

Overview and Detail + Focus and Context



CS 4460 – Intro. to Information Visualization
October 16, 2017
John Stasko

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

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

Fall 2017

CS 4460

5

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

Fall 2017

CS 4460

6

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

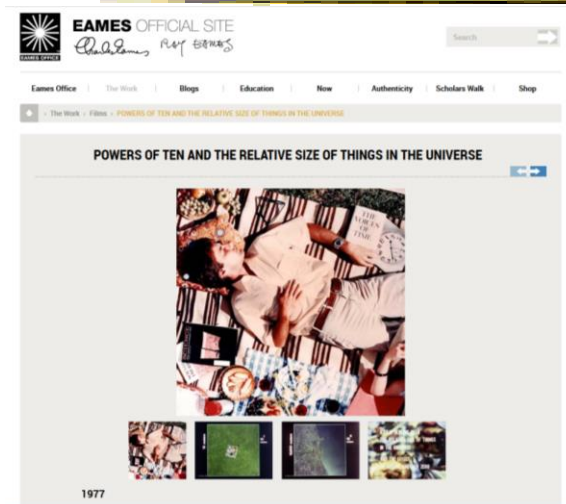
Fall 2017

CS 4460

11

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

Powers of Ten



Famous video

Fall 2017

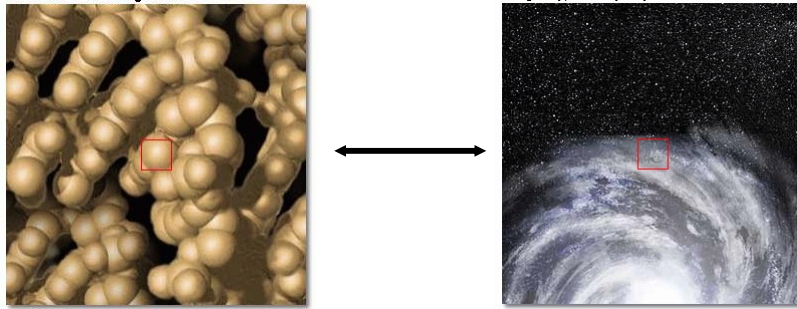
CS 4460

12

Web Interpretation



Powers of 10



<http://micro.magnet.fsu.edu/primer/java/scienceopticsu/powerof10/index.html>

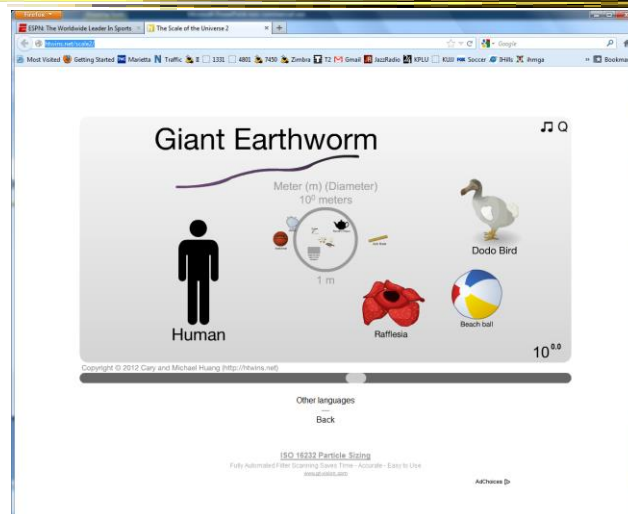
Fall 2017

CS 4460

13

Similar Idea

<http://htwins.net/scale2/>



Fall 2017

CS 4460

14

Early Zooming Applications

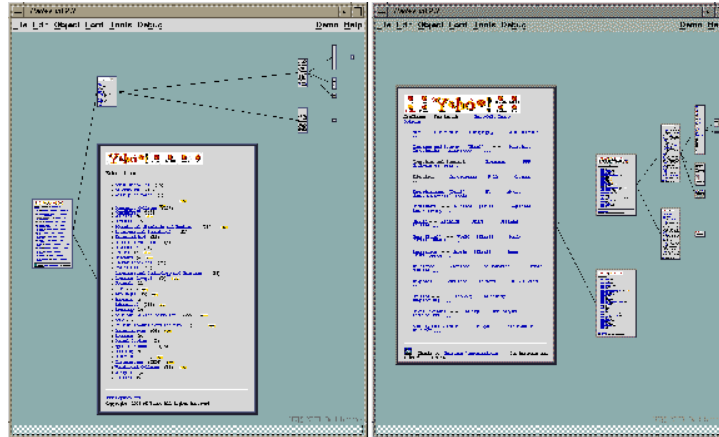


Web traversal history

PadPrints

Hightower et al
UIST '98

Video



Fall 2017

CS 4460

15

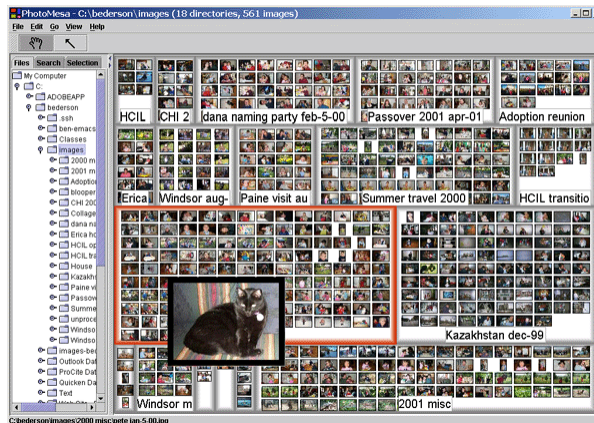
Browsing Images



PhotoMesa

Uses panning and zooming to browse a photo collection

