Twinkle: Interface for using Handheld Projectors to Intaract with Physical Surfaces

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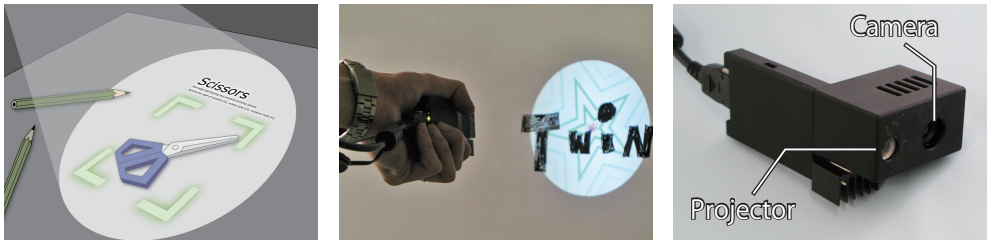

Figure 1: *(left):Concept of Twinkle, (center):Projected Image, (right):Prototype Device*

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1 Introduction

Recently, many small pocket-size projectors have been developed. It is expected that in the near future, such projectors will be installed in portable devices. Meanwhile, intuitive interfaces that operate according to the user's motion have been popular. Therefore, the interfaces that can be used for accessing information using handheld projectors have been increasingly studied [Forlines et al. 2005][Cao et al. 2007]. However, these interfaces suffer from a number of problems. Some systems need motion-tracking systems in order to measure the position of the projector. Further, the surface where image is projected are limited to plain screen like a white wall.

The purpose of our study is to propose a novel interface for interaction with an arbitrary physical plane surface; here, we define interaction as the utilization of a physical surface to perform certain tasks. We call the interface "Twinkle". We define a physical surface as a surface that exists in a physical environment and is not plain. Examples of such surfaces are a poster on a wall, figures or characters on a whiteboard, and a desk on which objects are placed. When a user shines light from a handheld projector such as a flashlight onto a physical surface, pictures are displayed and sounds are emitted according to the objects that are present on the surface and the user's motion. **Figure 1** (left) shows the concept behind Twinkle.

Our method enables various applications. A few examples of the applications of Twinkle are mentioned below. First, we propose an interface for music composition and musical performance. The pitch of a sound is determined by the size of the object illuminated by the projector. The color of the object and the user's motion determine the tone and the volume, respectively, of the sound. The user can create melody and rhythm by laying out objects on a surface. This interface enables users to compose and play music on the basis of intuition, i.e., they can compose and play music even if they do not have knowledge of musical score. Next, we propose an AR annotation system. The system recognizes figures or characters on a surface, and information is presented near theose objects. Additionally, the proposed interface can be used in shooting games or action games. In such games, real objects on a surface are regarded as obstacles.

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2 System Overview

The proposed system comprises a handheld projector and a video camera fixed to the projector. The system is quite simple and does not need other motion-tracking systems. The camera captures a physical surface illuminated by the projector. The camera has the following two roles: to estimate the user's motion and to recognize the features of the physical surface. The process of estimationi of the user's motion is described below. By recognizing the shape of the area on which the light is projected, we can calculate the projector's position relative to the surface and the distance between the projector and the surface. Moreover, an optical flow technique enables the estimation of the direction and velocity of the motion of the user's hand on a two-dimensional surface. In order to recognize the features of the physical surface, various existing image-processing methods can be used. For example, by using a labeling process and pattern recognition, we can estimate where the object is located on the surface and estimate its shape. These processes are executed in parallel and in real time. Then, images are generated according to the user's motion and the features of the surface, and these images are projected onto the surface by the projector.

We have developed a prototype device and implemented several applications. **Figure 1** (center) shows a projected image when a user plays music on the interface, and (right) shows a prototype device.

3 Conclusion

We proposed a novel interface for interaction with an arbitrary physical plane surface, where the interaction involves the use of handheld projector. Further, we have developed a prototype device and implemented several applications.

References

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