

중고령 주부를 고려한 김치냉장고 제어판의 사용자 인터페이스 디자인

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User Interface Design of the Control Panel of Kimchi Refrigerator for the Older Women

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ABSTRACT

To evaluate the usability of a Kimchi refrigerator, we performed an evaluation test that consisted of an experiment and a post-hoc questionnaire survey. In this study, we focused on the older women who have less physical and cognitive ability than younger women. In physical usability, there was no significant difference between the older and the younger subject group. However, there was some significant statistical difference in the results of cognitive usability test. When the subjects debriefed their operations after finishing the experiment, the all subjects in the older group reported the difficulties in identifying the labels and icons in the control panel and in understanding operation sequences. Also, they couldn't learn and remember the operation procedures well. Based on the analysis of the video protocols, some causes of the problems were found and then several improvement ideas were suggested.

Keyword: Kimchi refrigerator, Control panel, Usability, Older women

1. Introduction

In Korea, the Kimchi refrigerator is specially used as the second refrigerator that preserves Kimchi, Korean traditional food, and ferments it. Since it was launched in market in 1995, it has become very popular in Korean homes. It is reported that 63% of Korean homes have the Kimchi refrigerator (Korea Power Exchange, 2007). Moreover, the market trend has led the models with

larger size and with more functions. Therefore, the increase of substitution purchasing aims to change small one to bigger one. As the size and the functions of the Kimchi refrigerator increase, some ergonomic problems are inevitably accompanied.

Compared with home refrigerators, most of Kimchi refrigerators have different shapes. The dominant type, top-door style, has two refrigerating rooms with top covers and may have an additional drawer that preserves fruits and vegetables. Figure 1 shows typical models of

the Kimchi refrigerators. These forms are effective in keeping lower temperature in air flow, but they are likely to bring about users' bad postures.



Figure 1. Typical Kimchi refrigerators

Especially, the old people are more susceptible to this problem. Koppa et al.(1989) pointed out some design problems of the home refrigerator for the old person and suggested some design guidelines. Regarding the Kimchi refrigerator, Lee et al.(2007) reported that 75% of users experienced pain or discomfort while using it. U2 Systems Inc.(2006) also reported that the top-door style Kimchi refrigerators invoked users' bad postures while putting in or pulling out containers.

The major factor of the pain and discomfort is the awkward postures induced by the deep preserving room of the top door style Kimchi refrigerator that is most popular in market. Also, the weight of containers with Kimchi, up to around 10Kg, adds on the pain and discomfort (U2 Systems Inc., 2006). Although the number of handling Kimchi containers is not frequent, the instant burden on musculo-skeletal system while lifting up a container from the Kimchi refrigerator can be harmful for the old housewives (Park et al., 2006).

According to the development of microprocessor and display technologies, home electric appliances have also adopted them in control panel design as like digital information appliances. Therefore, the control of home electric appliances became more difficult than the control of traditional ones. It made the home electric appliances need usability test on control panel. For the refrigerator, Park and Jung(1998) performed a usability test. It showed that the control was not easy even for the simple tasks.

Especially, the older people are not adapted well in digital environment due to their visual, auditory and

cognitive limits. Song et al.(2000) found out that the older people were weak in reading information, especially from small visual things, and in controlling multi-functional devices in their experiment with microwave ovens. Hong et al.(2002) also reported that the older people experienced some difficulties in reading characters and in manipulating buttons on cellular phones.

However, the design of home electric appliances has not been fully considered the older people yet. The only things considered severely are the functions and the outlook of products in the marketing viewpoint. The Kimchi refrigerator is one of them.

In this study, we tried to find usability problems of a Kimchi refrigerator especially in the view of the older women. Based on the prior questionnaire survey (Lee et al., 2007), we designed an experiment with a scenario and a post-hoc questionnaire. Congruent with the assumption, the older people showed poor performance in cognitive usability test.

The results of this study could be referred specifically in the design of the new Kimchi refrigerator and generally in the home electric appliances considering older users.

2. Method

2.1 Subjects

Volunteered six old women(50.3 ± 2.3 years) and six young women(20.8 ± 0.8 years) participated in the experiment. The average height of the older group (154.5 ± 4.2 cm) was shorter than the younger group (162.9 ± 7.2 cm). The older women were house wives and the younger women were university students. They all have used the same top-door style Kimchi refrigerator that was used in this experiment, but they were new to the control panel of the Kimchi refrigerator used in this experiment. To motivate the engagement in the experiment, they were paid.

2.2 Kimchi refrigerator and control panel

A newly launched Kimchi refrigerator sized in 210 l was used in the experiment. It has a crystal control panel with a touch screen (Figure 2). The Kimchi refrigerator

is the first model that adopts the crystal panel among the products. The former models have button-type membrane switches. The control panel of the Kimchi refrigerator has arrow keys, LED displays for mode selection and for food selection (Figure 3).



Figure 2. Crystal control panel with touch screen



Figure 3. Control panel; (a) arrow keys, (b) mode selection keys, (c) food selection keys

2.3 Tasks and procedures

The tasks consisted of two parts: Firstly, the subjects were asked to pull out the six containers from the preserving rooms and then to put back them. They repeated the cycles varying the weight of the containers, 4, 6, 8, and 10Kg (Figure 4). Then they were asked to clean the inside of the preserving rooms by using a rug. Secondly, they were asked to control the basic functions of the Kimchi refrigerator.

Five basic tasks were given to the subjects: 1. 'Power on and refrigerate two preserving rooms', 2. 'Ferment Chongak-Kimchi', 3. 'Preserve Mul-Kimchi in strong mode', 4. 'Store pork in fresh mode', and 5. 'Prepare to clean the refrigerating room'.

