Aging and perception of graphic representation: A case of icon design in mobile phone functionality

Kingkarn Pijukkana and Nopadon Sahachaisaeree

Abstract: Distinctive human attribute such as age, sex, and cultural background created a large number of problems in the understanding of graphic representation. This research is conducted by using pictorial icons in cell phone as a case study to reveal the age and cultural bias between age groups. Most of them are able to operate only the basic features. The study thus has an ultimate goal to discover a universal representation of iconic symbol, which would help enhance the learning ability of senior group in particular, and to improve the usage of other technological oriented equipments in general. We intend to study in three features: complexity of iconic symbols, the visual limitation among the age group, and the interpretation of iconic symbols. The first issue deals with learning new technology’s capability and the recollection. Next, it involves graphic icon visible format -simple, detailed and textual including size and color. Finally, we look at the 2D/3D format, realistic/symbolic, and with/without textual display. From the research, it is found that respondents are proved to be able to learn complicated level as equal as younger users. With reading glasses, they are able to visualize and understand simple icons as small as 5-10 mm, complicated as 30 mm and graphical icons with textual as 10-15 mm. Bright color is for simple icon, and cooler tone is for complicated ones. 2D is for familiar objects while 3D and realistic are for unfamiliar ones. Textual representation could enhance the understanding of representation as well.

Keywords: technology-driven; elderly; perception; mobile phone

Introduction

Technology has been greatly advanced and profoundly affected our daily lives. Population ageing in Thailand, as in a number of other Asian countries, is occurring faster that in more developed countries in the West in the past. For example, the amount of time it took for the percent of the population in ages 65 and over to double from 7% to 14% took many decades in the developed countries of the West (UN 1956). According to my survey, the most widely used technological products among the elderly are mobile phones. However, the interface features in mobile phones seem to be underutilized as those features are too difficult for them, too advanced for them, and eventually prevent them from using the mobile phones effectively.

Literature Review

This research has an objective to explore the research approach for universal design utilizing the factors determining perceptual and comprehension of the elderly on the interface (graphical icons) of cell phones as a case study. The study bases its framework on three lines of thoughts. Firstly, the theory of psychology and human behavior is reviewed to understand the factors of the older people’s cognition process and the indicator about interface design (graphical icons). Secondly, concepts about levels and capability of the elderly are assessed to understand body capability and the need of technology products for the elderly user. Thirdly, theories of human interface are reviewed to understand the factors and indicators for interface design. Finally, theories about technological requests from users are studied to understand the factors and indicators for the need of technology products.

Psychology and human behavior

The research examined the perception and knowledge of the older people in the line of human behavior theory, perception and stimulus. But the important factor is the step of human cognition such as thinking process, memory, and recalling process. The ability to divide attention efficiently and to ignore irrelevant stimuli diminishes with age (Pattison and Stedmon 2006, 271). This can be a problem if elderly must pay attention to multiple stimuli simultaneously, especially if all of the stimuli have attention-grabbing characteristics such as beeping or blinking or there is a time limit imposed on the response. Changes in physical abilities, assistive devices, living arrangement, sociologic status (income level) and social network, and normative aging refer to the biological, environmental, social, cultural and historical influences. They may similarly have an effect on an individual's normal development for people in the same age group (McClelland 2011). Therefore, this research considers the other points by reviewing of literature regarding principles of graphical design and the senior citizens cognitive process.

Levels and capability of the elderly

The proportion of the senior citizens or the elderly (age 60 and up) in Thailand increased to 5.4% in 1980, from 4.9% in 1970. And, it was forecasted to be 9.5% in 2011 (Office of the National Economic and Social Development Board under the Prime Minister’s Office 2005, 2). The number of elderly population in the world is also rapidly increasing. The senior citizens tend to be dependent and it is possible that the elderly in Thailand will climb up to 11 millions. During the period 2000-2030, the projected increase in the elderly population in the 52 studied countries, range from 14 percent. The highest elderly population is Singapore
(372%) and Bulgaria has the lowest elderly population in the world (14%) (Pattison and Stedmon 2006, 268).

The elderly population in Thailand has 197% and Thailand is in the rank 12th from 52 countries. According to this study, we can see that Thailand has the number of elderly people in the top rank, so we have to be concerned about that and consider about how to deal with this problem (Kinsella and Velkoff. 2001, 11).

