Entropy: Managing Data in an Electronic World

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1. ABSTRACT

This paper describes a prototypical desktop metaphor called *Desktop Plus+,* a spatial metaphor that incorporates spatial organization of data, 'piles' [9], radar views, and dynamic querying [14]. The spatial information arrangement allows users to organize information easily and special filters supports easy searching and retrieval of desired data. Desktop Plus+ is a proposed solution to the drawbacks found the Window's hierarchical file structure in terms of data management. This paper describes an iterative design approach that begins by examining the weaknesses of the Windows desktop and its hierarchical file system and then moves on to design and test a spatial metaphor for data management, Desktop Plus+ in order to examine the strengths and advantages this alternative metaphor.

2. INTRODUCTION

> "'I know it's here somewhere,' was lame enough when "here" meant a messy desk and maybe a filing cabinet. Now that "here" is a PC with an 80GB or 120GB hard disk hiding dozens of folders, thousands of files, and tens of thousands of e-mail messages and attachments, it's an admission of defeat."
>
> - *Eric Grevstad (Win Planet*) in a review of *'Scopeware Vision'*

2.1 Motivation

Organizing electronic information on computers is one of the central issues concerning designers of user interfaces. Easy searching and retrieval of information is essential. The hierarchical structure of folders and files is central to the desktop metaphor, and although this concept was a tremendous improvement over older interfaces, with the exponential increase of computers' storage capacity and the introduction of the World Wide Web, the amount of data that resides on one's computer has grown enormously. Therefore, I contend that the desktop metaphor's hierarchical folder structure does not provide an ideal structure for data management. Users have difficulty organizing and managing their data and often get lost within this hierarchical structure of folders and files (Figure 1), making searching and retrieval of data a frustrating task. My goal is to show that data management within the desktop's hierarchical file structure is problematic, and could be better achieved through an alternative metaphor, which makes better use of human's cognitive spatial abilities.

The remainder of this section provides support for this claim from related research, and states the problem and goal of this research in more detail.

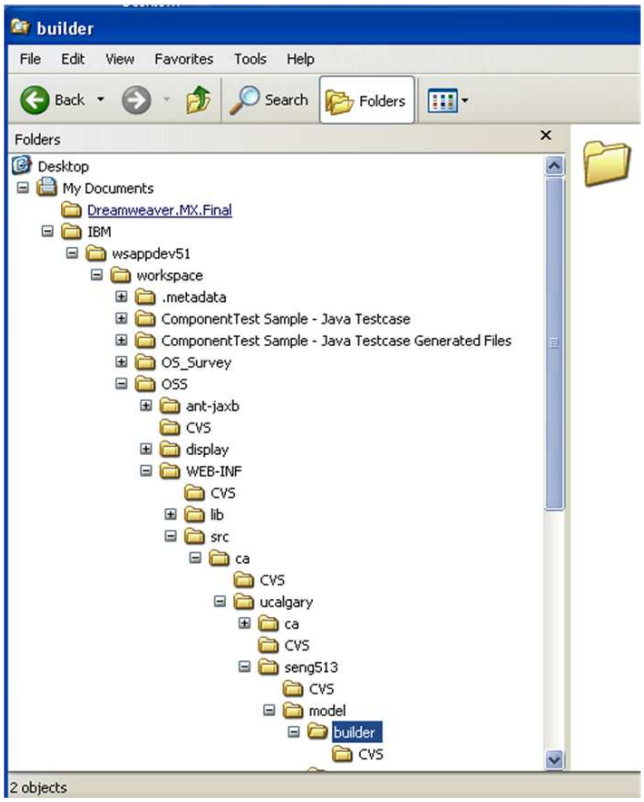

Figure 1: A snapshot of a Windows's folder structure. As shown in this example, desktop hierarchies can be quite deep and complex.

2.2 Problem and Research Direction

The problem addressed by this research is that the desktop metaphor does not provide an ideal interface for users to organize, structure, and thereby navigate data efficiently and quickly. Fertig, Freeman and Gelernter cite studies [5] that support this claim. They found that users of desktop systems had difficulty organizing and finding information within the hierarchical file system, as well as getting an overview of their data (Figure 1). Soules and Ganger [15] report a similar limitation to the hierarchical file system, stating that:

1. Information describing a file is lost without a well-defined and detailed naming scheme
2. Little way to establish a relationship between related files not placed within a common folder or sub-folder

Rekimoto [11] states a number of drawbacks to the folder hierarchical structure:

1. Limited flexibility required to properly organize a large number of files
2. Strict hierarchy providing only single categorization

Rekimoto [11] continues to note that users often avoided the use of document folders altogether by placing icons directly on their desktop. With the deep hierarchical structure of files and

folders (Figure 1), files stored three or four levels down are hidden from view and take a multitude of mouse clicks to get to; on the desktop, these documents are just one-click away. This is because the items are always there; people can access them immediately, and can arrange them spatially to form implicit structures (Figure 2). Studies performed by Barreau and Nardi [2] support this idea. Their study found that users placed files where they could serve as a reminding function, highlighting the importance of location-based organization and searching.

In Marshall and Shipman's examination of hypertext and the web, they discovered that a user's information access and retrieval performance is dependent on the user's ability to obtain an effective mental or 'cognitive map' of the information space to be navigated [10]. With this in mind, this paper focuses on methods of effectively conveying cognitive mappings through the use of spatial cognition, as research has indicated that the spatial aspect of the human cognition is the most useful aspect of human's cognition in term of data management. The domain of the research is restricted to mapping in two-dimensional spaces, as research has indicated that navigation of three-dimensional spaces can be more cognitively demanding [16].

Figure 2: An example using spatial organization to form an implicit structure. The top right section of the screen contains a number of files for a project the author is working on for ENTI 201. The relationship between these various documents is easily identified on the Windows Desktop.

3. RELATED WORK

This section examines two areas of related work that are particularly relevant to this investigation. First, it looks at information and studies provided by several researchers that show a relationship between user's spatial cognition and their performance with user interfaces. Secondly, it summarizes some proposed alternatives to the desktop metaphor that utilizes human's spatial cognitive abilities.

3.1 Spatial Cognition and User Interface Performance

In order to properly understand the advantages of spatial organization, it is necessary to first acquire a basic knowledge of human cognition of the spatial world. *Cognition* is defined as the mental process by which human's acquire, store, retrieve and manipulate knowledge. This includes perception, memory, learning, reasoning and problem solving. *Spatial cognition* deals with the cognition of spatial properties of the world, including location, size, distance, direction, shape, pattern, movement, and inter-object relations.

A spatial interface allows users to take advantage of their visual memory and pattern recognition. The use of a spatial metaphor alleviates many of the problems identified in Section 2.1. As mentioned in Section 2.2, users often have difficulty organizing and finding information within the desktop's hierarchical file system. Using a spatial interface for data management rather than a folder hierarchy, makes remembering where one saw a document in a visual workspace a process of recognizing the area in which a document was located rather than having to remember the navigational path one took to get to the document [10]. The claim that user performance is strongly enhanced by the use of spatial organization, has been confirmed in many separate experiments with varied interfaces. Cockburn [3] cites findings of psychology experts Vincent, Hayes and Williges who all agreed that measures of spatial ability predict performance in a variety of file management tasks. However, it is important to note that other studies show that the combining of semantic labelling with spatial organization does even more for enhancing performance [8].

