Evaluating the Significance of the Windows Explorer Visualization in Personal Information Management Browsing tasks

Maria Golemati[1], Akrivi Katifori[1], Eugenia G. Giannopoulou[2], Ilias Daradimos[1], Costas Vassilakis[2]
[1] Department of Informatics and Telecommunications, University of Athens, Athens, Greece
[2] Department of Computer Science and Technology, University of Peloponnese, Tripoli, Greece
margo@di.uoa.gr, vivi@di.uoa.gr, egian@uop.gr, drid@mm.di.uoa.gr, costas@uop.gr

Abstract

The visualization of hierarchies is very important for digital information management and presentation systems. Especially in the context of Personal Information Management, file browsers play a very important role. Currently the most common file browser visualizations are Windows Explorer and the simple zoomable visualization offered by Microsoft Windows. This work explores the issue of file browser visualization through a user study based on interviews and an experiment.

Keywords--- **File browser visualization, Indented list visualization, User study, Windows Explorer.**

1. Introduction

Hierarchies have been the subject of research in the domain of Computer Science for some time now, as they are one of the most common and important information structures [1]. As they are used in a wide range of applications, from file browsing to ontology management and digital library thematic categorizations, many proposed hierarchy visualizations have been reported, which could be grouped in the following general categories:

Indented List, with the Microsoft Windows Explorer (WE) as a very common example.

Node – Link Trees. These could have a top to bottom or left to right layout and also be available in 2D, as the SpaceTree [2] or 3D, as the Cone Tree [3].

Zoomable User Interfaces (ZUIs) allow users to zoom in/out of specific hierarchy parts, e.g. Grokker [4, 5].

Space–Filling. Space filling techniques use the whole of the screen space by subdividing the space available for a node among its children, as TreeMap [6].

Context + Focus. These techniques distort the view of the presented hierarchy to combine context and focus. Most use hyperbolic distortion, as the StarTree [7, 8].

Despite the multitude of existing visualization methods, there are very few applications employing them and even those are mostly addressed to specialized groups of experts. The visualizations used for file browsing are still the WE indented list paradigm (and its variations in Linux and Mac operating systems) and the simple zoomable visualization in existence since the creation of the first windows-based environments. The indented list in particular has been used as a baseline method in many visualization evaluations, having the best performance in the majority of the cases. The familiarity of users with this visualization has been suggested as the main point for its success.

This work is an attempt to further explore the issue of file browsing visualizations and the indented list paradigm in particular, based on several hierarchy evaluations, an interview-based user study and an experiment. The experiment evaluates the performance of WE against the simple ZUI file browser visualization in locating a specific node, both for a known and an unknown hierarchy. Furthermore, user browsing habits in the context of Personal Information Management (PIM) are also explored, to provide further insight on how to improve these two widely accepted and used visualizations. Our current study uses only WE as an indented list implementation, so results cannot be generalized, since certain features or shortcomings of the particular implementation may have affected the outcome. A more thorough survey, incorporating other implementations and OSs is planned as future work.

The following section presents related work and further explains the motivation for this work. Section 3 briefly outlines the results of the interview-based user study on the use of WE. Sections 4 and 5 present the evaluation and its results respectively. Finally, section 6 concludes the paper and outlines future work.

2. Related Work and Motivation

Browsing in hierarchies for a specific item is a common practice both in the context of web browsing and PIM. Especially in the case of PIM, there is a well-documented

tendency of users towards browsing (as opposed to searching) in order to locate a specific file in their collection. Barreau and Nardi in [9] note that users overwhelmingly preferred browsing and suggest that this probably happens because it engages more actively the mind and body and imparts a sense of control. User preference for browsing against searching has also been observed in [10]. However, it is unclear from existing studies how the WE visualization relates to browsing and what is the extent of its use.

There have been many efforts to evaluate existing hierarchy visualization techniques and identify their strong points and weaknesses for specific tasks. In this work we focus on the task of finding a specific hierarchy node, the location of which could be known or unknown to the user.

For finding a node for the first time, Plaisant et al [2] record better performance for WE compared to the StarTree [7, 8] hyperbolic visualization for one task, whereas for another task SpaceTree [2] performed better than WE, noting a statistically significant difference. For revisiting a node, the study in [2] presents an analysis for two tasks, a long one involving going from one node to another and a shorter one, in which users had to simply return to a node. WE proved faster than SpaceTree and StarTree for the long task, being substantially helped by the ability to keep several branches opened. For the shorter task, no statistically significant differences were found.

