CPSC 503 ---- Final Report

Think 3D!

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1.0 Abstract

The effective management of documents on the desktop has been a key concern for many years. One of the most common approaches to this problem is the use of a 2-dimensional iconic interface, which involves a type of spatial layout of icons; mostly the icons are used to represent data and programs. This approach was designed to take advantage of the human spatial cognitive abilities [2]. As computer graphical user interfaces are loaded with increasingly greater numbers of objects, researchers in Human Computer Interaction have been looking for a new way of constructing user interfaces. Recently many 3-dimensional spatial layouts have been introduced also trying to maximize the human spatial cognitive ability. In the first part of this paper, I describe the differences of 2-dimensional and 3-dimensional interfaces by examining related work in employing both approaches looking for the strengths and weaknesses of each. The meaning of 3-dimensional in this paper is a 3-D interface that incorporates the use of proper landmarks, customizable semantics and color.
A 3-dimensional mock up prototype is then constructed based on the strengths and weaknesses of existing systems. A study was then conducted to study the strengths of both the 2-dimensional iconic display and a 3-dimensional prototype. Results then indicated that both form and layout significantly affected user performance; subjects located information more quickly when using the 3-dimensional prototype then they did in a 2-dimensional layout. These results may suggest that an interface with proper landmarks, semantics, color and 3-dimensions for general placement may be an improvement over traditional interfaces.

1.1 keywords

3-dimensional spatial layout, 2-dimensional iconic interface, Landmarks, Semantics, Color and Placement.

2.0 Introduction

For the past thirty years the management of information on desktop computers has been a key user interface problem [2]. It is proposed that this problem can be integrated by taking advantage of human spatial cognitive abilities and the application of appropriate metaphors.

User interfaces are based on metaphors that help users to understand the system in terms of basic concepts that the user may intuitively already know. A spatial metaphor exploits the human capability to organize objects in a space, to recall and reason about their location, and many other space related cognitive abilities [1].
The 3D metaphor provides an attractive opportunity for enhancing interaction. With the popularity of 3D applications such as MUD, 3DNA(www.3dna.com) and various computer games such as Doom and Quake (www.blizzard.com). Users are becoming more comfortable with 3D objects and 3D navigation. It may be possible to leverage human spatial capabilities by providing computer generated 3D scenes that better the way users perceive there natural environment. Proposed representations such as the ‘Data Mountain’ [2] (Figure 1) and the ‘Task Gallery’ [3] (Figure 2) provide some evidence supporting improved spatial memory in 3 dimensions.

Figure 1 DataMountain[4]

Figure 2 Task Gallery [5]

The 'DataMountain' **[2]** team showed that task times and error rates were lower when users were asked to retrieve and find files in a 3D environment. They also concluded that the Data Mountain outperformed the traditional 2D 'Favorites' function offered by Microsoft Internet Explorer. This is due to the fact that the spatial layout allowed immediate access to every item, while the favorites system did not. Many users had to spend time scrolling to find items.

In addition Tavanti and Lind **[4]** in their study showed that 3D representations takes better advantage of peoples spatial memory then 2D representations, specifically in the placement of objects. Tavanti and Lind **[4] ,** described an experiment comparing the spatial memory in 2-dimensional and 3-dementional displays. The task involved recalling the location of letters in the alphabet, which are placed on cards, depicted using hierarchical 2-demension and 3- dimensional displays shown in **Figure 4** and **Figure 5.** Tavanti and Lind**[4]** concluded that the spatial memory was much better in the 3-dimensional environment. This paper will go through other experiments, similar to Tavanti and Lind's**[4]** experiment to compare the effectiveness of the spatial metaphor in 2-dimentional and 3-dementional computer displays. The implications of this research will show that if 3D interfaces allow a higher efficiency in spatial memory then there is a

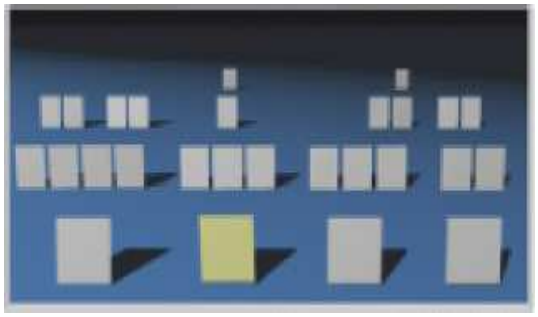

Figure 3 Tavanti and Lind's 3D Interface

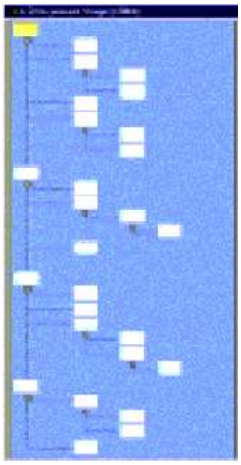

Figure 4 Tavanti and Lind's 2D Interface

strong reason of belief that today's user interface performance can be highly improved with the incorporation of 3-dimensional environments.

3.0 Related Work

Several researchers have shown the relationship between users and the spatial metaphor. At the present there exists work on visualizing in 3-dimensions as well as the effectiveness of 2-dimensial and 3-dimensional interfaces. However very little effort was made in whether the spatial memory capabilities differ in 2-dimensions or 3-dimensions. As well as the ability for users to perform more efficiently with the use of familiar objects that relate to a users everyday environment, these include colors and landmarks and semantics.

3.1 Spatial Memory and User Interface Performance

The performance with user interfaces is predicted by the users spatial cognition, his/hers ability to remember were things are and how to retrieve them. Vincent, Hayes and Williges[12] concluded in their finding that the measures of spatial ability predict performance in browsing hierarchical and file management tasks.

The Data Mountain's [2], a 3-dimensional spatial layout of web page's, as mentioned earlier allowed a more rapid retrieval then the Microsoft Explores 'Favorites' tool. It also showed that participants of the evaluation, even after four months after setting up and organizing their personal web-pages were still able to retrieve favorites faster then in

Microsoft Explorer. Two researchers, Jones and Dumais[14] through their research they conclude that the use of semantic labels and spatial organization enhance the performance in searching and finding files in an interface.

3.1.2 Two-dimensions

Interface development such as Xerox Star[15](figure 5), in the past included 2-dimensional list views, expandable lists for viewing hierarchical file structures and the ever so popular iconic spatial layouts. There system included list views and a spatial layout, which incorporates 2-dimensional icons. The spatial layout was the introduction to a visual method in which the user can group files and programs (represented as icons) in any arrangement on their screen (Figure 5). Apple then added a function that allowed users to use expandable list (figure 6) for hierarchies and piles[6]. This improved the existing Circa it allowed users to use less screen real-estate, when grouping their files. Another 2-dimentional interface was the 'TreeMap'[7], this system used an extraordinary amount of the screens real estate and was generally used for overviews of document collections and large hierarchies. It was a somewhat efficient spatial metaphor due to the fact lists and piles could be used as an organizational tool.

