Panning and Zooming

CS 7450 - Information Visualization
April 5, 2011
John Stasko

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

Solutions We've Seen

- Overview and detail views
- Focus+Context distortion

- How about one view in which changing focus is fast and smooth?

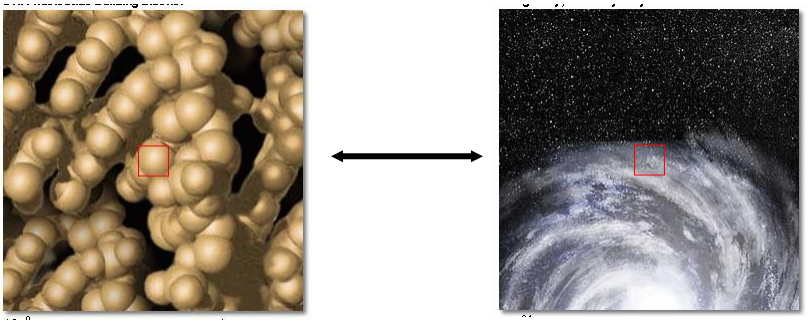
Panning and Zooming

- Panning
  - Smooth movement of camera across scene (or scene moves and camera stays still)
- Zooming
  - Increasing or decreasing the magnification of the objects in a scene

- Useful for changing focal point

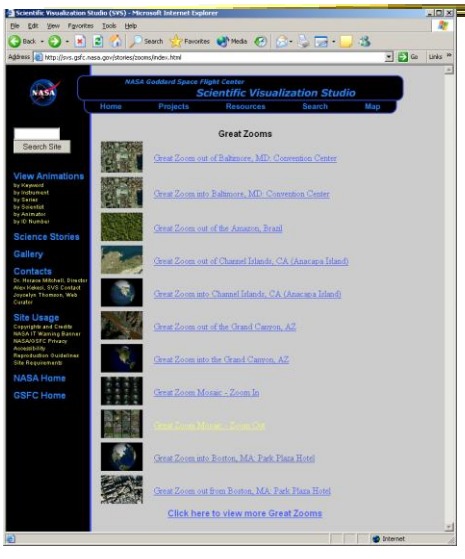
Zooming

Powers of 10



http://micro.magnet.fsu.edu/primer/java/scienceopticsu/powersof10/index.html

NASA Zooms



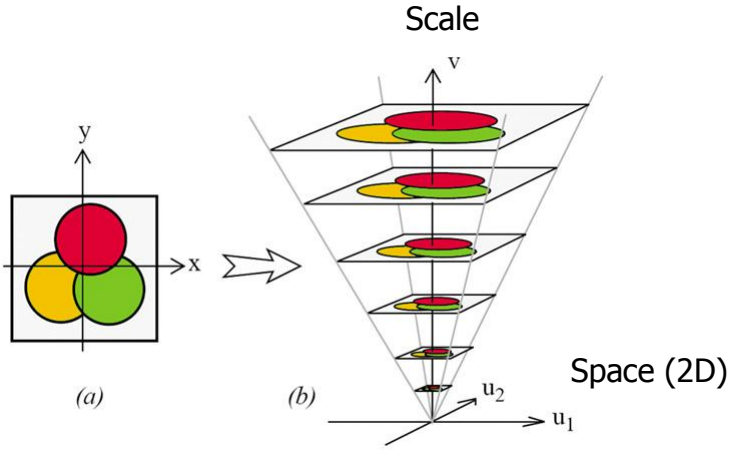
http://svs.gsfc.nasa.gov/stories/zooms/index.html

Understanding Zooming

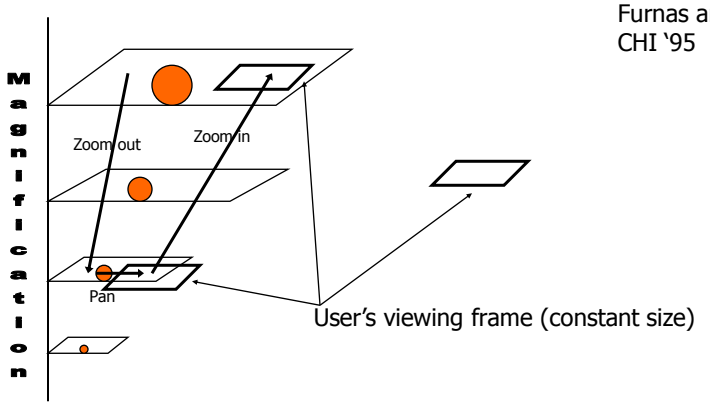
- Introduction of idea of "space scale diagram"
- Characterizes operations in zooming through this new diagram they introduce
- Goals
  - Understand multiscale systems
  - Guide design
  - Authoring tool

