FOLDER3D: A GRAPHICAL FILE MANAGEMENT SYSTEM SUPPORTING VISUALISATION OF FILE RELATIONSHIPS

Saturnino Luz*
Department of Computer Science, Trinity College Dublin, Dublin, Ireland
luzs@cs.tcd.ie

Masood Masoodian, Bill Rogers, Simon De Schutter
Department of Computer Science, The University of Waikato, Hamilton, New Zealand
M.Masoodian@cs.waikato.ac.nz, B.Rogers@cs.waikato.ac.nz

Keywords: File management systems, 3D user interfaces, information visualisation, hierarchical folders, file relationships, virtual folders, window management systems.

Abstract: The desktop metaphor with its hierarchical structure of folders is the basis of almost all graphical file management systems. Despite this popularity, these systems suffer from several problems, including the restrictiveness of the single inheritance structure of hierarchical file management. Although various alternative systems have been proposed, none of these have gained popularity. We argue that the reason for this failure is that these systems have generally proposed complete alternatives to the hierarchical system, thus ignoring many of its positive aspects. In this paper we describe a 3D graphical file management which complements conventional 2D hierarchical folder structures by allowing visualisation of alternative file relationships.

1 INTRODUCTION

Xerox Star (Smith et al., 1982) introduced to the world the concepts of the graphical computer desktop, making it possible for users to directly manipulate files and folders as they would in a real physical desktop. Despite its popularity, this metaphor suffers from several shortcomings, including the well-known problem of single inheritance in a hierarchical structure used for management of files within nested folders. Different operating systems have attempted to solve this problem by introducing "aliases", "shortcuts", or "symbolic links" to give the users the possibility of moving between different parts of the file management structure across different paths. In terms of the graphical visualisation of files and folders, however, the problem remains largely unsolved, with all the major file management systems showing files in a single inheritance hierarchy of nested folders.

Although alternatives to the desktop metaphor have been proposed, none of them has been adopted. We believe that the main reason for this is that these alternatives have aimed to replace the desktop metaphor completely. In this paper we describe a 3D graphical file management system, which aims to complement, rather than replace, the single inheritance file management systems by maintaining a wider range of relationships between different document files, and providing for a better visualisation of such relationships through the use of dynamically created virtual folders.

*The authors, listed in alphabetical order, have contributed equally to the ideas presented in this article.

2 FOLDER STRUCTURES

Shortly after Xerox Star was released Malone (1983) published his paper on the study of how office workers manage their physical desktops. The results of this study had clear implications for the design of future systems which based on the desktop metaphor. Unfortunately, however, almost all modern graphical file management systems have, for the most part, ignored Malone's interesting findings.

Among the results of this study was the observation that there are two groups of people: those who manage their desktop "neatly", and those who are "messy". One reason for this difference is related to the primary type of tasks performed by people, with some tasks requiring strict "filing" of documents while others rely on "piling" of documents in

Luz, S., Masoodian, M., Rogers, B., and Schutter, S. D. Folder3D: A graphical file management system supporting visualisation of file relationships. In *Proceedings of the International Conference on Information Visualization Theory and Applications (IVAPP'10)* (2010), INSTICC, p. 4pp.

loosely defined groups. Piling of information on the desktop assists with the process of "reminding" and helps users manage the cognitively demanding task of categorising their files. Malone suggests that to improve the process of categorisation computer systems need to allow *multiple* classification as well as *deferred classification* of information.

Studies of people's file management habits on computers have identified similar problems with classifying information. For instance, Nardi and Barreau (1997) report that, in their studies, there was a preference for location-based search for files, people archived very little information, and the placement of files had a critical reminding function. However, Fertig et al. (1996a) argue that the main reason for these findings was due to the limitations of the desktop metaphor itself. They argue that users may have different preferences when they "are provided with richer and more functional interaction environments."

A more comprehensive study by Ravasio et al. (2004) showed that the users of systems based on the desktop metaphor find it impossible to "impose the same type of hierarchical structure on the screen as in the file system", and because of this they tend to use "the concepts of thematic proximity and document type to group the content on the desktop", which is then mainly used as temporary storage. Ravasio et al. (2004) also point out that users view information from at least three different angles: (1) task oriented: focusing on task to be accomplished, (2) context oriented: focusing on other documents and tasks at hand, and (3) content oriented: focusing on the actual information contained in documents. The strict hierarchical folder structure is therefore clearly restrictive in that a file can only be placed in one folder, and as such, can only be viewed from one perspective.

