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The Influence of Menu Structure and Layout on Usability of Smartwatches

Fan Mo, Chongqing University, Chongqing, China
Jia Zhou, Chongqing University, Chongqing, China

ABSTRACT

This study aims to investigate the effect of smartwatches' menu structure and layout on user performance and satisfaction. A total of 30 younger and older adults participated in this study. Usability testing was first conducted, and it identified the two most serious usability problems of smartwatches: confusing information structure and interface content. Furthermore, results showed that menu disorientation was predominant. Therefore, prototypes with a different menu structure and menu layout were developed and tested in two subsequent experiments. The menu structure experiment indicated that the tree structure of the menu is better than the linear structure in terms of performance and satisfaction, and the two-branch hierarchical menu contributed to better performance than the three-branch hierarchical menu. The menu layout experiment indicated that menus with high visual density had a slightly better performance but lower satisfaction than low visual density. In the end, design guidelines about smartwatch menus were proposed.

KEYWORDS

Menu Layout, Menu Structure, Mobile Devices, Navigation, Older Adults, Satisfaction, Smartwatches, Usability, Visual Density, Wearable

INTRODUCTION

Smartwatches are facing a dilemma about how to stand out from smart phones and fitness trackers. One major advantage of smartwatches over fitness trackers is its display, but it could also become a disadvantage if poorly designed. The interface design of smartwatches mainly followed practices of smart phones, and little is known about how to adapt to smartwatches' characteristics.

The tiny display of smartwatches causes many usability problems. Particularly, smartwatches can download abundant applications like smart phones, but displaying them on a much smaller display is challenging. To solve this problem, the menu is widely used in smartwatches to organize applications.

The menu structure and menu layout might influence users' performance and satisfaction. Most previous research has investigated the menu structure of computers and smartphones and found that a proper menu structure could improve interface usability. However, there is a lack of studies on the menu structure of smartwatches. Apart from that, menu layout is a relatively untapped topic. Since many smartwatches are equipped tiny round displays, which are quite different from the square displays of computers and smartphones, it would be interesting to examine the effect of menu layout.

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Both menu structure and menu layout are likely to make a difference in the usability of smartwatches. Therefore, this paper proposed different menu structures and layouts of smartwatches, developed prototypes, and tested their effect on users' performance and satisfaction through experiments.

RELATED WORKS

Menu Design and Usability

Menu design of the display has great influence on product usability (Albers & Mazur, 2014; Hilbert & Redmiles, 2000; Nielsen & Loranger, 2006). There are many factors influencing menu navigation performance and they can be classified into two sources: human and devices.

Regarding the human factor, the experience of using technology products, users' age, verbal memory, and spatial ability influence navigation performance. During the menu navigation process, users are exposed to information such as landmarks and routes, just like navigation in the real world (Thorndyke & Goldin, 1983). Based on the information, they form mental models to understand how the menu works (Ziefle & Bay, 2004). However, this process involves many cognitive abilities. Declined verbal memory and spatial ability (Arning & Ziefle, 2009) of older adults resulted in poorer menu navigation performance than younger adults (Ziefle & Bay, 2005).

Regarding devices, menu structure and menu layout influence navigation performance on desktop computers and smart phones (Beck, Han & Park, 2006). For desktop computers, the depth and breadth of menus and the number of menu items influence interaction performance (Parkinson, Hill, Sisson & Viera, 1988). Parkinson, Sisson and Snowberry (1985) found that the column menu contributed to better navigation performance than the row menu. On web pages, menus located in the left and right side were better than those located at the top (Kingsburg & Andre, 2004). Furthermore, a comparison between the simple selection menu, the global and local navigation menu, and the pull-down menu showed that the pull-down menu contributed to better performance in searching tasks (Yu & Roh, 2002).

For the smartphone, the limited display size could increase users' memory load (Chae & Kim, 2004). There are two ways to deal with limited display. The first way is to stay with the tree structure and improve its design. Previous studies have either provided navigation tools or balanced menu depth and breadth (Zhou, Rau & Salvendy, 2012; Ziefle, 2008, 2009). Menu breadth might conflict with font size. Displaying five menu items per page on feature phones was better than displaying one menu item per page, and 12 pt. font size was better than 8 pt. (Ziefle, 2010). A navigation tool, which added survey knowledge to the tree structure of feature phones, helped users achieve better interaction performance (Ziefle & Bay, 2006). The second way is to abandon the tree structure. A pie menu with round pattern was designed and compared to the linear menu. Results showed that the pie menu reduced target searching time and error rates (Callahan, Hopkins, Weiser & Shneiderman, 1988). Also, the round rotating menu was implemented on a personal digital assistant (PDA) prototype and gained positive feedback from older adults (Zao, 2008).

Application Scenarios of Smartwatches in Daily Life

Smartwatches have the potential to seamlessly integrate with the human body and enhance life experiences (Mann, 1997, 1998). Most smartwatches extend the function of smartphones by integrating existing applications (Maglogiannis, Ioannou, Spyroglou & Tsanakas, 2014) to improve the quality of medical care, work, and home life (Bieber, Kirste & Urban, 2012; Seppälä & Broens, 2013). Regarding medical care, smartwatches could better monitor users' health than smartphones, because they collect users' physical data more accurately (Lee, Seong & Kang, 2013). They are considered to be health aides (Wile, Ranawaya & Kiss, 2014) and an adjuvant treatment tool (Dubey, Goldberg, Abtahi, Mahler & Mankodiya, 2015). Regarding work, the work efficiency of smartphones and smartwatches were compared and the results showed that smartwatches saved more time than smartphones in