A Study for Touchable Online Shopping System with Haptical Force Feedback

Kenji Funahashi
Nagoya Institute of Technology
Gokiso-cho, Showa-ku,
Nagoya, Japan
kenji@nitech.ac.jp

Yuuta Kuroda
Denso Corporation
1-1 Showa-cho,
Kariya, Japan

Masumi Mori
Onda Techno
Intl. Patent Attys.
12-1, Omiya-cho 2-chome,
Gifu, Japan

Abstract

This paper proposes the Touchable Online Shopping *system. Users can touch and grasp commodity with their own hand. The purpose of this system is to make it easy to measure the size of the commodity intuitively. Other purpose is to make the system with small-scale input and output device with vibrators. In this Touchable Online Shopping system,* haptical force feedback *is introduced in order to cover an impression such as the touch feeling for interface problem while grasping commodity. Using this system, users can grasp it and measure the size through a data-glove as similar to real ones.*

1. Introduction

Many researches on object manipulation in virtual space have been proposed. These virtual reality technologies are being applied to the medical area, space developments and amusement attractions, and these demands for the VR technology are getting higher. In this virtual object manipulation technology field, there are many researches using glove type input device [1]. The development of input device itself has been advanced, the glove is marketed which has vibrators at fingertips to convey information and the glove which can make feedback forces to each of four fingers and thumbs with wire.

On introducing haptic and force feedback, the vibration technic has been proposed as basic researches [2, 3, 4], however, it has applied only for amusement field like video game. Of course in some field, e.g. medical field, priority is often given to precision over cost, hence, for example, virtual scissors system has been proposed in which the force feedback is considered. And the size of equipment probably will be large-scale and more expensive [5, 6].

On the one hand, utilization of Online shopping is increasing recently as the evolution of the mail order. In the former mail order, only the images of a commodity and their explanations are shown. In the next mail order system through TV, the motion and sound of a commodity are shown too. And now we can look it from any direction on the Internet with interactive 3D technique. However we usually touch and take the commodity in our hand at a store for checking the size and feeling of it.

In this research, we considered the *Touchable Online Shopping* system under thin haptic and force feedback [7]. Especially, the system consists of only vibration feedback elements for small-scale size and low-price, because our goal is widely generalization. One of our proposals was that we considered vibrating not only at the contact points but also at non-contact points. The subjects could judge the different of thickness between two virtual mobile phones in an experiment.

In this paper, we describe firstly the outline of Touchable Online Shopping system. Then we would like to show the experiments and results. This technique might be not only for Touchable Online Shopping system but also for any virtual reality system to use at personal home.

2. Touchable Online Shopping

In our system, we considered the virtual hand in PC monitor which moves, opens and closes following the movement of the real hand which wears a data-glove. The illustration of our future system is shown in Figure 1. Although the data-glove with vibrators we used was expensive exactly, the *PAX PowerGlove* was marketed for *Nintendo Family Computer* with low price in the nineties (Figure 2), and *Essentialreality P5 GLOVE* which was able to connect to PC via USB was marketed for around $100 recently (Figure 3). It is expected that vibration system is able to be attached on a data-glove such as the PAX PowerGlove and Essentialreality P5 GLOVE, and the glove with vibratators is able to be marketed in low-price if there are many demands.

