

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

James Tam

1) Scrolling



Scrolling along one dimension



Scrolling in two dimensions

James Tam

2) Overview And Detail: Separate



Overview



Detailed view

Images from "Information Visualization" by Robert Spence

James Tam

2) Overview And Detail: Separate



Defender © Midway Home Entertainment Ltd.

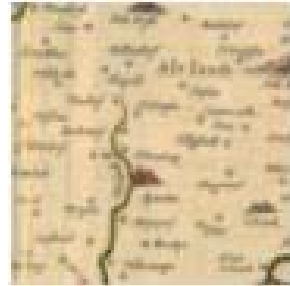
James Tam

2. Overview And Detail: Separate

Relating the detailed and overview can be a challenge:



Overview



Detailed view

James Tam

3) Magnification: Inline

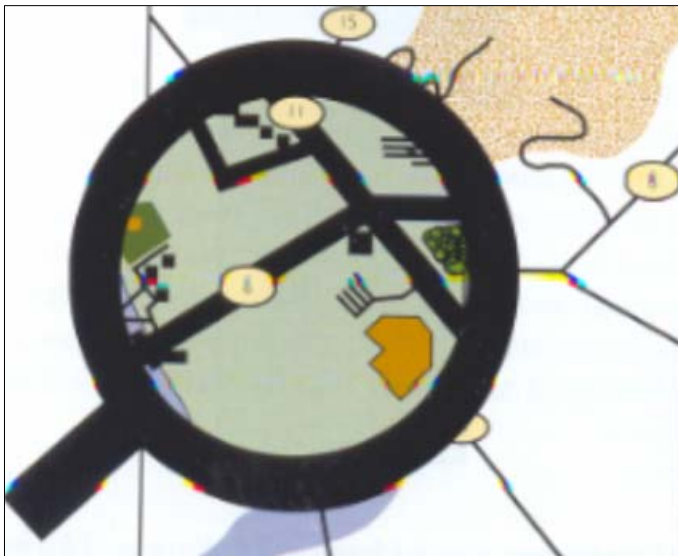


Image from "Information Visualization" by Robert Spence

James Tam

3) Magnification: Inline

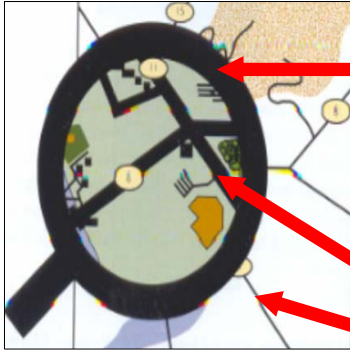


Image from "Information Visualization"
by Robert Spence

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.

