

# Enriched Links: A Framework For Improving Web Navigation Using Pop-Up Views

*Gary Geisler*

Interaction Design Laboratory  
School of Information and Library Science  
University of North Carolina at Chapel Hill  
Chapel Hill, NC 27599-3360, USA  
E-mail: geisg@ils.unc.edu

## ABSTRACT

We describe a conceptual framework for enriching Web links by displaying small, information-rich visualizations—pop-up views—that provide the user with information about linked pages that can be used to evaluate the appropriateness of the pages before making a commitment to select the link and wait for the page to load. Examples of how the enriched links framework could be applied in contexts, such as e-commerce catalog pages, search results for a video repository, and desktop icons, are also presented.

## KEYWORDS

Visualization, navigation, overviews, previews, World Wide Web, enriched links

## INTRODUCTION

The World Wide Web provides us with a vast number of resources, easily accessible with a click of the mouse. Knowing what we will get when we select a hyperlink, however, is often not so obvious, as the hyperlink itself provides no information about the type of quality of the resource it represents. As any regular user of the Web knows, navigating Web pages can often be a very frustrating activity; seeking information, you follow links that turn out to no longer exist (dead links), go to pages that haven't been updated in years (outdated links), and often end up looking at pages that are low in quality or inappropriate for your purpose. While information seeking often entails some degree of trial and error, there is clearly room to reduce the amount of unnecessary clicking by providing users with more information about resources represented by links [3].

Our framework enables Webmasters to enrich any link on their site with informative pop-up views. Access to the views is through a relatively unobtrusive pop-up selector, shown in Figure 1, which is activated when the user moves the mouse over the link anchor, similar to a tooltip.

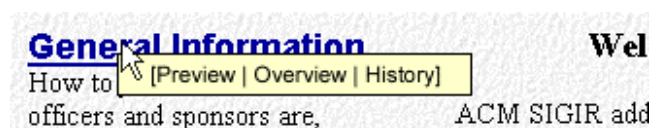


Figure 1. Enriched link with pop-up selector

In this case, however, the pop-up selector enables the user to mouse-over one of three selections to view three types of information about the linked resource via preview, overview, and history pop-ups. Figure 2 shows an example of the Overview pop-up. As shown in Figure 2, the purpose of the pop-up views is to present, in a visual and quickly comprehensible way, data about the linked resource. In this case, the Overview pop-up shows how many links (both active and dead) the page contains, as well as how many images and other media files it contains.

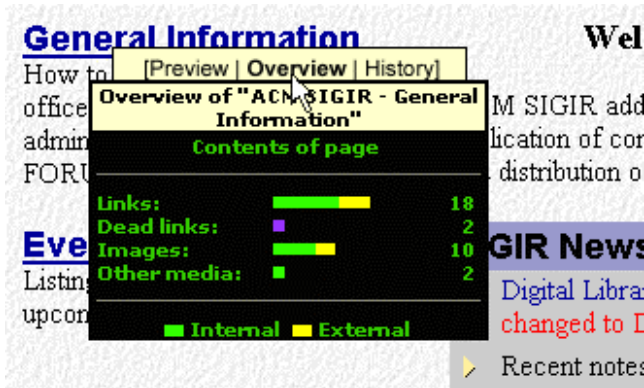


Figure 3. Overview pop-up visualization

When the user moves the mouse away from the pop-up selector, the pop-up view and the selector disappear. The goal is to provide the user with additional information about the linked resource if they want it, but to otherwise make no noticeable changes to the displayed page.

## RELATED WORK

The amount of previous research on enhancing Web links with additional information of some type is surprisingly scarce. The work that has been done shares the same basic goal as the enriched links idea presented in this paper, but on a much more limited scale.

Researchers at IBM created a system that adds small annotations, “traffic lights,” next to link anchors to indicate the Internet connection speed of the linked resource [1]. The color of the annotation is red, yellow, or green, depending on the speed of the connection. No other information is displayed for the link, making this a very specific type of preview. Because the annotations are so small, they are always displayed and require no interaction on the user’s part. The researchers performed three usability studies to determine the usefulness of the traffic lights. While two of the experiments failed to show a improvement in Web navigation, the third did show an improvement in user link evaluation and decision-making. The presence of the traffic lights do not appear to add any perceptual performance cost for the users.