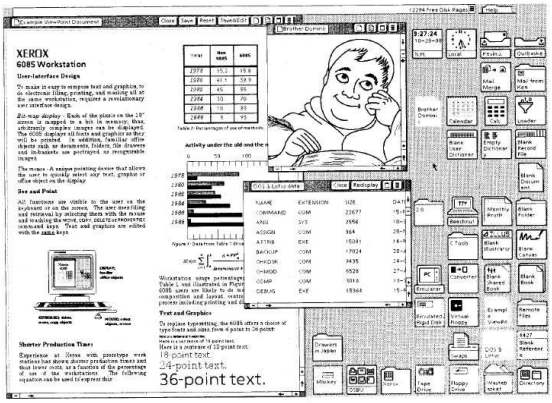

Figure 5: Xerox Star – Use of the icons and windows

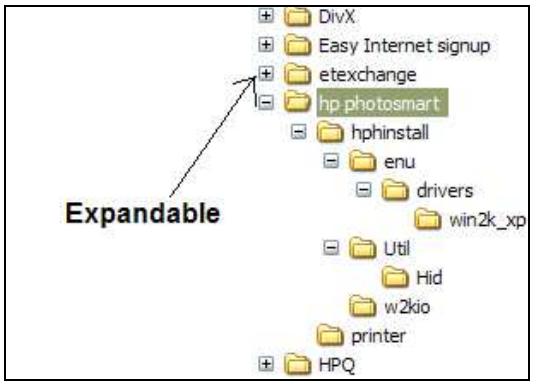

Figure 6: Shows the Use of expandable lists

3.1.3 Three Dimensions

Xerox then cam up with the 'Xerox Star'[15](figure 5), which introduced a number of 3-dimensional visualizations and interaction techniques for understanding information in the system. The Maya Research Group released their own 3-dimensional system Workscape[9] (figure 6.a) which was the first example of a true 3-dimensional interface using similar aspects that Microsoft Windows 95 and MacOS had in their 2-dimensional interfaces. Workscape[9] used a 3-dimension spatial layout of documents and files with full user control. The Web Forager[17] took the experience from Apple's PARC and used a 3-dimensional spatial layout for browsing through WebBooks[10] (no picture available) and web pages.

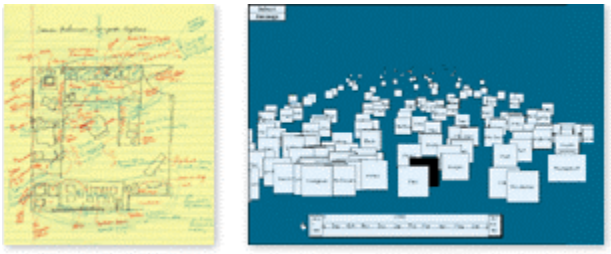

Figure 6.a Maya Workscape

3.1.4 Two Dimensional vs. Three Dimensional Spatial Memory

Throughout the years there has been a great deal of prior work in the comparison of 2-dimensional and 3-dimensional interfaces. The primary question of this paper is "Does a 3-dimensial interface with the proper use of landmarks, color, and semantics provide an improvement on spatial memory in comparison to a 2-dimensional interface?" Czerwinski [2] and others stated that 3-dimensional techniques could lead to improved user memory.

4.0 Why 3-dimensional?

Cockburn [11] in 2000 compared tasks of 2D and 3D physical models on equivalent processor speeds and memory. They stated that the 2D physical model was more reliable and faster then the 3D environment, however several participants commented that the 3-dimensional environment had extreme potential, if the computer hardware was just a little faster. Three-dimensions with the use proper landmarks, colors and shapes and semantics can enhance a user speed to retrieve objects, creating a more efficient desktop. Mandler [16] and Hasher and Zacks [17] showed in there finding that people automatically encode spatial information in three dimensions. When recalling where a user placed a file, the user in a three dimensional interface will spend the least amount of cognitive efforts so they can focus on the task they want to accomplish when the file is retrieved.

5.0 Problem

In a 3D world, there are many different factors, "Many of these factors are visually salient attributes that have many users having to recall objects and placement"(1998)[15]. There are several 3D interfaces that have been proposed; however none of them had a significant impact on today's market. The DataMountain[2] provided an interface that had the capabilities to store hundreds upon hundreds of files, however it lacked visual landmarks, shapes and semantics. WorkScape[9] which was another 3-Dimensional interface that also offered spatial management lacked visual landmarks, shapes, and color. The question is that if 3-dimension has been seen (as seen in the Related Work section) to provide a better spatial metaphor, what other factors or ideas can be added to a 3-dimensional prototype to make it more efficient then its predecessors?

6.0 Proposed Solution

There are several factors that allow for an efficient 3-dimensional interface.

6.1 Placement

There is an abundance of information stating the importance of location, many have come to the same conclusion that the placements of an object on the users interface relates heavily to the effect a user may have in recalling were that object was placed. Mandler[16] and Hasher and Zacks [17] showed in there finding that people automatically encode spatial information. When recalling where a user placed a file, the user wants to spend the least amount of cognitive efforts so they can focus on the task they want to accomplish when the file is retrieved.

Through researches such as Hess[18] we can assume that adequate metaphors can facilitate the learning process. In turn, the learning process facilitates automatic actions; hence the cognitive load has been reduced.

6.1.1 Proposed solution

Objects in a 3-dimensional layout not only have their individual locations, but they form connections that make sense to the user. An example may be an office metaphor, where the "My computers Icon" (Windows 95-Xp) (figure 8) can be placed on the desk as a computer and the My Documents Icon can be represented as a drawer in front of the desk (Figure 7). These connections may facilitate target acquisitions.

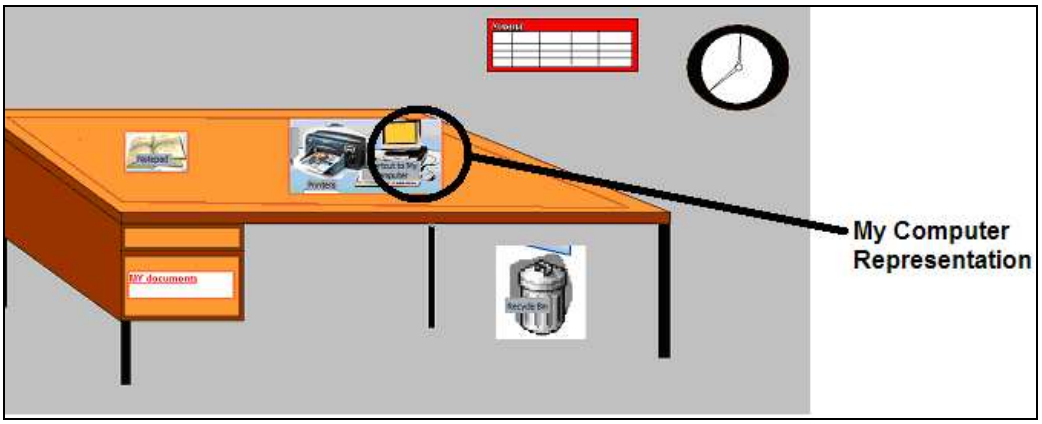

Figure 7 Three-dimensional Representation of object placement

Figure 8 Two-dimensional Representation of placement

6.3 Color

Color is another important feature in creating an efficient 3-dimensional interface. It is a feature of realism; color has the ability to make an object more realistic. There is adequate amount of research about when and where color is useful and when color is distracting. Christ in 1975 [19], reviewed the comparisons of color usefulness against various achromatic codes (size, shape, etc.) gave evidence that a color coded target was more accurately identified than monochrome codes, size and shape, and brightness.

