USABILITY EVALUATION TO IMPROVE OPERATION INTERFACE OF WIRELESS DEVICE: PRESSURE RANGE OF TOUCH SENSOR

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ABSTRACT

Usability evaluation of wireless device can find improvement about user convenience. This study investigated natural finger pressure range when presses touch sensor. Fifteen adults (Male: 10, Female: 5, Age: 26.13 ± 3.98 years) were recruited in this experiment. Subjects carried out a usability evaluation about wireless device operation. The usability evaluation measured finger pressure on touch sensor operation of wireless device using finger pressure sensor. Subjects performed 1.76±0.95 times until pressing the touch sensor to complete task ($t = 3.091$, $p = 0.008$). In comparisons between natural movement and the movement to complete task, more finger pressure value was decreased in natural movement than the movement to complete task ($t = -2.277$, $p = 0.039$). This study found a finger pressure values to improve effectiveness of wireless device operation interface. Finger pressure value was presented to induce natural movement for the use of touch sensor.

KEYWORDS

Usability Evaluation, Operation Interface, Finger Pressure Range, Wireless Device

1. INTRODUCTION

Wireless devices are being widely disseminated in various fields with the development of Bluetooth technology. In particular, Bluetooth technology had been utilized in IoT-based home appliances and healthcare filed. Manufacturers are increasingly interested in usability evaluations to improve the efficiency of their user interface.

Many usability studies have been conducted on the user interface of Wireless devices [1, 2, 6]. Traditional usability evaluations used interview-based subjective scoring methods to validate product-use interface [3, 4]. According to the development of measuring devices (motion, cognition and sensation) that can analyse human factors, it is possible to investigate the user interface that can induce natural behavior in usability evaluations [2, 7]. Chang et al. developed a usability evaluation method that evaluates the efficiency of product-use behavior by motion analysis technology [2]. Human factor analysis can provide an objective result of user interface from usability evaluation [5, 8].

Dhinaharan Nagamalai et al. (Eds): CSEIT, WiMoNe, NCS, CIoT, CMLA, DMSE, NLPD - 2020
pp. 45-49, 2020. CS & IT - CSCP 2020 DOI: 10.5121/csit.2020.101104

Usability evaluation of wireless device can find improvement about user interface. To improve effectiveness of wireless device, it is necessary to reduce the joint load in product use. This study investigated finger pressure range for the use of touch sensors in wireless devices.

2. METHODS

2.1. Subjects

We recruited 15 healthy adults with no history of neurological disorders (F=5, M=10, 26.13 ± 3.98 yrs) as shown in Table 1. All subjects that consented to participate in this study were informed about the experimental protocol. All subject had the use experiment of wireless devices in daily life.

Table 1. Demographics of subjects

Subject	Gender	Age	Occupation	Wireless device Use experiment* (O/X)
S1	Male	27	Office Worker	O
S2	Female	26	Office Worker	O
S3	Male	26	Undergraduates	O
S4	Male	26	Office Worker	O
S5	Male	26	Undergraduates	O
S6	Male	26	Office Worker	O
S7	Female	21	Undergraduates	O
S8	Female	22	Undergraduates	O
S9	Male	24	Undergraduates	O
S10	Male	20	Undergraduates	O
S11	Male	24	Undergraduates	O
S12	Male	36	Office Worker	O
S13	Male	28	Office Worker	O
S14	Female	30	Office Worker	O
S15	Female	30	Office Worker	O

* O: Subject has experience controlling touch sensors on wireless devices such as Smart phone.

2.2. Experiment protocol

Wireless device has two functions both standby mode and operating mode. The standby mode was deactivated touch sensor of wireless device. The operating mode can control a volume size and play/stop of audio using touch sensor of wireless device. The operating mode is activated when the user presses the touch sensor harder than the reference value. The usability evaluation requires finger pressure to be applied to the touch sensor to move from standby mode to operating mode. All subjects performed the usability evaluation three times. Natural finger movement is that exclude finger joint load and subject was pressed touch sensor without uncomfortable of operation interface. The first attempt was performed with natural finger movement. If the subject fails to move to the operating mode in the first attempt, increase the pressure on the fingers until moving to the operating mode. The usability evaluation measured finger pressure on touch sensor of wireless device using finger pressure sensor (pliance®, novel.de).

