A Study on Interface Design Guidelines of Web Maps for Elder Users

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Abstract. The aim of this research is to find out the interface design guidelines of web maps from the viewpoint of elder people's acceptance. This stage of the research is a qualitative exploration to web map user experience to find out interface design issues and problems. Web map user experience of participants was explored with methods of observation and interview. Six elder participants were taught some basic operations to use Google Maps. From the result of data analysis, this study adopts natural mapping as a core concept of proposed design guideline. The interface design guidelines of web maps for elder users are proposed: (a) compatibility of map display and cognitive map, (b) mental model of interface operation, (c) learnability of interface platforms, and (d) physical dimension of map display and operation interface.

Keywords: web map, interface design, aging.

1 Introduction

The aim of this research is to investigate the interface design guidelines of web maps from the viewpoint of elder people's acceptance. Web map is a type of application service to support people for locating places and routes by spatial information with the form of maps via World Wide Web protocol on the Internet. For elder people, applications of information technology facilitate convenience in life, but obstacles in learning and accommodating also emerge. Because of the changing of elder people's psychological and physiological abilities, the design of information technology for elder people is similar to the design of home environment and life appliance; much more considerations are necessary beyond functionality.

Technologies can make life easier for elder people. Tacken [1] has found that elder users are satisfied with technologies. Rama [2] discussed that the problems elder users meet mostly are: (a) Complexity of user interface: a layered control panel with many functions may fail to provide information about the available functions, (b) Age: certain cognitive abilities including reasoning ability and working memory for spatial information change with increasing age, and (c) Technology generation: generations with different previous technology experiences could learn current products differently.

Aging changes the abilities of elder people in many dimensions. It makes declines of the physiological abilities, including vision, speech, hearing, and psychomotor

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ability. It also makes declines of the psychological abilities, including attention, memory, and learning ability [3]. Hawthorn [4] has proposed interface design suggestions for elder users in such dimensions.

It is important to evaluate the proper size and position of interactive objects in interface for elder users. In addition to this, creating clear conceptual models to the new environment could be a more powerful solution for future interface design. The problem of elder users in future like us is not only decline of abilities, but a lack of previous experience and conceptual models. The transparency of conceptual models could help elder users' learning beyond ability limitation.

To consider the web map interface for efficiency, Fitts' law is a basic guideline to deal with time and distance factors. Fitts' law states the relationship between movement time, distance, and accuracy for people engaged in rapid aimed movements [5]. It's a model of human movement, predicting the time required to rapidly move from a starting position to a final target area, as a function of the distance to the target and the size of the target [6]. It can be applied both in the physical world and computer space. To consider web map interface for learnability, it is natural to arrange controls according to the directions of corresponding functions. Norman [7] has explained the principle of mapping. The principle is about the relationship between two things, such as the controls and the results in the world. If the mapping is natural, related to the desired outcome, and providing immediate feedback, it could be easier to learn and to remember.

2 Method

Participants. According to a research on policy of aging labor by Employment, Labour and Social Affairs Committee of OECD, the research defines elder people is above 55 [8]. The participants were recruited from elder volunteers of museums for their motivation of learning new technology. The participants' computer and/or the Internet experience were required. Six elder participants, including three male and three female, were recruited in this stage. Two were 55-60, one 60-65, and three above 65. The education of five participants was college or above.

Devices and Material. (1) Hardware: A desktop computer with 19 inch LCD monitor, 1280*1024 pixels, and a mouse. A smartphone (iPhone 3g) with 3.5 inch multi-touch screen, 320*480 pixels. A DV camera to record the behavior and protocol of the participants. (2) Software: Windows operation system with Chrome browser. Apple iPhone OS 4.2 with Maps app. Google Maps Traditional Chinese version. (3) Location of interview: Multi-function Classroom of Kuandu Museum of Fine Arts.

Procedure. The whole exploration for each participant would take about one hour. First, the investigator introduced the exploration observation and interview procedure. Second, tasks were given one by one for the participant to find the places on the map. During tasks, the participants were asked to talk about his or her behaviors, thoughts, and experience with the web map. Video and audio recordings were taken during the tasks and interview. Third, after all the tasks were completed, an interview was held to gain for a deeper understanding of each participant's inner experiences. The investigator would ask the participant some open-ended questions about the web map.

Data analysis. This study uses Glaser & Strauss' grounded theory as method of qualitative data analysis [9]. It utilizes a method of induction to analyze real phenomenon to conclude theoretic results. It is useful to explore a practical or interdisciplinary field, especially for the not well-defined concepts and relationship among concepts. In this study, the investigators tried to understand the user experience in web map use and to propose theoretic interpretation and guidelines.

