Reflective, Deformable, Colloidal Display: a waterfall-based colloidal membrane using focused ultrasonic waves.

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Figure 1: (top-left)flexible screen. (top-center)Omnidirectional display. (top-right)waterfall frame. (bottom-left) system overview. (bottom-center) reflective material display. (bottom-right) deformable display

1. Introduction

Our previous research[1] indicates that we can control the reflectance, transparency, and the view angle of the colloidal membrane using ultrasonic waves. The problem was the membrane was rather easy to break. However, in order to widen the view angle and extend the research, the screen is required to withstand powerful ultrasonic waves.

In this research, we developed a new colloidal screen using the waterfall concept. This system can now supply the colloidal solution continuously to the colloidal membrane resulting in the extension of the membrane's life with high stability against the powerful ultrasonic waves. In addition to this system, we are using a different ultrasonic speaker which can be focused[2]. Using these components, we are able to display different kinds of materials, create a deformable screen, and widen the view angle. This research opens up a new field in flexible display.

2. Design

Our system has 4 components, the first is the water tank with the colloidal solution, the second is the membrane frame that contains the water supply and the replacing mechanism, the third is the focused ultrasonic speaker, and the fourth is the projector. The setup of these components is displayed in Figure 1(bottom-left) and the system overview is displayed in Figure 2. The water supply system(in Figure1 top-right) supplies the colloidal solution from the water tank to the frame continuously using a pump. If the film breaks, it will be replaced by dipping into the water tank using a servo.

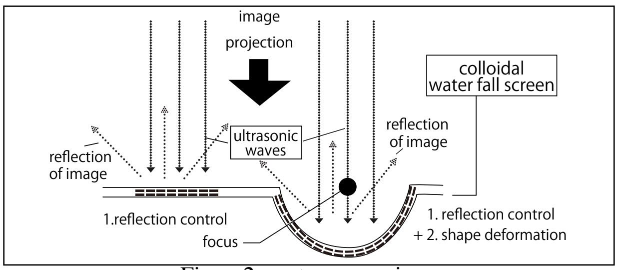

Figure2: system overview

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3. Application

3.1 Reflective Material Display

By switching the membrane's reflectance in high frequency, it creates an optical illusion that displays realistic materials such as glitter, diffuse, and so on. Figure 1(bottom-center) shows some of the materials we were able to demonstrate.

3.2 Deformable Display

When the ultrasonic waves are focused in one spot, a force field is created. We developed a deformable screen by controlling the spatial position and the power of the force field. The deformation can be controlled from 0 to 20mm with 1khz animation. Focused ultrasonic system uses 40kHz. The result can be seen in Figure 1(bottom-right).

3.3 Omnidirectional Display

Previously[1], we were only able to control the view angle for up to 40 degrees. We increased the range control to up to 160 degrees by applying stronger ultrasonic waves. This can be used as a multi-view angle screen by changing its reflectance (Figure 1 top-center).

4. Conclusion & Future Work

In this research, we conquered the problem of soap film's stability using a waterfall based design, and upgraded the speakers to allow the focusing of the ultrasonic waves. We have demonstrated some applications that can be used with these new components. Because this cannot be easily scaled to a bigger membrane, our next potential goal is to conquer this problem and create a bigger colloidal screen with unique interactions.

REFERENCES

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