Blended Shelf: Reality-based Presentation and Exploration of Library Collections

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Abstract
We present the user interface Blended Shelf, which provides a shelf browsing experience beyond the physical location of the library. Blended Shelf offers a 3D visualization of library collections with the integration of real-world attributes like the size and availability of books. The application reflects the actual arrangement of items in the physical library and enables implicit serendipitous support of the shelf browsing process in the digital world. The interface offers multiple views with different levels of detail regarding the collection as well as various entrance points to it. The user can explore and search the shelves by touch interaction. Tracking the user's position and line of sight ensures the ideal perspective on the interface. Thus, a user can explore collections in a familiar way and benefit from serendipitous browsing discoveries without forfeiting the advantages of the digital domain.

Author Keywords
Blended library; shelf browsing; digital library

ACM Classification Keywords
H.5.2. [Information Interfaces and Presentation]: User interfaces.

Selected qualitative feedback from different library users to the question: "*What do you miss for scientific work and managing source literature?*"

"The research direct at the shelf!"

"The library shelves, where you could browse at random."

"Having the opportunity to go quickly to the shelf and take a look in the book again and to have the thematically appropriate books placed next to it."

"Right now, especially, browsing the shelves of the Library of the University of Konstanz (asbestos renovation), which is one of my favorite research methods."

"A library without asbestos for the research at the shelf […]."

(Citations were translated to English by the authors.)

Introduction

The Library of the University of Konstanz was closed on November 5th, 2010 because of an asbestos discovery. Until today, a huge part of the library is not accessible to the public. Before the contamination, users were accustomed to having direct physical access to 98% of the library's collection (approx. 2.1 million items), which is systematically ordered and updated by the library staff. Currently, more than 75% of the collection is located in closed stacks and only available to users if they order the items through the Online Public Access Catalog (OPAC). While it is still possible to access most items– with latency between order and delivery – it is no longer possible to have the whole direct shelf browsing experience.

An online questionnaire (N=682) that was sent via email to the students and the academic personnel of the university revealed that 56% of the users check library shelves when they are looking for literature (Figure 1). The qualitative feedback of our study confirmed the importance of shelf browsing for the users (see left column) and gave a first insight into the advantages of shelf browsing. Moreover, our results resonate with a study conducted in 2009 by Head et al. [4], which covered six US campuses (N=2193). The study shows that 55% of the users check the surrounding library shelves when searching for literature in the library environment.

Browsing through open and systematically ordered stacks offers many advantages for library users since they are able to examine the actual objects themselves. The visual and haptic feedback embodied in a book or other item is less abstract than when dealing with purely metadata. When you have direct access to the library's collection, you do not have to wait to acquire an item. The systematic presentation of the collections allows users to explore thematically related items that are located close to each other. In addition, serendipity is already explicitly supported as an inherent part of the library or as Rice et al. put it: "*Serendipitous findings are one of the consequences of browsing in the library […]*" [8].

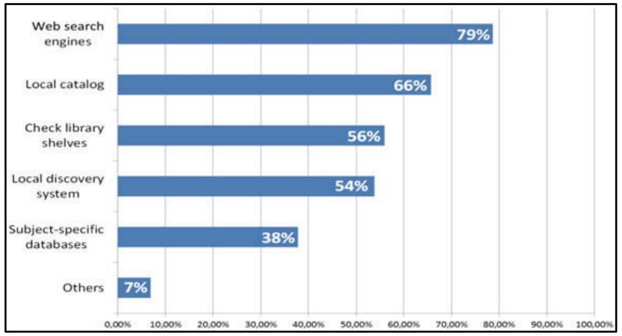

Figure 1: Results of the question: "*In which catalogs / search forms are you looking for literature?*" (N=682, online from December 22nd, 2011 to February 16th, 2012).

In contrast to the physical library, the typical way to present search results in the digital domain is to use vertical lists that display document surrogates based on the documents' metadata and excerpts (e.g., Google's search result list) [5]. This kind of display of results is also common for search and exploration tools within the library context (e.g., the Summon Service[1]). A review of current literature and related work shows that various approaches use the properties of shelves to present results or to support collection exploration. For instance, *libViewer* [7] is a visualization for digital li-

[1] The Summon Service is a Resource Discovery Service (RDS) http://www.serialssolutions.com/en/services/summon/

Figure 2: Setting A with a large interactive whiteboard.