In an evaluation of 4 ontology visualizations [12] of the Protégé [13] ontology editor, the Class Browser, which is an indented list visualization very similar to WE, received very positive reactions. Many users commented the familiarity with the visualization due to the usage of the WE. Its average task completion times were generally better than the ones of the other 3 visualizations, but for node finding the performance was found to be better only compared to the node – link tree visualization OntoViz.

Kobsa [11], in his evaluation of several hierarchy visualizations among which the StarTree [7, 8] and TreeMap [6], notes that WE showed a very good overall performance, both with regard to correctness, speed of task completion, and user satisfaction. He suggests that any comparison with other systems must be viewed taking into account that the subjects can be assumed to be highly skilled at least in its basic functionality. On the other hand, he believes that one should not overestimate the potential practice effects for the other systems since all tested visualization systems were relatively simple and the training was quite thorough. He concludes that while at least one system achieved the same performance as WE, none of them showed benefits for users that went significantly beyond this baseline.

Rivadeneira and Bederson in their evaluation involving the ZUI Grokker, its text version Grokker Text and Vivisimo (an intended list visualization) [4], using hierarchies produced by clustering of keyword search results, found no important differences regarding efficiency among the three interfaces, although there was a strong trend: Users took an average of approximately 5 minutes to find information in Grokker, 4.5 minutes in Grokker Text and 3.5 minutes in Vivisimo. In Vivisimo, users could look at results before going to clusters. User ability to immediately access results has proven to be an advantage for Vivisimo; note that in the other two interfaces, the user had to navigate to the lowest level before seeing a result.

The question, however, as to what extent the success of WE is owing to user familiarity with it (since it is used for file browsing) remains open, since one could also argue that it is effective due to possible inherent advantages compared to other visualizations. In [14] for example, Hierarchical Browsing is reported to facilitate information seeking tasks when the user is not looking for specific and already known information. As previously mentioned, studies focused on the use of WE for retrieval tasks in an unknown hierarchy. It remains unclear how it compares to the simple ZUI-based file browser when used for hierarchies very familiar to the user. The following sections present an attempt to further clarify these issues.

3. Preliminary Interview – based user study

As a first step, in the context of an on-going interview-based user study which covered a wide aspect of PIM issues, we investigated the use of the "search" functionality and the WE. A series of 18 semi-structured interviews was conducted at the places where the users work with their computer, either their workplace or their home. They were asked to describe the way they perform certain tasks and organize their documents, as well as to provide examples and common practices. They were also encouraged to elaborate on issues that seemed to interest or preoccupy them or that they found more important and to point out things they would like to be or do differently. User expertise and confidence with the computer, as perceived both by the user and the interviewer were recorded. The users' answers were noted down and recorded by audio.

The study has not been focused on a particular user group. The users interviewed so far comprise a very heterogeneous group with the following characteristics:

- Gender : female (14), male (4)
- Age Distribution: age 18–25 (3), age 26–33 (12), age 34–41 (2), age 42+ (1)
- Educational Background (1st Degree): Computer Science (7), Philosophy/History (2), Fine Arts (1), Psychology (1), Engineering (1), Secondary Education (1), Management (1), Physics/Mathematics (2), Communications (1), Natural Resources (1).

The results regarding the use of the WE were really interesting: From the 18 interviewed users only 2 stated that they in fact use it. One said that she uses it always and the other only when she does not know or remember the location of the file she is looking for (quoting "It opens everything without really opening it"). The reasons given by the remaining 16 participants for not using WE are summarized in Table 1.

We should elaborate here on the reasons that users gave for not using the WE. According to them, they don't

need it because they know where their files are, they are confident that they remember their file structure well enough to access their files directly through the ZUI folder visualization. One of them added that "it is nice that it exists because it could be useful, but it has not been advertised enough". Another user thought that WE is not "cozy" enough because it feels like "a tool you would use to organize your work files, not your personal documents".

Reason for not using WE	Participants
Do not know it exists	4
Do not find it convenient	4
Don't need it, I know where my files are	2
Never used it, not accustomed to it	6

Table 1. Reasons why WE is not used

These results suggest that (a) WE is not as widely used as one would expect and (b) Some users feel that it is useful for finding a file, the location of which is unknown.