Before beginning the experiment, an experiment conductor explained the objective of experiment briefly



Figure 4. Tasks for physical usability test

and provided a set of task scenarios. The subjects were measured in height and weight. During the experiments, all actions of the subjects were videotaped. Because the think-aloud method was used to find out the problems of the control panel, subjects' speaking was encouraged.

When a subject finished all the tasks, she was asked to rate the some questions on physical usability and cognitive usability in 5-Likerts scales; from 'very bad' to 'very good'.

3. Results and discussions

3.1 Subjective ratings

Figure 5 shows the overall results of the Student's t-test between the younger and older groups on the post-hoc questionnaire. Contrary to our expectations, there was no significant difference ($\alpha=0.1$) between the younger and the older group in terms of physical usability. Only in the term, 'door open', the older group felt more discomfort comparing with the younger group ($p=0.01$). This could be caused of the difference in stature between the younger group (162.9cm in average) and the older group (154.5cm in average). During opening and closing the top cover fully, the older women hardly reached the end of the door.

However, in terms of cognitive usability, the older group felt more difficult than the younger group did. In the term, 'operation', there was statistically significant difference between two groups ($p=0.10$). Also, the older group didn't understand well the meaning of labels on the

control panel rather than the younger group ($p=0.06$).

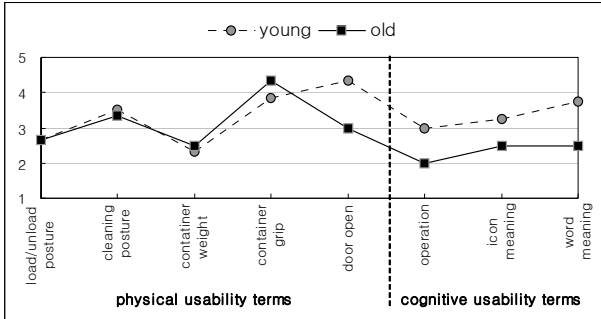


Figure 5. The result of post-hoc questionnaire analysis

3.2 Success rates

The quantitative comparison of the success rates between two groups in the cognitive tasks was meaningless. Nobody in the older group completed any tasks without help from conductors. The younger group also performed poorly; two younger subjects succeeded in task 1 and task 2, three subjects in task 3, and five subjects in task 4 and task 5. Basically the total failure of the older group was caused by the very poor visibility of the crystal control panel. What made the older subjects fail are described in the next session.

3.3 Video protocol analysis

To find out the causes of the cognitive usability problems, we analyzed the video protocols. First of all, most of the subjects regardless the age generally didn't perform the tasks well. This was caused by the poor readability of the symbols and the labels on the crystal control panel that had low contrast and brightness. Ergonomic guidelines recommend the high contrast between targets and background and high brightness (Sanders and McCormick, 1997).

Also, the lack of tactile feedback in finger touching didn't give subjects certainty of their actions. They didn't recognize well the system responses for their actions. These phenomena were severer to the older women who had poor visual acuity and rare experience on touch screen.

The time lag in visual feedback also made the subjects

wonder what to do next. They did wrong actions when they would have waited the system response in some operations.

Besides, the lack of border between the control part and the display part made the subjects wander around display part when they were asked to control something.

All these problems prolonged task completion time and made the subjects commit lots of errors. Furthermore, no older subjects finished the tasks without help from the experiment conductors.

3.4 Suggestions

Based on the analysis, some design guidelines were suggested. First, although the crystal panel looked fancy, the readability was very poor. Brightness and contrast are key factors in enhancing readability of displays. However, the crystal control panel showed lower brightness and contrast than other conventional models with button keys and LED displays. Especially, the older people are weaker than the younger people in recognizing information at the same lighting condition. Therefore, the brightness and the contrast of the crystal control panel should be raised, or the use of it should be reexamined.

Second, the system feedbacks of user actions were too weak in visual and auditory senses. Severally, there was no tactile feedback in the crystal control panel. So, the visual and auditory feedback should be enhanced to give users some cues for their actions. For example, while cooling the preserving room, the blinking signals with sound can be used for letting users wait. As the other way, to enhance the tactile feedback, the control part can be separated from display part in the crystal control panel.

Third, there was no clear identification between the display and the control symbols. To enhance the distinction between controllers and displays, some color codes or border lines can be used. As presented in the above paragraph, the physical separation between them also can be considered.

4. Conclusions and further study

The spread of digital technologies in home appliances makes the older people embarrassed in controlling them and frustrated sometimes. In this study, the control of Kimchi refrigerator was not easy for the older women. Especially, the crystal control panel caused it. It's poor brightness and contrast did not meet the ergonomics guideline. They could not identify the symbols and labels. The lack of feedback in touch and no cue on operational procedures made it worse. To enhance the usability of the control panel of the Kimchi refrigerator, some guidelines were suggested.

In this study, we found the significant differences between the younger and the older people in cognitive usability. Although there was no difference in physical usability, it didn't mean that there was no problem of the Kimchi refrigerator. On the contrary, the physical problems were common for the younger and the older people.

This study has some limits because of the little number of subjects. Also, the results should be confined on a specific model used in this study. Therefore, in applying the results to the other models, it is needed to consider the experiment conditions of this study.

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논 문 접 수 일 (Date Received) : 2009년 01월 13일
 논 문 수 정 일 (Date Revised) : 2009년 07월 17일
 논문게재승인일 (Date Accepted) : 2009년 07월 21일