USABILITY OF A ROLL-UP STYLE MENU ON A MOBILE PHONE

Jaehyun Park1, Sung H. Han2, Youngseok Cho3, Wonkyu Park4, Hyunsuk Im5, and Sang W. Hong6

12345 Department of Industrial and Management Engineering
Pohang University of Science and Technology (POSTECH)
Pohang, Kyungbuk, South Korea
Corresponding author’s e-mail: shan@postech.ac.kr

6 Technology Innovation Center
SK Telecom
Seoul, South Korea

Abstract: This study proposes a roll-up style menu on mobile phones. The roll-up style menu shows the lower level menu items together with the main menu items, similar to the window desktop menu. A user-involved experiment was conducted to evaluate its usability and to compare with existing menu styles (list, grid, and cross style). Twelve subjects participated in the experiment. The experimental task was to find a target menu item in a prototyped mobile phone interface. Measures such as task completion time, number of clicks, easiness for search, and overall satisfaction scores were collected. The results with the one-way ANOVA and the SNK test showed that the roll-up style menu was better than the cross style menu in terms of ‘easiness for search’ (α = 0.05). A roll-up style menu would be preferred by the users since it helped them understand the menu structure quickly and was familiar to them because of its window-like interface.

1. INTRODUCTION

Menus are widely used in mobile phones. As the number of functions in the software application increases (Sharpe and Stenton, 2003), the navigation tools finding a certain function easily and efficiently should be needed. The menu is one of the most important interface elements which can help navigation tasks. Like other software applications, a mobile phone has a variety of functions. Therefore, many types of menus are used in mobile phones.

Various research studies on comparing menu styles have been conducted. Callahan et al. (1988) compared a pull-down menu and a pie menu in terms of performance. Pull-down menu designed in a linear fashion lists items from the top to bottom while pie menu is a menu style where the menu items are placed along the edge of a circle at an equal radial distance from the center. Results showed that a pie menu is better than a pull-down menu in performance such as task completion times and error rates. However, the performance of a pie menu decreased when the target size becomes small. Sears and Shneiderman (1994) proposed a split menu which places the frequently selected items at the top of the menu, and found that the split menu outperformed the others in performance and satisfaction. In addition, Bederson (2000) compared user preference of pull-down menus with fisheye menus which apply traditional fisheye graphical visualization techniques to linear menus. As a result of a pilot study, the users preferred the fisheye menus for browsing tasks, and hierarchical menus for goal-directed tasks. On the other hand, Park et al. (2007) newly proposed an adaptive highlight menu that automatically boldfaces frequently used menu items, and conducted a user-involved experiment. The adaptive highlight menu was not significantly better than the traditional menu in terms of the selection time. However, it was preferred by the users because of several reasons: it helped the user select frequently used items and was less sensitive to the variations of selection frequency.

The research studies described above referred to desktop menu styles. They did not consider usability problems in mobile phone menus. The users with mobile phone menus should select menu discretely in the form of pushing a button only. And the screen size is too small that only a limited number of menus can be displayed at a time (Amant et al., 2004). Thus, new and enhanced studies should be needed to compare the menu styles of mobile phones instead of desktop environments.

This study examines the usability of four menu styles: roll-up, list, grid, and cross style. A roll-up style menu was newly designed in this study, and the other menu styles (list, grid, and cross style menu) were existing menu styles in commercial mobile phones. Detailed descriptions of the four menu styles are introduced in the next section. For comparing the four menu styles, a subjects-involved experiment was conducted to compare their usability. In the experiment, task performance and subjective satisfaction scores were collected as measures.
2. MENU STYLE

2.1 The Roll-Up Style

The roll-up style menu shows the lower level menu items together with the main menu items, similar to the window desktop menu. The lower level menu items are shown when moving the navigation cursor to an item of the current selected menu and pressing the OK or right arrow key. If there is no lower level menu for the current selected menu, the OK key or the right arrow key doesn’t work. On the other hand, the lower level menu items disappear and the navigation cursor moves to the current selected item of the higher level menu, when the cancel key or the left arrow key is pressed. The roll-up style menu is shown in Figure 1.

