Information Visualization In Practice

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

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.

Too Much Information To Show All At Once

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/

Too Much Information To Show All At Once

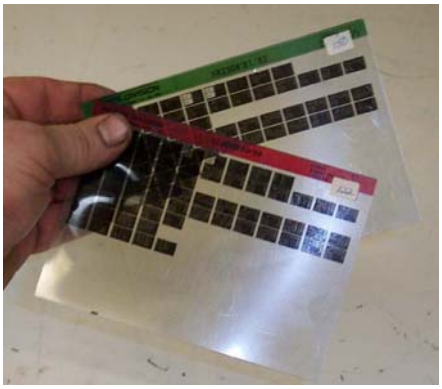
Approaches to the problem:

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

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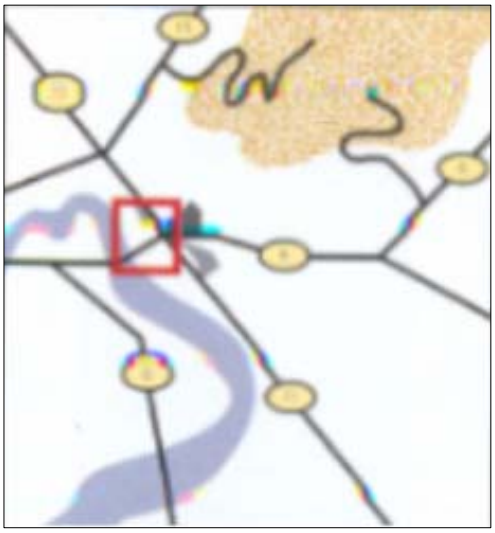
2) Overview And Detail: Separate



Overview

Detailed view

Images from “Information Visualization” by Robert Spence

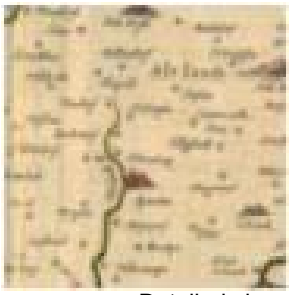
2) Overview And Detail: Separate

Defender © Midway Home Entertainment Ltd.

2. Overview And Detail: Separate

Relating the detailed and overview can be a challenge:

