Lecture 10: Focus+Context

Information Visualization

CPSC 533C, Fall 2009

Tamara Munzner

UBC Computer Science

Mon, 19 October 2009

News

- project meetings due this Fri 10/23
- written proposals due next Fri 10/30

Papers Covered


- [Thurston and Weeks 84]


Focus+Context: Cockburn

- DOI: API(x) - D(x,y)
- API: a prior interest
- D: distance, semantic or spatial
- x: data element
- y: current focus
- DOI for selective presentation vs. distortion
- infer DOI through interaction vs. explicit selection
- single vs. multiple focus

SpaceTree

- focus+context tree: filtering, not geometric distortion
- animated transitions

- semantic zooming

- demo

Document Lens, Table Lens


- fisheye effect from hyperbolic geometry
  - video: open-video.org/details.php?videoid=4567


2D Hyperbolic Trees

- 2D hyperbolic plane

- Euclid’s 5th Postulate
  - exactly 1 parallel line
  - spherical
  - geodesic — great circle
  - no parallels
  - hyperbolic
  - infinite parallels

- hyperbolic: inseparable

- euclidean: polynomial

- hyperbolic: exponential

- 2π sinh2 r

- sphere area

- hemisphere area

- 2π sinh2 r

- euclidean: polynomial

- 2π r2

3D Hyperbolic Trees/Graphs

- scalability argument: information density at periphery

Avoiding Disorientation

- problem
  - maintain user orientation when showing detail
  - hard for big datasets

- exponential in depth

- node count, space needed

Exponential Amount Of Room

- room for exponential number of tree nodes

- hyperbolic: exponential

2D Hyperbolic Models

- Klein/projective
- Poincare/conformal
- Upper Half Space

Noneuclidean Geometry

- Parallel vs. Equidistant

- Euclid’s 5th Postulate
  - exactly 1 parallel line

- spherical
  - geodesic — great circle

- hyperbolic
  - infinite parallels

- hyperbolic: different

- hyperbolic: exponential

More Reading


- [H3: Laying Out Large Directed Graphs in 3D Hyperbolic Space. Tamara Munzner, Proc InfoVis 97.]

**Results**

- troubles with focus-lock mode
  - demo: www.cs.umd.edu/hcil/fisheyemenu
  - hierarchical (baseline) outperformed for known-item task
  - faster, more accurate
  - smaller screen footprint
  - no differences for browsing tasks
  - eyetrack: transition and context regions not used much for fisheye
    - readability important - multifocus
    - give up on showing entire context?
    - less space for transition regions?

**Distortion Challenges**

- how to visually communicate distortion
  - gridlines, shading
  - target acquisition problem
  - lens displacing items away from screen location
  - unsuitable if must make relative spatial judgements
  - mixed results comparing to O+D, pan/zoom

**Untangling Usability of Fisheye Menus**

- compare fisheye, overview, multifocus, hierarchical
  - measurements
    - performance time, errors
    - preferences
    - eyetracking
  - design issues
    - distortion vs. O+D vs. Hierarchical temporal
    - landmarks
    - fine-grained navigation: focus-lock when needed

**F+C Without Distortion**

- specialized hardware

**Menus: Hierarchical**

- degree of interest (DOI): a priori importance (API), distance (D)
  - distance can be semantic or spatial
  - distortion vs. selection
  - agnostic to geometry
  - DOI for selective presentation vs. distortion
  - what to shown vs. how it is shown
  - how shown
    - geometric distortion: TrueSize as implicit API
    - API: temporal/memory harder than side by side
    - multiple views: topological discontinuity at edges
    - multires displays: big and heavy...

**Menus: Fisheye, Overview, Multifocus**


**Fisheye Followup**

- [A Fisheye Follow-up: Further Reflection on Focus + Context. George W. Furnas. SIGCHI 2006.]

**Generalized Fisheye Requirements**

- static structure, allowing distance defn
  - LOD/API at points within structure
  - interaction focused at point/region

**Future Goal: 10M node Tree of Life**


**Paper Comparison: Multiple Trees**

- side by side comparison of evolutionary trees

**TreeJuxtaposer**

- [M Meegaskumbura et al., Science 298:379 (2002)]

**Phylogenetic/Evolutionary Tree**

- [Robertson et al 91]

**Future Goal: 10M node Tree of Life**

- [Robertson et al 91]

**Phylogenetic/Evolutionary Tree**

- [M Meegaskumbura et al., Science 298:379 (2002)]

**Common Dataset Size Today**

- [M Meegaskumbura et al., Science 298:379 (2002)]

**Future Goal: 10M node Tree of Life**


**Future Goal: 10M node Tree of Life**


**Guaranteed Visibility**

- [Robertson et al 91]

**Accordian Drawing**

- rubber-sheet navigation
  - stretch out part of surface, the rest squishes
  - borders nailed down
  - Focus+Context technique
    - integrated overview, details
    - old idea
    - [Sarkar et al 93]
    - [Robertson et al 91]
  - guaranteed visibility
    - marks always visible
    - important for scalability
    - new idea
    - [Munzner et al 03]
Guaranteed Visibility Challenges

- hard with larger datasets
- reasons a mark could be invisible
  - outside the window
  - AD solution: constrained navigation
  - underneath other marks
  - AD solution: avoid 3D

Guaranteed Visibility: Small Items

- Naïve culling may not draw all marked items

Guaranteed visibility of marks
No guaranteed visibility

Matching Interior Nodes

rayfinned fish
lungfish
salamander
frog
mammal
turtle
crocodile
lizard
snake
turtle
lungfish
bird

Matching Leaf Nodes

rayfinned fish
lungfish
salamander
frog
mammal
turtle
crocodile
lizard
snake
turtle
lungfish
bird

Similarity Score: $S(m,n)$

$S(m,n) = \frac{|L(m) \cap L(n)|}{|L(m) \cup L(n)|}$

Best Corresponding Node

$BCN(m) = \text{argmax}_{v \in V} (S(m,v))$
- computable in $O(n \log^2 n)$
- linked highlighting

Marking Structural Differences

- Nodes for which $S(v,BCN(v)) = 1$
  - Matches intuition
TreeJuxtaposer

- video, software from olduvai.sourceforge.net/tj