Shadow++: A System for Generating Artificial Shadows Based on Object Movement

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1 Introduction

This paper proposes a novel system that generates an artificial shadow by focusing on the position and angle of an object that is used to create a shadow. Our proposed system employs the metaphor of shadow-picture playing. By placing an object in front of a screen, its shadow is projected onto the screen. At the beginning, only the "real shadow" is displayed. After a short while, the shape of the shadow changes, and some additional effects appear on the screen. Our system utilizes the movement of the object as a trigger; it generates a kinetic artificial shadow that corresponds to the movement patterns of the object. When the user moves the object, additional effects change along with the location and position of the object.

2 System Components

Figure 1 shows an outline of the proposed system. This system consists of two infrared light sources emitting different wavelengths, two cameras with an infrared pass filter (IR filter) to capture shadows made by the infrared lights, a beam splitter, a projector, and a screen. An object covered with an IR filter is used to create an artificial shadow. The system utilizes infrared light as the light source to avoid the mixture of real shadows that are created by the light sources and artificial shadows that are projected onto the screen from the back by the projector.

This system uses two CCD cameras with an IR filter to capture images of the near-infrared spectral region. Each camera has an IR filter (one is IR-80, and the other is IR-92) attached to the lens that allows light over a specific wavelength (i.e., 800 and 920 nm, respectively) to penetrate. This lets the cameras capture only shadows generated by the light sources. This system uses infrared LEDs with two wavelengths as the light sources to create the shadows: 870 and 940 nm.

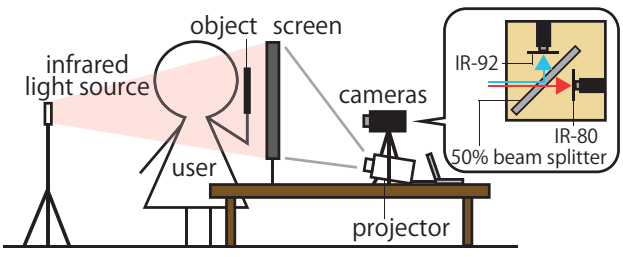

Figure 1: System component

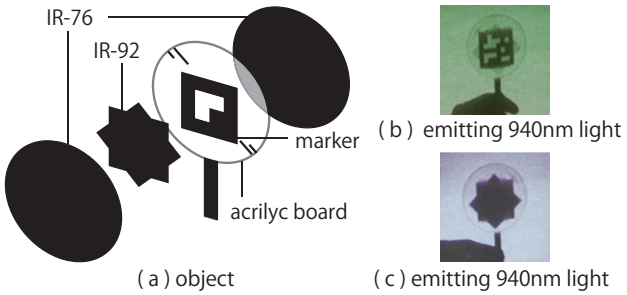

Figure 2: object

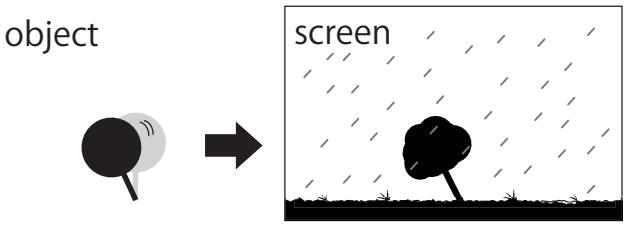

Figure 3: application

3 Handheld Object

This system uses markers to recognize the location and position of the object held by the user. To recognize the object, a two-dimensional black-and-white marker is used. The marker is made of black drawing paper. To transmit light, white regions in the marker are removed from black regions. When the object is irradiated with infrared light, only the black region of the marker is projected onto the screen as an invisible shadow. Because both sides of an object, which has a marker attached, are covered with IR-76 filters, as shown in Figure 2, the user can use the object without having to worry about the marker; thus, turnoff can be avoided.

Figure 3 shows an application of this system. In this application, by placing the object in front of the screen, the object's shadow changes to a tree; then, the ground and falling snow appear. When the user changes the object's angle, the angle of the falling snow changes along with it. When the user moves the object up, the root of the tree appears.

4 Concluding Remarks

This paper proposed a system for generating artificial shadows based on the movement of objects. With this system, a user can have an amazing experience by participating in a "shadow world" in which shadows behave differently from those in our ordinary lives.

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