Overview



Detailed view

James Tam

3) Magnification: Inline

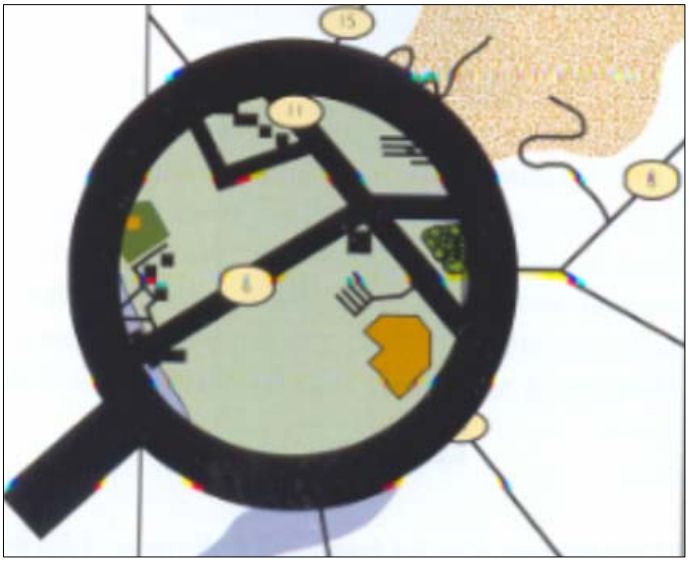


Image from “Information Visualization” by Robert Spence

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3) Magnification: Inline

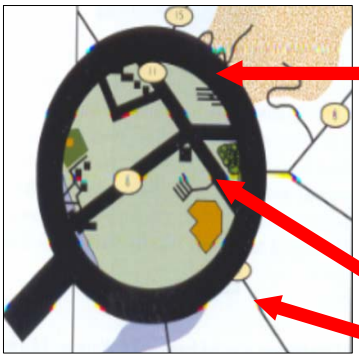

Image from “Information Visualization” by Robert Spence

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

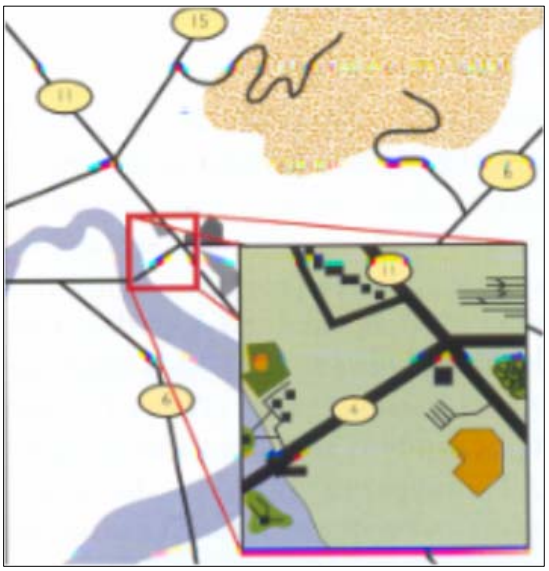

Image from “Information Visualization” by Robert Spence

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4) The DragMag

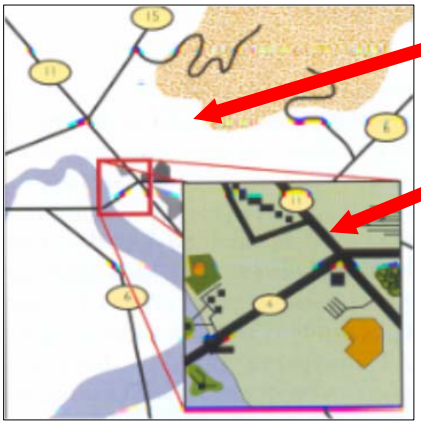

Image from "Information Visualization" by Robert Spence

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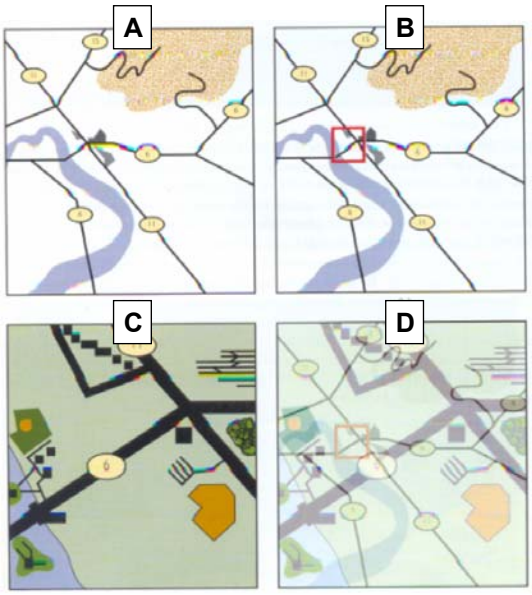
5) Transparent Overlays



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

James Tam

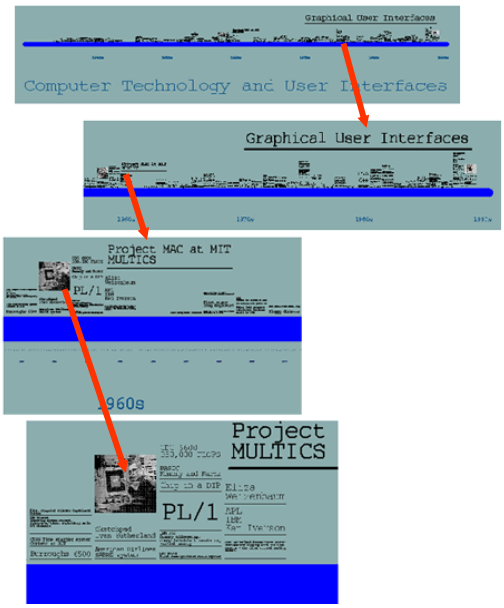
5) Transparent Overlays

Diablo © Blizzard

James Tam

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

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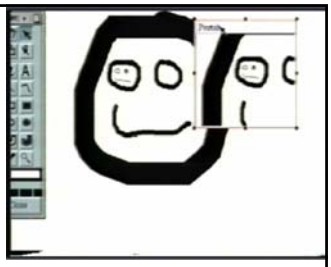
Pad++: The Details



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

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. Filtering

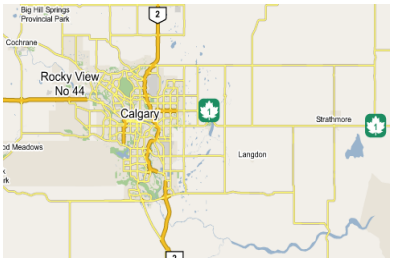
C. Semantic zooming

James Tam

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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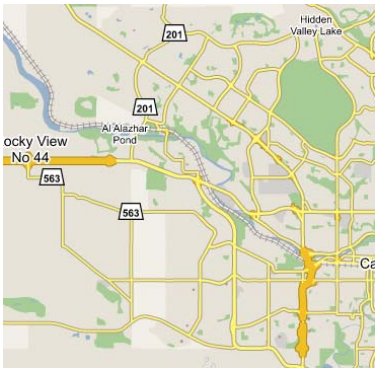
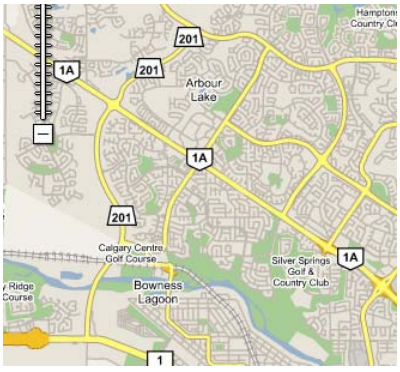
B. Filtering

Block the appearance of some of the information



Zoomed out



Zoomed in

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

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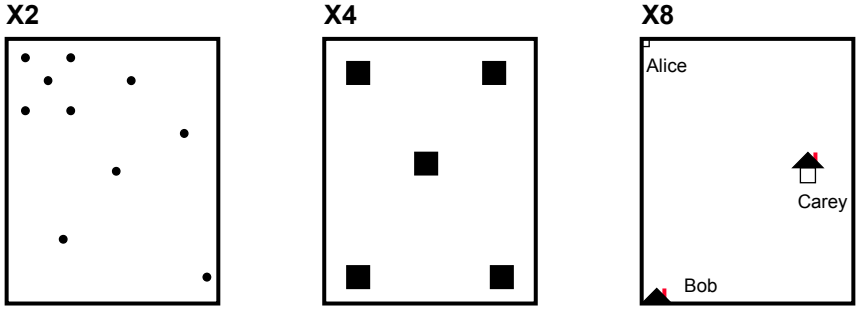
C. Semantic Zooming

