

A Fast Focus+Context Viewing Technique for Web Navigation

Quang Vinh Nguyen

Faculty of Information Technology
University of Technology, Sydney
PO Box 123 Broadway, NSW 2007, Australia

Mao Lin Huang

Faculty of Information Technology
University of Technology, Sydney
PO Box 123 Broadway, NSW 2007, Australia

Abstract

Most web browsers do not give users a proper visual aid to guide their web journey. One of the approaches to overcome this problem is to use graphs and trees visualization. This paper presents a simple and fast focus+context technique for the navigation of web sites. We firstly give an overview of existing visualization techniques for web navigation. We then briefly present the hierarchical layout techniques as well as its advantages and limitations. We finally describe our focus+context technique for the navigation of hierarchical web structures.

Keywords: tree layout, focus+context, web navigation, visualization, sitemaps.

1. Introduction

With the increasing popularity of the Internet, the World Wide Web has become an important source of information. Because of the limited number of available access methods, web users often suffer from being lost in the hyperspace of vast amount of information. There are two traits of this syndrome: disorientation and cognitive overhead.

There are two categories of the solutions to the above problem. These are *search paradigm* and *browse paradigm*. The search paradigm is based on search engines while

the browse paradigm allows users to navigate the document space by triggering links via visual features on web pages. The browsing methods might employ visual aids, such as web site mapping techniques, to help the users in their navigation.

Available web site mapping techniques can be summarized into three categories:

- hierarchical mapping
- three dimensional mapping
- graphical or mesh mapping [8]

Hierarchical mapping uses parent-child format to show the site structure that the lower hierarchies display further detail of the above hierarchies. The three dimensional mapping uses a 3D space to visualize the content of the websites. In the other hand, graphical or mesh mapping organizes the content of the websites in 2D space using node-link diagrams. Because the structure of sitemaps is presented as a tree or graph, the graphical or mesh mapping systems often use available graph drawing algorithms [12] for visualizations of sitemaps. The typical visualization techniques for website mapping are hierarchical view [1], radial view [3], balloon view [4], WebOFDAV [9], hyperbolic browser [5], etc.

2. Classical Hierarchical Layout

The classical hierarchical layout is based on the algorithm developed by Reingold and Tilford [1] which is also called *RT algorithm*. In this algorithm, children nodes are positioned below their common ancestor. In short, the algorithm calculates the relative positions of sub-trees independently and then joins them in a larger tree by placing these sub-trees as close as possible (see Figure 1).

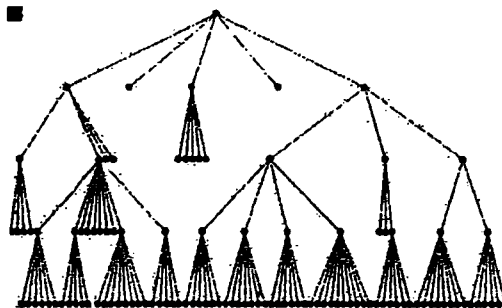


Figure 1. An example of the classical hierarchical layout.

RT algorithm produces not only aesthetically nice trees on the plane but it is also simple, fast and predictable. This algorithm can be applied to draw the abstract of sitemaps. Figure 1 shows the abstract sitemap of the Faculty of Information Technology at The University of Technology, Sydney. Unfortunately, there are no available good navigation techniques for viewing large hierarchies using this layout. Typical viewing techniques available for navigating classical hierarchical layouts are zooming [2] and fisheye-view [6, 7]. When a focused area is zoomed, the overall context is lost. This might lead to the broken of mental map during the navigation in the zooming techniques. On other hand, the fisheye-view is a focus+context technique that the context is kept during the navigation. However, this technique causes the distortion of views. This distortion reduces the geometric area reserved for displaying the overall context on the plane that might

prevent users from understanding the overall structure of the hierarchy.

Furthermore, most classical focus+context methods use 2D distortion techniques for viewing hierarchies which cost considerable large amount of the computation time for each change, especially for viewing large hierarchies. This is also an obstacle preventing from using this technique in navigating website where interactive speed is important.

This paper proposes a fast and simple focus+context technique applied on the classical hierarchical tree visualization for the web navigation. Our technique attempts to retain the shape of the layout during the navigation. This attempts to overcome the problem of the layout distortion of the fisheye technique. In our approach, the hierarchical layout is presented in vertically top-down manner where nodes in the equal-level are placed at the same horizontal line. The navigation operates horizontally and focus regions are dragged into the middle. This reduces the computation time for changing views as we only consider one dimension distortion of views for the browsing of hierarchies. We also provide a mechanism to solve the problem of labeling, especially the problem of displaying very long node's labels.

3. The Hierarchical-Layout Navigation System

Our hierarchical-layout navigation system includes two parts: layout and navigation. In the system, the sitemaps are represented as tree hierarchies where nodes indicate web pages' and edges indicate hyperlinks among these pages.

