Overview and Detail + Focus and Context

CS 4460 – Intro. to Information Visualization
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Learning Objectives

- Explain motivation behind providing overview & detail
- Provide examples of zooming visualization applications and describe benefits and limitations of such applications
- Describe different methods of providing overview & detail
- Define concept of focus+context and fisheye view
- Explain components of fisheye view and how its equation is calculated
- Describe different fisheye data visualization applications
- Understand limitations of fisheye approach
**Fundamental Problem**

- **Scale** - Many data sets are too large to visualize on one screen
  - Too many cases or too many variables

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**Scale Solutions**

- Potential solutions for dealing with large-scale data:
  - Representation
  - Interaction
  - Both
One Solution :^)

You can just buy more pixels

Problem: You’ll always eventually run out of pixels

Overview

- Providing an overview of the data set can be extremely valuable
  - Helps present overall patterns
  - Assists user with navigation and search
  - Orients activities

- Generally start with overview
  - Shneiderman mantra
Details

- Viewers also will want to examine details, individual cases and variables

- How to allow user to find and focus on details of interest?

- Generally provide details on demand

Providing Both

- Overview + detail displays can be combined via either time or space
  - Time - Alternate between overview and details sequentially in same place
  - Space - Use different portions of screen to show overview and details

- Each has advantages and problems
Specific Problem

• Develop visualization and interface techniques to show viewers both overview + detail, and allow flexible alternation between each

• Potential Solutions????
  – Discuss....

One Common Solution

• Pan/Scroll
  – Provide a larger, virtual screen by allowing user to move to different areas

• Problems?
  – Still not a true overview
  – Clunky interaction
Another Solution

- Zoom
  - Zoom out shows an overview of data space then zooming in allows viewer to examine details

http://www.eamesoffice.com/the-work/powers-of-ten/

Powers of Ten

Famous video
Web Interpretation

Powers of 10


Similar Idea

http://htwins.net/scale2/
Early Zooming Applications

Web traversal history
PadPrints
Hightower et al.
UIST '98

Video

Browsing Images

PhotoMesa
Uses panning and zooming to browse a photo collection
Bederson
UIST '01

Demo & Video:
www.cs.umd.edu/hcil/photomesa
FacetZoom

• Combine (hierarchical) facets with zooming UI for exploration

Dachselt et al
CHI '08

Giving Presentations

http://prezi.com
Other Alternatives

- Allow viewer to examine cases and/or variables in detail while still maintaining context of those details in the larger whole
- Concession
  - You simply can’t show everything at once
- Be flexible, facilitate a variety of user tasks

Nature of Solutions

- Not just clever visualizations
- Navigation & interaction just as important
- Information visualization & navigation
An Example

Overview and detail (from *Civilization V* game)

Related Approaches

Multi-level views

Tiled multi-level

Bifocal magnified

Strengths/Limitations?
Important Issue

- The “overview” display may need to present huge number of data elements
- What if there simply isn’t enough room?
  - The number of data elements is larger than the number of pixels

Approaches?

Two Main Approaches

1. Reduce the data
   - Eliminate data elements
     - But then is it still an overview?
   - Aggregate data elements
2. Reduce the visual representation
   - Smart ways to draw large numbers of data elements
Drawing the Overview

Information Mural
What do you do when your data set is too large for your overview window?
--- More data points than pixels
--- Don’t want to fall back on scrolling

Use techniques of computer graphics (shading and antialiasing) to more carefully draw overview displays of large data sets

Think of each data point as ink and each screen pixel as a bin

Data points (ink) don’t fit cleanly into one bin, some ink may go into neighboring bins

Can map density to gray or color scale

Mural Example

Sunspot activity over 150 years
Challenge

• Have context/overview seamlessly and smoothly co-exist with focus/detail

• Why?
  – Easier to move between the two, helps assimilate view updates, less jarring, ...

