



Visual articulation of navigation and search systems for digital libraries



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ARTICLE INFO

Article history:

Received 17 May 2015

Received in revised form 22 June 2015

Accepted 24 June 2015

Keywords:

Searching

Browsing

Information visualization

Information management

Digital libraries

ABSTRACT

Journal and digital library portals are the information systems that researchers turn to most frequently for undertaking and disseminating their academic work. However, their interfaces have not been improved. We propose an articulation of the navigation and search systems in a single visual solution that would allow the simultaneous exploration and interrogation of the information system. *Area* is a low-cost visualization tool that is easy to implement, and which can be used with large collections of documents. Moreover, it has a short learning curve that enhances both user-experience and user-satisfaction with journal and digital library websites.

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1. Introduction

When designing a digital information system, the first objective that has to be met is that of facilitating the most intuitive means for users of locating information. To satisfy this objective, the systems of organization, labeling, navigation and searching have to be properly designed, as do the controlled vocabularies that articulate this digital environment (Morville and Rosenfeld, 2007).

For a web page, for example, this means that the organizational systems must serve to structure and organize website content. They are usually constructed by using a classification, based on one or more specific criteria of the content housed on that page (for example, the subject that is being dealt with, the date of creation or the audience being targeted). The labeling system consistently and efficiently defines and determines the terms used to name the categories, options and links used on the web in a user-friendly language. The navigation system allows users to move comfortably around the different sections that make up the website. It provides a method of orientation for users to move in a controlled way from one point of the website to another and to ensure that at all times they know where they are and where they can go within the structure of the web. Based on a previous indexing strategy, the

search system allows the user to formulate queries and to retrieve information from within the website. Controlled vocabularies or languages are documentary resources (thesauri, taxonomies, synonym rings, etc.) that facilitate, by articulating the other elements of the architectural structure, the search and retrieval of information on the site (Pérez-Montoro, 2010).

While all these elements form part of the architectural anatomy of a digital information system, the two elements used most frequently by users when seeking information are the search and navigation systems. These two systems tend to be clearly identified in the system interface using the search box and the navigation bar, respectively. Users are typically well versed in their use and, to improve their performance, they are usually articulated via the labeling system (i.e., the navigation system labels are used as indexing terms in the search engine).

In the case of journals and digital libraries, in common with other digital information systems, architectural elements are usually employed to facilitate user location of the information they manage.

Among these elements, the most frequently used are typically their navigation and search systems. In this case, the navigation system is usually quite simple, allowing an exploration of the resources filtered through such criteria as author, year of publication, journal or publisher and, in the best of cases, subject. The results of this navigation appear as a list of clickable labels that lead the user to the set of resources, listed alphabetically, corresponding to these criteria. Search systems usually allow the formulation of queries (e.g.,

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any word, all words or exact phrase) by field (e.g., title, description, keywords or anywhere). The result of the query is a list of resources; normally sorted alphabetically too; which corresponds to the criteria in the search interface.

These architectural systems and their interfaces are typically adapted to the nature of the documents managed by these systems and to the metadata used. The documents are static, non-dynamic, resources as far as their content is concerned, and they do not change over time. Moreover, their metadata describe the contents stored (based on qualitative, ordinal, nominal or hierarchical data) (Hearst, 2009; van Hoek and Mayr, 2014).

These systems are the direct heirs of the classical interfaces of the document databases on CD-ROM developed in the eighties and which have barely evolved since. In contrast with other information systems, such as e-commerce websites, their interfaces have not been improved on the basis of the findings provided by user studies, nor have the advances developed in specific disciplines, such as information architecture, or those derived more generally from user experience (UX), been applied to them.

2. Visualization of information in digital libraries

One of the options for improving classical interfaces is the introduction of new visual solutions in the search process that improve user-experience and user-satisfaction with these digital systems of scientific information.

Traditionally, following on from the initial query, the search systems implemented in information systems of this type offer a very simple representation of the results retrieved. They usually only provide a vertical list of results sorted alphabetically, and, for each result, they give additional information about the retrieved item, such as its author, the title or date of publication of the document, among others.

