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Collaborative Visual Interface for Knowledge Management: The Design and the Influence Analysis

中文摘要

既有的查詢介面，常以單一的使用者為設計的核心，因此使用者常需單獨面對查詢資訊的過程。本研究建議設計新的合作式視覺介面，讓使用者在查詢資訊的過程中，可以輕易地找到有類似興趣的人，並透過彼此的溝通與討論，提升資訊搜尋的速度與品質。為了了解所設計的介面對決策的影響，我們也在研究中提出模式與假設，希望利用實驗的方式，深入分析不同的介面設計所帶來的影響。我們的研究成果，將提供系統設計及資訊搜尋者，作為設計查詢介面的參考以及分析介面設計影響的基礎。

關鍵字: 資訊視覺化，介面設計，知識管理

ABSTRACT

Existing efforts on query interface design concentrate on single user and result in lonely knowledge seeking process. Therefore, in this research, we suggest to design a *collaborative visual interface* in which human users can take advantages of the behavior of the like-minded people via interaction, and thereby exploring complex information space collaboratively. In order to understand the influence of the designed interface on decision making, in this research, we also propose a model to test the interactive querying environment. The results of this research will provide system designers with heuristics of constructing querying interfaces and inform knowledge seekers how querying interfaces influence the performance of decision making.

KEYWORD: Information Visualization, Interface Design, Knowledge Management

Collaborative Visual Interface for Knowledge Management: The Design and the Influence Analysis

1. Introduction

One prevailing assumption in the existing query interfaces is that information seeking is basically viewed as an *individual* activity (Twidale et al. 1997; Nichols et al. 2000). In these systems, information seekers individually represent their needs, receive system responses, and refine their searches until responsive data points meet their own needs. There is no one to ask for help as they entered into a bewilderment of documents, and there is no means to capitalize from others' experiences.

At the same time, collaborative activities are often observed in physical information seeking and retrieval process (Twidale et al. 1997; Nichols et al. 2000). Information seekers often search for information by oral interpersonal communications with their friends or colleagues. They often ask their friends/colleagues for some required information or for advice and assistance on how to get it. Therefore, it is imperative to consider information seekers' need of consulting people in information seeking and retrieval process in designing a new query interface.

In this research, we therefore propose to design a *collaborative browsing interface* to support navigation through complex information space.

2. Literature review

As noted by Twidale et al. (1997), collaborative activities which are often observed in physical information seeking and retrieval process can be classified into three types. The first type of collaborative activities is personal interaction which occurs during the information seeking and retrieval process. An information seeker may ask an individual or a group for some required information or for advice or assistance on how to get it at any time before or during a search. The second type of collaborative activities is the sharing of search product. An information seeker may pass information of a successful search to other appropriate users or add various kinds of information to the document records for enhancing the documents from which others can benefit. The third type of collaborative activities is the sharing of search process. Many searches are similar or even identical to those which have already been done many times before. New users therefore may ask experienced users how they find related information to speed up their search progress.

To support the first type of collaboration in information seeking and retrieval process, communication tools, such as electronic mail, online chatting, and videoconferencing, etc., are increasingly used (Twidale et al., 1997). A number of CSCW tools have been developed to support group communication, cooperative query formulation, and cooperative browsing of results (Applegate et al., 1986; Foster and Stefik, 1986; Hymes and Olson, 1992; Rodden, 1991; Sugimoto et al., 1995). The Who-Knows system (Streeter and Lochbaum, 1988) and several expertise recommendation systems (Domingue et al., 2000; McDonald and Ackerman, 2000; Sidler et al., 1997) have also been constructed to help user find a group of people who have experiences on the topic of interest. This form of collaboration has been extended by interacting in a virtual reality environment where both information and users are visualized (Benford and Mariani, 1994; Chalmers, 1995; Crossley and Davies, 1999).

As second type of collaborative activities, an information seeker who comes across some interesting information may pass them on to known individuals. Recommendations of this kind increasingly occur today, mainly through the medium of e-mail (Twidale et al., 1997). A number of systems that intend to provide recommendation to similar but unknown individuals have also been developed (Goldberb et al., 1992; Kantor, 1993; Resnick et al., 1994; Sarwar et al., 2000; Shardanand and Maes, 1995). These systems look for relevance among users by observing their interest profiles and recommend the target user items that appear in the profiles of those users that exhibit the strongest relevance to the target user. Also, some systems which allow users to attach annotations, such as link (Kantor, 1993; Park and Chon, 1994), free-text comments (Cohen, 1994), keywords (Brewer and Johnson, 1994; Davis and Huttenlocher, 1995), or ratings (Maltz, 1994), to enhance the value and accessibility of information resources have also been constructed.

