Clickable Virtual Button in Real Space

Atsushi Sugiura Masahiro Toyoura Xiaoyang Mao
Interdisciplinary Graduate School of Medicine and Engineering
University of Yamanashi
Kofu, Yamanashi, Japan
{g12dhl02, mtoyoura, mao}@yamanashi.ac.jp

***Abstract*— Clicking a virtual object is the most fundamental and important interaction in Augmented Reality (AR). This paper presents a new natural click interface for AR systems. Through a primary study, we found the acceleration of fingertips provides cues for detecting click gesture and succeeded in use it for recognizing natural click gestures with a single camera. The proposed technique was evaluated through a virtual calculator application.**

I. INTRODUCTION

We propose a natural input interface for AR systems. Some systems force users to make unintuitive gestures such as pinching with the thumb and forefinger for the ease of detection [1]. We succeeded in detecting natural gesture of clicking a virtual object with a single camera by tracking the acceleration of a user's fingertip.

II. NATURAL CLICK GESTURE

A. Primary Study

Virtual buttons were displayed on a video-see-through HMD with a single camera for 12 subjects. The subjects were asked to "click" virtual buttons with their pointing fingers without any training. During the operation, the finger is always displayed in front of the virtual button. No other visual, aural or haptic feedbacks were provided for the interaction between the finger and the buttons. We observed following facts in the study.

1. The depth at which subjects tried to click the buttons varies by subjects. They could not perceive the correct position of the buttons in depth.
2. The click gesture is similar to but more exaggerated than a tapping gesture. Since there is no haptic feedback about the interaction with a virtual button, the subjects try to represent the clicking by raise their finger up, push down quickly and then stop on the button suddenly.
3. The click gesture includes 3D movements which vary by subjects as well as the positions of the buttons.

B. Visual Feedback of Pointing

The observed facts suggest the importance of visual feedback. To provide an interface consistent with conventional point-and-click metaphor, we change the color and size of a button when it is pointed(Figure1(b)). Since a user cannot place his/her fingertip at an intended position in depth, we detect the pointing by checking whether the 2D position of the fingertip has been within the region of the button for a given time period.

C. Acceleration-based Click Detection

Due to the 3rd fact observed in the primary study, it is very difficult to detect the click gesture with a single camera or with existing finger/hand gesture recognition methods using trajectory and speed analysis. However, through a careful analysis of the 2nd fact, we found that all click gestures share a common feature that the fingertip stops suddenly at the end of the gesture. By the complementary use of both the 2D acceleration and the approximated acceleration in depth direction, we succeeded in detecting click gestures at a high success rate.

III. EXPERIMENT

Five subjects in their 20s or 30s joined the evaluation experiment. Figure 1(a) is a snapshot of the experiment and Figure 1(b) is what a subject saw on HMD. They were asked to perform a task of using the virtual calculator. Each subject clicked 80 times and on average, 4.0% could not be detected and 0.4% was falsely detected.

(a) A snapshot of the experiment (b) AR Calculator

Figure 1 Clicking virtual buttons in AR environment

IV. CONCLUSIONS

A natural clicking interface for augmented reality has been presented. As a future work, we plan to extend the technique for supporting other gesture based intuitive interactions in AR system.

REFERENCES

[1] A. Wilson, Robust Vision-Based Detection of Pinching for One and Two-Handed Input, UIST, 2006.

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