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



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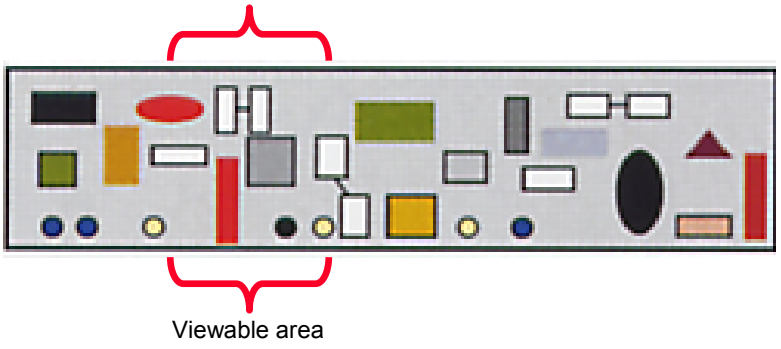
7. Focus And Context

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



From "Information Visualization" by Robert Spence

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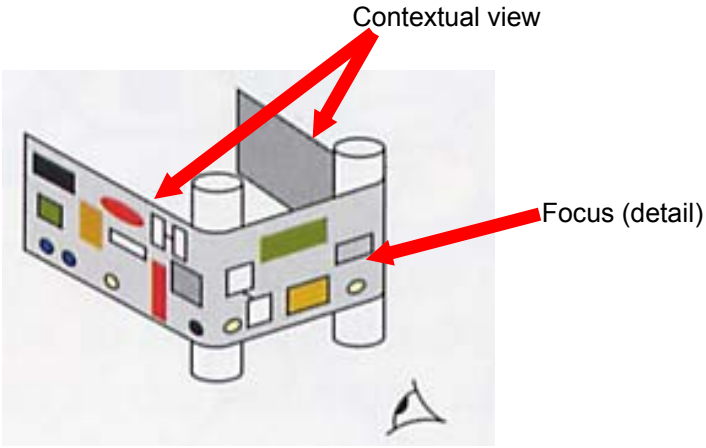
7) Focus And Context

- **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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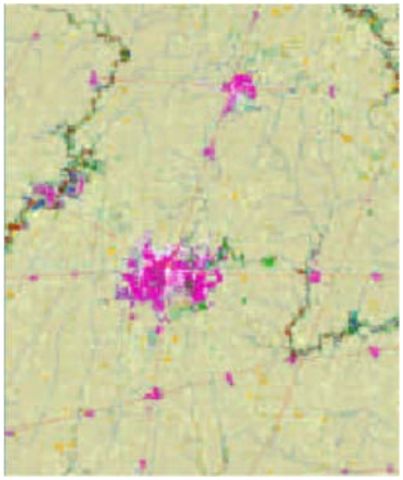
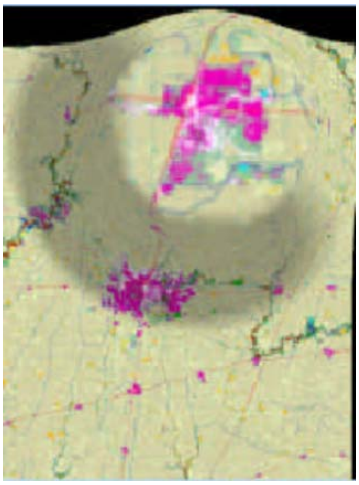
Fisheye View: Information Visualization

An application of the focus and context approach





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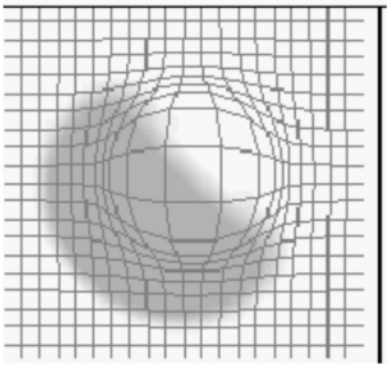
Fisheye View: Visual Cues For The Distortion

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**

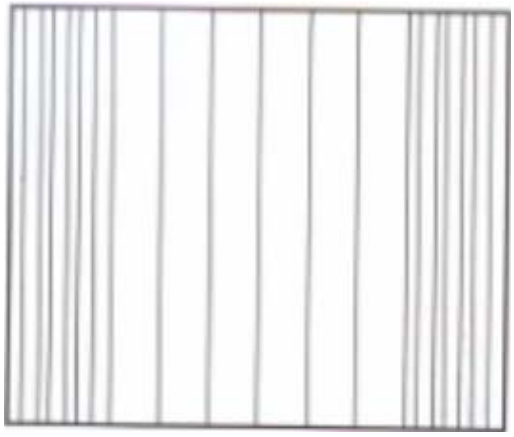
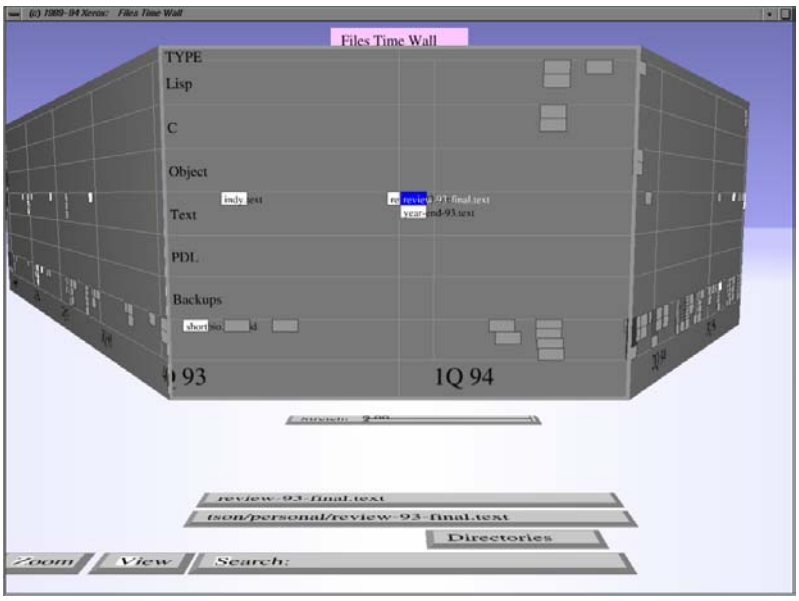