Several attempts at improving this situation have been made. Lifestreams (Fertig et al., 1996b,a), for instance, replaces the spatial aspect of desktop, and acts like a diary of items which can be viewed across time. One important feature of Lifestreams is the support for different data views through "stream filters", which divide information into dynamically created sub-streams. Sub-streams are therefore a form of virtual file organisation in which, unlike a hierarchical folder structure, a file can be in different places. Lifestreams is similar to "semantic" systems, such as MIT's Semantic File System (Gifford et al., 1991). A different view of time-oriented file management is provided by Time2Hide (Lepouras et al., 2008) a system in which items that the user has not accessed for a while gradually fade on the desktop.

Systems which aim to enhance the spatial grouping of related items, such as Data Mountain (Robertson et al., 1998), are generally based on the "pile" metaphor (Mander et al., 1992). Piles are also used in Presto (Dourish et al., 1999), but Presto allows automatic grouping of items based on their attributes and provides a space called Vista (similar to a desktop) on which items can be placed in piles.

The problem with most of these prototypes, and other systems which allow organisation of information using a logical (Dourish et al., 1999), temporal (Fertig et al., 1996b,a), or spatial metaphor (Rekimoto, 1999a,b; Robertson et al., 1998), is that they propose radically alternative ways of organising information, as replacements for the hierarchical folder system, often without taking into account many of their benefits. A study by (Jones et al., 2005) has identified some of the positive aspects of folder hierarchies. According to this study folder hierarchies are more than just a means to re-access information, and they have information value in themselves. As well as organising files, folders also "represent an emerging understanding of the associated information items and their various relationship to one another." The results however also show that additional information, particularly those that are common across multiple folders, often have to be "squeezed" into tree hierarchies.

There is, therefore, a need for enhancing the capabilities of the folder structure by supporting relationships between files across multiple locations as well as facilitating the visualisation of such relationships.

3 VIRTUAL FOLDERS

In general, relationships between files can be defined in terms of their *content* and their *context of use*. We are particularly interested in how content and contextual information can be used as the basis for better visualisation of file relationships, and as such, allow for more effective browsing of file groupings, while at the same time retaining the familiar nested folder tree hierarchy which can provide an effective means of traversing between folders (Golemati et al., 2008).

Although content information can be automatically extracted by the system, there are some limitations to doing this completely automatically. Any proposed content-based system should therefore allow an easy way of manually associating files based on their content. The folder system itself is one way of doing this, though only in a limited single inheritance hierarchy. In contrast, a dynamically generated virtual folder would allow creation of many different groupings of a single file within different categories.

Contextual information, on the other hand, can be extracted automatically much more easily. Examples

Luz, S., Masoodian, M., Rogers, B., and Schutter, S. D. Folder3D: A graphical file management system supporting visualisation of file relationships. In *Proceedings of the International Conference on Information Visualization Theory and Applications (IVAPP'10)* (2010), INSTICC, p. 4pp.

of useful context information related to a file include links to other files created or accessed about the time that a particular file itself was created or accessed (Dourish et al., 2000). Once again, although physical folders are a means of placing contextually related files together, dynamically created virtual folders would allow creation of many different contexts for a single file depending on the users real-time activities, needs, or preference settings. Another way of enhancing the hierarchical folder structure is to use of the file attributes which are best recalled by computer users (e.g. file location, type, format, associated events, etc) and could aid file retrieval (Blanc-Brude and Scapin, 2007).

4 FOLDER3D PROTOTYPE

In order to investigate the issues discussed in the previous sections, we have developed a prototype 3D graphical file management system, called FOLDER3D, which provides mechanisms for creating alternative grouping and visualisation of related files using the concept of virtual folders. FOLDER3D prototype is based on the *Looking Glass* 3D desktop environment (SUN Microsystems, 2009), and uses its window management infrastructure. Figure 1 shows a frontal view of the user interface with its 3D file management object containing four panels, which the user can rotate along the vertical and horizontal axes. All panels are equally interactive and display synchronised views of different components of the file system structure. The user can select and navigate across the folder hierarchy by selecting any icon on any of the panels. The front panel represents the user's current focus which can be either a folder which the user could further explore (causing the side panels to be simultaneously updated) or a file whose properties are displayed on the panel, as shown in Figure 1. The use of simulated perspective in FOLDER3D implements a distortion-oriented technique similar to the well-known techniques of bifocal display and perspective wall (Leung and Apperley, 1994) which fits in naturally with the platform's 3D metaphor.

