# WikiFolders: Augmenting the Display of Folders to Better Convey the Meaning of Files

**Stephen Voida & Saul Greenberg**
Department of Computer Science, University of Calgary
Calgary, AB Canada T2N 1N4
{svoida, saul.greenberg}@cpsc.ucalgary.ca

## ABSTRACT
Hierarchical file systems and file browsers offer powerful capabilities for managing and organizing folders and files. Yet they lack robust tools for annotating and documenting these files—individually or collectively—with descriptive text. In contrast, Web pages and wikis make it easy to create rich and meaningful narratives around digital artifacts, allowing files to be embedded within explanatory text and images. Unfortunately, considerable effort is required to manage files stored on Web servers and to ensure that the published content remains up-to-date. In this note, we describe WikiFolders, a hybrid system for annotating file folders that draws upon the strengths of both the hierarchical file system and wikis.

### Author Keywords
Semantic organization, personal information management, annotation, folders, hierarchical file systems, wikis, WikiFolders.

### ACM Classification Keywords
H3.2. [Information Storage and Retrieval]: Information Storage—File organization.

## INTRODUCTION
Traditional hierarchical file systems allow people to see and organize their digital artifacts. Generally, these file systems are managed through direct manipulation interfaces that allow people to create folder hierarchies and find and locate files within them. File browsers' visualizations of these hierarchies are often limited to sorted lists of folder and file names or spatially organized layouts of thumbnail icons. While other organizational strategies have been suggested (e.g., [3, 5]), none have been widely adopted.

Yet hierarchical organization is not enough. People also require the ability to *annotate* their artifacts and collections. In traditional file hierarchies, the user can only provide simple annotations. For example, people must name their folders and files. They may optionally specify additional information, such as a short text comment or a highlight color, which are stored as file system metadata. Other annotations are automatically supplied by the system, including the icon associated with the file type, the date the file was last modified, and, perhaps, a thumbnail view of the file's contents. The problem is that these annotation capabilities are extremely limited, given the volume and diversity of files that most individuals must manage. For example, most systems do not allow annotations to be attached to folders or groups of files within a folder to explain the purpose of or relationships among the files. Consequently, people often rely on memory to recall the purpose of their folders and files, or else they use workarounds like "readme" files stored in each folder.

By way of contrast, consider the design of the World Wide Web. Web pages essentially serve as rich index documents for files stored on servers. However, the design philosophy of the Web places value and focus both on the archived files and the semantically rich descriptions *about* the files (the HTML text) [1]. The Web's presentation-oriented model encourages people to add text and images to describe the purpose and meaning of linked files. They can create arbitrarily complex organizational structures for their files using HTML markup (e.g., tables, lists, or slide shows). They can embed files within rich, multimedia narratives. Collaborative Web sites, or *wikis*, have made it even easier to create and edit the descriptive text used to annotate files on the Web [4]. Yet wikis still do not match the ease of file management provided by hierarchical file systems; in order to update a file on a wiki, it needs to be saved locally, uploaded using a Web browser, and the wiki's markup edited to ensure that its file link refers to the correct version of the file. It would be quite impractical to use a wiki for the day-to-day management of individual digital artifacts.

So, while file browsers are excellent for allowing people to create, modify, move, and delete files, they provide extremely limited tools for annotating these artifacts. Web pages and wikis, on the other hand, are well suited to annotating information, but considerable effort is still required to manage files stored on a Web server. These contrasting capabilities suggest a design space for exploring novel interface designs that take advantage of the benefits of both of these approaches.

