Virtual Browse: Designing User-Oriented Services for Discovery of Related Resources

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Abstract

Although academic libraries are increasingly converting stacks into collaborative spaces and physical books and journals are being replaced by their electronic counterparts, the concept of browsing as a means of discovery is seeing a resurgence in the world of search and discovery. While many users start their online research with electronic databases and library catalogues, interviews with North Carolina State University Libraries patrons provide evidence that physically browsing the shelves to find similar materials is still common. A growing awareness of the need to preserve this type of serendipitous discovery as a complement to keyword searching is inspiring the development of online virtual browsing tools that replace and enhance physical access to library stacks.

What Is Virtual Browsing?

The term "browsing" refers to a range of human activities and is used in multiple disciplines, but according to Marchionini (1995), in the field of computer and information science it generally means "navigating, scanning, and scrolling" (p. 100). Browsing also has a specific meaning when used in libraries, where it is "most often associated with card catalogues or bookshelves" (Marchionini, 1995, p. 100). By "virtual browse," we refer here to a computer interface designed to facilitate navigating and scanning a virtual set of records displayed using the visual metaphor of books on a shelf. This is a combination of the traditional library and the computer and information science use of the word "browse."

The advantages and characteristics of browsing as part of the information-seeking process have been discussed by a number of information science scholars. Bates (1989) describes one method of browsing as

"area scanning" and notes that "this technique is most commonly used with books arranged by a library classification scheme on the shelves of a library" (p. 416). Area scanning is useful, Bates argues, because "the searcher is exposed to a variety of related areas, some of which, because of the jumping around, may be related in unexpected ways—thus producing serendipitous discoveries" (p. 417). Although made useful by the classification scheme, area scanning is especially productive because it can give the searcher a deeper sense of the work than the classification scheme can alone: "a searcher can look directly at the full text of the materials" and thereby "get a quick gestalt sense" of the work (Bates, 1989, p. 417). Another advantage of browsing mentioned by Marchionini (1995) is that "it requires a smaller cognitive load than analytical search strategies" (p. 103).

Bates (1989) suggests that employing the familiar activity of shelf browsing as a metaphor in a computer search interface could be advantageous, as it allows searchers to intuitively utilize browsing skills they have already developed. Such an interface could be designed to reproduce the advantages of browsing physically, including lower cognitive load, using item collocation to promote serendipitous discoveries, and promoting the ability to examine the content of potentially interesting items.

Although Bates (1989) mentions a hypothetical computer interface that presents visual representations of books on a virtual bookshelf, Beheshti, Large, and Bialek (1996) actually built one. Beheshti et al. discuss the design and performance of the Public Access Catalogue Extension (PACE) interface that displays library catalogue records as book spines, sized according to data in the MARC record. In user testing they found that the PACE interface "performed just as well as a second-generation OPAC in terms of speed and search success." Additionally, they found that the "majority of students . . . preferred the browsing capability of PACE through the familiar metaphor of books and library shelves to a text-based OPAC" (p. 231).

Despite the positive reception by students in Beheshti et al.'s study, visual shelf interfaces have not yet become common features of library OPACs, the shelf list being the most similar, though text-based, incarnation. Instead, visual shelf-browsing interfaces were popularized in online environments outside of libraries. For example, the Android Market, iTunes, and Netflix present differently categorized sets of items for browsing as horizontal rows of objects. This is more similar to browsing products in a store than searching an e-commerce site. Browsable sets most commonly include items arranged by subject category, such as "financial applications" or "electronic music," but other common sets leverage user history or aggregate user behavior to present results. For example, Netflix shows sets of movies "popular near you," while Amazon shows items related to a user's recent browsing history. These interfaces are popu-

lar, presumably because they are effective at exposing content to users of these services. The prevalence of shelf-browsing interfaces also means that many Internet users are familiar with them.

The visual metaphor of virtual browse also obscures the difference between a record that represents an object and the object itself. As early as 1996, Beheshti et al. recognized that experimental graphical OPAC interfaces were "utilizing concepts that move users closer to direct manipulation of objects or documents" (p. 231). In 2011, when many e-books, electronic journal articles, movies, and music are available immediately over the network, the distinction between a record and the content it refers to is further diminished. This may be why sites like Netflix, Apple TV, the iTunes store, and Android Market, where content is delivered immediately over the network, use the shelf metaphor so frequently (see fig. 1).