The interface object can be rotated arbitrarily (using the 3D manipulation primitives available in the platform) or flipped into pre-defined positions which highlight each of the different views supported by the browser through the "handles" provided, which are represented in the interface by the arrows on the bottom (left and right) and top of the panel.

Flipping the object to the left brings into focus the indented tree panel (left panel of Figure 1), which displays a traditional view of a folder structure as a

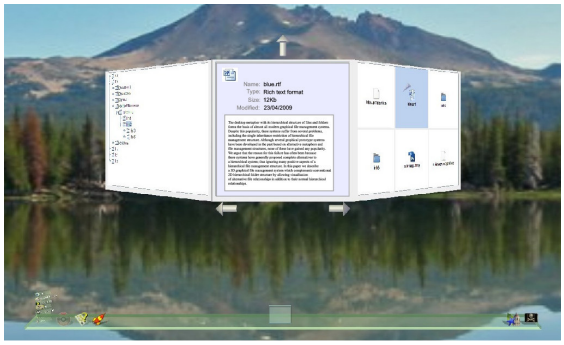

Figure 1: Front view of FOLDER3D.

hierarchy. From this viewpoint, the user can easily navigate the file system while at the same time maintaining a peripheral display of the details of any file selected during this navigation task.

The panel on the right-hand side of the selected file panel displays the icons corresponding to the files and folders situated on the same level as the selected file in the file system hierarchy. Navigation is also possible through this panel, following a standard "zoomable" interface interaction mode. However, it is more likely that the user will use it to inspect file properties, which are displayed on the left as the user moves the cursor over the file icons.

As the user navigates the file system, they might want to explore files which are related, either in terms of the content or context, to the file currently in focus. FOLDER3D supports the visualisation of related files on the virtual folder panel located at the top of the properties panel. As with the other panels, the related-files panel can be highlighted by rotation of the FOLDER3D object, as shown in Figure 2.

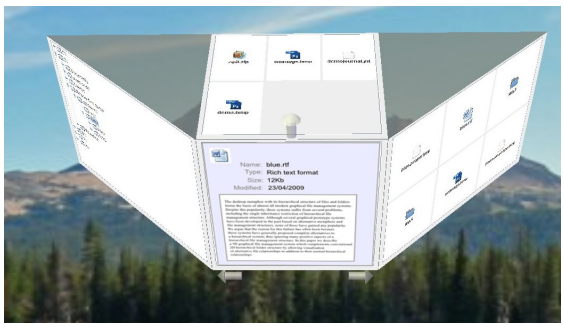

Figure 2: Top panel showing related files in a virtual folder.

In order to allow visualisation of related files, FOLDER3D defines a set of properties for each file in the system. These properties, which include the standard file properties common to most file management systems (e.g. file type, size, ownership), also list a set

Luz, S., Masoodian, M., Rogers, B., and Schutter, S. D. Folder3D: A graphical file management system supporting visualisation of file relationships. In *Proceedings of the International Conference on Information Visualization Theory and Applications (IVAPP'10)* (2010), INSTICC, p. 4pp.

of related files. Although the current version of our prototype only allows the list of related files to be created manually, we will also provide a drag and drop mechanism for interactively moving files from different folders into the virtual folder of a file. It will also be possible for the users to select from a list of categories so as to determine which virtual folder should be displayed in the top panel of a selected files. Examples of such categories include the list of files that are related temporally, share common keywords with the selected file, have the same properties, etc.

5 CONCLUSIONS

We presented a graphical file management system based on a 3D desktop metaphor which combines indented lists, zoomable icon panels and file property visualisations with a representation of file relationships that can be defined across and above the standard directory hierarchy. Although these relationships can be inferred according to file content (keywords, semantic similarity, etc) or context (time, task, etc), FOLDER3D provides a visual representation to support the definition of such relationships by the user as they explore the structure of the file hierarchy.

We are planning to extend FOLDER3D to support dynamic creation of folder and file relationships by drag-and-drop, to allow selection of categories of relationships displayed on the top panel, and to enable the use of FOLDER3D as a dynamic desktop background.