The Fluid Links technique, developed at Xerox PARC, provides *glosses*, or explanatory text, at the site of a hypertext anchor [5]. When the user mouses over the link anchor, a short text description expands out from the link, providing more information about the link text. This text description is presented in a smoothly animated way, appearing below the link while the existing lines on the page below the link are pushed down out of the way. Additional functions enable the user to freeze a gloss or display all glosses on a page at once. The authors suggest that these glosses could contain a wide variety of different types

of information, including meta-information about the link or link popularity and recommendation information, but they do not appear to have implemented these suggestions.

## POP-UP VIEWS

As the Xerox PARC researchers suggest, there is a wide range of useful information about linked Web resources that could be displayed to the user. This is especially true if log data for the resource is accessible. Therefore the most comprehensive version of the enriched links idea presented in this paper assumes that it will be implemented by a Webmaster on a server for which the Web access logs are available. After considering the Web log data and the other information about Web pages that is readily available, we allocated it into three categories:

- **Preview:** A high-level, general look at page
- **Overview:** A more detailed look at the objects that make up the page
- **History:** Data that characterizes the past access of the page

Assuming this information is available, our next decision was to determine how it should be displayed. Having the information appear on a layer that pops-up near the link seems to require the least cognitive effort on the part of the user, since user focus is already on the link. The next issue was how much information to put on a layer. Putting all three categories of information on one layer would simplify the interaction technique, but the layer would have to be relatively large to accommodate all the information that might be useful to display. A layer too large might be too obtrusive for the user and, depending on where the associated link is physically displayed on the Web page, might be difficult to fit on the page while keeping it near the link anchor.

Our solution was to create three separate layers, one for each category of information. This enables each layer to be fairly small, so they can remain in close proximity to the link anchor without risking space problems. And because they are small, a displayed layer only obscures a relatively small part of the Web page.

The method by which the user activates the pop-up views, however, is somewhat complicated by the three-layer solution. If there is only one layer, it can be activated simply by the user moving the mouse over the associated link anchor. When the user moves the mouse off the link, the layer disappears. With three layers, however, we need a way to distinguish which layer the user wants to display. Our approach to this problem is to display a small pop-up *selector* when the user moves the mouse over a link anchor (shown previously in Figure 1). The selector is basically a menu containing options for the three layers: Preview, Overview, and History. The options themselves are selected by the user moving the mouse over the option text.

While it requires additional effort on the part of the user, the pop-up selector approach actually has several advantages over the one-layer pop-up approach. Because the pop-up selector itself is very small, a user who moves the mouse over links on a page without intending to view the pop-up layers is less likely to be disturbed by unintentional display of the pop-up information. Furthermore, because there are three distinct categories of pop-up layers available, users can choose to display only the information that is most appropriate for their navigational purpose. For example, a user who is trying to locate a

page he or she has seen before might simply look at the preview information for each link until they recognize the look of the desired page from the thumbnail image.

The process of activating the pop-up views, then, is relatively simple. The user moves the mouse over a link anchor, elects to view the information in one or more pop-views by mousing over the appropriate option on the pop-up selector, and then moves the mouse away from the link to dismiss the selector. Examples of the three pop-up views are described below. In these examples, the user is looking at the main page of the ACM SIGIR Web site, and is contemplating whether to navigate to the page represented by the link “General Information.”

The **Preview** pop-up view provides the most immediate look at the linked page; it consists simply of a thumbnail image of the page and its file size, as shown in Figure 3. Because we believe that the visual cues in a page layout provide important clues that inform intelligent link following, this simple preview might be useful in a number of situations.