James Tam

3) Magnification: Mutually Exclusive



Icewind Dale © Interplay productions

James Tam

3) Magnification: Mutually Exclusive



Icewind Dale © Interplay productions

James Tam

4) The DragMag

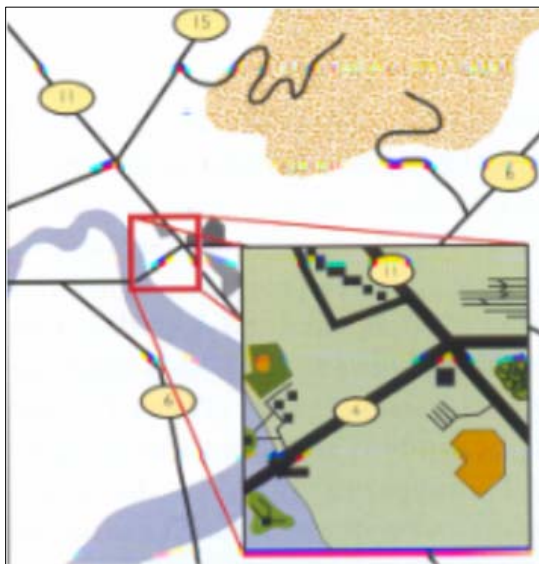


Image from "Information Visualization" by Robert Spence

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4) The DragMag



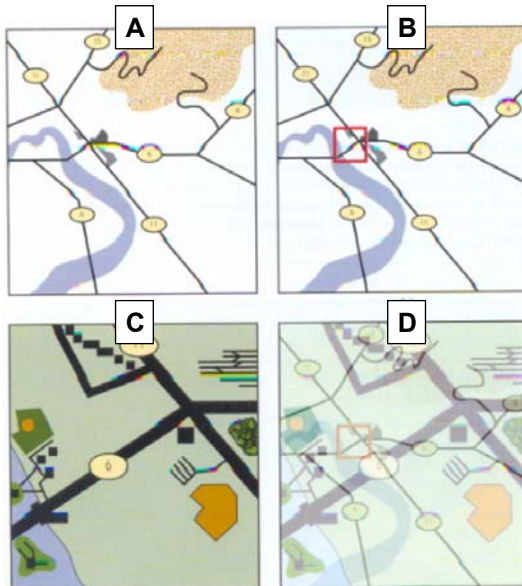
Contextual overview

Detailed view

Image from "Information Visualization" by Robert Spence

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5) Transparent Overlays



t9

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

James Tam

t9 Animate this so only a part appears at once.
tamj, 2/15/2006

5) Transparent Overlays

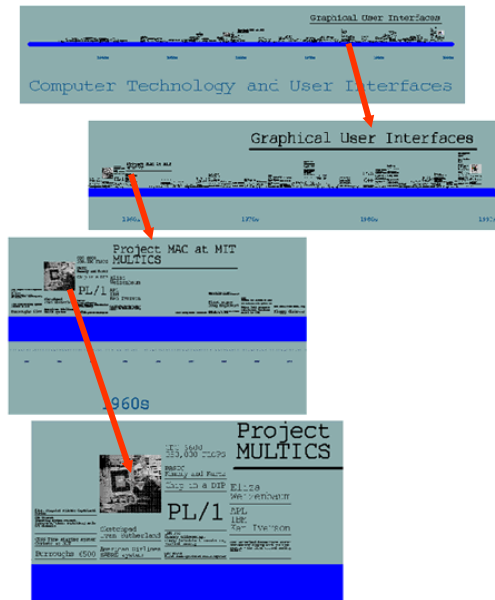


Diablo © Blizzard

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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

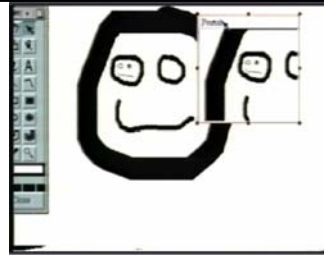
<http://java.sun.com/features/2001/08/photomesa.html>

James Tam

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

James Tam

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

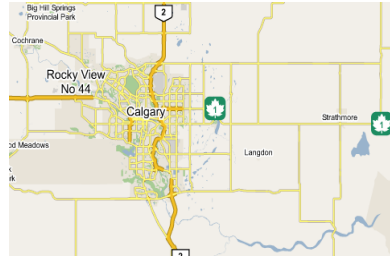
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A. Aggregation

Aggregation – combine information into some compact yet meaningful way



Zoomed out



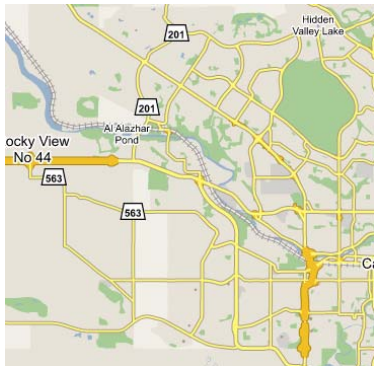
Zoomed in

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

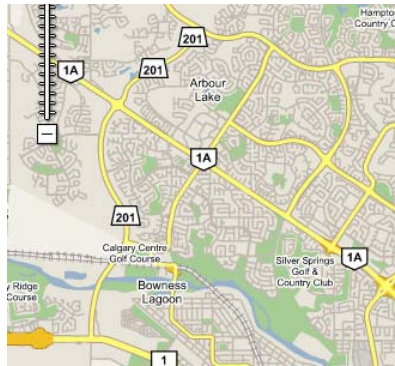
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B. Semantic Zooming

Block the appearance of some of the information



Zoomed out



Zoomed in

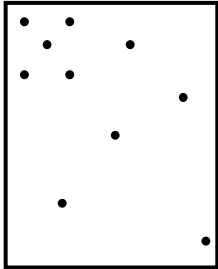
Images from Google Maps: <http://maps.google.com/>

James Tam

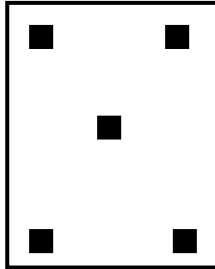
B. Semantic Zooming

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

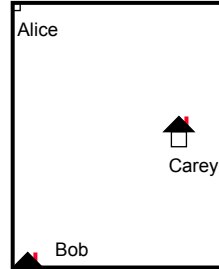
X2



X4



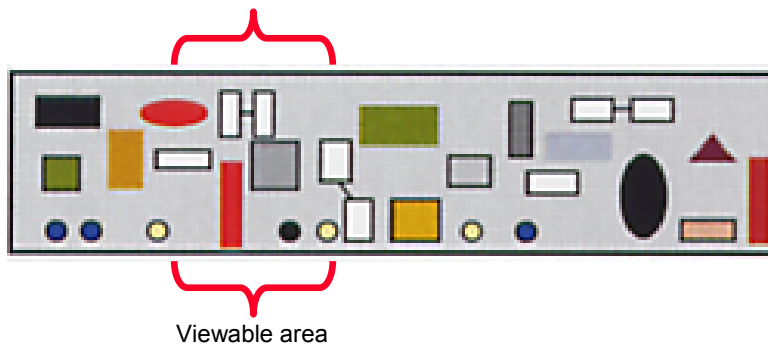
X8



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7. Focus And Context

• Again the amount of the information is too large to display all at once.

