Z-touch: A multi-touch system for detecting spatial gestures near the tabletop

Yoshiki Takeoka
The University of Tokyo
yoshikinoko@gmail.com

Takashi Miyaki
The University of Tokyo

Jun Rekimoto
The University of Tokyo
Sony Computer Science Laboratory

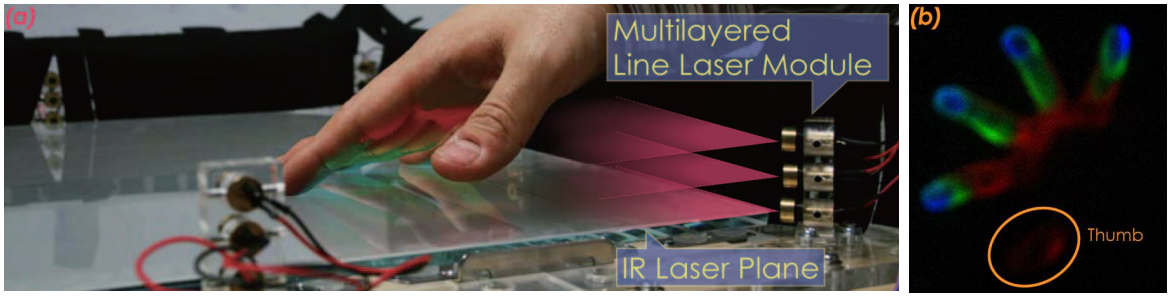

Figure 1: *These two pictures have been captured simultaneously. (a): Tabletop of Z-touch. Multilayered line laser modules are placed at the edge of the tabletop panel. (b): Captured depth map of the hand near the top panel of Z-touch shown in (a). RGB channels correspond to the Laser Plane: R-Highest, G-Middle, B-Lowest (very close to the surface of the tabletop). The image at the bottom of (b) is that of the thumb not touching to the surface, so the silhouette is in a pale red color.*

Abstract

We introduce Z-touch, a multi-touch table that can detect spatial hand gestures near the tabletop surface. This system uses a combination of a multilayered infrared (IR) laser plane and a high-speed camera. Multilayered IR line laser modules are synchronized with the shutter signal of the high-speed camera. This system allows user interaction on the basis of the posture of the user's fingers near the tabletop surface without the use of special markers or devices on the fingers.

Keywords: multi-touch, hand gesture interaction

1 Introduction

Since multi-touch systems detect multiple contact points on a tabletop surface, user interaction is restricted to a 2D planar surface. However, users often forget this restriction and interact with the system using 3D gestures near the tabletop. When carrying out physical interactions such as manipulating some objects, we simultaneously control multiple points and continuous parameters. This is because the most of the parameters are dependent on "how the fingers/hands touch to the objects." In the same context, we believe that it is very important to take into account the interaction using the postures of fingers when designing multi-touch systems. We may use finger posture in applications such as those for controlling 3DCG objects and effects of music. We introduce Z-touch, a novel multi-touch table that is capable of detecting posture and position of multiple objects (fingers) near the tabletop. Users can interact with the contents displayed on Z-touch by using their bare hands without wearing special markers. [Benko and Wilson 2009] introduced the concept of 3D hover gesture interaction in front of the projection screen surface. They used a depth sensing camera to detect 3D interaction. However, we use a multilayered laser plane synchronized with the shutter signal of a high-speed camera to obtain a clear image of the depth map near the surface (Figure1(b)).

2 System Design

Figure 2 shows the system architecture of Z-touch. The key components of Z-touch are multilayered IR line laser modules and a high-speed camera. The appearance of each of IR laser plane is

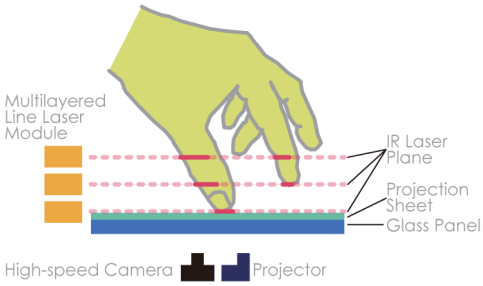

Figure 2: *System architecture.*

controlled by synchronization with the shutter signal of high-speed camera. The IR laser is reflected by the objects in the middle of the top panel and is captured by the high-speed camera embedded under the surface (Figure1(b)). We used Pointgrey Grasshopper which can capture 8bit gray scale VGA image at 200fps. Eight sets of triple line laser modules are placed at center of edge and vertex of the top panel (Figure1(a)). The IR laser plane is calibrated along the distance between each laser plane (11.5mm) and is parallel to the top panel. The lowest laser plane is very close to the surface of the top panel. The top panel (control area) is 420 mm square glass panel having a thickness of 6mm. This panel is covered by a projection sheet, the DILAD screen sheet, which only diffuses visible light from the rear projector to the surface of the top panel but allows reflected IR light to pass through.

3 Conclusion

We introduced Z-touch, that combines multi-touch and 3D hand gesture detection near the surface of a tabletop, using multilayered IR line lasers synchronized with the shutter signal of a high-speed camera.

References

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