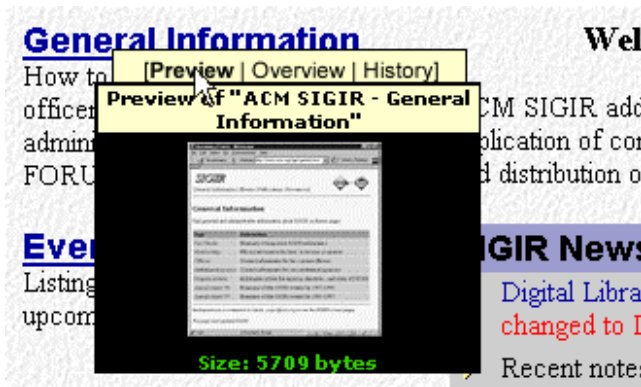


Figure 3. Preview pop-up visualization

The **Overview** pop-up, shown in Figure 4, provides a more detailed summary of the objects that make up a linked page. A graphical representation shows the number of links, images, and other media contained by the linked page, each categorized by internal or external links, with internal links being resources that reside on the same domain as the parent page. Also, a representation of dead links is provided to help identify pages that are out-dated or poorly maintained.

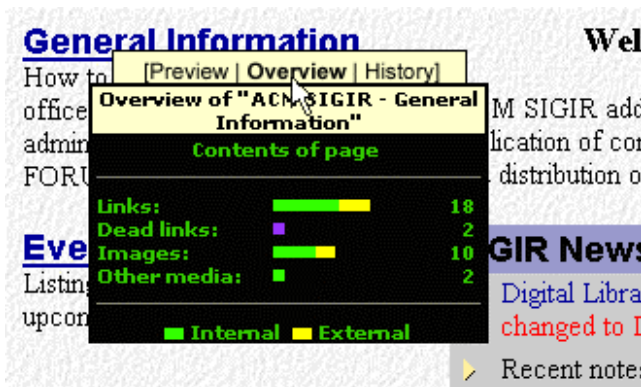


Figure 4. Overview pop-up visualization

The **History** pop-up uses Web access log data to give the user an indication of how the page has been accessed by other users. As shown in Figure 5, this pop-up shows how recently the file was last updated, and displays a graphical representation of the hits to the page, both recently (the previous day, two days previous) and over time (the past month and year). These representations are further categorized by the top four domains to access the page.

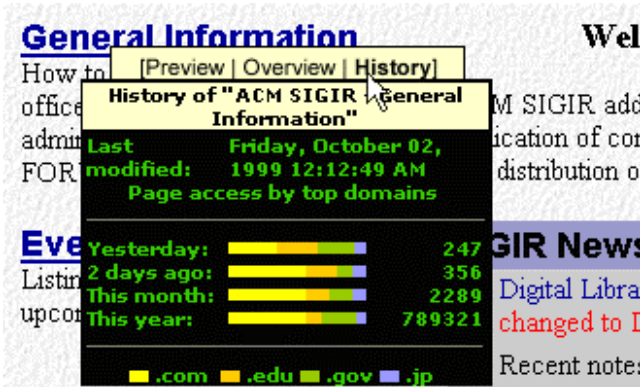


Figure 5. History pop-up visualization

It is important to note that from the user's point of view, these pop-up views do not affect the appearance of Web pages significantly. Unless the user lets the mouse linger over a link for a few seconds, the availability of the pop-up views is not even evident, and the Web page looks like any other. (This assumes that the pop-up selector will display only after a certain amount of time has elapsed from the time the user first moved the mouse over the link anchor—such as one second—but this function has not yet been implemented.)

Our expectation is that when a user is unsure about whether to follow a link, the enriched links with pop-up views will provide an easy way for the user to view information that can be used to judge the potential relevance of the linked page. By using this information, the user can make a more informed decision before clicking on a link and thus reduce the amount of page clicks, saving both time and cognitive effort.

## GENERATING DATA FOR THE VIEWS

Making available the enriched links with pop-up views as described above requires that two significant operations occur on the host Web server. The data displayed on the views has to be generated and saved, and the Web server configuration must be modified to append this data to the requested Web page at the time of the request.

To ensure that the information displayed on the pop-up views is relatively current, the data must be generated on a regular basis (nightly, for instance). Automated scripts can generate this data. The scripts could be configured to operate on a customizable set of directories, or an entire Web server, depending on the scope of links the Webmaster wants to be able to enrich with pop-up views.