Image from “Information Visualization” by Robert Spence

The Perspective Wall



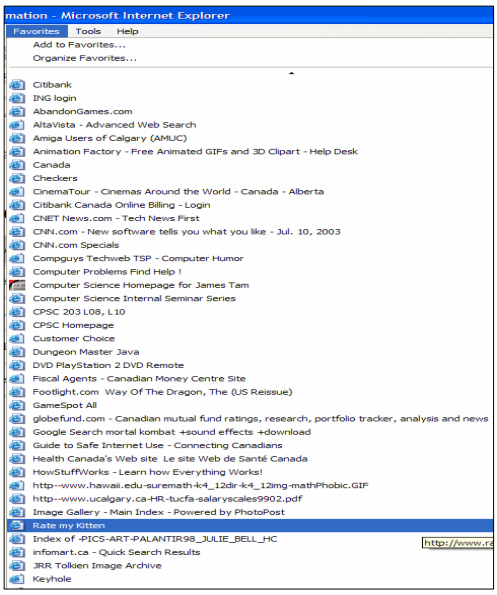
Mackinlay / Robertson / Card: Proc ACM CHI'91

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

Approaches to mitigating the problem:

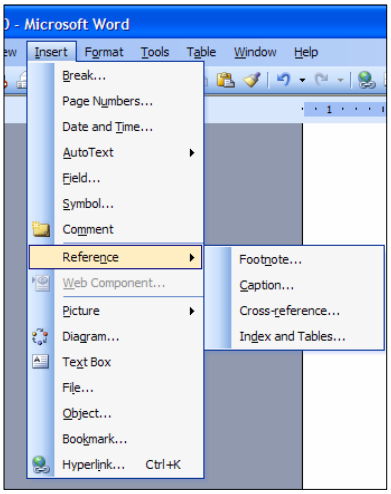
- Scrolling
- Setting up hierarchies
- Fisheye (distortion in one dimension)

Scrolling Menus



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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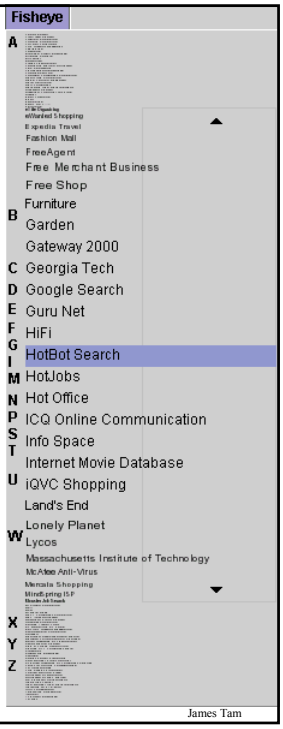
Fisheye Menus



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

James Tam

Table Lens

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.

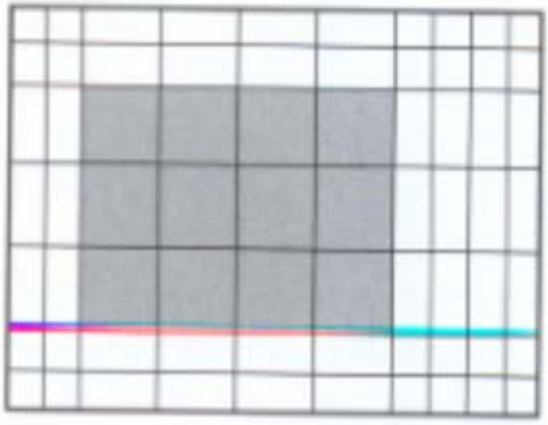
James Tam

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**

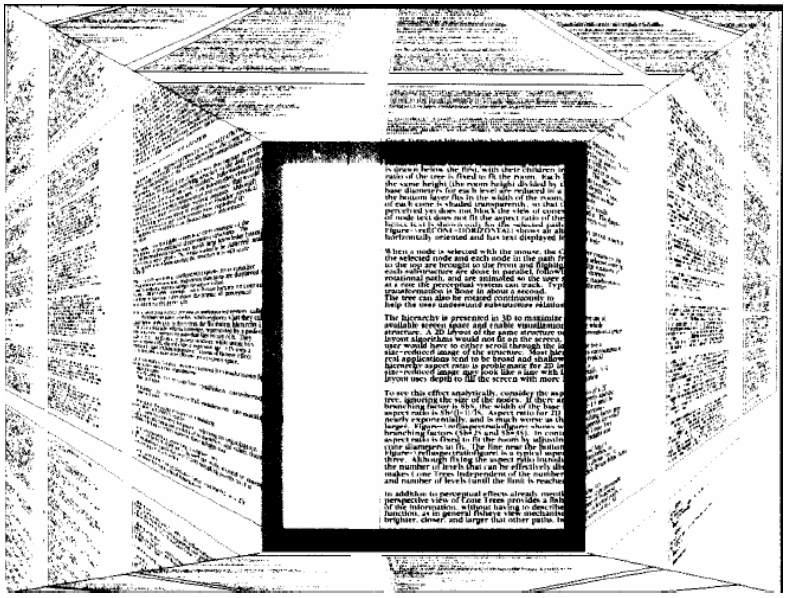
Focus And Context: Distortion In Two Dimensions