In addition to allowing for improved organization of data, spatial metaphors enable the expression of implicit relationships between documents. According to a study of spatial hypertext, people prefer creating relationships among different documents based on their relative location. Users favour a more implicit expression of relationships through spatial proximity and visual attributes, such as icon images [10] (Figure 2).

3.2 Alternative Spatial Metaphors

Several research groups have proposed alternatives to the desktop metaphor, which incorporate a higher level of spatial cognition. A few of these interfaces are explored below.

3.2.1 TimeScape

TimeScape is a desktop metaphor that allows users to spatially arrange information on the desktop [11, 12]. The system supports time-travel to the past or the future of the desktop allowing for the combination of spatial navigation and chronological navigation. With TimeScape users can organize and archive electronic information without using document folders or file classifications.

Figure 3: TimeScape – *desktop* view

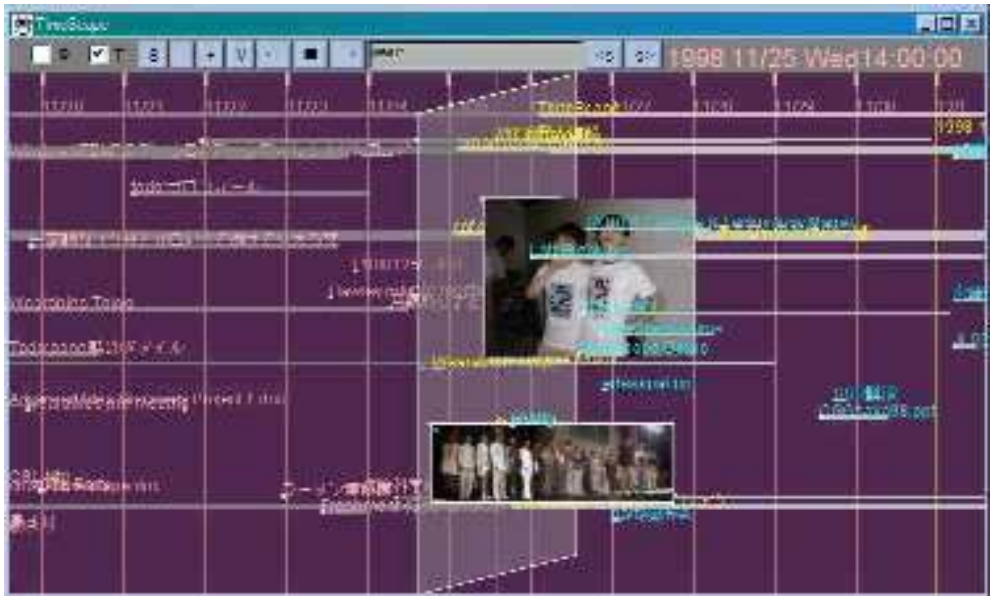

Figure 4: TimeScape – *Timeline* view

Figures 3 [12] shows a typical screenshot of the TimeScape desktop; there are no folders and all items are placed directly on the desktop. Figure 4 represents the timeline view; here desktop items are visualized on a semitransparent rectangle in the middle of the screen. The left and right parts represent the past and future of the desktop. Users can zoom-in or zoom-out to browse activities from a day, week or month.

Future directions that Rekimoto and his research team were considering included ways to enhance TimeScape by improving the visualization of time. In addition to animation, zooming, and semitransparency, they suggested nonlinear (i.e. fisheye Figure 5) zooming to visualize the space-time continuum.

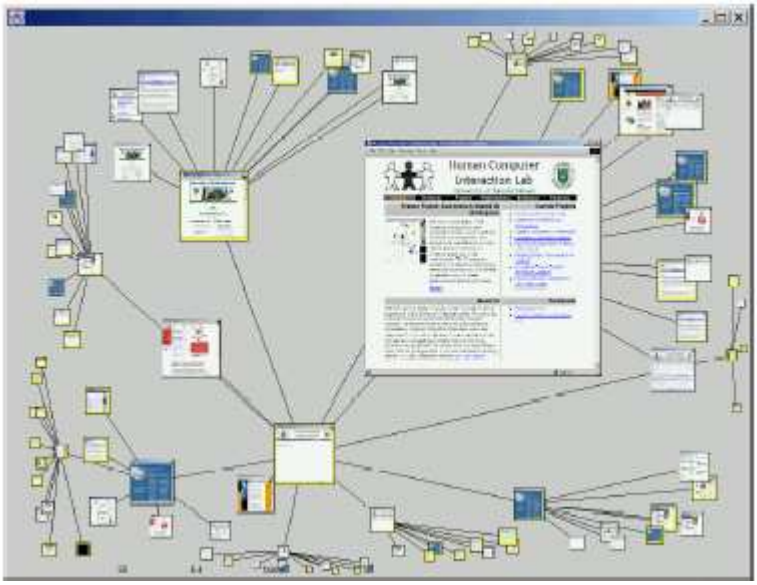

Figure 5: An example of a Fisheye view. This image represents an interactive fisheye view for browsing a web site.

3.2.2 'Pile' Metaphor

The pile concept was developed by Mander, Salomon, and Wong, [9] and is based upon findings of a user study which examined how people organized their work in real world situations. This study found that piles were: (1) created in order to quickly and informally manage information (2) seen as complementary to the more formal archiving system provided by folders and file cabinets. Mander et al. proposed a 'Pile' metaphor, where files could be piled on the computer desktop, for casual organization of information. Since his study found that users liked grouping items spatially by creating physical piles of paper, rather than immediately categorizing it into a specific folder, he decided to extrapolate this to computer interfaces for organizing electronic data. The proposed 'pile' metaphor which would allow for user to create their own piles or system created piles. In this design, a user could browse a pile by moving the cursor over the documents in the pile, which displayed a miniature representation of each item.

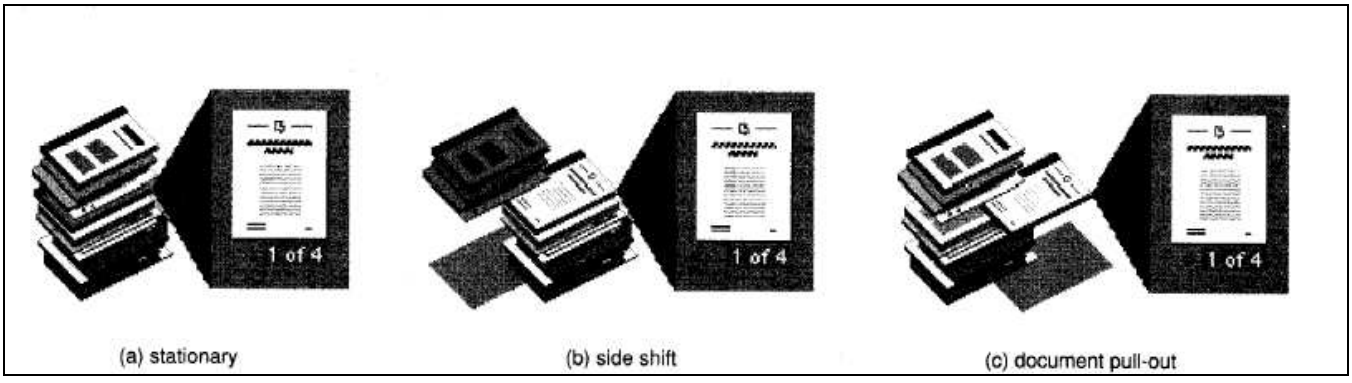

Figure 6: Example mock-ups of Mander et. al's 'Pile' Metaphor [9]

Figure 6 presents the three different ways a pile could be viewed. In style (a), the pile remains stationary, in (b) each item above the currently viewed is moved to the side, and in (c), the item being viewed is temporarily moved out of the pile to the right [9]. One area that Mander et. al planned to explore in order to improve upon the current prototype included incorporating other ways to browse data, such as textual searches or dynamic filters.