VIRTUAL BROWSING IN LIBRARIES

With the physical shelf literally disappearing in many libraries, traditional stack browsing is becoming less feasible. In order to increase user space in libraries, many physical volumes are being moved to off-site storage facilities. An OCLC report published in 2007 concluded that "high-density library storage facilities have moved into the mainstream for collection management in academic libraries" (Payne, 2007, p. 5). At that
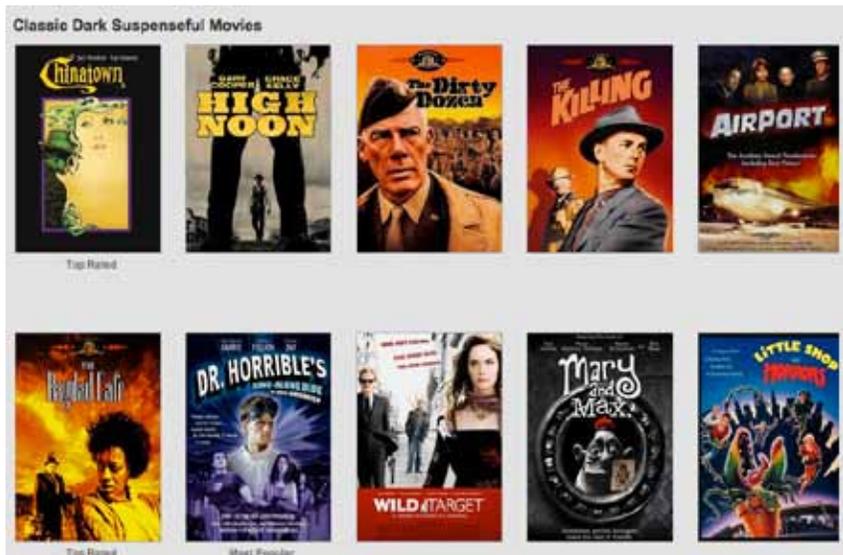

Figure 1. Netflix uses a virtual browsing interface to allow users to explore different categories of movies. (Source: Netflix, http://movies.netflix.com)

time, there were sixty-eight high-density library storage facilities in North America holding approximately 7 percent of the 1 billion volumes across the continent (Payne, 2007, p. 8). At the North Carolina State University (NCSU) Libraries, about 770,000 of the approximately 3.3 million items in the collection are stored in a closed-stacks shelving facility on campus. Although these represent the least-circulated volumes in the collection, it still means that close to 25 percent of the collection is not available on open stacks. In addition, another 7 percent of the collection is dispersed across four branch libraries.

Another major trend across academic libraries is a growing commitment to purchase electronic content. Increasingly, academic libraries are investing more significant portions of their collections budgets in electronic resources, and the Association of Research Libraries (ARL) statistics from 2008–2009 reveal that the average ARL university now spends 56 percent of its budget on electronic materials (Kyrillidou & Morris, 2011, p. 18). At the NCSU Libraries, approximately 20 percent of the monographic collection is composed of e-books. The intangible nature of these digital materials confounds traditional shelf-browsing activities.

For NCSU Libraries patrons, these trends mean that a user browsing the shelves at the main D. H. Hill Library is exposed only to about 60 percent of the collection. The decision to migrate 1.3 million volumes of the NCSU Libraries collection into an automated storage and retrieval system in the new Hunt Library[1] provided added impetus to begin exploring virtual browsing tools as a complement to traditional keyword searching. In-depth interviews with a small number of faculty members on the NC State campus, which is focused on science, engineering, textiles, and agriculture, indicated that while searching the library catalogue to find specific items is the primary entry point for discovering non-article resources, it is often followed by physically browsing the stacks as a valued secondary discovery strategy. Even when faculty focus on recent journal publications to support their research, access to books in the library can play an important role when entering new areas of interdisciplinary research or teaching that are less familiar.

