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Innovations Affecting Us -- Hyperbolic Browsers: From GUI to KUI

Norman Desmarais
Providence College, normd@providence.edu

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Innovations Affecting Us —
Hyperbolic Browsers: From GUI to KUI

by Norman Desmarais (Acquisitions Librarian, Phillips Memorial Library, Providence College, Providence, RI 02918; Phone: 401-865-2241; Fax: 401-865-2823) <normand@providence.edu>

The World Wide Web has often been described as a library where all the books have been thrown on the floor. The challenge for librarians and information workers has been to try to organize a plethora of disparate material. The challenge for researchers has been to locate pieces of information relevant to their research.

Advances in computer storage and digital information have allowed for increasing complexity, making it difficult for users to understand the contents and structure of a site by following hyperlinks on individual web pages. Researchers typically complain about information overload, unfriendly interfaces, the absence of intuitive search structures, and the need to learn special languages or conventions to search effectively.

GUI

The graphical user interface (GUI) vastly simplified the process of training researchers to use computers because it allowed them to visualize information. But there has been very little progress in user interfaces since Douglas Engelbart built the first GUI — in 1969! For instance, the amount of information displayed on a monitor hasn’t increased much since 1990. And the pointing device or mouse has seen more modifications and improvements than the user interface.

Representing the quantity of information and its distribution within a set of linked documents poses a problem in visualizing information on the World Wide Web. Hypertext readers find this information along with the type of document (text, image, audio, video) useful in deciding on the suitability of a Website without spending a great deal of time browsing its structure. However, they find it difficult to navigate large document spaces. They often become disoriented and lose their location in the network, make decisions about where to go next, and keep track of pages previously visited, as documented by McKnight, Dillon, and Richardson. The problem of disorientation becomes more severe as the number of nodes increases.

GUIs, such as Microsoft Windows, focus on delivering information to the screen. They do not even begin the process of transferring knowledge to humans. A first step to knowledge acquisition requires understanding the relationship between various elements and how they affect one another. Just as a skilled manager must understand the technical or operational parts of a business as well as how they relate and affect one another to run a successful operation, a researcher needs to see the various facets of a topic or problem and how these factors interrelate to get a complete picture and formulate a solution.

KUI

One way to improve hypertext design is to provide a structured overview of the hypertext contents so as to facilitate understanding. A so-called knowledge user interface (KUI) uses visual cues rather than text or a combination of an underlying graphical structure with a textual component to visualize information. The User Interface Research Group at Xerox PARC (Palo Alto Research Center Inc.) [http://www.parc.xerox.com/islt/projects/usr/projects/InformationVisualization.html] defines information visualization as “the use of computer-supported interactive visual representations of abstract data to amplify cognition.”

Work done at the PARC promises to go far beyond the traditional GUI in speeding up the rate at which people can understand information, not just see it. It uses visual hierarchies, webs of nodes, even head and hand tracking devices, retinal projection, and virtual environments to enable navigation through complicated knowledge bases by making more relevant information available within a single view.

Dr. Ben Schneiderman of the University of Maryland is responsible (both directly and indirectly) for much of the reported research in information visualization. His Online Library of Information Visualization Environments (OLIVE) [http://www.vtl.umd.edu/Olive/] provides a wonderful resource for obtaining background information on the types of visual structures and their uses. It lets researchers read about eight structure types and follow links to current projects utilizing the technology.

Donald T. Hawkins effectively summarizes information visualization when he says, “It is important to note that what is being communicated in visualization is not the information itself, but its structure.” Just because we do not readily perceive the structure does not mean it is not there. We must discover and impose structure if we are to apply technology to information management or information-intensive work because it is the structure that identifies the relationships between the various elements. Work on metadata and metatlanguages such as SGML and XML goes a long way to identifying information structure.

