TopicShop: Enhanced Support for Evaluating and Organizing Collections of Web Sites

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ABSTRACT

TopicShop is an interface that helps users evaluate and organize collections of web sites. The main interface components are *site profiles*, which contain information that helps users select high-quality items, and a *work area*, which offers thumbnail images, annotation, and lightweight grouping techniques to help users organize selected sites. The two components are linked to allow task integration.

Previous work [2] demonstrated that subjects who used TopicShop were able to select significantly more high-quality sites, in less time and with less effort. We report here on studies that confirm and extend these results. We also show that TopicShop subjects spent just half the time organizing sites, yet still created more groups and more annotations, and agreed more in how they grouped sites. Finally, TopicShop subjects tightly integrated the tasks of evaluating and organizing sites.

INTRODUCTION

In previous work [2], we motivated an important task for web users – gathering, evaluating, and organizing information resources for a given topic. Current web tools do not support this task well; specifically, they do not make it easy to evaluate collections of web sites to select the best ones or to organize sites for future reuse and sharing. Users have to browse and view sites one after another until they are satisfied they have a good set, or, more likely, they get tired and give up. Browsing a web site is an expensive operation, both in time and cognitive effort. And bookmarks, the most common form of keeping track of web sites, are a fairly primitive organizational technique.

We designed and implemented the *TopicShop* system to provide comprehensive, integrated support for this task. TopicShop aids users in finding a set of relevant sites, in narrowing down the set into a smaller set of high quality sites, and in organizing sites for future use. TopicShop has evolved through a number of design iterations, driven by extensive user testing. We report here on lessons we learned from a pilot study, how these lessons re-shaped our understanding of the task and led to a significant re-design, and the results of a second, larger user study.

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RELATED WORK

Our research program investigates the major information problems faced by users of the World Wide Web:

- finding collections of items *relevant* to their interests;
- identifying *high-quality* items within a collection;
- finding items that contain a certain *category* of information, e.g., episode guides (for a television show) or song lyrics (for a musician);
- *organizing* personalized subsets of items.

We have addressed these problems by developing algorithms, implementing them in web crawling and analysis tools, creating interfaces to support users in exploring, comprehending, and organizing collections of web documents, and performing user studies [2, 3, 4, 15]. The work reported here focuses on understanding the user tasks of evaluating and organizing collections of web sites, as illuminated by the design, evaluation, and re-design of interfaces to support these tasks.

Other researchers have investigated these issues. Much recent work has been devoted to algorithms for adding meta-information to collections of web sites to enhance user comprehension, typically by analyzing the structure of links between sites. This approach builds on the intuition that when the author of one site chooses to link to another, this often implies both that the sites have similar content and that the author is endorsing the content of the linked-to site. Pirolli, Pitkow and colleagues [12, 13] experimented with link-based algorithms for clustering and categorizing web pages. Kleinberg's HITS algorithm [8] defines *authoritative* and *hub* pages within a hypertext collection. Authorities and hubs are mutually dependent: a good authority is a page that is linked to by many hubs, and a good hub is one that links to many authorities.

After evaluating items and selecting the interesting ones, users must organize the items for future use. Card, Robertson, and Mackinlay [5] introduced the concept of information workspaces to refer to environments in which information items can be stored and manipulated. A departure point for most such systems is the file manager popularized by the Apple Macintosh and then in Microsoft Windows. Such systems typically include a list view, which shows various properties of items, and an icon view,

which lets users organize icons representing the items in a 2D space. Mander, Salomon, and Wong [10] enhanced the basic metaphor with the addition of "piles". Users could create and manipulate piles of items. Interesting interaction techniques for displaying, browsing, and searching piles were designed and tested.

Bookmarks are the most popular way to create personal information workspaces of web resources. Bookmarks consist of lists of URLs; typically the title of the web page is used as the label for the URL. Users may organize their bookmarks into a hierarchical category structure. Abrams, Baecker, and Chignell [1] carried out an extensive study of how several hundred web users used bookmarks. They observed a number of strategies for organizing bookmarks, including a flat ordered list, a single level of folders, and hierarchical folders. They also made four design recommendations to help users manage their bookmarks more effectively. First, bookmarks must be easy to organize, e.g., via automatic sorting techniques. Second, visualization techniques are necessary to provide comprehensive overviews of large sets of bookmarks. Third, rich representations of sites are required; many users noted that site titles are not accurate descriptors of site content. Finally, tools for managing bookmarks must be well integrated with web browsers.