REFERENCES

Blanc-Brude, T. and Scapin, D. L. (2007). What do people recall about their documents?: implications for desktop search tools. In *IUI '07: Proc. of the 12th intl. conference on Intelligent user interfaces*, pages 102–111. ACM.

Dourish, P., Edwards, W. K., LaMarca, A., Lamping, J., Petersen, K., Salisbury, M., Terry, D. B., and Thornton, J. (2000). Extending document management systems with user-specific active properties. *ACM Transactions on Information Systems*, 18(2):140–170.

Dourish, P., Edwards, W. K., LaMarca, A., and Salisbury, M. (1999). Presto: an experimental architecture for fluid interactive document spaces. *ACM Transactions on Computer-Human Interaction*, 6(2):133–161.

Fertig, S., Freeman, E., and Gelernter, D. (1996a). "finding and reminding" reconsidered. *SIGCHI Bulletin*, 28(1):66–69.

Fertig, S., Freeman, E., and Gelernter, D. (1996b). Lifestreams: an alternative to the desktop metaphor. In *CHI '96: Conference companion on Human factors in computing systems*, pages 410–411. ACM.

Gifford, D. K., Jouvelot, P., Sheldon, M. A., and O'Toole, Jr., J. W. (1991). Semantic file systems. *SIGOPS Operating Systems Review*, 25(5):16–25.

Golemati, M., Katifori, A., Giannopoulou, E. G., Daradimos, I., Vassilakis, C., Lepouras, G., and Halatsis, C. (2008). An interview-based user study on the use of visualizations for folder browsing. In *Proceedings of the 12th International Conference Information Visualisation, 2008. IV '08*, pages 106–112.

Jones, W., Phuwanartnurak, A. J., Gill, R., and Bruce, H. (2005). Don't take my folders away!: organizing personal information to get ghings done. In *CHI '05: CHI '05 extended abstracts on Human factors in computing systems*, pages 1505–1508. ACM.

Lepouras, G., Papatriantafyllou, A., Katifori, A., and Dix, A. (2008). Time2hide: spatial searches and clutter alleviation for the desktop. In *AVI '08: Proc. of Advanced visual interfaces*, pages 355–358. ACM.

Leung, Y. K. and Apperley, M. D. (1994). A review and taxonomy of distortion-oriented presentation techniques. *ACM Trans. Comput.-Hum. Interact.*, 1(2):126–160.

Malone, T. W. (1983). How do people organize their desks?: Implications for the design of office information systems. *ACM Transactions on Information Systems*, 1(1):99–112.

Mander, R., Salomon, G., and Wong, Y. Y. (1992). A "pile" metaphor for supporting casual organization of information. In *Proc. of CHI'92*, pages 627–634. ACM.

Nardi, B. and Barreau, D. (1997). "finding and reminding" revisited: appropriate metaphors for file organization at the desktop. *SIGCHI Bulletin*, 29(1):76–78.

Ravasio, P., Schär, S. G., and Krueger, H. (2004). In pursuit of desktop evolution: User problems and practices with modern desktop systems. *ACM Transactions on Computer-Human Interaction*, 11(2):156–180.

Rekimoto, J. (1999a). Time-machine computing: a time-centric approach for the information environment. In *UIST '99: Proc. of the 12th annual ACM Symp. on User interface software and technology*, pages 45–54. ACM.

Rekimoto, J. (1999b). Timescape: a time machine for the desktop environment. In *Proceedings of CHI '99*, pages 180–181. ACM.

Robertson, G., Czerwinski, M., Larson, K., Robbins, D. C., Thiel, D., and van Dantzich, M. (1998). Data mountain: using spatial memory for document management. In *UIST '98: 11th ACM symposium on User interface software and technology*, pages 153–162. ACM.

Smith, D. C., Irby, C., Kimball, R., Verplank, W., and Harslem, E. (1982). Designing the star user interface. *Byte*, 7(4):242–282.

SUN Microsystems (2009). Project Looking Glass. https://lg3d-core.dev.java.net/, (10th November 2009).

Luz, S., Masoodian, M., Rogers, B., and Schutter, S. D. Folder3D: A graphical file management system supporting visualisation of file relationships. In *Proceedings of the International Conference on Information Visualization Theory and Applications (IVAPP'10)* (2010), INSTICC, p. 4pp.