These results have led us to further investigate the performance of WE as a browsing tool, both in a hierarchy very familiar to the user and in an unknown one. We performed an experiment to this end, which also lead us to conclusions relevant to the users' browsing patterns.

4. Evaluation Description

Our initial hypothesis was that the Indented List visualization (WE) would perform better than the simple ZUI one in the case when the user browsed for items the location of which was not known, whereas the simple ZUI would perform better for items the location of which was known. In order to test this hypothesis, we performed the evaluation described in this section. The following paragraphs present the evaluated visualization methods, user group, test hierarchy and evaluation method.

4.1. Evaluated Visualizations

Our aim for this experiment is to test the two visualizations in an environment familiar to the user, so as to be able to use both visualizations with ease without training. To this end, we used the operating system environment and its available visualization methods.

The **Indented List** visualization is the one offered by WE when the "Folders" option is active; in this case the indented list appears on the left pane of the window, representing the folder hierarchy as a tree with the sub-folders presented as a list under their parent and indented to its right. The lists of sub-folders may be retracted or expanded at will by clicking on their parent. The files and sub-folders of the selected folder are displayed to the right of this visualization, in a separate pane.

The **ZUI** visualization is represented by the common way offered by the Windows operating system for file browsing when the "Folders" option on the folder window is inactive. The current hierarchy level is displayed with each sub-folder visible either in a list or in a tiled manner. If the user wishes to inspect the contents (sub-folders and files) of a particular folder s/he has to double-click on that folder so as to make it the current one. Depending on the user preferences, a preview for documents may be displayed (e.g. a thumbnail of pictures, movies or graphics), while document previews may also be embedded within the icon corresponding to the containing folder.

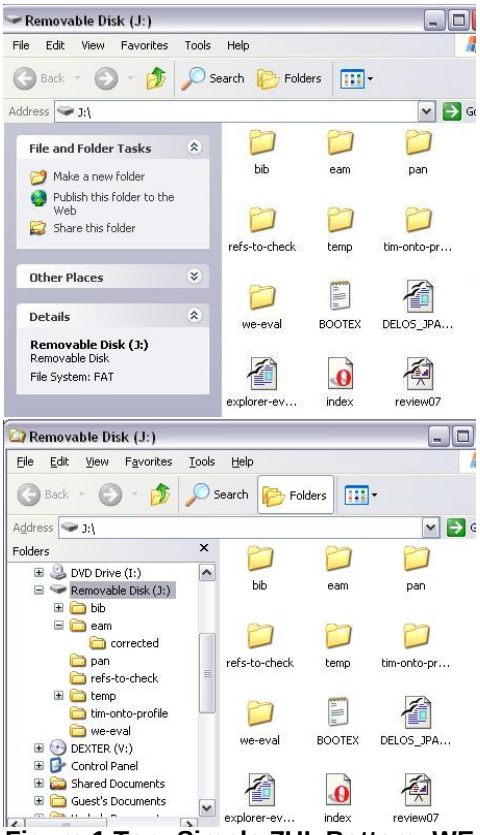

Figure 1 Top: Simple ZUI, Bottom: WE

4.2. User Group

The user group for the experiment was selected in order to satisfy two conditions: (a) users should have adequate experience with using the computer, which should be a result of at least two years of almost everyday use and (b) each user should have a sufficiently large file repository with an organized file hierarchy (more than 300 folders with at least 3 levels of depth).

Our user group had the following characteristics:

- Gender : female (7), male (8)
- Age Distribution: 18–25 (4), 26–33 (9), 34–41 (2)

All participants were Windows XP users and had more than 3 years of experience with using the computer.

4.3. Test Hierarchy

The folder hierarchy that was selected to be used in the experiment was a selected part of the hierarchy of one of

the authors. It contained 1.513 folders and 15.245 files and its depth was greater that 4 levels. Depth 4 was selected because from the preliminary interview we concluded that most users avoid very deep hierarchies and rarely use more than 4 levels.

Depth	Files	Folders
2	2	2
4	2	2

Table 2. Number and depth of items in the test hierarchy that users were asked to locate

About 1500 was set as a maximum size for this evaluation as it was close to the mean number of files of the basic and high competence users interviewed in the preliminary user study. (Low competence users did not have folder hierarchies). From the selected part of the hierarchy 4 files and 4 folders were chosen for the evaluation (Table 2).