Many researchers have created experimental information workspace interfaces, often designed expressly for web documents. Card, Robertson, and York [5] describe the WebBook, which uses a book metaphor to group a collection of related web pages for viewing and interaction, and the WebForager, an interface that lets users view and manage multiple WebBooks. Mackinlay, Rao, and Card [9] developed a novel user interface for accessing articles from a citation database. The central UI object is a "Butterfly", which represents an article, its references, and its citers. The interface makes it easy for users to browse among related articles, group articles, and generate queries to retrieve articles that stand in a particular relationship to the current article. The Data Mountain of Robertson et al [14] represents documents as thumbnail images in a 3D virtual space. Users can move and group the images freely, with various interesting visual and audio cues used to help users arrange the documents. In a study comparing the use of Data Mountain to Internet Explorer Favorites, Data Mountain users retrieved items more quickly, with fewer incorrect or failed retrievals.

Our research shares goals with much of the previous work. We focus on designing interfaces that make automatically extracted information about web sites readily accessible to users. We show that this increases users' ability to select high-quality sites. Through ongoing user studies and re-design, we developed easy-to-use annotation and grouping techniques that let users organize items better and more quickly. Finally, we learned how users interleave work on various tasks and re-designed our interface to support such task interleaving.

TOPICSHOPEXPLORER, VERSION 1

The TopicShop Explorer is implemented in C++ and runs on Microsoft Windows platforms. Version 1 was based directly on the Macintosh file manager / MS Windows Explorer metaphor (see [3] for detail of TopicShop Version 1 and the pilot study). Accordingly, users could view collections in either a details (Figure 1) or icons (Figure 2) view. The details view showed *site profile* information (see below) to help users evaluate sites, and the icons view let users organize sites spatially.

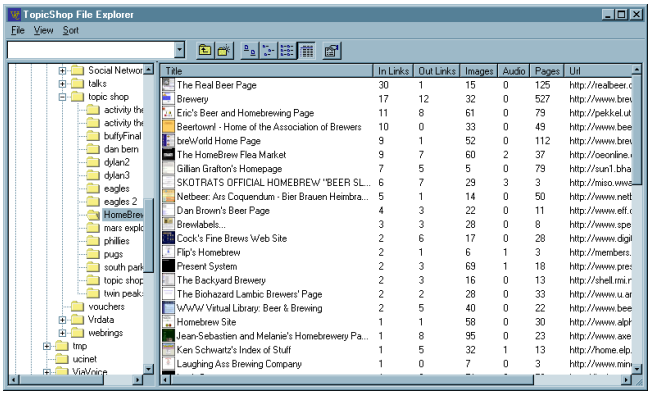

Figure 1: TopicShop Explorer (version 1), details view. Each web site is represented by a small thumbnail image, the site title, and profile data including the links to/from other sites in the collection, and the number of pages, images, and audio files on the site. Users can sort by a property by clicking on the appropriate column.

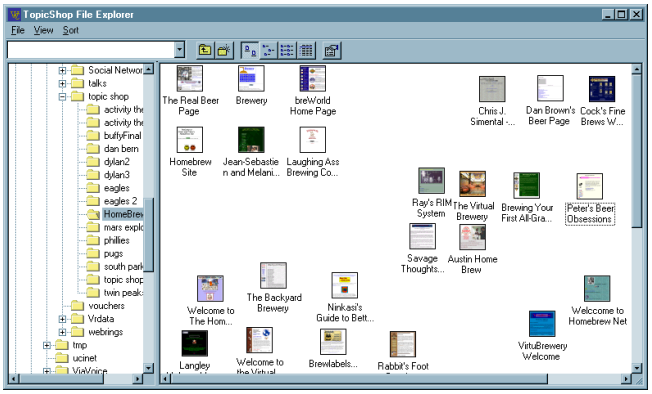

Figure 2: TopicShop Explorer (version 1), icons view. Each site is represented by a large thumbnail image and the site title. Users can organize sites by arranging them spatially, a technique especially useful in the early stages of exploration.

The collections of sites and site profile data used in TopicShop are obtained by running a webcrawler/analyzer. The crawler takes a user-specified set of seed sites as input, and follows links from the seeds to construct a graph of the seed sites, pages contained on these sites, and, optionally, sites determined to be related based on their textual and hyperlink connections to the seeds.

Site profiles are built by fetching a large number of pages from each site. Profiles contain content data, including the page title, an estimate of the page count, and a roster of audio files, movie files, and images; they also record links between sites in the collection. In addition, a thumbnail image of each site's root page is constructed.

