Information Visualization In Practice

How the principles of information visualization can be used in research and commercial systems

Putting Information Visualization Into Practice

A Common Problem

- There is a large set of information to represent.
- The display space is limited.
- Also:
  - Providing all the details all at once is not useful (results in overload).
  - Showing only a subset of the information may result in a lost of context.
Too Much Information To Show All At Once

Another Example Of The “Large Data Set – Limited Display Space Problem” : Adventure/RPG Games

Dungeon Master (Java version) [http://www.cs.pitt.edu/~alandale/dmjava/](http://www.cs.pitt.edu/~alandale/dmjava/)

Applying the principles of information visualization
Too Much Information To Show All At Once

Approaches to the problem:

1) Scrolling
2) Overview and detail
3) Magnification
4) The DragMag
5) Transparent overlays
6) Zooming
7) Focus and context

1) Scrolling

Scrolling along one dimension

Scrolling in two dimensions

Scrolling along one dimension
2) **Overview And Detail: Separate**

Overview

Detailed view

Images from "Information Visualization" by Robert Spence

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2) **Overview And Detail: Separate**

Defender © Midway Home Entertainment Ltd.

James Tam
2. **Overview And Detail: Separate**

Relating the detailed and overview can be a challenge:

![Overview Image](image1.png)

![Detailed View Image](image2.png)

3. **Magnification: Inline**

![Magnification Image](image3.png)

*Image from “Information Visualization” by Robert Spence*
3) **Magnification: Inline**

**Problem 1:**
Occlusion of the area to be viewed by the viewer.

**Problem 2:**
Lack of continuity between the magnified area and the surrounding context.

Image from "Information Visualization" by Robert Spence

3) **Magnification: Mutually Exclusive**

Icewind Dale © Interplay productions
3) **Magnification: Mutually Exclusive**

4) **The DragMag**
4) **The DragMag**

Contextual overview

Detailed view

![Image from “Information Visualization” by Robert Spence](image)

5) **Transparent Overlays**

**Key:**

A. Overview

B. Which part of the overview will be magnified

C. The magnified portion of the overview

D. The magnified view transparently overlaid on the overview

![Image from “Information Visualization” by Robert Spence](image)
Animate this so only a part appears at once.

tamj, 2/15/2006
5) **Transparent Overlays**

[Brazil © Blizzard]

6) **Zooming**

Pad++: A Zoomable Graphical Sketchpad for Exploring Alternate Interface Physics
Bederson et al
*Journal of Visual Languages and Computing* 7, 1996

Browsing of digital images
Pad++: The Details

Not a system in and of itself!
- A proposed alternative to WIMP interfaces.
- Allows for zooming to be added to existing systems (“ZUI’s”)

Characteristics
- An infinite 2D plane
- Objects can be placed anywhere
- The plane can be scaled to any size

Zooming Need Not Be Just Tied To Simple Magnification/Reduction Of Size!

Some ways that zooming can show more (or less information)

A. Aggregation

B. Semantic zooming
A. **Aggregation**

Aggregation – combine information into some compact yet meaningful way


B. **Semantic Zooming**

Block the appearance of some of the information

**B. Semantic Zooming**

At different zoom levels the same information may appear in the display but it is represented in a different fashion:

<table>
<thead>
<tr>
<th>X2</th>
<th>X4</th>
<th>X8</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
</tbody>
</table>

**7. Focus And Context**

- Again the amount of the information is too large to display all at once.
7) **Focus And Context**

• With this approach detailed view can still be viewed within its surrounding context.

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**The Fisheye Lens: Photography**

Image from: http://rick_oleson.tripod.com/
Fisheye View: Information Visualization

An application of the focus and context approach

Fisheye View: Visual Cues For The Distortion

Distortion is understandable through the use of a grid and shading
Focus And Context: Distortion In One Dimension

• Distortion in the X-dimension

Image from "Information Visualization" by Robert Spence

The Perspective Wall

Mackinlay / Robertson / Card: Proc ACM CHI'91
Another Example Of The “Large Data Set – Limited Display Space Problem”: Lists

Approaches to mitigating the problem:

• Scrolling
• Setting up hierarchies
• Fisheye (distortion in one dimension)

Scrolling Menus
Hierarchical Menus

Works well for goal directed tasks (e.g., selecting from a menu of functions that are familiar).