4.4. Method

The experiment was conducted at the participant's home or working environment. After explaining to the participant the evaluation procedure and asking him/her to fill in a questionnaire relevant to his/her profile, s/he was asked whether there was a part of the hierarchy s/he did not want the interviewers to browse. Then s/he was asked to leave the interviewers alone with the computer in order for them to select the files that would be used in the retrieval tasks during the evaluation. The evaluation proceeded with the following steps.

4.4.1. User Hierarchy selection The first step was to select a part of the user's folder hierarchy to be used in the experiment, if the hierarchy was substantially greater than the test one (more than 1.650 folders). The selected part should have at least 3 levels of depth and contain files recently used by the participant.

4.4.2. Selection of files to be used From the selected part of the hierarchy 4 files and 4 folders were chosen to be used in the evaluation as shown in Table II. When no recent files or folders were available at level 4, level 3 was used.

In order to select recently used files the experiments employed the "Recent Documents" feature in Windows XP, as well as the date of last modification of the files and folders. Items with characteristic and unique names were chosen, avoiding names like "test" or "temp". Recent documents were selected at this stage to maximize the possibility that the user would actually remember the file and its location.

4.4.3. Participant training During this step the user is given a set of instructions on how to browse during the experiment:

1. When using the Indented List, the participant is asked not to double click on folders on the right in order to reach the lower levels of the hierarchy but rather to click on the sub-folders on the indented list. This measure was taken to avoid using the indented list visualization as if it were a ZUI.
2. The participant is not allowed to use a "Search" tool during the experiment.
3. The participant was not allowed to use the explorer bar, either to write the path directly or change the current folder using the drop-down list.
4. The participant was instructed to think aloud during the experiment.
5. The participant was allowed to use the keyboard.
6. The participant was allowed to change the view of his/her files and folders.
7. The participant was asked not to complete a task when feeling too frustrated or that it would be impossible to find the answer.

4.4.4. Experiment The user was asked to locate 16 items: 8 (4 files – 4 folders) located in his/her personal folder hierarchy and 8 (4 files – 4 folders) in the hierarchy provided by the experimenters. At the beginning of each browsing task the user was given the name of the file or folder to locate.

To minimize the effect of learning the folder hierarchy or remembering the location of a requested item from a previous search, the participant was asked to search alternatively using the indented list and the ZUI and also alternatively in his/her hierarchy and the test one, provided by the experimenters.

For each task the user reactions, comments, browsing method and steps were recorded by the experiment conductor. Errors and back-tracking were recorded too. Users were given a 5 minute time limit for each task and their time for task completion was also recorded. At the end of the experiment users were asked to fill in a brief questionnaire measuring their satisfaction regarding task completion time and easiness in both hierarchies and visualizations.

4.4.5. User Browsing Method After the experiment, a brief interview followed and the participant was asked to demonstrate his/her own browsing method for accessing files and folders in his/her hierarchy.

5. Evaluation Results

After the conclusion of the evaluation for the group of 15 users, the results were analyzed. During the experiment, factors that had not been predicted were observed, which seem to affect the results.

Firstly, although we had believed that the "Recent Documents" feature and the modification date would be excellent indicators for locating files or folders the location of which would be known to the user, this was not the case. For about 17% of the retrieval tasks assigned to them in their own hierarchy, the users did not seem to remember the exact location of the item they were looking for. For 75%

of these tasks they did not remember at all where the file/folder could be whereas for the 25% they remembered the general location, i.e. an ancestor folder of the requested item, and they had to browse inside in order to locate it.

These results indicate that even the most organized users may have problems refinding a file or folder, when this is requested suddenly and out of context. As to the use of WE, in this user group only 4 users reported that they use the WE and only 1 of them always does; this result is in line with the findings of our preliminary study. Table 3 presents the reasons the participants gave for this choice, further elaborating the results illustrated in table 1.