Hyperbolic Browser

John Lamping, Ramana Rao, and Peter Pirolli take another approach to information visualization. They call their approach the Hyperbolic Browser. It represents information in a tree-like structure, with the root node at the center and the branches extending outward. Each branch is a hyperlink to another page, and clicking on a branch expands it to show more details. This allows users to quickly find the information they need without having to navigate through many layers of links.

National Identification Systems

Essays in Opposition


Lie Detectors

A Social History


Library World Records


A True Politician

Rebecca Browning Rankin, Municipal Reference Librarian of the City of New York, 1920–1952

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visualization. They explain how to map a hierarchical tree structure
to a hyperbolic display that provides a “fisheye” representation
of information. A traditional 2-D display, such as the Windows file
manager, can only display about 100 nodes in a 600- by 600-pixel
window. A tool like InXight Categorizer, developed by InXight
Software Inc. [http://www.inxight.com], helps publishers and infor-
mation aggregators arrange unstructured information into classifica-
tions or taxonomies. It uses a strong natural language processing
system that automatically classifies documents by subjects and can
display up to 1,000 nodes in the same 600- by 600-pixel window. A
hyperbolic browser like InXight Software’s Star Tree navigator then
makes it possible to navigate, visualize, and absorb far more complex
sets of information.

John Lamping and Ramana Rao of PARC state that “the amount
of information that can coherently be displayed on the screen of an
interactive computer system can dramatically affect the ease of inter-
acting with a large information structure.” They demonstrate the
Hyperbolic Browser technique for displaying and manipulating large
hierarchies and graphs, such as organization charts, file system hier-
archies, and the link structure of Web servers and spaces. These
structures have been converted to trees that initially display with the roots
at the center with multiple branches off. Different nodes continu-
ously appear and disappear. As one moves along the roots, the dis-
play transforms smoothly to bring other nodes into focus.

For a library example, see The Universal Library at Carnegie
Mellon University’s site [http://www.uli.org/webRoot/_hTree] which uses
InXight’s software. This site is an excellent illustration of the technol-
yogy both because of the size of its structure and because of the expectation that it will continue to grow with the addi-
tion of more material. This site shows what hyperbolic structures can
do for the organization of knowledge; but it also demonstrates some
of the limitations of the technology in its current state. Rick Lugg of
R2 Consulting also uses InXight’s Star Tree to map the ebook indus-
ytry. The various nodes branch off the central node (original con-
tent) in a star fashion as seen in the following graphic.

Fig. 1 Main screen of R2 Consulting’s map of the ebook industry.

The various topics appear in different colors to facilitate group-
ing, conceptualization, and navigation. Sub-topics overlap each other
as can be clearly seen — particularly at the top and the right side of
the screen. Moving the mouse or pointing device over a button oper-
ates much like a pop-up window, making the content of the button
clearly visible. (Mouseovers are another navigational tool to high-
light connections between nodes.) Clicking on a button re-focuses
the display with the selected button at the center.

Looking at the eBook Formats button at the bottom of the screen, we
see lines branching to nodes that are not identified. Clicking on
this button brings it to the center, revealing several of the sub-topics.
Clicking on Peanut Press centers on that button (fig. 2); and we no-
tice several lines at the upper left that lead to other formats not dis-
played. To return to the initial display, one only needs to click on the
Original Content button.

Fig. 2 Selecting the eBook Formats button followed by the Peanut
Press button re-centers the display to focus on the desired sub-topic.
Clicking on the Original Content button returns to the initial display.

Information Mapping

The information hierarchy is laid out on a hyperbolic plane which is a
non-Euclidean geometry where parallel lines diverge from one another.
In this construct, the circumference of a circle grows exponentially with
its radius. This means that as distance increases, exponentially more
space becomes available.

The mathematical construct is then mapped onto a circular display
region. This allows laying out the hierarchies in hyperbolic space in a
uniform manner so that the distance between parents, children, and
siblings is roughly the same across the hierarchy — even the more detailed
hierarchies. Tamara Munzner, a graduate student at Stanford Univer-
sity, has extended hyperbolic browser technology into three dimensions
by plotting the nodes onto a hemisphere instead of a circle. This allows
the software to handle over 100,000 nodes by hiding those not relevant to
a particular search.

