

Overview and Detail + Focus and Context



CS 7450 - Information Visualization
September 28, 2016
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
 - May simply be too many cases
 - May be too many variables
 - May only be able to highlight particular cases or particular variables, but viewer's focus may change from time to time

Large Scale



- One of the fundamental challenges in information visualization
 - How to allow end-user to work with, navigate through, and generally analyze a set of data that is too large to fit in the display
 - Potential solutions lie in
 - Representation
 - Interaction
 - Both

One Solution :^)



You can just buy more pixels



Problem: You'll always eventually run out of pixels

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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

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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

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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
- Hybrid approaches exist

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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
- Still a problem
 - Clunky interaction
 - Only get to see one piece

Another Solution



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

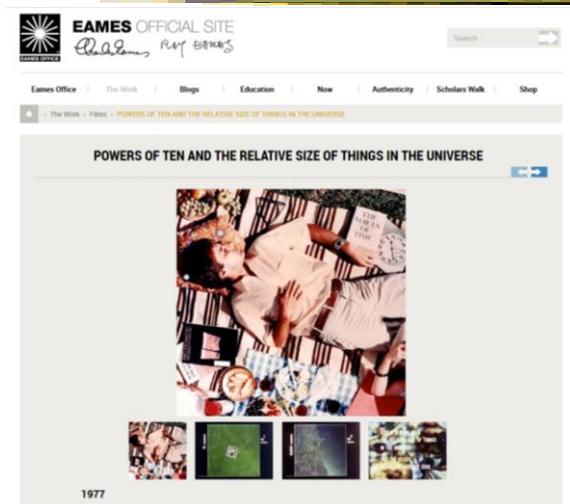
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<http://www.eamesoffice.com/the-work/powers-of-ten/>

Powers of Ten



Famous video

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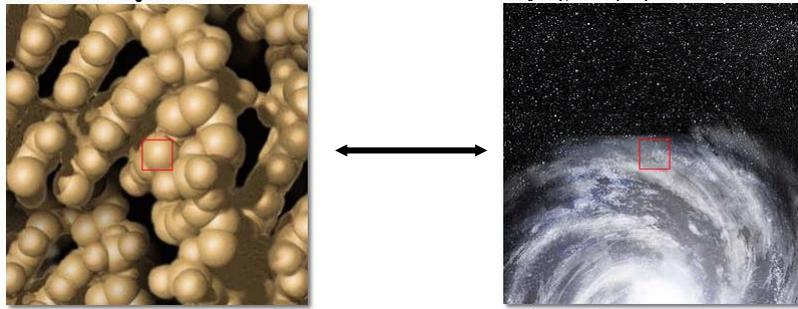
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Web Interpretation



Powers of 10



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

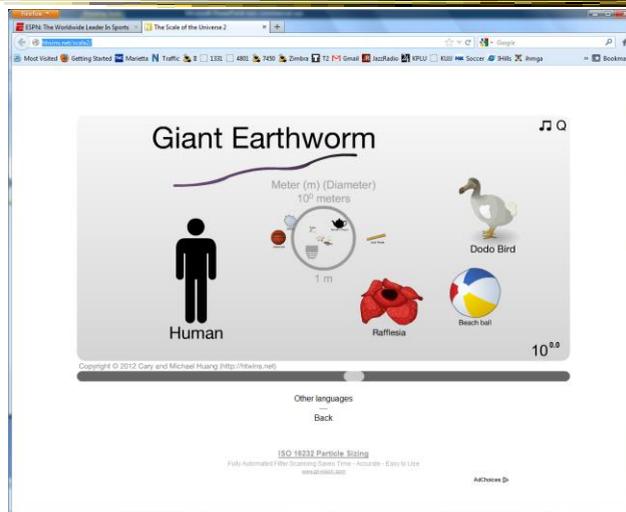
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Similar Idea