• Not all overview and detail techniques are good at this

Focus + Context Views

• Same idea as overview and detail, with one key difference:
  – Typically, the overview and the detail are combined into a single display
  – Mimics our natural vision systems more closely
Prototypical Example

- When people think about focus+context views, they typically think of the *Fisheye View* (distortion)

Why is it called Fisheye?

- *Fisheye Camera Lens*
Fisheye of Source Code

```c
1 #define DIG 40
2 #include <stdio.h>
3 ...
4 main()
5 {
6    int c, l, x[DIG/4], t[DIG/4], k = DIG/4, noprint = 0;
7    while((c = getchar()) != EOF)
8        if(c >= '0' && c <= '9'){
9            switch(c){
10                case '+' :
11                    l = l + x[k];
12                    break;
13                case 'e' :
14                    for(i = 0; i < k; i++) t[i] = x[l];
15                    break;
16                case 'q' :
17                    default:
18                    if(noprint){
19                        l = l + x[k];
20                    }
21                    noprint = 0;
22                }
23            }
24        }
25    }
```

Figure 4. A fisheye view of the C program. Line numbers are in the left margin. "..." indicates missing lines.

Definition

- **Fisheye View** -

  "Provide[s] detailed views (focus) and overviews (context) without obscuring anything...The focus area (or areas) is magnified to show detail, while preserving the context, all in a single display."

  -(Shneiderman, *DTUI*, 1998)
Everyday Life Example

Real fisheye camera lens

Atlanta Journal

On I-285, another Perimeter maul

Traffic creeps along I-285 westbound during the evening rush hour Thursday after a hole developed in a bridge over the Chattahoochee River and it closed. Officials say recent construction work may have caused the problem. This photo, taken with a fisheye lens, is looking south toward downtown.
Fisheye Terminology

- Focal point
- Level of detail
- Distance from focus
- Degree of interest function

Focal Point

- Assume that viewers focus is on some item, some coordinate, some position,...

![Diagram showing focal point (0.8, 0.1)]
**Level of Detail**

- Some intrinsic value or quantity on each data element
- How important is it to you in a general sense?
- Simplest example is that all data items have same level of detail

**Distance from Focus**

- Calculation of how far each data item is from the focal point
**Degree of Interest Function**

- Function that determines how items in display are rendered

\[
\text{Degree of Interest} = \frac{\text{Level of Detail}}{\text{Distance from Focus}}
\]

Focal point \((0.8, 0.1)\)

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**DoI Function**

- Can take on various forms
  - Continuous - Smooth interpolation away from focus
  - Filtering - Past a certain point, objects disappear
  - Step - Levels or regions dictating rendering
    - \(0 < x < 0.3\) all same, \(0.3 < x < 0.6\) all same
  - Semantic changes - Objects change rendering at different levels
Bifocal Display

• Interesting application of fisheye view
• View office documents
• Take items in periphery and fold back in 3-space
• Project onto front viewing screen

Spence & Apperly
BIT '82
Table Lens

From Xerox PARC and Inxight

A bifocal display

Rao & Card

CHI '94

Application - Calendars

- DateLens - Uses “fisheye view”
- Helping people better manage their calendars and appointments on a handheld display
- At different points in time, you want different perspective on your appts.
  - See how my month looks
  - What’s happening later this week
  - Am I double-booked this afternoon

Bederson et al

ACM ToCHI '04
Different Perspectives

Month view  Zooming to a week  Zooming to a day

Panacea?

- Are there any disadvantages of focus+context or fisheye techniques?
Disadvantages

- Distortion can be annoying
- Can be very difficult to implement
- Any change in focal point potentially requires recalculation of DoI for all objects and hence re-rendering of all objects - Expensive!

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P1

- Questions?
- Due Friday at noon

Midterm Exam

- Results
Upcoming

• Interaction
  – Prep: Read Yi article

• Lab: D3

References

• Spence and CMS books
• All referred to articles
• S. Meier, Civilization II. MicroProse:1998
  http://www.civ2.com
• Demonstration maps generated at MapQuest,
  http://www.mapquest.com
• Shneiderman, B. Designing the User Interface, 1998