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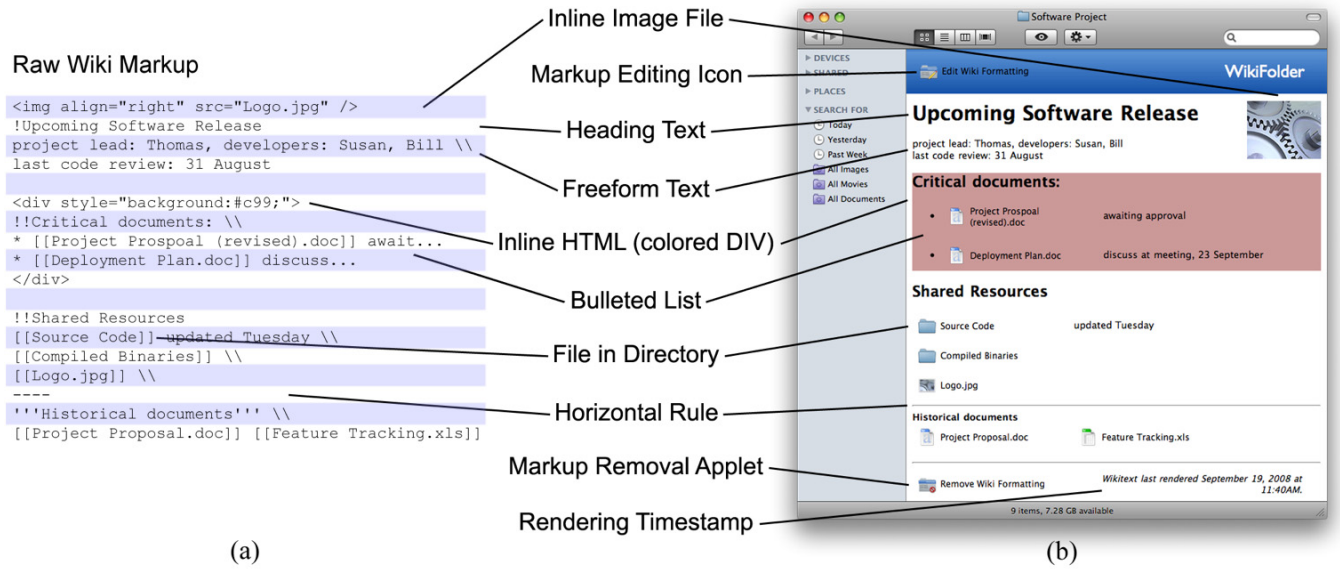


**Figure 1. Different representations of an annotated folder using WikiFolders. (a) The markup language used to add annotations and specify formatting. (b) The view that a WikiFolder presents in a standard file browser, given the corresponding markup. The markup editing icon, markup removal applet, and rendering timestamp are all automatically added during the rendering process.**

In this note, we describe *WikiFolders*, a hybrid system for annotating digital artifacts that fills a unique position in this design space, building on the strengths of both the hierarchical file system and wikis and mitigating some of their weaknesses.

## THE WIKIFOLDERS INTERFACE

Our WikiFolders prototype application modifies the way that folders appear within the existing Mac OS X file browser. Its purpose is to enable individuals to organize and document their digital artifacts as if the folder itself were a wiki page (Figure 1). The end user sees the traditional file browser interface as usual, with typical options for displaying files as lists, icons, and so on. However, there are several key differences:

1. The user has an additional option of seeing file listings in a text editor, adding text annotations to the listing, and modifying its appearance and spatial layout using a simplified, wiki-based markup language (Figure 1a).
2. The file browser's "icon" view displays the folder's contents and associated annotation inline, as specified by the user's markup directives (Figure 1b).
3. The annotated view of the folder is automatically presented to anyone who accesses the folder (e.g., as a shared folder) using the standard OS X file browser, even if they do not have the WikiFolders application installed themselves.
4. The WikiFolders application provides these capabilities without requiring wholesale changes to the underlying file system or incurring the interaction costs typically associated with wikis' publish-and-annotate model.

In the following sections, we describe the details of the WikiFolders interface design and implementation, noting features that draw from characteristics typically held by the hierarchical file system or Web-based wikis.

### The Anatomy of a WikiFolder

Through the main WikiFolders window (not shown), an individual can select an existing folder and then click a button to convert that folder into a WikiFolder. Internally, this conversion is accomplished in five steps. First, the WikiFolder application creates an empty document file in the folder entitled "Edit Wiki Formatting." The icon representing this file serves as a button; double-clicking it launches the WikiFolders application and initiates editing of the folder's wiki markup. Second, a small application named "Remove Wiki Formatting" is copied to the folder. When selected, this application "rolls back" the changes caused by WikiFolders to the folder's original state, even if the main WikiFolders application is not accessible or is no longer installed. Third, an invisible wiki markup file is created in the directory (`.wikitext`) and initially populated with an alphabetically sorted list of links corresponding to each of the files in the folder. Fourth, the wiki markup is rendered, providing an initial, annotated view of the folder. Finally, the WikiFolders application begins continuously monitoring the folder for changes, re-rendering the wiki markup whenever files are created, copied, moved, or deleted inside the folder and whenever the wiki markup file is edited.