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



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Early Zooming Applications

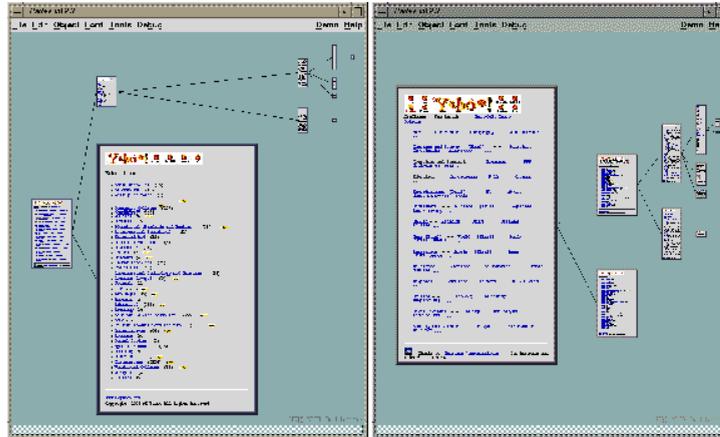


Web traversal history

PadPrints

Hightower et al
UIST '98

Video



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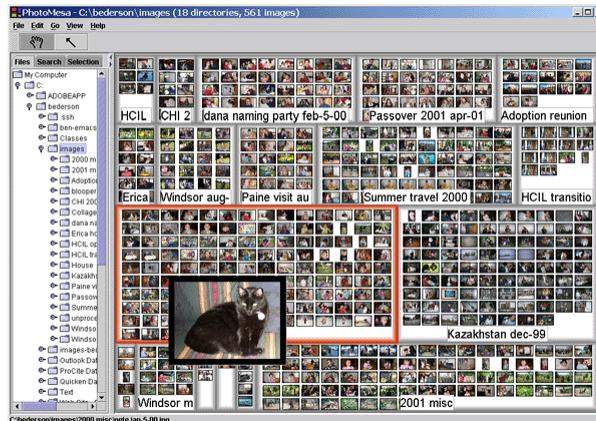
Browsing Images



PhotoMesa

Uses panning and zooming to browse a photo collection

Bederson
UIST '01



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

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Other Systems



- Let's see some other recent examples...

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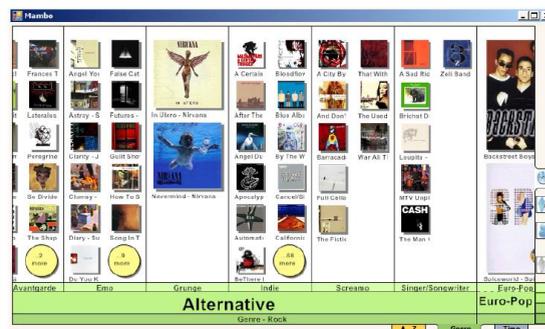
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FacetZoom



- Combine (hierarchical) facets with zooming UI for exploration



Video

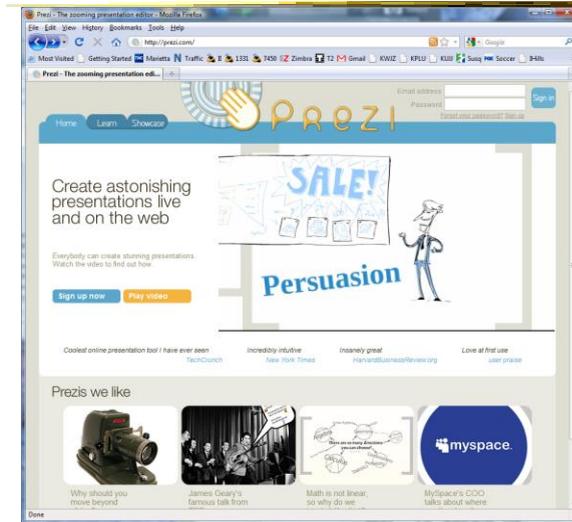
Dachsel et al
CHI '08

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Giving Presentations



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Zooming Reflections



Interview with Ben Bederson, CACM 55(12), Dec. '12, pp. 18-19

Regarding PhotoMesa: "I used all kinds of tricks to help you organize your images, but in the end it was not a good idea. It has this essential problem that its goal was to spatially organize tens of thousands of images, but nobody wants to do that."

ZUIs wanted to mimic spatial organization, such as people do on their desks. Bederson says, "But the reality is people don't have 10,000 papers on their desks. You can't remember the position of 10,000 things. For these kinds of problems, you can't beat visual scanning of a one-dimensional list."

Regarding Prezi: "It's cool. The first time you see it you say 'Wow, this will change everything.' But there is little real benefit and a real cost." He says the cost comes from needing to sit thru the animated transitions, each of which takes a small amount of time. "It's a lot of distraction that ultimately annoys people."

