A Taxonomy of the Functions Supported by Browsing Facilitators

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ABSTRACT

Browsing is a key method by which humans obtain information, yet it is often neglected in the design of search interfaces. In this paper, we selectively examine the literature on tools developed to facilitate browsing and propose the root of a taxonomic tree of the processes that browsing facilitators need to support. Finally, we explore how a select set of browsing tools currently support these functions.

RÉSUMÉ

Parcourir est une méthode clée par laquelle les humains obtiennent de l'information, cependant elle est souvent négligée dans le plan des interfaces de la recherche. Dans cette étude, nous examinons à des actions ponctuelles la littérature sur les outils dévéloppés pour faciliter parcourir et pour proposer l'origine de l'arbre taxonomique du processus dont les facilitateurs qui parcourirent ont besoin soutenir. Finalement, nous explorons comment une série privilégiée des outils pour parcourir soutiennent actuellement ces fonctions.

INTRODUCTION

Browsing is an unstructured and human-driven method of information acquisition, conducted using systems that facilitate user-system interactivity. It is usually seen as synonymous with following a series of linked hypertext nodes, or scanning an organized list of titles, names, or keywords. Browsing is generally considered to be a key method by which humans obtain information (e.g., Marchionini 1988); yet, compared to querying, it is not given a lot of weight in discussions of information seeking (Choo, Detlor, and Turnbull 2000; Ellis, Cox, and Hall 1993; Kuhlthau 1988) which have tended to focus on the active, directed, analytical search process. Interestingly, browsing can occur at any point in the search process, from the initial stage of defining the query and becoming familiar with the sources, to the final stage of scanning the results of a specific query. In this sense, browsing is a key component of the constellation of activities involved in the quest for information; however, its importance is often overlooked.

Few systems deliberately provide a stimulus to encourage browsing in the same way that books on a bookshelf encourage one to scan or provide the visual cues that prime or support the browsing process. Current implementations of browsing mimic the following of a 'set of crumbs'; the interface tools do not assist the complex human process that is invoked. The goal of this ongoing research is to develop a comprehensive set of tools that support user interactivity with textual information. In this paper, we selectively examine the literature on tools developed to facilitate browsing and propose the root of a taxonomic tree of the processes that browsing facilitators need to support. Finally, we explore how a select set of browsing tools currently support these functions.

FACILITATING BROWSING

To date many tools have been developed to support browsing. Some have been tested while others have been conceived of in the context of innovative projects that may or may not have found a specific purpose. In this section we discuss a selection of tools and techniques to highlight current work in the development of browsing facilitators.

Some browsing tools support multiple functions, as exemplified by the fisheye view (Furnas 1986), which can be defined as a method of presenting an information space that shows a local area in detail, while maintaining global context, the former usually being represented as some form of abstraction. Fisheye views are one method of presenting as much information as possible in a limited screen space, and have been used in numerous contexts with many different data structures, such as hyperdocuments (Tochtermann & Dittrich 1992), electronic books (Remde, Gomez, and Landauer 1987), hierarchically clustered networks (Schaffer et al. 1996), nested graphs (Noik 1993), and menus (Bederson 2000). The element that all of these have in common is that they facilitate one aspect of browsing, which is to maintain a constant view of the scope of an information system as specific areas are explored. Fisheye views also serve to orient the user by showing where he/she is located within the larger information scheme. As well, they allow for multiple perspectives of the information space, depending on the area of detail specified.

Another method of integrating local and global views is the overview window, also known as the map view strategy (Beard and Walker 1990), in which a window appears that provides a full view of the information system while the user navigates through more detailed data areas. A sophisticated variation on this method is evident in a tool called the Thumbar™ which can be scrolled along a thumbnail-sized version of a full textual document (Graham 1999). The Thumbar™, a hybrid of the scrollbar and thumbnail, acts as a kind of magnifying glass, in that whichever area it rests upon presents itself fully on the central screen window. Other ways of highlighting detail while maintaining scope are bifocal displays (Leung, Spence, & Apperley 1995), and more recently, the use of "fluidity" which involves typographical adjustments to certain parts of a document on demand, allowing the reader of a textual space to view additional information without having to navigate further (Zellweger et al. 2000).