Fisheye Menus

Bederson, B.B. (May 2000)
University of Maryland
www.cs.umd.edu/hcil/fisheymenu/
Applying the principles of information visualization

Table Lens

Overview:
- Show all the information in an abstracted graphical form

Focus:
- Show all the details of only a subset of the data.

Housing Market for Santa Clara County, CA - March 2000
Table Lens: The Details

- Abstracts a large volume of data into a small space.
- The overview may allow the user to spot:
  - Trends
  - Patterns
  - Outliers
- Details are provided on demand
- The data can be manipulated

Focus And Context: Distortion In Two Dimensions

- Distortion in both the X and Y dimensions

Images from “Information Visualization” by Robert Spence
DocumentLens: The Details

Recall:
• The Perspective Wall can only be used when the data is structured into different categories.
• Laying out a complete overview of a large dataset is not feasible.

DocumentLens:
• Can be used when the data is not organized.
• Portions of the data can viewed in greater detail while the surrounding context can still be seen.
The DateLens

Detailed calendar view of one day (focus)

Abstracted calendar information of other days and times (context)

The DateLens: The Details

• Combines a fisheye view of calendar information with zooming (zoom's)

• The fisheye view can be distorted to increase the ‘weight’ of particular information.

• Integrated searching
  • Results show up in greater detailed in the area of focus
  • Results also show up in an abstracted form in the contextual view

• Zooming
  • Double headed scrollbar can be used to zoom in or out of the calendar
  • Automatic rescaling of the detailed view
Fisheye vs. Separate (Overhead And Detail) Views

Separate

Fisheye

Visual Information-Seeking Mantra

• Overview first, zoom and filter, then details on demand
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• Overview first, zoom and filter, then details on demand

Ben Shneiderman, Designing the User Interface 3rd Ed. 1997 p523
Dynamic Queries: HomeFinder

Start with an overview of the data
- All query results may all appear in an abstracted form

Dynamic queries (rapid, incremental, reversible actions to filter the data)
- All query results are displayed instantly
- No “search button”
- Prevents errors

Direct manipulation of
- Queries
- Query results
- Can be interacted with like real-world objects

Details on Demand
- Additional information can be provided about each query result
FilmFinder: The Details

FilmFinder employs many of the principles employed in the HomeFinder:

- Overview of the data
- Filtering query results through
  - Dynamic queries
  - Direct manipulation
- Details on demand

But with FilmFinder system there are additional concepts:

- Zooming in on the data set.
  - When the number of query results is small additional details are provided about each result (thumbnails and text)
- Starfield display
  - The entire database can be viewed and manipulated on one screen with meaning attached to each dimension.
- Tight coupling of interface components (to the state of the system)
A Student Project: HomeBay

Dynamic Queries

Radar Overview

Progressive details on demand

PhotoFinder

University of Maryland
Human Computer Interaction Laboratory
http://www.cs.umd.edu/hcil/

481 Student Project (April, 2000) Rob Pearson, Kashama Willms and James Chisan
PhotoFinder: The Details

Multiple Views Of A Large Data Set:
- 3 levels of detail

Library view
Collection view
Photo view

PhotoFinder: The Details (2)

Allows for the annotation of each photo with pertinent information (“tagging”)
Representing Connectivity

• The problem of having large data set – but limited display space must still be dealt with

• Also there is the additional problem of showing how things in a large data set relate
  - e.g., How do we show Internet connections between servers?

• Some issues:
  - Occlusion of information
  - Edge crossing
  - Overwhelming quantity of edges

Representing Phone Network Connections

Images from “Information Visualization” by Robert Spence
Which Folder Has The Most Documents?

right menu + properties

Where Am I? Where Was I Going?
**Cone Trees**

Robertson / Mackinlay / Card
Cone Trees: Animated 3D Visualizations of Hierarchical Information, Proc ACM CHI'91

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**Cone Trees: The Details**

- Employs 3D in order to more efficiently represent the data and their relationships.
  - Used to represent complex hierarchies
  - To mitigate the effect of occlusion transparency is employed

- Fisheye effects are used to highlight nodes.

- Dynamic filtering of the tree.

- Animates the display to help the user to interpret results.
Applying the principles of information visualization
What You Now Know

Ways of dealing with the “large data set but limited display space” problem

- Scrolling
- Magnification
- The DragMag
- Transparent overlays
- Overview and detail
- Focus and context
- Zooming

The information seeking mantra and how it has been applied in the HomeFinder and FilmFinder systems

Problems and some solutions when representing connectivity in large data sets
Applying the principles of information visualization