Spatial Hypertexts as an Interface to the File System

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INTRODUCTION

The starting point of Spatial Hypertexts was a result of the move from document-centered hypertext systems to map-based hypertext systems, a change in perspective from the links among texts to the organization of the documents themselves [1]. Today spatial hypertext systems, like VKB [2], support the user in organizing small nodes of text or links to documents and web pages.

In this paper we propose the use of spatial hypertexts to organize personal collections of files in a workspace environment.

Files in file systems are organized in hierarchical directories and are located using the filename and the position in the hierarchical directory system. A graphical "desktop" interface to the file system was introduced in the 1970s. The graphical interface to the file system maintained the original hierarchical structure to locate files.

Today the desktop consists of three main components: the desktop itself, where the users can visually organize icons of several items, the folder/directory structure where users store their files, documents and programs, and the start menu to directly access specific folders or to start programs.

While the desktop itself allows a spatial organization of the files, the interface to the file system, the folder structure, closely resembles the tree structure of the underling hierarchical file system, and it doesn't provide support for a rich use of the space.

Users would benefit from a different folder structure that exploits the spatial environment and that allows to specify spatial relationships among the items.

DIFFERENT WAYS TO USE THE FILE SYSTEM

The file system is one of the most important components of a computer system. Its main purpose is to store and retrieve files. The most common way to organize files, from the system point of view, is to organize them in a hierarchical tree. Links and shortcuts were introduced to make the hierarchical structure less rigid, but they do not really change the main hierarchical structure. Recently some companies introduced an alternative to a hierarchical system: the files are stored in a database and that makes it easier to retrieve files by a query.

From the user point of view the file system is used for different purposes:

- as an archive,
- as a working space,
- as a reminder.

In this paper we only consider the portion of the file system that stores user data, or personal files. We do not consider operating system files, applications or application libraries, but only documents that the user organizes and stores for his/her personal use.

Archive: the user stores files at the end of a project and retrieves them either remembering the name and location inside a directory, performing a search or browsing the directory structure. An archive is generally used for long term storage of files that are not actively used. An archive is also used to store collections of media files, such as photographs or audio file such as MP3.

Working Space: often a user collects all files related to a project in a folder. He organizes them in subfolders, and if possible he spreads them in the space. The desktop is often used for this, but its use is mainly limited to the most recently activities and/or few projects. It is difficult to use the desktop to organize several projects without it becoming cluttered.

Reminder: Certain files placed in predefined positions, for example on the top right of the screen, remind the user of a task. Nardi and Barreau. [3] in their studies found that users often placed files where they could serve a reminding function. This included placing icons where they would be noticed and leaving messages in electronic mailboxes where they would serve as reminders of things to be done. They talk about ephemeral information that, in contrast with archival information, has a short shelf life and includes items such as (some) electronic mail messages, "to do" lists, note pads, memos, calendars, and news articles downloaded from databases.

While traditional file systems have concentrated their attention mainly on the first point, archiving files, users would benefit from a system that supports them in the other uses. In particular they would benefit from an environment that supports the organization of files in space.

FILE SYSTEM LEVELS

The file system can be view at different levels.

Physical Level: this is the level that deals with the physical organization of the files on the hard disk.

Logical Level: this level deals with the organization of the files in a logical structure. It decides the method of naming of the files, and the organization in a structure, like a directory tree or a database.

Interface level: this level deals with the way in which file are presented to the user. A common graphical interface is for example MS Window Explorer that presents both a tree view of the file system, and a folder view in which an open folder occupies a window and the files are represented as icons inside the window.

We are only interested in the interface level. And in particular only in that portion that deals with personal collections of files.

ALTERNATIVES TO A HIERARCHICAL STRUCTURE

The current interface to the file system very closely resembles the underlying logical structure. The interface uses either trees or folders to represent the hierarchical structure.

Hierarchies have always been used in computer systems, and users are accustomed to them. But are hierarchical structures really the most natural way to organize things?

Henderson and Card [5] proposed a system called Rooms, where activities were divided in workspaces, called rooms. Each room, similar to a desktop, collects documents and represents windows. At the bottom of each room there is a space where it is possible to represent doors. Each door is a connection to another room. Overall such a system creates a graph where each room is a node and each door is a link to another node.

Quan et al. [4] more recently conducted a study where users used directories as a way to classify documents. Users used the folder name to represents an attribute of the file. For example a Chinese receipt containing fish can be both placed in the directory of Chinese receipts and in the directory of the receipts containing fish. Not surprising one problem with that is the inability to conveniently file documents in more than one category. They concluded their study “providing evidence that compared to the folder paradigm, multiple categorization not only improves organization and retrieval times but also matches more closely with the way users naturally think about organizing their information.”

In situations in which there is the need to organize documents according to different attributes, multiple categorizations or a database seems an adequate structure for organizing files.

But there are situations in which users need a more fluid organization and at certain stages it is too early to commit to any structured document organization.