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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

Confound



Devices with even smaller screens are becoming more popular!



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An Example



Overview and detail (from *Civilization V* game)

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Survey of Techniques



- Application concern: viewing and editing large images
- Expanding the notion of the one dimensional scroll bar: zooming, diagonal panning, multiple detailed views
- List of visualization/interaction solutions...

Plaisant et al
IEEE Software '95

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1. Detail-only



- Single window with horizontal and vertical panning
- Works only when zoom factor is relatively small
- Example: Windows



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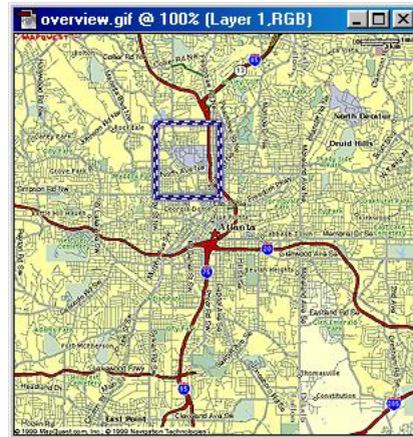
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2. Single window with zoom and replace



- Global view with selectable zoom area which then becomes entire view
- Variations can let users pan and adjust zoomed area and adjust levels of magnification
- Context switch can be disorienting
- Example: CAD/CAM



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3. Single coordinated pair



- Combined display of the overview and local magnified view (separate views)
- Some implementations reserve large space for overview; others for detail
- Issue: How big are different views and where do they go?



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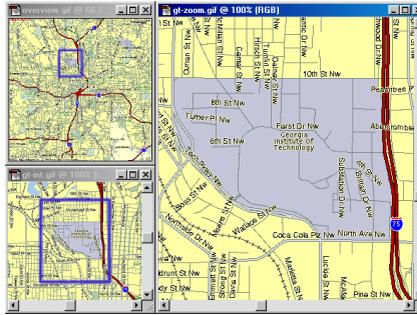
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4. Tiled multilevel browser



- Combined global, intermediate, and detail views
- Views do not overlap
- Good implementations closely relate the views, allowing panning in one view to affect others



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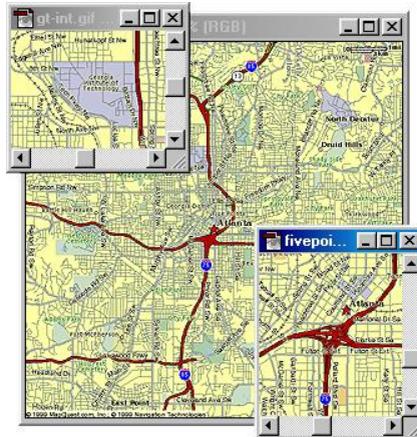
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5. Free zoom and multiple overlap



- Overview presented first; user selects area to zoom and area in which to create detailed view
- Flexible layout, but users must perform manual window management



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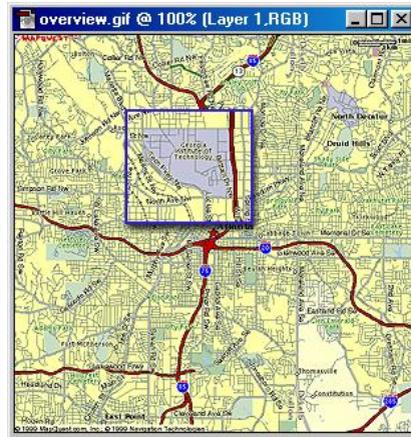
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6. Bifocal magnified



- “Magnifying glass” zoomed image floats over overview image
- Neighboring objects are obscured by the zoomed window



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7. Fish-eye view



- Magnified image is distorted so that focus is at high magnification, periphery at low
- All in one view
- Distortion can be disorienting
- More details coming...



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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
 - (Recall Table Lens question?)
- Approaches?