Furnas & Bederson
CHI '95

The Space - Scale Diagram



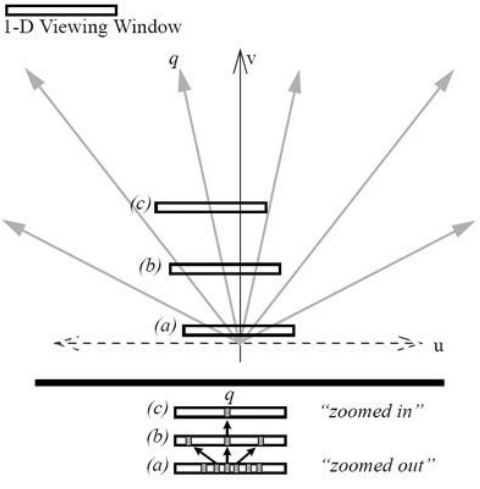
Space-Scale Diagram



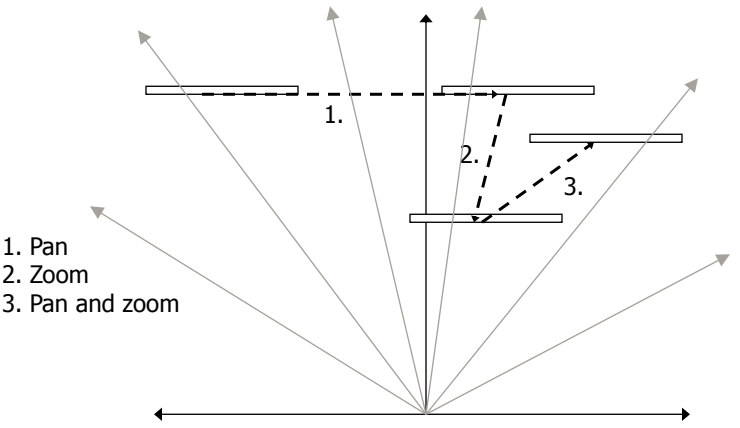
Furnas and Bederson
CHI '95

Technique for describing panning and zooming interfaces

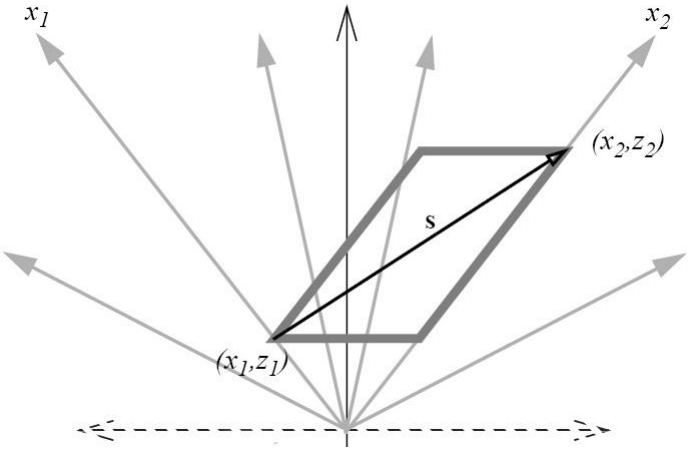
Simplification: 1D Space



Space-Scale Diagram



Joint Panning and Zooming

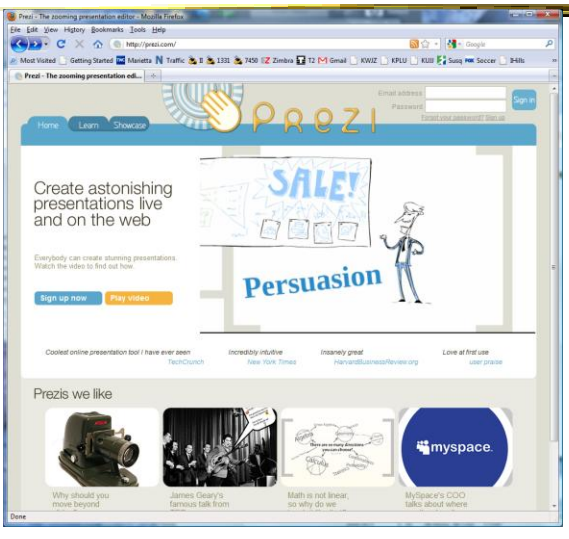


Optimal Actions

- Sometimes, these kinds of UIs can be disorienting to viewer
- Example
  - Long pan isn't any good
  - Better: Zoom out, pan a little, zoom in

