The Usability Evaluation of The HCI Interface of SHARP-R22AT Microwave Oven

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1 Introduction

For the students studying at the University of Edinburgh, microwave ovens can be one of the most used daily cooking tools used every day. In daily use, we found that the human-computer interaction (HCI) interface of the SHARP-R22AT microwave oven (currently used in the Residence Hall - 9D Holyrood dormitory area) may not be very friendly to users who have not been exposed to such operational logic so that they can experience certain confusions when attempting to adjust heating time and power manually when first using this microwave oven as they cannot infer the operation method through observing such interface.

Figure 1 is the picture of the SHARP-R22AT. In the middle part of the interactive interface, the numbers 0 to 9 represent ten preset shortcuts (most users will treat them as buttons that control the heating time when they first see this microwave oven). However, when the shortcut keys do not meet the daily needs of all users, it is necessary to change the heating time and power manually. The regular operation method is first press "MANUALL/REPEAT"

Figure 1: SHARP-R22AT microwave oven

to set time then press “POWER LEVEL” to set power (the microwave oven does not respond if the order is reversed).

Most users first look for keywords (Yih et al., 2006) such as “time” and “power” when manually adjusting the heating parameters. In this HCI interface, there is indeed a “POWER LEVEL”, but the microwave oven does not respond after pressing this button. At this point, the user is in an awkward situation: there is no ”time” button on the control panel, and it is useless to press the ”POWER LEVEL” button. Therefore, the user has to use a combination of shortcut keys (and the user needs to memorize the heating parameters represented by each shortcut!) instead of manually adjusting time and power. For example, to heat for 1 minute and 40 seconds, the user needs to press the “Shortcut Key 1” and stand in front of the microwave oven to wait for 1 minute (“Shortcut Key 1” represents heating for 1 minute) and then press “Shortcut Key 4” for another 40 seconds. Doing so would waste too much unnecessary time.

2 Method

In (Nielsen, 1994), Nielsen divided usability into five components: learnability, efficiency, memorability, errors, satisfaction. We explore how the relatively unfriendly HCI interface of SHARP-R22AT affects users who have not previously been exposed to such operational logic, according to these

Usability Attributions	**Evaluation Methods**
Learnability	Record the time: from we start teaching participants the usage of this microwave oven until they successfully operate the microwave oven according to the cooking instruction (a plate of noodles which needs to be heated for 2 minutes with 900W of power).
Efficiency	Record how long it takes participants to operate the microwave oven given a cooking instruction (a plate of pasta which needs to be heated for 5 minutes with 750W of power).
Errors	Record the number of clicks of participants to operate the microwave oven given a cooking instruction (a plate of pasta which needs to be heated for 5 minutes with 750W of power).
Memorability	Ask participants if they still remember how to adjust the heating parameters manually after one-month winter vacation (most participants did not live in Residence Hall during the vacation since they were travelling abroad or staying at home).
Satisfaction	Ask participants to rate this HCI interface, with a full score of 10.

Table 1: Five attributions of usability and their evaluation methods

five aspects. Our measurement of this problem consists of two parts: operation and questioning. For learnability, efficiency, and errors mentioned above, we ask the participants to operate the microwave oven under certain requirements and record the experimental data. To evaluate memorability and satisfaction, we asked participants related questions to get users' relatively subjective feelings about this HIC interface. The detailed evaluation methods are shown in table 1.

Our participants are students living in the Residence Hall. We went to the kitchen and randomly find students who are not previously exposed to such HCI interface. We started the usability evaluation after they read and signed the Participant Information Template (shown in Appendix A) and Consent Form (shown in Appendix B). The questionnaire is attached in Appendix C. Our usability evaluation is conducted in the order of the questions in this questionnaire. The answer to the first question determines whether we are going to the second or fourth question.

Questions	**Results**
Q1: Can you adjust heating time and power manually?	**(a)** Yes: 26/40 **(b)** Can only adjust time: 5/40 **(c)** No: 9/40
Q2: Teach participants who cannot operate the microwave oven manually and record the time used	**(a)**1m20s-1m40s: 7/14 **(b)**1m40s-2m00s: 5/14 **(c)**2m00s-2m20s: 2/14
Q3: Heat the food for 5 minutes with the power of 750W and record clicks and the time used.	**Time:** **(a)**0s-5s: 0/40 **(b)**5s-10s: 12/40 **(c)**10s-15s: 17/40 **(d)**15s-20s: 9/40 **(e)**20s-25s: 2/40 **Clicks:** **(a)**7-8 clicks: 38/40 **(b)**13-14 clicks: 2/40
Q4: Did you still remember how to adjust heating parameters manually after one-month winter vacation?	**(a)** Yes: 19/21 **(b)** No: 2/21 P.S. There should be 26 participants answering this question, but 5 of them lived in Residence Hall during the winter vacation so they are not required to answer this question.
Q5: Rate this HCI interface	**(a)** 6: 5/40 **(b)** 7: 23/40 **(c)** 8: 10/40 **(d)** 9: 2/40

Table 2: The results of users study.