Current Projects

An increasing number of projects in the area of virtual browse provide evidence that these trends are impacting libraries on a wide scale. Two recent efforts that explore virtual browsing of bibliographic materials are Harvard Library Innovation Lab's ShelfLife project and the Infinite Digital Bookshelf from Google. The ShelfLife project experiments with enabling users to browse an online "shelf" of book spines (fig. 2); rather than focusing on visual browsing with cover art, it sizes the spines based on physical dimensions and uses the concept of "ShelfRank" to emphasize titles that are considered most relevant to the community. Users can pick
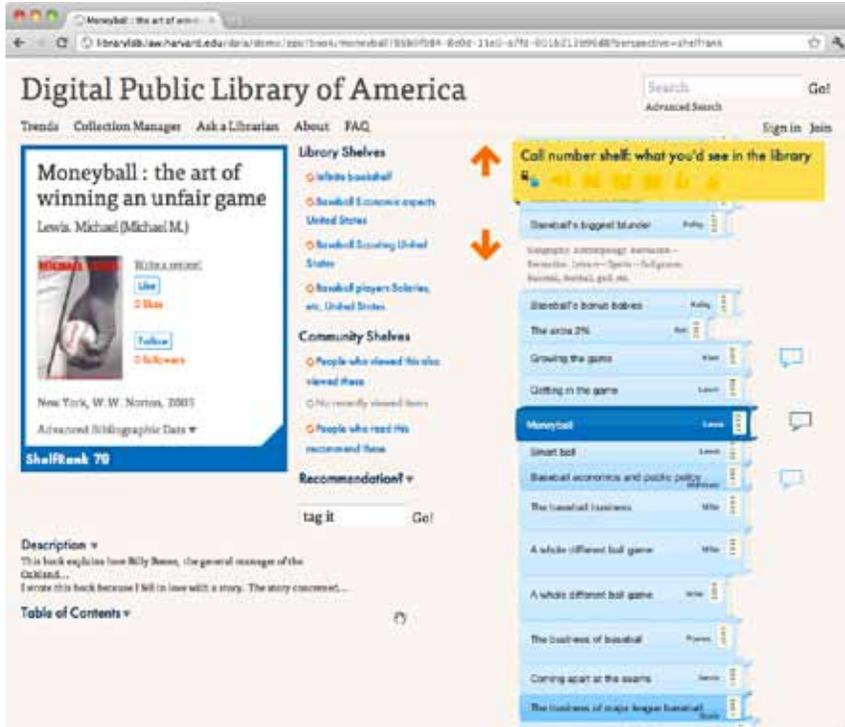
Figure 2. ShelfLife's Infinite bookshelf (ordered by call number) as viewed from an individual title. (Source: Harvard Innovation Lab, Creative Common 0, http://librarylab.law.harvard.edu/dpla/demo/app/book/moneyball/86b9f984-8e0d-11e0-a7fd-001b213b96d8?perspective=shelfrank)

whether they want their "ShelfRank" experience to be based on overall interactions with the university community, to be weighted toward undergraduate interactions, or to consider only the number of copies owned across the library system. The ShelfLife designers emphasize that this digital environment is "better-than-real shelves" because it allows books from many physical libraries to colocate on one shelf and also allows users to reorganize the shelves to see items colocated by author, subject, or community interest (Harvard Library Innovation Lab, n.d., §3).[2]