3.2.3 Life streams and Scopeware

Lifestreams [5], the predecessor of Scopeware, is a time-ordered sytem intended solely for organizing data on one's computer. Lifestreams incorpates Mander et. al's [9] 'pile' metaphor as well as time-ordering of documents. Thus, the Lifestreams interface combines both spatial coginition with chronological navigation. The Scopeware interface presented in Figure 7, shows a typical view of the one's documents. To find information, the user had the ability to search using boolean searches, wildcards or by entering the partial name of the file. Results are then immediately displayed in an easy to navigate manner.

4. DESKTOP PLUS+ DESIGN SKETCH

The next step of the design process of Desktop Plus+ involved producing a few simply mocked up view of Desktop Plus+ (Figure 8), a proposed alternative to the desktop's hierarchical file structure. This enhanced desktop is a spatial metaphor that incorporates spatial organization of data, 'piles', radar views [7], dynamic querying [14] and zooming. In this prototype users can organize their current data directly on the desktop, providing easy, immediate access to relevant data. As Figure 8 displays, users are able to place documents on the desktops in piles – allowing for easy spatial organization of their data. As with Mander et. al's [9] proposed implementation, the user would be able to to manually search through piles by moving the mouse "through" the pile. As the user moves the mouse over the desired document,

Figure 7: An example of the Scopeware interface

the document becomes highlighted and enlarged (Figure 8). In addition, a textual label describing the document is displayed for the document in question (Figure 8). This label could be specified by the user or simply left to default using the document's filename. In order to support the ever-expanding amount of data that may need to be stored on the desktop, this prototype implements a "scrolling" desktop interface with a corresponding radar view so that users do not get lost within this expanded desktop. To avoid confusion caused by accumulating too much data on this desktop, old, irrelavant data can be archived within the traditional file structure.

In addition to the increase in screen real estate and spatial organization, browsing will be enhanced through a number of filters. Dynamic queires [14] will provide quick searching through large amounts of data. As these filters are employed, the irrelevant data will be 'removed' from the current view of the desktop. Figure 9 represents what the desktop in Figure 8 would look like after filtering for all '.doc' files. An additional filter incorporating Rekimoto [11] and Geleneter's [5] concept of time-based organization and searching, allowing users to filter data by a specified date range. All filters can be applied to either a specific pile, a group of piles or to the entire desktop; the filter used in Figure 9 has been applied to the entire desktop

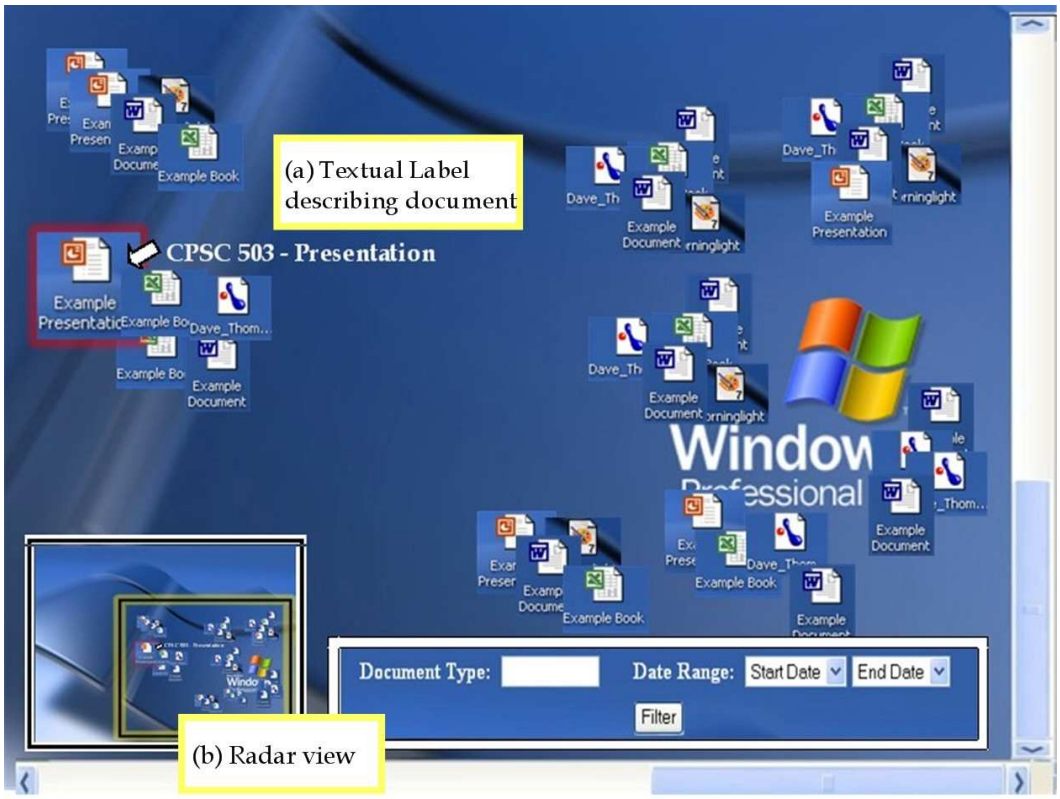

Figure 8: A prototypical view of Desktop Plus+

Figure 9: A filtered prototypical view of Desktop Plus+. The Radar view still contains all the documents prior to filtering.

In order to provide some preliminary analysis of Desktop Plus, I completed an introspective evaluation of Desktop Plus+. To do this, I examined these prototypes against Windows' current hierarchical file structure, as shown in Figure 10, as well as Windows' current desktop, as shown in Figure 11. Each interface contains the same information as shown in Figure 8.

4.1 Strengths

When comparing the protoype of Desktop Plus+ against the heirachical file structure (Figure 10), the following strengths were identified.

1. Desktop Plus+ provides an overview of all data, whereas, the Windows file structure is only able to display one folder's data at a time, hiding all other data inside each folder, unless one opens mulitple windows.
2. Desktop Plus+ allows for a "one-click" easy access to all data, wheras, the Windows file structure requires at least "two clicks" depending on the depth of the folder structure.
3. Desktop Plus+ allows the user to create relationships among different types of data through spatial organization. These relationship are easily seen, as related data is placed within the same 'pile'. The Windows file structure allows for relationships between files contained within the same folder; however only vague and weak relationships can be implied for data for that is stored in different folders.

However, many of the above strengths are also provided by the current Windows desktop interface, as shown in Figure 11. However, I believe with the addition of the expanded desktop with horizontal and vertical scrollbars, the Desktop Plus+ allows for stronger spatial organization of items than the current Windows' desktop. Furthermore, when it comes to searching for a desired document, the filtered view (Figure 9) provides a much less cluttered interface than in Figure 8, making searching and retrieval much quicker. I feel that many of the advantages of Desktop Plus+ could be better illustrated with much larger data sets.

