

Information Visualization In Practice

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

James Tam

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.

James Tam

Too Much Information To Show All At Once



James Tam

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/>

James Tam

Too Much Information To Show All At Once

Approaches to the problem:

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

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1) Scrolling



Scrolling along one dimension



Scrolling in two dimensions

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2) Magnification: Inline

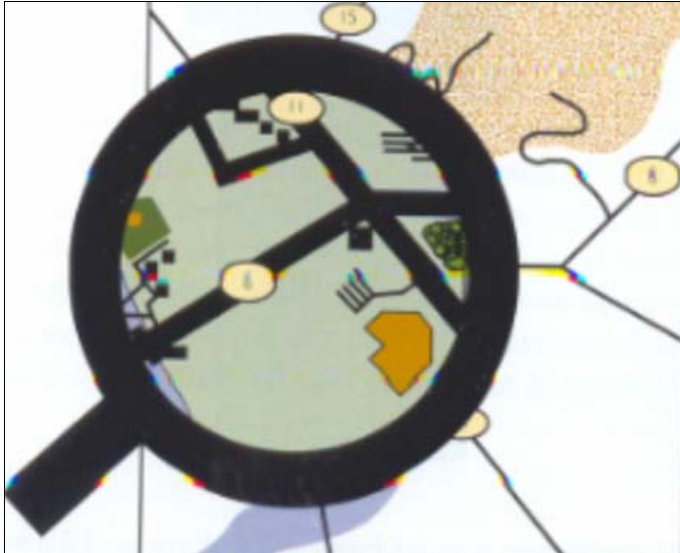


Image from "Information Visualization" by Robert Spence

James Tam

2) Magnification: Inline

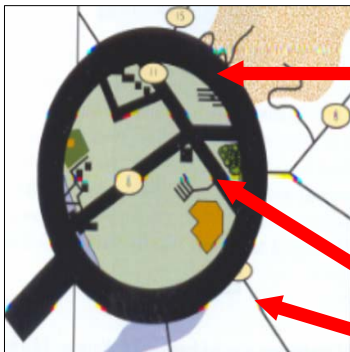


Image from "Information Visualization"
by Robert Spence

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.

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2) Magnification: Mutually Exclusive



Icewind Dale © Interplay productions

James Tam

2) Magnification: Mutually Exclusive



Icewind Dale © Interplay productions

James Tam

3) The DragMag

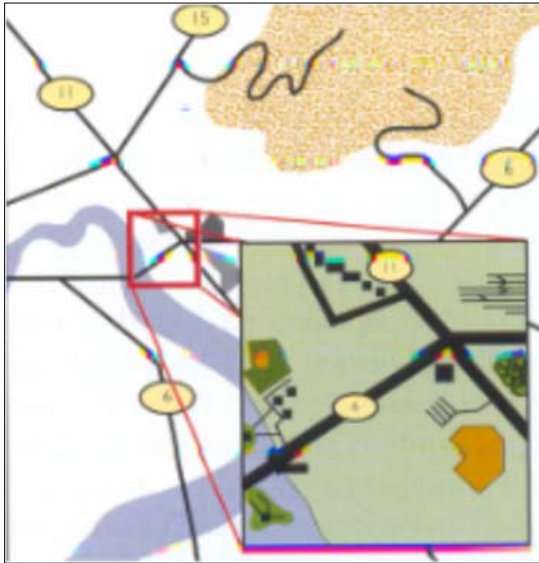


Image from "Information Visualization" by Robert Spence

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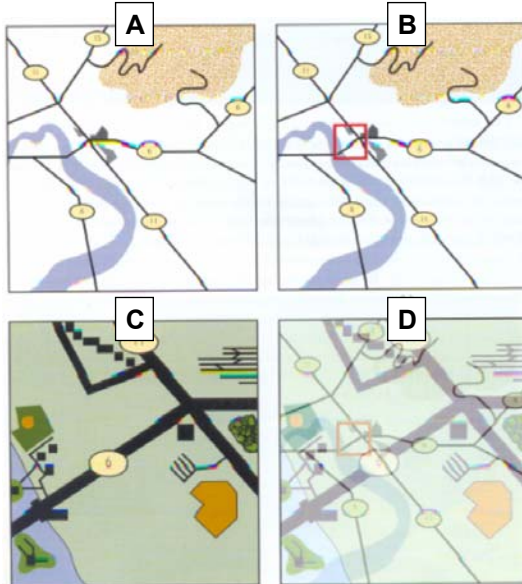
3) The DragMag



Image from "Information Visualization" by Robert Spence

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4) 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

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4) Transparent Overlays



Diablo © Blizzard

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5) Overview And Detail: Separate



Overview



Detailed view

Images from "Information Visualization" by Robert Spence

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5) Overview And Detail: Separate

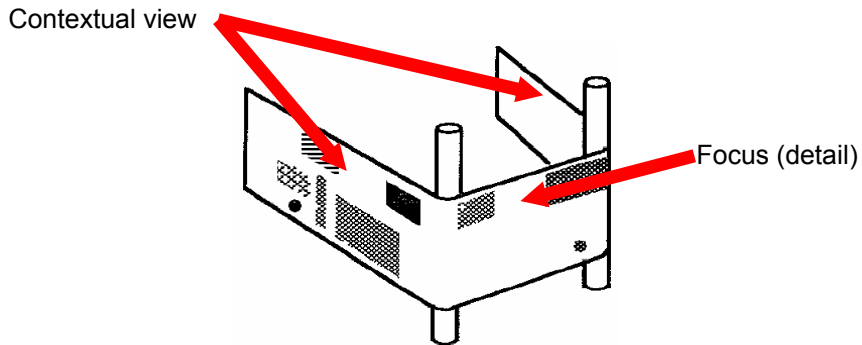


Defender © Midway Home Entertainment Ltd.