Typically, these degenerative effects including diminished vision, varying degrees of hearing loss, hand eye coordination and psychomotor impairments which we find in the elderly affect the difficulty with small motor coordination and the lack of the nervous system about cognition (Pattison and Stedmon 2006, 271). It is well established that aging is associated with functional losses in many areas that may affect the ability to interact with communication devices: hearing, vision, tactile discrimination, memory, tracking and target acquisition, attention, perceptual speed, strength and flexibility, and response time. Although different people experience different age related changes at different points in their lives and to different degrees, in general older people must operate in the world with one or more functional limitations. The following is a brief discussion of the types of age-related handicapping functional losses that may affect the ability to use communication devices (Charness, Park, and Sabel 2001, 158). This research examined the elders’ personal factors for understanding characteristics that involved about the usage and communication factors between user and products. So, it conforms to the guideline of interface design.

Human interface

The important roles in technology product are the fast driven of technology so users and user interfaces are varying. We could communicate to the electronic devices by using interfaces as medium. Because of request from users to make information systems easy to use, comfortable and efficient, the designer has integrated not only the conventional design process for designing shapes and colors but also the upstream processes for designing information exchange and interactivity between humans and a system (Matsumoto 1999, 174). Generally, Industrial design (such as the beauty and attractive of products) including the functional interface must be considered based on users that is concluded to be characteristics of products, conforming to ergonomics and style (Sahachaisaeree 2004, 57). To design communications systems and processes that work for older population and other populations with limiting cognitive conditions, as well as the general population, however, we must also be concerned with the less concrete elements of the human and communication-devices interaction. These elements include users’ mental models of how these devices work and what they need to do to use the device, their ability to learn, their attention capacity, the efficiency of their working memory, their reasoning skills, and the strategies they develop for using telecommunications devices. Evaluating all of these components is an integral part of the critical interaction design (Kinnear 2001).

Developments of technological products

User-driven products are focused on the function of the product and the interactions between user and product, including the visual and aesthetic elements of product. The interactions between user and products represents one of the most important elements in interface design. Design analysis must be considered in 2 dimensions: Need of Ergonomics and Beauty. Ergonomics in this point means touching points about human interface. Ergonomics are focused on easy to use, easy to maintain, interaction between users and products during usage, innovation of interaction between users and products, and safety to use. In the topic of aesthetic element, product that attracts customers must be different from the rival product (especially the product that has constant market and a little technology changing). Users are proud of the owner of an image and modernity (Sahachaisaeree 2004, 46). Technology is pervasive in today’s world. We use technology to make our meals, clean our clothes, communicate with our friend and family, keep abreast of current events, learn new skills, shop, pay bills, bank, and work. In some cases, we choose to use technologies to support our acuities; but in other situations we have no choice because there are no alternatives (Charness, Park, and Sabel 2001, 158).

Methodology

A preliminary study was conducted to examine how the Elderly used the 15 functions in mobile phones. Then, further research on related literature review concerning 4 theories and concepts: psychology and human behavior, levels and capability of the Elderly Human Interface Development of technological products. The research tools used were questionnaires and pictorial stimuli. The research samples are the Elderly living in Bangkok, totaling 50 people.
1. Exploration

Survey quantity and typical menu in senior people’s mobile phone for 15 functions

2. Surveying factors

4 Relevant theory and concepts: (1) Psychology and human behavior; (2) Levels and capability of the elder; (3) Human interface; (4) Development of technological products

3. Developing research tools

Questionnaire and pictorial stimuli

4. Sampling

Sample population: (1) Senior association group for 36 people (2) General senior citizen group for 14 people

5. Data Collection by computer stimuli & questionnaire

1. Personal, background and experience information
2. Testing symbol via different size and color features
3. Testing the complication level to access the menu
4. Technology learning
5. Dimension of graphic representation

6. Analyzing the result

Statistical analyzing to summarize the data and devices the pattern; One way ANOVA to explain the pattern

7. Guideline/Recommendation

The guideline for the interface (graphic icon) design that adding the efficiency of the perception and understanding of icon in the aging.

