Collapsible Cylindrical Trees:

A Fast Hierarchical Navigation Technique

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Outline

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- Related Work
- Collapsible Cylindrical Trees (CCT)
 - Navigation and Interaction
 - Tree Size and Presentation Aspects
 - Implementation
- Conclusion & Future Work

Motivation

Hierarchies: important structure

- Organizational and web structures, product catalogs, part hierarchies, table of contents...
- Mostly trees (or convertible to trees)
- Many medium-sized hierarchies
- Not only display, but fast navigation crucial
- CCT initially developed for web hierarchies
 - Focus on usable tree visualization & navigation
 - Comprehensible 3D navigation technique

Related Work

2D-Tree visualization

- 2D Layouts, H-trees, radial & balloon views, tree-maps, onion graphs... [Herman et al. 2000]
- Problems: performance, viewability, usability, screen space usage
- Menus: long item lists, large mouse movements
- 3D-Techniques for larger hierarchies
 - Cone trees [Robertson et al. 91] & augmented solutions
 - Object occlusion, bad text readability, interaction

Related Work

- Navigation Cones in LyberWorld [Hemmje et al. 94], successor visual trees
- Focus+Context extensions to 2D and 3D visualization
 - Hyperbolic browser [Lamping & Rao 96], hyperbolic cone trees [Munzner 97]
 - Problems: interaction, performance, usability
- 3D Web navigation techniques [Benford 99]
 - Large hierarchies, structure vs. interaction, cognitive difficulties of 3D navigation

Collapsible Cylindrical Trees

3D Visualization and interaction technique for medium-sized hierarchies

First two tree levels plus chosen path



CCT - The Model

- Tree with finite list of nodes
 - Associated attributes: label, action,color, icon …
 - Intermediate nodes p have set of children C
- Cylindrical Mapping
 - For every p child nodes C are mapped on *facets* of a rotating cylinder
 - Facets evenly spaced, unnecessary removed, not evenly distributed
 - Endless cylinder concept (if count(C)>num_f)



CCT - The Model

Nested cylinders Telescope Metaphor

- For every p on level l=i a smaller cylinder with C of p is constructed
- All *l*=*i*+1 sub-cylinders are nested and hidden within the *l*=*i* cylinder
- x-axis for tree depth
- Siblings of C displayed along y-axis
- Parallel display of all *l*=1 cylinders
 - Squeeze or x-scale all other cylinders, same screen space





CCT - Navigation and Interaction

- Navigating the tree structure without clicks
 - Move mouse in upper or lower region → rotation
 - Branch node facets provide tree expansion functionality, mouse rollover and movement to the right
 - Short vertical & horizontal axis-aligned mouse movements
- Performing an action on a node: 1 click



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CCT - Tree Size and Presentation

Size

- Number of root children limited $num_{rc} \le 7$
- For $l \ge 1$ high branching degree (good: $num_f=20$)
- High tree depth (good: $d = num_{rc} 1 = 6$)
- Breadth instead of depth encouraged (except top)
- Typical values: few hundreds to thousand nodes
- Presentation Aspects
 - Cylinder radius, width, color; scale; facet number
 - Facet color, icon, text, indicator for branch nodes

CCT - Tree Size and Presentation

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dkompression

raktale Kompress.

CCT - Implementation

Internal tree representation with XML

<!ELEMENT NODE (NODE*)> <!ATTLIST NODE label CDATA #REQUIRED target CDATA #IMPLIED color CDATA #IMPLIED icon CDATA #IMPLIED>

VRML97

- Web-Prototype
- Shockwave3D
- (Java3D)



Conclusion & Future Work

Main CCT Characteristics

- Tree visualization AND fast & intuitive interaction
- Useful balance of detail and context: dynamical expanding & collapsing sub-hierarchies
- Comprehensible layout, fixed sizes and viewpoint
 maximum display quality and readability
- Resemblance with traditional menu systems
 → almost no training, intuitive interaction
- Restricted number of root children, medium-size

Conclusion & Future Work

Research context

- Example 3D Widget of Contigra Framework
- Component-oriented 3D graphical applications
- www.contigra.com
- Future Work
 - Enhanced implementations
 - Evaluation and usability testing (online course)
 - Investigate more complex hierarchies

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