Use of WE	Users	Reason for this choice
Always (1)	1	Habit and Ease of Use
Sometimes (3)	2	To see other disk partitions/network locations
	1	When I don't know the precise location of the file/folder
Never (11)	2	It's a waste of space
	3	It is tiring and confusing
	2	I don't need it because I know where my files are
	4	Never tried it

Table 3. Study results on the use of WE

Users that presented "waste of space" as a reason probably also in reality found it confusing because we noted that even though the WE was not visible, the same area was occupied by a "Details" pane. On the other hand, the only participant that uses WE noted that she does not like the "Details" pane in the ZUI visualization that occupies the same space with WE and this is one of the reasons she prefers the WE.

It is interesting that 2 of the users that never use WE, stated that they use its equivalent in Linux, an indented list visualization that presents hierarchically folders but also files in the same pane. Another user noted that WE does not offer an effective overview in case folders with many children are open and a scrollbar appears.

5.1. Results of the Statistical Analysis

We perform non-parametric Mann-Whitney tests on various groups of the measured times for evaluation retrieval tasks. Our hypothesis did not seem to be verified by these results, as shown in Table 4. Total mean times for WE and ZUI are almost the same and no difference was noted in either hierarchy (user and test).

Mean times for folder retrieval were better than those for files but again there is no statistically important difference. However, this result indicates that files in general are more difficult to locate than folders. This is probably due to the fact that users pay more attention to the naming of folders than of files, as folders constitute conceptual categories in their file organization. Finally, the number of folders is considerably smaller than the number of files, and this can also be an important reason.

Another interesting result was that significant difference was indeed noted for files/folders located at the 2nd and at the 4th level both in both hierarchies. This fact proves a difficulty for users to browse deep hierarchies and can explain the user tendency to avoid creating deep hierarchies (9 out of the 15 participants reported few or no folders at a level greater than 3).

		Mean	Std	Asymp. Sig.
ZUI		46.3	61	
WE		47.9	63.1	
User Hierarchy		29.84	38.7	$<10^{-3}$
Test Hierarchy		67.8	76.8	
Files		50.7	60.43	0.09
Folders		43.7	63.34	
User Hierarchy	**ZUI**	31	44.2	
	WE	28.7	32.8	
Test Hierarchy	**ZUI**	66.6	73.8	
	WE	68.7	79.8	
User Hierarchy	**Level 4**	35.4	40.2	$<10^{-2}$
	Level 2	24.7	36.9	
Test Hierarchy	**Level 4**	101.37	85.9	$<10^{-3}$
	Level 2	43.81	59.7	
Folders	**ZUI**	45.6	71.3	
	WE	42	56.4	
Files	**ZUI**	46.3	48.8	
	WE	55.1	70.4	

Table 4. Statistical Analysis of measured times

Mean times for file and folder retrieval with the ZUI and WE are not significantly different, but it seems WE has a slightly better performance for folders and slightly worse for files. These mean times agree with a problem some users had during the experiment when looking for files: they had to switch their attention back and forth from the WE pane to the right where the files of the selected folder were presented. At some points when looking for a file they got distracted and browsed the WE pane without paying attention to files on the right.

The study of failure in retrieval or cessation of the task may also lead to several conclusions. As shown in Table 5, tasks that were left incomplete for both aforementioned reasons concerned retrieval of a file/folder located at level 4. The percentage of such failures is particularly large (almost 91%). Furthermore, it seems that there were no failures for the user hierarchy and level 2. For the test hierarchy, the ZUI interface seems to result in more failures (100% for level 2 and 71.43% for Level 4). For the user hierarchy and level 4, 66.67% of the failures concerned WE. This result may in fact support our initial hypothesis concerning the advantages of WE for browsing unknown hierarchies in comparison to the ZUI one.

It should be noted that although we believed that the familiarity of participants with the Windows GUI would be enough to ensure competence with the use of WE, this was not the case. Only high competence participants used WE efficiently. Some of the less experienced ones had several problems with it, like not recognizing that only folders with a small cross on their left have children, or that only a single click is enough to expand the sub-hierarchy of the folder. We believe that this is another important factor that has influenced our results.

Quit	12.5%	**L2**	30%	**Test**	55.56%	**ZUI**	60%
						WE	40%
				User	44.44%	**ZUI**	50%
						WE	50%
		L4	70%	**Test**	76.19%	**ZUI**	62.5%
						WE	37.5%
				User	23.81%	**ZUI**	60%
						WE	40%
Fail	4.58%	**L2**	9.09%	**Test**	100%	**ZUI**	100%
						WE	0%
				User	0%	**ZUI**	0%
						WE	0%
		L4	90.91%	**Test**	70%	**ZUI**	71.43%
						WE	28.57%
				User	30%	**ZUI**	33.33%
						WE	66.67%

Table 5. Percentages of task completion failure and quitting for the various retrieval tasks.