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Two Main Approaches



- 0. Interactive display (add scrolling)
 - Is it still an overview?
- 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

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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

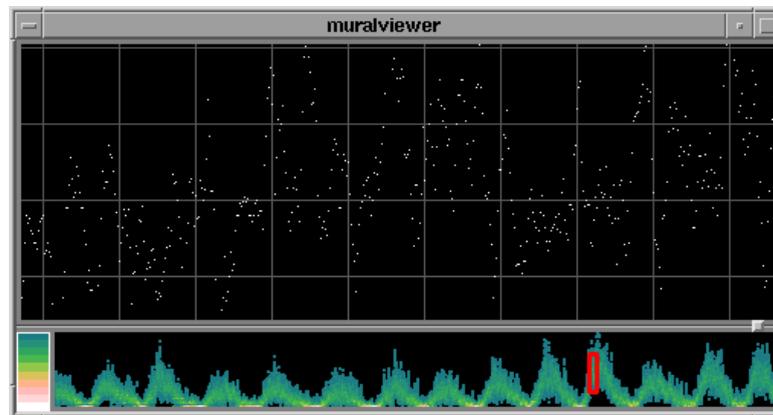
Jerding and Stasko
InfoVis '95, *IEEE TVCG* '98

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Mural Example



Sunspot activity over 150 years

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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

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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

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Prototypical Example



- When people think about focus+context views, they typically think of the *Fisheye View* (distortion)
- Introduced by George Furnas in 1981 report, more famous article is 1986 SIGCHI paper

