Elective in Software and Services
(Complementi di software e servizi per la società dell'informazione)

Section Information Visualization

Numbers of credit : 3

Giuseppe Santucci

7 – Presentation

Thanks to John Stasko, Robert Spence, Ross Ihaka, Marti Hearst, Kent Wittemburg
Outline

• Presentation & Screen limitations
• Space limitations
  – Scrolling
  – Overview + details
  – Distortion
  – Suppression
  – Zoom & pan
• Time limitation
Presentation & Screen limitations

Once you got a representation you have to present it on the screen.
Outline

• Presentation & Screen limitations
• Space limitations
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7.1 A PROBLEM

Many of us have found ourselves with a report that has to be completed by a deadline, with the result (Figure 7.1) that the dining room table, extended to its 12-guest state, is covered by piles of paper as well as reports, books, clippings and a slide, perhaps even arranged on the floor and on a couple of chairs. There may even be piles on top of piles. Such a presentation of vital information makes a lot of sense: everything relevant is to hand (Bolt, 1984, page 2), what might be relevant at any particular juncture, possibly triggering a situated action (Suchman, 1987). In this environment I can concentrate on creative tasks rather than organisation.

Despite the availability of high-resolution displays and powerful workstations I still write most of my reports in this way. Why? Because the display area provided by the typical workstation is far too small to support, visibly, all the sources that are relevant to my composition.

7.2 THE PRESENTATION PROBLEM

I am not alone in the sense of having too much data to fit onto a small screen. A very large and expensive screen, for example, would be needed to display the London Underground map in sufficient detail (Figure 1.1), and it would be difficult or impossible to present, on a normal display, the complete organisation chart of IBM or ICI. Moreover, the recent emergence of small and mobile information and communication devices such as PDAs and wearable displays has additionally identified a pressing need for a solution to the ‘too much data, too little display area’ problem: the presentation problem.

7.2.1 Scrolling

An obvious solution is to scroll the data into and out of the visible area. In other words, to provide a means whereby a long document can be moved past a window until it reaches the required ‘page’ (Figure 7.2). This mechanism is widely used, but carries with it many penalties. One relates to the “Where am I?” problem: I’m working on Chapter 2, (it may be section 2.3, I don’t know) and I want to remind myself of a figure that is in chapter 5, it may be in section 5.3 – or was it 5.6? All I can do is operate the scrolling mechanism and look out for the figure I need, albeit assisted by various cues such as the page number indicated in the scrolling mechanism.

With a scrolling mechanism, most of a document is hidden from view. I have the same problem when using a microfilm reader, with the additional complication that if I move the tray to the left, the image moves to the right. A similar difficulty applies to my use of the famous London ‘A to Z’ street directory. I’m driving along a road that goes off the edge of the page, so I desperately need whatever page contains the continuation of that road (and quickly!)

Even if I get it, I will typically have trouble locating the same road on the new page. These and other similar problems can be alleviated by the provision of context. Much of this chapter, in fact, is concerned with deciding how to provide context.

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Space limitations:
- Scrolling!
- Scrolling where?
- Boring
- Time consuming
- Most content is hidden from view
Outline

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composite brushes by the use of a scatterplot visualization, we clearly see that brushes based on logical operators select sub-sets which are aligned with the display axes, whereas angular brushes select sub-sets which are aligned with the diagonals when visualized in a scatter-plot (see also figure 5 for comparison).

2.2. Smooth Brushing and Non-Binary DOIs

Many well-known F+C techniques in InfoViz such as fisheye views [7,8], for example, do not use a discrete distinction between focus and context, but allow a multi-valued or even continuous transition, which inherently supports the mental connection between data-points in focus and their context. This corresponds to a degree-of-interest function,
Space limitations: overview + detail
Space limitations: overview + detail
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Space limitations: distortion

(a) An information space containing documents, emails, etc.

(b) The same space wrapped around two uprights.

c) Appearance of the information space when viewed from an appropriate direction

Horizontal distortion
Space limitations: distortion

Documents on a (early) bifocal display

Sequence of amino acids
Space limitations: distortion

Data (histograms) about baseball players:
- number of 'hits'
- ball speed

Interaction
- sort

The table lens

Expansion to show names and numbers
Generalized distortion

Combined X- and Y-distortion
London Underground map
## Combined distortion for a calendar

<table>
<thead>
<tr>
<th>Mar</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>11 Sun</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Check slides, notes. Family barbeque</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>12 Mon</strong></td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fly LA Kathy to airport Model Maker</td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
<td><strong>13 Tue</strong></td>
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<td><strong>15 Thur</strong></td>
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<td></td>
<td></td>
<td></td>
<td><strong>16 Fri</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Flight to SFO Tutorial set-up Tutorial United flight Heathrow Pointer Color OHs Jane+John</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Call Kathy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>17 Sat</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fly LHR Kathy to collect Chapter 2/see Dave March</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Combined distortion on a PDA

The distortion preserves the continuity of transportation links
Macintosh OSX distortion
The perspective wall

- Bifocal display + 3D
Outline

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Suppression

Saul Steinberg

A view of the world from 9th Avenue

Distortion + Suppression

Presenting only relevant data
Relevant data (?)