Example Application

http://prezi.com



Pad -> Pad++ -> Jazz ->Piccolo

- Environments for supporting flexible, smooth zooming and panning on structured graphics world
  - Pad - Perlin & Fox, NYU
  - Pad++ - Bederson & Hollan, Bellcore & New Mexico
  - Jazz - Bederson, Maryland
  - Piccolo, Bederson, Maryland

Support

- Pad
  - ???
- Pad++
  - Tcl and C++, GL and X Windows
- Jazz
  - Java, Java 2D & Swing
- Piccolo
  - Java & C#/.net, Java 2D, OpenGL & GDI+

Interface Physics

- Creators of the systems talk about them creating a new form of interface physics
- One which works a lot like the physical world
  - You can walk around, look at some things closely, etc
- But one that also adds some "magic" of what the computer does well

Pad++

- Support library for building applications
- Infinite plane, panning in x-y, zooming in-out
- 2.5-D, not 3-D
- Built on top of C++, Tcl/Tk and X Window System

Bederson et al
JVLC '96

Important Concepts

- Portals
- Lenses
- Sticky objects
- Semantic zooming

Portals

- Views onto another place in the world
- Implemented typically as separate rectangular region
- Zooming, panning, I/O all work independently in there
- Can be used to create overviews or focus regions

Lenses

- Rectangular regions/objects that can be moved around on display
- Objects that alter the appearance and behavior of objects seen through them
- Much like Magic Lenses of Xerox

Sticky Objects

- Objects in the world that do not respond to the basic zoom/pan interface physics
- Objects are "stuck" to the display
  - They never change position
  - They never change size

Semantic Zooming

- Zooming that is not simply a change in size or scale like simple magnification
- Objects change fundamental appearance/presence at different zoom levels
- Zooming is like step function with boundaries where

Jazz

- All the stuff from Pad++
- Implemented in java and swing
- Utilizes scene graph approach and minilithic design philosophy
- HiNote application is simple drawing editor (like PadDraw)

UI Operations

- Navigation
  - Left mouse button down, drag - Pan
  - Right mouse button down, drag right - Zoom in
  - Right mouse button down, drag left - Zoom out
  - Alternate: Arrow and page keys
- Hyperlinks
  - Smoothly move you from one position to another

Challenges

- How the heck do they do that?
- Must keep rendering speeds up

Efficiency Measures

- Spatial indexing
  - Hierarchy of objects based on bounding boxes
- Clustering
  - Restructure hierarchy to maintain a balanced tree, speed for indexing
- Level of detail
  - Render items depending on how large they are on screen, don't draw small ones

Efficiency Measures

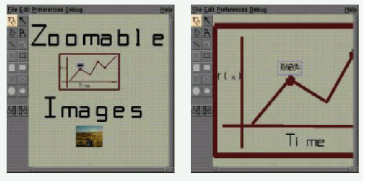
- Refinement
  - Render fast with low detail while moving, refine image when still
- Clipping
  - Only render portions of objects that are visible
- Region management
  - Only update portion of screen that has been changed

Efficiency Measures

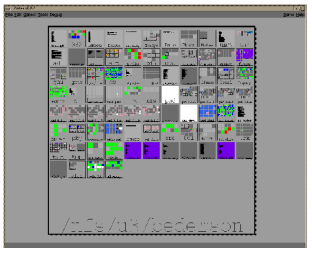
- Adjustable frame rate
  - Keep animation and zoom rate constant independent of environment
- Interruption
  - User input takes precedence, moves animations to their end state, gets handled
- Optimized image rendering
  - Code to render zoomed images has been worked on a lot!