The scripts would generate the pop-up view data by examining the contents of each Web page on the server and outputting the data, possibly in a couple of stages, to a *fragment file*, a file (one for each Web

page examined) containing the HTML code and data necessary to display each pop-up view layer for that page. The type of data that these scripts would generate include:

- Page title, file size, and last modification date
- A count of links on the page, categorized by internal or external domain
- A count of images and other linked media, categorized by internal or external domain
- Access data, by certain time periods, broken down by requestor domain

Additionally, a script would generate a thumbnail image of the page and store it as a GIF file. As shown in Figure 6, the data from these scripts is combined with HTML code to form the HTML layers used for the pop-up views, and these layers are combined to create the file fragment for the page.

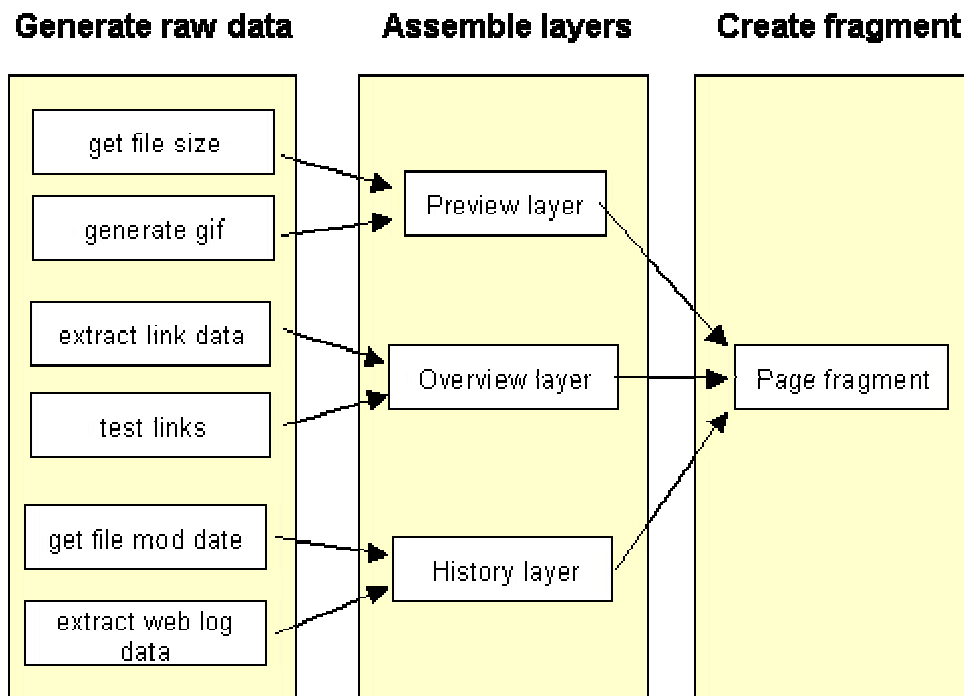


Figure 6. Generating the data for the pop-up views

How often these scripts are run is up to the Webmaster. After these scripts are written, however, the entire process would be automatic and wouldn't require any human involvement. Note that the scripts only *extract* information from the Web pages on the server to generate data; they make no modifications to the Web pages themselves, and no preparation of the Web pages is necessary. This means that pop-up view data will be automatically generated for new Web pages added to the Web server the next time the scripts are run.

## DISPLAYING THE POP-UP VIEWS

Once the underlying data is generated and the file fragments are created, enabling the user to actually view the pop-ups is relatively simple. The Web server is configured to intercept each Web page request and determine if view information for the requested page exists. If so, a script inserts the generated fragment file into the page and updates any links in the page for which views exist to enable the mouse-

overs that cause the pop-up visualizations to be displayed. The modified file is then returned to the browser. Figure 7 illustrates this process:

