Design Guidelines and Design Recommendations of Multi-touch Interfaces for Elders

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Outline

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Overview

- Worldwide population is aging. (Farage et al., 2012)

- The number of people over 65 years in the world. (Ribeiro et al., 2010)

<table>
<thead>
<tr>
<th>Year</th>
<th>People Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>2030</td>
<td>~1 billion</td>
</tr>
<tr>
<td>2000</td>
<td>420 million</td>
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</tbody>
</table>

- In 2030, one habitant out of four will have over the age of 65. (Zaphiris et al., 2005)

- Aging brings age-related changes, e.g., physical and cognitive changes, that influences the interaction. (Loureiro and Rodrigues, 2011)

- Elders have difficulties handling traditional input devices, e.g., keyboard and mouse. (Boustani, 2010)
Overview

- An alternative are NUI (Natural User Interfaces), in particular Multi-Touch Interfaces.

- Many lists of design guidelines are proposed in the literature for elders, e.g., websites, TV user interfaces, etc.

- Lack of set of design guidelines and design recommendations of multi-touch interfaces for elders.

- This paper proposes a set of design guidelines and design recommendations of multi-touch interfaces for elders.

- Useful resource for designers, application developers, usability specialists and researchers.
Background

Aged-Related Changes

Physical Changes

Visual
Main Changes:
- Visual acuity;
- Peripheral vision;
- Dark adaptation.
(Fisk et al., 2009)

Hearing
Main Changes:
- Hearing loss;
- Detection of tones in all the frequencies in special high-pitched sounds.
(Caprani et al., 2012)

Motor
Main Changes:
- Gait disturbances;
- Balance difficulties;
- Motor control problems.
(Schut, 1998)

Cognitive Changes

Memory
Main Changes:
- Short-term memory;
- Long-term memory.
(Hawthorn, 2000)

Attention
Main Changes:
- Difficulty in complex tasks;
- Maintaining attention (long periods of time).
(Comodori and Guarnera, 2008)
Background

Suitable Input Devices For Elders

- Human-computer interaction is possible using a wide range of input devices, e.g., keyboard, mouse, touchpad, touchscreen, etc.

- The input devices can be classified in indirect and direct input devices. (Wood et al., 2005)

  **Indirect Input Devices**
  - Coordination of spatial information;
  - Hand-eye coordination;
  - Difficult to use by elder users.

  **Direct Input Devices**
  - Direct user input on a display;
  - Reduced cognitive and coordination demands;
  - Easy to use by elder users.

- The interaction modes in touchscreens can be classified in single-touch and multi-touch interaction. (Lepicard and Vigouroux, 2013)

  **Single-Touch Interaction**
  - A only a point of contact is recognized, e.g. using a finger;
  - Performing of basic operations, e.g., open and close programs or pushing buttons.

  **Multi-Touch Interaction**
  - Detection of multiple simultaneous touch points, e.g., using the fingers of a single hand or the both hands;
  - Gestures on surface, enables a diversity of operations.
Natural User Interfaces use natural interactions of humans to interact with user interface elements, using:

- Multi-Touch
- Gestures/Movements
- Speech
- Facial Expressions/Body language
- Eye-gazing

There are a diversity of devices that supports multi-touch and gestural input, an interesting device for elders is tabletop, due to:

- Large interaction area;
- Multi-user support;
- Great potential in face-to-face social interaction (e.g. playing games).

A pair of elderly using a multi-touch tabletop.

(Apted et al. 2006)
The design of a multi-touch user interface should suit elder’s needs to be easily used. (Leonardi et al., 2010)

Lists of design guidelines of multi-touch interfaces are scarce in the literature.

(Boustani, 2010) presented a list, but some aspects are missing, e.g., gestures desirable and avoidable and guidelines to help the interface testing.

Design recommendations to attenuate aged-related changes:

**Visual**
- Appropriate size of interface elements and text;
- Make use of high contrast colors. (Caprani et al. 2012)

**Hearing**
- Presence of a control to adjust audio is crucial.
- (Nunes, 2010)

**Motor**
- Large targets for accurate selections;
- Avoid the use of scrolling.
- (Boustani, 2010)

**Memory**
- Use of appropriate feedback;
- Include the current system location.
- (Nunes et al., 2012)

**Attention**
- Avoid animations;
- Avoid irrelevant information.
- (Boustani, 2010)
The list of design guidelines was reached using the following methodology:

1. Selection of relevant works on design guidelines of multi-touch interfaces for elders.
   - Selection of 14 relevant works.