The first goal of TopicShop is to help users evaluate and identify high quality sites. We sought to achieve this goal by providing site profile data and interface mechanisms for viewing and exploring the data. Making this data visible means that users no longer had to select sites to browse based solely on titles and (sometimes) brief textual annotations. (A chief complaint of subjects in the Abrams et al [1] study was that titles were inadequate descriptors of site content — and that was for sites that users already had browsed and decided to bookmark.) Instead, users may visit only sites that have been endorsed (linked to) by many other sites or sites that are rich in a particular type of content (e.g., images or audio files). Users can sort resources by any property (e.g. number of in-links, out-links, images, etc.) simply by clicking on the label at the top of the appropriate column. Users can "drill down" to investigate the profile data in detail, for example, to see a list of all the audio files on a site and all the other sites that it links to or that link to it. And users can browse the site in their default web browser just by double-clicking it.

The second goal is to make it easy for users to organize collections of sites for their own future use and to share with others. TopicShop let users organize sites both spatially (in the icons view) and by creating subfolders and moving resources into the subfolders. Thumbnail images also serve as effective memory aids to help users identify sites they already have visited.

PILOT STUDY

We needed a suitable yardstick of comparison for the user studies. For the task of exploring and evaluating web sites, we chose Yahoo, the most widely used search tool on the web. For the task of organizing web sites, we chose Netscape Communicator bookmarks, since bookmarks and the equivalents in other browsers are the primary means by which users organize web sites.

We chose two topics for the study: home brewing and the TV program "Buffy the Vampire Slayer" – each contained about 60 sites in their corresponding Yahoo category.

Design and Methodology

The experiment was a 2x2, between subjects design, with topic and user interface as factors. Sixteen members of our lab participated, resulting in four subjects in each condition.

The key metrics we wanted to measure were the quality of sites that users selected and the amount of effort required. To give a quality baseline, four experts for each topic were presented a list of the sites (in random order) on that topic. Experts had to browse each site, evaluate it based on its content and layout, and select the 20 "best" sites. For our studies, we define "best" as a set of sites that collectively provide a useful and comprehensive overview for someone wanting to learn about the topic. During analysis, we used the "expert intersection", the set of sites that all experts for each topic selected, as the yardstick for measuring the quality of sites selected by the subjects.

Subjects for a given topic were presented with the same set of sites to evaluate. The sites were obtained from the Yahoo category. Yahoo subjects saw (as usual) site titles and, for about half the sites, a brief textual annotation. For the TopicShop condition, we applied our webcrawler to the Yahoo sites to produce site profiles; TopicShop subjects thus had access to site titles, thumbnail images, and profile data, as shown in Figures 1 and 2.

Subjects were assigned randomly to one of the four conditions. To begin the experiment, subjects received 15 minutes of instruction and training in the task and user interface. For the main task, subjects investigated the sites for their assigned topic by using the interface (TopicShop or Yahoo) and browsing sites. They were asked to choose the 15 best sites (as defined previously). Subjects were given 45 minutes to complete the task and were kept informed of the time, although they could take more time if they chose. There is a relationship between time on task and quality of results: the more time spent, the better results one can expect. By limiting the amount of time, we hoped to focus on any differences in the quality of results (i.e., the selected sites) between the two interfaces. And people do not spend unlimited amounts of time browsing, so we wanted to see whether users could find high-quality sites in a limited amount of time.

When subjects completed their task, they filled out a short questionnaire, and an informal interview was conducted.

Results

TopicShop subjects performed significantly better than did Yahoo subjects (see [3] for details). TopicShop subjects found over 80% more high-quality sites, i.e., sites in the expert intersection ($p<0.05$) while browsing fewer sites and completing their task in less time. TopicShop's site profile data were the key to these results. The questionnaire and the informal interviews confirmed this; users emphasized the particular importance of the number of pages on a site and the number of other sites that link to it.

Lessons Learned

Despite these positive results, interviews and observations revealed some major shortcomings with TopicShop and thus important lessons for us. Subsequent reflection led to a major system redesign.

Like all artifacts, the TopicShop Explorer embodied claims about how users will conceive and carry out their tasks [7]. With its two separate windows for exploring site details and for organizing icons into groups, only one of which could be visible at a time, it embodied a claim that the tasks of evaluation and organization must be carried out separately.

Further, it assumed a single data set (the collection of all topic-relevant items), which could be manipulated in two ways (exploring site profiles or organizing by spatial grouping). The pilot study revealed problems with both implicit claims.

We found much evidence that users wanted to integrate work on the evaluation and organization tasks. First, they wanted to be able to organize items without losing sight of the detailed information contained in the site profiles. One subject commented:

> I really want to organize the large icons, but don't want to lose the detailed information. Switching all the time is too painful, so I have to settle for the details view only.