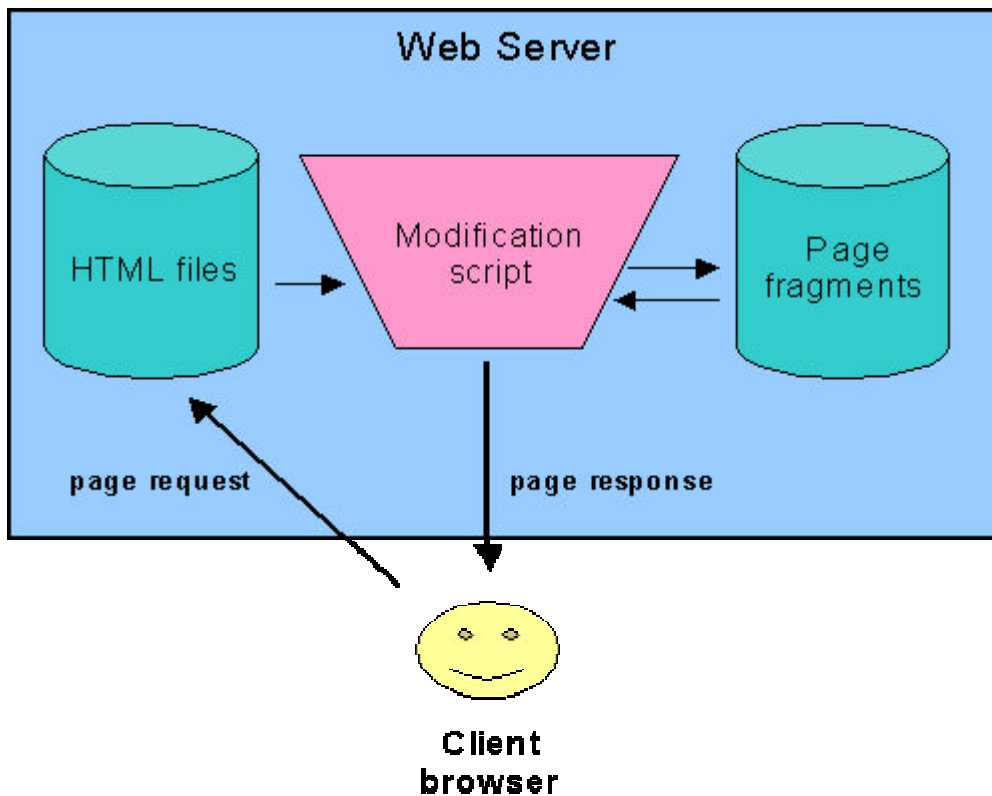


Figure 7. Modifying the requested Web page to provide pop-up views

Inserting the file fragments into the Web page at request time has several advantages over making permanent modifications to the Web pages:

- Attributes related to content and appearance of the pop-up views can be changed in the file fragment generation scripts and will be automatically applied to all pop-ups views
- Web pages can be modified and updated without any consideration of the pop-up view code (of course, the pop-up views for the page won't reflect these modifications until the next time the scripts are run)
- New Web pages added to the Web server are provided with pop-up views without any additional human effort

A potentially significant disadvantage to applying the pop-up views at request time is that the responses to client requests for Web pages are delayed by the time it takes to run the script that inserts the file fragment and modifies the link anchors in the page. The extent of this delay will be evaluated through testing, but if the code is optimized, it is not expected to be unreasonably long.



## POP-UP VIEWS FOR OTHER WEB OBJECTS

Thus far, the enriched links idea has been described in the context of providing previews, overviews, and history views for linked Web pages. However, we believe that pop-up views could be useful for many other types of objects, in both Web and non-Web contexts. In the Web context, links sometimes represent objects other than Web pages, such as the search results for a multimedia collection where the linked objects are media files, or represent Web pages that describe a specific object, such as an e-commerce catalog page that contains information about a product. To show how pop-up views could be customized to these contexts, examples of each are described below.

## POP-UP VIEWS FOR E-COMMERCE CATALOG PAGES

E-commerce is the fastest growing segment on the Web, with a rapidly expanding range of companies selling their products through on-line catalog pages. Although complete information, such as price, size, color, and a photograph, for a given product is sometimes provided, access to the product page is often through a long list of links, differentiated only by the product name or description. Browsing through product pages arranged in this way can be very time-consuming and frustrating, as each time the user wants to view another product he or she has to wait for a new page to load, only to find in many cases that the product is not in the desired price range, or is the wrong color or size.