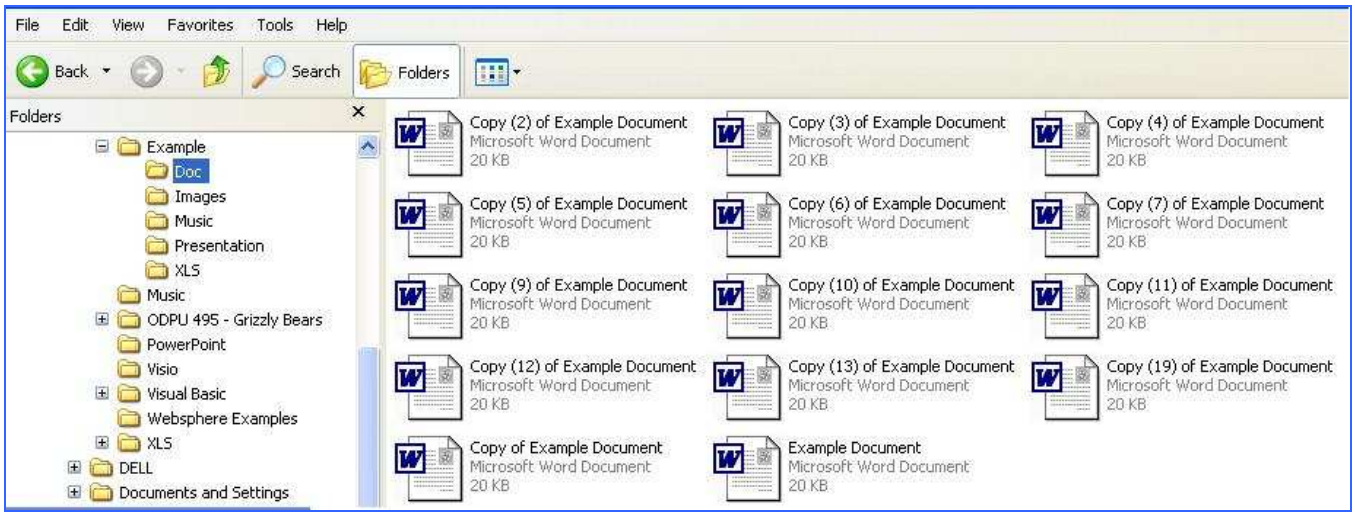

Figure 10: An example of the Windows hierarchical file structure

Figure 11: An example of the Windows' desktop interface

4.2 Weaknesses

In examining and comparing Desktop Plus+ to Windows (Figures 8, 9, 10, and 11), a number of weaknesses were identified. First of all, the exapnded, scrolling desktop with the addition of the radar view, could make Desktop Plus+ a little confusing to a new user. Second, if the user was dealing with a relatively samll data set, the current Windows desktop would likely suffice and be easy easier to navigate. Finally, the addition of the radar view in conjunction with the scrolling desktop, could be confusing for users when trying to locate document.

5 USER TESTING

As part of this iterative design study, I designed and developed a protoypical system of Desktop Plus+, in order to properly examine the strengths and weaknesses of this design idea. This system was constructed using Visual Basic 6; the details of this system are outlined below.

5.1 Desktop Plus+ System Details

The prototypical system of Desktop Plus+ implemented features described in Section 4. The prototype (Figure 12), Desktop Plus+ presents a user with an expanded, scrollable desktop, approximately twice the size of a regular Windows' desktop. In conjugtion with this, a radar view located in the bottom left-hand corner of the screen, provides the users with an overview of the entire desktop. Finally, commonly used applications are placed along the bottom of the expanded desktop, and remain stationary as the desktop moves.

Piles

An important feature of Desktop Plus+ is the ability for users to create 'piles' with relevant files on their computer. Piles on Desktop Plus+ were intended to be viewed as complementary to the hierarchical file system, which could be used for more formal archiving. Piles created in Desktop Plus+ represent a collection of individual files. Users are presented with a series of minature representations of each document (Figure 13) These iconic images chosen to represent the document should be familiar to all Windows users, so as to increase rate of recognition for the user. Each icon could be selected and moved with the mouse. When on file was placed over another file, both would create a 'cascading pile' (Figure 13). Files could be removed by dragging them away from the pile.

Browsing Techniques

The ability to perform quick, efficient searches that provide instant feedback was another important feature of Desktop Plus+. The prototyped system implemented three types of dynamic queries [14]; by file type (Figure 14a), boolean search (Figure 14b), and by date (Figure 14c). Each search could be employed upon the entire data set in Desktop Plus+; results are immediately displayed on both the main desktop view and the radar view. Users could also browse piles and data on the screen by moving the mouse over the document in question, this would display a brief textual description of the document (Figure 13).

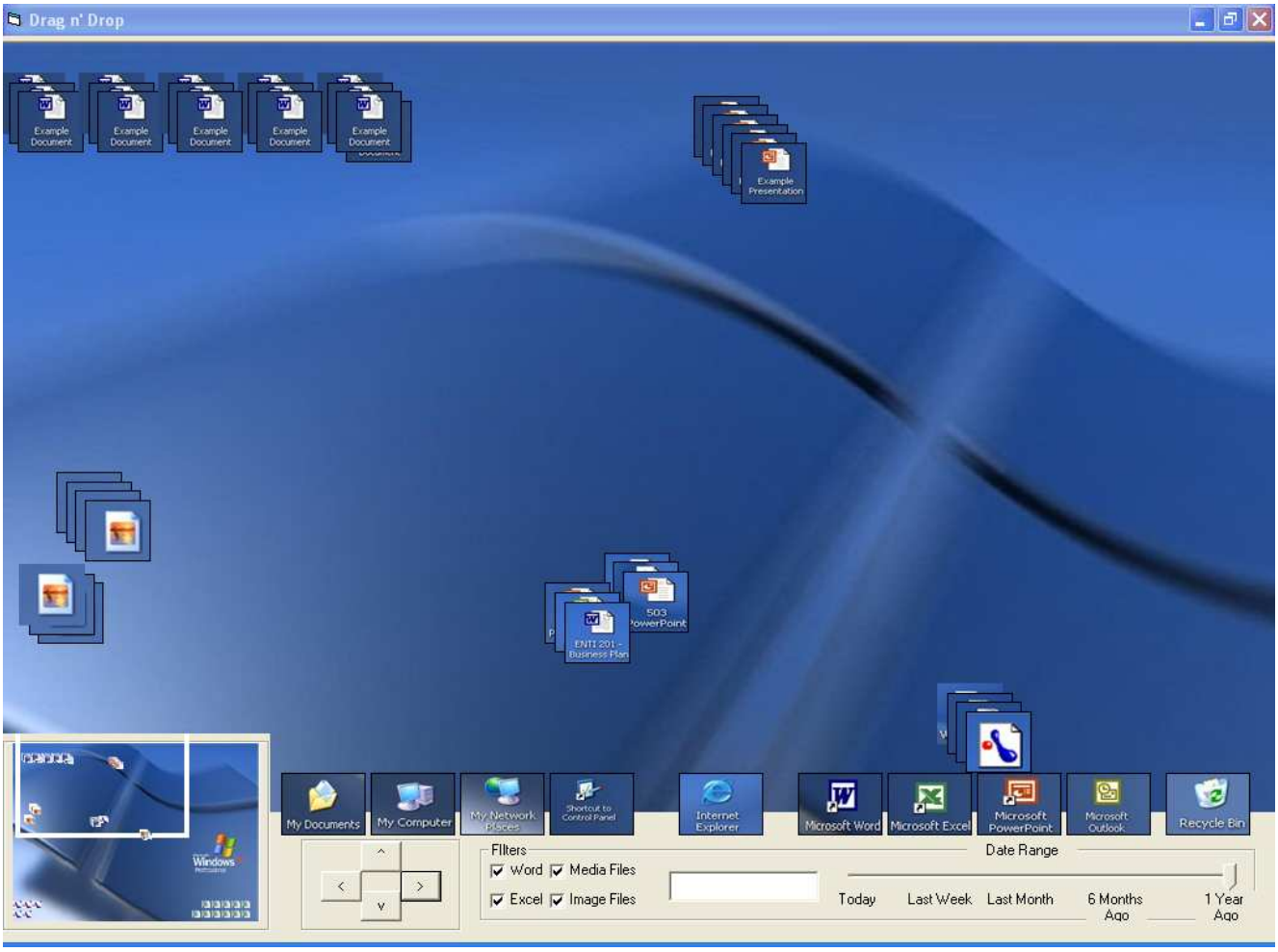

Figure 12: A snapshot of the Desktop Plus+ prototype.