Pad++ Applications

- PadDraw
  - Simple graphics editor

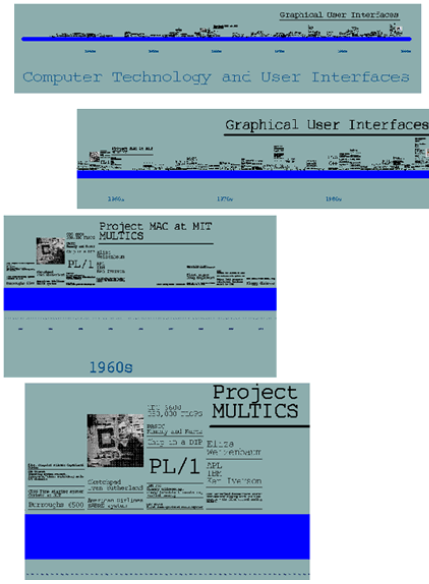


- File/Directory browser



Applications

Timeline views



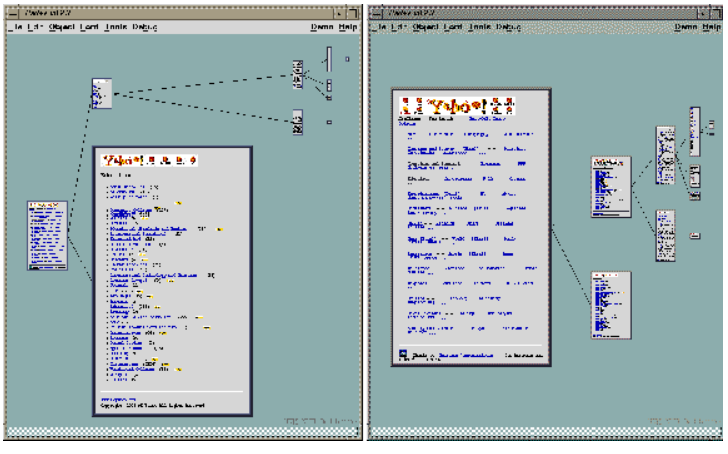
Web History

Web traversal history

PadPrints

Hightower et al UIST '98

Video

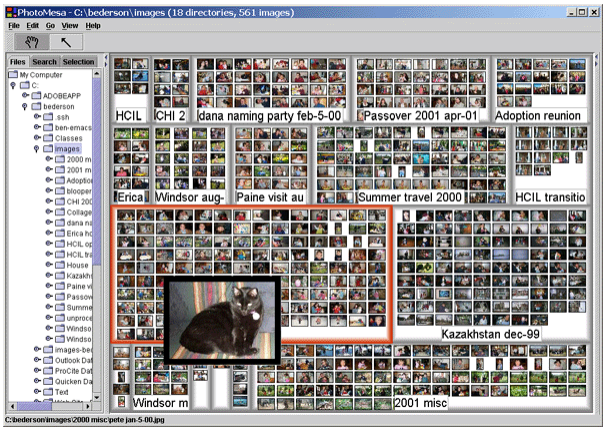


Browsing Images

PhotoMesa

Uses panning and zooming to browse a photo collection

Bederson
UIST '01



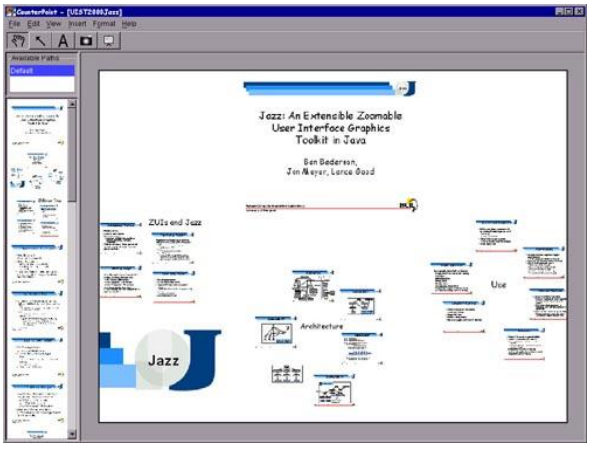
Demo & Video:
`www.cs.umd.edu/hcil/photomesa`

