Sound Planet: An Interactive Sound Visualization on the Spherical Display for Group Work

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ABSTRACT

Sound Planet is a spherically-shaped interactive installation with the group interaction and the real-time visualization against audiences' voice and singing. The audience approaches the sleeping planet, wakes it up, creates some artifacts such as soil, water, and atmosphere, and then populates it with the life forms, thereby creating a living planet of their own. Its compelling storyline reinforces the audience's experience while the audience - mostly young children - establishes an emotional engagement with the fictitious planet. The installation whose primary purpose is to provide the synesthetic experience to young children has been operational since April 2014, serving about one hundred children and their family per day.

Categories and Subject Descriptors
H.5.3 [Group and Organization Interface]: Computer-supported cooperative work

General Terms
Design; Human Factors

Keywords
Sound visualization; Interactive art; Spherical display; Interactive storytelling; Group interaction

1. INTRODUCTION

Sound Planet is an artistic audio/visual installation based on the sound visualization onto a spherical display. It was installed at DDP (DongDaeMun Design Plaza), a new landmark designed by the world-famous architect Zaha Hadid, in Seoul, South Korea.

Figure 1. Sound Planet at the DDP(DongDaeMun Design Plaza), Seoul, Korea.

The installation aims at providing the synesthetic experience to young children, who will design and create a new ‘planet’ through their voice as the input interface, roughly following the 5-minutes storyline [2][4]. The primary reason that Sound Planet was designed with sound interaction has to do with the concern on the level of difficulty. The interaction should be designed without high difficulty because the target age of exhibition is young children who cannot understand any sophisticated interaction. The storyline consists of singing and voicing so that any audience can easily participate and see the artistic result on the fly [3].

We have studied various technologies for creating interactive multimedia contents on various display systems such as media façade, titled LCD’s, and spherical displays. Sound Planet is one of our latest attempts where a multitude of audience members interact, collaborate, and most of all, enjoy themselves through the multimedia visualization.

2. SOUND PLANET

2.1 Spherical Display System

The spherical display system has the following advantages over the conventional flat display:

1. Symmetrical experience: Each and every participant is treated fairly in the sense that he/she is positioned equally against the installation. In a typical two-dimensional flat display setting, the audience, depending on which part of the display he/she stands at, may exercise different experiences. However, when the audience surrounds the spherical display, any experiential variation by location becomes negligible.

2. Focused experience: Participants can easily recognize the object of their own control. Due to the structural characteristics of the spherical screen, the audience perceives images larger and clearer at the right angle than on the other side, thereby creating more vivid and engaging experience.

Sound Planet was implemented based on the external projection system with four projectors. Since 2004, we have developed...
numerous contents for the spherical display [1]. The external Projection system is more complex than the internal projection system, but it can produce brighter and clearer images on the surface [6].

The configuration of the display system consists of one spherical screen, one computer, and four projectors. The diameter of the screen is two meters, and the reflection gain of the surface is close to 1.0. The screen was made of molded two hemispherical screens by welding, and the weight is about 200Kg. The display is installed 40cm above the floor using a horizontal cylinder bar of 76mm in diameter.

Each projector is placed in a position based on a 90-degree angle near the projector and 2.3m, 2.1m, 2.3m, and 3.3m away from the screen. The distance from the ground is 2.1m, so that shadow made by the audience can be minimized. All the projectors are controlled by one computer that four channel displays throughout two graphic cards (GTX760).

The software for Sound Planet was coded in Processing\(^1\), which is one of the visual art tools based on Java language. The program makes virtual spherical objects in a three-dimensional virtual space, and four virtual cameras shoot the spherical object at the projector's locations. The images generated from the computer are transmitted to the projectors so that a real spherical displaying is realized.

### 2.2 Sound Visualization

Although precise and accurate interactions based on the voice/speech recognition may not be realizable, simple and natural interactions based on sound and voice may be appropriate for the spontaneous, multi-user environment [5]. In Sound Planet, the pitch detection technique based on FFT (Fast Fourier Transform) and the loudness of voice are used to reflect the audience’s intention. Sound Planet processes and visualizes the audience’s voicing in real-time through the multi-channel audio processing. MAX/MSP\(^2\), simple music software and the OCTA-CAPTULE by ROLAND, an external audio interface are used to handle multi-channels audio signals from the microphone.