James Tam

6) Focus And Context

- Again the amount of the information is too large to display all at once.
- With this approach detailed view can still be viewed within its surrounding context.



Leung and Apperly TOCHI'94

James Tam

The Fisheye Lens: Photography

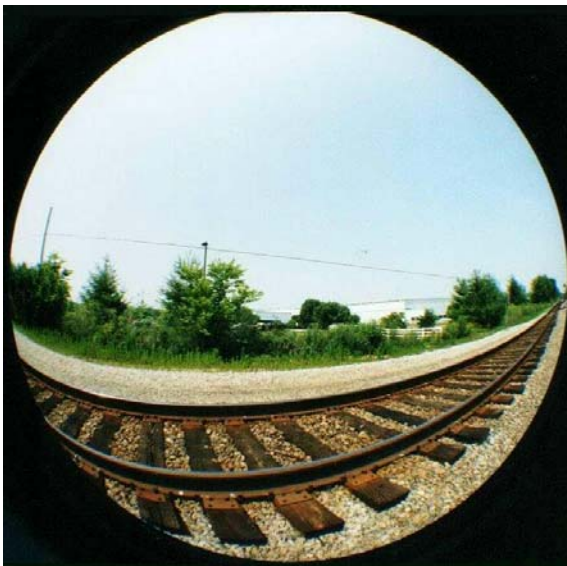
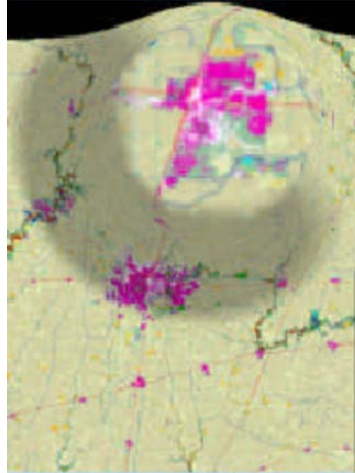
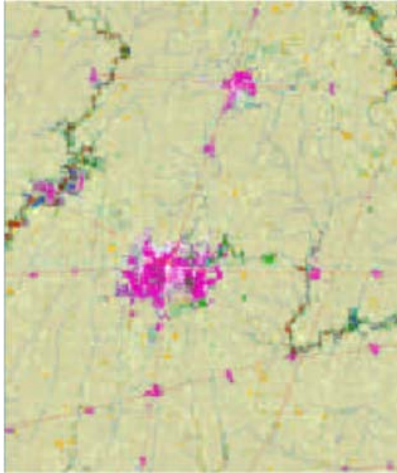


Image from: http://rick_oleson.tripod.com/

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Fisheye View: Information Visualization

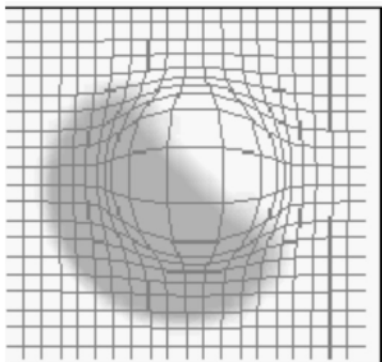
An application of the focus and context approach



James Tam

Fisheye View: Visual Cues For The Distortion

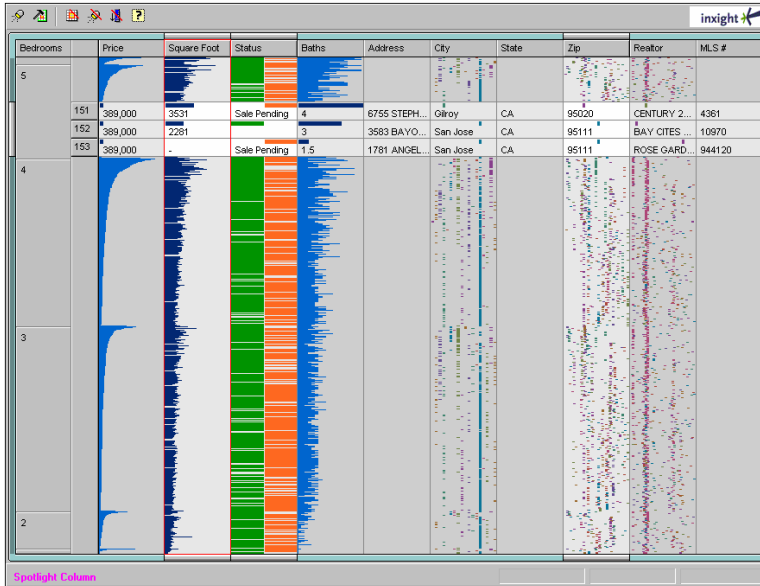
Distortion is understandable through the use of a grid and shading



James Tam

Table Lens

Housing Market for Santa Clara County, CA - March 2000



James Tam

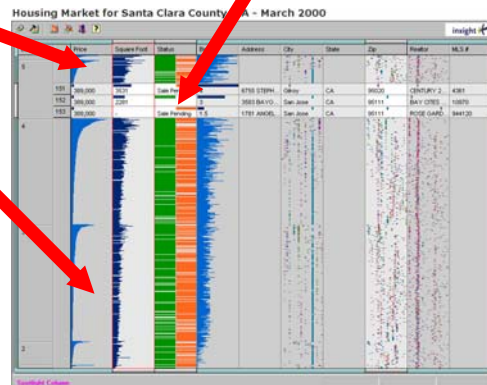
Table Lens

Overview:

- Show all the information in an abstracted graphical form

Focus:

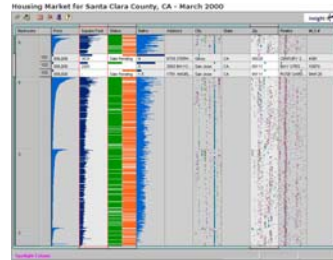
- Show all the details of only a subset of the data.