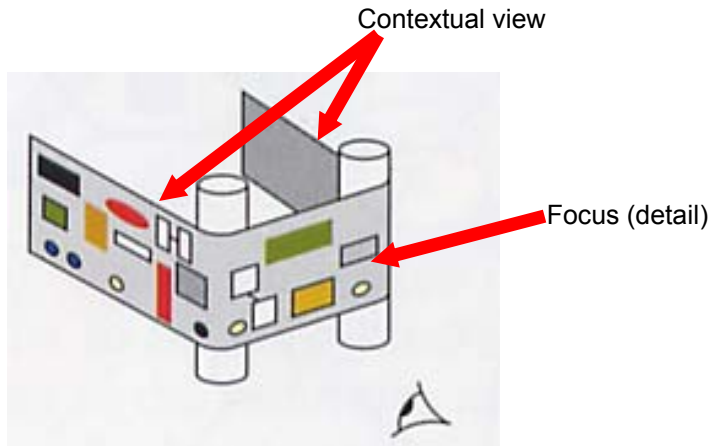


From "Information Visualization" by Robert Spence

James Tam

7) Focus And Context

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



From "Information Visualization" by Robert Spence

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The Fisheye Lens: Photography

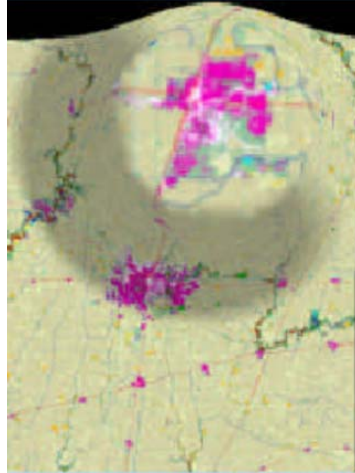
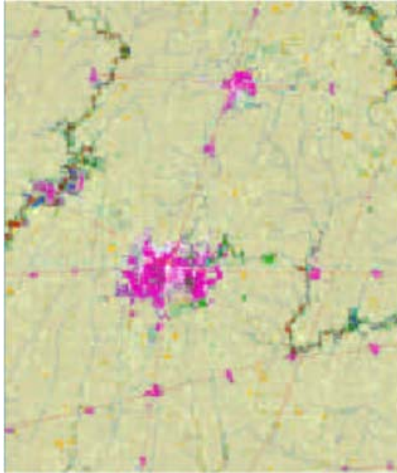


Image from: http://rick_oleson.tripod.com/

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Fisheye View: Information Visualization

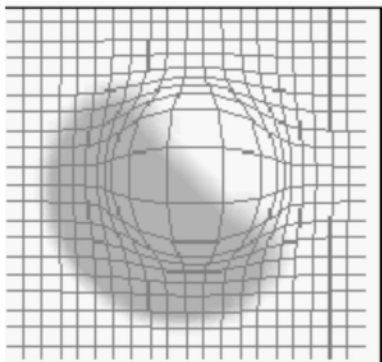
An application of the focus and context approach



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Fisheye View: Visual Cues For The Distortion

Distortion is understandable through the use of a grid and shading



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Focus And Context: Distortion In One Dimension