With their Infinite Digital Bookcase, Google designers began experimenting with what a bookshelf might look like if it was transitioned to the digital environment and designed to hold digital books (Koblin and Schilit, 2011). Books are colocated by general interest subjects, such as Bestsellers, Children's Books, Fantasy, History, or New Arrivals. Users select a subject area, "spin the shelf" with their mouse (fig. 3), and then "open" a three-dimensional representation of a book to see a short synopsis (fig. 4).[3]
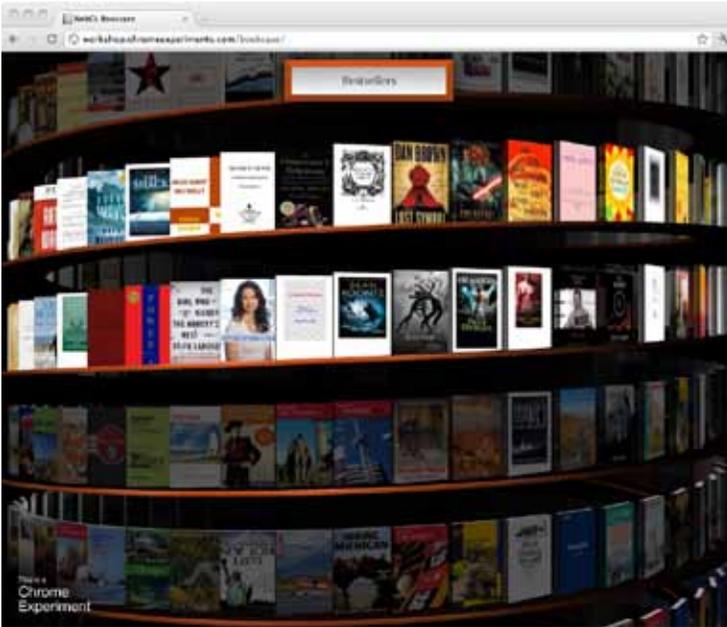
Figure 3. Google's Infinite Digital Bookcase. (Source: Google Chrome Experiments, WebGL Bookcase, http://workshop.chromeexperiments.com/bookcase)

Figure 4. Viewing details about an individual book from the "bookcase." (Source: Google Chrome Experiments, WebGL Bookcase, http://workshop.chromeexperiments.com/bookcase)

Beyond experimental projects, browsing tools are also in production in some bibliographic systems. At the Open Library, virtual browse is presented as one of several metaphors for exploring works by subject area (fig. 5).[4] Virtual browsing interfaces penetrated the library vendor market back in early 2010 when LibraryThing released a shelf-browse widget that can be embedded within a library catalogue. This widget allows users to see where a book would sit on the library's physical shelves and browse other titles that would be adjacent (Spalding, 2010) (fig. 6). In fact, virtual browse is making a more and more prominent appearance in a variety of vendor, open-source, and locally developed discovery systems. Stanford's SearchWorks (powered by Blacklight) allows users to browse related items by call number from any given title, while VuFind uses subjects to present a list of "similar items" on every title record. The OPACs for the BiblioCore ILS from BiblioCommons and the open source Koha ILS have long provided integrated call number shelf browsing for patrons viewing a specific title. It seems safe to say that the problem of discovering related items in the online-only environment is a hot topic in the world of library resource discovery.
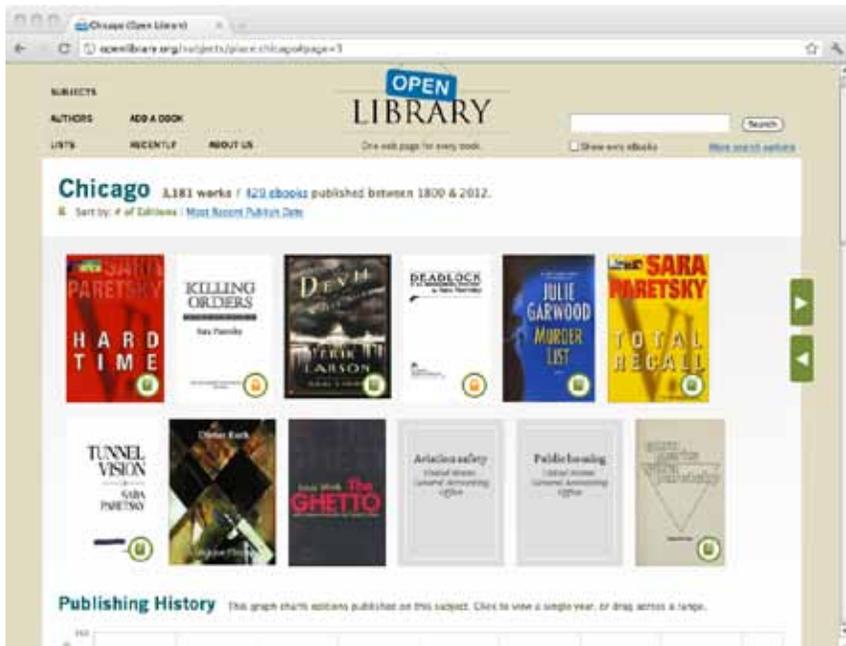