James Tam

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



James Tam

Focus And Context: Distortion In One Dimension

- Distortion in the X-dimension

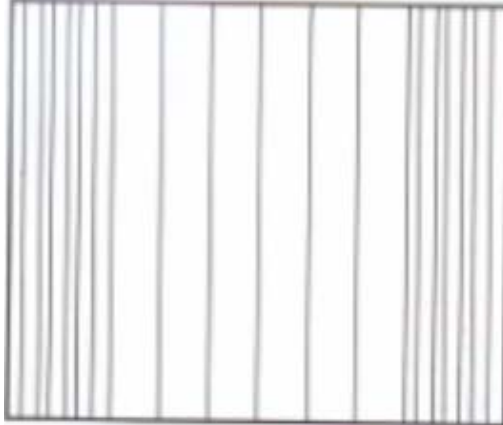
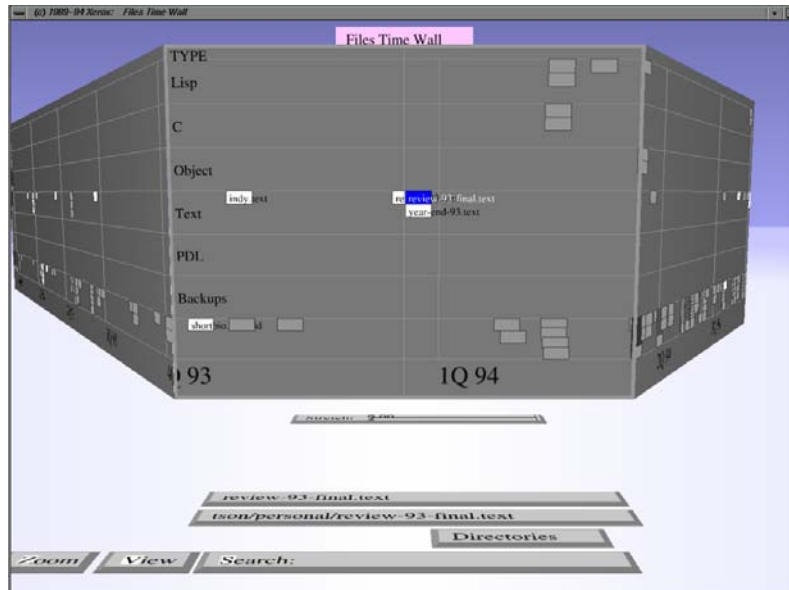


Image from "Information Visualization" by Robert Spence

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The Perspective Wall



Mackinlay / Robertson / Card: Proc ACM CHI'91

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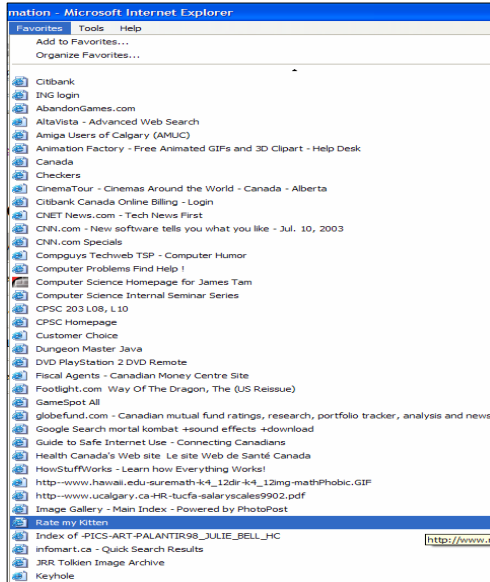
Another Example Of The “Large Data Set – Limited Display Space Problem” : Lists

Approaches to mitigating the problem:

- Scrolling
- Setting up hierarchies
- Fisheye

James Tam

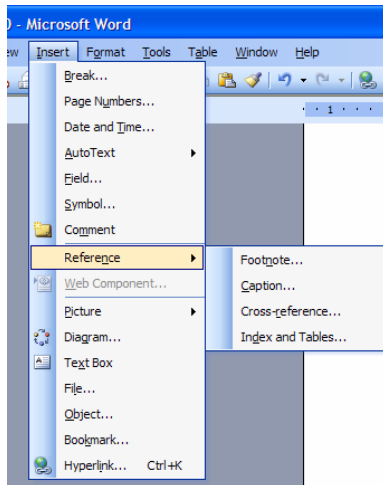
Scrolling Menus



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Hierarchical Menus

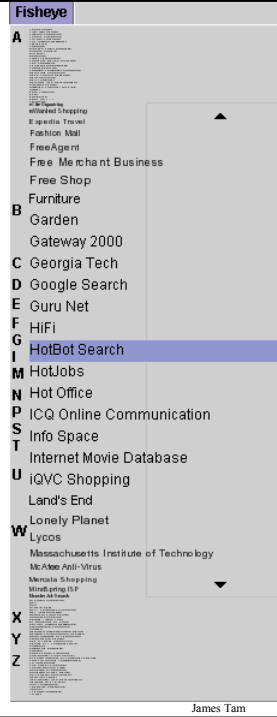
Works well for goal directed tasks (e.g., selecting from a menu of functions that are familiar).