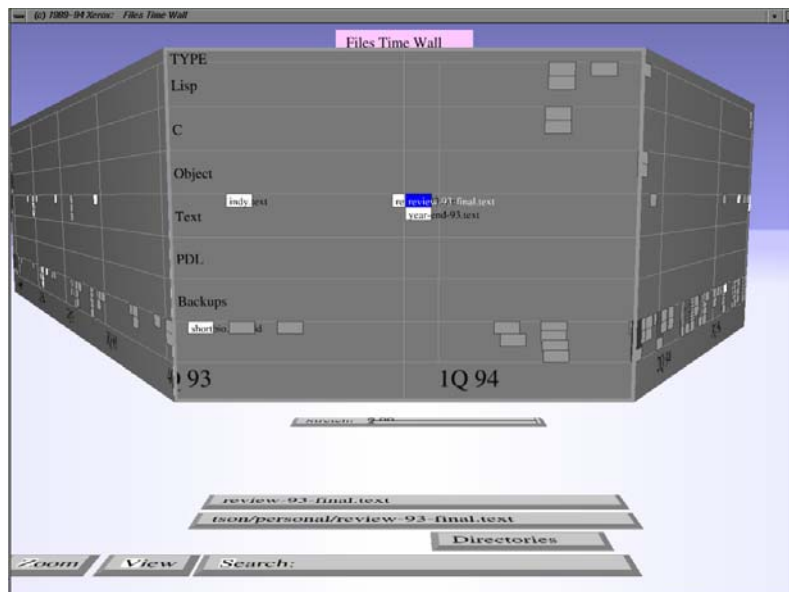
•Distortion in the X-dimension



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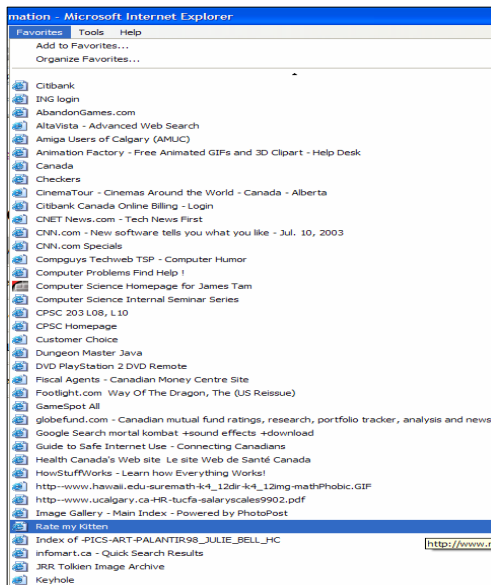
Another Example Of The “Large Data Set – Limited Display Space Problem” : Lists

Approaches to mitigating the problem:

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

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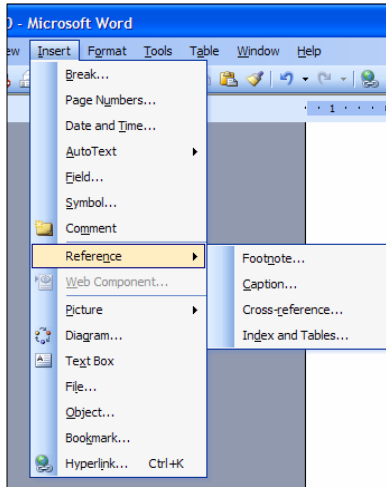
Scrolling Menus



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Hierarchical Menus

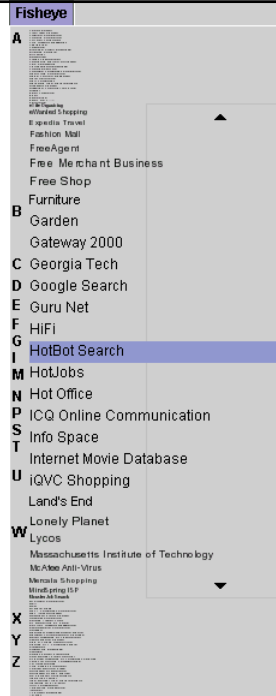
Works well for goal directed tasks (e.g., selecting from a menu of functions that are familiar).



Word © Microsoft

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Fisheye Menus

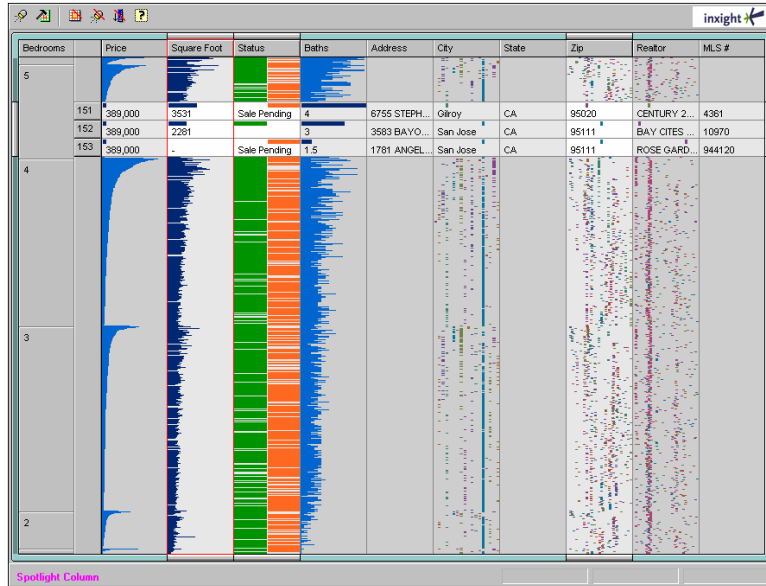


Bederson, B.B. (May 2000)
University of Maryland
www.cs.umd.edu/hcil/fisheyemenu/

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Table Lens

Housing Market for Santa Clara County, CA - March 2000



James Tam

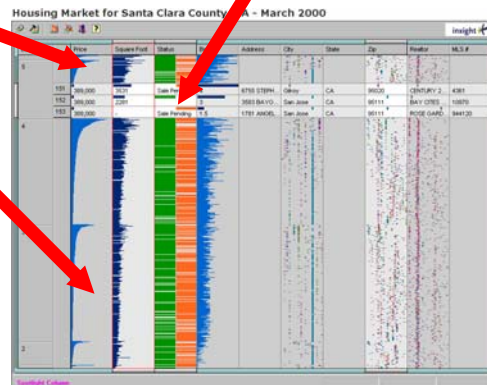
Table Lens

Overview:

- Show all the information in an abstracted graphical form

Focus:

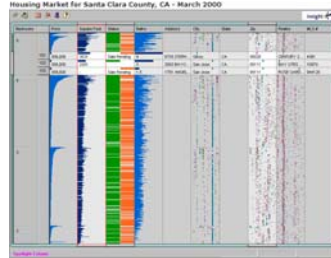
- Show all the details of only a subset of the data.