In addition to sharing search result, the third type of collaborative activities-sharing search process-has been supported by existing systems. In (Lin et al., 1991; Mobasher et al., 1999, 2000), search patterns which are extracted from search processes are utilized to help users find relevant information. A growing number of systems further utilize visualization techniques to display search processes and thus support their sharing. ARIADNE, proposed by Twidale et al. (1997), allows users to observe, record, and analyze others' navigation histories to facilitate their information seeking tasks. StarWalker, proposed by Chen et al. (1999), spatially visualizes both information and users to form a virtual world. Users within the same neighborhood are made visible and thus can communicate with each other.

In this research, we focus on the design of query interface. We investigate above three types of collaborative activities to design a new collaborative query interface CBI.

3. Proposed approaches

CBI provides a browsing interface, in which a work-oriented subject directory is provided. Documents that are often accessed together tend to be related to the same work and thus belong to the same category. Therefore, the work-oriented subject directory is learnt by looking at the work associations of the documents. Specifically, we make use of usage logs to cluster documents for building a work-oriented subject directory. The main theme of the designed interface is to help information seekers find people with specific competencies and experiences to facilitate their information seeking tasks. People that often retrieve same documents express similar interests and thus belong to the same interest group. Therefore, we look for relevance among users by analyzing their navigation behavior. We make use of usage logs to partition users into a set of interest groups. Based on the work-oriented subject directory and the set of interest groups, collaboration mechanisms are added to the CBI system.

The overall architecture of CBI, shown in Figure 1, consists of two basic components: off-line and on-line subsystems.

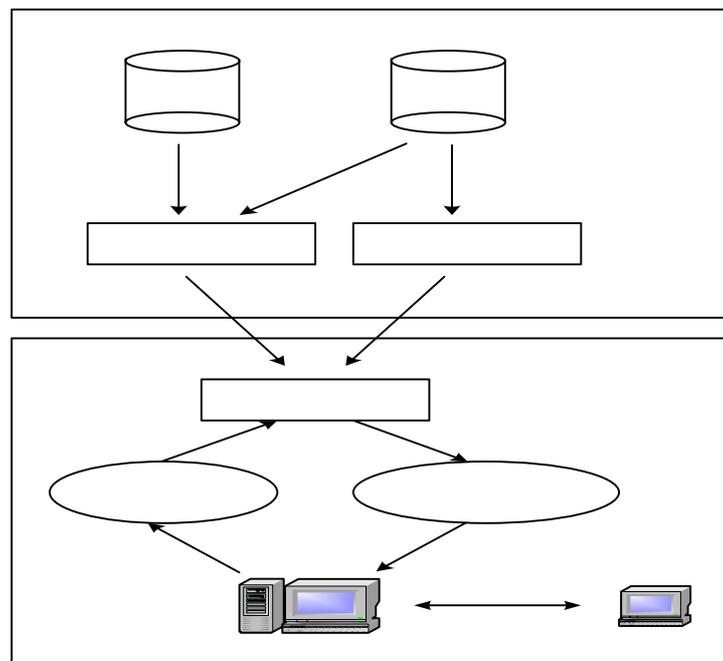


Figure 1. The overall architecture of CBI

Off-line subsystem

The goal of the off-line subsystem is to build a work-oriented subject directory and extract a set of interest groups. Accordingly, the subsystem comprises two parallel tasks: the document clustering task and the user clustering task. In document clustering task, we examine the usage logs to partition documents into a set of clusters. In the user clustering task, we analyze the usage logs to cluster users into a set of interest groups.

On-line subsystem

The goal of the on-line subsystem is to provide the interfaces to interact with users in real time. Therefore, as a user logs onto the system, the on-line subsystem provides the designed interface, which consists of four windows: an information directory window, a document list window, a document browse window, and a chatting window, to the user. Figure 2 shows a screenshot of the collaborative browsing interface.