An entirely different domain of browsing is represented in techniques falling under the general category of visualization. Visualization has been defined as "compact graphical presentation and user interface for manipulating large numbers of items, possibly extracted from far larger data sets," and allows the user to make discoveries about individual items or patterns between items (Shneiderman 1999). The corpus of research on visualization techniques is astounding, and there are many different models through which textual information can be represented visually (for an introductory overview of visualization concepts, see Grinstein and Ward 1997). An interesting example of presenting information through visualization is the Cosmic Tumbleweed model, in which themes are displayed in two and three dimensions, placing documents between the themes they best represent (Hetzler and Miller 1998). Other visualization models include the starfield display (Shneiderman 1999); timelines (Kumar, Furuta, & Allen 1998); the cone tree (Robertson, Mackinlay, & Card 1991); and fractal approaches (Koike and Yoshihara 1993).

Many of the methods used to facilitate browsing might seem so simple that they do not warrant mention. The list, whose ubiquity speaks volumes of its importance and usefulness, is an excellent example of this. Lists can show scope, direct the user, facilitate navigation (through hypertext links), provide options, organize and present possibilities. In other words, there are not many functions that a list cannot serve. Lists can be menus, table of contents or indices, can be hierarchical or flat, and can be organized alphabetically, chronologically, by topic, by theme or subject, or by any other variable. An example of an excellent use of lists is the "keyphrase" model, in which phrase hierarchies form the basis of browsing document collections (Paynter et al. 2000). This model involves an initial query, after which a list is generated based on the presence of key phrases. Lists facilitate browsing by presenting information to the user in a way that encourages easier scanning and gathering of available information, and in some cases, in encouraging spontaneous exploration, as in the example of the "Items-to-browse" list, which is a dynamic list of possible areas to browse that is presented to a user during information gathering (Toms 2000).

The dynamic list mentioned above exemplifies a recent turn in browsing research toward personalization tools that use information about the user or the search act, in some form, to stimulate the browsing experience, or, more commonly, direct the development of a specific browsing task. One example of this is the history-rich tool; search histories are used by the system to generate suggestions that direct the user (Wexelblat and Maes 1999). These tools, which include objects such as maps, paths, signposts and annotations, can be very efficient in using the information available from the current user's search process, as well as those of past users of the same information system. In the domain of digital books, a system uses information about reading patterns to make suggestions to the user for further reading (Woodruff, Gossweiler, and Pitkow 2000).

Lastly, some browsing facilitators are designed to enhance the use of another facilitator. Labelling techniques are one example of this. A technique called "excentric labelling" generates labels for a neighbourhood of objects such that each appear without overlap when the cursor is passed over (Fekete and Plaisant 1999). Another mechanism

proposes to provide enhanced methods of cueing the user of the presence of information that is often overlooked when omission and iconification are not properly reflective of scope (Woodruff & Olston 1998).

Multiple tools support multiple tasks or multiple functions and this list is by no means comprehensive, but is illustrative of the range available. While they all support some aspect of the quest for information, they seem not to be part of a holistic solution, but rather follow a random development track.

WHAT ARE THE FUNCTIONS THAT BROWSING FACILITATORS MUST SUPPORT?

In this research, we are exploring the browsing process in an effort to understand the ways in which browsing can be optimized. To do this we have studied the browsing experience as a whole, and dissected it into workable, more understandable pieces. We refer to these pieces as the *functions* of browsing, which can be defined as *the actions or processes of a user interacting with an information space.* In Table 1, we outline a set of functions, which are used in browsing. These are activities or processes that browsing facilitators should provide, facilitate, enhance, or promote. This is the base of a taxonomic tree (a work in progress) that will conceptualize the browsing process beyond the scanning approach that is traditionally taken.

