Running Head: USABILITY OF USER INPUT DEVICE

Usability of User Input Device for the More System

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INTRODUCTION

Refer to Guidelines for the Development of Input Device for Aircraft Technicians for a comprehensive explanation about the Input Device. This paper is on an experiment conducted to test the usability of the dial that was constructed by the Rapid Prototyping class of 2006

METHOD

Participants

Six Carnegie Mellon University took part in this experiment. Four of the participants were male and the other two were female.

Materials

The input device created by the Rapid Prototyping class of Spring 2006. The input device consists of a palm-grip knob that scrolls a highlight on the screen from keyword to keyword. Rotating the knob clockwise moves the highlight down the screen and moving the knob counter-clockwise moves the highlight up the screen. There are four push buttons - 3 finger activated and 1 thumb activated. One push button is used by the index finger and switches the highlight from pane to pane. Another push button is also activated by the middle finger and is in the center of the ideal. This button does a search on the currently highlighted keyword. There are two buttons on the side of the device; one is activated by the thumb and the other by any finger. These buttons switch the focus from tab to tab. If pressed in together at the same time, this places the currently highlighted keyword's page into a new tab. This input device was attached to the input

device belt, so that it would be placed in the middle of the chest. It was also used with the head mounted display.

Three gloves were used for this experiment. These consist of one thin surgical glove, one gardening glove, and one thick work glove.

Procedure

The participant's hand was measured. The height – the base of the palm to the top of the middle finger – and the breadth – from the thumb to pinky across the broadest area.

The participant were given the task of doing a search on a keyword, opening one of the search results in a new window, and switching focus back to the original window. These tasks were done with the head mounted display and with the input device attach This involved

1. Rotating the dial so that the highlight moves down to the fifth keyword
2. Pressing down on the button in the center of the dial
3. Pressing down on the pane button until the highlight moves to the search pane
4. Rotating the dial until the second search result is highlighted
5. Pressing in both side buttons to open result in a new window
6. Press thumb activated side button to move focus back to the first window

Participants did this task with no glove, thin surgical glove, gardening glove, and work glove. The ordering of type of glove was done using the Latin Square Design so that there would be no ordering effect.

Each step of the procedure was timed.

At the end of the experiment, participants were given a questionnaire, which is in the Appendix.

RESULTS

Four areas of interest were compared: Glove Type vs. Times, Hand Length vs. Time, Gender vs. Times, and Gender vs. Hand Length.

The time is measured by averaging the time for each task over all participants.

Quantitative Measurements

Table 1. Glove Type vs. Time

Glove Type	**Average Time (Seconds)**
No Glove	4.2
Thin Surgeon Glove	4.5
Garden Glove	6.3
Thick Work Glove	5.3

Table 2. Hand Length vs. Time

Hand Length (Inches)	**Average Time (Seconds)**
7.3	8.2
7.3	10.4

7.6	6.7
7.8	6.0
7.8	5.8
8.1	5.2

Table 3. Hand Breath vs. Time

Hand Breadth (Inches)	**Average Time (Seconds)**
4.0	8.2
4.0	10.4
4.3	6.7
4.4	5.8
4.4	6.0
4.5	5.2

Table 4. Gender vs. Time

Gender	**Average Times (Seconds)**
Male	5.9
Female	9.3

Gender vs. Hand Size

Gender	**Average Hand Length**

	(Inches)
Male	7.8
Female	7.3

Qualitative Measurement

Table. 1 Glove Type vs. Movement of Dial

Glove Type	**Average Score**
No Glove	6.1
Thin Surgical Glove	7
Garden Glove	7
Work Glove	7

Table 2. Glove Type vs. Pushing Center Button

Glove Type	**Average Score**
No Glove	2.3
Thin Surgical Glove	2.1
Garden Glove	1
Work Glove	1

