (Figure 7). They opened their mouth and pointed out birds. In addition, we observed that children enjoyed to this exhibition tremendously. Most children played with this chair and surprised with projected images (Figure 7)

Figure 7: *People watching above and children enjoyed this artwork*

Figure 8: *Result of a questionnaire survey (n=35)*

4.3. Questionnaire survey

We conducted a questionnaire survey. Number of subjects were 35. The age range were from 10s to 50s, men and women. We asked them to answer down the questionnaires; 1) How was sitting conditions? 2) How do you feel about the couch's materials? 3) Did you want to sit down ? 4) Did you want to see above? 5) Could you see a bird image? 6) Did you see a scene that birds are stopping and flying away? 7) Is it better to see above on the chair than see from far place? 8) What do you think that is it better to put this kind of artwork in the public space? Subjects were asked to select five levels from Very Bad / Totally Disagree, Bad/ Disagree, Neutral, Good / Agree, to Very Good / Totally Agree. They were also asked to provide reasons for their selection and their impression regarding the image of the artwork figures and expression.

The results are shown in Figure 8. Almost answers are about good / agree. Image of this artwork is an island, a tree, a floating something, a wide sky, and so on. Some people like the couch's material very much. A several subjects wrote that they want to use this chair in their home.

In terms of the couch, many people feel comfortable and feel soft. The chair has an appeal to people to sit down and to see above. A several subjects wrote that they felt sleepy when they sit down on it. In terms of display, most people can see birds and birds' animation. Some people feel a little sick by rotating propellers. But most people feel positive. Several people were surprised that they could see some birds on the propellers. In terms of a public art, most people are welcome to be a public art. Some people want us to make much more in the public. Because it is comfortable and it will be a good waiting point. Some mothers wrote that it is good for children to grow their curiosity.

The result indicates that
1) Tree-shaded screen works as a display
2) It is suitable to sit down and see above
3) It is acceptable in the public spaces.

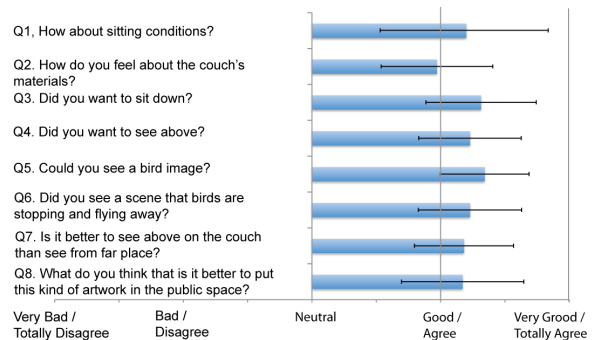However, we could observe that future tasks. Many people, especially children, tend to vandalize, such as putting litters into the chair or to hold a clear color board on the projector. Sometimes a button of a bottom picks up the chair's material because the material is like a nest. vandalization, anti-litters, and durability are the future tasks for tree-shaded screen.

5. Conclusions

In this paper, we proposed a novel type artwork display : Tree-shaded screen for the public spaces. By the implementation and exhibition of this screen, it revealed that it can work as a display and be a public art. For the public art, people do various things to the artwork. Thus the artwork required durability for a long time as well as a power to appeal to the public people. We will improve it in order to much more acceptable for the public. Tree-shaded screen will be a good example of Digital Public Art. It requires a mixture of contents and a hardware. It also requires physically appealing to the public.

Aknowledgement

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