6.3.1 Proposed Solution

Color must be an important feature in the user interface, if it is not the right amounts and types of colors, color becomes a shortcoming and a distraction on the screen. Color can

be used to group objects and represent actions taken on a particular object. Figure 9 shows a use of color to organize groups on a 3-dimensional desktop.

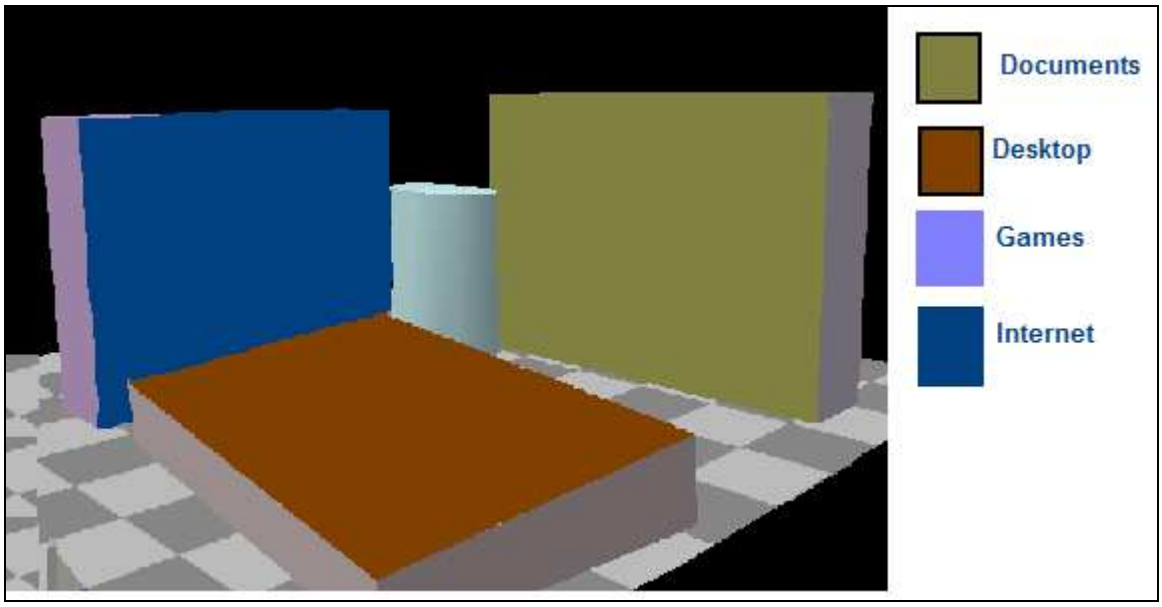

Figure 9 (Mock-up 1) Shows the use of color to organize groups of documents and programs on a 3D interface

6.4 Landmarks

Landmarks are inherent in any situation. The difficulty in developing a good test to study landmarks is the fact that landmarks are a personal discrepancy. Landmarks such as bookshelves, tables may be able to improve a user's memory ability as to where things are located. Landmarks allow for groupings and a type of spatial separation.

Landmarks serve as memory aids. Findlay in 1998[20], concluded that "the effort occasioned by the use of external props (Landmarks) is less demanding than the cognitive effort required to encode and retrieve information from the internal memory sources".

6.4.1 Proposed Solutions

Landmarks may help a user, in the efficient retrieval of an object allowing the user to use more of his/hers external memory. Since good landmarks are personal discrepancies. A landmark is difficult to choose and needs to be chosen well. A good example of a landmark is an office setting shown in Figure 10. The landmarks in an office have many visually recognizable characteristics that help users to place and retrieve information. Many users can relate to placing things in drawers or on a desktop.

Figure 10 Shows the use of landmarks such as walls, drawers, recycling bin and a desk

6.5 Semantics

Rothkopf in 1982[21], improved on the claims of Mandler**[16]** and Hasher and Zacks**[17]** by stating that the ability for a user to recall a location of an object can be directly effected by meaningful semantics such as labels. Lansdale in 1987**[22]**, also stressed the important factor in the utility of a cue in the form of a label. He believes that this enabled the user the ability to form a meaningful association with relevant documents. Lansdale also discovered that users from different backgrounds had a consistency between cues, which they have seen or previously used.

6.5.1 Proposed Solution

In order for users to extract a useful meaning from objects, objects can be properly labeled, as well allowing the labels to be fully customizable. An example shown in Figure 11 shows the use of labeling. The label "My Computer" is used to represent a visual representation of a computer. This may intern remove any speculation to what the object is or what it represents. All labels will be entirely customizable allowing for a more personal desktop which may in-turn create a more efficient desktop Other semantics such as post-it's give the ability for users to create notes for various reasons helping to create an organized desktop that will make sense to the user as shown in Figure 12.

Figure 11 Use of labeling

Figure 12: Use of customized labeling

7.0 Design

There are many issues that will be considered into account when designing the interfaces that will be used in the experiments. The windows desktop uses a 2D iconic representation. The Layout consists of rows and columns (Figure 13). The 3-dimensional layout will be portrayed as a room metaphor. An example would be an office room where the desk, bookshelf and back walls will serve as visual landmarks. The proper labeling (semantics), colorization, and placement of objects will hopefully create an easy to understand interface.

7.1 Designers Overview (The system at first glance)

Before the system was ready to be hand delivered the system went through many design phases. This included even a complete reworking of the medium fidelity prototypes. Several low and medium fidelity prototypes were looked at in the design, one such prototype shown in figure 14, was tossed based on the fact that it lacked color, and seemed to be too busy with only 53 icons. Using people's input and insight I was able to create a more usable system shown later on in this paper.