The two primary roles of sound are the landscape design and the creature design. Sound Planet first paints the landscape with various colors, and then at the following stage, creates four different life forms, all depending on the pitch and loudness.

![Figure 2. Four-elements metaphor on the Sound Planet story line. There are four creatures – fishes, bugs, mammals, and birds, respectively.](image)

We borrowed the classical four-element metaphors for the basic story line. The concept of four elements is suitable for the subject on how to design a planet. Furthermore, the distinction of the concept is useful to help the audience recognize their interaction feedback with the minimal cognitive load. The concepts of ‘water, fire, earth, and air’ represent the different shapes of brush in the level of ‘Nature of Sound Planet’, and it also affects the shapes of artificial creatures (See Figure 2).

### 3. STORY DESIGN

![Figure 3. The structure of interactive storytelling.](image)

In numerous literatures, it has been argued that compelling stories reinforce the quality of experiences, especially group experiences. In our Sound Planet, the three main points were taken into account. First, the story should enable the audience to participate actively, getting out of the passive participation. The active experience is mainly correlated with physical presence like ‘hear sound’, ‘look at image’. Second consideration point is the nature of the group interaction - either collaboration or competition. For group interaction with the audience of over ten people, it is known that collaboration task is more appropriate. Therefore, the group interaction mainly consists of collaboration task and contains some competition task as well. Last consideration point is functionality. The exhibit should be able to provide fun and learning through the designed story line.

The following interaction techniques were used to express above considerations:

1. **Story in steps:** The Sound Planet responds only to the voices of audience throughout the story run, and it proceeds to next step only when participation is achieved.
2. **Visual feedback:** In order to express the reaction of a voice effectively, Sound Planet provides visual feedback. It also supports the function of fun and education with artistic visualization using various combination of color.
3. **Audio feedback:** Appropriate sound effects are provided to induce the audience's action depending on situation.
4. **Rotation:** affecting range is unavoidably limited because the audience cannot see the whole screen at a time. Therefore, visual components are rotated to enable effective cooperation experience.
5. **Characterized agent:** Creating characterized agent depending on each participant arouses the competition between the audiences.

The story line of Sound Planet incorporates the universal notion of ‘Creation of Life’. The story consist of following four steps:

1. **Sleeping Sound Planet:** The Planet looks like a colorless, desolate planet in the beginning. When the audience is gathered and begins to give voices, the Planet begins to react for a little bit of shine. When the participants gathered their voice cooperatively, the story goes to the next step.

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\(^{1}\) Processing - [http://www.processing.org](http://www.processing.org)

\(^{2}\) Cycling 74 MAX/MSP - [http://cycling74.com/products/max](http://cycling74.com/products/max)
2. **Nature of Sound Planet:** After the wake, *Sound Planet* begins to formulate landscape with various colors. The audience controls the different kinds of elements (water, fire, soil, air) depending on the location of the microphone. Because of this difference, the participants should cooperate for making well-decorated *Sound Planet*.

3. **Living Life of Sound Planet:** Having completed the colorful landscape, the living creatures start getting populated. Similarly to the preceding steps, the audience controls the four different creatures depending on the location of the microphone. The participants’ singing and voicing can help the creature’s liveliness. When the participant makes his voice louder, the bigger creature is created. If the audiences actively participate in the competition, the population of Sound Planet has reached its maximum.

4. **Revived Sound Planet:** In the case where the audience is actively involved, *Sound Planet* expresses its appreciation to the audience with the farewell messages.

Figure 4. Views of the exhibition, proceeding from a) to d).

4. **CONCLUSION**

From the technical point of view, *Sound Planet* is a novel platform to investigate some of the critical research issues such as information visualization, ubiquitous display systems, natural user interface and multi-user interaction. At the same time, it is a multimedia installation that serves both educational and entertainment purposes. Some of the future work is as follow:

1. Incorporating other voice/music parameters for richer interactions, such as tonality, beat, and voice color.
2. Incorporating other input modalities for richer interaction, such as audience’s position and gesture.
3. Incorporating other auxiliary displays such as wall display and mobile displays for richer and more immersive surrounding.

5. **ACKNOWLEDGEMENT**

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6. **REFERENCES**


