A Colloidal Display: membrane screen that combines transparency, BRDF and 3D volume

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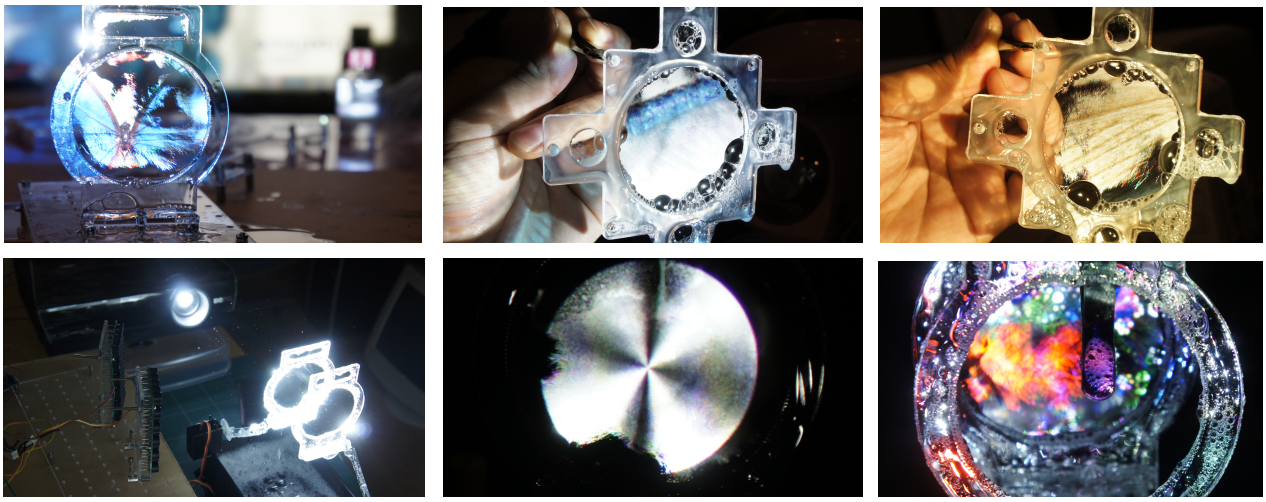

Figure 1: (top-left)controllable transparency, (top-center) sardine's back texture (top-right) wood texture on membrane screen (bottom-left) plane based 3D screen (bottom-center) metal texture on screen (bottom-right) piercing the object into the screen It's very difficult to take the picture as we see this display. The reflection of projector light is difficult to capture in cameras.

1. Introduction

It is a common knowledge that the surface of soap bubble is a micro membrane. It allows light to pass through and displays the color on its structure. We developed an ultra thin and flexible BRDF screen using the mixture of two colloidal liquids. There have been several researches on dynamic BRDF display[1] in the past. However, our work is different in several points. Our membrane screen can be controlled using ultrasonic vibrations. Membrane can change its transparency and surface states depending on the scales of ultrasonic waves. Based on these facts, we developed several applications of the membranes such as 3D volume screen.

The combination of the ultrasonic waves and ultra thin membranes makes more realistic, distinctive, and vivid imageries on screen. This system contributes to open up a new path for display engineering with sharp imageries, transparency, BRDF and flexibility.

2. Design

We developed the first prototype by using soap and milk. These are colloidal liquids and their molecules have different sizes and colors. With ultrasonic parametric speakers, we could control their movements (liquids and particles) on the membranes. If they move with intensity, the reflections change while the membrane works as a projector screen. Since we can control the dynamics of the wavelengths, the state of the surface can be easily changed.

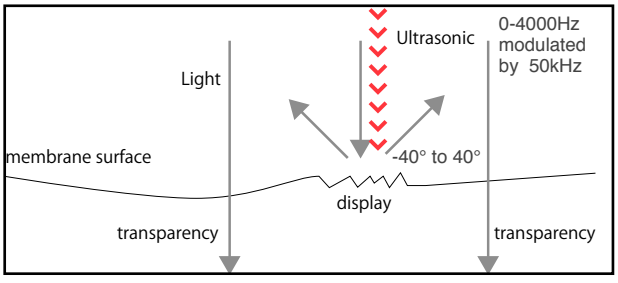

Figure2: ultrasonic & membrane

SIGGRAPH 2012, Los Angeles, California, August 5 – 9, 2012.
ISBN 978-1-4503-1435-0/12/0008

With the parametric speakers, this system can make the screens drastically thinner since it does not need any additional systems or materials on the screen. The thinness of the screen is approximately 1 micrometer. Since we could control the state of the surface, we were able to have several interactions such as piercing a finger through it or enlarging it by using its elasticity and flexibility.

3. Application

First we developed a screen for displaying realistic material. The display's state changes in correspondence to the images the projector shows.

Secondly, we developed the plane based 3D screen with three membranes using a single projector. (changing frequency 25Hz) The transparency of each membrane is controllable by frequency of the sound from the parametric speakers. We set the projector and linked it with the transparency of each membrane.

In addition, we developed polyhedrons made from these membranes and displayed several images on it. This system shows that this is useful to flexibly display 3D objects.

4. Future Work

We introduced the first prototype of a new kind of display by using colloidal liquids and a method of controlling them by using ultrasonic waves. Due to its thinness and transparency, the method could be applied to a variety of cases in using display technologies. The 3Ds screen and texture screen are exemplary applications of this system.

Currently our membrane can maintain its surface (screen) for 5 minutes. However, there are several solutions for this problem and there are rooms for new potential colloidal materials for the use.

REFERENCES

[1] M. Hullin et al., Dynamic Display of BRDFs. In: Proceedings of Eurographics 2011.

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