The experience of browsing online catalog pages can be improved by enriching the links to products with pop-up views. For example, Figure 8 shows a partial view of an e-commerce catalog that sells backpacks and Figure 9 shows the page that contains the full description of one of the listed items:

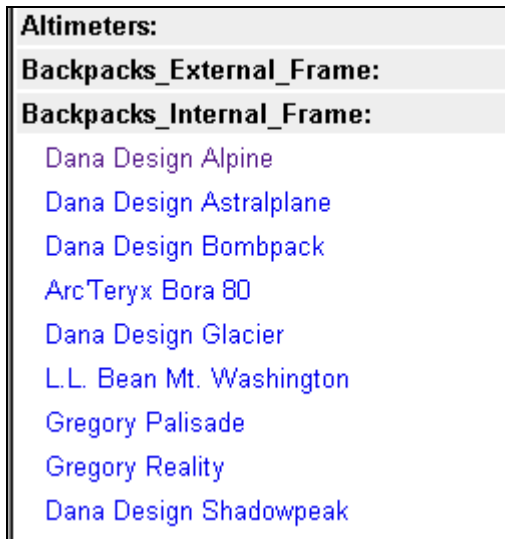


Figure 8. Product listing excerpt from a catalog page



Figure 9. Product description page

The backpacks listed span a wide range of prices and sizes. The potential customer of this site could spend quite a bit of time and effort going down the list, clicking each link and waiting for the product page to load. The potential customer is also likely to become very frustrated because many of the products probably are not in his or her desired price or size range.



Figure 10 and Figure 11 show how enriching the links on the product listing page could save the potential customer both time and effort browsing the listed products. Instead of navigating to another Web page to see information about a listed product, the pop-up views give the user information that can be used to determine if the linked resource—in this case, a particular product—is relevant to his or her needs. If so, they can click the link and view the complete information about the product. If not, they can quickly move on and get previews of other products, without waiting for inappropriate pages to load.



Figure 10. Product listing page with pop-up view



Figure 11. Close-up of preview pop-up

Note that in this example, the third pop-up view has been changed from History to Reviews. While for Web pages access data could be useful information to the user, in the e-commerce catalog context this information is probably less useful than review or recommendation information. The pop-up views can be customized to provide the most useful information for the context.

## POP-UP VIEWS FOR MULTIMEDIA COLLECTIONS

Another way enriched links might be applied is on Web sites that contain multimedia collections. Links on the pages at these types of sites might represent image, audio, or video files. Clicking a link to a multimedia file, if clicking means downloading the file, can be very expensive in terms of time, as these files are generally significantly larger than text files. Providing pop-up views that supply the user with more information about the media files could potentially save a lot of time.

An example of a Web site that contains a multimedia collection is the Open Video Project, a digital video repository. This site contains video segments that researchers can download for digital video research purposes. There are currently about a half dozen video titles at the repository, each divided into a number of smaller segments. A Web site enables users to query a database to retrieve information about available video segments.

Figure 12 shows how the enriched link pop-up views might be used at the Open Video Project Web site to help users more quickly evaluate the available video segments. In this example, the user has moved the mouse over the “Hurricanes” video title, and selected Preview from the pop-up selector. A key frame from the Hurricanes video is displayed to give the user an idea of the visual quality of the video segments it contains. (The preview might also be an animated loop of key frames from all the Hurricane video segments.)