Figure 3: Setting B with two Samsung SUR40. One is mounted to the wall, the other remains in its original table configuration.

braries that maps attributes such as height, page count, condition, and the usage of items to a book-like representation in a virtual shelf. The realistic imitation of a shelf allows the user to quickly recognize certain aspects of a collection as well as the items contained in it. *Search Wall* [3] uses the shelf concept to support children's exploring in a library. The tangible interface is a mix of shelves, screens, and diverse input elements. Because catalog and search interfaces that only allow textual input and output are not well suited for children, this tangible and shelf-oriented approach aids them in searching through the library in a way that is similar to browsing. In contrast, the *Bohemian Bookshelf* [9] does not look or feel like a classical bookshelf, but it obtains serendipitous discoveries similar to those that may appear with shelf browsing. It offers five visualizations to provide different access points to a library's collection, uncover relationships between items, and stimulate curiosity.

Nevertheless, it seems that no approach focuses on a digital but strongly reality-based pendant of the shelf browsing experience. We want to investigate if users will benefit from transferring the well-known process into the digital domain with little learning effort and an intuitive perception of the interface. Therefore, Blended Shelf uses real-world attributes in the visualization combined with an interaction concept derived from the actual use of physical shelves. This allows us to maintain the serendipitous effects common in the physical library. At the same time, well-chosen trade-offs between expressive power and reality [6] expand the shelf browsing with digital functionality, such as instant reordering and mixing of collections, analytic keyword searches, and more. The combination of both worlds offers not only an alternative for the inaccessible shelves but provides users with added values. For example, today a user in need of specific information has to consult a catalog system first and then search the shelves for the given call numbers. With the hybrid approach of Blended Shelf, it is possible to search the library collection digitally and instantly view the results in their shelf context, even if they are scattered throughout multiple collections or even buildings.

Design Goals

As a foundation for the design and implementation, we analyzed the shelf browsing process and developed five design goals. These design goals are based on the empirical results from the online questionnaire.

DG 1: Integration of Spatial Characteristics of Browsing
While looking for information, we often narrow down our broad view to focus on details. In the field of Information Visualization, in particular, we find the distinction between a macro-level (an information aggregation of multiple objects) and a micro-level (objects or their representations) [10]. A path between the different levels could be established by browsing processes, as we can see in Bates' definition of browsing: "*1. Glimpsing a field of vision; 2. selecting or sampling a physical or representational object from the field; 3. examining the object; and 4. physically or conceptually acquiring the examined object, or abandoning it."* [1] The same thing happens in systematically ordered and arranged libraries: We enter, look for a certain topic or category (macro-level), and fluidly narrow our focus towards the individual items (micro-level).

DG 2: Categorized and Ordered Presentation
The categorized order and alignment of library collections allows users to find thematically similar items adjacent to each other. As our study showed and as

Figure 4: Different perspectives depending on the users' position and sight of view.

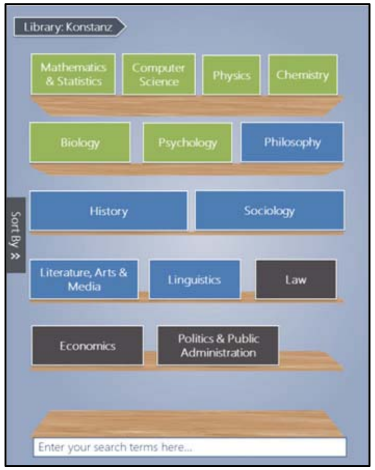

Figure 5: Selection of disciplines with a collapsed sorting option (left) and navigation breadcrumbs (top).

intended by the libraries classification efforts, many people use this property intentionally as an exploration strategy. However, users loose this powerful tool if a collection is not publicly accessible or ordered by acquisition date. Therefore, we consider the categorized and ordered presentation an important factor on the way to a shelf browsing experience.

DG 3: Use of Physical and Visual Properties
While browsing of shelves, we absorb and exploit many physical features. Even the visual impression of a book cover reveals a great deal about it [7]. The company logo of a publisher can reflect a certain quality and reputation. Color and graphical layout may indicate a series we prefer or refuse. Other properties, such as the size of a book, also say something about it: We would not expect a common textbook to be a very small work with a four-line title; rather we would recognize it if we saw ten identical looking weighty tomes. On that account, we consider it crucial to maintain as much of the real appearance as possible and use other physical properties, such as gaps between the items, to our favor (see the *Implementation* section).