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Table Lens : The Details

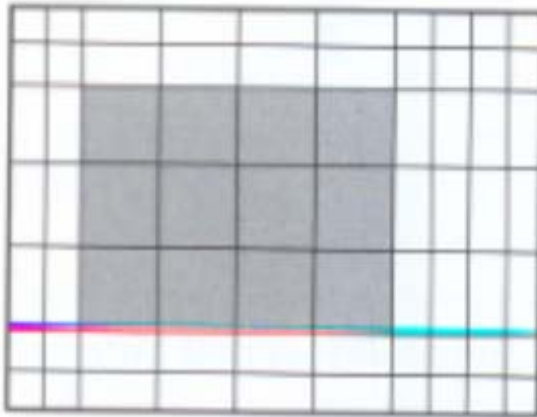
- Abstracts a large volume of data into a small space.
- The overview may allow the user to spot:
 - Trends
 - Patterns
 - Outliers
- Details are provided on demand
- The data can be manipulated



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Focus And Context: Distortion In Two Dimensions

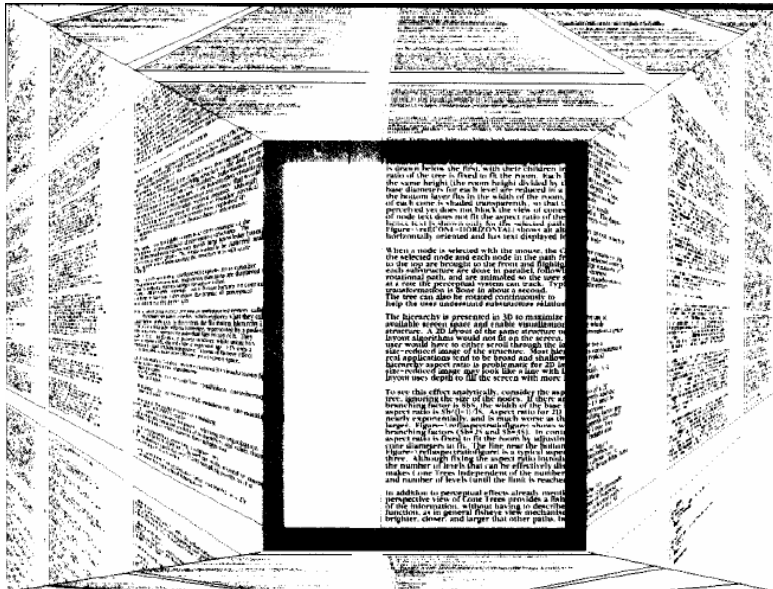
- Distortion in both the X and Y dimensions



Images from "Information Visualization" by Robert Spence

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DocumentLens



Robertson / Mackinlay ACM UIST 1993

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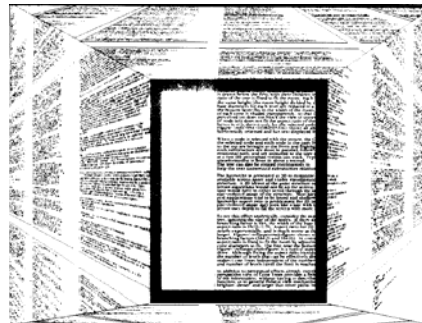
DocumentLens: The Details

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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The DateLens



Detailed
calendar
view of one
day (focus)

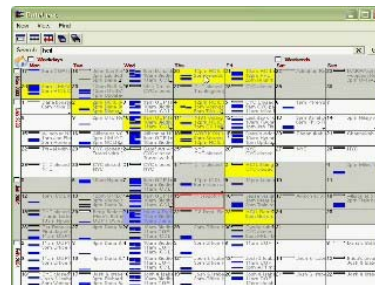
Abstracted
calendar
information of
other days and
times (context)

The DateLens: HCIL (University of Maryland) and Microsoft Research

James Tam

The DateLens: The Details

- **Combines a fisheye view of calendar information with zooming (zui's)**
- **The fisheye view can be distorted to increase the 'weight' of particular information.**
- **Integrated searching**
 - Results show up in greater detail 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



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Fisheye vs. Separate (Overhead And Detail) Views

Separate



Fisheye



James Tam

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/>

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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