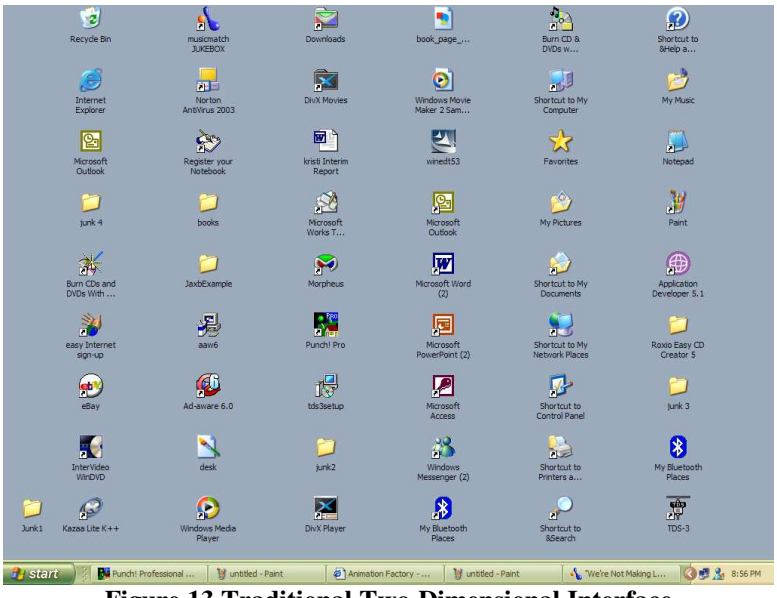

Figure 13 Traditional Two-Dimensional Interface

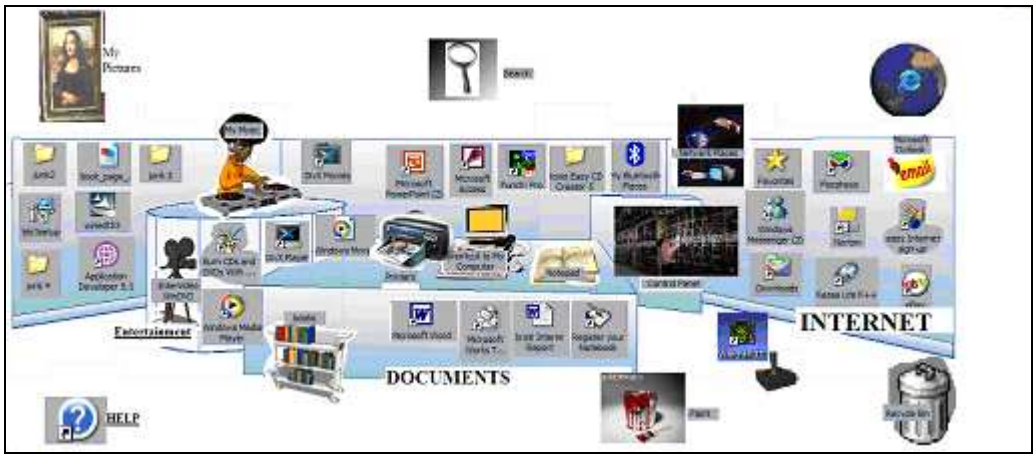

Figure 14: (Mock –up 2) Example of 3D mock up

8.0 A System Design

3-dimensional visualization, with the use of color, landmarks and semantics can provide a large reduction in effort associated with program fimiliarization which in turn can relate to faster search and retrieval times. For the program to increase the reactivity of its users as well as the overall understanding, visual information should be delivered in a way, which the largest number of people can relate. All of the visualizations used in my software prototype are based on the room(s) metaphor. There are 3-basic rooms in the software, an Office (figure 15), a Bedroom (figure 16) and an Entertainment Room (figure 17.

Figure 15: Office Room

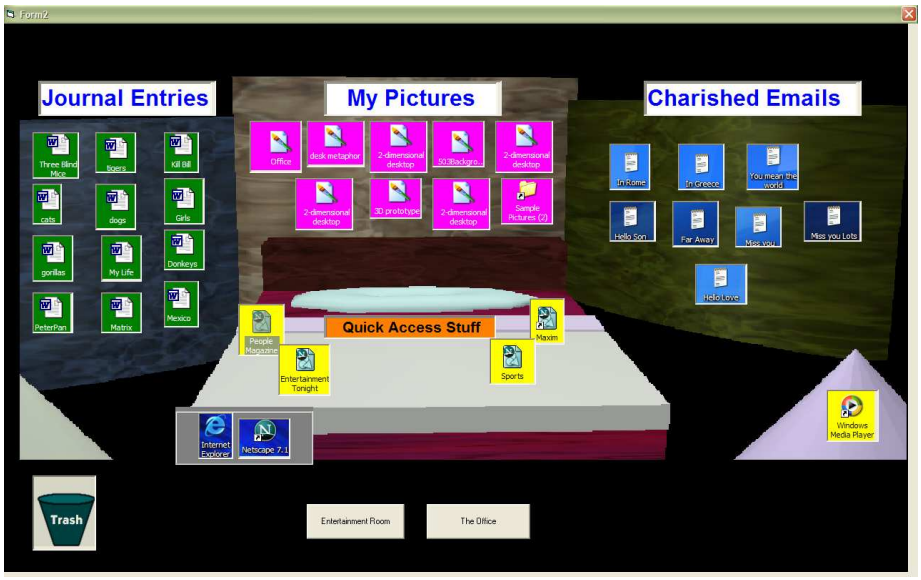

Figure 16: Bedroom

Figure 17: Entertainment Room

8.1 Why These Three Rooms?

The office was decided, basically on a small survey conducted) in where almost 64% of the 50 random people asked, said that their primary use of a computers pertained to work or school. For this reason it was decided that many users would find this room meaningful and somewhat useful. 22% of the survey takers said that their primary use of a computer was emailing, and private documents. This included reading past emails, financial statements, personal budgets, online recipes and so on. The participants were then asked what place in their homes they would generally place these items. Most of the 22% of the participants said their bedroom; hence why the bedroom was chosen as another important room in the prototype. Finally 14% of the users primary use of their

computers pertained to entertainment, such as movies, games and music, which is why the entertainment room was created.

8.2 Placement

The prototype uses a drag and drop type of system, once an icon is created it is sent to one of the three rooms. The icon is then sent to the top of the screen. This then allows the user to click on the object and drag it to a certain place on the screen, which they would find to be most fitting (figure 18).

Figure 18 shows the creation of an object and the ability to move it anywhere in the interface.

8.3 Navigation

This initial design was to create a fully functional 3D world, however due to feedback; a 3D world involved walking around and trying to find your place in the environment. This resulted in many users getting lost and spending time trying to figure out where they are in the world. So in the design phase of the system, navigation was created keeping in mind the following questions that users may have:

- "Is there particular information I need?"
- "How do I get this information in the fastest way possible?"
- "Where am I now in relation to…..?"

The formulation of these questions indicated a spatial conception of the navigation process. So the decision was then to use navigation buttons, which allowed the user to quickly access other rooms (figure 19).

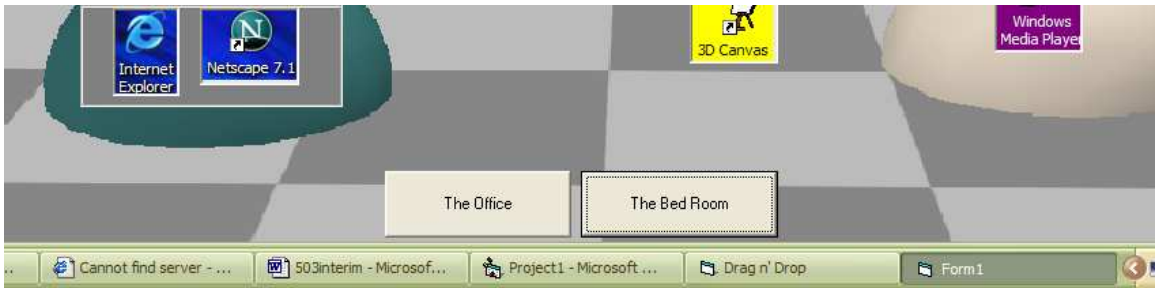

Figure 19: Button navigation for 3D protoype

8.4 Elements of the System

When closing in on the prototype, many regions of the screen can be recognized, such items as back walls, desktops, Garbage bins (Figure 21), and even an entertainment system. These all work to land landmarks in the system. Color is also used to separate regions of the back walls, the floor, and several other objects in the interface (figure 9). Semantics (figure 20) were also used to help users make more sense of the interface and to make it their own by the use of customizable labels. These two features were intended to make the system as user-friendly as possible; and thereby, hopefully creating a great experience for the user.