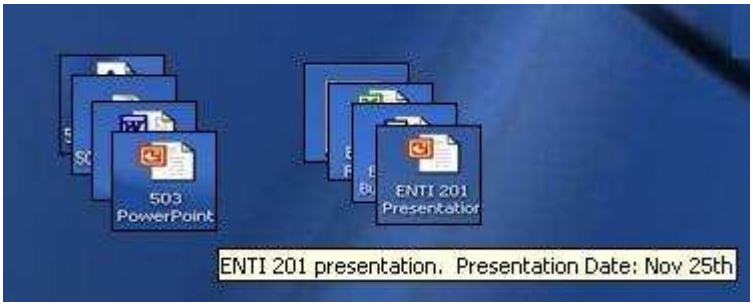

Figure 13: An example of 'piles' created in Desktop Plus+. As a user placed a file over another file, this cascade-like pile would be created. A user could obtain a brief textual description of the document by placing their mouse over the desired document.

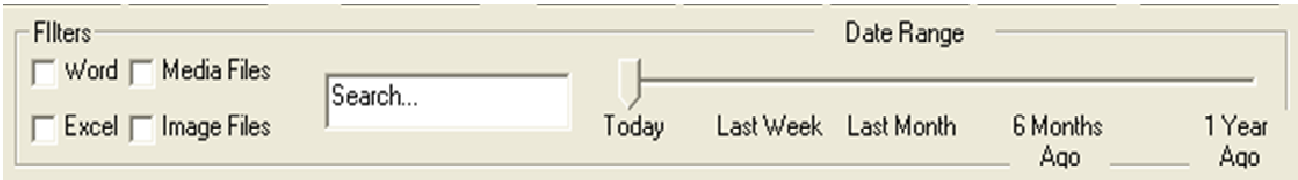

Figure 14: Participants were presented with three different ways to search for data in Desktop Plus+. In (a), participants could check-off the file types they wished to view on the desktop. In (b), participants could enter their desired search criteria and the system would remove all data which did not match the entered criteria as they typed. In (c), participants could move the 'Date Range' slider to view files that were created within the desired date range.

5.2 Method

The comparative usability study conducted was intended to examine the strengths and weaknesses of the prototypical system, Deskktop Plus+, in comparison with the Windows XP operating system. The objective was to identify the weaknesses of the current Windows desktop and its heirarchical file system, in terms of organizing, searching and retreiving *relevant* data. Here *relevant* data refers to data that the user accesses freqently, on a daily or weekly basis; in other wards, this study was not examining management of archived data, which is defined here as data that has not been access for over one year. Next, this study examined if the alternative, prototypical desktop, Desktop Plus+, alleviated any of the weaknesses found under the current Windows desktop. Each participant was asked to perform the same set of data management tasks (Appendix C) using the same data set (Appendix A) in both. This study examined the speed, ease, and success rate of each type of data management task under each interface. The steps used to carry out this study are outlined below.

5.3 Procedure

To begin, each participant was given a list of files (Appendix A) to create in Windows environment several days before the study was conducted. Participants were instructed to organize this data as they would commonly organize data on the system, using either the file system, or the Windows desktop, or a combination of both. The same data set was used in Desktop Plus+, and upon receiving a brief demonstration of Desktop Plus+ in order to familiarize themselves with this new interface, they were asked to organize the same information in this system as well.

Next, each participant was made aware of the purpose of the study, and carefully made to understand that it was the product that was being tested, and that the purpose was to identify where either system was difficult to use. At this point, each participant was briefly interviewed and asked to fill in a pre-test questionnaire (Appendix B).

Once the participant felt comfortable and was ready to proceed, they were given a set of task to perform (Appendix C). During the study, the following measurements were evaluated. (1) The time users took to complete a specific task. (2) The ratio between successful interactions and unsucceful interactions. (3) The number of commands or other features that were utilized by the user. (4) The amount of "dead" time, where the user was not interacting with the system. This includes both response-time delays and thinking-time delays, both of which were recorded seperately.

In order to properly measure the time each user took to complete a specific task, upon reading each task, the participant was instructed to inform the recorder when he or she was ready to proceed with the task. This resulted in the start time for the task and once the participant felt that he or she had successfully completed the task, he or she informed the recorder, resulting in the stop time. All other quantitative measurements were obtained through observing each participant throughout the study.

Once the test pariticipant had complete the required tasks, a post-test questionnaire was administered (Appendix D).

5.4 Results

Each test session took on average thirty minutes. Each participant was asked to think aloud while working through the three tasks (Appendix C), with the data presented in Appendix A.

5.4.1 Usage Statistics

This section shows the relationship between the user's self-reported experience level with the Windows desktop environment, and the times it took to complete each task.

Experience Level

In general, the participants were intermediate Windows users. Intermediate users reported that they felt comfortable creating folder and sub-folder heirarchies. As well as, re-organizing or deleting files and folders as they saw fit.

The graph displayed in Figure 16 shows each participant's self-reported level of experience in correlation to the number of years they had been using Windows. This graph indicates that the users did not feel that their level of experience correlated with how long they had been using Windows.