2. Creation of an initial set of design guidelines.
   - Initial set of 138 design guidelines.

3. Review, grouping and organization of the initial set of design guidelines.
   - Association of identical guidelines;
   - Resolve the guidelines in divergence;
   - Rewrite indistinct guidelines;
   - Creation of 10 groups of guidelines.

4. Completing data of each design guideline.
   - Attributes used:
     - Guideline number;
     - Title;
     - Group;
     - Description;
     - Example;
     - Guideline source;
     - Classification tags.

5. Final set of design guidelines.
   - A set of 113 design guidelines organized by group.
### List of Design Guidelines

#### Examples of selected works:

<table>
<thead>
<tr>
<th>Title</th>
<th>Author(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>“An Exploratory Study of a Touch-based Gestural Interface for Elderly.”</td>
<td>(Leonardi et al., 2010)</td>
</tr>
<tr>
<td>“Tabletop sharing of Digital Photographs for the Elderly.”</td>
<td>(Apted et al., 2006)</td>
</tr>
<tr>
<td>“Determining the Benefits of Direct-touch, Bimanual, and Multifinger Input on a Multitouch Workstation.”</td>
<td>(Kin et al., 2009)</td>
</tr>
<tr>
<td>“Exploring the Accessibility and Appeal of Surface Computing for Older Adult Health Care Support.”</td>
<td>(Piper et al., 2010)</td>
</tr>
<tr>
<td>“Touch Screens for the Older User.”</td>
<td>(Caprani et al., 2012)</td>
</tr>
<tr>
<td>“Designing Touch-based Interfaces for the Elderly.”</td>
<td>(Boustani, 2010)</td>
</tr>
<tr>
<td>“Design Recommendations for TV User Interfaces for Older Adults: Findings from the eCAALYX Project.”</td>
<td>(Nunes et al., 2012)</td>
</tr>
</tbody>
</table>
List of Design Guidelines

Guidelines Organization

Examples of Guidelines

G1 - Target Design
- Ensure the user can easily make interface elements larger (adjustable);
- Different physical properties have to be considered while designing the interface (e.g. size of buttons).

G2 - Use of Graphics
- Use icons along with labels;
- Use high contrast between the elements of the user interface;
- Blue and yellow or red and green tones should be avoided.

G3 - Navigation and Errors
- Provide a good navigation;
- Design error messages that make it clear that the user is not the cause of the error;
- Make it easy for user to correct input errors.
List of Design Guidelines

G4 - Content Layout Design
- Concentrate information on the center of the screen;
- Maintain consistency in the user interface;
- Remove user interface elements calling attention.

G5 - User Cognitive Design
- Be prepared for older adults that refuse to learn;
- Make use of behaviors developed by older adults to cope with memory loss.

G6 - Audio
- Increase duration of sound signals;
- Use male voices for delivering auditory information;
- Remove sound distractions.

G7 - Text Design
- Use a very large font type;
- Use left-aligned text;
- Use an easy to read font family, e.g., Helvetica, Arial.

G8 - User Feedback and Support
- There is lack of tactile user feedback;
- Use supporting peripherals if needed.

G9 - Multi-Touch Interaction
- Tap gestures (when applied to well recognized objects) are the easiest ones to understand and remember;
- Iconic gestures are very engaging;
- Natural affordances of screens are needed.

G10 - Interface Testing
- Inform the older adult of the goal of the project beforehand;
- Keep the test short and make use of breaks;
- Respect the opinions of the test participants.
List of Design Guidelines

- On-line Version

http://eldermultitouchguidelines.wordpress.com

Main Features
- Responsive design;
- Quick access to guidelines list;
- Search of guidelines;
- Visualization of guidelines by group;
- etc.
Conclusion and Future Work

- An organized set of design guidelines of multi-touch interfaces for elders was proposed;
- List of design guidelines structured in a very detailed and comprehensive way;
- Useful resource for designers, application developers, usability specialists and researchers;
- Possible extensions of this work:
  - Use of the design guidelines in an automatic detection system;
  - Inclusion of other design guidelines in the list;
  - Review and rating of the design guidelines by experts;
  - Design of a multi-touch interface with and without the use of proposed guidelines.
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Thank You!

Questions?

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