

# Expanding the characteristics of shadows by combining optical materials

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**Abstract**—This paper proposes an optical material combination method to diversify the nature of shadows. The proposed method permits four types of catabolized shadows to be generated: those with fine detail, those with color, those with details changed according to the lighting direction, and those that appear on the near side of the object.

**Keywords**—interactive art; optical materials; shadow;

## I. INTRODUCTION

Shadows are a natural phenomenon that appear when an object blocks light. Shadows reflect the shape and movement of objects, but visual elements such as color and texture are eliminated. In recent years, shadow-themed interactive art has been produced [1], [2]. The aim of this research is to diversify interactive art expression by extending the nature of shadows. Previous studies have provided users with interests and wondering experiences by catabolizing the basic characteristics of shadows, but the effects of combinations of these methods have not been organized well. To solve this problem, this paper categorizes patterns in shadow characteristics by combining various optical materials.

## II. MATERIALS AND METHOD

The system consists of a transparent box with a polarizer attached to the front, a handheld torch that emits white light, and objects placed in the box. The polarizing plate of the object is used in the orthogonal direction to the polarizing plate attached to the box. On the rear side of the object's polarizing plate, materials cut out in the shape of a shadow are attached. On placing the objects parallel to the front of the box and looking at them from outside the box, the orthogonality of the two polarizers makes the object appear black. However, applying the torch light to the object means that light passes through one polarizing plate.

By combining the drawing paper with the polarizing plate of the object, only the part where the light is blocked appears as the shadow of the pattern. By combining colored cellophanes, only the light transmitted through the film appears as a colored shadow. By combining Lumisty films, the directions of light transmission are different on the left and right, and it is possible to express shadows with different patterns, whose appearance depends on when light is applied from the front, right, or left side. By combining half mirrors,

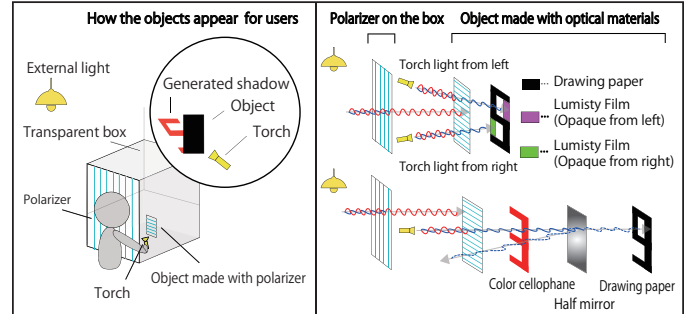


Figure 1. System Configuration and Object configuration

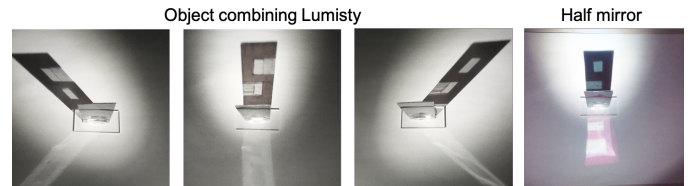


Figure 2. Shadows appearance generated by objects combining Lumisty films and half mirrors

it is possible to make shadows appear not only on the rear side of an object but also on the front side.

## III. EXPERIMENT

We conducted experiments to confirm if the extended shadow generated using this method is perceived by the users as we intended. The experiment participants were tasked with applying the torch light to the objects from various directions, and describing freely the features of the shadows. As a result, the recognition rate of shadows with fine detail were 90%, those with color were 70%, those with details changed according to the lighting direction were 40%, and those that appear on the near side of the object were 10%.

## REFERENCES

- [1] Minomo Y. et al. : Transforming your shadow into colorful visual media: multi-projection of complementary colors, ACE2015, 61-68 (2015).
- [2] Sakaguchi, S., et al.: Layered Shadow: Multiplexing Invisible Shadow Using Infrared Lights with Different Wavelengths, VRIC2013 (2013).