For simplification, only rectangular parallelepiped is

ICAT 2008
Dec. 1-3, Yokohama, Japan
ISSN: 1345-1278

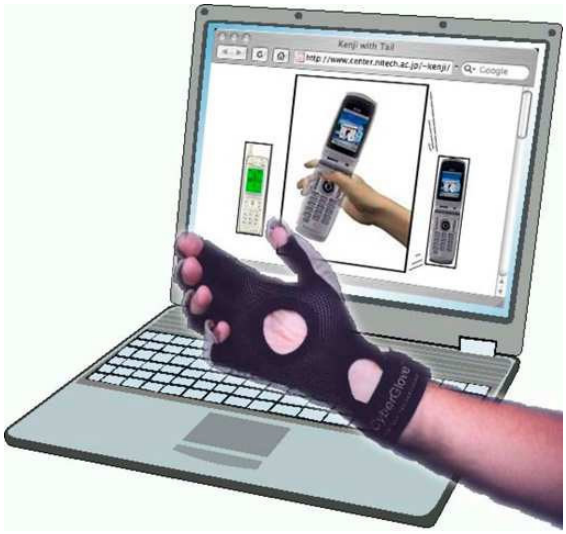

Figure 1. Illustration of our future system

Figure 2. PAX PowerGlove

considered as commodity in the experimental system, for example, digital camera and mobile phone. When a subject touches a virtual object, the system convey information through vibration. However actual force dose not feedback to a subject, subject feels touch sense through vibration and feels the thickness from vibration as reaction force. We call the haptic as force *haptical force* in this research. In addition, the movable area of virtual hand was restricted in order to compensate the understanding of three dimensional space (Figure 4).

In the pre-experiment, the strength and the position vibration were evaluated (Figure 5, 6). Three strengths were considered for fingers and palm as follows;

Figure 3. Essentialreality P5 GLOVE

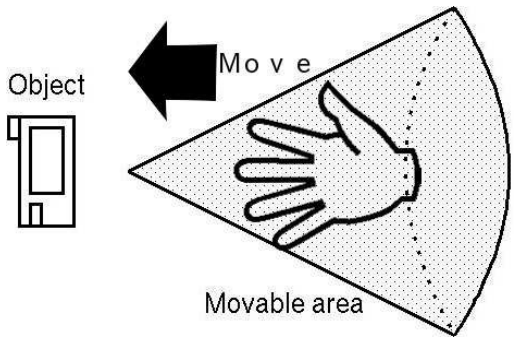

Figure 4. Movable area of wrist of virtual hand

1. the subject dose not feel it excessively
2. the subject can feel it
3. no vibration.

The result showed that a little vibration (1) at palm was effective. Vibrations (2) at a finger which contacted to an object was also effective.

3. Experiment and Result

The Touchable Online Shopping system mentioned above was implemented on a PC (Pentium4, 2.80GHz, 1GM memory) with C language. The position of hand was detected by Polhemus 3SPACE FASTRAK and the angles of each finger were detected by Immersion CyberTouch. The system appearance and CG image of this system are shown in Figure 7 and 8. It refreshed the CG image at 20 frames/sec. The virtual hand shown in CG was assumed as that of adult man's.

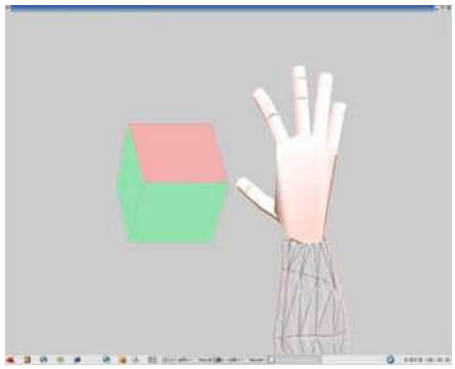

Figure 5. Pre-experiment (touch)

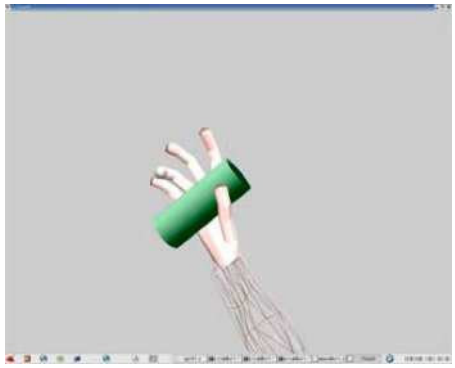

Figure 6. Pre-experiment (grasp)

Then the effects of vibration feedback were evaluated. The number of right-handed subjects was six and they did not have any experience of this system before experiments. The number of virtual object was five and the size was 5cm width and 10cm hight, and the thicknesses were 2, 2.5, 3, 3.5 and 4cm respectively.

The three pattern were prepared from every combination as follows;

1. difference of thickness: 0.5cm
2. difference of thickness: 1cm
3. difference of thickness: 2cm,

and every subject tried two times for every pattern in randomized order, totally tried six times. After each test, they answered which is thick. The result is shown in Table 1.