DG 4: Support for Serendipity and Advanced Searching
Although the shelf browsing process leads to serendipitous discoveries [8], we would like to further expand the potential space for accidental but fortunate findings. Serendipity is actively encouraged through visualizations with the use of principles including the *highlighting of adjacencies* and *enticing curiosity* [9].

Shelf browsing is only one of many options for researching literature, and critical voices claim that it is not sufficient for achieving eminent search results [2]. Therefore, we consider it valuable to add other, more analytical search approaches in addition to the strict browsing approach.

DG 5: Access to Objects or Their Representations
The browsing process centers on a user's desire to access interesting items (see definition of *browsing* in DG 1). Although it is not possible to drag a printed book out of a digital display, it is possible to provide a digital equivalent or a guide towards the original object.

Implementation

Common library shelves are large in format and offer plenty of space for items. Therefore, we decided to implement a large interactive whiteboard (Figure 2) and combine tabletop and wall-mounted multi-touch displays (Figure 3). This setup provides enough physical space to allow natural body movements as well as sufficient display size for the visualization, and it simultaneously allows touch interaction (DG 3).

Although users explicitly interact with items on shelves by touching and grasping them, we also "zoom into" a shelf by moving closer to it and adjust ourselves to a good viewing angle by turning our vision towards interesting items. Therefore, we track the user's position and use his current field of vision to adjust the viewing angle of the visualization. With help of these proxemic measures, the shelf zooms in by moving closer and zooms out to an overview by stepping backwards. A dynamic adjustment of the 3D perspective towards the user guarantees that the cover images are always visible with the use of implicit/subtle interaction only (see Figure 4). We assume that users will benefit from this direct interaction mapping between real and digital shelves and thus possibly reduce the cognitive load when navigating in large digital information spaces (DG 1 and 3).

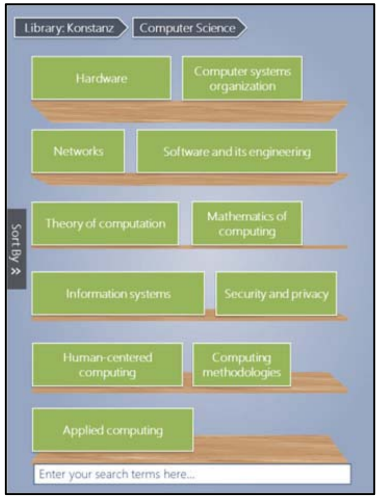

Figure 6: Selection of sub-disciplines in the faculty of computer science.

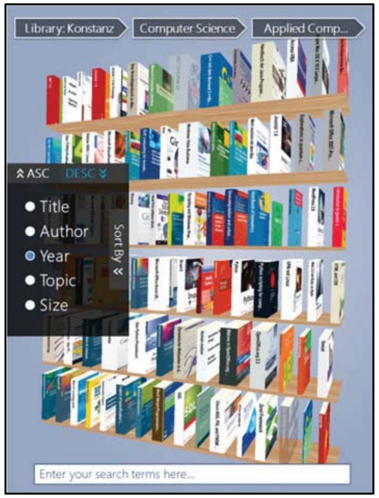

Figure 7: 3D shelf view with books and an expanded sorting option (left).

Because of the large number of items in library collections, Blended Shelf allows us to reduce the visible information space (DG 1) via a hierarchical entrance to the collection. The different colors provide information about the category, field, or subject (e.g., green for mathematics and sciences, Figure 5) and the width represents the number of items that correspond to the underlying sub-collection. By selecting a faculty, the user can travel further down to the individual sub-disciplines (Figure 6). Breadcrumbs at the top communicate the current position in the hierarchy and allow users to walk back down the path they took (DG 1). The ordering options on the left apply to the information set displayed by the breadcrumbs. If the user touches a selection (Figure 6), an ordered view of books in the field of computer science appears (Figure 7). Because most of the generated result sets do not fit into one shelf visualization (the whole collection contains approx. 2.1 million items), the user can drag the adjacent shelves into focus with a swipe gesture.