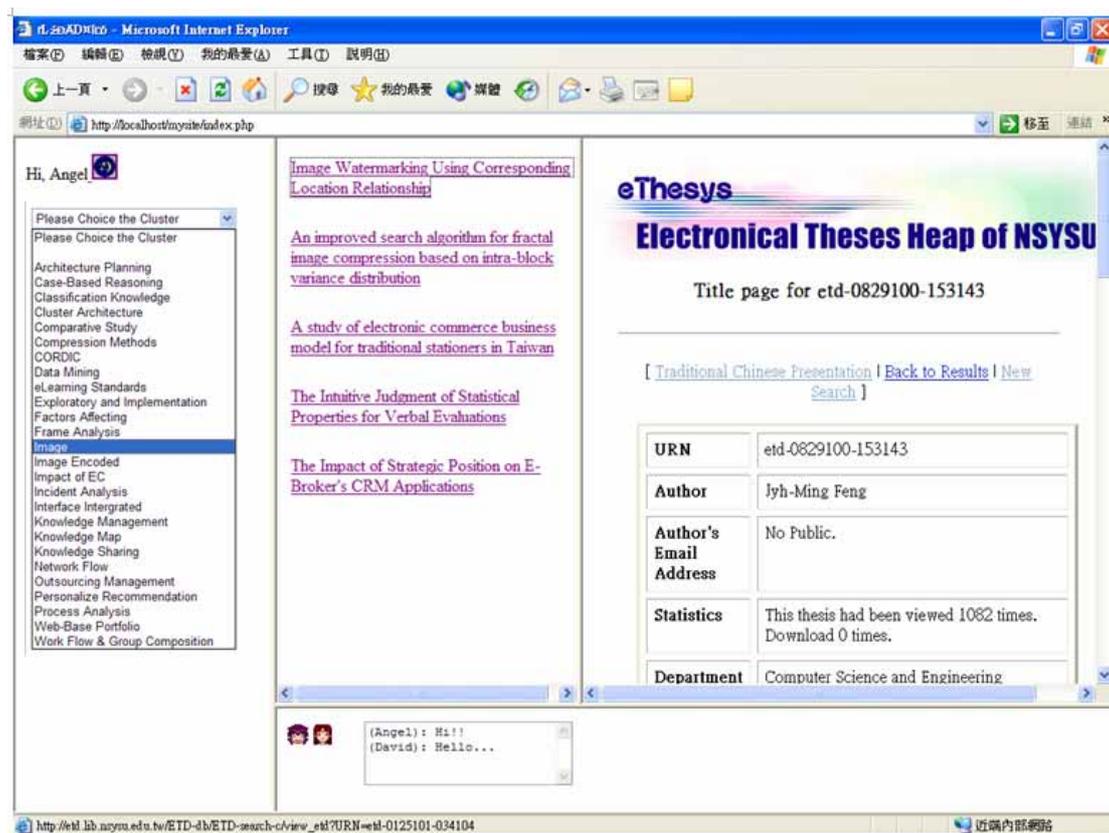


Figure 2. A screenshot of the collaborative browsing interface

In the information directory window, a list of topics is displayed, and users choose a document cluster by click on the respective topic. Documents of the selected cluster are rendered in a linear list in the document list window. The selected document is

displayed in the document browse window. Also, in the designed interface, each user is equipped with an avatar. The avatars of users who are currently reading documents in the same cluster (i.e., current interest) or users who are in the same interest group (i.e., general interest) are displayed in the chatting windows. For example, suppose Angel and David are currently reading some documents in the image cluster and Angel and Bob are in the same interest group, David and Bob will appear in Angel's chatting window. By doing so, users can readily find others who have similar interests. When users encounter difficulties in learning from the documents, they can readily turn to those who have similar interests and have the potential to help. Users can create a connection (i.e., a chatting room) to share their experience or collaboratively do their projects. Users might also be stimulated to generate new ideas and attach reviews or comments after discussing with others.

4. Evaluation

In order to understand the influence of the designed interface on decision making, we test the interactive querying environment empirically. Since considerable researches suggested that the decision maker's perception of effort required to use the system as well as their decision accuracy and speed in reaching a solution will be affected by interface-based differences and the relationship between query interface design and decision outcomes will be moderated by the complexity of task, we modify the model developed by Speier et al. (2003) to test the interactive querying environment. The model used in this research is shown in Figure 3. Decision accuracy and decision time are the primary outcomes of interest. In this research, the single-browsing interface refers to a browsing interface without the ability of collaboration.