Figure 20: Customizable labels in 3D prototype

Figure 21: Garbage can in 3D prototype

8.5 The Necessary Amount of Realism

The room metaphor can be a useful form of organization for many tasks that are of a diverse nature. The keyword is diverse; the room metaphor breaks if all objects are of the same nature. However in the assumption that most computer users have several diverse

items on their computers it is important that the room metaphor visually makes sense. This is done by making the objects in the interface contain a large amount of realism. What this means is that an office room looks like an office without the use of large textual descriptions. The system contains the ability for a user to socially navigate through the system. Social navigation is a behavior where users of information systems freely share pointers to information, and help out other users who are disjointed or new to the system[16].

9.0 Usability Study

9.1 Method

This report summarizes results of a usability study on a 2-dimensional interface (Windows XP) and a 3-dimensional prototype (Think 3D). I conducted these tests in the beginning of December 2003. The usability test consisted of two parts: Part 1 was a test based on organization, the ability of participants to organize the 2-D interface and then the 3D interface. Part 2 was a test based on the retrieval of the objects they previously organized on both systems. This report goes through a series of tasks that allow research in basic organization and retrieval of objects when using a 2-dimensional interface and 3-dimensional interface. The main question in these studies is, does the addition of 3-dimensions, prominent landmarks, meaningful color, creative placements and descriptive semantics help to create a more efficient desktop?

The tests were conducted with three Pentium IV PCs with 512 MB RAM memory. After the test, the users were interviewed on their opinions of the application. The test subjects were also encouraged to "think aloud". Each session lasted approximately two hours with an interview; each test was spread between two days. During testing the users had a half an hour to familiarize themselves with Think 3D.

9.2 The Test Participants

A total of 10 users were tested, the subjects were between ages 18 and 54. All users were familiar with Microsoft's Windows XP Desktop. In order to achieve unbiased and close to accurate results, test participants were chosen carefully, by choosing people of diverse ages and backgrounds in terms of occupations. Due to time constraints only 10 participants could be chosen to conduct the usability tests needed. Using the graph below (Figure 22) you can see that 5 of the participants were male and 5 were female. Out of the 10 participants 4 were novice users, 4 were intermediate and 2 were expert users. A questionnaire (Appendix A) was used to help determine what classification (Novice, Intermediate and Expert) of users is being tested. This helped me to analyze a wide range of users, giving me different types of feedback. The participants were also chosen based on different backgrounds, participants ranged from Art majors to house moms (figure 23). This helped to create a more thorough study.

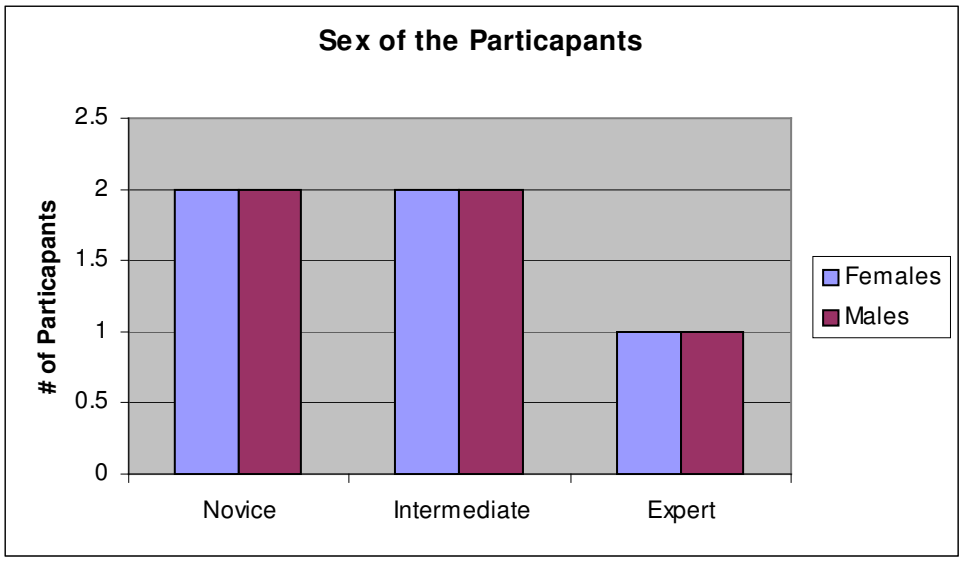

Figure 22: Gender of test participants versus self-reported experience level

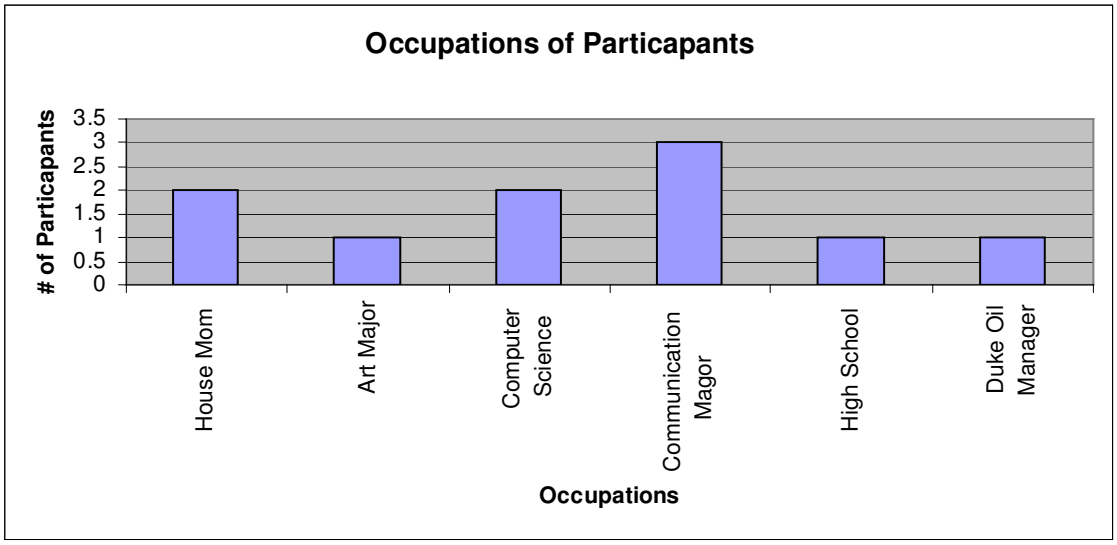

Figure 23: Occupations of test participants

Based on the preliminary questionnaire (Appendix A) more females reported using the desktop over the file system, also a larger number of intermediate and novice users used the desktop over the file structure when storing items they needed quickly and fast (Figure 24). When asked why they used the desktop the common answer was "it is a pain having to browse through several files trying to find what you need". However on the other hand experts (being someone familiar with most desktop functionality) preferred the file system. When they were asked why they claimed, "the desktop was inefficient and it lacked space requirements and organizational tools that were needed".