Word © Microsoft

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Fisheye Menus

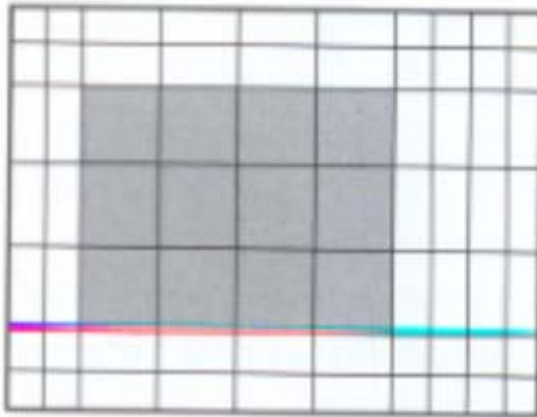


Bederson, B.B. (May 2000)
 University of Maryland
www.cs.umd.edu/hcil/fisheyemenu/

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Focus And Context: Distortion In Two Dimensions

•Distortion in both the X and Y dimensions



Images from "Information Visualization" by Robert Spence

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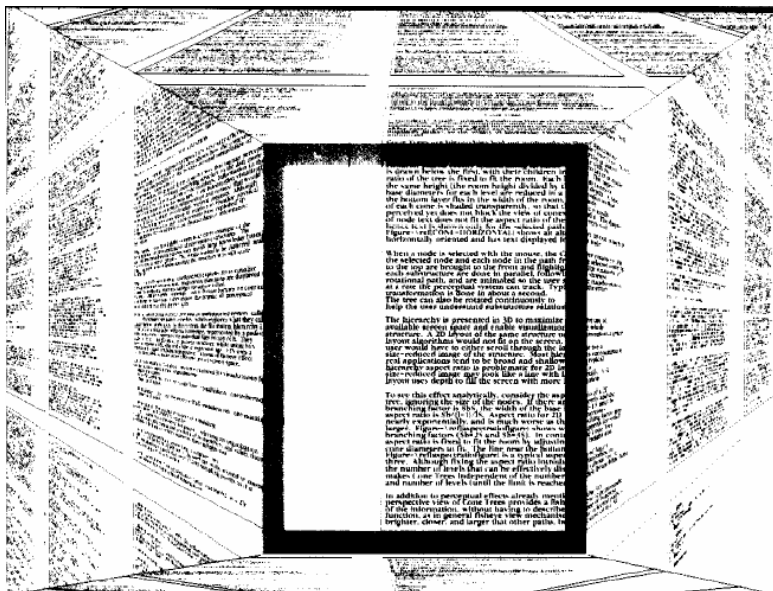
Distortion In Two-Dimensions: A Calendar System

Mar	April	May	June	July	Aug	Sept	Oct
				11 Sun Check slides, notes Family barbeque			
				12 Mon Fly LA Kathy to airport Model Maker			
				13 Tue			
				14 Wed			
				15 Thur			
				16 Fri Flight to SFO Tutorial set-up Tutorial United flight Heathrow Pointer Color OHs Jane + Jonh Call Kathy			
				17 Sat Fly LHR Kathy to collect Chapter 2/see Dave March			

Image from "Information Visualization" by Robert Spence

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DocumentLens



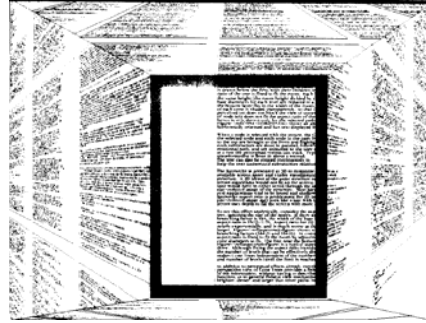
Robertson / Mackinlay ACM UIST 1993

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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.



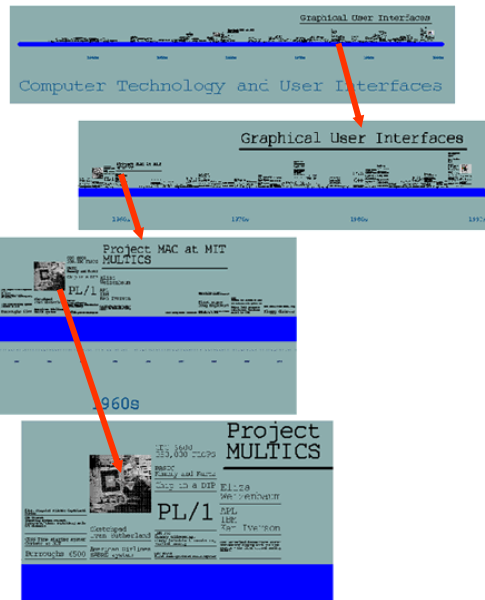
DocumentLens:

- 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.