One of our design goals was to have WikiFolders work within the existing file browser rather than to replace it, in order to preserve the file browser's file manipulation capabilities. Our general strategy for integrating with the browser involves rendering the wiki markup as a background image behind the file browser's icon view and then positioning the actual icons atop placeholder regions. More specifically, WikiFolders uses a custom markup-to-HTML conversion engine to transform the folder's markup (e.g., Figure 1a) into an HTML file. Within the wiki markup file, each file reference is replaced with a

transparent HTML `IMG` tag and assigned style attributes that force it to take up the same amount of space that the actual file icon requires in the file browser. The rest of the wiki-style formatting is then converted into corresponding HTML tags. The resulting HTML file is merged into a pre-defined template file, which provides the overall look-and-feel for the final WikiFolder appearance. The system then renders the converted markup into an image (e.g., Figure 1b) using the WebKit open-source HTML rendering engine [11] and saves the result to a hidden file inside the folder. Finally, the application executes a series of short AppleScripts to (1) direct the OS X file browser to display the hidden background image file behind the folder's icons when browsed in "icon" view and (2) move each of the file icons in the folder to overlap the position of their corresponding placeholder image in the rendered HTML.

One advantage of rendering the markup as a background image is that this approach removes the requirement for having the WikiFolders application installed to view the modified folder layout. Folders are displayed with all of the custom formatting, even if, for example, another colleague—who might not even have the WikiFolders application on her computer—accesses it remotely as a shared folder. The drawback is that the markup is not directly accessible for indexing by Spotlight (the OS X search engine); however, we believe we can expose the markup text for indexing through a secondary channel.

### Editing a WikiFolder's Annotations

Individuals can edit a WikiFolder's annotations in two ways: they can either select the folder and click an "edit" button inside the WikiFolders application, or they can double-click the "Edit Wiki Formatting" icon that appears in each WikiFolder's banner region. Double-clicking this icon in the folder launches the WikiFolders application and initiates editing for the specified folder.

Our markup editor is a simple text editor. It is displayed in a window with a set of reminders about the markup commands that are available, along with buttons that commit the changes or cancel the editing operation. Once a user has edited and accepted the folder's annotations, the text is saved to the hidden markup file inside the folder and the folder's annotated view is automatically re-rendered. Like a web-based wiki, this markup is editable by anyone who has write access to the folder.

### Annotation Markup

WikiFolders allows individuals to annotate their folders using a subset of the markup language used in the open-source wiki platform PmWiki [7]. In our initial version of WikiFolders, markup can consist of:

- references to the files in the folder (e.g., "`[[file]]`");
- text headings (e.g., "`!!Heading`");
- formatted text, including italics and boldface;
- manual line ("`//`") and paragraph breaks (a blank line);
- horizontal rules ("`----`" by itself on a line); and
- any other standard HTML formatting, including inline images and custom-formatted `SPAN` and `DIV` tags.

An illustration of how each of these wiki markup elements is rendered is annotated in Figure 1.

Adding markup to the folder does not change any of its characteristics with respect to file management; all of the icons in the window are actual live file icons. They can be double-clicked to launch an application or referenced as usual from Open or Save dialog boxes in existing applications.

### Maintaining Consistency with File System Contents

Since any application can potentially change the contents of an annotated folder, it is important that the annotation text be kept up-to-date, in order to prevent inconsistencies between the folder display layout and the contents of the markup file. The WikiFolders application maintains a list of all active WikiFolders on the local machine and constantly monitors these folders for changes using the *fsevents* file monitoring framework in OS X. When files are created, WikiFolders detects this action and appends a corresponding link to the new file to the end of the markup file. When files are deleted, their position in the markup is replaced with a text placeholder (e.g., "(File deleted: Document.txt"), indicating the prior spatial location and name of the deleted file (Figure 2).