Function	**Definition**
Connection	Shows relationships between separate objects
Definition	Describes specific terms and how they are used
Discrimination	Distinguishes between desirable and undesirable areas of exploration
Divergence	Enables departure from a set course
Explanation	Elaborates on a definition
Organization	Re-structures information to render it more useable
Orientation	Shows position
Personalization	Incorporates information about a user into the information spaces
Perspectives	Presents information from many different viewpoints
Simplification	Minimizes the complexity in a body of information
Stimulation	Promotes ideas and enhances user's overall intellectual/mental experience
Suggestion	Provides alternatives
Scope	Shows extent of entire information space

Table 1: List of functions of browsing

Breaking down the browsing act in this way also allows an examination of available tools in order to provide insights into: a) which tools fulfill which functions and how; b) which functions are not being supported and facilitated as strongly as they could be; and c) which functions could be fulfilled in the browsing act, but may not yet have been conceived.

HOW FUNCTIONS ARE SUPPORTED BY EXISTING TOOLS

To ascertain how existing tools currently support these functions, we examined two browsing facilitators. One tool was the Thumbar™ which replaces the traditional thumbnail images of document pages with a single "thumbar", a miniaturized icon of the entire document. A magnifying scroll feature enables the user to navigate around the document, with the selected portion of the document appearing as full size. The other tool considered is the more traditional menu, which typically involves hierarchically related lists of options.

In addition to examining the functions that each tool supports, we identified the key characteristics that are present in these tools as illustrated in Table 2. These characteristics were not pre-ordained but were derived from the descriptions of the tools; this list is by no means comprehensive. As indicated, both tools have many characteristics, each of which may support one or more browsing functions. For example, multiple characteristics support relationships or connections. Graphical features such as representing the document as an icon, and text based features such as lists and hierarchies help to establish relationships or connections. The Thumbar™ includes a feature to highlight portions of the document that are pertinent to the search terms used to retrieve it. This use of colour supports the discrimination between more and less relevant passages.

It is interesting to consider how different tools support the same functions in different ways. Menus show connections through lists and hierarchies. Options are linked conceptually, and shown in a text format. The Thumbar™ shows connections graphically. By presenting an icon of the miniaturized document, physical connections between the parts of the document can be seen. While both tools show connections, the menu shows conceptual connections, while the Thumbar™ shows connections based on the document layout.

Some functions are better supported by one tool than the other. Divergence is supported by the menus, which present a range of options to the users, allowing them to choose which direction to follow. Orientation, on the other hand, is better supported by the graphical Thumbar™. By showing an icon of the entire document, the Thumbar™ allows the users to see where they are within the document, as well as where they can go.

Function	Clickable	Colour	Dynamic	Expands /Contracts	Graphic	Hierarchy	Icon	List	Scrolls
Connection		**T**	**T,M**	**T,M**		**M**	**T**	**M**	
Definition									
Discrimination		**T**		**T**	**T**		**T**		
Divergence				**M**		**M**		**M**	
Explanation									
Organization						**M**	**T**	**M**	
Orientation			**T**				**T**		**T**
Personalization									
Perspectives			**T,M**	**T,M**			**T**		**T**
Scope					**T**		**T**		**T**
Simplification							**T**		
Stimulation									
Suggestion			**M**	**T,M**		**M**	**T**	**M**	**T**
T= Thumbar™, M=Menu									

Table 2: Features and functions of browsing facilitators.

As demonstrated, current browsing facilitators already support some of these functions. How effective and intuitive that support is remains to be seen.

CONCLUSIONS

Browsing is often referenced as a simple scanning operation. Yet the act of browsing supports multiple complex cognitive functions that are often taken for granted at the interface. The work described here is our initial approach: we have isolated some of the functions that browsing facilitators need to support. We are continuing this work by characterizing how a tool might facilitate the process. Our ultimate goal is to design the tools needed to facilitate those functions and/or identify existing tools that support those functions. We also aim to expand our approach to a holistic ecological examination of the quest for information, integrating analytical search, browsing and serendipity.

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