Visual Interfaces to Digital Libraries

The accelerating rate of scientific and technical discovery, typified by the ever-shortening time period for the doubling of information – currently estimated at 18 months – causes new topics to emerge at increasing speed. Libraries have a hard time just cataloguing the large amount of produced documents. Scientists and practitioners who must read and process relevant documents are in need of new tools that can help them to identify and manage this flood of information. Visual Interfaces to digital libraries apply powerful data analysis and information visualization techniques to generate visualizations of large document sets. The visualizations are intended to help humans mentally organize, electronically access, and manage large, complex information spaces and can be seen as a value-adding service to digital libraries. This talk motivates the design and usage of visual interfaces to digital libraries, reviews diverse commercially successful systems, and discusses opportunities and challenges.

Reference:
Overview

1. Motivation
2. Visual Interfaces to Digital Libraries (DL)
   - Research Systems
   - Commercial Interfaces
3. Collaborative Information Visualization Environments
4. Top Ten List of Major Challenges

1. Limitations of Today’s Interfaces to DL

Facing the Information Flood:

- Information available in electronic form doubles every 18 months.
- Human perception stays constant.
- Almost no development in online interfaces. Can’t pack more text.

Let's see how much our means of accessing information have changed using [http://www.archive.org/](http://www.archive.org/).
Yahoo
Oct 17, 1996

Yahoo
Sept 2, 2002
Yahoo
Nov 21st, 2005

Amazon
Sept 02, 1999
Amazon
Sept 2, 2002

Amazon
Nov 21st, 2005
Facing the Information Flood:
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- Human perception stays constant.

Opportunity & Challenge:
Shift user’s mental load from slow reading to faster perceptual processes such as visual pattern recognition.

Facilitated by:
- CPU speed & hard disk sizes have increased by two orders of magnitude.
- Bandwidth: Since the invention of the web browser, international IP bandwidth deployments have more than doubled each year.
- Monitor resolution has increased by a factor of 4 (800x600 -> 1600x1200).
2. Visual Interfaces to Digital Libraries

Present search results not as rank-ordered lists of matching documents but as clusters of semantically similar documents.

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VisDL to ISI’s Web of Science Interface

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VisDL to IUB’s Art Image Database

“head” into a search result - “get inside a head”

VisDL Usability Studies

- Comparison of text-based and 2-D desktop interface and 3-D immersive CAVE interface.
- Error rates and completion times for a range of different tasks.
- Steep learning curves for 2-D & 3D visualization & 3D input devices, 3D navigation.

Other Research Systems not captured in the book

GRIDL
HCI Lab
U Maryland
applied to court cases

Jair Space (by Mark Foltz, MIT, 1995)

Designing Navigable Information Spaces
NicheWorks: The Chicago Tribune Website

By Graham Wills, Bell Labs (Lucent Technology).

A set of visualization tools for very large graphs. MOMspider plus layout algorithms for very large graphics.

(Source: http://www.bell-labs.com/user/gwills/NICHEgui/de/nichepaper.html)

Smithsonian Institution’s HistoryWired: A few of our favorite things. This experimental site introduces visitors to some of the three million objects held by the National Museum of American History, Behring Center.

http://historywired.si.edu/index.html

SmartMoney
Maps electronic card catalog searches in libraries can be projected into a virtual architectural world, where spatial qualities can provide orientation and increase intellectual productivity.

(Source: http://www.arch.columbia.edu/DDL/research/SWIRL/)

Spatial Worlds for Information Retrieval and Learning

Visualisation pour les bibliothèques numériques
Numéro spécial de la revue « Document Numérique »
Coordonnateurs de ce numéro:
Jean-Daniel Fekete (INRIA Futurs/LRI) & Eric Lecolinet (ENST)
3-D DL interface

User interfaces for information strolling on a digital library
Mikiya Tani, Toshiyuki Kamiya, and Shunji Ichiyama, Kansai C&C Labs. NEC Corp.

(Source: http://www.cc.gatech.edu/gvu/people/Visitors/Mikiya.Tani/report/ISDL/)

Shared Knowledge Garden

(Source: Crossley et al., BT Laboratory, UK)
KartOO by Laurent and Nicolas Baleydier

Organizes search results retrieved from relevant web search engines by topics and displays them on a 2-dimensional map.