Table 3. Glove Type vs. Pushing Pane Button

Glove Type	**Average Score**
No Glove	4.3
Thin Surgical Glove	3.9

Garden Glove	2.3
Work Glove	1.5

Table 4. Glove Type vs. Pushing Side Buttons

Glove Type	Average Score
No Glove	1
Thin Surgical Glove	1
Garden Glove	1
Work Glove	1

Table 5. Glove Type vs. Pushing Thumb Button

Glove Type	Average Score
No Glove	1
Thin Surgical Glove	1
Garden Glove	1
Work Glove	1

Table 6. Glove Type vs. Overall Ease of Use

Glove Type	Average Score
No Glove	1
Thin Surgical Glove	1
Garden Glove	1
Work Glove	1

DISCUSSION

The most informative data comes from the qualitative analysis. As can be seen, the dial was overall difficult to use. The dial was too quick and the buttons were too difficult to use.

There are obvious problems with the buttons considering that there are not even usable side buttons but just little knobs. Other than that, though, it can be clearly seen that the dial moves too fast and the buttons are too hard to use. Listening to participants, it is not that the resistance of the buttons is too much but that it is the size and placement. Everybody complained about using the center button to select on keywords, and most people complained about the pane button. Complaints just increased when gloves were added. Due to the extra size the gloves add and difficulty of seeing and feeling where the hand was located, finding and pushing buttons became even more difficult. Participants' had an extremely difficult time with wearing gloves and trying to push the center button, whereas pushing the pane button was not as bad.

A mention about the time data. The garden glove took longer to do the tasks than the work glove. It is believed that this happened because the work gloves are made of a material that is very slippery, therefore causing great difficulty in gripping. Beyond that, though, it can be seen that adding gloves increased the time it took to accomplish the tasks and that the smaller the hand the longer it took to accomplish the tasks.

While watching the participants, those with the smaller hands had a hard time reach the buttons due to the size of the dial, whereas those with larger hands did not have as much of a difficult time. Even though the gloves added length to the smaller hands, this did not enable them to reach the buttons noticeably any better.

Another area of difficulty that was noticed, was that one person was left handed. Starting out, this person rotated the dial counter-clockwise to move the highlight down. This of course did not work, since the dial must be rotated clockwise. For a left handed person the rotation of the dial counter-clockwise maps with moving down, whereas with a right handed person, rotating clockwise is what maps with moving down. Along these lines, another line that could have been faced with a left handed person is that their thumb will be where a right handed person's fingers will be and vice versa, causing a problem with using the side buttons. The left side button was constructed to be made for the thumb and the right side button was constructed to work with the other fingers. No problems were noticed in this experiment as the side buttons were not installed.

Conclusion and Future Work

The data shows that the prototype is very difficult to use, with the dial turning to easily and it being difficult to find and using the buttons. This is a good step, though, showing areas of difficulty that can guide future designs. Possible designs to add would be to add texture to the dial, to add greater resistance to the dial, to decrease the width of the dial, and to increase the size of the buttons. It will also be important to explore methods to deal with the natural inclination of left handed users to rotate

the dial counter-clockwise to move the highlight down. Another problem there is also that the side buttons were designed, well at least going to be designed, for right handed users.

Even though this experiment was done with participants and materials that would not be found at an Airfield where this More system would be used, it does show areas that really need to be worked on before even testing it with real users. Since access to real users is difficult to obtain, doing tests with college students or another type of person will provide good information about the shortcomings of the dial. When a better design of a dial is created, then it will be extremely important to actually test it with real users in the field.

APPENDIX

Questionnaire

Movement of Dial

1 2 3 4 5 6 7

Too slow No Problem Too Quick

Pushing Center Button

1 2 3 4 5 6 7

Too hard No Problem Too Easy

Pushing Pane Button

1 2 3 4 5 6 7

Too hard No Problem Too Easy

Pushing Side Buttons at same time

1 2 3 4 5 6 7

Too hard No Problem Too Easy

Pushing Thumb Button

1 2 3 4 5 6 7

Too hard No Problem Too Easy

Overall Ease of Use

1 2 3 4 5 6 7

Too hard No Problem