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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 }
```

Furnas
CHI '86

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

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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



Why is it called Fisheye?



- Fisheye Camera Lens

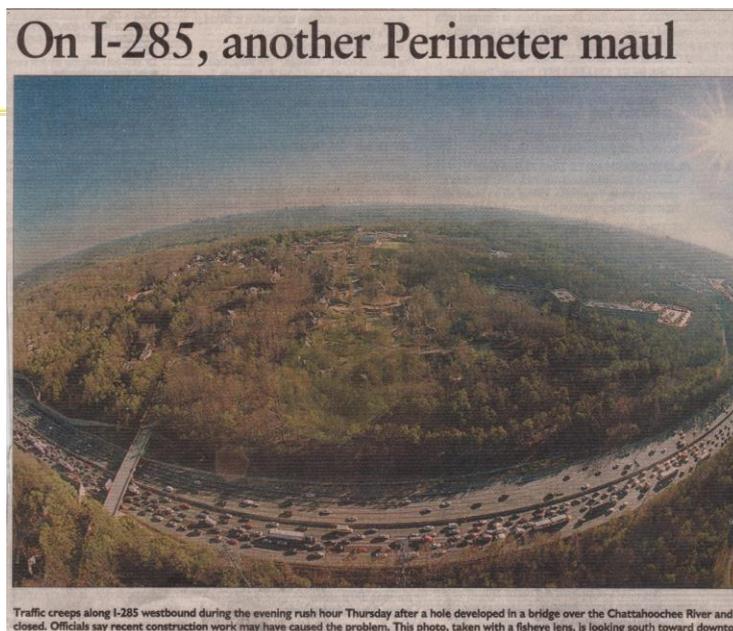
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Real fisheye
camera lens

Atlanta Journal



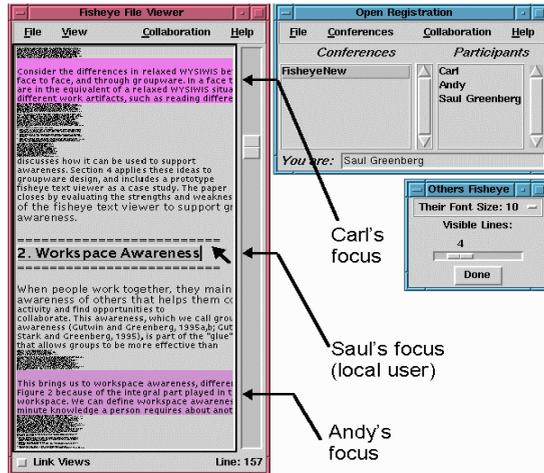
Traffic creeps along I-285 westbound during the evening rush hour Thursday after a hole developed in a bridge over the Chattahoochee River and the road was closed. Officials say recent construction work may have caused the problem. This photo, taken with a fisheye lens, is looking south toward downtown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

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Applications



Shared text editor
for CSCW

Gutwin and Greenberg
HCI '96

Video

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Graphical Fisheye Views



- Apply fisheye techniques to 2D graph
- Experiment with a variety of distortion factors
- Interactive tool that allows user to browse display and change focus

Sarkar and Brown
CACM '94

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Graphical Fisheye Views

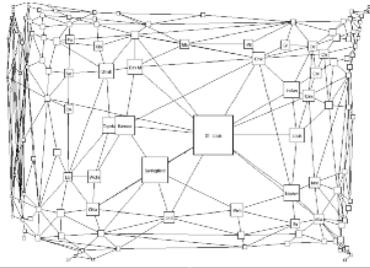


Figure 2: A fisheye view of the graph in Figure 1. The focus is on St. Louis. (The values of the fisheye parameters are $\beta = 5$, $\epsilon = 0$, $\epsilon = 0$, $VWcutoff = 0$; the meanings of these parameters are explained in Sections 4 and 6.)

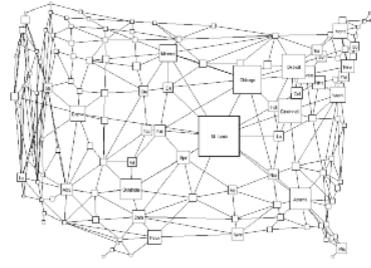


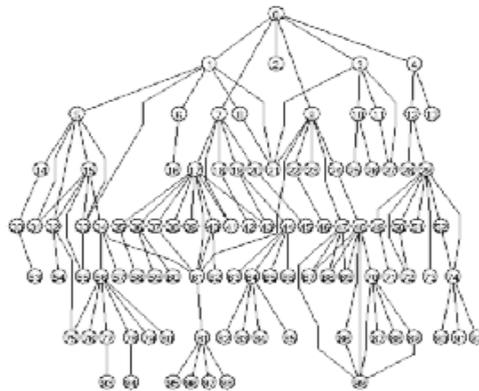
Figure 3: A fisheye view of the graph in Figure 1, with less distortion than in Figure 2. The values of the fisheye parameters are $\beta = 2$, $\epsilon = 0.5$, $\epsilon = 0.5$, $VWcutoff = 0$.

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Example



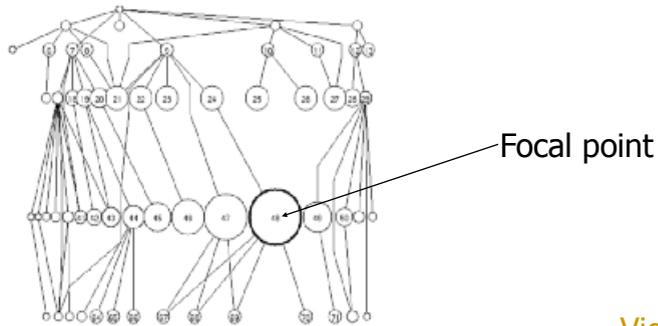
Original

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Example



Video

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Fisheye Terminology



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

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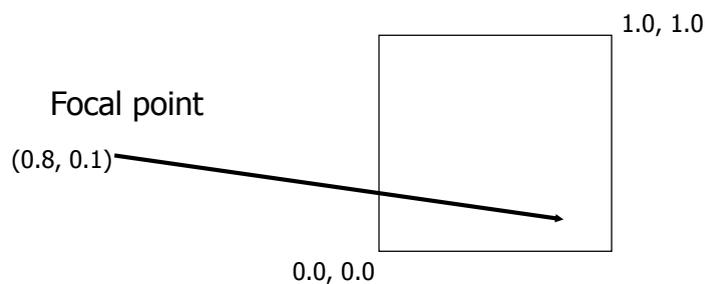
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Focal Point



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



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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

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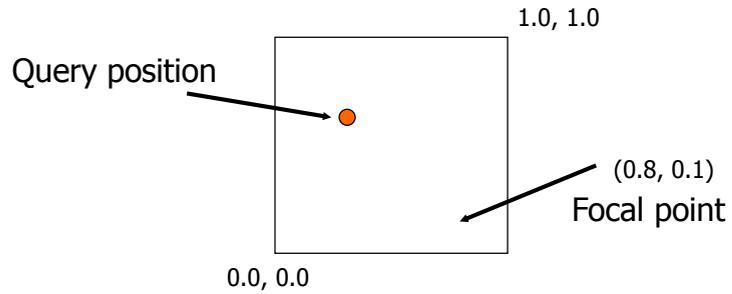
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Distance from Focus



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



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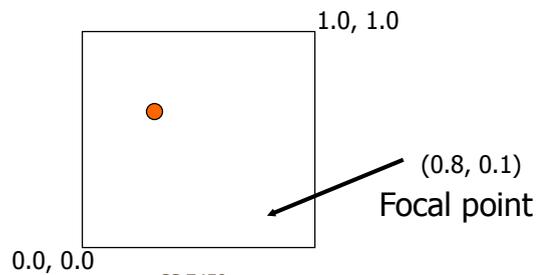
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Degree of Interest Function



