AEVE:
An Audiovisual Experience Using VRHMD and EEG

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ABSTRACT
The *AEVE* provides for a brain-computer-interface (BCI) controlled audiovisual experience, presented through a virtual reality head-mounted display (VRHMD). We have developed an audiovisual art piece where progression through 3 sections and 1 extra section occurs using an "Attention" value derived from the Electroencephalography (EEG) data. The only interaction in this work is perspective that is participant's view, and the EEG data. However, we believe the simple interaction amplifies the participant's feeling of immersion. Through the narrative of the work and the simple interaction, we attempt to connect some concepts such as audiovisual experience, virtual reality (VR), BCI, grid, consciousness, memory, universe, etc. in a minimal way.

Author Keywords
Audiovisual, Brain-computer-interface, Electroencephalography, Virtual reality head-mounted display

ACM Classification
J.5 [Computer Applications] ARTS AND HUMANITIES --- Fine arts, I.3.7 [COMPUTER GRAPHICS] Three-Dimensional Graphics and Realism --- Virtual Reality.

1. INTRODUCTION
Generally, audiovisual expression means a fusion expression between sound and visual, or a visual presentation of sound and music, such as visual music. Furthermore, interactive audiovisual expression means audiovisual expression with interactive technology or media, such as motion sensors, an EMG, or EEG, etc. We have long been fascinated by interactive audiovisual expression and the relationship between sound, visual and media technology [2, 3, 4, 5].

2. BACKGROUND
Because the VR platforms for consumers, such as *Oculus Rift*, *HTC Vive,* and *SONY PlayStation VR* were released in 2016, 2016 is called "The Year of VR." Using VR for audiovisual mechanisms isn't novel. However, integrating recent VRHMD, interactive media, development environments for VR contents, such as *Unity* and *Unreal Engine,* etc. may enhance the manner of experience and expression of interactive audiovisuals.

3. IMPLEMENTATION
3.1 Hardware
We have created an interactive audiovisual art work named *AEVE* using VRHMD and EEG. The participant of the *AEVE* is going to wear the VRHMD which consists of Samsung *Galaxy S7*, *Gear VR* with an EEG attached, and noise-canceling headphones (see Figure 1, 2). We use *MindWave Mobile* as an EEG, which can measure the degree of "Attention" and "Meditation." The *AEVE* uses the "Attention" value to move in the VR space.

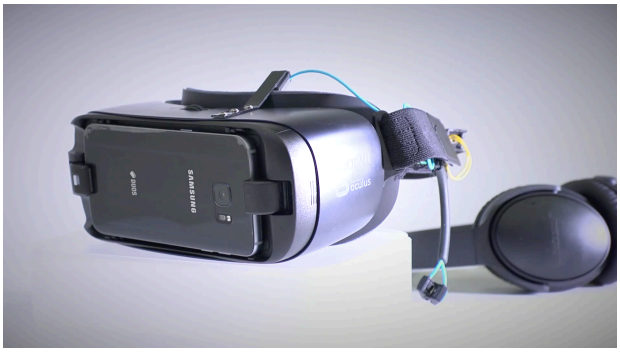

Figure 1. The VRHMD with an EEG attached and noise-canceling headphones

Figure 2. The participant wearing the *AEVE* system

The way of using the "Attention" value to perform actions in VR space is related to prior systems. *NeuroSky Brainwave Visualizer 2* [6] is the application software for the *MindWave Mobile* EEG headset, in which a user with the headset can burn and explode a barrel by increasing his/her "Attention" value. Such a simple neuro-feedback method is used as a simple BCI method in many art works. Judith Amores et al. [1] proposed in the *PsychicVR*, a proof of concept model system that integrates the artistic expression of a psychic power, the mindfulness practice, BCI using EEG, and VR. In the system, a player can float in the VR space by increasing the

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"Attention" value. We believe that the simple BCI method gives the participant more immersion.

3.2 Content

The implementation of the software of the *AEVE* is used *Unity*. The *AEVE* runs approximately 9 minutes and has 3 sections and 1 extra section. In the first section, firstly, the participant is going to see an object like a white plane in front of the participant. Then, when the "Attention" value derived from the participant's brain wave exceeds the threshold, grid objects that are parts of the object like the white plane are going to spread out with the rising of the pitch of the sound (see Figure 3). The sound is similar to "Sho" that is a traditional Japanese wind instrument. Then the participant is going to perceive spatial perception of the VR space. This section also functions as a training section for using EEG.

