A Pixel-Free Display Using Squid's Chromatophores

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Abstract

In this ongoing project, we propose a pixel-free display using a squid's chromatophores. The squid's body surface has cells which contain a pigment called chromatophores. Instead of using pixels of standard visual displays, we stimulated the chromatophores of a squid by sending sound signals of accompanied music to its body through electronic probes and made an experimental music video.

1. Introduction

Our daily lives are surrounded by various types of visual displays, such as computer monitors, smart phones, projectors, VR headsets etc. The information carried by them varies depending on the applications or purposes such as videos, news, slides, games, etc.

However, almost all of the displays are the same in that they are composed of pixels. Even in the case of computational "generative" art like biological simulation, it is inevitable to compute and render an image by pixel unit. [1] In this project, we consider squids as an alternative display free from pixels. The squid's body surface has cells which contain a pigment called chromatophores. [2] The squid freely changes its body color by changing the size of the pigment with electric signals from nerve cells to the chromatophores. To take advantage of these features, we stimulated chromatophores by sound signals and shot our experiments as a music video.

2. Related work

Backyard Brains Inc. introduces an experiment to stimulate chromatophores by sound signals from iPod. [3] Based on the trial, we measured Chromatophore's frequency response (Fig. 1). [4]

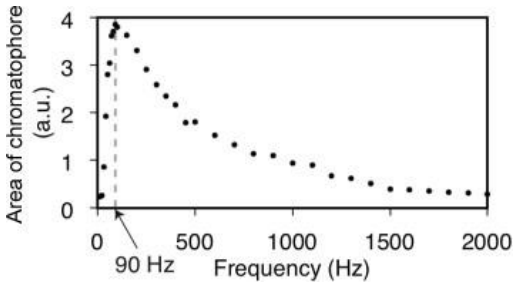

Fig. 1. The area of chromatophore per frequency [4]

Based on the experiments, we seek a best relationship between chromatophores and sound signals in a form of music.

3. Our approach

3-1. Sound

As a preliminary experiment, we first explored how chromatophores respond to sound signals. We attached a copper needle to a sound cable as an electronic probe and directly produced sound signals from a computer into the surface

of a fresh squid (Fig. 2). The result showed that the lower frequencies (i.e., the bandwidth of drum and bass) cause a higher effect to the chromatophore.

Fig. 2. Setup of the experiment.

To make music (i.e., sound signals) appropriate to the squid, we finely generated waveforms of the music (i.e., sound signals) with a numerical programming environment, MATLAB, by checking the effectiveness with different arrangements. We generated each waveform with MATLAB, and arranged the waveforms in a form of music with standard music production software Ableton Live10.

3-2. Shooting

We shot our experiments by Canon 60D with Canon EF-S 35mm f/2.8 Macro IS STM. We shot several footages by changing the stimulation point of the squid with the same music. After the shoot, we edited the footages by Adobe Premiere Pro CC 2018. To keep the consistency between the sound and the display, we limited our edits to cutting, masking, and subtle color grading.

4. Result

As a result, we made a music video as one application of the pixel-free display using the squid's chromatophores (https://youtu.be/66-RoX2h8aI). The duration of the video is 2min 45sec, and the resolution is 1080p (Fig. 3).

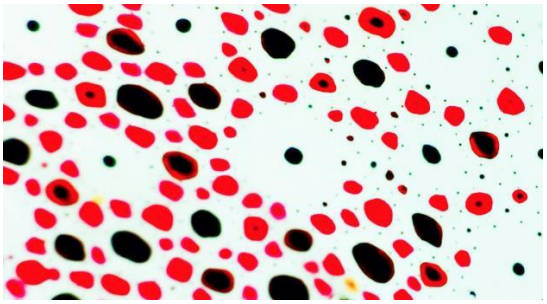

Fig. 3. Footage form a music video

Even though display successfully escaped from the use of pixels, the video itself remained in pixel form. Therefore, as future work, we plan to show the display in real time as the form of live performance.

Acknowledgements

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References

1. Hartmut Bohnacker, et al. *Generative Design: Visualize, Program, and Create with Processing* (2012).
2. R.A. Cloney, and E Florey. Ultrastructure of cephalopod chromatophore organs. Cell and Tissue Research 89, (1968) : 250-280
3. Backyard Brains, “Insane in the Chromatophores,” (2012). http://blog.backyardbrains.com/2012/08/insane-in-the-chromatophores/.
4. Ryo Adachi. 2017. “Frequency Response of Chromatophores to Electrical stimuli in *Uroteuthis edulis*.” Bachelor thesis, School of Design, Kyushu University. (in Japanese).

Biography

Juppo Yokokawa is in the 1st year of a Master’s degree in Graduate School of Design, Kyushu University. He has received the Bachelor in visual communication design from the School of Design, Kyushu University in 2018. His research interests include media art, especially bio art and kinetic art, under the supervision of Kazuhiro Jo.