- Function that determines how items in display are rendered

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



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Dof 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

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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

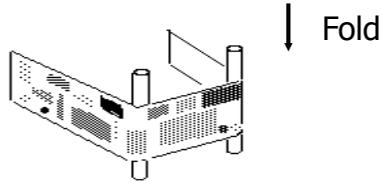
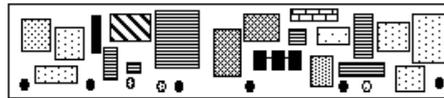
Spence & Apperly
BIT '82

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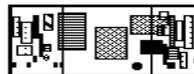
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Bifocal Display



↓ Project

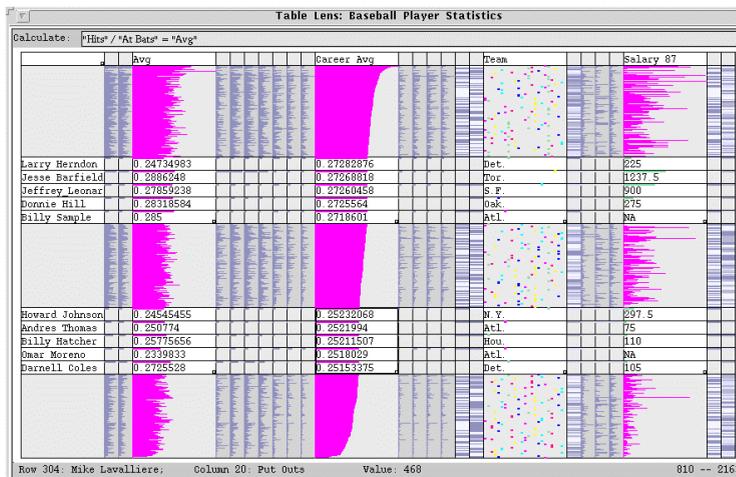


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Table Lens



From Xerox PARC and Inxight

A bifocal display

Rao & Card
CHI '94

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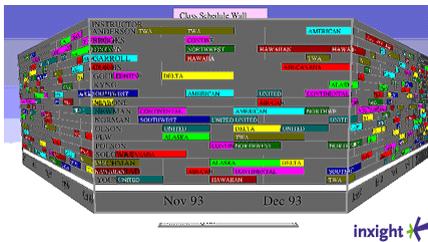
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Perspective Wall



- Computerized, automated 3D implementation of Bifocal display
- Map work charts onto diagram, x-axis is time, y-axis is project



Mackinlay, Robertson, Card
CHI '91

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Fisheye Application



- The Problem
 - Menus have too many items
 - Especially a menu of data items (fonts)
 - Scrolling arrows & bars
 - Hierarchical groups

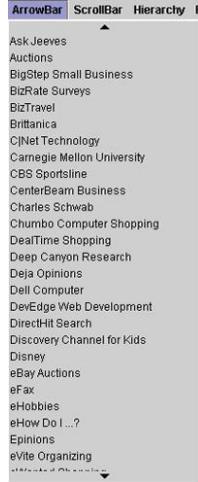
Bederson
UIST '00

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Existing Options



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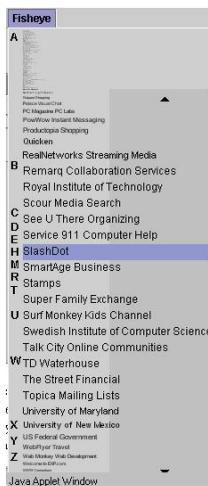


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Fisheye Menus



- Dynamically change size of menu item & provide focus area around the pointer
- Items near cursor displayed at full size
- Items further away on either side are smaller
- Uses a distortion function so items will always fill menu

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Focus Lock



- Problem of small movements resulting in change in focus
- Focus lock by moving to the right side of menu
- Focus region is highlighted and pointer can move up & down selecting within this area
- Moving above or below the region on the right increases the area of the region
- Controls the trade-off between number of items at full size versus those rendered smallest

Demo:

<http://www.cs.umd.edu/hcil/fisheyemenu>

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Apply to 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

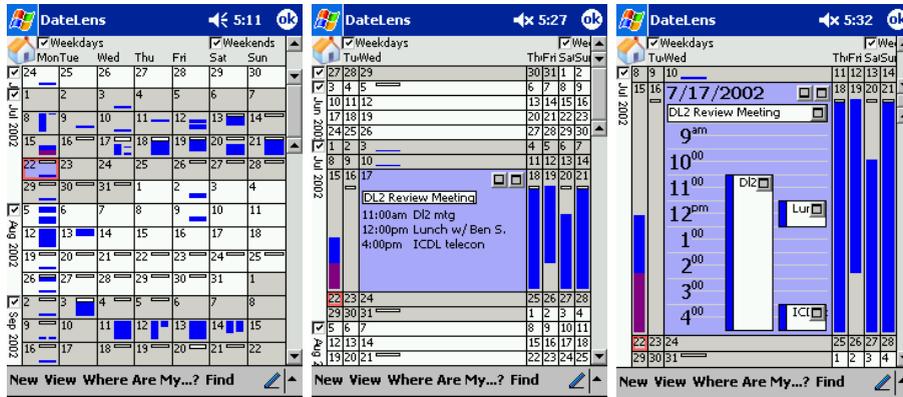
Bederson et al
ACM ToCHI '04

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Different Perspectives



Month view

Zooming to a week

Zooming to a day

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Video

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Panacea?



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

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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!

Nice Review