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7) 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

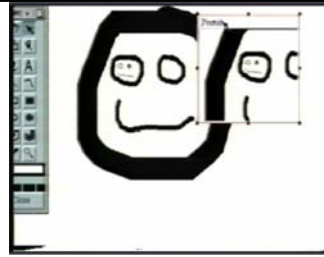
<http://java.sun.com/features/2001/08/photomesa.html>

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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

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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. Filtering**
- C. Semantic zooming**

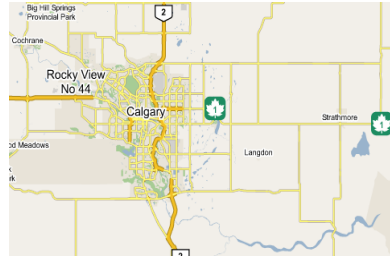
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A. Aggregation

Aggregation – combine information into some compact yet meaningful way



Zoomed out



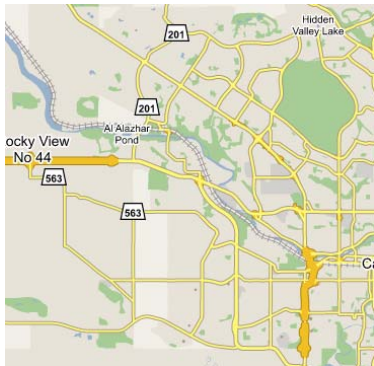
Zoomed in

Images from Google Maps: <http://maps.google.com/>

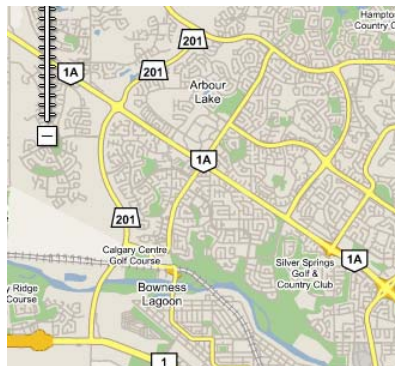
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B. Filtering

Block the appearance of some of the information



Zoomed out



Zoomed in

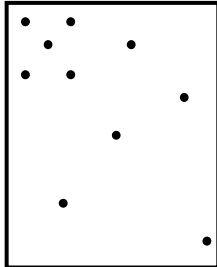
Images from Google Maps: <http://maps.google.com/>

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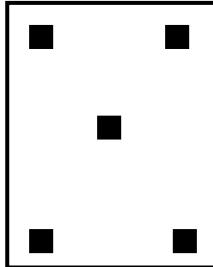
C. Semantic Zooming

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

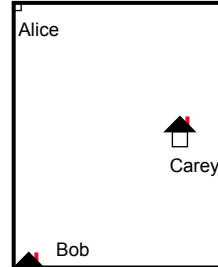
X2



X4



X8



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Visual Information-Seeking Mantra

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

Dynamic Queries: HomeFinder



The yellow dots above are homes in the DC area for sale. You may get more information on a home by selecting it. You may drag the 'A' and 'B' distance markers to your office or any other location you want to live near. Select distances, bedrooms, and cost ranges by dragging the corresponding slider boxes on the right. Select specific home types and services by pressing the labeled buttons on the right.

Dynamic HomeFinder

Reset Quit

Save Print

Dist to A: 1 30

Dist to B: 1 30

Bedrooms: 1 7

Cost: \$50k \$500k

Look at: Hse TH Cnd

Features: Grg Fp1 CAC New

Shneiderman et al University of Maryland <http://www.cs.umd.edu/hcil/spotfire/>

James Tam

HomeFinder: The Details

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

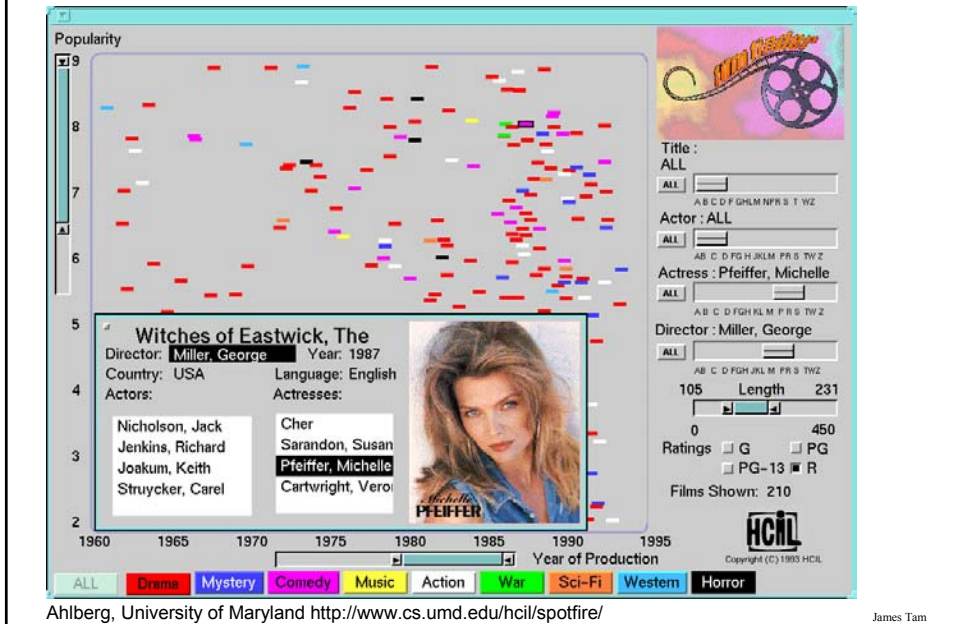
Details on Demand

- Additional information can be provided about each query result



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Starfield Display: FilmFinder