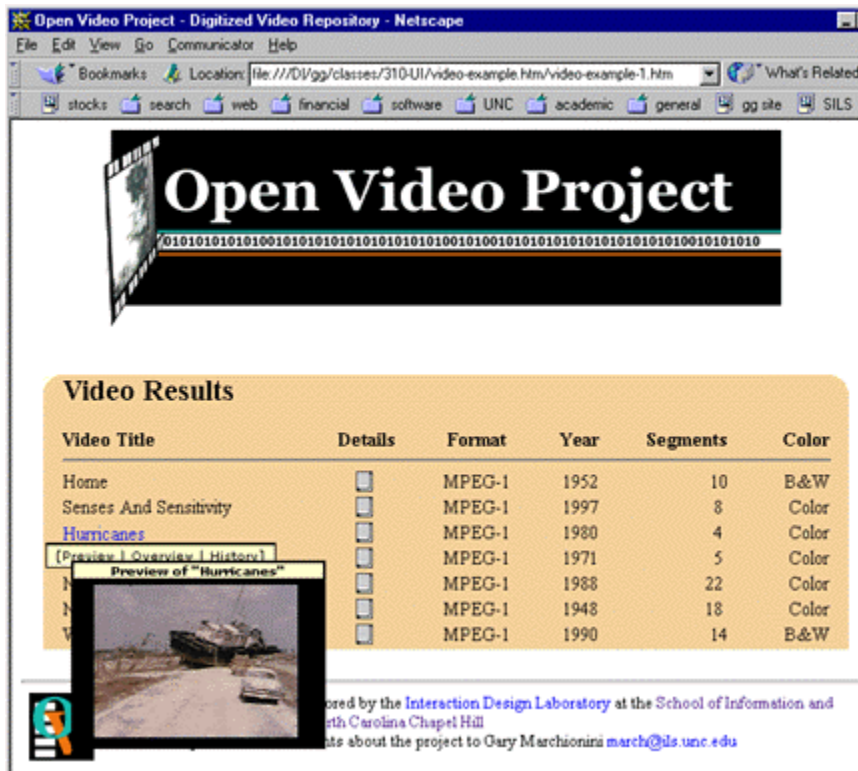


Figure 12. Pop-up views for a video repository

The Overview pop-up view could be used to quickly show the user how many segments from the Hurricane video are available and their length in seconds, as shown in Figure 13. The History pop-up, shown in Figure 14, could provide access information for the video, showing the user how often the video has been downloaded by other users, and how it ranks compared to other videos in the repository in terms of downloads.

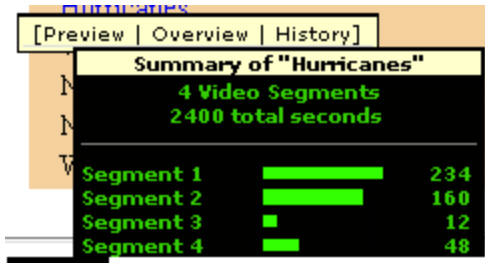


Figure 13. Close-up of overview pop-up



Figure 14. Close-up of history pop-up

As the video repository and e-commerce catalog examples show, the enriched links idea can be applied to Web links in various contexts. The basic idea remains the same: give the user information about the linked object that can be used to evaluate its relevance, without requiring the user to expend the time and cognitive effort to actually navigate to the object.

### POP-UP VIEWS FOR CONTEXTS OUTSIDE THE WEB

While hyperlinks on the Web seem to be the most natural context for applying the enriched links concept, pop-up views might be very useful in contexts other than the Web. For example, consider the problem of finding out information about files on computer systems, such as on a computer running a version of the Windows operating system.

Information such as modification dates and times, access history, and file size can all help the user determine the relevance of a specific file. Knowing when a given file was last updated, or how often it has been accessed by other users, can improve a user's efficiency by reducing the amount of time spent opening files that turn out to be irrelevant to the user's task. Although descriptive information about files is often available in various forms, such as directory listings and access logs, it is not as readily accessible as it could be. In the standard icon view of a file system such as Windows, for example, the only information provided about a file is its name and perhaps its file type (through the type of icon). The details view adds modification date and time, as well as file size and type, but there still is no indication of when the file was originally created, who created or modified it, or what it looks like.

If we apply the enriched links idea to computer files by thinking of the file icons as links, we can imagine being able to provide the user with information that would be useful in determining whether a given file is the one for which that user is looking. Figure 15, for instance, shows how a preview might look when applied to file icons in the Windows Explorer directory view:

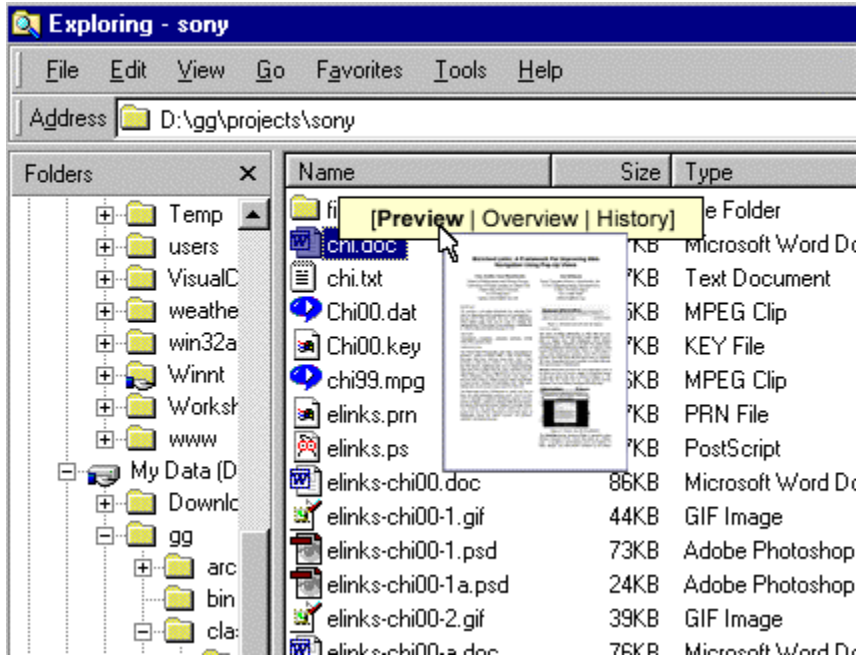


Figure 15. Preview pop-up for Word document in Microsoft Explorer

Here, the user has selected the preview pop-up for a Word document. The thumbnail image might be enough to tell the user whether this is a relevant file or not. If necessary, the overview and history pop-ups might provide descriptive and access information that the user could use to further evaluate the relevance of the file.

The application of pop-up views to computer files icons could be useful for other desktop GUIs (UNIX Motif, LINUX Gnome or KDE, Macintosh), as well as more innovative desktop interfaces such as Jun Rekimoto's Timescape interface, which relies heavily on user interaction with file icons. Additionally, the access history and modification information might be particularly useful for collaborative or group file systems, where files are created, modified, and checked in and out by a variety of users. A history or status pop-up view could make determining the current status of a given file easier for users of such systems.

## FUTURE WORK

This paper describes a framework for enriching the links of Web pages and suggests other contexts in which the idea could be applied. To more completely evaluate the potential value of the enriched links concept, we will need to develop more functional prototype systems and conduct usability studies with a variety of users on these systems.

Although the basic method of modifying links and displaying the pop-up views has been prototyped, work remains to be done to refine the method and optimize the required code. More significantly, the scripts that generate the underlying data must be written. Because this system requires a requested page to be modified on the Web server before it is returned to the client browser, a time penalty is unavoidable. A fully functional prototype will enable us to measure this time penalty and evaluate how much of a factor it is.

At the same time, more complete prototypes that explore how the pop-up views are displayed and how they look should be completed, especially for the e-commerce and Open Video repository contexts. The enriched links with pop-up views concept would seem to have the potential to increase user effectiveness and satisfaction when navigating the Web. Creating working prototypes of the Web page, the e-commerce, and the Open Video repository examples will enable us to conduct usability studies to test this hypothesis.

## **ACKNOWLEDGMENTS**

This project was partially funded by the NSF's Summer Institute in Japan program and the Smallwood Foundation. We also thank the Sony Computer Science Laboratory in Tokyo for providing additional support.

## REFERENCES

- [1] Campbell, C. S., & Maglio, P. P. Facilitating Navigation in Information Spaces: Road-Signs on the World Wide Web. *International Journal of Human-Computer Studies*, 50, 4, (1999), 309-327.
- [2] Greene, S., Marchionini, G., Plaisant, C., & Shneiderman, B. Previews and Overviews in Digital Libraries: Designing Surrogates to Support Visual Information Seeking. *Journal of the American Society for Information Science* (in press).
- [3] Nielsen, J. Using Link Titles to Help Users Predict Where They Are Going. *Alertbox, useit.com* (1998).
- [4] Rekimoto, J. TimeScape: A Time Machine for the Desktop Environment. In *Proceedings of CHI '99, Late-Breaking Results* (Pittsburgh, PA, May 1999), ACM Press, 180-181.
- [5] Zellweger, P. T., Chang, B.-W., & Mackinlay, J. D. Fluid Links for Informed and Incremental Link Transitions. In *Proceedings of HyperText 98* (Pittsburgh, PA, June 1998). ACM Press, 50-57.