Bederson
UIST '01



Demo & Video:

www.cs.umd.edu/hcil/photomesa

Fall 2017

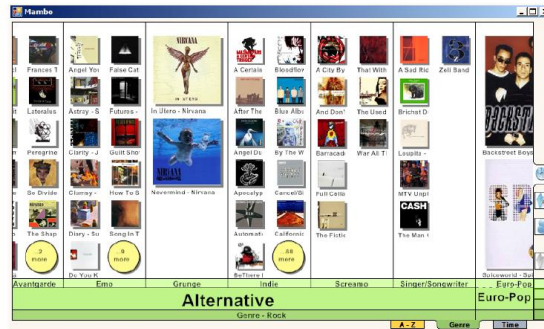
CS 4460

16

FacetZoom



- Combine (hierarchical) facets with zooming UI for exploration



Video

Dachselt et al
CHI '08

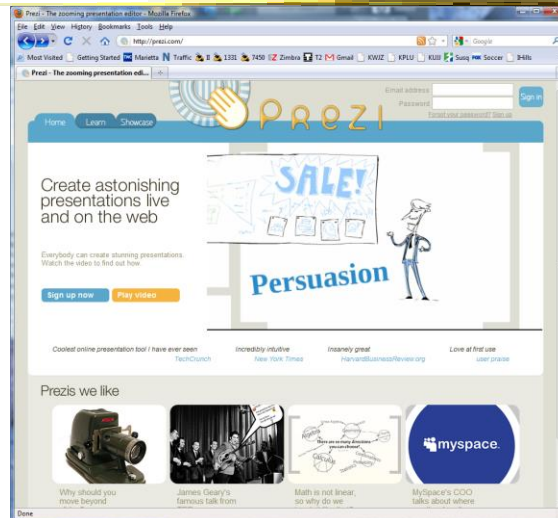
Fall 2017

CS 4460

17

Giving Presentations

<http://prezi.com>



Fall 2017

CS 4460

18

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)

Fall 2017

CS 4460

21

Related Approaches



Multi-level views

Tiled multi-level

Bifocal magnified

Strengths/Limitations?

Fall 2017

CS 4460

22

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

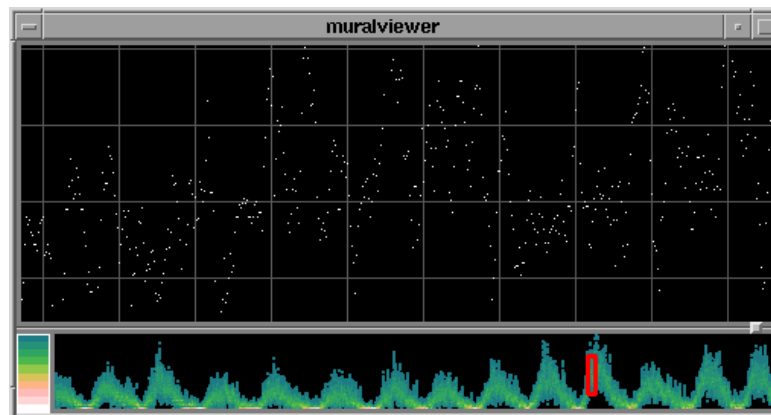
Jerding and Stasko
InfoVis '95, *IEEE TVCG* '98

Fall 2017

CS 4460

25

Mural Example



Sunspot activity over 150 years

Fall 2017

CS 4460

26

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

Fall 2017

CS 4460

27

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

Fall 2017

CS 4460

28

Prototypical Example



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

Fall 2017

CS 4460

29

Why is it called Fisheye?