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 data base can be viewed and manipulated on one screen with meaning attached to each dimensions.
- Tight coupling of interface components (to the state of the system)

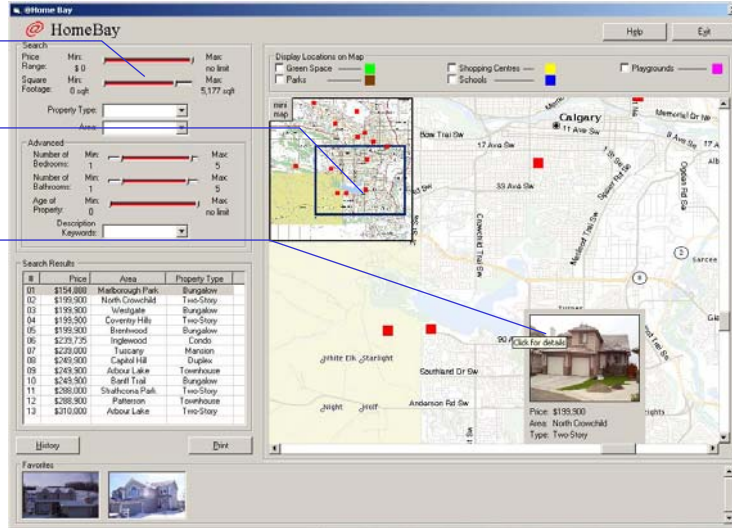


A Student Project: HomeBay

Dynamic Queries

Radar Overview

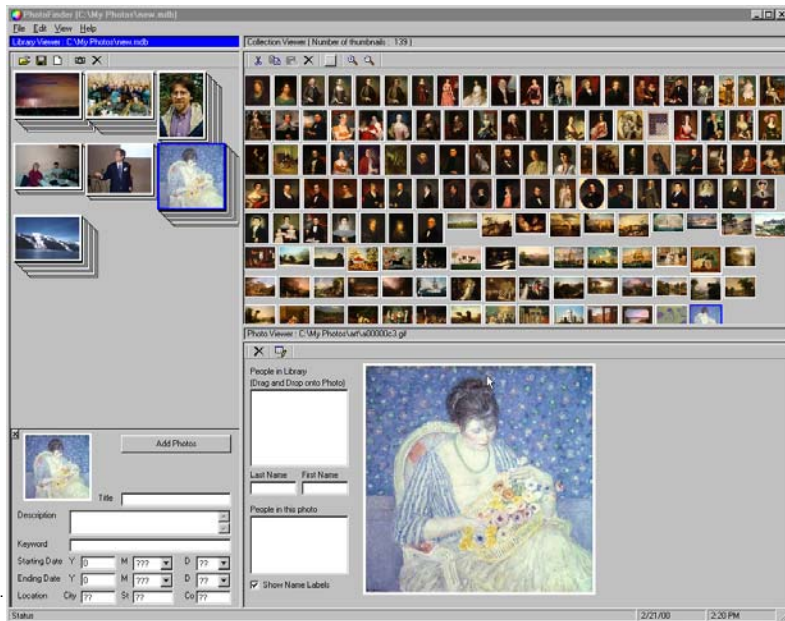
Progressive details on demand



481 Student Project (April, 2000) Rob Pearson, Kashama Willms and James Chisan

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PhotoFinder



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

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PhotoFinder: The Details

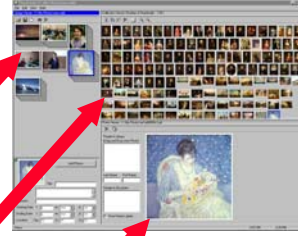
Multiple Views Of A Large Data Set Set:

- 3 levels of detail

Library view

Collection
view

Photo view



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PhotoFinder: The Details (2)

Allows for the annotation of each photo with pertinent information ("tagging")

A detailed screenshot of the annotation form in the PhotoFinder application. The form is titled 'PhotoFinder' and contains several input fields and sections. On the left, there is a small thumbnail of a photo and an 'Add Photos' button. Below this are fields for 'Title', 'Description', 'Keyword', 'Starting Date' (with Year, Month, and Day dropdowns), 'Ending Date' (with Year, Month, and Day dropdowns), 'Location' (with City, State, and Country dropdowns), and 'Status'. On the right side, there is a section titled 'People in Library [Drag and Drop onto Photo]' with a list box. Below that are 'Last Name' and 'First Name' input fields, another 'People in this photo' list box, and a checkbox labeled 'Show Name Labels'.

James Tam

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

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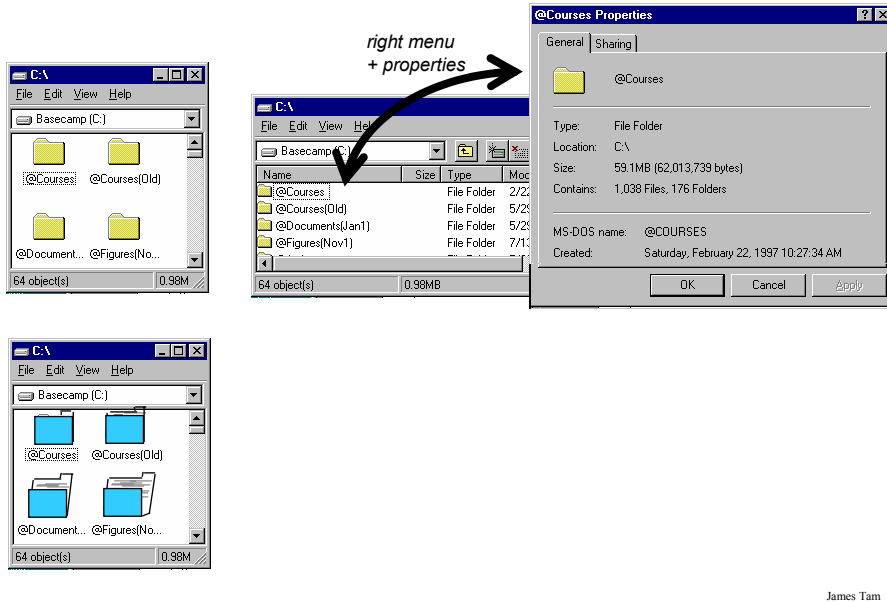
Representing Phone Network Connections