Second, we realized that most items in a collection never would need to be organized, because users would not select them as worthy of further attention. Thus, rather than supporting a single collection, a better design would support two data sets. Users can evaluate the initial, machine-generated collection and select promising items. Organization will only be done for the selected items.

This also has implications for the nature of task integration. Users must be able to explore within groups they have created; for example, some users selected fairly large sets of similar sites, say ones that contained multimedia information, then wanted to keep only the best of these sites and throw the rest away. In order to do this, the interface should make it easy to sort within a user-defined group, e.g., to find multimedia sites with the most in-links or largest number of pages.

Third, the status of the user's task must be manifest. Most important, it had to be clear which items in the initial collection users had already evaluated and which they had not. Unevaluated items are a kind of agenda of pending work. Subject comments made this clear:

> An indication of whether or not I visited the site would be useful. I can't tell what I've already seen.

> It's hard to know what you've looked at and what you haven't…

Fourth, while the interface let users group sites by spatial organization or by creating explicit folders, users preferred the former technique. This is consistent with Nardi & Barreau [11], who found that users of graphical file systems preferred to organize their files by spatial organization. This is particularly useful early in the task while users are still discovering important distinctions among sites and explicit categories have not yet emerged. While the icons view supported spatial organization, the groups were not first class objects. We wanted to explore spatial techniques to make it easy to create and manipulate groups.

Finally, site recall could be improved by including more graphical and textual information. Many subjects asked for the ability to annotate both individual sites and groups of sites. (Note that annotations also make collections more informative for others.) And other subjects asked for a larger thumbnail image to provide a better visual cue:

> A larger thumbnail would be nice… It can be used to refresh your memory … and would be more effective if it looked more like the site.

TOPICSHOP EXPLORER, VERSION 2

We created a new version of TopicShop (see Figure 3) based on the above lessons. We describe the new features and discuss how they respond to these lessons.

Two always visible, linked views support task integration and a cleaner definition of each task.

The site profile data and a work area for organizing sites are visible at all times. Items in the initial collection are displayed in the Site Profiles window, and the Work Area is initially empty (unlike Figure 3, which shows the results of a subject from the user study). As users evaluate items and find good ones, they select them simply by dragging them and dropping them in the work area. Since icons are created just for selected items, the work area is uncluttered, and provides a clear picture of the sites users care about.

"Piling" icons makes it easy to create first-class groups by spatial arrangement.

Groups can be formed in the work area by simply dragging icons. When a user positions one icon "close enough" to another, a group is automatically formed. (How close two icons must be before a pile is formed is a system parameter, set by default to occur just when their bounding boxes touch.) Each group is assigned a color. As the views are linked, both the group of icons in the work area and the features for sites in that group in the Site Profiles window are displayed using the color as a background. To help users better organize their groups, they can perform operations on piles (i.e. move, name/annotate, arrange, and select) as well as the normal operations on single sites.

Multi-level sorting is a useful operation that can be applied to a pile; it also illustrates how the linked views support task integration. In the site profiles view, users can reorder the sites based on primary and secondary sort keys. Users commonly sorted first by the groups they defined and then by some additional feature, such as in-links or number of pages. This lets users evaluate and compare sites within a single group. Figure 3 shows just such a sort.