Figure 5. Open Library's subject-based virtual browsing interface. (Source: Open Library, http://openlibrary.org/subjects/place:chicago)

Figure 6. LibraryThing for Libraries' full-screen Virtual Shelf Browser. (Source: Wake County Public Libraries Online Catalogue, http://wakeipac.co.wake. nc.us/)

Virtual Browse at NCSU Libraries

Browsing on the Web

In fall 2009, NCSU Libraries implemented its first shelf-browsing interface. This basic tool was inspired primarily by the original Google Books browsing interface[5] and the shelf-browsing capabilities of the BiblioCore OPAC.[6] It combines call number ordering with a cover flow-type interface in an attempt to recreate the benefits of physically browsing library shelves in an online environment while enabling users to explore digital and physical materials side by side.

This first implementation utilizes a local database storing shelf order information for all print and electronic holdings with Library of Congress (LC) and Superintendent of Documents (SuDoc) call numbers. Call numbers are used to colocate items for the online "shelf" because the classification scheme specifies an order of arrangement where items covering similar subjects are located near each other. Shelf order information is extracted from the Integrated Library System (SirsiDynix Symphony) on a daily basis to ensure any new items are added into the index. A Web

service serves as the interface between the database and the front-end virtual browse application. The Web service responds to requests for records by call number or by catalogue key and returns a special identifier called a "batch ID" that can be used to retrieve sets of titles before and after the specified "batch ID" in the ordered index. For example, from a specific title in the catalogue, say, Schuyler Erie's "Mapping Hacks," users can find similar items by selecting "Browse Shelf" on that title's record in the catalogue. The virtual browse application uses the title's catalogue key to find its position in the virtual browse index and then uses this "batch ID" to request a set of records located before and after Erie's book to create a virtual shelf (fig. 7).

By default, the virtual shelf interface is presented as a single row of cover images with the original item (Erie's book, for example) highlighted in the center of the screen. Left and right arrows control movement of the shelf to allow browsing on either side of the selected title, and users can browse infinitely in either direction. Critical metadata (title, author, publication date, and call number) is provided in a popup that is accessed by hovering over each cover image. The browse interface is also available in a more traditional list view without covers.

When planning for the Hunt Library's automated storage and retrieval system kicked into full gear, virtual browse again became a prominent topic at the NCSU Libraries. Although both users and staff loved the concept behind the initial shelf-browsing tool, a brief user study revealed a number of usability problems with the design. In particular, users were very confused when the virtual shelf opened in a popup window; they continually tried to use the browser's back button to return to the popup after viewing a specific title. While the initial implementation provided cover images and basic metadata, users wanted access to more evaluative

Figure 7. NCSU Libraries' first virtual browse interface. (Reproduced courtesy of NCSU Libraries.)

information without having to leave the shelf-browsing tool. Specifically, they wanted easy access to supplemental information like summary, table of contents, and links out to Google Books.

Based on user recommendations, the NCSU Libraries redesigned its shelf browsing tool within the library catalogue. The enhanced browsing interface is based on the same call number–ordered database and supporting Web services built for the initial implementation. However, users can now filter results to one of the NCSU Libraries' locations. This allows a patron doing research at Hunt Library for a paper due the next day to limit browsing to materials readily accessible at Hunt. User interaction with the browser's back button was also examined. The browsing interface now opens as a page in the browser (fig. 8) instead of a popup to enable users to easily navigate to and from it using the back button. Clicking on any given cover opens a Quick View popup (similar to many e-commerce sites) that provides basic metadata, links to Google Books and the full