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A Review of Overview+Detail, Zooming, and Focus+Context Interfaces

ANDY COCKBURN
University of Canterbury

and

AMY KARLSON and BENJAMIN B. BEDERSON
University of Maryland

There are many interface schemes that allow users to work at, and move between, focused and contextual views of a dataset. We review and categorize these schemes according to the interface mechanisms used to separate and blend views. The four approaches are overview+detail, which uses a spatial separation between focused and contextual views; zooming, which uses a temporal separation; focus+context, which minimizes the seam between views by displaying the focus within the context; and cue-based techniques which selectively highlight or suppress items within the information space. Critical features of these categories, and empirical evidence of their success, are discussed. The aim is to provide a succinct summary of the state-of-the-art, to illuminate both successful and unsuccessful interface strategies, and to identify potentially fruitful areas for further work.

Categories and Subject Descriptors: D.3.2 [Software Engineering]: Design Tools and Techniques—User interfaces; H.5.2 [Information Interfaces and Presentation]: User Interfaces—Graphical user interfaces (GUI)

General Terms: Human Factors

Additional Key Words and Phrases: Information display, information visualization, focus+context, overview+detail, zoomable user interfaces, fisheye views, review paper

ACM Reference Format:
Cockburn, A., Karlson, A., and Bederson, B. B. 2008. A review of overview+detail, zooming, and focus+context interfaces. *ACM Comput. Surv.* 41, 1, Article 2 (December 2008), 31 pages. DOI = 10.1145/1456650.1456652 <http://doi.acm.org/10.1145/1456650.1456652>

Learning Objectives



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- Explain components of fisheye view and how its equation is calculated
- Describe different fisheye data visualization applications
- Understand limitations of fisheye approach

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Reading



- Cockburn et al, '08
- Watch videos
 - Powers of 10
 - PhotoMesa
 - Fisheye Views of Graphs

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HW 4



- Questions?
- Most time-consuming one, so plan ahead
- Due two weeks from today

Project Advice



- Work on design ideas (variety!)
 - Poster session one week from today
 - Minimum to show: 2 innovative single designs and 2 coordinated multi-view designs
- Should have your data
 - Work on getting it into a usable form

Upcoming



- User Tasks & Analysis
- Poster session

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References



- Spence and CMS books
- All referred to articles
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<http://www.civ2.com>
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- http://www.cpsc.ucalgary.ca/group/lab/papers/1996/96-Fisheye.GI/gi96_fisheye.html

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