- A more formal definition
- Degree of interest (Doi) = f(API,D)
  - API = a priori importance
  - D = distance

Organization tree of a company

A priori importance
Relevant data (?)

Distance from the focus

DoI=API-D
Relevant data (?)

- Defining a Doi threshold define context

Doi $\geq 7$

Doi = API-D
OntoViewer Demo
Relevant data

Part of an engineering drawing

The drawing simplified in the context of a suspected fault
Suppression through layers: magic lens

**Magic lens.** (a) shows a conventional map of an area, (b) shows the location of services (gas, water and electricity pipes) in the same area, and (c) a (movable) magic lens shows services in an area of interest, in context.
Suppression through layers: magic lens

A molecular surface of the protein transferase. The magic lens window allows a view of the atomic structure bonding to be shown, thereby providing a view inside the protein.
Distortion + suppression
Link between representation & presentation

Representation & presentation to provide context for a small display
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Zoom and pan

In both cases we have to care about the context
NY to London
Long, boring panning (unless you like blue ... )
Combining zoom an panning

What a complex interaction!

Who acts this way?

video
Geometric & semantic zoom

View A

View B
S.S Artemis 200K tons
Fuel 2 days    Readiness RED

View C
S.S Artemis 200K tons
Fuel 2 days    Readiness RED
Capt. F. Watkinson    Code blue
Aircraft: 30 W121   6 heli
Armament 20 FF 6 XA 2 YF

Geometric zoom + semantic zoom

Semantic zoom
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Time limitations

- Rapid serial visual presentation vs parallel visualization
- Up to 10 images per second ...

Concurrent presentation

Serial presentation
What an odd task?

• Browsing !!!
  – Looking for a page in a book (using its appearance)
  – Looking for a picture in a collection of photos
  – Looking at a movie through a trailer
  – Looking for a gift in a catalogue
  – Searching a product in a supermarket shelf
• ........video (v21imagebrowsing.mov)
Browsing of posters advertising videos. Cursor movement along the stacks causes posters to briefly ‘pop out’ sideways, and the whole bifocal structure can be scrolled to bring a video of interest to the central region, where a mouse click will cause a clip from a video to be played.
How fast we can go?

• Experiment
  – A subject is shown an image
  – After he is exposed to a large set of images at rate 10 per seconds
  – The subject is asked for the target image belongs to the set
  – 80%-90% success rate

Prior instruction to subject

“Here is a target image. Tell me if this image appears in the sequence of N images you’re about to see”

Presentation of images

unrelated images

about 100 ms

time

Subjects’ performance

Recognition about 80% to 90% successful
Space and time...

Mode A: Slideshow

Mode B: Mixed

Mode C: Tile

Mode D: Diagonal

Mode E: Ring

Mode F: Stream

Videos...  A  B  D
Do you remember the 1° fovea?

- To evaluate such kind of interfaces it is mandatory to recall the way an eye behaves
- Fovea: narrow high resolution spot
- Quick eye-gazes plus fixations

A simple representation of eye-gaze behavior. The rapid saccades are shown green, the fixations (F) of varying duration by circles of proportionate size.
Eye tracking

Recording of eye-gaze. An infra-red laser beam is aimed at the user’s eye, and reflections from the retina and cornea are detected by a television camera. It also records pupil diameter.
Eyes gazes: A) slide-show

Mode A: Slideshow
Eyes gazes: B) mixed
Eyes gazes: C) tile
Eyes gazes: D) diagonal (liking it)
Eyes gazes: D) diagonal (disliking it)
The accuracy with which the presence or absence of a target image was reported for the six presentation modes.
Matter of opinion...

The (static) slide-show, mixed and tile image presentation modes account for three-quarters of the preferred modes.

Almost all the least preferred image presentation modes were moving modes and the stream mode accounted for over half.
Interaction!

- Control the speed
- Expand images

Macintosh like interaction...
Still on human visual performance

- Another experiment

Prior instruction to subject | Presentation of image collection | Subject’s performance
--- | --- | ---
None | | The subject was shown an image and then asked, ‘Was this image present in the sequence you have just seen?’

Recognition success was 10% to 20% unless the question was asked within about 4 seconds of the end of the presentation.

4 seconds?
Conceptual short-term memory (sound and images)...
Still on human visual performance

- You can argue that 100 ms is too short but...

<table>
<thead>
<tr>
<th>Prior instruction to subject</th>
<th>Presentation of image collection</th>
<th>Subject’s performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td><img src="image.png" alt="Diagram" /></td>
<td>The subject was shown an image and then asked, ‘Was this image present in the sequence you have just seen?’</td>
</tr>
<tr>
<td></td>
<td>About 100ms</td>
<td>About 300ms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>time</td>
</tr>
</tbody>
</table>

Up to 92% recognition success
Interaction design

A third palette for designing Infovis applications

*Rapid Serial Visual Presentation