Figure 8. NCSU Libraries' redesigned virtual browse interface. (Source: NCSU Libraries Online Catalogue, http://www2.lib.ncsu.edu/catalogue/ browse?callNumber=QA76.73+.J38+R447+2011&format=covers&origin=925987)
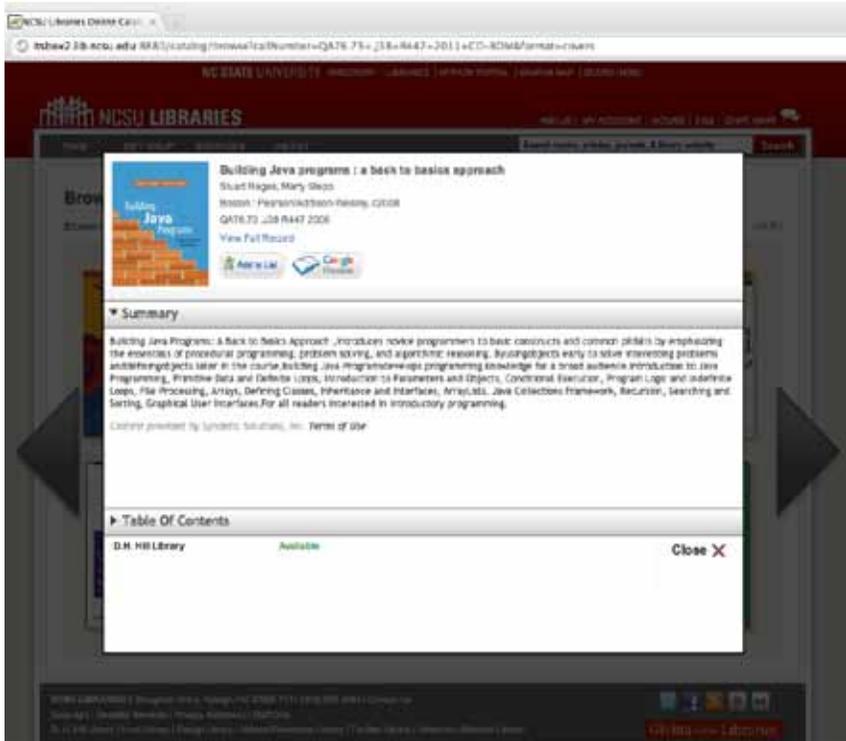
Figure 9. Quick View popup in NCSU Libraries' redesigned virtual browse interface. (Source NCSU Libraries Online Catalogue, http://www2.lib.ncsu.edu/catalogue/browse?callNumber=QA76.73+.J38+R447+2011&format=covers&origin=925987)

catalogue record, and all available supplemental content (summary, table of contents, and first chapter preview). In order to provide supplemental content, the NCSU Libraries purchases an annual subscription to cover images, summaries and annotations, tables of contents, video and music (summaries/reviews), and first chapters and excerpts from Syndetic Solutions via their Syndetics Plus service. Because a summary is often a critical element in determining basic interest in a resource, it is immediately visible upon opening the Quick View (fig. 9).

As of Fall 2011, an alpha version of this redesigned browsing tool was undergoing testing. This was made available to the public in early 2012.

Browsing on Multitouch Devices
Concurrent with efforts to improve virtual browsing within the library catalogue, the vision for NCSU Libraries' new high technology Hunt Library

was developing with an emphasis on visualization and gesture-based interactive computing. The availability of large screen, multitouch devices, combined with faculty concern about the inaccessibility of books in the automated storage and retrieval system, sparked an investigation into virtual browsing on multitouch devices as a means to provide an interactive, exploratory collection-browsing experience to patrons within the Hunt Library building.

The ubiquity of multitouch interfaces on consumer handheld devices like the iPhone and iPad is evidence of a new computing paradigm that has potential for enhancing the virtual browse experience. The ability to control applications with a hand gesture offers an opportunity to reintroduce elements of physical interaction with the collection. When combined with compelling graphics, actions such as opening a book or turning a page can be authentically replicated through the use of gestures on the screen. In preparation for Hunt Library, the NCSU Libraries acquired two Microsoft Surfaces and a Perceptive Pixel display to explore the potential of these technologies for virtual browsing and other uses. The large screens, up to 88 inches, allow for display of multiple items at actual size or larger, which can better replicate the physical shelf and can display much more data than a desktop monitor. These devices can quickly respond to complicated gesture input with dozens or more simultaneous touches to provide a unique, physical experience.