![Figure 1. A roll-up style menu](image)

2.2 The List Style

The list style menu shows the current level menu items with a simple text list and the lower level menu items with a pop-up list. The Pop-up list which was proposed by Beck et al. (2006) only shows the lower level menu, thus the navigation cursor can not move to the pop-up list. Different to the roll-up style which shows the current and lower level together, the list style menu opens a new window which covers the screen and shows the lower level menu items only, when the OK key is pressed. The new window with the low level menu disappears, when the cancel key is pressed. Figure 2 shows the list style menu.

![Figure 2. A list style menu](image)
2.3 The Grid Style

The grid style menu draws up nine main menu items with three rows and three columns. The main menu items are arrayed in a 3 by 3 matrix. When the OK key is pressed, a new window covers the screen and shows the lower level menu items, similar to the list style menu. But there are no pop-up lists to show the lower level menus. On the other hand, the new window with the low level menu disappears, when the cancel key is pressed. The grid style menu is presented at Figure 3.

![Figure 3. A grid style menu](image3)

2.4 The Cross Style

The cross style menu shows the current selected main menu items and the lower level menu items together. In this case, the current selected main menu item is shown instead of all main menu items. As a unique characteristic of the cross style menu, there exist two navigation cursors in the menu navigation screen. When the left/right arrow key is pressed, one navigation cursor moves to the previous/next main menu item. Similarly, when the up/down arrow key is pressed, the other navigation cursor moves on the lower level menu items. Figure 4 shows the cross style menu.

![Figure 4. A cross style menu](image4)
3. METHODS

A total of twelve experienced mobile phone users voluntarily participated in the experiment. The participants were undergraduate or graduate students and consisted of ten males and two females. Their experience periods for mobile phones ranged from 3 to 9 (average = 6.8) years, and their ages ranged from 18 to 25 (average = 21.8) years. All participants had neither visual nor physical disabilities that could cause any problem with use of the experimental prototype.

A software prototype was developed on a PDA (Hewlett-Packard iPAQ rz1717) using Microsoft Visual Studio 2005. The PDA had navigation keys which included four direction keys and one OK key. The diagonal length of the PDA screen was 8.9 cm and the screen resolution was 240 by 320. A total of seven keys were used to conduct the experimental task. The seven keys consist of four direction keys, one OK key, and two application keys. When the up/down/right/left arrow key was pressed, the navigation cursor moved towards related directions. The OK key was used for selection tasks. The other application keys conducted certain functions such as activating menu panel or canceling a task. Figure 5 shows the seven keys including navigation keys and application keys.

![Figure 5. Seven keys used in software prototype](image)

A within-subjects design with one factor was used in the experiment. The factor consists of four menu styles (roll-up, list, grid, and cross style). A balanced Latin square was used to minimize the effect of presentation order of these four treatment conditions. The experimental task was to find a target menu item such as ‘volume’ and ‘scheduler’ in the prototype where the menu structure of a commercial mobile phone used. In addition, two types of measures including the task performance and the subject satisfaction scores were collected. The task performance consists of ‘task completion time’ and ‘number of clicks’, which were collected when each task was performed. The subject satisfaction scores include ‘easiness for search’ and ‘overall satisfaction score’, which were collected by a subjective rating (0~100).

In the experiment, an experimenter explained the menu style to the participants and they were asked to feel free to adapt each menu style to make the selection faster and easier. After an introduction about menu styles, the experimenter exercised the participants to conduct a task using the PDA prototype. The participants conducted ten tasks for each menu style and were asked to rate the subjective satisfaction scores for corresponding menu styles, in the main experiments. The task performance measures were automatically collected during the task. Finally, they were also instructed to write down their comments on the advantages and disadvantages of the menu types.