- **Distortion in both the X and Y dimensions**



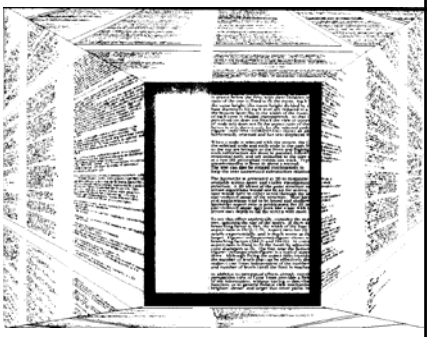
Images from “Information Visualization” by Robert Spence

DocumentLens



Robertson / Mackinlay ACM UIST 1993

DocumentLens: The Details



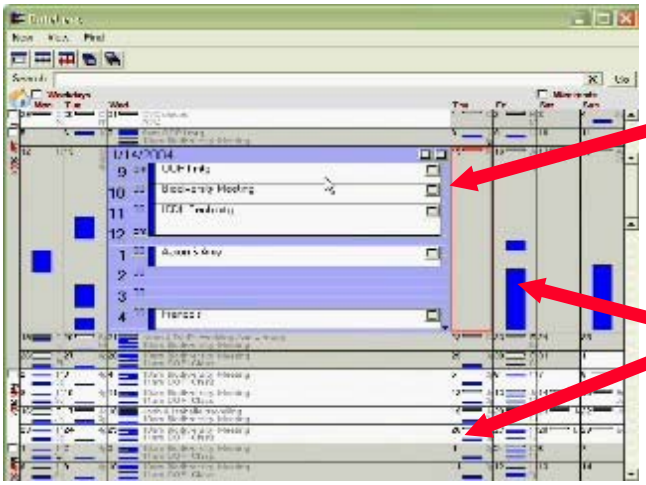
Recall:

- 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.

The DateLens



Detailed calendar view of one day (focus)

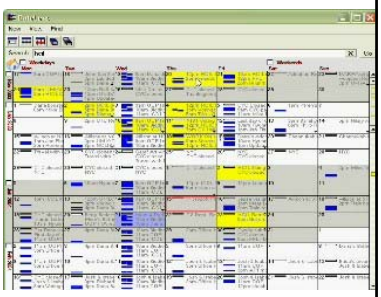
Abstracted calendar information of other days and times (context)

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 detailed 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

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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**
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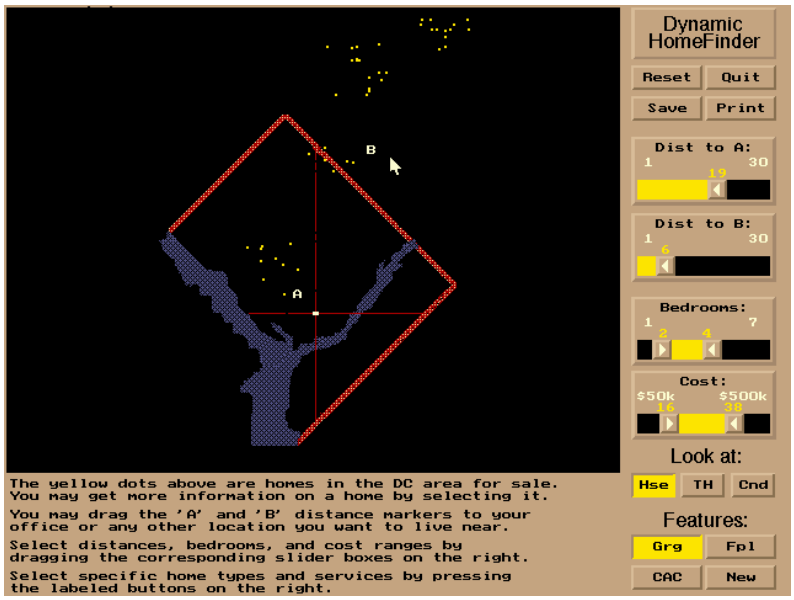
Ben Shneiderman, Designing the User Interface 3rd Ed. 1997 p523

James Tam

Dynamic Queries: HomeFinder



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

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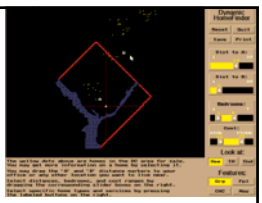
HomeFinder: The Details



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

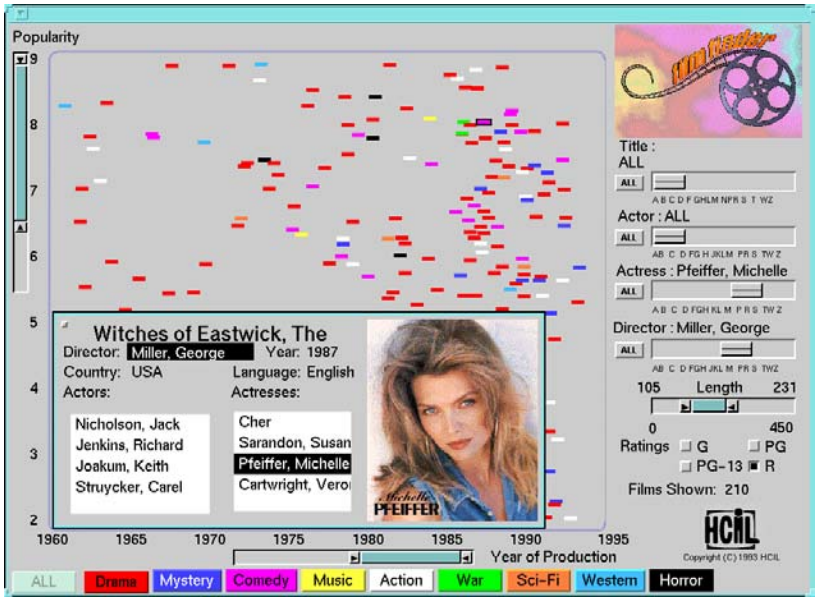
- Queries
- Query results
- Can be interacted with like real-world objects