- Fisheye Camera Lens

Fall 2017

CS 4460

30

Fisheye of Source Code



```
1 #define DIG 40
2 #include <stdio.h>
...4 main()
5 {
6     int c, i, x[DIG/4], t[DIG/4], k = DIG/4, noprint = 0;
...8     while((c=getchar()) != EOF){
9         if(c >= '0' && c <= '9'){
..16             } else {
17                 switch(c){
18                     case '+':
..27                     case '-':
..38                     case 'e':
>>39                     for(i=0;i<k;i++) t[i] = x[i];
40                     break;
41                     case 'q':
..43                     default:
..46                 }
47                 if(!noprint){
..57                 }
58             }
59             noprint = 0;
60         }
61 }
```

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

Furnas
CHI '86

Fall 2017

CS 4460

31

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)

Fall 2017

CS 4460

32

Everyday Life Example

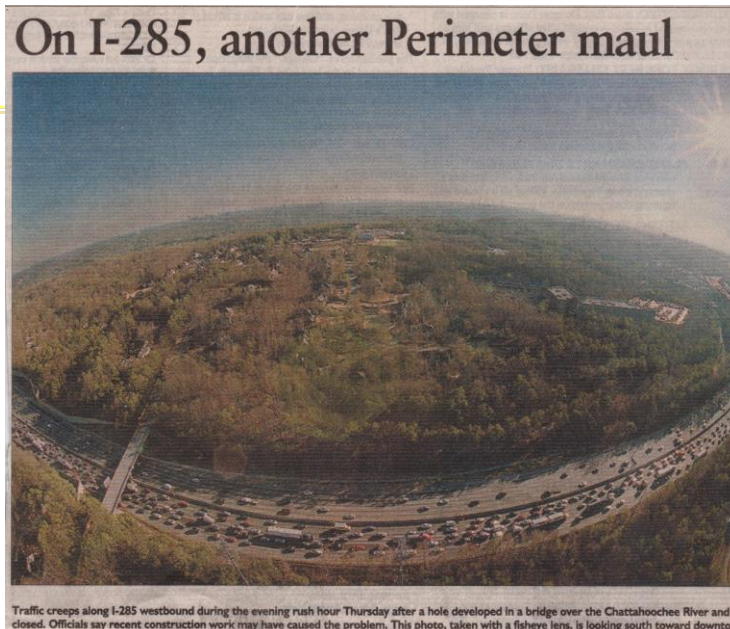


Fall 2017

CS 4460

33

Real fisheye
camera lens



Atlanta Journal

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

Fall 2017

CS 4460

34

Fisheye Terminology



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

Fall 2017

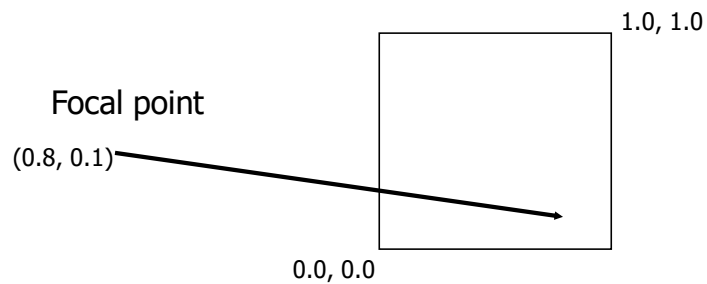
CS 4460

35

Focal Point



- Assume that viewer's focus is on some item, some coordinate, some position,...