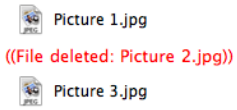


**Figure 2. A placeholder is created when files are deleted, indicating the filename of the file and preserving its relationship to surrounding files and annotations.**

Anytime the contents of the folder or the markup file are changed, WikiFolders automatically re-renders the folder formatting: it re-synchronizes the folder's appearance with its wiki markup. This capability enables individuals to continue using their folders as before without having to manually re-generate the annotated view after each change. A special case is file dragging: if a file is dragged to another folder, it is copied or moved normally, but if it is dragged to a new location within a folder, it returns to its original position when the folder is re-rendered.

## DISCUSSION AND RELATIONSHIP TO PRIOR WORK

WikiFolders occupies a unique point in the design space anchored by hierarchical file systems and wikis. Our design allows annotations to be created and displayed *in place*, extending the existing file browsing mechanism. We believe that this choice illustrates an interesting point in the design space, as it encourages the use of annotations both in the context and at the site of current file browsing practices. However, the system also takes advantage of the *presentation-oriented* and *flexible authoring* characteristics of wikis and the Web; these decisions change the nature of file management from focusing on *spatial* organization of

files to being a much more *descriptive* activity. We do not argue that WikiFolders represents the best possible combination of these characteristics, but rather that the system occupies a previously unexplored point in the design space and offers a new perspective on personal archiving and file management.

There are two fundamental differences between the approach to file management instantiated by WikiFolders and that taken by earlier personal information management tools like the Personal Project Planner [2] and TheBrain [9]. First, PPP and TheBrain are both standalone applications that are used to manage files; this stands in significant contrast to the design of WikiFolders as an extension to the system file browser. Second, WikiFolders doesn't presume or impose a particular ontology for annotations; by contrast, the Personal Project Planner establishes a flexible, but fixed "outline" representation that mirrors the hierarchical structure of the underlying file system, and TheBrain presents information primarily in a node-link, "mind map" style. While these organizational strategies might be well suited for particular individuals' mental models for organizing information or for managing particular classes of digital artifacts, WikiFolders offers a much more flexible approach, due to its support for freeform annotations.

## INITIAL FEEDBACK AND FUTURE APPLICATIONS

We informally deployed WikiFolders to five of our colleagues to gather initial feedback on the system's design. All responded positively to the concept of annotating folders in place. Several individuals noted that one possible benefit of using the system is that it would potentially enable them to reduce the depth (and complexity) of their folder hierarchies. Rather than creating subfolders to organize information, they envisioned using WikiFolders to cluster groups of files together and annotate each group to distinguish them from one another. A common feature request was for more direct annotation editing, using, for example, a live, WYSIWYG editor instead of requiring the use of an intermediate markup language.

We anticipate that the broader availability of in-place annotation features like those demonstrated by WikiFolders might fundamentally change the nature of personal archiving on personal computers. WikiFolders reduces the need for creating complex folder structures and index documents (e.g., "readme" files or local Web pages), lowering the bar for meaningfully archiving important materials and reducing the effort required to re-organize files that were previously archived.

However, visualizing files together with descriptive annotation has benefits beyond long-term archiving. Park and Furuta observed that changing work contexts and the accumulation of electronic artifacts can increase the difficulty of effectively resuming interrupted tasks [6]. They note that as people construct *narratives* corresponding to each of their tasks over time, these narratives serve an important function in reminding them of the status of the task and the role of the artifacts embedded in the task. Because WikiFolders provides a contextually relevant, convenient, and easily accessible mechanism for storing information about digital artifacts alongside those artifacts, one could easily imagine the system being appropriated as a lightweight, ad hoc task management tool as well.

Additionally, file sharing is an extremely prevalent collaboration practice, especially among small, tight-knit groups of colleagues [10]. Shared files serve as boundary objects in these kinds of collaborations; that is, different participants construct different interpretations of what the files they are collaborating around "mean" [8]. Each collaborator might use different language to describe the semantics of a shared file; each might also be inclined to organize these files using a different schema. These differing perspectives can make collaborating within traditional hierarchical file systems challenging. Systems like WikiFolders stand to offer valuable benefits for collaboration scenarios like these, since the ability to embed shared files within descriptive annotations constitutes an in-place communications channel that can be used to convey colleagues' interpretations of and intentions for various shared files in the context of the browser, itself.

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