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(Title)

A Consideration on Controller Interaction for VR Devices

1. Background

User interface (UI) is all the points of contact for users to interact with services and products. In software, UI is important from the viewpoint of indirectly manipulating what cannot direct touches. UI is also an important factor for playing games comfortably. The UI used in VR equipment is called Graphical User Interface (GUI), and it is intuitive for users because changes are immediately reflected when they directly manipulate information in the computer. However, because of the nature of VR, the user cannot directly see the controller, so the interaction between the user and the VR equipment through sensory feedback other than visual senses such as hearing and touch is important.

2. Purpose

In this study, we investigate the effects of tactile and auditory feedback such as vibration and sound on the user's sense of operation when operating buttons and triggers using a pointer-type keyboard, which is an input operation UI in VR.

3. Method

Because of the nature of VR, we cannot see the controllers directly, so interactions by senses other than sight are more important than those of other game devices. In this experiment, we focus on tactile and auditory feedback from the controller when the user performs input operations on the controller. Perceivable feedback from the VR equipment to the user includes auditory feedback through sound, as well as tactile feedback through button presses and controller vibrations. Considering the above reasons, we conduct the following nine types of experiments.

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Experiment 1: Trigger-only operation
Experiment 2: Trigger + feedback by sound
Experiment 3: Trigger + feedback by vibration
Experiment 4: Trigger + feedback by sound and vibration
Experiment 5: Button-only operation
Experiment 6: Feedback by button + sound
Experiment 7: Feedback by button + vibration
Experiment 8: Button + feedback by sound and vibration
Experiment 9: Operation of a trigger with a button built into the innermost part of the trigger

We conduct the above 9 types of experiments. In each of the experiments with buttons and with triggers, we compare the case with various types of feedback with respect to the case without feedback. We also examine the effectiveness of various types of feedback in keyboard operation in VR.

4. Discussion

Data were collected from 12 subjects and the results were statistically analyzed. The results confirmed, at the one-sided significance level of 1%, a significant difference between the experimental results for the triggering operation with vibration and sound and vibration feedback and those for the triggering alone. For the button operation, significant differences were found between the experimental results with sound and sound-vibration feedback and those with button-only feedback. From the above, vibration feedback in the case of trigger operation and sound feedback in the case of button operation affect the operability of the pointer-type keyboard in VR. In addition, the feedback combining sound and vibration is effective in improving the operability of both trigger and button operations.

5. Conclusion

In the operation of buttons and triggers, we verified the operability when vibration and sound are fed back using a pointer-type keyboard, which is a standard feature of each VR device. We also examined the usefulness of triggers containing buttons in users' VR experiences. In the case of trigger operation, vibration and feedback by sound and vibration are effective in improving the operability of the trigger. In the case of button operation, we concluded that sound and feedback by sound and vibration were effective in improving the operability of the buttons.

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