3.1 Layout

There are two steps of constructing the tree layout. We firstly build the layout based on *RT algorithm* [1]. Then, we apply a

transformation to every node in order to achieve the final drawing.

The *RT algorithm* takes the modular approach to calculate the position of nodes. The relative positions of the nodes in a sub-tree are calculated independently from the rest of the tree. Conceptually, the algorithm recursively traverses through the tree and place the nodes from leaves upward to the root of the tree. It is a bottom-up direction process in our system. Each sub-tree is considered as a local unit. From left to right direction, the siblings of a node in a sub-tree are placed to a proper minimal distance from one another. Then, all nodes of each sub-tree are shifted to the right in order to avoid intersection between sub-trees.

The final displacement of the hierarchy is calculated based on values from the above *RT algorithm*. This transformation is applied to x coordinate value of every node. In detail, we use the property of the function *ArcTangent* to ensure that the magnification is higher around the middle compared to region near the left and right borders. The magnifying value can be adjustable to suit with each application and user. Figure 2 shows an example of the final layout that the display is dense around the borders.

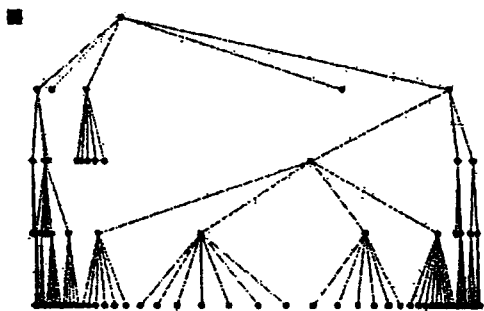


Figure 2. An example of the layout after applying the transformation.

3.2 Navigation and Interaction

In our system, the navigation operates horizontally by dragging information to the focus area, i.e. the middle in horizontal direction. For each movement, the similar transformation is also applied to x coordinate value of every node. This process makes sure that the context is remained by enlarging the interested part and reducing size of others. We remain the y coordinate value of all nodes during the navigation.

In the system, we only display the detail of nodes that are not very close to their siblings. Similarly to the classical hierarchical layout technique, we also have problem with labeling when the label of nodes are very long. To overcome this problem, we draw nodes' information just below their normal positions if their labels are too long that clash with others.

Figure 3 is a screen dump of our hierarchical layout of our faculty website. Figure 4 shows an example of an action when using our system to browse the site. In this example, the user browses and clicks the "COTAR" node to view the content of the page.

4. Conclusions and Future Work

We have presented a fast focus+context technique for the website navigation. This technique helps to browse and retrieve the hierarchical information without losing the context. We choose Reingold and Tilford layout algorithm to implement our viewing technique. This is because of its simple, fast, predictable and nice-layout features.

We currently refine our technique for the websites navigation. We will conduct a usability test to assess the effectiveness of this approach. We believe that this technique is a good method for navigating the websites.

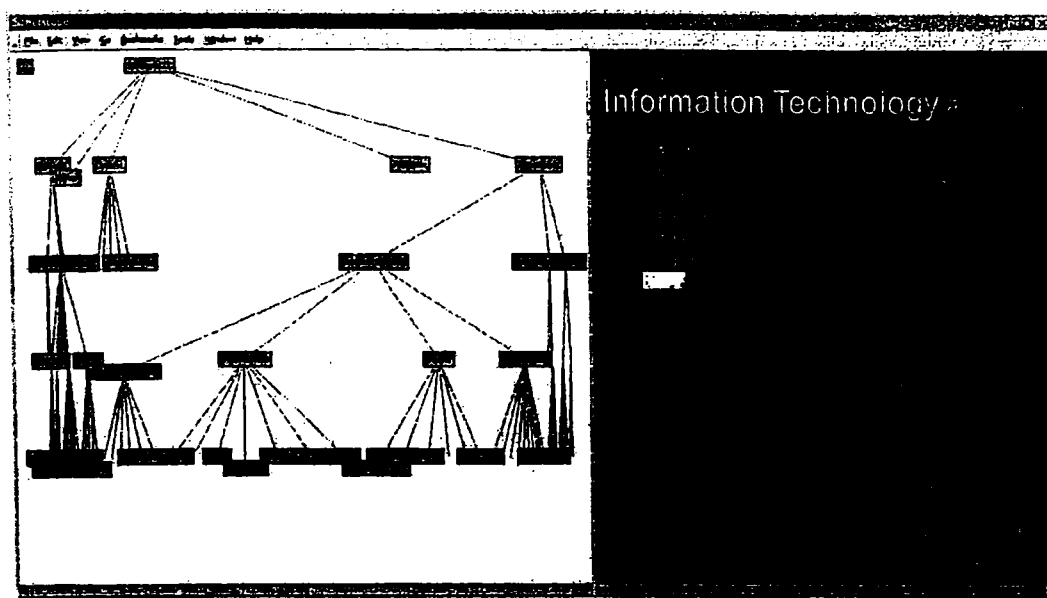


Figure 3. An example of final layout of our faculty website.