Research framework

In the preliminary research, the study about usage of technology product in daily for the elderly concluded that the most of them use mobile phones technology. And it found that functions of products did not conform to the complexity of menu in the cell phones for the elderly. The perception and knowledge in the elderly were examined in the line of human behavior theory and cognition exist at that time, relying on stimulus. But knowledge is the human cognition process such as thinking process, memory, and recalling. The level and capacity of the elder and the factors of perception and knowledge of graphical icon in the senior were studied. Thus, human interface, including the need of technology products were examined.

Technological product needs
- Physiological need or Aesthetic need
- Interface Product

Demographics factors (The elderly)
- Background and experiential facet
- Activities and interests
- Physiological capacity level

Interface (a case study on graphic design of mobile phone for the elderly)

Basic factors for interface design that promotes the cognition

Perception and comprehension of the graphical meanings

Behavior of Users

Guidelines for interface (graphic icon) design enhancing efficiency of perception and understanding of icon the aging.

Figure 1: Conceptual Framework

Research Instrument

The instrument used in this research can be divided into 2 categories and 5 parts as follows: Interview form (a set of pictorial stimulus): To find cognition factors and comprehension of graphical icon in the cell phone for the aging.

Part I: Personal information
Part II: Testing of readability on icon size
Figure 2: Example Testing of readability on icon size
Model by computer: To examine the level of complexity in menu access.
Part III: The level of complexity in menu access - five levels of menu complexity to the tested via compute box experiment.

Figure 3: Example The level of complexity in menu assessment

Part IV: Graphic icon elements: Using pictorial, drawings, and other realistic figures as stimuli.

Figure 4: Example Graphic icon elements

Part V: Graphic icon elements - using pictures as stimuli and interviewing the respondent to match pictures (such as abstract simplistic forms of representation: 2D, 3D, textual, and other simplified representation) with functionalities.
Figure 5: Example Graphic icon colors

Research Finding and Discussion

Experimenting with a group of 50 respondents, whose age ranging from 60 to 82 years old, the research is able to reach an understanding and make certain recommendations on iconic design for elderly cell phone users. Most of the respondents are retired civil servants, have an average monthly income of baht 20,894, and have an educational attainment ranging from high school to college graduate. Most of the elderly subjects declared that they had a visual and / or memory impairment of some kinds. Most of their daily lives are engaging in activities such as religion, leisure, and other entertaining pursuit. The study found that graphical symbols of objects which the participants found recognizable or had experience with were most suitable for the elderly. Despite their rather impaired visual and mental conditions, they still possess the ability to learn an unfamiliar technology, comprehend the symbolic representation, and reach the most complicated level of menus access. Most of them have no memorizing problem; all they needed is some instruction on the gadget’s utilization. They can read textual material as small as 5 mm. Complicated symbols with extensive detail would be most appropriate to be as large as 30 mm., preferably realistic pictorial types of symbols rather than the 2D type of simplified symbols. Graphical symbol together with textual explanation make it easier to comprehend than those with plain graphic alone. In terms of color, the study found that simplified graphic should be rendered in warm color, while graphic with text should be different in colors, and should avoid using warm color tone. Finally, graphical symbols with extensive detail should be rendered with cool color tone to help enhance the visibility of the elderly.

Table 1.2: The graphic icon design that introduces the efficiency of the Perception and understanding of the graphic icon in the interface design.

<table>
<thead>
<tr>
<th>Graphic icon element</th>
<th>Warm Color</th>
<th>Cool Color</th>
<th>One Tone</th>
<th>Mixed Colors</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Graphic icon colors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Plain style</td>
<td>46%</td>
<td>36%</td>
<td>4%</td>
<td>14%</td>
</tr>
<tr>
<td>3.2 Plain style + messages</td>
<td>-</td>
<td>10%</td>
<td>12%</td>
<td>78%</td>
</tr>
<tr>
<td>3.3 Detailed style</td>
<td>14%</td>
<td>56%</td>
<td>2%</td>
<td>28%</td>
</tr>
</tbody>
</table>

Additional Recommendation

This research attempts to explore the research approach for universal design utilizing the factors determining perceptual and comprehension of the elderly on the graphical icon of cell phones as case study. Since the elderly already have the visual and cognitive short coming in the first place, experimentation and interview should be as short as possible to reduce inaccuracy and experimental error due to the subjects’ fatigues.
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