Details on Demand

- Additional information can be provided about each query result

James Tam

Starfield Display: FilmFinder



Ahlberg, University of Maryland http://www.cs.umd.edu/hcil/spotfire/

James Tam

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)

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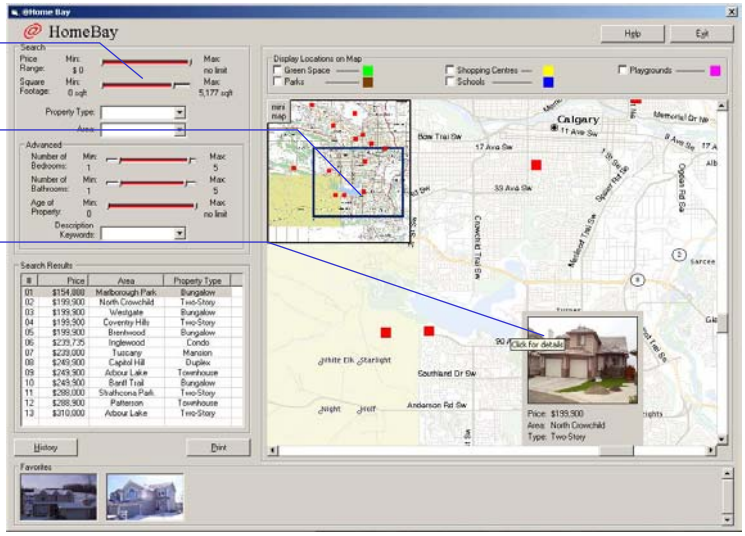
A Student Project: HomeBay

Dynamic Queries

Radar Overview

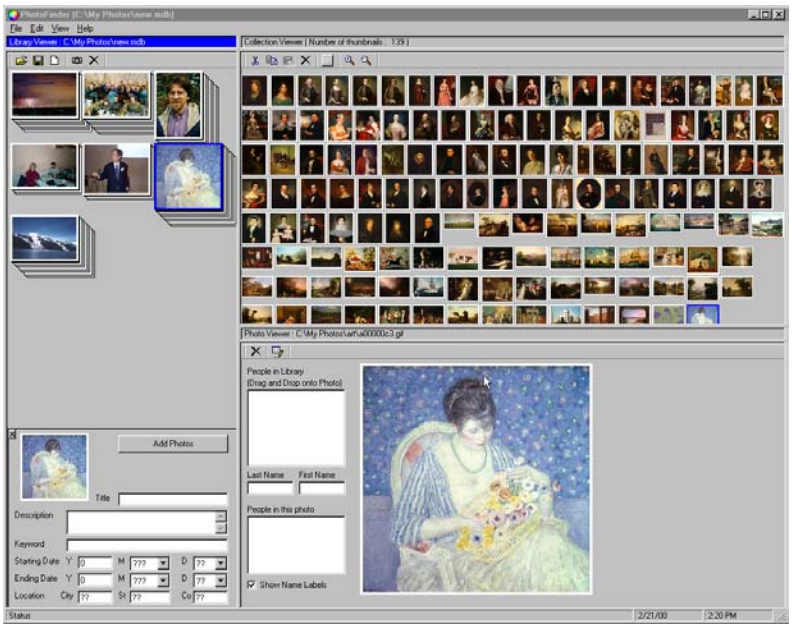
Progressive details on demand



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

James Tam

PhotoFinder



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

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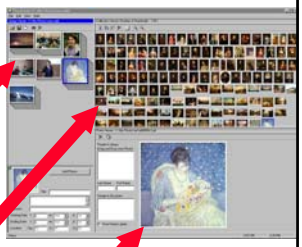
PhotoFinder: The Details

Multiple Views Of A Large Data Set:

- 3 levels of detail



Library view

Collection view

Photo view

James Tam

PhotoFinder: The Details (2)