5.2. User Suggestions

Two users thought that it would be useful to be able to see if a folder has sub-folders without having to open it. One of them also suggested showing a preview of its contents on "mouse over". He also proposed color-coding in WE in order to be able to recognize immediately the parent folder of a specific folder. These suggestions according to the user would be useful to him as he has a wrist problem and minimizing unnecessary moves during browsing would be very important to him. Another user suggested that an alternative file system that would make multiple categorization or file tagging possible would be desirable.

6. Conclusions and Future Work

Although the statistical analysis of the experiment results does not directly support our hypothesis, the study of WE and the simple Windows ZUI visualization has provided useful insight concerning these two common visualizations. The degree of organization of personal information has a great impact on the use of folder hierarchy visualizations on information retrieval. None of the users stated 100% satisfaction with the organization of their files.

We had almost no WE users. This finding will be further investigated by conducting a large scale (possibly online) survey on the issue. This result probably means that familiarity with the indented list visualization is not a result of the WE use. Perhaps user familiarity results from the use in other applications or it is "natural" to the user.

We also plan to investigate the implementations of hierarchical browsers in other operating systems like Mac OS X and Linux. This will provide more generic results regarding the indented list paradigm, since current results may have been affected by certain features or shortcomings of WE. Incorporating a larger number of participants is also planned to obtain better statistical confidence, particularly for groups of users which are currently underrepresented (e.g. WE users).

References

[1] J. T. Stasko, R. Catrambone, M. Guzdial, and K.McDonald. An Evaluation of Space-Filling Information Visualizations for Depicting Hierarchical Structures. In *International Journal of Human-Computer Studies*, vol. 53, pp. 663-694, 2000.

[2] C. Plaisant, J. Grosjean and B. B. Bederson. SpaceTree : Supporting Exploration in Large Node Link Tree, Design Evolution and Empirical Evaluation, In *Proceedings of IEEE INFOVIS '02*, Boston, 57 -64, October 2002.

[3] G. G. Robertson, J. D. Mackinlay and S. K. Card. Cone Trees: Animated 3d Visualizations Of Hierarchical Information, In *Proceedings of CHI '91 Human Factors in Computing Systems*. ACM, New York, 189-202, 1991.

[4] W. Rivadeneira and B. B. Bederson. A Study of Search Result Clustering Interfaces: Comparing Textual and Zoomable Interfaces, University of Maryland HCIL Technical Report HCIL-2003-36, October 2003.

[5] Grokker, url: http://www.groxis.com.

[6] B. Shneiderman. Tree visualization with Tree-maps. A 2-d space-filling approach, In *ACM Transactions on Graphics*. Vol. 11, No. 1, 92-99, September 1992.

[7] J. Lamping and R. Rao, The Hyperbolic Browser: A Focus + Context technique for Visualizing Large Hierarchies, In *Journal of Visual Languages and Computing 1996*, vol. 7, 33-55, 1996.

[8] StarTree, url: http://www.inxight.com/.

[9] D. Barreau, and B. Nardi, Finding and Reminding: File Organization From the Desktop. *SIGCHI Bulletin* 1995.

[10] P. Ravasio, S. Guttormsen, and H. Krueger. In Pursuit of Desktop Evolution: User Problems and Practices With Modern Desktop Systems. In *ACM Transactions on Computer-Human Interaction*, Vol. 11, No. 2, June 2004

[11] A. Kobsa., User Experiments with Tree Visualization Systems, In *Proceedings of IEEE INFOVIS'04* , 9-16 2004.

[12] A. Katifori, E. Torou, C. Halatsis, C. Vassilakis, G. Lepouras, 2006, A Comparative Study of Four Ontology Visualization Techniques in Protégé: Experiment Setup and Preliminary Results, In Proceedings of IV '06, London, 2006.

[13] Protégé, Stanford University, http://protege.stanford.edu.

[14] S. Walters, F. Jayakanth, Hierarchical Browsing Interface: A case study with India Business insight Database, In Proceedings of Workshop on Multimedia and Internet Technologies, DRTC, Bangalore, 2000.