There are two ways of mapping the hyperbolic plane: the Klein model
and the more common Poincaré model. The latter works better for visu-
alizing hierarchies because it preserves the fan-out shapes at nodes and
uses the screen real estate more efficiently. As one navigates the display
and changes the focus at the center of the disk, the rest of the hyperbolic
plane fades off toward the edge of the disk. The effect resembles that of
the fisheye lens, giving more room on the display to a point at the center
than to points around the periphery.

Clicking on any visible point or dragging any visible point to any
other position changes the focus smoothly with that point at the center.
Regions closer to the center appear magnified while those further from
the center shrink as they move toward the edge, allowing researchers to
concentrate on the portion of interest and reducing distraction caused by
unnecessary information. Thus, a hyperbolic browser can display up to
ten times as many nodes and provide more effective navigation around
the hierarchy, allowing the reader to browse the tree structure while main-
taining the visual context.

Examples

Examples of hyperbolic browsers include InXight’s Star Tree,
www.clearforest.com] and HyperProfMapit, a hyperbolic browser that
provides a graphical display of patent citation information for U.S. and
European documents. Conc-Tree is a 3-D tree that focuses on nodes the
user touches and allows manual or automatic culling to show only items
of interest.

Hyper-G® represents Websites as nodes on a 3-D tree; but it does not use
the fisheye paradigm. Virtual Integration Technology’s knowledge man-
gement product, Deliverymanager, incorporates a hyperbolic browser that
allows users to navigate a business information directory and to re-
trieve corporate information throughout an enterprise. Customers can
display the entire directory on a single screen and find relevant informa-
tion at a glance instead of navigating through several directories.

TheBrain Technologies [http://www.thebrain.com] consists of a re-
lational database with a visual presentation similar to hyperbolic trees.
However, it differs in that it does not follow a hyperbolic structure mapped
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Drawbacks

Hyperbolic trees are good for browsing collections; but they become unwieldy and almost useless for finding specific documents or pages when one does not know their location in the hierarchy. Readers who select particularly dense areas of a tree and try to move them to the center of the display will notice that the labels crowd each other out, making them impossible to read. Also, hyperbolic browsers require a JavaScript-enabled browser such as Netscape or Internet Explorer to operate.

Circular hyperbolic trees and 3-D tree representations may also disorder new users, thus requiring more training than flat structures. However, as the number of nodes increases, a flat layout of tree hierarchy may become unwieldy. Information on the nodes may become too small to identify—a problem that can be corrected with higher resolution displays. Although it will always be more difficult to locate a node in such hierarchies because of information overload, the fisheye paradigm helps overcome this problem by showing the relevant portions of information.

George Lawton speaks of the weakest link in getting text information to people as the speed at which people can read from the computer. He offers studies that indicate that the average person reads between 240–400 words per minute (wpm) from paper but only 100–200 wpm from a monitor because of the lower resolution and the need to manually scroll the text. Peter McLean, president of Softology (www.softology.com) believes that people can absorb a maximum of 800–900 wpm which is almost four times faster than the average person can read on a computer screen.

Other constraints limiting reading speed include subvocalization and poor eye movement. Subvocalization refers to our habit of "speaking" the words in our minds while we read them. Poor eye movement refers to a habit of the eyes stopping repeatedly throughout a line of text. These factors limit most people to reading rates under 400 words per minute.

Critics believe that although hyperbolic trees and visually oriented relational databases are good for browsing collections, they will not replace traditional search engines any time soon. Information professionals will have to make an enormous cultural shift in currently ingrained conventions for searching and information retrieval. Neither the 2-D nor the hyperbolic browsers contain a sophisticated text retrieval engine with Boolean search capabilities; and initial studies have found almost no significant differences between the tree browser and the hyperbolic browser.