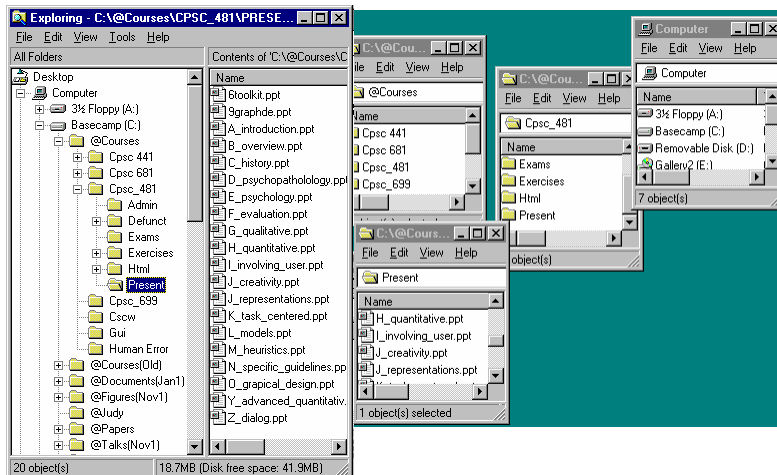
Images from "Information Visualization" by Robert Spence

James Tam

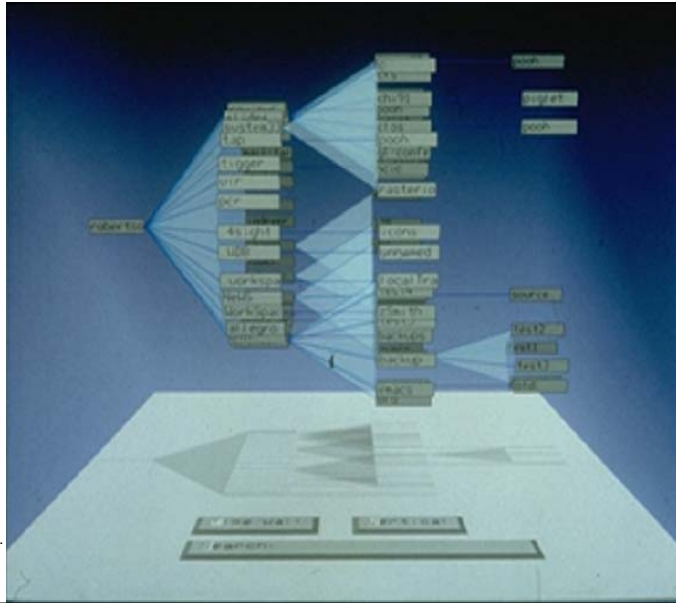
Which Folder Has The Most Documents?



Where Am I? Where Was I Going?



Cone Trees

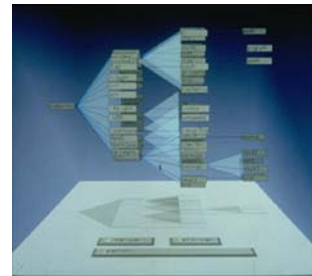


Robertson / Mackinlay /
Card
Cone Trees: Animated
3D Visualizations of
Hierarchical Information.
Proc ACM CHI'91