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

James Tam

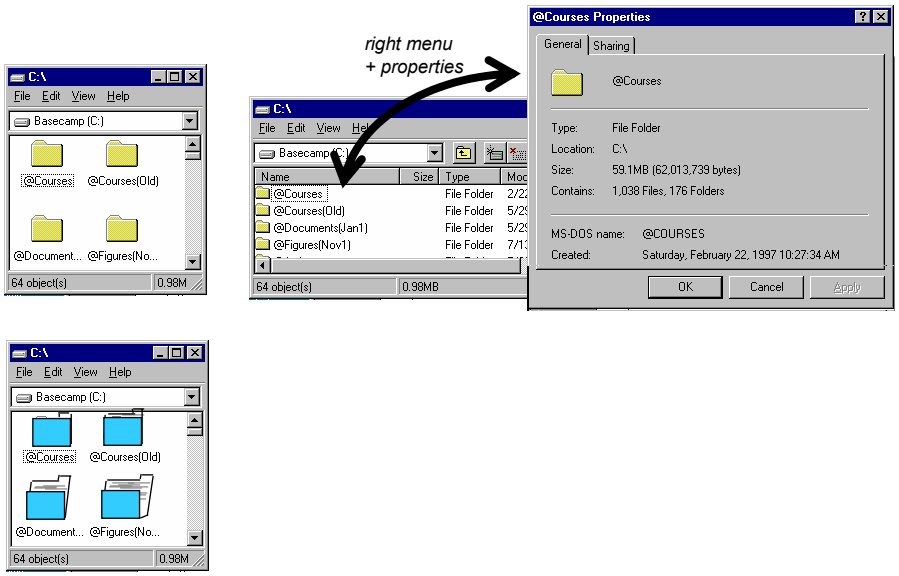
Representing Connectivity

- **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

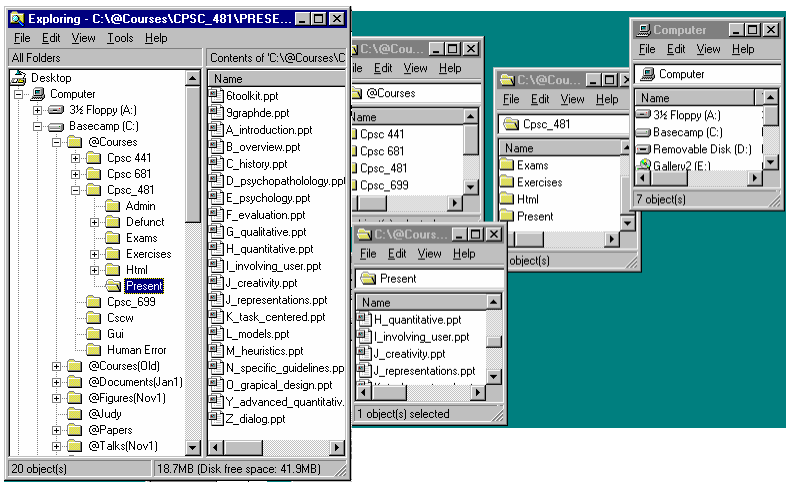
Representing Phone Network Connections

Images from "Information Visualization" by Robert Spence

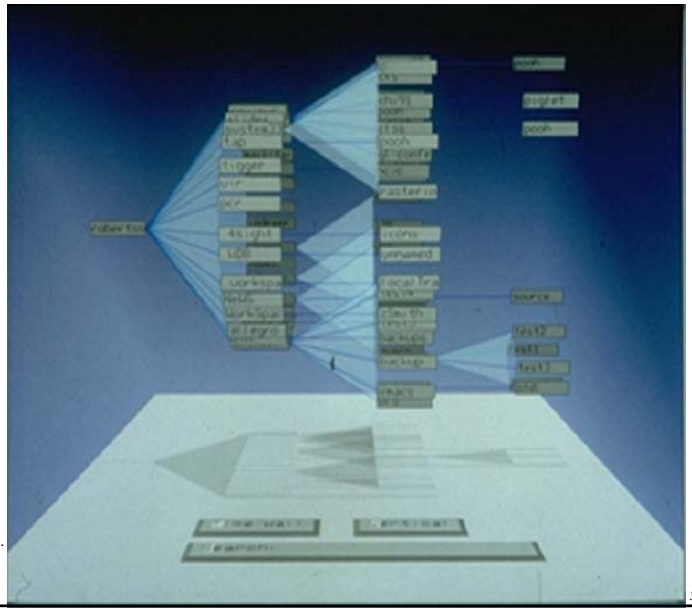
Which Folder Has The Most Documents?



Where Am I? Where Was I Going?