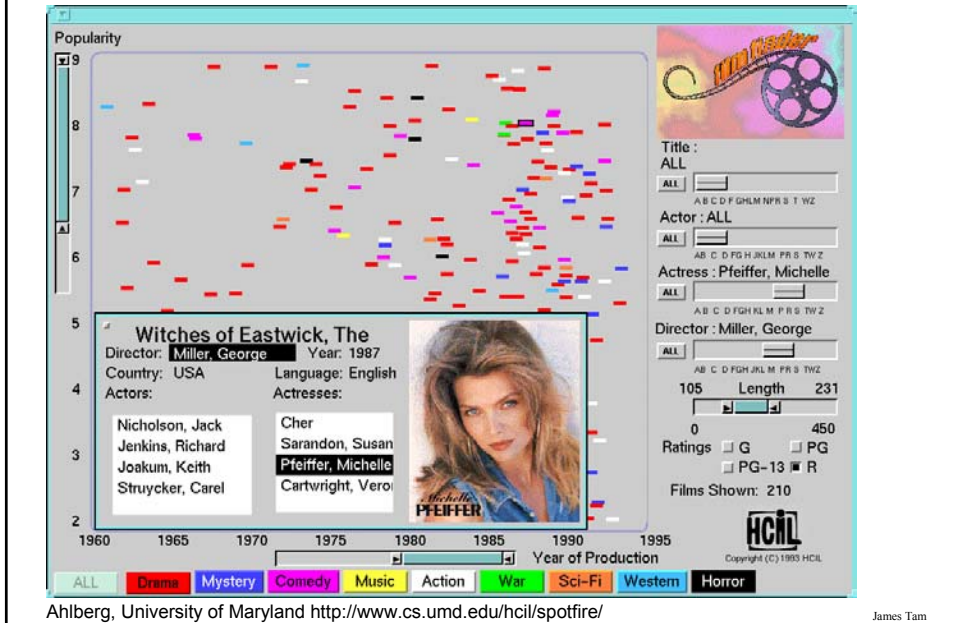
Details on Demand

- Additional information can be provided about each query result



James Tam

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)

