TweezersDevice: A Device Facilitating Pick and Move Manipulation in Spatial Works

Akimasa Uesaka[1], *Kengo Fukuda*[1], *Asako Kimura*[2], *Fumihisa Shibata*[1], *Hideyuki Tamura*[1]

[1]Graduate School of Science and Engineering
Ritsumeikan University
1-1-1 Noji-Higashi, Kusatsu
Shiga, Japan

[2]PRESTO
Japan Science and Technology Agency
4-1-8, Honcho, Kawaguchi
Saitama, Japan

ABSTRACT

We present a concept of our novel interaction devices; ToolDevice, which is for various operations in large electric working space. ToolDevice is a set of interaction devices using a metaphor of existing tools which are familiar in everyday life. They imitate not only the shapes of existing tools and their usages, but also the tactile and audio sensation to increase presences of virtual objects and improve operational feelings. As the first example of ToolDevice, this paper introduces TweezersDevice for pick and move manipulation, and describes its mechanism, manipulation methods, and prototype.

ACM Classification: H5.2 [Information interfaces and presentation]: User Interfaces. - Input devices.

General terms: Design, Human Factors

Keywords: Input Device, Metaphor, Tool Set, Multi - modal interfaces, Pick and Move, Tweezers

INTRODUCTION

In this paper, we present a concept of novel interaction devices; ToolDevice, which is for various operations in large electric working space, such as mixed reality (MR) space, and introduce TweezersDevice as its first example. ToolDevice is a set of interaction devices using a metaphor of existing tools which are familiar in everyday life. Such tools have good affordance themselves, and at the same time, every user already has the mental model for their operations. These advantages not only lead users to the correct operation, but provide an intuitive operation.

There have been some studies of interactive devices using metaphors of existing tools, such as brush, tong, paddle and chopsticks [1-4]. The differences in these studies and our approach are as follows.

- To increase a presence of virtual objects and improve the operational feeling, our devices imitate not only the shapes of existing tools and their usages, but also the tactile and audio sensation.
- ToolDevice users select and use various devices depending on their works.

To realize such device set, we firstly listed up the works requiring a large space, such as designing, layout and 3D modeling. Secondly we extracted necessary operations to complete these works "pick and move," "model" and "draw," and decided to develop ToolDevice for these three operations. In this paper, we introduce TweezersDevice, as the first ToolDevice, which facilitates pick and move manipulation in the spatial works (Figure. 1).

UIST'08, October 19-22, 2008, Monterey, California, USA
ACM 978-1-59593-975-3/08/10.

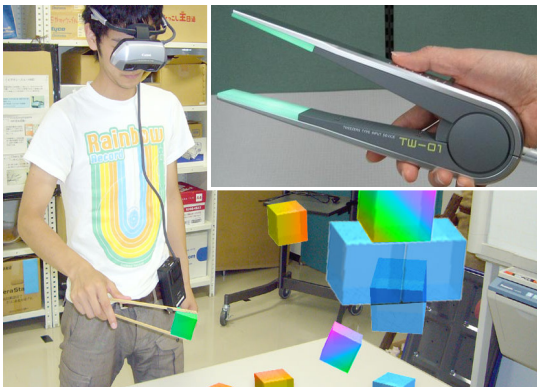


Figure 1: TweezersDevice and its pick and move manipulation

TWEEZERSDEVICE

Pick and move

The first device, we developed, is for pick and move manipulation which are frequently used functions in various works. We associated these functions with that of the tweezers which is a tool only for pick and move manipulation. The tweezers is a tool that can pick and move physical objects by adding pressure on its sides with fingers. The user can feel the object's size and softness from its reaction force.

Mechanism

To realize similar operational feeling to the tweezers, following electronic components were built into TweezersDevice (Figure. 2).

- A magnetic sensor to detect the position and orientation of TweezersDevice in 3D space.
- A potentiometer to detect the opening angle of TweezersDevice.
- Force feedback mechanism to present reaction force while picking virtual objects.