Exploring the collection on a large public kiosk in a public setting implies a different user interaction than browsing on a personal computer (fig. 10). Some online browsing workflows, such as typing search queries to find an item from which to begin browsing or logging into an account to request materials, may be more difficult on a large touch screen. An individual patron's interaction with virtual browse on a multitouch display could also become shared and social if multiple people gather around the screen. This highly visible implementation may be well suited for promoting serendipitous exploration of themed collections and increasing awareness of Web-based virtual browse services. NCSU Libraries is also exploring use of the campus ID that offers a readable magnetic strip and RFID "contactless" capabilities in lieu of username and password authentication for account-based activities. These methods could allow patrons to authenticate and request desired titles while retaining privacy.

Development for these large multitouch devices presents unique obstacles for early adopters. Unlike Web development, there are very few design patterns available to work from when shaping the user interface. In the case of virtual browse, the uncertainty about exactly what users want to do on a large scale multitouch device also makes the design process more challenging. Devices such as the Perceptive Pixel tend to utilize proprietary device drivers to read touch interactions and require use of specialized software development kits. Despite these challenges, experiments

Figure 10. Large-screen multitouch devices pose new questions for user interaction design. (Reproduced courtesy of NCSU Libraries.)

with multitouch development will likely pave the way for future users to experience library collections in an entirely new manner.

Challenges for Virtual Browsing in Libraries

There are several challenges inherent in developing systems that support patron browsing behaviors in the online environment. One of these challenges is effectively representing the physical item and its relevant characteristics. Clearly, patrons prefer to be able to view cover art, as it helps distinguish between long lists of similar-looking titles and may help identify series, publisher, or general date of publication. While cover images can be licensed from a variety of sources, a very large percentage of the collection will not be represented, and some other cover art representation must be generated on the fly. In addition, it is sometimes difficult to identify whether a cover is available and load it from a remote source in a timely fashion that supports users quickly browsing through large numbers of items. Other physical characteristics beyond cover art are important to users, as well. For instance, the size and length of the book may impact a patron's level of interest. Although some information

about these physical characteristics is available in bibliographic records, it is difficult to parse reliably and challenging to represent intuitively in an online display.

When patrons are browsing physical stacks, they will often flip through the content of the book itself to determine if it is of interest. Likewise, a virtual browsing tool should provide access to as much actual content as possible, from tables of contents to full text. Although some of this content can be licensed from vendors like Syndetic Solutions, it again covers only a small percentage of the collection. Service implementers may want to consider other sources of supplemental content as well (table 1), including Google Book's Embeddable Viewer API, which allows users to search inside a book in a popup window without leaving the host site. Presentation of full text can be challenging, as licensed e-book content is often restricted to proprietary vendor systems; the patron must leave the virtual browsing tool in order to actually read the full text.

A final challenge surrounds organizing and presenting materials to patrons. Ordering by call number is a first use case that translates well from the print to the digital environment. However, sorting call numbers requires careful normalization algorithms and raises questions of how to integrate materials cataloged using different classification schemes. Should items classified with SuDoc, NLM, or Dewey classification schemes be presented alongside LC classified items? If so, how can that be accom-

Table 1. Sample supplemental content providers

Service	More Information	Usage
Google Books API	http://code.google.com/apis/books/docs/v1/getting_started.html	Free service; requires prominent link back to Google; provides a JSON response
Google Embedded Viewer API	http://code.google.com/apis/books/docs/viewer/developers_guide.html	Free service; requires prominent link back to Google; use JavaScript to integrate viewer widget
LibraryThing Free Covers	http://www.librarything.com/blogs/librarything/2008/08/a-million-free-covers-from-librarything/	Free service; maximum 1,000 requests/day with local caching allowed
LibraryThing Web Services API	http://www.librarything.com/services/webservices.php	Free service; maximum 1,000 requests/day; provides JSON or XML response
Open Library Books API	http://openlibrary.org/dev/docs/api/books	Free service; no additional terms and conditions; provides a JSON response
Syndetic Solutions Syndetics Plus	http://www.bowker.com/syndetics/plus/index.html	Requires license; use JavaScript to integrate content widgets

plished? What about materials classed with local classification schemes, such as special collections materials? The inability of a classification-based virtual browsing algorithm to successfully incorporate special collections materials at NCSU Libraries suggests that this is just a first step in helping patrons browse relevant items and that other types of recommendation systems are desirable.