At the experiment of 2cm difference, positive answer ratio was 100Although the ratio for 1cm and 0.5cm difference were not 100result showed that these identification ratio were still high. From this result, we think that haptical force feedback is effective to judge the thickness and the size of virtual object.

Figure 7. System overview

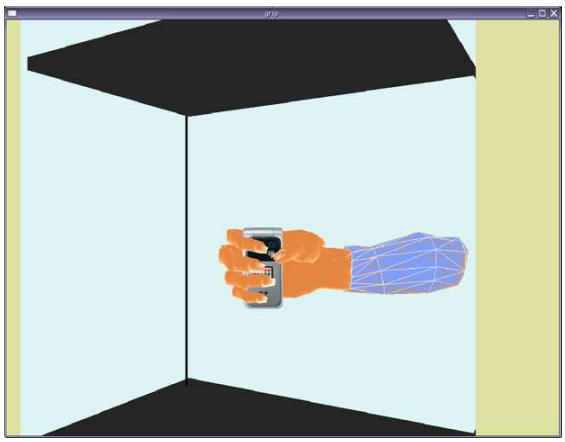

Figure 8. Execution screen

Table 1. Evaluation of judgement of thickness

difference of thickness	number of entire trials	number of positive answers
0.5cm	12	9
1cm	12	10
2cm	12	12

4. Conclusions

Experimental evaluations were done using Touchable Online Shopping system. The vibration feedback is effective as force feedback, and the vibrational stimulus where man can realistically never touch, i.e., palm is also effective.

Many kinds of force and haptic feedback device have been researched and developed, but the size and price of most of them are not for home use, while the vibrator system is used for the silent mode of mobile phone and video game controller recently. Although the data-glove we used is very expensive one, there are/were some data-gloves for video game in the market. It would be able to make a data-glove with vibrator at a low price in the future. Using this data-glove and the method proposed, various virtual reality system might be produced and sold, for example, for our home through the Internet.

Good results were obtained, but there are some points to be improved. For example, we tested just some patterns of vibration position and strength level. As a future subject, these above problems are remained to be solved. Many patterns of them should be tested and analyzed, and the optimized pattern should be found automatically. It also remains as our task that real object should be compared with virtual one, and virtual hand (size of hand, thickness of finger and color of hand) should be calibrated. Of course actual Touchable Online Shopping System should be realized. We are looking for the data-glove production company and Online shopping company.

References

[1] K. Funahashi, T. Yasuda, S. Yokoi, and J. ichiro Toriwaki. A model for manipulation of objects with virtual hand in 3-d virtual space. *Systems and Computers in Japan*, 30(11):22–32, 1999.

[2] Y. Kume, A. Shirai, M. Tsuda, and T. Hatada. Information Transmission through Soles by Vibro-tactile Stimulation. *Transactions of Virtual Reality Society of Japan (in Japanese)*, 3(3):83–88, 1998.

[3] H. Yano, T. Ogi, and M. Hirose. Development of Haptic Suit for whole human body using vibrators. *Transactions of Virtual Reality Society of Japan (in Japanese)*, 3(3):141–147, 1998.

[4] Y. Yokokohji, M. Kawai, and T. Yoshikawa. Proposal of a Motor Skill Transfer Method Using Vibration Cue and Teacher's Sight and Its Preliminary Experiment. *Transactions of Virtual Reality Society of Japan (in Japanese)*, 4(2):431–438, 1999.

[5] A. M. Okamura, M. R. Cutkosky, and J. T. Dennerlein. Reality-based models for vibration feedback in virtual environments. *IEEE/ASME Transactions on Mechatronics*, 6(3):245–252, 2001.

[6] A. M. Okamura, R. J. W. III, J. T. Nolin, K. W. Johnson, and H. Jafry. The haptic scissors: Cutting in virtual environments. In *Proc. the 2003 IEEE International Conference on Robotics & Automation*, pages 828–833, 2003.

[7] K. Tanida, K. Funahashi, M. Ohmi, and M. Kusumi. Embodiment evaluation for tools of virtual reality technology -a trial evaluation by measuring hemodynamic change in the brain-. *Transactions of Virtual Reality Society of Japan (in Japanese)*, 12(1):3–10, 2007.