4. RESULTS

The analysis of variance (ANOVA) was used to analyze each performance and satisfaction measure. The effect of menu styles was found to be significant at $\alpha = 0.05$ in ANOVA for ‘easiness for search’ only ($p = 0.031$), one of the subjective satisfaction scores. The effects of menu styles were not found to be significant in ANOVAs for the other measures such as ‘task completion time ($p = 0.552$)’, ‘number of clicks ($p = 0.054$)’, and ‘overall satisfaction score ($p = 0.081$)’.

Differences between the menu styles were analyzed by using the SNK (Student-Newman-Keuls) test at $\alpha = 0.05$, in the case of ‘easiness for search’. The results showed that there were no significant differences between roll-up, list, and grid style menus. In the same manner, list, grid, and cross style menus were also in the same group. Figure 6 shows the results of the SNK test for ‘easiness for search’.

![Figure 6. Results of SNK test for 'easiness for search'](image)
The users can quickly understand the menu structure with a roll-up style menu. That follows from the fact that a roll-up style menu shows the lower level menu items together with the main menu items, compared to other menu styles which show main menu items and the lower level menu items separately. Even if a cross style menu shows the main menu items and the lower level menu items together, it has the limitation that only the current selected main menu item is shown on the screen. It can be a critical problem to understand the whole menu structure with a cross style menu. The result of ANOVA and the SNK test for ‘easiness for search’ show that a roll-up style is better than a cross-style. It can be analyzed that the users with a roll-up style, other than a cross style, can understand the menu structure easily, so they can find easily where the target menu item is.

The usage experience of the users can affect the experimental results. As the results of debriefing questions, eight participants of a total of twelve participants currently use a grid style menu. Participants also have an experience with a list and cross style menu. On the other hand, a roll-up style menu does not exist yet for commercial mobile phones. Thus, this can be one reason that the effect of menu styles was not found to be significant in ANOVA for performance measures.

Table 1. Advantages and disadvantages of four menu styles

<table>
<thead>
<tr>
<th>Menu styles</th>
<th>Advantage</th>
<th>Disadvantage</th>
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| Roll-up     | • Familiar (similar to window menu)  
              • Easy to understand the menu structure  
              • Easy to see the lower level menu item | • Text size is too small to see  
              • Many clicks needed to move |
| List        | • Easy to see the lower level menu item (pop-up list)  
              • Easy to understand the menu structure | • Inconvenient to navigate, if there are numerous menu item  
              • Poor design (because it has only text lists) |
| Grid        | • Familiar (widely used in mobile phones)  
              • Easy on the eyes (when an icon is presented with a text) | • No information about the lower level menu  
              • Hard to understand the menu structure |
| Cross       | • Optimal path to target menu item is short  
              • Easy to see the lower level menu item | • Can’t see the whole main menu items  
              • Hard to understand the menu structure |
There exist some differences among the four menu styles, even if there were no significant differences in ANOVA for task performance measures and overall satisfaction measure. Table 1 shows the summary of the comments of the participants concerning the advantages and disadvantages of the menu styles. For example, considering a roll-up style menu, it can be one of the advantages that the users would be familiar with a roll-up style menu because it is similar to the window menu.

6. CONCLUSION

This study compared the four different menu styles: roll-up, list, grid, and list style. A roll-up style menu was newly designed in this study while the other menu styles (list, grid, and cross style menu) were existing menu styles in commercial mobile phones. The results showed that the roll-up style menu is better than the cross style menu with regard to ‘easiness for search’ (α = 0.05). However, there were no significant differences in the other measures including ‘task completion time’, ‘number of clicks’, and ‘overall satisfaction score’. Even if the effect of menu styles was not found to be significant in the task performance measures, a roll-up style menu was preferred by the users in terms of ‘easiness for search’. The participants commented that a roll-up style menu is familiar to them because of its window-like interface. On the other hand, an alternative design which improves drawbacks or a hybrid combination of several menu styles would be interesting for future research. For example, considering the disadvantages of the menu styles, a new roll-up style menu which automatically shows the low level menu items without pressing a key could be designed and examined.

7. REFERENCES