3 Results

The results of user study are shown in table 2. Participants who chose (a) in the Q1 skip Q2, and those who chose (b) or (c) in Q1 skip Q4. We conducted a user study on a total of 40 participants. After evaluation, we found that 26 users have already known how to adjust the heating parameters of the microwave oven manually, and 14 users still do not. Most users (12/14) can successfully understand the principle of manually using this microwave oven in two minutes. In the case of a given task, most users (38/40) can complete the parameter adjustment within 20 seconds, the operation time for most participants is between 5 seconds and 15 seconds (29 participants in this range). When we asked the participants who have already known the operation methods whether they had remembered how to adjust the microwave oven after the winter vacation, 19 participants gave a positive answer. Most users (33/40) gave a rating of 7-8 when scoring the HCI interface.

4 Discussion

All participants have lived in Residence Hall for more than five months (from 8th September) until the start of this user study. There are still 35% (14/40) of the participants who cannot manually adjust the heating parameters of this microwave oven. These participants took up to two minutes to learn the operation method. However, when using a conventional home microwave oven controlled by the knob (e.g., Daewoo-KOR6L77 microwave oven shown in figure 2), almost all users can infer how to adjust the heating parameters by just observing the knob. We can see that the HCI interface of SHARP-R22AT has a high learning cost for users who have not been exposed to such operational logic before. So the HCI interface of SHARP-R22AT does not perform well in terms of 'learnability'. The time used for most participants adjusting the parameters is between 5 seconds and 15 seconds given the cooking instruction, which is longer than that of the traditional microwave oven (usually less than 5 seconds). So the performance in terms of 'efficiency' is not very good. On the other hand, only 2 of the 40 participants clicks more than eight times, so the HCI interface performed well in terms of 'errors'. Most participants can remember the operating logic after a long time (one month) not using the microwave oven, and most participants (35/40) score the HCI interface higher or equal to 7 points. So the HCI interface performs well in terms of 'memorability' and 'satisfaction' attribution.

Based on the above analysis interpretation, we may draw a conclusion that the HCI interface of SHARP-R22AT has a higher learning cost for users who have not been exposed to such operational logic. However, once learned, the HCI interface has no significant impact on such people in the real use environment.

We can propose two solutions to solve this problem from the product and user aspecst respectively. From the product level, the "TIME" tag can be added to the "MANUAL/REPEAT" button to make it easier for users to find keywords. At the user level, the staff of Residence Hall can attach instructions for adjusting heating parameters to the microwave oven so that users who have not been exposed to such operational logic can quickly learn how to operate.

Figure 2: Daewoo-KOR6L77 microwave oven

References

Nielsen, J. (1994). *Usability engineering*. Elsevier.

Yih, W.-t., Goodman, J., and Carvalho, V. R. (2006). Finding advertising keywords on web pages. In *Proceedings of the 15th international conference on World Wide Web*, pages 213–222. ACM.

A Participant Information Sheet

What this study is about
The purpose of this study is to explore to what extent the HCI interface of SHARP-R22AT affects people's successful operation. Your participation in this study will help us measure this problem more accurately.

Your participation in this study is voluntary
You can take a break at any time. Just tell the researcher if you need a break. You can leave at any time without giving a reason.

Information we want to collect
We will ask you to show us how you use the product. We will watch how you do various tasks and we will ask you some questions. We will record the session and we will take notes to record your comments and actions.

How we ensure your privacy
People on the design team may view the sessions from another room. Other people involved in the design of the product may watch the recording of your session in the future. These recordings will be treated as confidential and will not be shared outside our company.
We may publish research reports that include your comments and actions, but your data will be anonymous. This means your name and identity will not be linked in our research reports to anything you say or do.

Your consent
Please sign this form showing that you consent to us collecting these data.
I give my consent (please tick all that apply):

- For people to observe me during the research.
- For the session to be recorded.
- For people on the design team to watch the recording in the future.

If you want to withdraw your consent in the future, contact the person named below who will destroy any personal data we hold about you (such as the recordings). Otherwise, we will delete your personal data after two years.
Data controller's name: Usability Sdudy
Email: sXXXXXX@ed.ac.uk.com

B Consent Form

Consent Form (Adult)

I agree to participate in the study conducted by the [Usability Study].

I understand that participation in this usability study is voluntary and I agree to immediately raise any concerns or areas of discomfort during the session with the study administrator.

Please sign below to indicate that you have read and you understand the information on this form and that any questions you might have about the session have been answered.

Date:_____

Please print your name: _____

Please sign your name: _____

Thank you!

We appreciate your participation.

C Questionnaire

1. **Can you adjust heating time and power manually?**
   (a) Yes, I can adjust both. [→ Do Q. 3]
   (b) I can just adjust heating time. [→ Do Q.2]
   (c) No, I have no idea about how to adjust the heating parameters manually. [→ Do Q.2]

2. Learnability: **Now we will teach you how to adjust these two parameters. After we've done so, we will ask you to operate the microwave oven to heat the food for 2 minutes with the power of 900W. We will record the time used as we begin to teach. Please feel free to interrupt us if you have any questions.**
   Time used: _____min ___sec

3. Efficiency & errors: **Now please heat the food for 5 minutes with the power of 750W. We will record the time used and the number of your clicking as you started.**
   Time used: _____min ___sec
   The number of clicking: _____times

4. Memorability: **Did you still remember how to adjust heating parameters manually after one-month winter vacation? [For participants who chose (a) in Q.1]**
   (a) Yes, I remember how to do that.
   (b) Not really.

5. Satisfaction: **Please rate the HCI interface of SHARP-R22AT with a full score of 10.**
   Your rate: _____