THE FUTURE

While work at the NCSU Libraries has focused primarily on building virtual browsing tools that offer a surrogate online experience to replace physical shelf-browsing workflows, the opportunity exists to transcend the limits of physical browsing by relating items through dimensions other than call number classification. In its current form, we hope virtual browse is a first step toward enabling patrons familiar with Amazon and Netflix recommendations to "find more" in the library. There is potential to develop other algorithms to associate related titles using currently available metadata such as related subjects and keyword associations. Circulation data or other interaction metrics could potentially be used to identify items of interest. As additional outside data sources capable of relating titles along facets such as usage or citation become available, these too may be integrated into visual browsing tools. Advances in visualization tools will lead to new ways of displaying items and collections of items from the catalogue. When combined with new methods of computer interaction, virtual browse may provide users with opportunities for serendipitous discovery beyond browsing the stacks.

NOTES
1. The Hunt Library, under construction at the time of this writing, is expected to open to the public in early 2013.
2. At the time of initial writing, the ShelfLife service was undergoing additional development to be re-released late 2011. While the text describes the original, primary functionality of ShelfLife, it has since been expanded to serve as a more full-featured interface for the Digital Public Library of America (DPLA), a multilibrary effort to aggregate library data in the cloud. More information about the ShelfLife project as part of the DPLA, as well as access to the new version of the interface is available at http://librarylab.law.harvard.edu/dpla/demo/app/.
3. With an up-to-date Chrome browser, you can experiment with the Infinite Digital Bookcase at http://workshop.chromeexperiments.com/bookcase.
4. As an example, you can browse resources with the subject "Chicago" at http://openlibrary.org/subjects/place:chicago.
5. Although it was at one time one of the primary entrance pages for Google Books, this interface is now much more hidden from users. However, a somewhat altered version can still be seen at http://books.google.com/books.
6. It is possible to see an example of this tool live at the Oakville Public Library: http://opl.bibliocommons.com/item/show/702875001_jupiter.

REFERENCES
Bates, M. J. (1989). The design of browsing and berrypicking techniques for the online search interface. *Online Review, 13*(5), 407–424.

Beheshti, J., Large, V., & Bialek, M. (1996). PACE: A browsable graphical interface. *Information Technology and Libraries, 15*(4), 231–240.

Harvard Library Innovation Lab. (n.d.). *ShelfLife*. Retrieved November 19, 2011, from http://librarylab.law.harvard.edu/shelflife/about.php

Koblin, A., & Schilit, B. (2011, October 18). Designing an infinite digital bookcase. Message posted to http://googleblog.blogspot.com/2011/10/designing-infinite-digital-bookcase.html

Kyrillidou, M., & Morris, S. (Eds.). (2011). *ARL Statistics 2008-09.* Retrieved November 19, 2011, from the Association of Research Libraries Web site: http://www.arl.org/bm~doc/arlstat09.pdf

Marchionini, G. (1995). *Information Seeking in Electronic Environments.* New York, NY: Cambridge University Press.

Payne, L. (2007). *Library Storage Facilities and the Future of Print Collections in North America.* Retrieved November 19, 2011, from OCLC Programs and Research Web site: http://www.oclc.org/programs/publications/reports/2007-01.pdf

Spalding, T. (2010, January 16). New Stuff: Shelf Browse. Message posted to http://www.librarything.com/blogs/thingology/2010/01/new-stuff-shelf-browse/

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David Woodbury is the director of learning commons services for North Carolina State University Libraries where he manages specialized learning spaces including the Libraries' Technology Sandbox and Digital Media Lab. He is currently involved in the planning of the public services for the James B. Hunt Jr. Library, opening in 2013. He served as the project leader of the NCSU Libraries Mobile site and is leading several technology initiatives including NCSU's technology lending program. Prior to NCSU, Woodbury was project manager of Bot 2.0, an NSF funded project at the University of North Carolina at Chapel Hill Metadata Research Center and the North Carolina Botanical Garden.