When the user reaches the visualization with the 3D representations of the items (either by browsing or searching), the default order conforms to the standard classification of the corresponding library (DG 2, Figure 7). Digital power enables the user to change the order criteria and sort the collection according to title, author, and year. The blend between real and digital shelves offers further promising effects. For example, we could apply other classification schemes to the library's collection. This enables visiting scholars to browse the local collection in the classification manner of their home university or vice versa.

To achieve a realistic representation (Figure 7) and help the user assess items quickly, we display the size of objects in all three dimensions (DG 3). If available, we display cover images. Due to artificial gaps between the items, it is possible to see the front without selecting items, which is hardly possible in real shelves due to space-saving book arrangement. We calculate a histogram of the book cover and use the most prominent color to render a spine. This does not always concur with the original, but it is adequate in many cases (Figure 8). Because a physical object can only exist at one place at a time, we traded reality in favor of more expressive power. Instead of presenting the user an empty gap when a book or item is on loan, we visualize loaned books semitransparent (Figure 9). Even if a given book is not physically available, the user is informed about its general existence and at least has the chance to consider it for future reservation or loan.

When the user discovers an item of interest, he can drag it to a deposit area (either a separate tray in setting A, or the table in setting B, DG 3 and DG 5). Thus, users can collect items without disrupting the browsing process. If the item is digitally available, Blended Shelf displays it directly to the user and offers a QR-tag containing the location (DG 5). This enables the user to utilize his preferred reading device, such as a tablet, or to save the source on his smartphone for later use. If no digital copy is available, we plan to provide instructions in the form of a map to guide users to the actual placement of an item in the physical library (DG 5).

When Blended Shelf is idle and not in active use, it presents new, recently returned, often borrowed, and random items to passing users (DG 4). The items slowly scroll through the shelf and may arouse interest. To *entice curiosity* [9], Blended Shelf offers order criteria like the size or color of items, which are untypical for libraries. At first this may not seem helpful, but we assume that users may be curious about the smallest

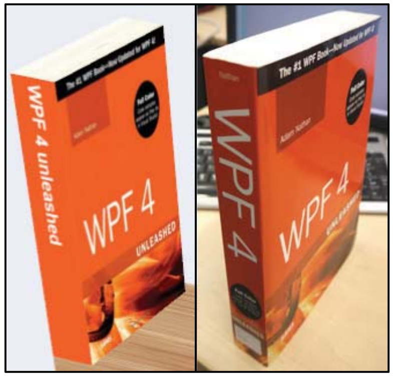

Figure 8: Comparison of a digital representation as rendered by Blended Shelf and the corresponding real book.

Figure 9: Trade-off between expressive power and reality: A loaned book does not leave an empty gap; rather, it is still (semitransparent) visible to the users.

or bluish colored books in their discipline and may discover interesting items that they may otherwise would not have discovered. Support for the *highlighting of adjacencies* [9] is provided by a proactive query-by-example function. After a user selects an item, the application automatically displays shelves with related media.

We allow users to perform analytical searches with result highlighting (DG 4). This is not possible in the real world, but it introduces additional filtering with instant response as an advantage of the digital search (Figure 7, bottom).

Conclusion and Future Work

Blended Shelf enables users to explore large collections using a familiar browsing strategy. The reality-based approach allows users to apply their knowledge and habits from library browsing in the digital domain and profit from the advantages of the intellectual indexed and organized library. Enriched with functionality like proactive search-by-example and untypical order criteria, we hope to create additional potential for serendipitous discoveries. The next step is an informal field study where we observe library customers using Blended Shelf to gather valuable feedback. This should validate and improve the visualization and interaction concept. In a second, quantitative study, we will compare the library setting - with its catalog system and real shelves - to Blended Shelf with specific search and browsing tasks. We want to measure the task completion time, the task completion rate (the coverage of the user's findings), and ask for the user's satisfaction. As future work, we plan to add personalization and collaboration aspects like the creation and sharing of personal shelves, and the rating and annotation of items as well as shelves.

Acknowledgements

This work was partially supported by DFG Research Training Group GK-1042 "Explorative Analysis and Visualization of Large Information Spaces" at the University of Konstanz and by the Ministry for Science, Research, and Arts in Baden-Württemberg.

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