This strategy of traditional representation has significant limitations. On the one hand, it does not always provide sufficient information about the content of the document to enable the user to accept it or dismiss it without having to read or interact with it first (Baeza-Yates, 2011; Nualart et al., 2014). And, on the other, it does not allow the user to deploy techniques of berrypicking in the search process (Bates, 1989), which could refine the results obtained so as to propose subsequent, more efficient searches in keeping with the user's changing information needs following interaction with the results.

In an attempt at overcoming these limitations, from the late eighties onward, a series of prototypes have been developed that seek to improve the visualization of results from journal and digital library portals. Some have focused on the representation of the content of the retrieved documents (Hearst, 1995; Egan et al., 1989; Weiss-Lijn et al., 2001; Woodruff et al., 2001; Lam and Baudisch, 2005; Hoerber and Yang, 2006; Nualart and Pérez-Montoro, 2013); while others have contributed new interactive visualizations of the set of results after formulating the search query.

If we focus on the second group of prototypes, we can identify two main types of strategy, some of which are interactive: first, those that provide support for query creation and refinement and, second, those that offer visual support for the presentation of results.

The earliest techniques were designed to help the user in formulating the query, facilitating the use of Boolean operators (Jones, 1998; Wong et al., 2011) or supplying and suggesting possible terms to the user for building their queries (Schatz et al., 1996).

Those focusing on the visual presentation of results include different alternatives. Some offer two-dimensional visualizations of the relationships between the retrieved documents by using maps or clusters (Chalmers et al., 1992; Andrews et al., 2001,

2002) or by using two-dimensional tables or grids (Fox et al., 1993; Shneiderman et al., 2000; Kim et al., 2011). Others present strategies based on three-dimensional visualizations of the retrieved results (Robertson et al., 1991; Hearst and Karadi, 1997; Cugini et al., 2000). These visual prototypes made a series of significant improvements to the classical interfaces of journal and digital library portals. Thus, on the one hand, they provided more rapid search times compared to those of traditional non-visual methods (Hienert et al., 2012) and, on the other, they permitted a more efficient formulation of queries in a way that was tailored to the information needs of users. And, finally, they provided additional information to users, information that was not available on a page of more conventional results. This extra information, which shows different semantic relationships between the documents retrieved, provides a better interaction with the results and facilitates the refinement of subsequent queries (Bauer, 2014).

Yet, even with these advantages, these prototypes and advances in visualization have not been widely implemented in the portals or websites of journals or digital libraries. The reasons for this are varied, but they can be classified into two main groups: reasons of a practical nature and methodological reasons.

In the case of the practical reasons, in resources of this type these tools are implemented as separate pages from the basic search interfaces, which means users perceive them as being secondary tools. Furthermore, these solutions, especially those that visualize the results, involve a high level of abstraction and conceptualization that means they are not very intuitive for users. And, perhaps more importantly, implementing these techniques, unlike traditional interfaces, does not offer any clear commercial or economic benefits in the world of digital systems of scientific information of this type.

If we focus on the methodological reasons, it can be seen that very few of the proposed techniques have been tested and evaluated with end users, which makes it difficult to draw any clear conclusions about their efficiency. Moreover, the prototypes have only been used with small collections of documents, and so their efficient use with large collections has not been demonstrated to users. Likewise, the paucity of the quantitative results reported in these studies of visual prototypes fails to demonstrate whether they are any better than the classical versions of the interfaces. As such, experiments are needed that analyze a period of widespread use over a broader period of time before it can be concluded whether or not the difficulty in using them stems from the users' learning curve and their degree of familiarity with the system. Similarly, when these prototypes are constructed by articulating different techniques it becomes more difficult to compare them, because it is not possible to attribute unequivocally the success or failure of the system to one or more of the techniques implemented. And, in this sense, these tools do not share a methodological design that would allow us to compare the results of each proposal and to analyze them jointly.

3. Area: an alternative visualization proposal

To overcome these practical and methodological limitations, new solutions and low-cost tools that can be readily implemented, and which can improve user-experience and user-satisfaction with these information systems, need to be identified. One possible alternative is the articulation of the navigation and search systems in a single visual solution that would allow the simultaneous exploration and interrogation of the information system.

Area is a new, low-cost visualization tool that is easy to implement, and which can be used with large collections of documents. Moreover, it has a short learning curve that articulates the two systems using a two-dimensional structure that can enhance both

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