New Reference Works from Grey House Publishing

Notions of the World, 2004
A Political, Economic and Business Handbook
from last year's US invasion of Afghanistan to the year's war in Iraq, the political, economic and business lifelines of the world have dramatically changed. This broad overview offers concise, clear analyses of the economic, political, social, and business conditions in 200 countries— including pertinent information on Political Risk, Macroeconomic Outlook, US-Mexican Trade, Doing Business in Latin America, Russia, China, Japan and more.

Ancestry in America: A Comparative Guide to Over 200 Ethnic Backgrounds
This broad new information work presents comprehensive articles on the ethnic, social, cultural, and business climates of over 200 countries— including pertinent information on Political Risk, Macroeconomic Outlook, US-Mexican Trade, Doing Business in Latin America, Russia, China, Japan and more.

Profiles of America: Facts, Figures & Statistics for Every Populated Place in the United States
Profiles of America is an easy-to-use source that rolls together, in one place, statistical, topographical, economic and descriptive information about every place in the United States in one easy-to-use format. This concise reference work is easy to read, easy to find, easy to comprehend.

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InNight Software [http://www.innight.com].


TheBrain Technologies [http://www.thebrain.com].

TheBrain Technologies WebBrain [http://www.webbrain.com].

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<http://www.against-the-grain.com> 97
Desperately Seeking Copyright

Copyright on Campus: Librarians Remain at the Head of the Class

by Edward W. Colleran (Director, Publisher Relations, Copyright Clearance Center) <ecolleran@copyright.com>

Copyright issues are taking center stage on college campuses, much as they have in the news, courts, and Congress. Controversial enforcement efforts by the Recording Industry Association of America (RIAA) are shining a spotlight on illegal music downloading. At the same time, significant developments, such as the enactment of the Technology, Education and Copyright Harmonization (TEACH) Act (see related article, page 34) and copyright infringement litigation efforts targeting coursepack providers, are breaking new ground by helping to clarify lawful versus unlawful content usage.

These measures reflect the realities of a digital environment in which the benefit of easier access to information has further complicated the already sensitive issue of copyright compliance. Central to the discussion are library professionals who have the complex task of balancing seemingly competing, but equally compelling, positions: the need for ready access to information that furthers the educational process; and the protection granted to authors and publishers to encourage continued creation of useful materials.

Widely regarded as the campus experts on copyright compliance, librarians offer knowledge and experience that helps their institutions solve these information and compliance challenges. They are accustomed to collaborating with fellow educators, authors, publishers and other sources of research, instructional and other materials in order to facilitate access to information.

Because they have been in the forefront of efforts to develop today’s copyright compliance solutions, they are also the ideal candidates to help frame the debate and to determine whether and how to adapt the old rules to new media.

The Truth About Usage Trends
The impact of the digitization of material that previously would have been restricted to print has been mixed. On the one hand are those who portray the demise of books, journals, and other forms of “hard copy.” On the other are those who believe the content opportunities of new electronic formats to be wildly overstated. Not surprisingly, publicly available research, as well as our own experience at Copyright Clearance Center, indicate that the truth lies somewhere in the middle. In fact, a recent survey by Outsell, Inc. indicates that while students drive changes in the way they access information and on print media, they tend to supplement printed materials with electronic content.

Conducted in collaboration with the Digital Library Federation (DLF) and the Council on Library and Information Resources (CLIR), the Outsell survey is one example of DLF’s ongoing efforts to gauge changing patterns of information use and their impact on libraries and library professionals. According to CLIR’s report on the survey, entitled “Dimensions and Use of the Scholarly Information Environment,” Outsell interviewed 2,208 faculty members and graduate and undergraduate students at private, public and doctoral research universities, plus 1,026 faculty members and undergraduates at private liberal arts colleges, for a total of 3,234 survey respondents. Among the survey’s findings:

- Although more than 70 percent of faculty and graduate students rely heavily on print for teaching, almost 60 percent of faculty members also maintain Web pages for their students. In addition, they make course information available on reserve at the library, in the campus bookstore and in the copy center.