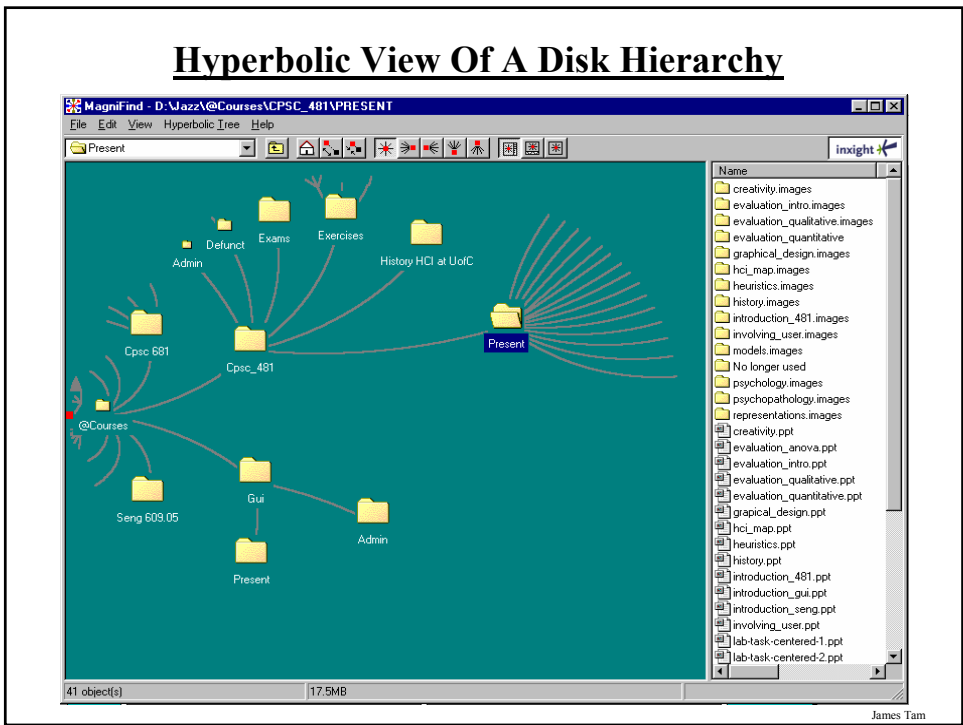
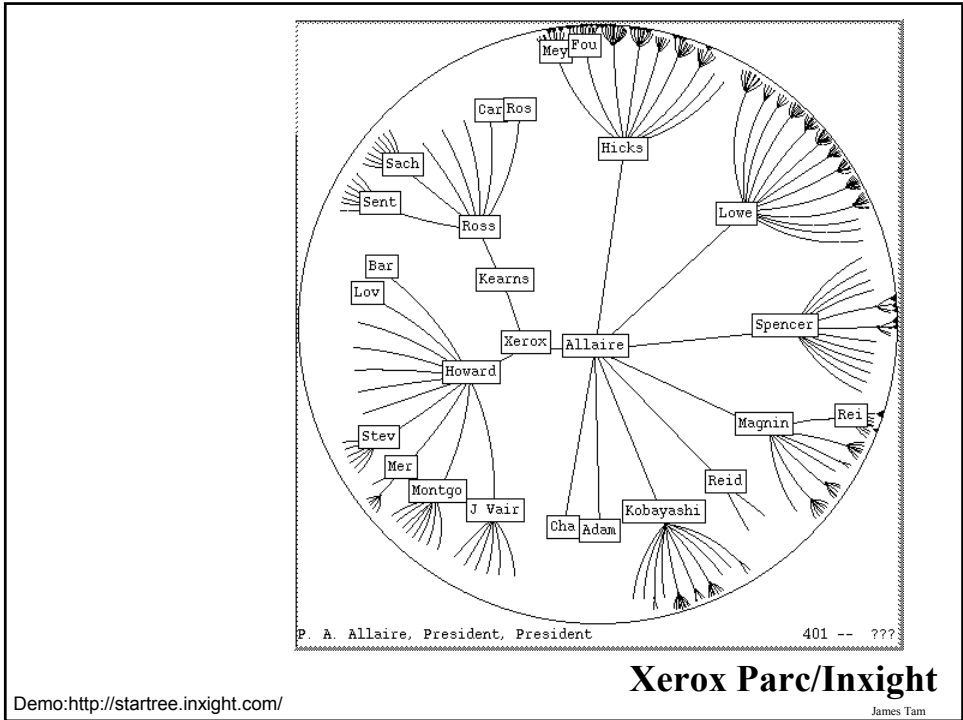
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Cone Trees: The Details

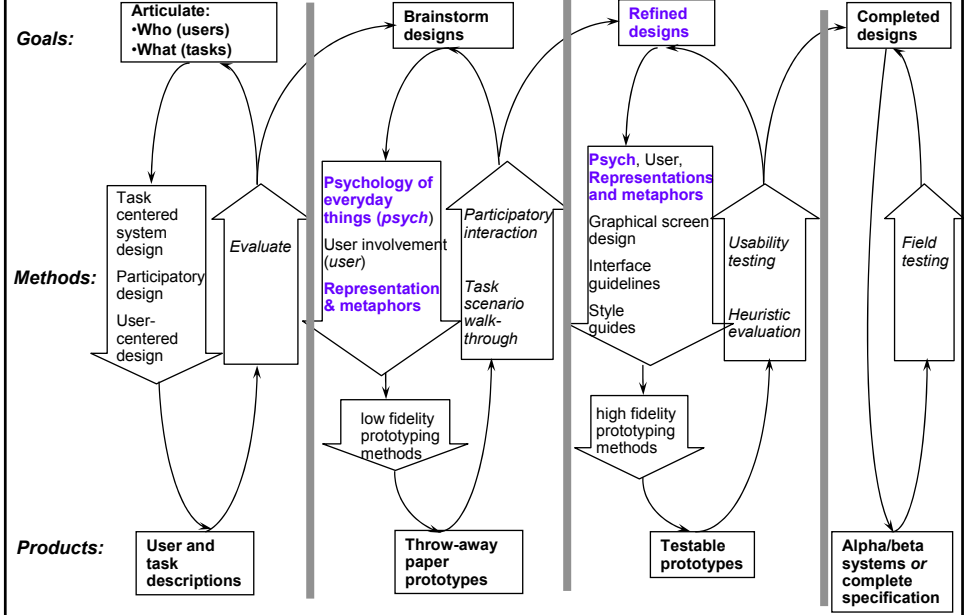
- **Employs 3D in order to more efficiently represent the data and their relationships.**
 - Used to represent complex hierarchies
 - To mitigate the effect of occlusion transparency is employed
- **Fisheye effects are used to highlight nodes.**
- **Dynamic filtering of the tree.**
- **Animates the display to help the user to interpret results.**



James Tam



Interface Design And Usability Engineering



This diagram is a variation of the one presented by Saul Greenberg

James Tam