Fall 2017

CS 4460

36

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

Fall 2017

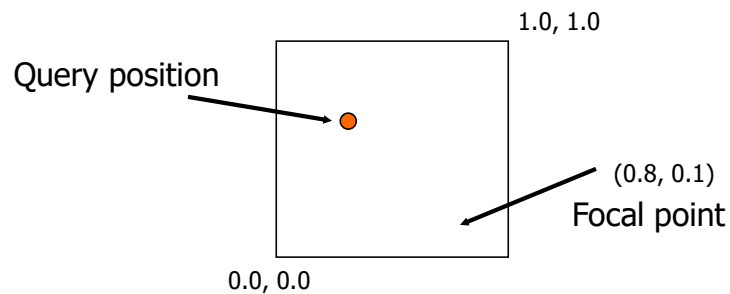
CS 4460

37

Distance from Focus



- Calculation of how far each data item is from the focal point



Fall 2017

CS 4460

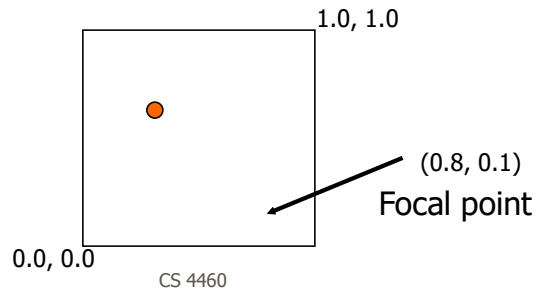
38

Degree of Interest Function



- Function that determines how items in display are rendered

Degree of Interest = $\frac{\text{Level of Detail} - \text{Distance from Focus}}{\text{Level of Detail}}$



Fall 2017

39

Dol 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 < .3 all same, .3 < x < .6 all same
 - Semantic changes - Objects change rendering at different levels

Fall 2017

CS 4460

40

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

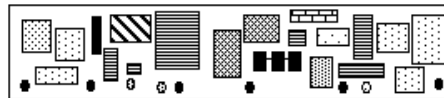
Spence & Apperly
BIT '82

Fall 2017

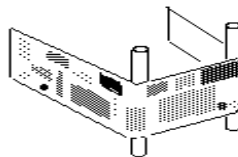
CS 4460

41

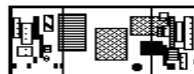
Bifocal Display



↓ Fold



↓ Project



Fall 2017

CS 4460

42

Table Lens



Table Lens: Baseball Player Statistics

Calculate: `"Hits" / "At Bats" = "Avg"`

	Avg	Career Avg	Team	Salary 87
Larry Herndon	0.24734983	0.27288276	Det.	225
Jesse Barfield	0.2886248	0.27268818	Por.	1237.5
Jeffrey Leonard	0.27859238	0.27268458	S.F.	900
Donnie Hill	0.23318584	0.2725554	Dak.	275
Billy Sample	0.285	0.2718601	Atl.	Na
Howard Johnson	0.24545455	0.25832068	N.Y.	297.5
Andres Thomas	0.250774	0.2521994	Atl.	75
Billy Hatcher	0.25775656	0.25211507	Hou.	110
Osmar Moreno	0.2339833	0.2518029	Atl.	Na
Darnell Coles	0.2725528	0.2513375	Det.	105

Row 304: Mike Lavalliere. Column 20: Put Outs Value: 468 810 -- 2163

From Xerox PARC and Inxight

A bifocal display

Rao & Card
CHI '94

Fall 2017

CS 4460

43

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

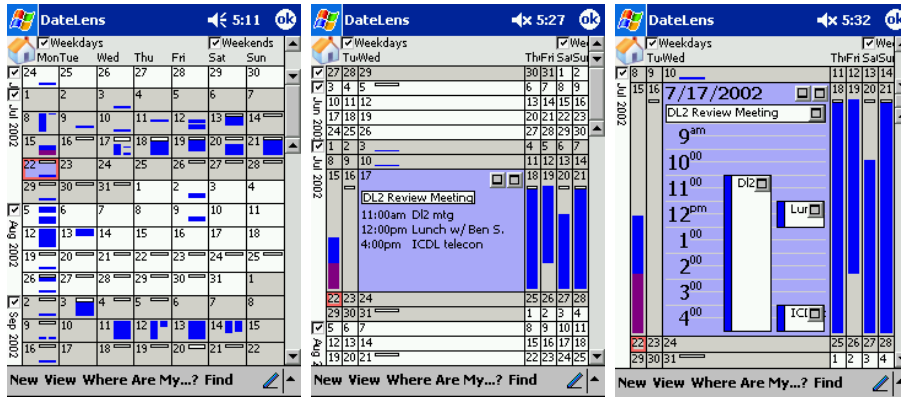
Bederson et al
ACM *ToCHI* '04

Fall 2017

CS 4460

44

Different Perspectives



Month view

Zooming to a week

Zooming to a day

Fall 2017

CS 4460

Video

45

Panacea?



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

Fall 2017

CS 4460

46

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!

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

P1



- Questions?
- Due Friday at noon

Fall 2017

CS 4460

49

Midterm Exam



- Results

Fall 2017

CS 4460

50

Upcoming



- Interaction
 - Prep: Read Yi article
- Lab: D3

Fall 2017

CS 4460

51

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
- <http://www.csi.uottawa.ca/ordal/papers/sander/main.html>
- http://www.cpsc.ucalgary.ca/group/lab/papers/1996/96-Fisheye.GI/gi96_fisheye.html

Fall 2017

CS 4460

52