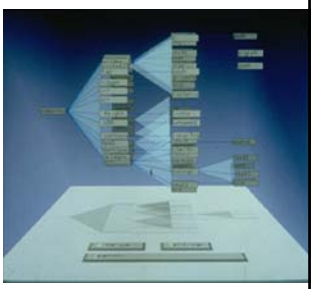
Cone Trees



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

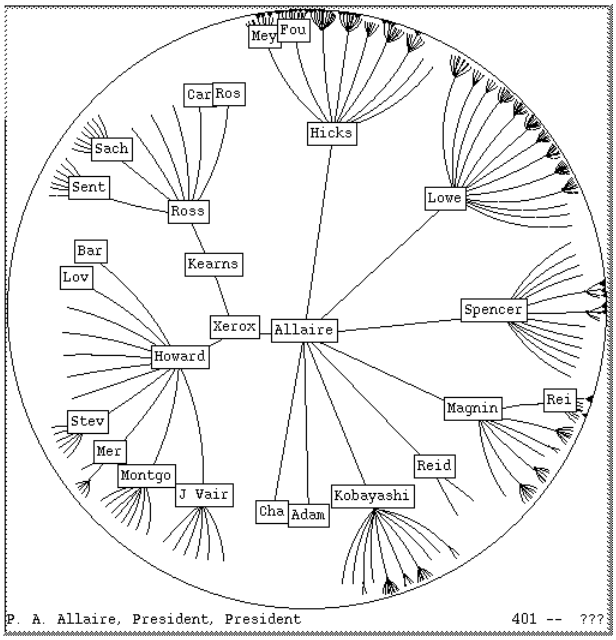
James Tam

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

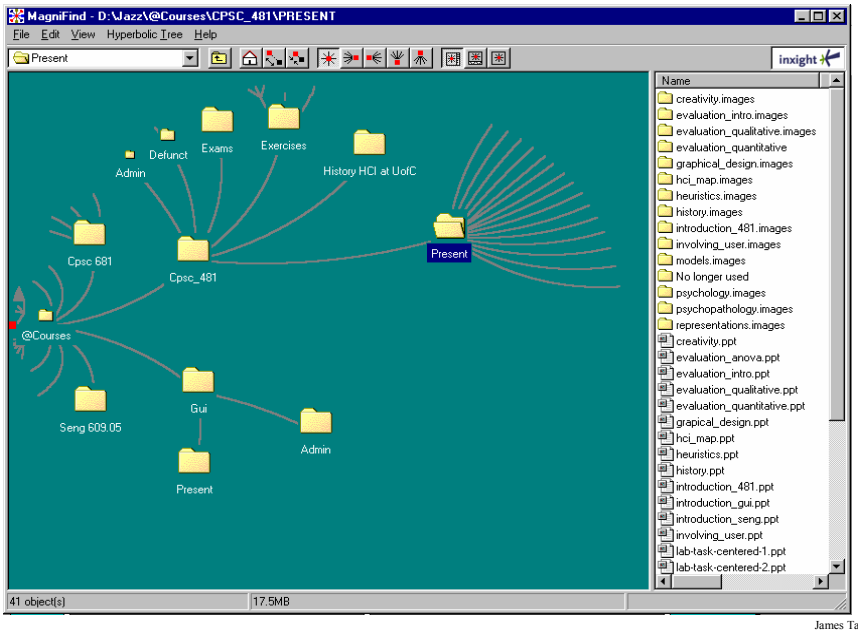


Xerox Parc/Inxight

Demo:http://startree.inxight.com/

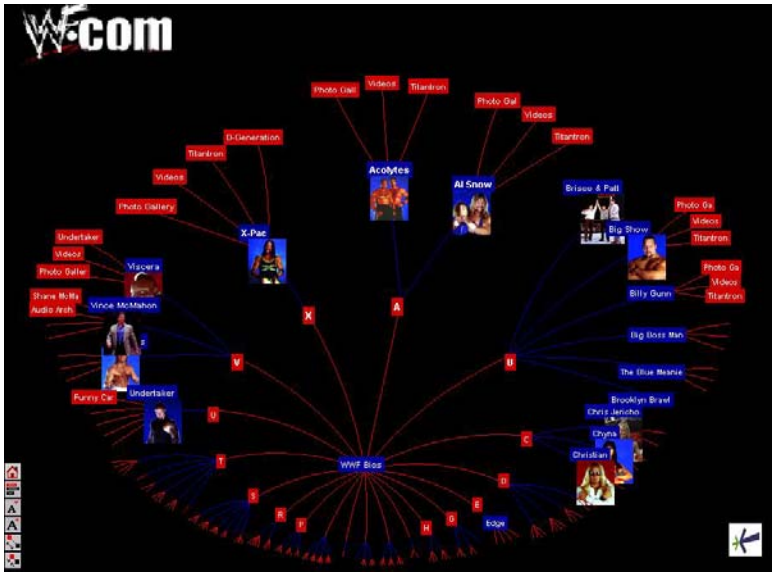
James Tam

Hyperbolic View Of A Disk Hierarchy



James Tam

Hyperbolic View Of The Web



Demo:http://startree.inxight.com/

What You Now Know

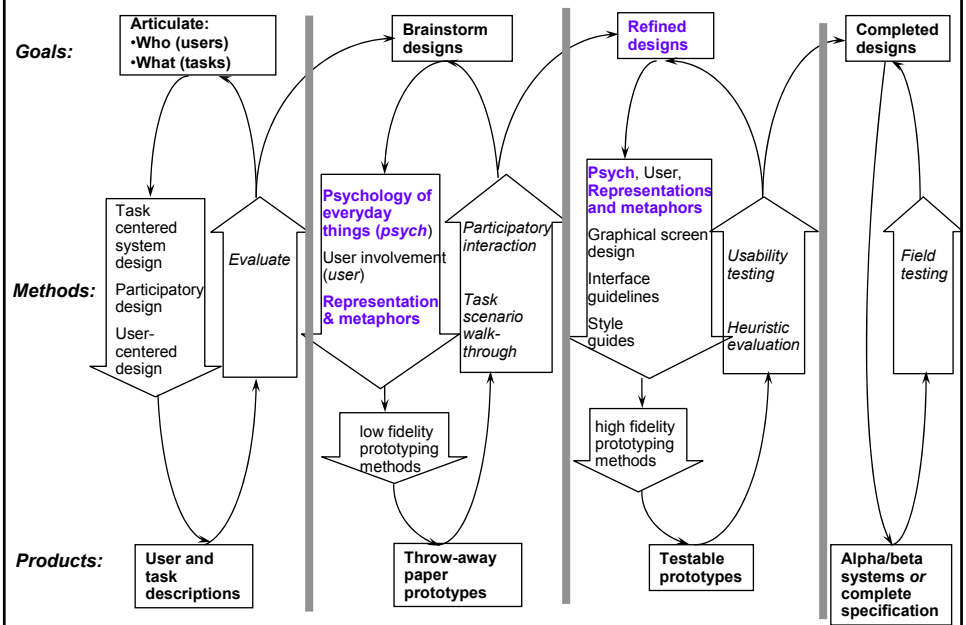
Ways of dealing with the "large data set but limited display space" problem

- Scrolling
- Magnification
- The DragMag
- Transparent overlays
- Overview and detail
- Focus and context
- Zooming

The information seeking mantra and how it has been applied in the HomeFinder and FilmFinder systems

Problems and some solutions when representing connectivity in large data sets

Interface Design And Usability Engineering



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

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