A space organization can help in this. The space can be designed in a way that maintains hierarchical structures, such as collections in VKB [2]. However, it is possible to design workspaces without hierarchical structures. User studies should prove if a spatial organization without hierarchies is useful.

SPATIAL SUPPORT FOR THE FILE SYSTEM

The commonly used windows interface doesn’t offer a great support to a user who wants to organize his files in workspaces.

Organization of files in a workspace is a very important activity: Nardi et al. saw [3] that users often place files in strategic positions where they could serve as a reminder. Moreover, a user positions files to express relationships. For example he can divide the workspace into areas: on the top left files related to important tasks to do, on the bottom left less important tasks, and on the center area tasks that he is currently working on.

Spatial organization can also express different relationships among files, like categories, or significance. For example in a workspace that collects papers for a personal digital library, papers may be grouped according to the topic: in one area background papers and in another area more recent developments. These kind of organizations requires a richer environment than the one currently offered by the graphical interface to the file system. The user may want to add labels to groups or collections of icons and may want to add small chunks of text such as comments. He may also want to visually separate the collections enclosing them in a colored area. Or he may want to identify different types of files with colors.

Spatial arrangement of big collections raises issues of what to do when one collection in the space becomes too big. Should the user store all the files in a folder and leave the icon of the folder in the space originally occupied by that collection? Should he use a collection like in VKB [2] where only few files are visible and the full content of the collection is visible when it is expanded? Should the user create a subfolder?

Spatial arrangement of files in a workspace inherit the benefits typical of spatial hypertext as described by Shipman and Marshall [1] takes advantage of people's considerable visual recognition and intelligence; it facilitates constructive ambiguity; it supports emerging problem-solving strategies; and it reduces overhead in communicating with others.

But spatial organization requires a richer environment than the one offered today by the desktop or the file system. In order to spatially organize files in the file system we need to overcome some issues of the current file system. There are two main problems in today’s interfaces to the file system. First there is a navigational problem. A folder structure is either represented by a tree, or by a set of Chinese boxes where each folder or node of the tree is

represented as a stand alone window. For example when I click on a folder a new window opens and the content of the folder is displayed in the window. Consequently, the folder loses its relationship with the context, with the parents and the sibling nodes.

So one problem with current folder graphical representation is

- Navigation: every time I open a window I enter in a new context and loose contact with the rest of the tree
- It is not possible to visualize the content of a folder and at the same time keep the relationship with the neighboring folders.

The second problem is the lack of a rich environment in which to organize the files. The objects inside a window are all icons of files, with the name attached to it. There are few basic organizational facilities: sorting the icons according to name, date or other attributes, keeping them in a predefined grid and auto arrange them. Or there is the possibility to move the icons inside the window, but today's systems often overwrite the user positioning after a while and automatically rearrange the icons.

The idea behind this paper is to propose an interface to the file system that uses a spatial hypertext to organize elements of a file system. The new interface should provide an environment where it is possible to create several workspaces, where it is possible to express relationships among files by locating them in a spatial structure. It also must be possible to add comments to files or group of files. For example I could divide the workspace in three areas, left middle and center, and add a paragraph of description to each area. Each area in turn contains icons that represent files. This text paragraph is not a file, is not a name of a directory and is not an element that can be part of current file systems. It is not too difficult to imagine that workspace if we think about a web page or a hypertext. In a web page it is normal to have a chunk of text followed by some links or a set of links organized in a table. But in this case the link is not really a link, it is a placeholder for a file that I can manipulate, move in a different position or even delete affecting the real file. And I have a spatial environment instead of a somewhat linear page of text.

In some respect it puts together the idea of a spatial hypertext, a web page and a file system.

The following suggests a list of important characteristics that the interface to file systems should have.

IMPORTANT CHARACTERISTICS

Important characteristics of a spatial environment/hypertext for files.

- Possibility to use different items along the file icons: labels, spatial structures like border or boxes where to group files
- Functions to operate on spatial items: to sort object swapping positions but keeping original user layout. Example: if a user places a group of items in a row, it will be useful to have a function that sort all of them according to some attribute, but keeping all of them in a row. And the function must be able to operate only on a selected group of elements instead of all the elements in the folder.
- Navigational system that allows visualizing open folders in their context, without every time opening and closing new windows.
- Zoomable interfaces that allow overview of the full system or that reveal details of certain area of the system.

CHALLANGES

There are also several challenges to realize a spatial hypertext as an interface a file system.

- One challenge with a file system is to deal with a large amount of elements. A spatial hypertext doesn't scale very well while dealing with a huge amount of items. The challenge is therefore to interface the spatial file system with the traditional or database style file system to take advantage of the facilities offered by the file system to deal with lots of files. One suggestion would be to have a spatial interface that deals with recent elements and an archival environment with files belonging to old and completed projects.
- The spatial system must be able to nicely merge with the rest of the file system, with application files and libraries.
- We need to find different ways to deal with space and containments. What do collections represents? Are they the equivalent of folders? Or are they something different?
- How is one file represented in several workspaces?

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