Each Web page is represented by a ball. Size of the ball corresponds to relevance to the query. Color-coded links suggest how the documents interrelate. Resting the mouse pointer over a "ball" causes a brief description of the contents to appear.

http://kartoo.com/
Antarcti.ca System Inc.'s Visual Net™

product

Provides visual interface to the National Library of Medicine's PubMed database, in particular the Anatomy/Body Regions section. Initial data map shows the top-level Medical Subject Headings (MeSH) categories arranged alphabetically in rows from left to right, top to bottom.

Users can click on an area of interest to zoom into the corresponding area, causing an enlarged version of the area to appear further subdivided into subcategories, if there are any. The subcategories are listed in the legend on the left, and labeled in bold on the map.

Alternatively, users can filter out documents of interest by entering a keyword in the search window. Matching documents will be marked on the map to facilitate visual browsing based on the Boolean search result.

http://pubmed.antarcti.ca/start

3. Collaborative Information Visualization Environments

**Mirror Gardens**
Visualize user interaction data to evaluate the effectiveness and usability, to optimize design properties, or to examine the evolving user community of a world.

**Memory Palaces**
Provide intuitive, efficient, and collaborative document access for a scholarly community.

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**Indiana University’s Collaborative Information Universe**

This project is a collaboration between the School of Library and Information Science and UITS’ Advanced Visualization Laboratory. The project's goal is to provide a 3D web-based collaboration mechanism for all IU faculty, staff and students on any of the eight IU campuses, located throughout the state of Indiana.

[http://iuni.slis.indiana.edu/](http://iuni.slis.indiana.edu/)

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Visualizing Social Diffusion Patterns in 3D (Virtual Worlds)
(Börner & Penumarthy, 2003 & 2004)
Temporal-spatial distribution of Conference attendees

- Conference worlds are represented by square, perspective maps, each labeled by its name.
- Worlds accessed at the beginning of the conference are placed at the bottom, worlds accessed later toward the top.
- Next to each world is a circular snapshot of the virtual venue. Short descriptions of the main sessions are added as text.
- Major jumps between worlds are visualized by transparent lines. The thickness of each line corresponds to the number of traveling users. Color coding was used to denote the chronological paths of the conference sessions.
Figure 5: The seed map for Group 1.

Figure 9. Episodes of collaborative search by Group 3.


Figure 10. Episodes containing extended intervals of silence while group members being engaged in individual search.

Figure 13. Group Tightness Space, colored by tightness measures.
4. Top Ten List of Major Challenges
detailed in Borner & Chen book.

1. **Theoretical Foundations.** Although principles for perception and cognition, principles for computer graphics, and principles for human-computer interaction do exist, they do not lead themselves readily in the form of design principles. Many principles are tightly coupled with particular environments and it is hard to generalize them. More often, the same fundamental problem disguises itself in different forms, which also complicates the process of putting available theories into practice. Foundation works are urgently needed.

2. **Empirical Foundations.** It is crucial to make clear what has been empirically proven to be useful and beneficial.

3. **Scalability.** Computing and data processing power is growing faster, so is the volume of the data we need to handle. Visual scalability is the capability of visualization tools to display large datasets effectively, in terms of either the number or the dimension of individual data elements.

4. **Labeling.** Displaying readable labels and selecting meaningful labels.

5. **Individual Differences.** One size can hardly fit all. Spatial ability indicates an individual’s ability to recognize and handle spatial relationships of objects. Research in human-computer interaction has shown that individual differences can be the most significant factor in one’s performance.

6. **Supporting Collaborative Work.** Given the individual differences we need to accommodate and the diversity of social norms in cyberspace, supporting collaborative work is a challenging in its own right.

7. **Benchmarking and Standardization.** The provision of commonly accessible and comparable test collections has been proven useful in several fields, especially test collections in information retrieval and associated text retrieval conferences (TREC).

8. **Evaluation** is needed to answer what has worked.

9. **Personalization.** Pro-active, customized, and personalized information delivery is an increasing trend in digital libraries. Visual interfaces are in a good position to organize and re-organize the way an underlying digital library is presented to a client, tailored accordingly to the client’s background and access history.

10. **Modularization and standardization** of digital library services and information visualization services will save valuable resources from re-inventing wheels.

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Publications

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