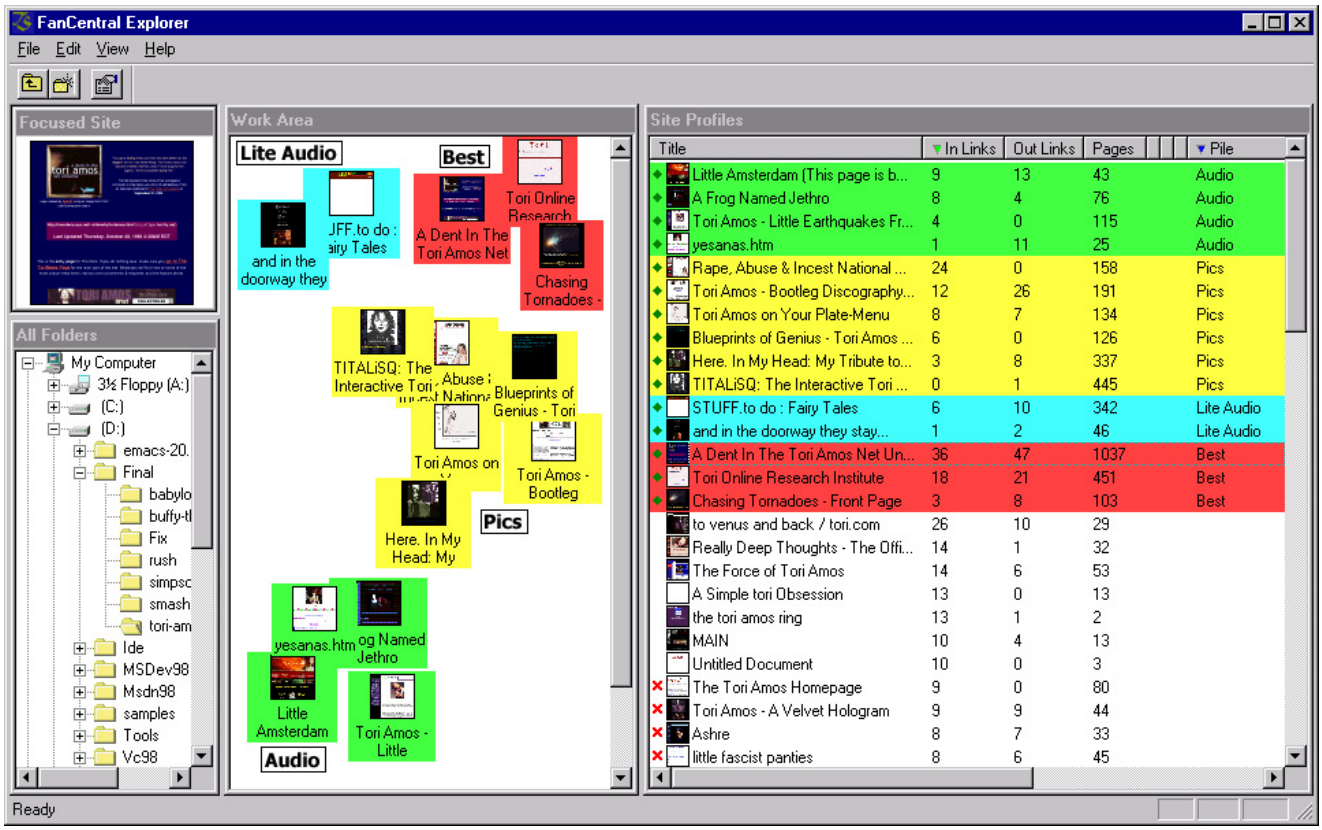

Figure 3: TopicShop Explorer (version 2)

Visual indicators make the task state apparent.
Any site included in the work area is marked with a green diamond in the site profile view and kept at the top for easy reference. Users can mark irrelevant or low-quality sites for deletion; this marks the sites with a red X and moves them to the bottom of the list. Thus, users quickly see which sites they have already processed (selected or deleted) and which need additional evaluation.

Annotations and large thumbnails support reuse and sharing.
The Focused Site window (upper left of Figure 3) displays a large thumbnail of the most recently clicked-on site. Users can create textual annotations for piles or individual sites in the work area. Annotations become visible as "pop ups" when the user lets the cursor linger over an object (pile or individual thumbnail) for a second or two.

USER STUDY

To test the advantages of the new design, we carried out a large empirical investigation of how web users evaluate and organize collections of web sites. In most respects, this study was similar to the pilot study. In describing the design and methodology, we highlight the differences.

Design and Methodology

We selected 5 popular entertainment topics, the television shows Babylon 5, Buffy The Vampire Slayer, and The Simpsons, and the musicians Tori Amos and the Smashing Pumpkins. We again compared TopicShop to Yahoo+ Bookmarks, obtaining collections from Yahoo and applying our webcrawler to obtain site profiles and thumbnail images for use in TopicShop.

The experiment was a 2x5, between subjects design. We recruited 40 subjects from a local university. Subjects were assigned a topic and interface at random. The task still began with subjects selecting the 15 best sites. However, we also instructed subjects to organize their selected sites into groups and annotate the groups with descriptive labels. All subject actions were recorded and stored in log files.

We again used topic experts to rate site quality. We obtained 4 experts for The Simpsons, and 3 for all other topics. The expert task was a bit different, too. We decided it would be easier for them and more informative for us if experts rated site quality on a scale of 1 (worst) to 7 (best). A further change from the pilot study was due to the fact that the topic collections were much larger, ranging from about 90 to over 250 sites. Since we wanted to limit the number of sites experts rated to about 40, it was impossible for experts to rate all the sites. It wasn't even possible to rate all the sites that any subject selected. Instead, experts rated all the sites selected by multiple subjects and a sample of sites selected by one or no subjects.

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