Presenting Talks

CounterPoint

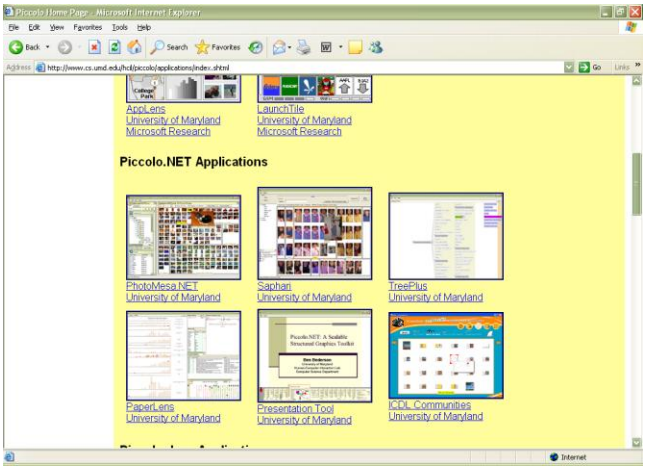
Uses panning and zooming in PowerPoint

Good & Bederson
Information Visualization '02



Demo:
`www.cs.umd.edu/hcil/counterpoint`

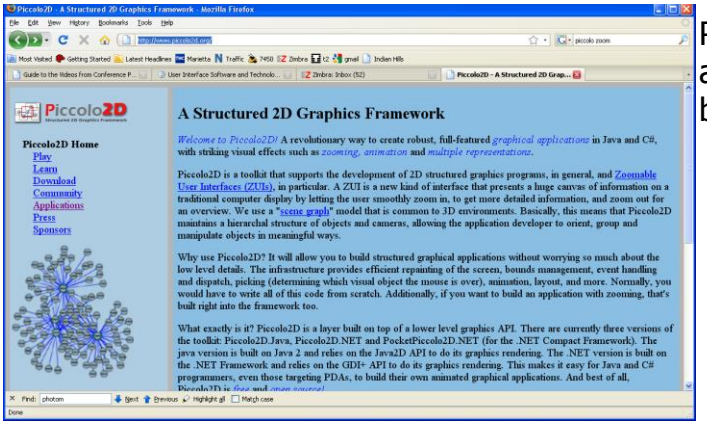
Many More Applications



http://www.cs.umd.edu/hcil/piccolo/applications/index.shtml

Current Status

http://www.piccolo2d.org/



Piccolo has an active user base

Other Systems

- Let's see some other examples…

Continuous Zoom

- Bartram et al, Simon Fraser
- Discussed in previous class (focus+context)
- Uses smooth zooming in changes of focus on fisheye view
- Objects give/take screen real estate
- Implemented on graphs with rectangular nodes

Video

Wing

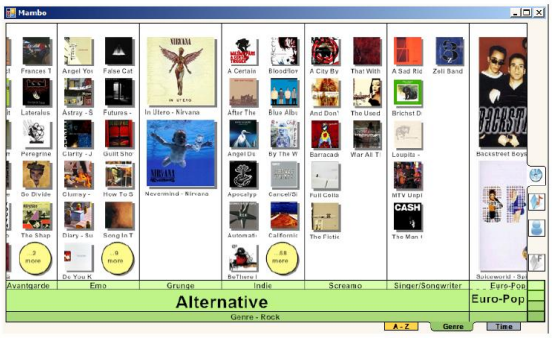
- Another system providing zooming techniques
- Provides zooming on an index or table of contents to see more detail
- Integrated with multi-window overview and detail multimedia tool

Masui, et al
UIST '95

Video

FacetZoom

- Combine (hierarchical) facets with zooming UI for exploration



Video

Dachselt et al
CHI '08

Issues

- Getting lost
  - Zoom in or out way too far
  - Can't see anything

- Termed "Desert fog" by Jul and Furnas

Videos

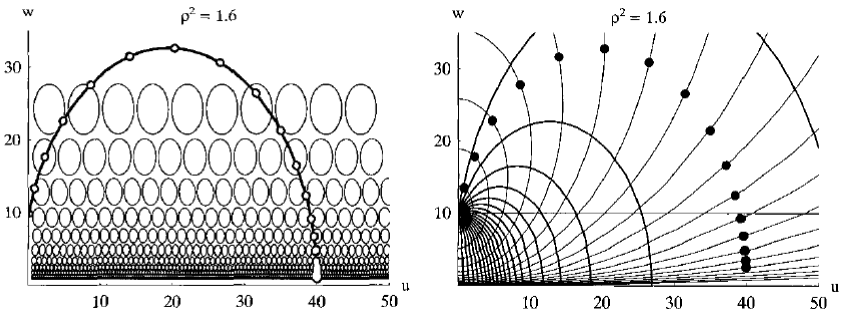
Jul and Furnas, UIST '98

Jul and Furnas, UIST '00

Optimal Actions

- Sometimes, these kinds of UIs can be disorienting to viewer
- Example
  - Long pan isn't any good
  - Better: Zoom out, pan a little, zoom in

Optimal Trajectories



Van Wijk & Nuij
InfoVis '03

So?

- Is this a different paradigm?
  - Overview and detail
  - Focus + context
  - Distortion
- Is this just an assistive technology that can help do those general techniques above?

So?

- Is this technique (flexible zoom+pan) useful?
- How can it be used in, or how does it compare to?
  - Overview and detail
  - Focus + context, fisheye
  - Distortion techniques

HWs

- HW 7 discuss (NodeXL)

Upcoming

- Time series data
  - Reading
    Aigner et al
- Big data
  - Reading
    Yang et al

References

- Spence and CMS texts
- Romero '06 slides
- All referred to papers