3 Results and Discussion

3.1 Data Analysis

The result of data analysis consists of categories of problems as follows.

Some participants didn't understand the spatial structure of the neighborhood, for example, the related direction between geographic districts. Although the targets they searched were familiar places or paths, they cannot find targets quickly during browsing the map. They might try to read the labels one by one and recall some familiar place names near the targets. It is a searching method with lower efficiency.

Although with some experience, not all participants were familiar with user interface of computer operation system or web maps. For the interface operations such as clicking buttons or dragging objects/windows, they could not predict the computer's response properly and might feel frustrated. They may not have appropriate mental model for the interface operation. It was also found there was much difference between continuous and discrete interface. Continuous interface could help users explore and understand unfamiliar functions well.

Operating indirect physical interface, such as mouse and touch pad, was hard for participants with motor and cognitive difficulties. They had problems to operate mouse to locate the curser on proper positions. But with direct physical interface, such as a mobile phone with a multi-touch screen, participants had better learning experience and satisfaction. It is obvious that they did not have the problem of mental model. Only the interface device was changed to make the difference.

Poor ability to read labels and buttons was a problem for some participants who could not use web map well. They could not move their sight and attention fast. They must look at each object one by one. Detail and overview could not be examined in the same time. The trial-and-error period lasted longer. Smaller buttons were hard to click in the range of space that they covered. Errors might happen and result in unexpected events. It frustrated elder users to take following actions.

3.2 Proposed Design Guidelines and Discussion

From the result of protocol analysis, *mapping* is a core concept among all the factors. In the context of web map interface, including map display and controls, elder people perceive digital and physical environment and try to construct conceptual models to connect experience and phenomena. They check the feedback to confirm their actions, and mostly important their conceptual models. The appropriate and natural mapping is necessary between map display and cognitive map, between mental model and interface system image, between controls and display, and between senses and

perception. This study adopts *natural mapping* as a core design guideline of web map interface for elder users to provide transparency of conceptual models.

Interface design guidelines of web maps for elder users are proposed: (a) compatibility of map display and cognitive map, (b) mental model for interface operation, (c) learnability of interface platforms, and (d) physical dimension of map display and operation interface.

Compatibility of Map Display and Cognitive Map. It is a complicated task to relate the map display to personal cognitive map. The problem is that they cannot recognize the spatial features and build the relationship between maps and their cognitive maps. For ones who understand the spatial structure of the neighborhood, they can recognize the positions of the targets from the shapes of features on the map, such as estuary or bend of rivers, without reading the labels. A layout to focus overview, such as a hierarchy structure in graphics, may help users browse a map with top-down methods to use their previous knowledge.

Mental Model for Interface Operation. Mental model is the model user relies on to predict system response. People construct mental model from observed phenomena. In the digital space, no natural characteristics help users understand the interface. Simulated shapes or materials, such as a digital image with physical button shading, may help give clues with meaning. The response of interface is another main phenomenon that can be observed. Continuous interface provides real-time visual feedback. It helps adjust the actions or directions and realize the principle of the interface. An appropriate mental model can be constructed. Discrete interface provides faster change without intermediate response. It is possible to get new image/layout faster, but the total efficiency and satisfaction is not necessarily high. Because the result can only be seen after action (clicking), it is not necessarily what the user needs. More efforts are necessary to adjust next step.

Learnability of Interface Platforms. New or unfamiliar interface platforms need time and efforts to learn. Indirect interfaces need more skills and learning time to coordinate the hand movement and cursor display. Although a smaller screen limits overview of information, the benefits of direct interfaces can overcome this issue. If touch screen of the same size is available, it should combine the benefits of direct operation and broader overview.

Physical Dimension of Map Display and Operation Interface. Because of the changing of elder people's physiological abilities, there are more limitations in reading text and controlling interface. It has been discussed much in literature. Larger size of map display and operation interface helps elder users to read labels and features and to click the correct positions. According Fitts' Law, larger target size and shorter distance can lower the movement time. It is more important for elder users.

4 Conclusion

Natural mapping is a core design guideline concluded in this study. The problems and issues analyzed in the observation and interview have the common concept of

mapping. The suitable interface design guidelines of web map for elder users are proposed from the analysis. The guidelines consist of four parts: (a) compatibility of map display and cognitive map, (b) mental model for interface operation, (c) learnability of interface platforms, and (d) physical dimension of map display and operation interface. In next stage, further study will test the interface design guidelines from the viewpoint of elder people's acceptance.

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