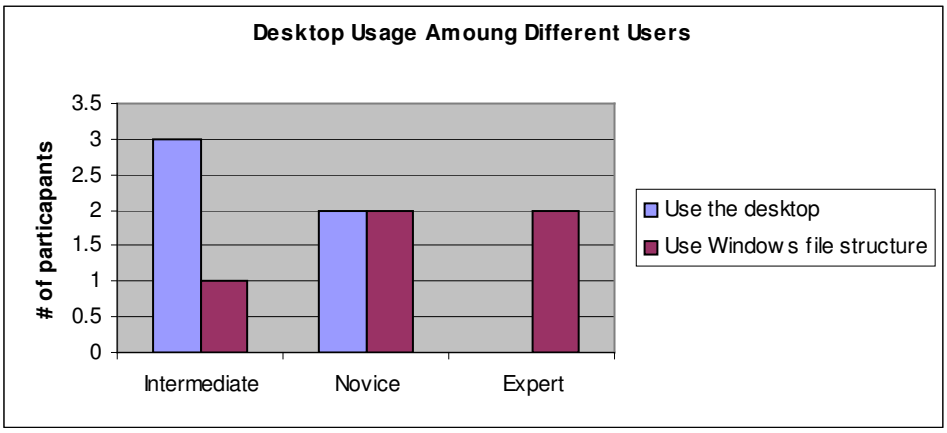

Figure 24 Graph showing the number of participants that use the desktop for organization or the windows file structure

Other questions in the preliminary interview (Appendix A) also helped us understand our participants, and their skills coming into the study. One of the most interesting things that came out of the interview was most of the participants were dissatisfied with the current windows desktop and found it either inefficient or hard to use.

9.3 The Study

9.3.1 Preliminary Interview

Before the participants started the test they were asked a series of questions, about the 2-dimensional prototype. The questions (Appendix A) helped in the analyzing what kinds of attitudes they have developed in the past about the 2-dimensional system and attitudes towards 3-dimensions. It also helped me to understand each participant as an individual rather then as a group or a category.

Part 1 of User testing (Day 1)

The test participants were then asked to arrange 101 icons, varying from media to word documents to system files. The test participants first organized the icons on the 2-dimensional windows platform in anyway they saw fit (figure 25). The users were allowed to use any functionality that windows provided. The time it took was then recorded. The test participants were then asked to also arrange 101 of the same icons using Think 3D application. When the test participants were completed they were quickly interviewed, all participants were then given a post-test questionnaire (Appendix B).

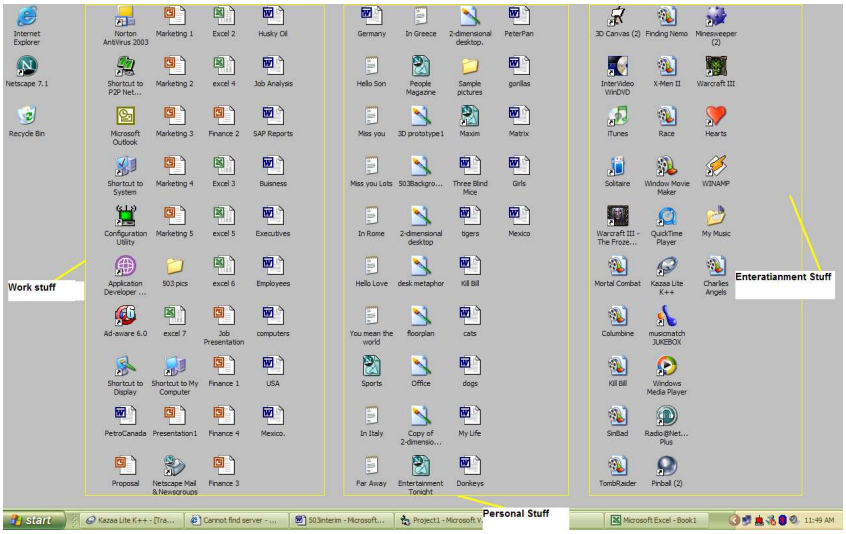

Figure 25: Example of organizational structure in the Windows 2D desktop

Part 1- The User Tasks: The 2-dimension (Windows XP desktop) and Think 3D Task

1. In front of you there are 101 icons placed in 3 categories (Work, Personal and Entertainment), the icons represent items such as documents and media. A number of icons belong to each category. You are to organize the icons in any matter you wish. Remember in 2 days you will be asked to retrieve certain icons from each major category.

You may use any of the windows functionality. You are encouraged to think aloud and let us know of any problems you are facing, so they can be noted. The goal is pure organization, organize these icons in the best way you can. Your time will be recorded for as well as you thoughts for further research.

Part 2 of User testing (Day 3)

In Part 2 the test participants where asked to perform a number of tasks, the order of the tasks varied between the test sessions. The tasks were created to be real world tasks that covered basic retrieval of icons that they organized two days ago. The test participants performed the same tasks on both systems. The times were then recorded and used for the study to measure efficiency. In all the tasks, an essential part of the task was navigating to the correct location.

The icons are retrieved by simply placing your mouse pointer over the correct object. Once the object is found test participants moved onto the second object and so on. Once all objects related to the particular task were found the test participants moved on to the next task.

Once the test participant were finished the tasks they were interviewed in regards to both systems. (Specific questions asked in the interview can be seen in Appendix C)

Part 2 – The Tasks

Retrieving multimedia

1. A couple of days ago you had organized a number of movies in the Entertainment category; Locate the following movies, Kill Bill, Charlie's Angels and Race. Please indicate that the movie is found by placing your mouse pointer over the correct movie. Once the first movie is found continue to the second and then to the third. Once all movies have been found, the task has been completed and move on to the next task.

Retrieving Word documents

2. You are at work and your boss wants the report that you wrote on Germany, Mexico and the USA. Locate these word documents. Please indicate that the is document is found by placing your mouse pointer over the correct document. Once the first document is found continue to the second and then to the third. Once all documents have been found the task has been completed. Then move onto the next task.

Retrieving Games

3. You are waiting for your favorite TV show to air and you decide to play a number of games while you wait. Locate the following Games in the application, Warcraft 3, Solitaire, and Pinball. Please indicate that the game is found by placing your mouse pointer over the correct game. Once the first game is found continue to the second and then to the third. Once all games have been found the task has been completed. Then move onto the next task.

Retrieving Music Players

4. You love music and you can't get enough of it you love to play music while you work. Locate the following music players Radio, Windows Media Player, and Jukebox.

Retrieving Excel Sheets

5. Your boss never leaves you alone and needs several spread sheets that you have created for him. Locate the following Excel sheets in the application Excel1, Excel2 and Excel3

Retrieving Personal emails

6. You work overseas and you are really homesick and miss your loved one. Locate the following emails: Hello Love, Miss You lots and You mean the world to me.

Retrieving Personal Pictures.

7. You have been working on a breakthrough prototype; you have several pictures of this prototype that you would like to view. Locate the following pictures: 3D prototype, Office, and Desk metaphor.