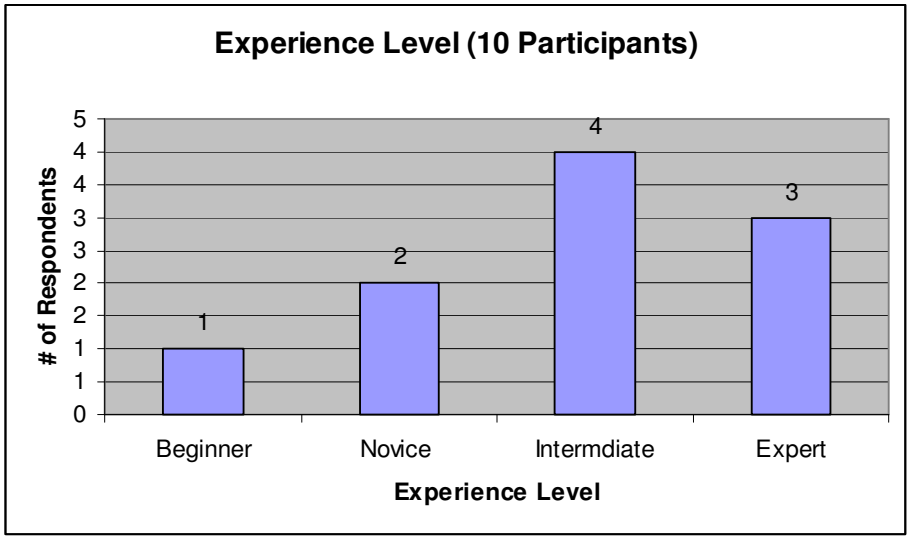

Figure 15: Experience Level of Participants

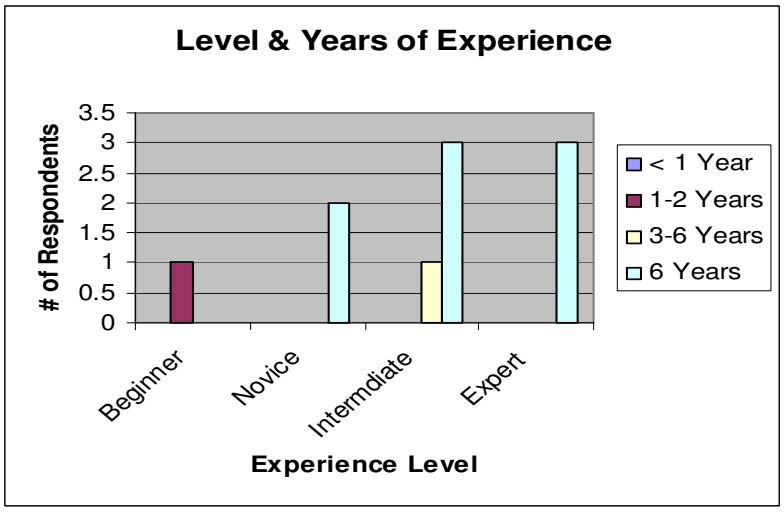

Figure 16: This graph represents participants self-reported experience level versus the number of years they have worked with Windows

5.4.2 Preferred Placement of Data

Participants were asked where they normally saved files they were working on (Figure 17). The many Intermediate and Expert users preferred to save their documents in an sub-folder heirarchy. However, there did not seem to be any relationship between experience level and desktop use for data management.

All participants reported that they used piles for organizing their daily files, such as bills, receipts, work or homework.

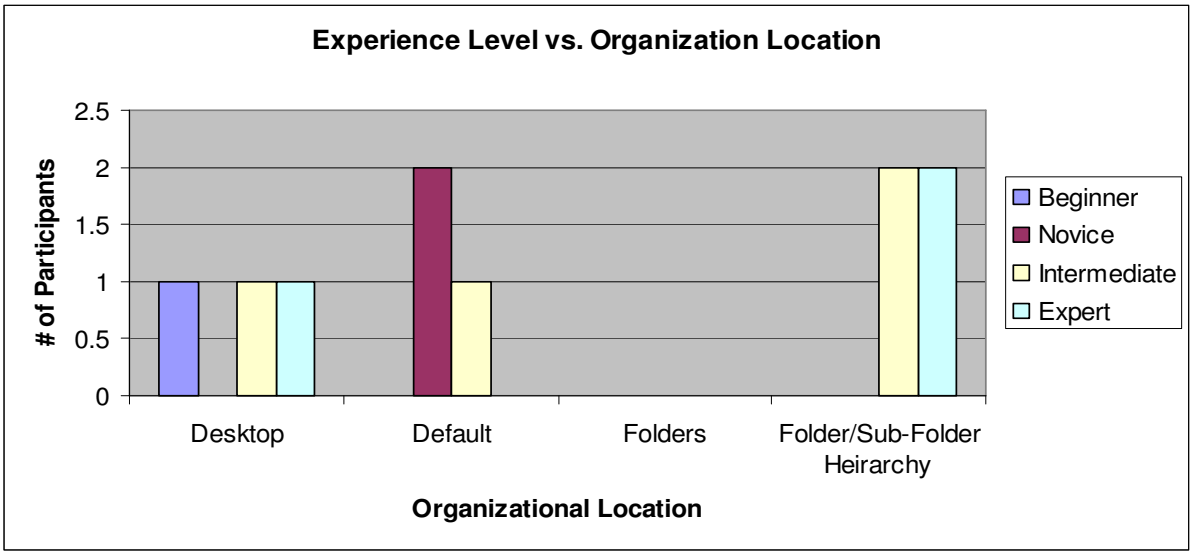

Figure 17: This graph represents participant's self-reported and their preferred placement of files in Windows

5.4.3 Searching Method

Participants were also asked how they searched and retrieved desired files within Windows. The graph (Figure 18) shows that majority of users, of a wide range of experience levels, used My Computer (or Windows Explorer) to locate their desired files. However, when conducting the post-test questionnaire participants, beginner, novice and some intermediate users, stated that they often made use of Windows' most recent documents, when trying to locate their files. If this failed, most participants resorted to using 'My Computer' to manual search for their files; it was at this point that users experienced more difficulty when locating their files.

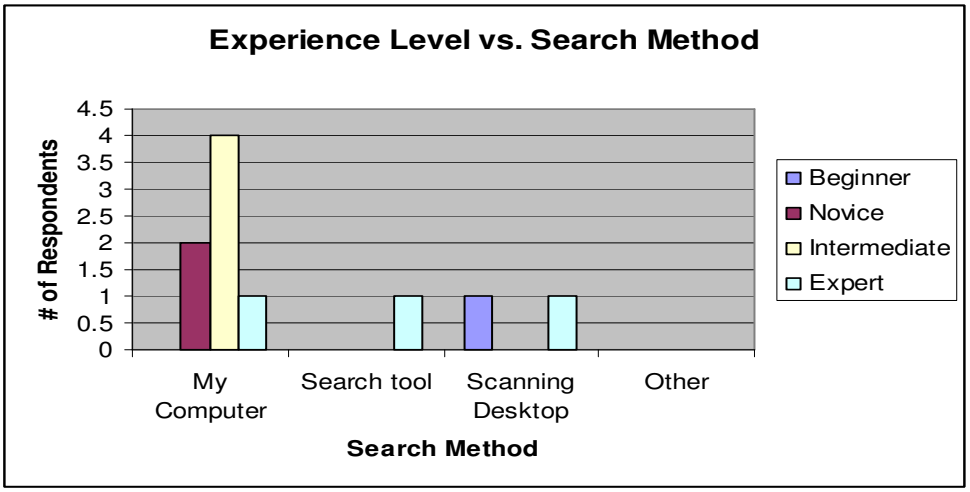

Figure 18: This graph shows the correlation between the participant's experience level and the method they commonly used to search for these files.

5.4.4 Task Results

The overall results for completing each task indicated that Desktop Plus+ was faster in term of retrieval rates for most test participants. All tasks were completed successfully for each level of participant.

Beginner

The beginner Windows' user preferred to place all documents on their desktop and had slower retrieval times in Desktop Plus+ than in Windows. This participant did not use any features in Windows to aid them in finding the required documents; however, the participant did make use of the 'search by type' feature (Figure 14) when using Desktop Plus+, which speeded up the completion of Task 2 (Appendix C). However, because data was scattered, it took respondents more time to scroll the desktop when scanning for files when completing Task 3 (Appendix C). When interviewed, these participant liked the fact that search methods where visible on the screen at all times, making it easier for searching for items; however, they found the scrolling desktop more difficult to work with.

