Ballistic and Corrective Movements of Drag on Touch Screens

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I. Introduction

As the touch screen as an input interface, its accurate, efficient, and comfortable operation is an important aspect of user interface (UI) design. Because the finger assumes the role of a pointing device in operating the touch screen, the kinetic characteristics of the finger have a direct impact on the touch screen's usability. Therefore, in addition to the evaluation of efficiency, it is necessary to analyze the kinetic characteristics of the finger during the operation process and reflect them in the UI design. This study aimed to obtain the basic knowledge regarding the finger's ballistic and corrective movements through motion analysis based on the peak velocity of drag on touch screens.

II. Method

We conducted an experiment in which an object displayed on the screen was dragged to a target position using a finger (Fig. 1). The object and target were designed in a 20-mm square to ensure usability and that they are not completely covered by the participants' fingers. The drag direction and distance were adopted as experimental factors. Ten subjects participated in this study; their average age was 23.6 years. The drag directions were upward, downward, left, and right. The drag distances were 30 mm, 50 mm, 80 mm, and 120 mm. Each trial was performed 10 times; hence the total number of trials was 140. As for the motion component, it was assumed that the period from the start of a movement to the time when the peak velocity first appeared (T_{PV}) was "ballistic phase," and the period after that was "corrective phase" (Fig. 2). Then, the percentage of T_{PV} to the entire movement time was calculated and used as an evaluation index to investigate the temporal characteristics of the motion component during drag.

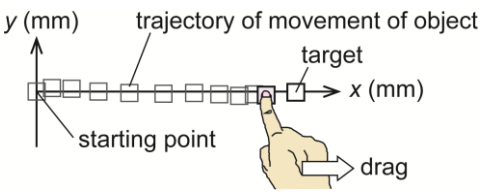

Fig. 1 Drag operation

III. Results and Discussion

Figure 3 shows the results. The results showed that the finger movement for drag corresponded well with the performance model based on Fitts' law. The peak velocity of dragging was almost linearly related to the distance to the target and was higher in the horizontal direction than in the vertical direction. As the corrective movement for positioning at the target accounted for more than half of the drag movement, operation support for the corrective movement may improve usability.

Acknowledgements

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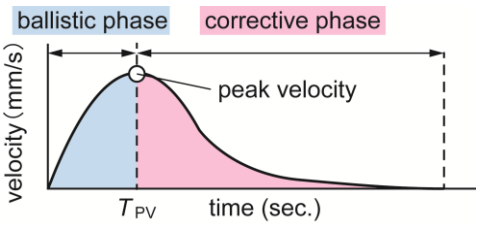

Fig. 2 Diagrammatic illustration of the finger's ballistic and corrective movements

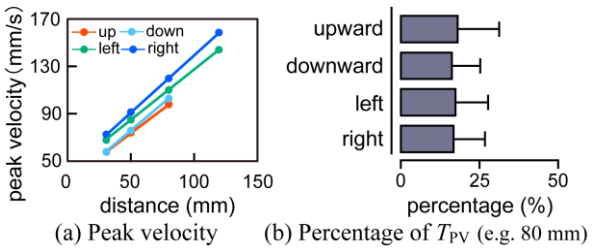

Fig. 3 Results of peak velocity and percentage of T_{PV} to operating time