Retrieving PowerPoint

8. It's your turn to shine at work and you are getting ready to present a PowerPoint presentation. Locate the following power point presentations: Job presentation, Proposal and Finance 4

Retrieving tools

9. You are at work and you notice you may have a virus on your computer locate Norton Virus icon.

10.0 RESULTS

The Interest of the experiment was to determine if a 2-Dimension iconic or a 3-Dimensions with the use of landmarks, Color and Semantics are important factors in the time it takes a user to search and organize several objects. One main bias to point out was the fact that many users never used the file structure for reasons unknown. This may skewed some of the results.

10.1 Part 1- Results

The participants were timed, on how long it would take them to organize the interface. I recorded the overall mean of how long it generally took users to organize the 3-dimensional Interface and the 2-dimensional interface. The results are as shown in figure 26.

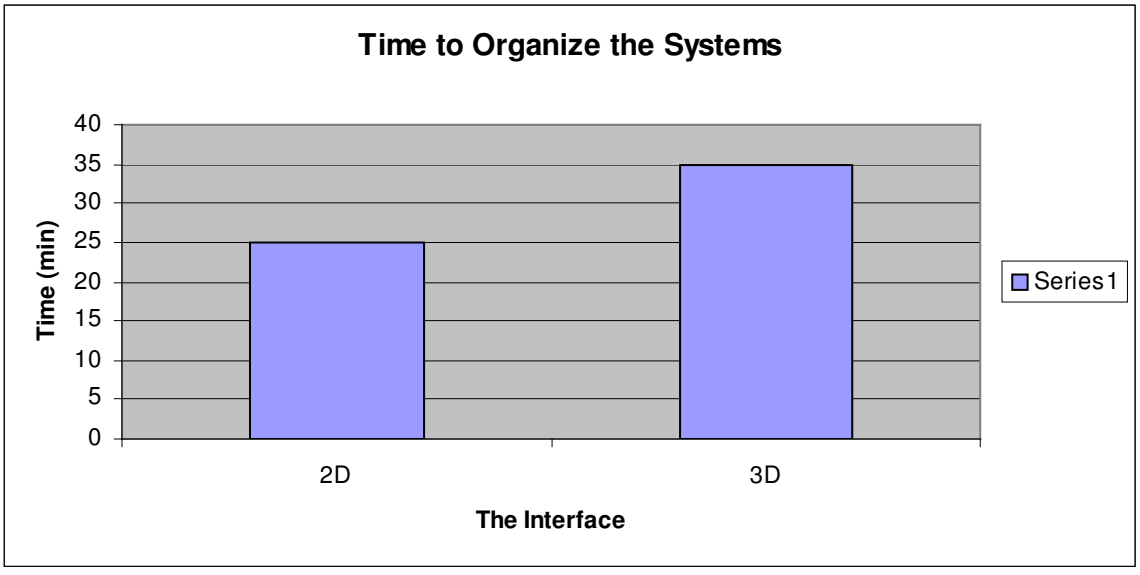

Figure 26: Time to organize given data in the Windows 2D desktop and the 3D prototype

The results indicated that participants generally were able to organize the 2-dimensional interface at a faster rate. However this indicated that the reason for these times was the fact little could really be done to the 2-Dimensional Interface and that non-of the participants used the file structure during the study. The 2-dimensional interface lacked

space, as well as landmarks which gave the users very little to work with resulting in faster organizational speeds.

To examine the general impact on how 3-dimensions, landmarks, color and semantics, had over the traditional 2-dimensional interface, a post interview was conducted (Appendix C). After the participants were completed the tasks of part 1, they were asked a series of questions. The results were extremely helpful; from these results I was able to determine issues such as layout and clarity, screen information and the general use of system.

10.2 Part 2- Results

To examine the impact of object representation and layout, I recorded the overall mean of how long it generally took users to locate an object in the 3-dimensional representation and the 2-dimensional representation. The results are as shown in figure 27.

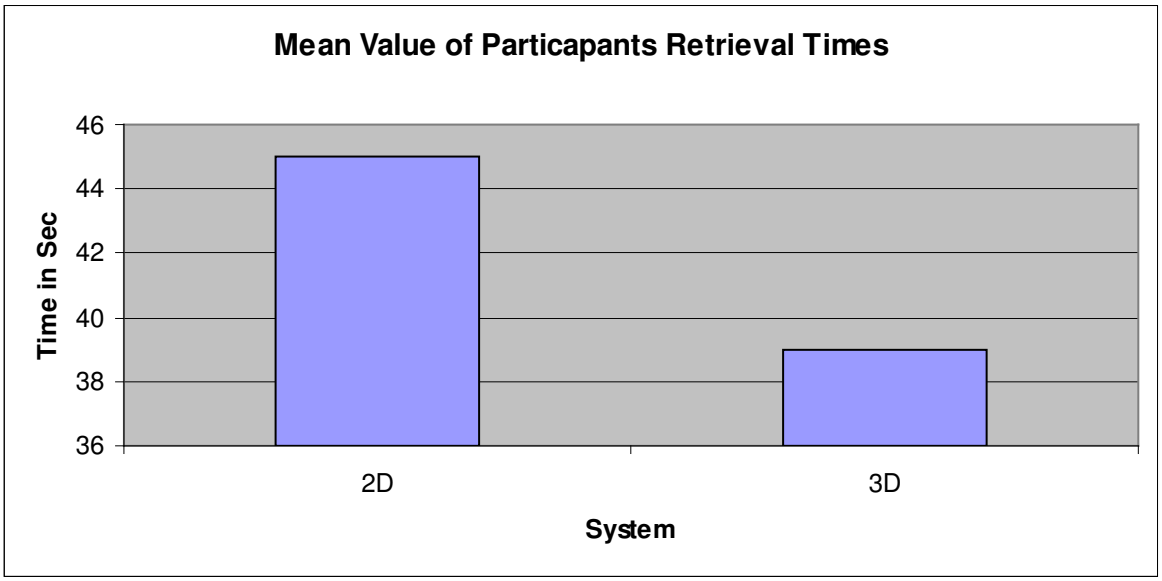

Figure 27: The average time test participants took to complete tasks in Windows 2D desktop versus the 3D prototype

The results indicated that a user will search for and acquire at a faster speed in the think 3D software in comparison to the 2-dimensional iconic interface.

10.3 2-Dimensional Windows Desktop V.S 3-Dimensional Interface

10.3.1 Layout and Clarity

Out of the 10 users 8 participants found it really difficult to organize the icons and were at times annoyed with the 2D interface. The average rating given on overall layout and clarity of the interface was only a 4 out of 10, reasons why the rating was so low ranged from, lack of visible tools to the interface being to cluttered and busy. One participant

even mentioned the lack of structure and color. When participants were asked to list one weakness they found, it was unanimous all said "lack of space to work with". On the other hand all participants agreed that the addition of 3-Dimensions as well as rooms allowed a larger spatial area to work with. The average rating given on layout and clarity for the 3-dimensional interface was 8 out of 10. However weaknesses included lack of landscape customization and the overuse of colors.