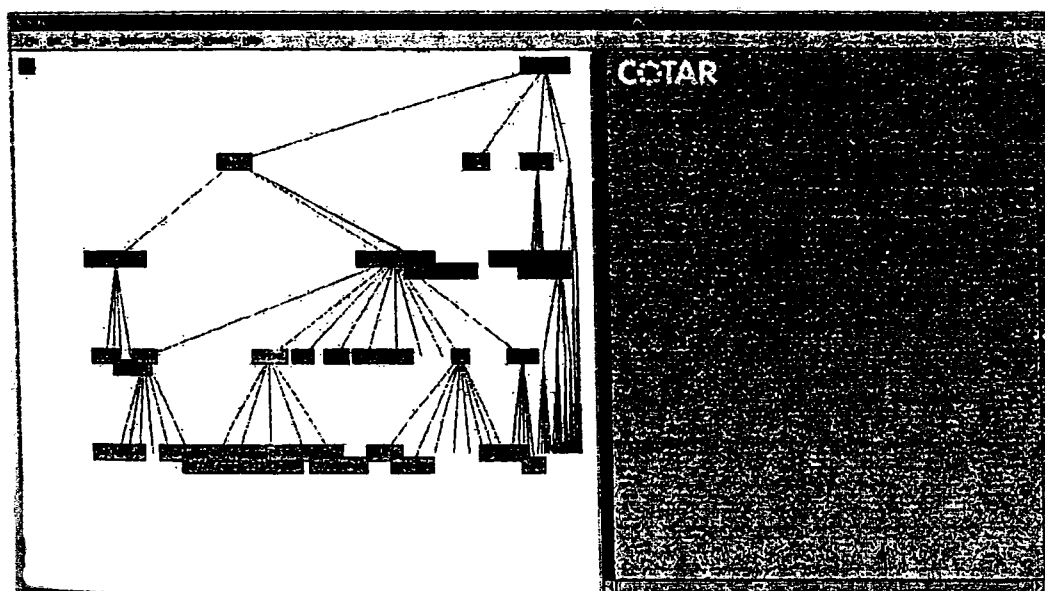


Figure 4. An example of an action when using our system to browse the site. In this example, the user browse and click the "COTAR" node to view the contain of the page.

References:

- [1] Reingold E.M. and Tilford J.S. Tidier drawing of trees. *IEEE Transactions on Software Engineering*, 7(2): pp. 223–228, 1981.
- [2] Herman I., Delest M. and Melancon G. Tree visualization and navigation clues for information visualization. *Computer Graphics Forum* 1998, 17 (2): pp. 153–165, 1998.
- [3] Eades P. Drawing free trees. *Bulleting of the Institute of Combinatorics and its Applications*, pp. 10–36, 1992.
- [4] Melancon G, Herman I. Circular drawings of rooted trees. *Reports of the Centre for Mathematics and Computer Sciences*, INS-9817, ISSN 1386–3681, 1998.
- [5] Lamping J. and Rao R. The hyperbolic browser: A focus+context technique for visualizing large hierarchies. *Journal of Visual Languages and Computing*, 7: pp. 33–55, 1995.
- [6] Furnas G.W. Generalized fisheye views. *ACM SIGCHI '86 Conference on Human Factors in Computing Systems* (Boston, Massachussetts), ACM Press, pp. 15–22, 1986.
- [7] Sarkar M. and Brown M.H. Graphical fisheye views of graphs. *ACM CHI '92 Conference on Human Factors in Computing Systems* (New York), pp. 83–92, 1992.
- [8] Huang M.L. Information visualization in web site mapping: a survey. *SCI2000/ISAS2000 Conference*, pp. 390–395, 2000.
- [9] Huang M.L., Eades P., and Cohen R.F. WebOFDAV – navigating and visualizing the web on-line with animated context swapping. *7th International World Wide Web conference* (Brisbane Australia), pp. 638–642, 1998.
- [10] Maarek Y.S. and Shaul I.Z.B. WebCutter: a system for dynamic and tailorable site mapping. *6th International World Wide Web Conference*, pp. 713–722, 1997.
- [11] Diebold B. and Kaufmann M. Usage-based visualization of web localities. *Australian Symposium on Information Visualisation*, p.p. 159–164, 2001.
- [12] di Battista G., Eades P., Tamassia R., and Tollis I.G. *Graph Drawing: Algorithms for the Visualization of Graphs*. Prentice Hall: New Jersey, 1999.
- [13] Website of Faculty of Information Technology, the University of Technology, Sydney. <http://it.uts.edu.au>.