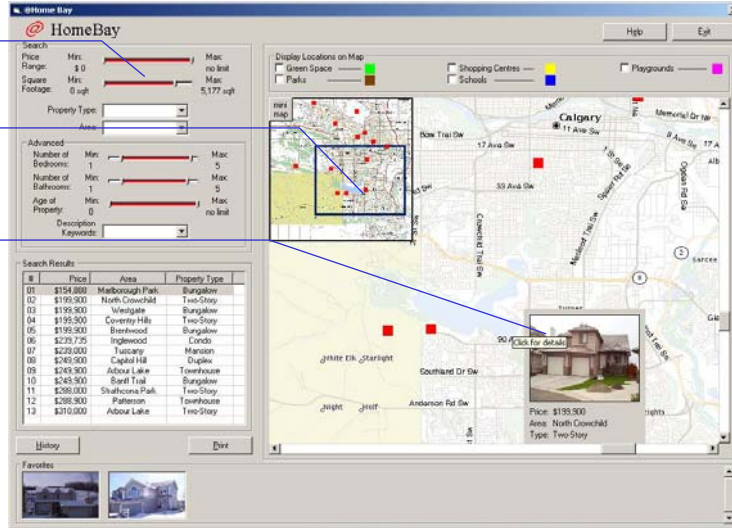


A Student Project: HomeBay

Dynamic Queries

Radar Overview

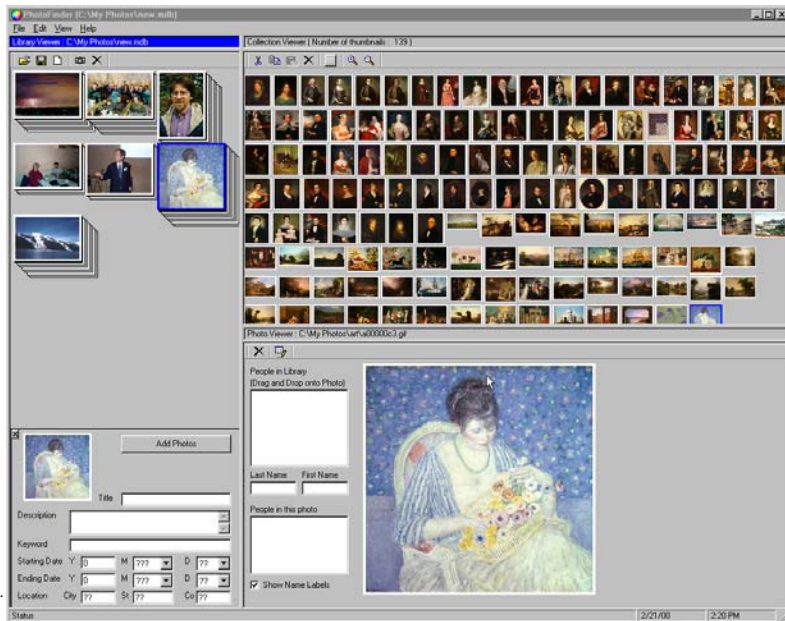
Progressive details on demand



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

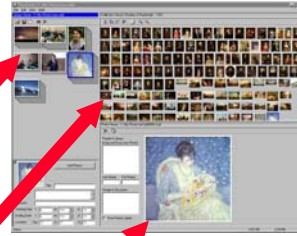
Multiple Views Of A Large Data Set

- 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 screenshot of the PhotoFinder application's annotation form. The form is titled 'PhotoFinder' and contains several input fields and sections. On the left, there is a small photo thumbnail 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), and 'Location' (with City, State, and Country dropdowns). At the bottom left is a 'Status' field. On the right side, there are two list boxes: 'People in Library (Drag and Drop onto Photo)' and 'People in this photo'. Below the second list box is 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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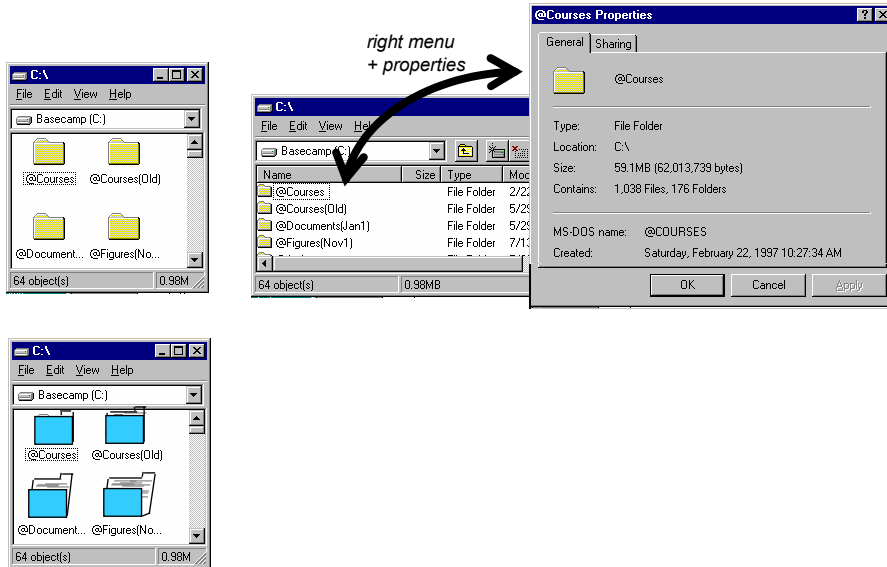
Representing Phone Network Connections



Images from "Information Visualization" by Robert Spence

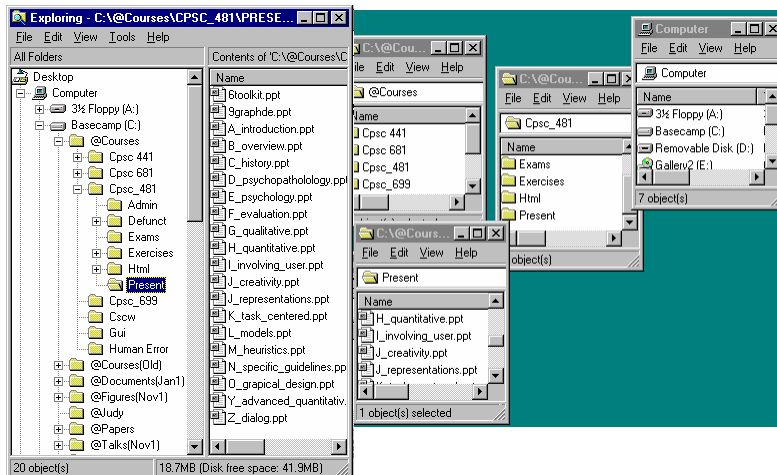
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Which Folder Has The Most Documents?