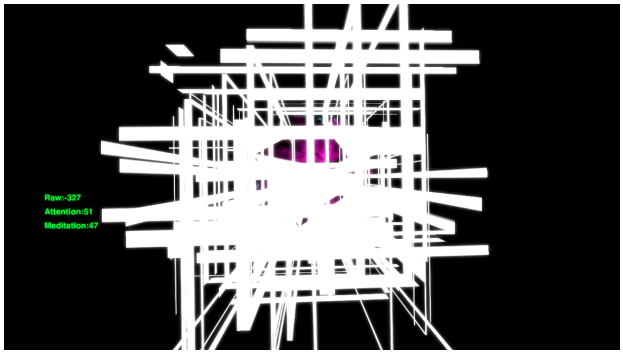

Figure 3. The first section

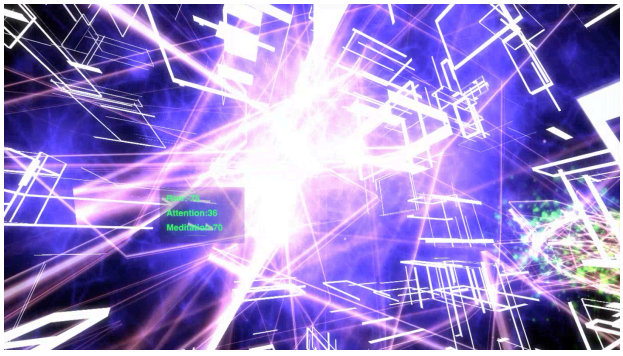

Figure 4. The second section

Figure 5. The third section

In the second and third section (see Figure 4, 5), when the "Attention" value exceeds the threshold, the participant is going to move forward. Then the participant is going to interact with sounding objects. Those sounds and graphics are designed as metaphors of memories and experiences of life. The participant can see the values of "Attention," "Meditation," and "Raw" in the panel on the left side of the screen. In the third section, concrete sounds are played back when the participant goes through grid objects (see Figure 5). The section doesn't have the EEG panel. The concrete sounds were sampled by us at many sites and venues such as a station, room, park, shop, school, etc. We also used free samples downloaded from the internet. After the third section, the screen is going to have a black out, and then have the extra section. In the extra section, the participant is in a room where the producer of the art piece is in the middle of wearing the same VRHMD that the participant is wearing (see Figure 6). We prepared this section for speculative thinking about what the real world is, and what you are.

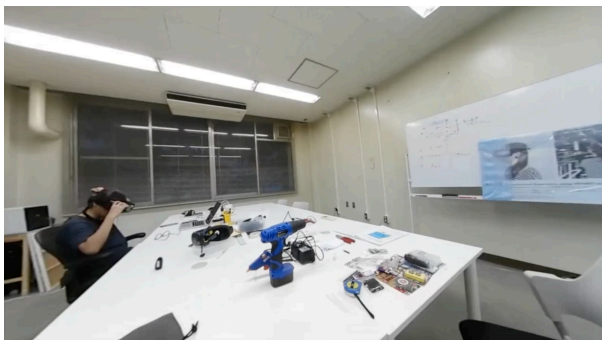

Figure 6. The extra section

4. OUTLOOK

The interaction of the *AEVE* uses a simple BCI method; however, we believe the simple interaction amplifies the participant's feeling of immersion. Through the composition, we attempt to connect some concepts such as audiovisual experience VR, BCI, grid, consciousness, memory, universe, etc. in a minimal way. We believe that this art piece is not only a novel experience but also shows many possibilities of audiovisual expression and performance. For the next step of this work, we expect that elements and concepts of the work will strongly connect. For example, by developing more interaction between sounds and BCI makes a new audiovisual experience possible. However, we should think deeply about the relationship among these elements.

5. ACKNOWLEDGMENT

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6. REFERENCES

[1] Judith Amores, et al. PsychicVR. *Proceedings of the 2016 CHI Conference, CHI EA '16, Extended Abstracts on Human Factors in Computing Systems*, Pages 2-2.

[2] K. Furukawa, T. Hamano, H. Terasawa, R. Hoshi-Shiba, R. Nakagawa, and T. Rutkowski. "'it's almost a song…' For Brain-Player and Clarinet," *NIME 2013*, Korea, 2013.

[3] T. Hamano, T. Kawamura, R. Nakagawa, et al. "MUCCA": an Integrated Educational Platform for Generative Artwork and Collaborative Workshops. *Proceedings of the International Computer Music Conference 2016,* 63–66.

[4] T. Hamano, H. Ohmura, R. Nakagawa, et al. "Creating a place as a medium for musical communication using multiple electroencephalography," *Proceeding of Joint 40th International Computer Music Conference (ICMC) and 11th Sound and Music Computing (SMC)*, 2014, 637–642.

[5] R. Nakagawa, N. Matsumoto, and K. Furukawa. Space Instrument: Prototype of Interactive Audiovisual System in Full-Body Immersive Wireless VR Environment. *IPSJ Interaction 2016*, 1100–1103.

[6] NeuroSky Brainwave Visualizer 2.0. http://store.neurosky.com/products/brainwave-visualizer