Master Recherche Informatique - Université Paris-Sud

Fundamentals of Human-Computer Interaction

Exam - 20 November 2012 - 2h

Authorized document: a single A4 handwritten sheet.
Please read the questions carefully. Answer clearly, precisely and concisely.

A. Analysis of scrolling (8 points)

This exercise compares the three most common scrolling techniques on a touch-enabled tablet: using a scrollbar, paging and direct scrolling.

The size of the tablet is 15cm wide by 20cm high, it is used in portrait mode. We consider two document sizes: a small, 10-page document and a long, 100-page document. The scrolling tasks are the following: in the small document, move by 2, 4 and 8 pages; in the large document, move by 5, 25, and 50 pages.

To use a **scrollbar**, the user moves the finger to the "elevator" of the scrollbar and moves it to the destination position (the scrollbar does not have arrows at the either end). The scrollbar is 1cm wide and is on the right of the display. The finger is initially 10cm away from the "elevator".

To use **paging**, the user makes a quick horizontal gesture (called a "flick") to the left or to the right in the document area to move to the next or previous page.

To use **direct scrolling**, the user touches the surface in the document area and moves the finger up or down, causing the document to move by the same amount. Depending on the speed of the finger at lift up, the document continues to scroll by itself as follows:
- High speed – up to 10 pages in 4 seconds, decomposed as follows: 5 pages in the first second, 3 pages in the next second, 1 page in the next second, and 1 page in the last second;
- Medium speed – up to 4 pages in 3 seconds: 2 pages in the first second, 1 page for each of the two subsequent seconds;
- Slow speed – 1 page in 2 seconds.

If the finger was steady when lifted up, the document does not continue to scroll.

1. Analyze the performance of the scrollbar:
   1a. Describe the scrolling action in terms of the following elementary tasks:
   - *Point(D,W)* – pointing, i.e. moving the finger to a target of width W at distance D, whether the finger is touching the surface or not; The table below gives the movement time for various values of D and W;
   - *Touch* and *Release* – put the finger on the surface and release it; These operations take 100ms each;

1b. Compute the scrolling time for each of the 6 scrolling tasks above using the following table to approximate the pointing time.

MT (ms)	D = 1cm	D = 4cm	D = 5cm	D = 8cm	D = 10cm	D = 15cm	D = 16cm	D = 20cm
W = 0.2cm	517	878	940	1072	1134	1250	1268	1332
W = 0.5cm	317	634	692	817	878	991	1009	1072
W = 1cm		464	517	634	692	800	817	878
W = 2cm		317	361	464	517	617	634	692
W = 5cm				276	317	400	414	464

2. Compare the performance of the scrollbar with that of paging for the 6 scrolling tasks above, assuming that a flicking gesture takes 200ms and that it also takes 200ms between successive flicking gestures.
   What do you conclude?

3. Analyze the performance of direct scrolling:
   3a. Show that the best strategy to scroll to a distant page is to scroll at high speed without waiting for the scrolling to stop.
   3b. Based on this result, evaluate the scrolling time for the 6 scrolling tasks.

4. **4a.** Fill out the following table with your results and plot movement time as a function of the index of difficulty (ID) for each scrolling technique.

	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
Distance / numpages	2 / 10	4 / 10	8 / 10	5 / 100	25 / 100	50 / 100
ID	1.6	2.3	3.2	2.6	4.7	5.7
MT (scrollbar)						
MT (paging)						
MT (direct scrolling)						

4b. Compare the performance of direct scrolling with the other two techniques. What do you conclude?

Note: the ID in the table above is computed with target width = 1 and target distance = number of pages to scroll.

B. Conceptual modeling (6 points)

You are asked to create an interface for a simple e-book application running on a multitouch tablet. This interface must allow the user to:
- Show the available books (in the device, not on an online store) and pick one to read;
- Read a book by turning pages;
- Browse through a book to find a particular page;
- Search for occurrences of a text string in a book or in the whole library;
- Bookmark a page;
- Highlight text and add comments to a page or to highlighted text.

The interface has four main displays:
- The **bookshelf**, showing miniatures of the covers of the available books;
- The **book**, showing miniatures of the pages in a book;

- The **reader**, showing one or two pages of the book, depending on the orientation (one page in portrait, two in landscape);
- The **search results**, showing the books or the pages that match the searched text.

1. Identify the objects and operations of the conceptual model.

2. Design a set of touch interactions to navigate between the four main displays described above. You can use a diagram similar to the one below (all transitions may not make sense in your design – if so, omit the unused ones):
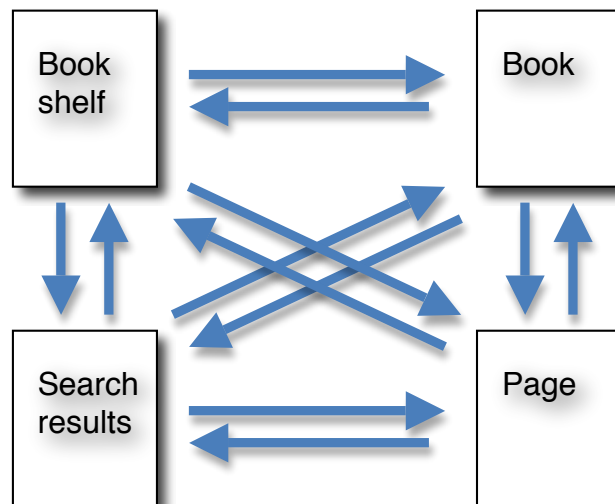
3. Fill out the objects and operations tables describing the conceptual model of the complete interface. For each operation, design two interactions to trigger the operation. To get you started, the tables below include one object and one operation (you can change those in your design).

Objects table:

Objects	Representations	Properties	Operations
Book ...	Cover page in the Bookshelf	Title, author, last opened page	Open

Operations table:

Operations	Commands	Feedback	Responses
Open a book ...	Double tap the book cover in the bookshelf	The book highlights	The book opens at the last opened page

4. Is you interface consistent? Explain.
   Is your interface instrumental? Explain.

Answer *part C* questions on both sides of this page.

C. Course questions (6 points)

1. Explain the difference between an **algorithmic** and an **interactive** system:

_____

_____

_____

_____

2. Check all that apply to Ivan Sutherland's SketchPad:

[ ] used a mouse   [ ] used a lightpen

[ ] used bimanual interaction   [ ] had videoconferencing

[ ] had windows   [ ] solved geometric constraints

3. List the four principles of direct manipulation:

1. _____

2. _____

3. _____

4. _____

4. What does WIMP stand for? _____

Cite a WIMP interface: _____

Cite a modern non-WIMP interface: _____

5. What are the three senses usually grouped under the sense of touch?

1. _____

2. _____

3. _____

6. What does 7 ± 2 refer to?

_____

_____

_____

7. What does Held & Hein's Kitten Carousel experiment demonstrate?

_____

_____

_____

8. Link each selection technique to the properties for which it is most adapted:

- small set
- scrolling list •
- large set
- fixed set
- radio buttons •
- variable set
- single selection
- checkboxes •
- multiple selection
- keyboard input

9. What is the Fitts' Index of Difficulty? _____

_____

_____

Why is it measured in bits? _____

_____

_____

10. What are the three facets of a widget and their role?

1. _____

2. _____

3. _____

11. In Activity Theory, what is the difference between Action and Operation?

_____

_____

_____

Give an example of an action becoming an operation and vice versa:

_____

_____

_____