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Study of Virtual Button Design in a Vision Based Interface

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Abstract: The current study aims to improve the operating performance on vision based interface. Its main objective is to evaluate the virtual button design in a vision based interface by verifying the interface elements which are trigger time, button size, and button position of the virtual buttons. This study developed a vision based interface with virtual button menu to examine the differences in operating time and error rate when adjusting the interface elements. The participants are 30 college students aged between 21 and 29 in Taiwan. The results showed trigger time, button size, and button position has significant impact on operation time and error rate. To adjust trigger delay time appropriately, the error rate can be effectively reduced.

Keywords: virtual button, vision based interface, performance

Introduction

By vision-based interactive techniques, some limitations with a keyboard/mouse that are used for input could be avoided. With vision based interface (VBI), users would interact with a computer in an intuitive way and not constrained by wires or space[2].
There are considerable differences between operating VBI and traditional inputs (keyboard/mouse)[1]. The way of operating VBI is by user's hand movements and gestures, so the requirement of user's muscle extensibility, limb sensitivity, and body control ability is different from those by keyboard / mouse which user simply sitting in front of a computer to operate[3]. Therefore, unique interface elements must be taken into consideration in VBI design.
This study developed a VBI with virtual button menu to evaluate user's operating performance which included operating time and error rate by adjusting the trigger time, button size, and button position of the virtual buttons.

1. Methodology

1.1 Participants

The participants are 30 college students aged between 21 years old and 29 years old, the average age was 23 years old. They were from National Taipei University of Education and National Taiwan University.

1.2 Experimental design

To examine the differences in operating time and error rate when adjusting the trigger time, button size, and button position of the virtual buttons in VBI, the experiment was within-subjects with three factors.
The VBI system developed in this study introduced motion-based approach. Using motion detection technique, the VBI system could sense user's hands movements. Participant stood in front of the projection screen, moved their hands to trigger the virtual buttons (Figure 1). There are 9 buttons maintained same distance around participant on system screen, and button design with three different trigger times (0 sec., 0.5 sec., 1 sec.). Participants trigger three different sizes of the buttons at 9 positions (Figure 2) to determine the operating time and error rate. Every participant was requested to finish 81 (3 trigger times * 3 sizes * 9 positions) trigger tasks.

1.3 Data collection and analysis

Once participants touched the start button the software and the operation time is recorded until all tasks were done. The error rate was the error button triggers in one experiment process. The operation time and error rate examined from this experiment were analyzed by three-way ANOVA.

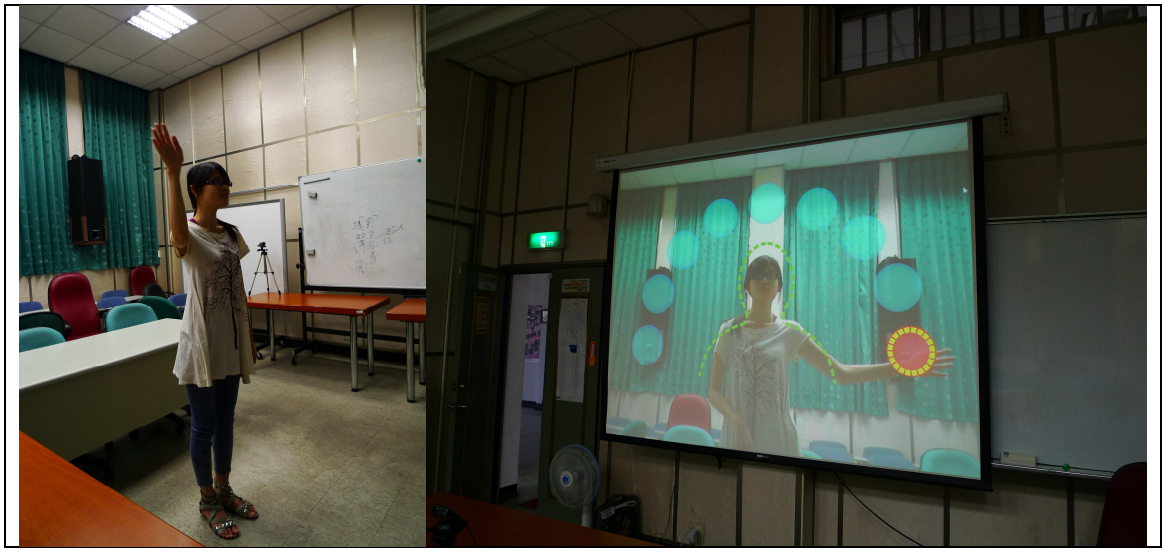

Figure 1. Screenshots of the participant's manipulation.

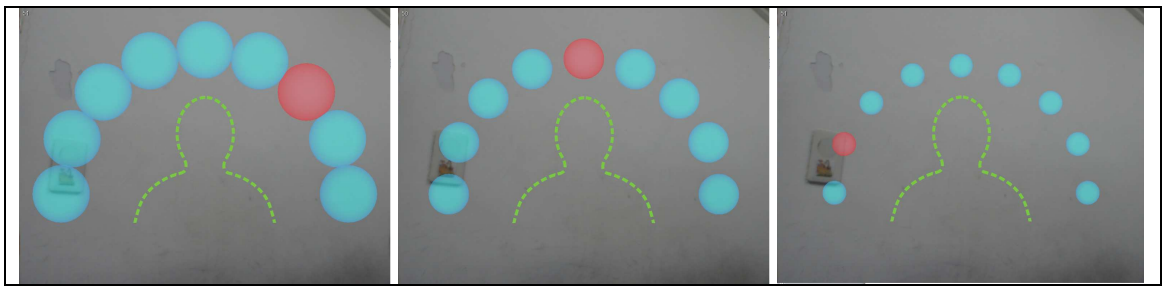

Figure 2. Screenshots of the button's positions and sizes.

2. Results and discussion

2.1 Trigger time

The trigger delay times are 1 sec., 0.5 sec., and 0 sec. in this experiment. The error rate of 0 sec. trigger delay time was the highest one. No significant differences were noted between the 1 sec. trigger delay time and 0.5 sec. trigger delay time. To adjust trigger delay time appropriately, the error rate can be effectively reduced.

2.2 Button size

The operating time with biggest button's size was significantly higher than the medium and small ones. Speculated that the reason causing this result may be the button's interval, there were minimum interval between the biggest buttons. This also results in which the biggest button operating case with the highest error rate.

2.3 Button position

The operating time of the buttons operated at the right side was significantly less than that at the left side, due to the participants in this experiment are all right dominant hand, the result shows that the button's position falls on the same side of the dominant hand can reduce the operating time.

3. Conclusions

The results indicate that trigger time, button size, and button position has significant impact on operation time and error rate. To adjust trigger delay time appropriately, the error rate can be effectively reduced. The bigger buttons size can reduce operation time and error rate, but button's interval should be considered when setting the buttons. The buttons position located on same side of user's dominant hand can reduce operation time and error rate.

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