- Just over half of undergraduates say they rely on print sources all or most of the time, compared with more than 70 percent of graduate students and faculty.

- Graduate and undergraduate students turn to the physical and virtual library to meet 65 percent to 70 percent of their information needs. They also use the library’s Web site as their gateway to online resources.

- About 16 percent agree with the statement, “The Internet has not changed the way I use the library.”

- 41.5 percent say they work and study away from campus more than they used to.

- Over 98 percent of those surveyed trust their library to contain information from credible and known sources. In contrast, 75.4 percent believe that the Internet “provides high-quality information.”

These findings underscore the critical function of the library and the expanded responsibilities of library professionals in an evolving information landscape. Librarians and library directors remain invaluable resources for those seeking access to both print and electronic information, be it for teaching, learning, or research. They are on the front line of the information revolution, bearing witness to emerging trends, identifying potential copyright and usage issues, and identifying solutions. They also play an integral role in fulfilling new requirements—particularly for institutions that take advantage of TEACH—to develop campus-wide copyright policies and follow through with the education that can ensure compliance.

What Does the Future Hold?
Not surprisingly, future challenges and opportunities have their roots in the current information environment. Digital technology will continue to drive changes in the way we access information and in the steps we take to ensure that such access complies with copyright law.

While there is every indication that paper and printed materials will remain integral to instruction and research, increasingly they will be supplemented by electronic information. Already evident in the growing use of electronic course materials, this trend is likely to continue in part because, as the Outsell survey indicates, younger students are more comfortable with electronic media. As authors and publishers become more convinced of the advantages of presenting information in this format, more are adopting online, more committed to providing users with convenient access to the rights to use such information, the digitizing of existing materials is likely to accelerate.

Today’s successful copyright and licensing solutions are apt to serve as models for the solutions of the future. Online services, such as those at Copyright Clearance Center’s www.copyright.com, which offer immediate access to content reuse rights are expected to continue to gain in popularity. Blanket licenses, currently offered to businesses as a convenient, economical option, may be modified to meet the needs of academic users and to encourage lawful use of copyrighted works by faculty and students alike.

Technological advances, such as more flexible, user-friendly versions of rights management tools, will ensure access to information for target audiences while protecting the rights of authors, publishers and other rightsholders. These same tools will enable library professionals to better meet the needs of information users.

Content management software can, for example, automatically record usage patterns to assist librarians with collection management decisions. Little-used materials could then be replaced with additional copies of high-demand works, or with new publications of interest to library customers.

The current focus on copyright compliance is a harbinger of things to come. The most obvious example, of course, is the firm stance adopted by the RIAA. Equally significant, however, are the TEACH Act requirements that institutions educate students about copyright policies and mandate compliance. One way to respond to this would be

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Additional Reading
Chimera, R., Wolman, K., Mark, S., Schneiderman B. (revised Sept. 1993) An exploratory evaluation of three interfaces for browsing large hierarchical tables of contents, ACM Transactions on Information Systems, vol.12, #4 (Oct. 94) 383-406. CS-TR-2620, CAR-TR-539 shows that tables of contents that allow the user to expand and contract levels of the hierarchy decrease browsing time compared to a stable, fully-expanded version.
Nardi, David A.; Plaisant, Catherine; Marchionini, Gary; and Konlodi, Anita. Visualizing Websites using a hierarchical table of contents browser: WebTOC http://www.cs.fsu.edu/~nardi/1999/elkhonon.html describes a method for visualizing the contents of a Website with a hierarchical table of contents using a Java program and applet called WebTOC. Early results from user studies suggest that WebTOC is easily learned and can assist users in navigating Websites.

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