10.3.2 Screen Information

Overall participants agreed that the windows desktop had very little in terms of screen information. It lacked in particular, any kind of landmarks, or semantics. Only 5 out of the 10 participants knew that icons and files could be renamed. In the 3-dimensional application, many of the users loved the fact that the labels were clear and could be customized. The landmarks were also very clear throughout the software, none of the participants had a problem with the visual landmarks; many of the landmarks had a touch of realism making them easy to understand.

10.3.3 Use of System

Overall both the 2-dimensional system and the 3-dimensional prototype were both quit easy to use. There was the obvious learning curve, when the participants used the 3-dimensional prototype. All participants were new to the system, however once they became more familiar with the system; they all agreed that the system was quite easy to use giving an average of 8 out 10 on overall Use of System. However many commented that a help option would have been helpful.

10.3.4 Weaknesses of the 3D Prototype

The studies shown above, not only gave feedback on the comparison between the 2-dimensional interface and the 3-dimensional prototype. It also allowed the participants to critic the prototype, giving me feedback on what could be re-worked in the design phase. One comment was the overall use of color, many participants thought it to be more of a distraction rather then helpful. Many of participants also commented on the recycling bin (can be seen in figure 21) being too small and tended to blend in with the other icons. One other weakness discovered through the studies is more of the screen could have been used, improving screen real estate.

11.0 Discussion

I was interested in whether objects representation (3-dimensional), landmarks, color and semantics would impact the time it takes users to search for particular objects that they organized. Due to the fact that not a single participant for some reason or another did not use the file structures, the organizational time on the windows interface took almost half the time based on the fact that most users found little or no functionality when using only the desktop. Using the 3-dimensional software the participants were able to organize each one of the rooms adding their own labels and semantics. However when it came to the basic retrieval of objects the combination of 3-dimensions, landmarks, color and customizable semantics allowed for a more efficient interface.

12.0 Future Work

In the near future other types of data structures will possibly be added to provide a more functional interface, objects such as piles and containers that may allow a larger number of objects to be efficiently stored in each room. Many participants commented on the issue of customizing and creating rooms. In the near future a possible addition may be the ability for users to create their own rooms and landmarks, as well as choose from a number of pre made rooms, which they could add to personalize their interfaces. Another feature that will be added in the near future is the ability to do dynamic searches. This will allow users to locate stored objects with either a name a date stamp or even an extension. This will allow users to search for an item without having to browse through different rooms. If in the future, I find that many users are finding that there is not enough space in the interface to contain their documents and programs in an efficient manner the idea of a scroll bar and a radar view may also be added. Thorough usability tests will be conducted on each feature; if the tests prove to be successful the addition will be added to the software. This paper is just a start to a long journey in finding an optimal, efficient, and easy-to-use system that may or may not replace the existent windows interface.

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Appendix A

Preliminary Interview Questions

1. Age:_____

2. Gender: F M

4. Are you currently A student? _____

a) If so are you a:

High school

Freshman (first year)

Sophomore (2-3)

Senior (4+)

Major/Department:

_____

If not a student what is your occupation:

_____

5. How long have you been using the windows desktop?

- < 2years
- 3 years
- 4 years
- 5 years
- 6 years +

6. What would type of User would you call your self?

Expert (Can create icons, and shortcuts easily can rename and even change the icon display, Very knowledgeable with all functionality Microsoft Windows desktop provides)

Intermediate (Can save to the desktop, but have some difficulty creating shortcuts, Some knowledge with Microsoft's Windows desktop's functionality)

Novice (Very little knowledge of Microsoft Windows desktop and its functionality)

6. If you have an important program or file that you would like to access quicly and tends to be accessed often, where do you place it in Microsoft windows

The desktop

In a folder hierarchy

Other_____

What are your reasons to storing you information in this manner?

_____

7. How do you find the current desktop?

Hard to use (in terms of creating shortcuts and labels)

Inefficient (due to space and organizational tools)

Efficient easy to organize and a good organizational tool

Other_____

9. How many often do you save items to the Desktop for easy access?

__ Never __ Few (1-2 times) __ Several (3 or more times)

10. If you could change one thing about the windows desktop what would that be (Note if you have no answer or you are unsure leave the question blank)?

_____

Appendix B

Part One Post-Interview Questions

2-Dimensional Windows Desktop

Layout and clarity

1. How did you find, overall the ability to organize the desktop?(1 being Not Very efficient)

   1 2 3 4 5 6 7 8 9 10

2. What would you say was the Windows Desktops Weaknesses when organizing objects (If any):

_____

3. What would you say was the desktops Strengths in organizing objects(If any):

_____

Information on the screen

1. Did you find it hard to organize the screen they way you wanted? _____(yes/no)

If so what could have helped to make it a more efficient desktop?

_____

Use of the system

1. Did you find the 2-dimension interfaces color, labeling and overall placement (the ability to place icons in places in order to help you remember where you placed them) helpful when organizing the icons

_____(yes/no)

3-Dimensional Prototype

Layout and clarity

4. How did you find, overall the ability to organize the desktop?(1 being Not Very efficient)

   1 2 3 4 5 6 7 8 9 10

5. What would you say was the Desktop;s Weaknesses when organizing objects (If any):

_____

6. What would you say was the desktops Strengths in organizing objects(If any):

_____

Information on the screen

2. Did you find it hard to organize the screen they way you wanted? _____(yes/no)

   If so what could have helped to make it a more efficient desktop?

   _____

Use of the system

2. Did you find the 3-Dimensional interface's color, labeling and overall placement (the ability to place icons in places in order to help you remember where you placed them) helpful when organizing the icons

_____(yes/no)

Appendix C

Part Two Post-Interview Questions

2-Dimensional Windows Desktop

Layout and clarity

7. How did you find overall retrieval on the desktop?

    - Easy to find certain icons
    - Some what difficult to find certain icons
    - Difficult to find certain Icons

8. What would you say was the 2-dimensional Interfaces Weaknesses when retrieving objects (If any):

_____

9. What would you say was the desktops Strengths in retrieving objects(If any):

_____

Information on the screen

3. Did you find it hard to remember where you placed objects? _____

If so what could have helped to make it a more efficient desktop?

_____

Use of the system

3. Did you find the 2-dimension interfaces color, labeling and overall placement (the ability to place icons in places in order to help you remember where you placed them) helpful

_____

Overall rate the 2-dimensional tool when it comes to the ability to retrieve objects, 1-being a poor device and 10 an Excellent:

_____

3-Dimensional Prototype

Layout and clarity

1. How did you find overall retrieval on the desktop?

    - Easy to find certain icons
    - Some what difficult to find certain icons
    - Difficult to find certain Icons

4. What would you say was the 3-dimensional Interfaces Weaknesses when retrieving objects (If any):

_____

5. What would you say was the desktops Strengths in retrieving objects (If any):

_____

Information on the screen

4. Did you find it hard to remember where you placed objects? _____

If so what could have helped to make it a more efficient desktop?

_____

Use of the system

6. Did you find the 3-dimension interfaces color, labeling and overall placement (the ability to place icons in places in order to help you remember where you placed them) helpful

_____

Overall rate the 2-dimensional tool when it comes to the ability to retrieve objects, 1-being a poor device and 10 an Excellent:

_____