2.3. Data analysis

The One sample t-test has been used in order to investigate the effectiveness of touch sensor operation using the SPSSWIN 20.0 software package. In addition, the paired t-test has been used to compare the finger pressure value between natural finger movement and finger movement to complete task.

3. RESULTS AND DISCUSSION

3.1. Problem of touch sensor operation interface

If the touch sensor operation interface is efficient, the number of touch sensor presses will be close to 1. Five subjects out of subjects were completed the task that presses touch sensor in natural finger movement. All subjects performed 1.76 ± 0.95 times until pressing the touch sensor to complete task ($t = 3.091$, $p = 0.008$) as shown in Figure 1. Subjects repeatedly pressed the touch sensor until operation mode activated. This result suggests that subjects had difficulty pressing the touch sensor of wireless device. To improve effectiveness of touch sensor operation, finger pressure value should be measured at natural finger movement.

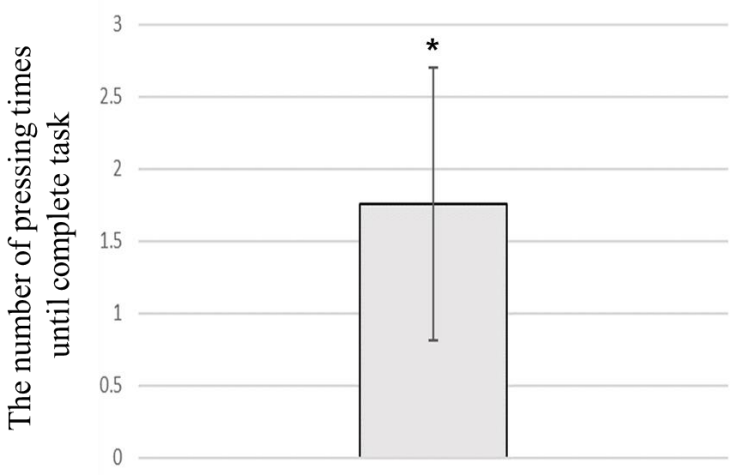

Figure 1. The number of pressing times until complete task (*: $p < 0.01$)

3.2. Change of finger pressure by finger joint load

The One sample t-test has been used in order to compare the training effects between tasks. All inserts, figures, diagrams, photographs and tables must be centre-aligned, clear and appropriate for black/white or greyscale reproduction. The mean finger pressure value of natural movement was 9.31 ± 2.64 kPa. The mean finger pressure value to complete task was 11.00 ± 3.71 kPa. In comparisons between natural movement and the movement to complete task, more finger pressure value was decreased in natural movement than movement to complete task. ($t = -2.277$, $p = 0.039$)

Table 2. Comparison of finger pressure value between natural movement and the movement to complete task

	Natural finger movement	**finger movement to complete task**	**p-value**
Finger pressure value (mean ± sem(kPa))	9.31± 2.64	11.00±3.71	0.039

In the results of finger movement to complete task, finger pressure value was shown that finger joint load of subjects is increasing. On the other hand, finger pressure range was decreased in natural finger movement that excluded finger joint load. This result suggests that the response range of the touch sensor should be adjusted to improve the user interface of the wireless device.

4. CONCLUSIONS

This study investigated finger pressure range to improve operation interface of touch sensors in wireless devices. The limitations of this study were that subject group did not include elderly group and teenager group. But, considering the fact that wireless devices have become more popular in the last 10 years, young adults can buy more wireless devices than elderly group and teenager group. Finger pressure sensor was used to evaluate an effectiveness of touch sensor interface. Finger pressure range could show natural finger movement that excluded joint load on touch sensor operation. This study found that the response range of the touch sensor should be adjusted to improve the user interface of the wireless device.

ACKNOWLEDGEMENTS

The Foundation Assist Project of Future Advanced User Convenience Service" through the Ministry of Trade, Industry and Energy (MOTIE) (R0004840, 2020) and Basic Science Research Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education (NRF-2017R1D1A1B04031182 / NRF-2020R1I1A1A01072101) and a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grant number : HI17C2594).

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