Novice

Both novice test participants again had similar times when locating the required files in Windows and Desktop Plus+. These participants created 'piles' for documents of the same type (*i.e. doc, xls*) in Desktop Plus+ (Figure 20a); however, in Windows, files where simply allowed to default to a specified system location (often set up by a more experienced computer user). When locating the required files (Appendix C), participants used 'My Computer', in which it took them anywhere from 5-10 clicks to locate the correct file or files. In Desktop Plus+, test participants where able to locate the required files with the aid of the 'search by type'; however, it took a bit time to scroll the desktop to the located pile and then browse the pile to find the required file or files. No other commands or features were utilized when completing tasks in Windows, and participants expressed that having the search tools readily available made was a feature that they found helpful.

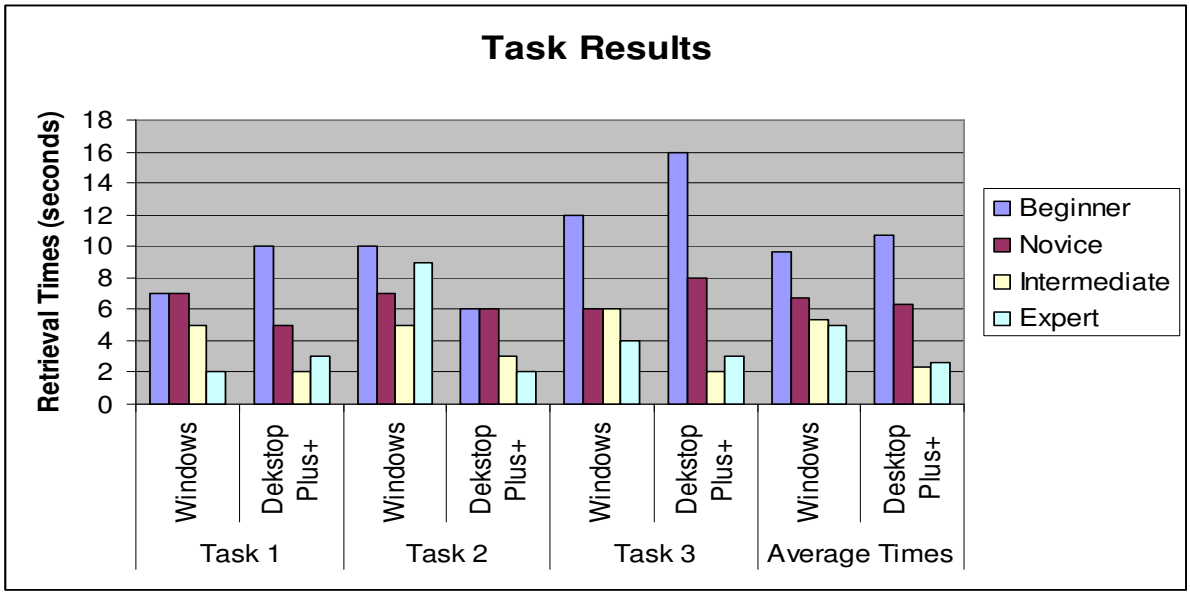

Figure 19: This graph shows the overall retrieval times for Tasks 1-3 (Appendix C) for each level of participants. The last column shows the overall retrieval times for all three tasks.

Intermediate

Intermediate test participants had faster retrieval times in Desktop Plus+ than in Windows. These test participants created two types of piles. One for documents of similar type, similar to the novice test participants, and another for files of related topic (Figure 20b). Within the Windows system, files were all organized within a heirarchy in the file system, either by default or via deliberate organization (see Figure 17) and completed each task by using 'My Computer' (see Figure 18). It took test participants much more time to complete Task 3 (Appendix C) in Windows than in Desktop Plus+. This is because in Desktop Plus+ all the required files were in the same location, in the same pile, in Windows, however, each file was stored within a file folder relating to its type, requiring the test participant to navigate their heirarchial file structure.

Expert

The expert participants' results varied. All expert test participants created piles similar to that of the intermediate test participants (Figure 20b). On average, retrieval times where higher in Desktop Plus+ than in Windows. This was mainly due to the fact that one expert test participant chose to use the Windows 'Search' tool (Figure 21) for retrieving the required files, which took a significant time to execute and failed several times to locate the desired file or files. The test participant was then forced to manual locate the files using 'My Computer'. When employing the 'boolean search' tool in Desktop Plus+, results were immediate and accurate, providing much faster retrieval times. The test participant using 'My Computer' had created a hierarchical file structure (Figure 22) similar the piles (Figure 20b) created for the specified data set (Appendix A) and therefore, retrieval rates in Windows were slightly faster than in Desktop Plus+. During the administering of the post-test questionnaire, the test participant suggested that this may be due to his familiarity with Windows over Desktop Plus+. Finally, the expert test participant who stored data on the desktop in Windows also had improved retrieval times in Desktop Plus+ than in Windows. Since Desktop Plus+ allowed for increased spatial organization, this test participant was better able to arrange the desktop in such a manner that allowed for faster searching and retrieval. Furthermore, this test participant did not utilize any commands or search tools when working in Windows; however, he made use of the 'boolean' search (Figure 14) when using Desktop Plus+.

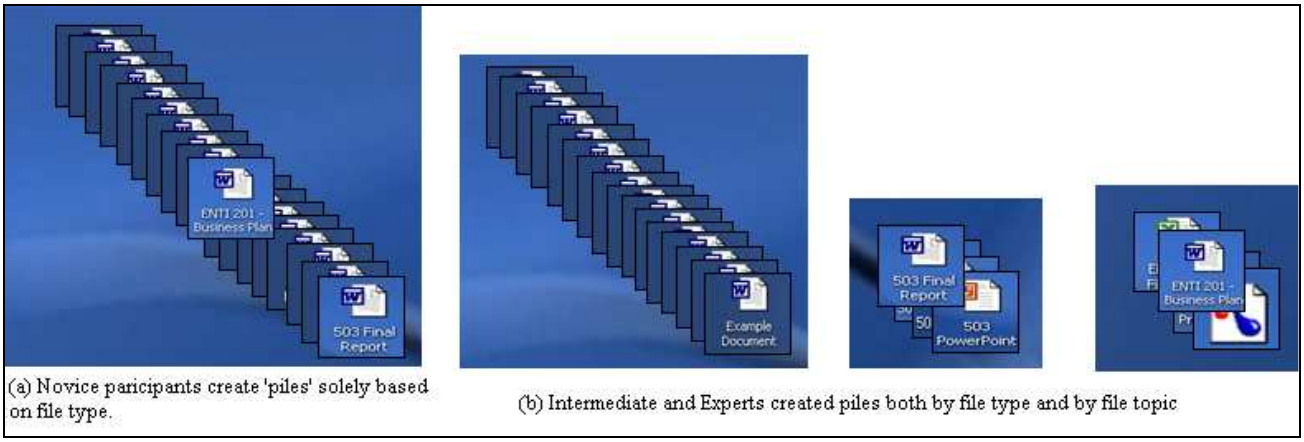

Figure 20: (a) represents the 'piles' created by novice test participants. These piles were created simply by matching file type (or icon). In (b), intermediate and expert test participants chose to create two types of piles. The pile on the left is composed of documents of the same file type. The piles on the right are piles created with different file types but for related topics.