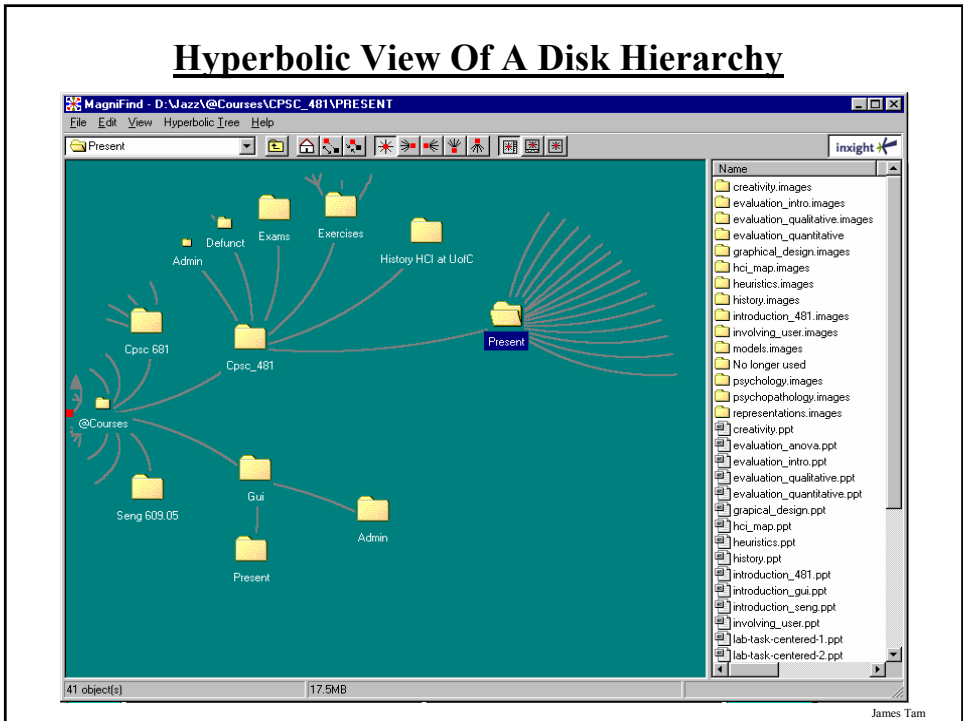
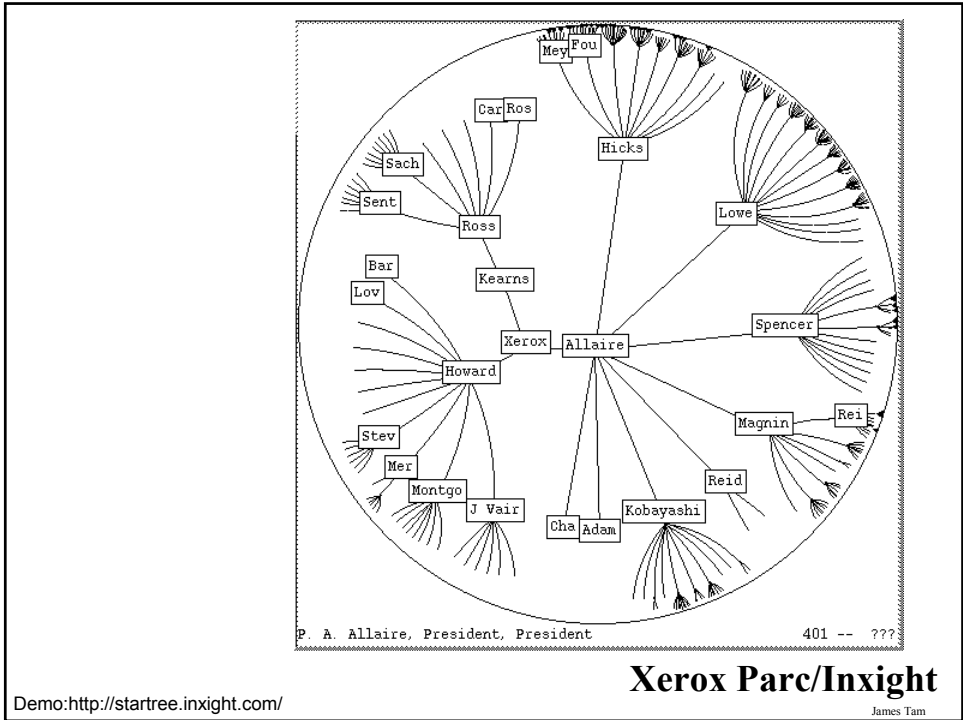


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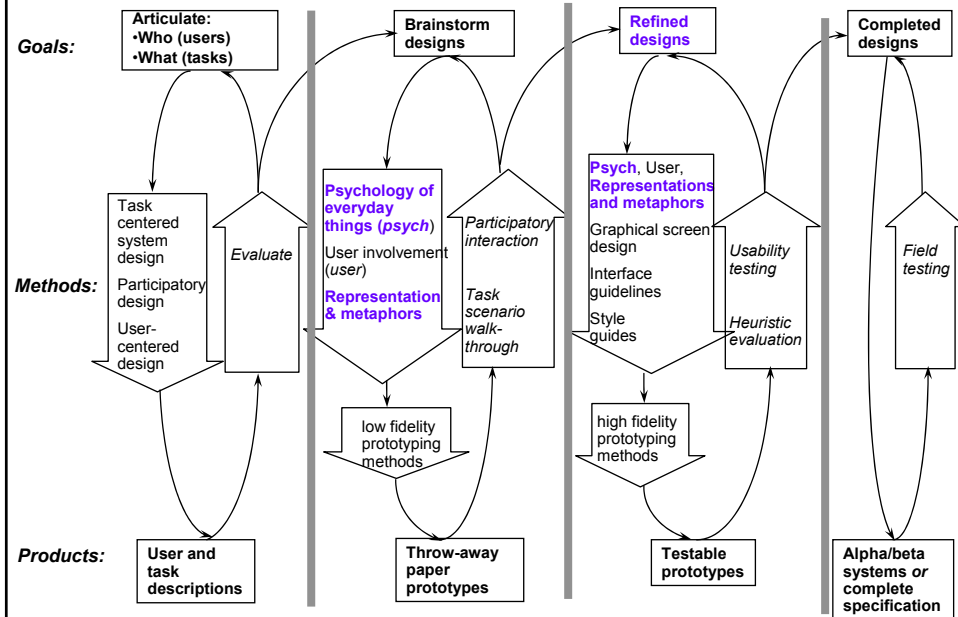
Where Am I? Where Was I Going?



James Tam



Interface Design And Usability Engineering



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

James Tam