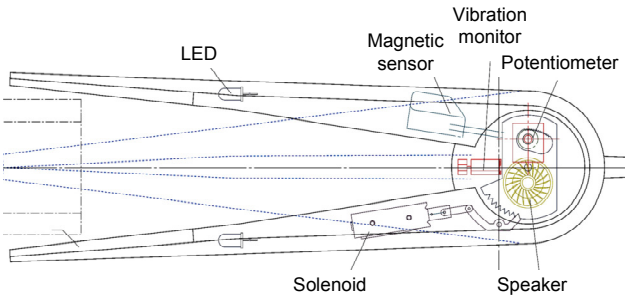
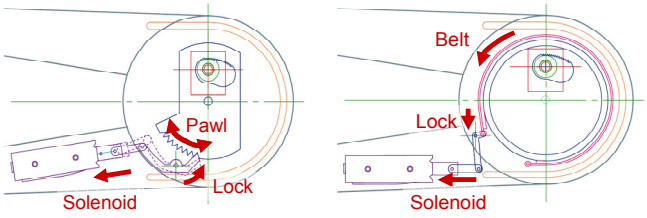


Figure 2: Mechanism



(a) Ratchet brake (b) Drum brake

Figure 3: Force feedback mechanisms

- Color LEDs, a speaker and a vibration motor for the confirmation of manipulation.

As for the force feedback, we implemented two brake mechanisms; a ratchet brake and a drum brake (Figure. 3). The ratchet brake locks the cylinder by a pawl. It can fix the opening angle of TweezersDevice depending on a size of the virtual object. The drum brake locks the cylinder by a belt. The additional function with this brake mechanism is that it can present softness of virtual objects by loosening the belt.

Manipulation methods

TweezersDevice enables the following manipulations.

(a) **Pick**: The users can pick a virtual object by pinching it with TweezersDevice. When they pinch the object, they can feel its size and softness from the fixed angle of the device and its reaction force.

(b) **Move**: The users can translate and rotate the virtual object directly in 3D space.

(c) **Release**: The users can release the virtual object by reducing the pressure of their fingers and opening TweezersDevice. In release manipulation, there are several options, such as putting a virtual object at the released position, dropping it on somewhere and tossing it.

Prototype

We developed the MR system with which the users are able to pick, move, and release virtual objects using TweezersDevice in MR space (Figure. 4). In this system, the users can manipulate simple geometry objects and CG characters, staying or moving in the MR space (Figure. 5). When the user picks one of the objects, the LEDs emit the same color of it, and the sound effect, vibration and reaction force are presented. The vibration is presented when the selected

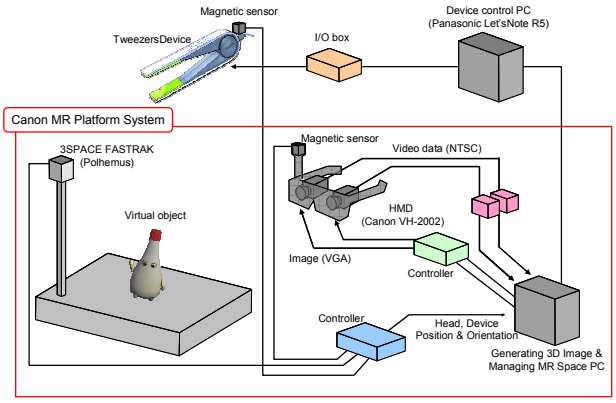


Figure 4: System configuration

Figure 5: Prototypes; the users can pick and move virtual objects in the MR space.

object is moving, and the intensity of the reaction force is changed depending on the size and material of the object. With this system, simple layout/modeling application for moving and placing virtual object, and application separating virtual objects to real/virtual cases could be easily implemented.

CONCLUSION

In this paper, we proposed the concept of ToolDevice which is a set of our novel interaction devices with large electric working space, and realized TweezersDevice as its first example. For future work, we are planning to evaluate TweezersDevice, and develop second and third generations.

ACKNOWLEDGMENTS

We would like to thank Mai Otsuki, Yusuke Takami and Masashi Tsukadaira of Ritsumeikan Univ. for their valuable contributions. This research was supported by Precursory Research for Embryonic Science and Technology Program of Japan Science and Technology Agency.

REFERENCES

1. K. Ryokai *et al*. I/O Brush: Drawing with everyday objects as ink. *Proc. of CHI 2004*, pp. 303 - 310, 2004.
2. S. Schkolen *et al*. Surface Drawing: Creating Organic 3D Shapes with the Hand and Tangible Tools. *Proc. of CHI 2001*, pp. 261 - 268, 2001.
3. H. Kato *et al*. Virtual object manipulation on a table-top AR environment. *Proc. of ISAR 2000*, pp. 111 - 119, 2000.
4. Y. Kitamura *et al*. Virtual Chopsticks: Object Manipulation using Multiple Exact Interactions. *Proc. of IEEE Virtual Reality*, pp. 198 - 204, 1999.