Summary

Overall, test participants from every experience level performed more quickly in Desktop Plus+ than Windows when performing the required data management tasks (Appendix C). In terms of strengths, all participants found the dynamic queries [14] extremely helpful when searching for the required files. Furthermore, the time it took respondents to initially organize the given data set (Appendix A), was considerably reduced when working in Desktop Plus+ than in Windows. When participants were asked their thoughts on this, the general response was that piles were more quickly created than a file structure, as it seemed more of a casual way of organizing their data and therefore easier to reorganize if need be.

In terms of weaknesses expressed by the participants, those participants who primarily created a folder and sub-folder file structure within Windows were less enthusiastic about the idea of using a desktop to organize all their data, than other users. This type of user expressed concern that Desktop Plus+ would become cluttered if they were to try to organize all their data on it, instead of just a small fabricated data set.

Figure 21: A snapshot of the Windows 'Search' tool. A weakness found with this searching method, is the elapse time from the time the search is employed to the time all search results are returned. Sometimes users wait for their results only to find that the search criteria entered is too narrow, returning no results, or too broad, returning too many results.

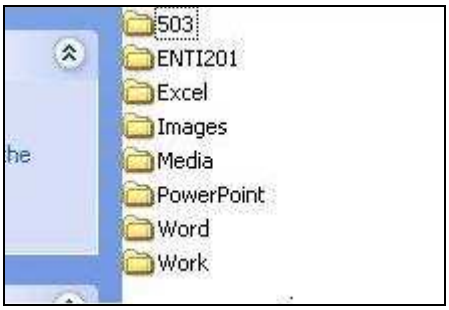

Figure 22: A snapshot of an expert test participants file structure. Here the expert chose two types of folders: (1) contained files of similar type, (2) contained files of related topic

6. FUTURE WORK

There are several areas in which this work could proceed in order to improve this design idea.

6.1 Improving Design to Work with Familiar Data

Currently, the prototype of Desktop Plus+ worked with a fabricated data set that was unfamiliar to the test participants. In order to better evaluate the strengths and weaknesses of the system, it would be necessary to construct a prototype that allowed test participants to construct piles with their own information over an extended period of time. This would also allow users to make use of the 'date' search feature (Figure 14c).

6.2 Improving Browsing Techniques

The current Desktop Plus+ design allowed users to browse the contents of the piles by viewing miniature representations of each item. Users could also dynamically apply different search criteria to all information displayed on the entire desktop. While users found both these features useful, they also expressed interest in being able to apply dynamic queries [14] on a specific pile or set of piles. Another suggestion is to allow users to browse by a textual abstract of the document, since the miniature visual representation might not provide enough insight. This method would allow for the combining of semantic labelling with spatial organization.

6.3 Improving Piles

When conducting the post-test questionnaire, several test participants expressed interest in having the system assist in automatic pile construction or reorganization. For instance, a user could select a desired number of files with which they wished to have a pile created, and the system could automatically create the desired pile. Another suggestion would be to allow for different views on piles. Therefore, instead of having to create the two types of piles as in Figure 14b, the user could instead create piles by type (Figure 14a) in one view and then switch to another view, which showed piles created by topic. The same data would exist in both views; however, this would provide optional organization techniques.

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Appendix A

Pre-Test Instructions

In order to conduct this usability study, would you please create and organize the following files on your Windows operating system. You may organize these files in any matter that you wish, using the Windows' file system, desktop of any combination of the two. When performing this task, please try to organize this data as you would normally.
(*Note: These files can be blank; they just need to be of the correct file type and the filename must be the same.)*

Excel:

- Create 1 Excel file entitled "Example Book" and make 10 copies of this file (you should 11 in total)
- Create 1 Excel file entitled "Work Graph"
- Create 1 Excel file entitled "ENTI 201 Financials"

Word:

- Create 1 Word document entitled "Example Document" and make 15 copies of this file (you should have 16 in total)
- Create 1 Word document entitled "ENTI 201 – Business Plan
- Create 1 Word document entitled "503 Final Report"

Media Files:

- Create 1 Media file entitled "Audio File" and make 4 copies of this file (you should have 5 in total)
- Create 1 Media file entitled "ENTI 201 Media File"
- Create 1 Media file entitled "503 Media File"

Image Files:

- Create 1 Image file entitled "Image File" and make 8 copies of this file (you should have 9 in total)
- Create 1 Image file entitled "Work Logo"

Web Pages:

- Create 1 web page entitled "Work - Final"
- Create 1 web page entitled "Work - Index"
- Create 1 web page entitled "503 Web-page"

PowerPoint

- Create 1 PowerPoint presentation entitled "Example Presentation" and make 9 copies of this file (you should have 10 in total)
- Create 1 PowerPoint presentation entitled "503 Presentation"
- Create 1 PowerPoint presentation entitled "ENTI 201 Presentation"

Appendix B

Pre-Test Questionnaire

1. At what level would you characterize your knowledge of the windows desktop?

    a. **Beginner** (*I can use a word processor, but I usually have to ask for help when using Windows*)

    b. **Novice** *(I can use Windows for word processing or to check e-mails)*

    c. **Intermediate** *(I feel comfortable creating folders and sub-folder hierarchies, as well as re-organizing and deleting them.)*

    d. **Expert** *(I create, delete, move, and search for files/ folders. I create relationships between related files placed in different folders or sub-folders.)*

2. Approximately how long have you been using Windows operating system?

    a. Less then 1 year

    b. Between 1-2 years

    c. Between 3-6 years

    d. More then 6 years

3. How do you organize your daily files (*i.e. bills, receipts, homework*)?

    a. Filing cabinet

    b. Computer

    c. Piles on the counter, desk, etc.

    d. Other _____

4. How do you normally organize ***relevant*** files in your computer?

    a. I place everything on my desktop for easy access

    b. I let it default to wherever the system chooses to save it

    c. I create folders to group together related files

    d. I create folders within folders to create a hierarchy of files

    e. Other (Describe)_____

5. When trying to locate a desired file on your computer, how do you generally go about it? (*i.e. My Computer, 'Search' tool, Scanning desktop)*

    a. Do you have difficulties searching and retrieving files in Windows?

6. How often do you lose files or miss place files when working in Windows?

    a. Never

    b. Very little

    c. Often

    d. All the Time

Appendix C

Scenarios

Task 1:
You are trying to finish up the project you a working on for ENTI 201. You have your presentation next Monday, so you would like to add some final information to it.

a. Locate the 'ENTI 201 Presentation file'.

b. Then locate the 'ENTI 201 Financials' file, so you can add the financial information to your PowerPoint presentation.

Time:

Task 2:
A couple of days ago, you were working on an Excel graph for work. You have recently received more information that you would like to add to this file. However, you cannot remember exactly what you called it…something to do with 'work' and it is and Excel file, but that is all you can recall.

a. Locate the above described file.

Time:

Task 3:
You need to submit all your 503 files to your supervisory today for his review. Please locate all 503 files so that you can send them to your supervisor.

Time:

Appendix D

Post-Test Questionnaire

1. When organizing the requested files, which system did you prefer to organize your files in? (Why?)

    a. How long did it take you to organize your files in Windows?

    b. How long did it take you to organize your files in Desktop Plus+?

2. While performing the required tasks of searching and retrieving, which system did you find easier to use? (Why?)

3. Did you find having the 'Radar view', which is intended to provide an overview of all your data, helpful when trying to locate data on your file?

4. Are they any features in Desktop Plus+ that you found helpful when performing this data management tasks?

5. Are there any key features of Windows that you find helpful when performing these data management tasks?

6. Do you have any suggested improvements for either Desktop Plus+ or Windows that you think would make data management easier?