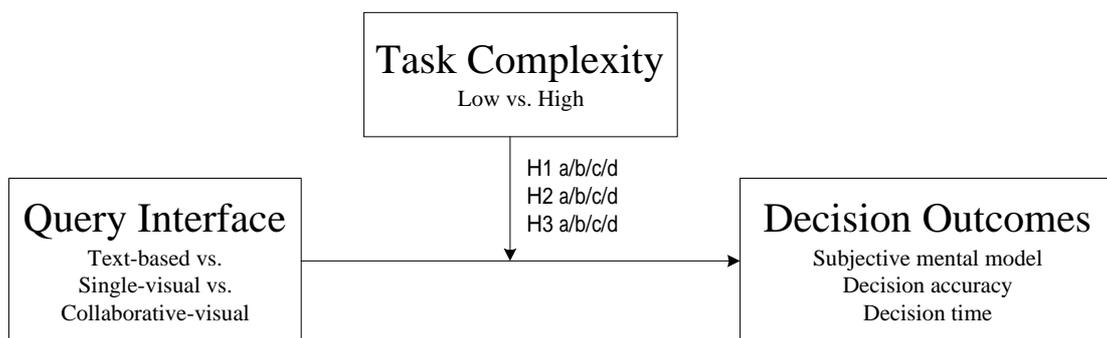


Figure 3: Test model

We empirically test the CBI system by using the document set of NSYSU-ETD, which is an electronic theses system at National Sun Yat-sen University. We use the methodology of lab experiment to analyze the collaborative visual interface's

influence on decision making. A 3*2 experimental design is implemented to test the hypotheses. The two factors are query interface (text-based vs. single-visual vs. collaborative-visual) and task complexity (low vs. high). Overall, the experimental results show that (1) *Decision accuracy will be higher with collaborative-browsing querying than with single-browsing querying when task complexity is high, and (2) Decision time will be faster with collaborative-browsing querying than with single-browsing querying when task complexity is high.*

5. Conclusion

The designed collaborative visual interface offers a novel approach to browsing information. In the interface, user can easily browse documents and find other users who have similar interests to ask for help. People who involve in the same project can even share their experience or perform their work in a collaborative environment. Hereafter, we will engage in the investigation on the issues of privacy, comparison, and disorientation. Also, more sophisticated experiments will be performed to test the effectiveness of the proposed collaborative browsing interface.

References

- Applegate, L. M., Konsynski, B. R., and Nunamaker, J. F., "A Group Decision Support System for idea Generation and Issue Analysis in Organizational Planning," *Proceedings of the Conference on Computer Supported Cooperative Work*, 1986.
- Benford, R. S., Snowdon, D., Greenhalgh, C., Ingram, R., Knox, I., and Brown, C., "VR-VIBE: a virtual environment for co-operative information retrieval," *Computer Graphics Forum*, 14(3), pp. c349-c360, 1995.
- Brewer, R. S., and Johnson, P. M., "Toward Collaborative Knowledge Management within Large Dynamically Structured Systems," *Technical Report CSDL-TR-94-02*, Department of Information and Computer Sciences, University of Hawaii, 1994.
- Chalmers, M., "Design perspectives in visualizing complex information", *Visual Database Systems 3: Visual Information Management*, 1995.
- Chen, C., "Information Visualization and Virtual Environments," Springer-Verlag, London, 1999.
- Cohen, E. S., "Review-based Information Services: Lessons Learned from the Boston Restaurant List," *Proceedings of the 2nd International World Wide Web Conference*, 1994.
- Crossley, M., and Davies, J., "The Knowledge Garden," *BT Technology Journal*, 17(1), 1999.
- Davis, J. R., and Huttenlocher, D. P., "Shared Annotation for Cooperative Learning," *Proceedings of Computer Support for Collaborative Learning*, 1995.
- Domingue, J., Dzbor, M., and Motta, E., "Collaborative Semantic Web Browsing with Magpie," 2000.
- Foster, G., and Stefik, M., "Cognoter: Theory and Practice of a Colab-orative Tool," *Proceedings of the Conference on Computer Supported Cooperative Work*, 1986.

- Goldberg, D., Nichols, D., Oki, B. M., and Terry, D., "Using Collaborative Filtering to Weave an Information Tapestry," *Communications of the ACM*, 35(12), 1994.
- Hymes, C. M., and Olsen, G. M., "Unblocking Brainstorming through the Use of a Simple Group Editor," *Proceedings of the Conference on Computer Supported Cooperative Work*, 1992.
- Kantor, P. B., "The Adaptive Network Library Interface: A Historical Overview and Interim Report," *Library Hi-Tech*, 11(3), 1993.
- Maltz, D. A., "Distributing Information for Collaborative Filtering on Usenet Net News," *MSc Thesis*, Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, 1994.
- McDonald, D. W., and Ackerman, M. S., "Expertise Recommender: A Flexible Recommendation System and Architecture," *Proceedings of the ACM Conference on Computer Supported Cooperative Work*, 2000.
- Mobasher, B., Cooley, R., and Srivastava, J., "Creating Adaptive Web Sites through Usage-based Clustering of URLs," *Proceedings of IEEE Knowledge and Data Engineering Exchange Workshop*, 1999.
- Mobasher, B., Dai, H., Luo, T., Nakagawa, M., and Witshire, J., "Discovery of Aggregate Usage Profiles for Web Personalization," *Proceedings of the WebKDD Workshop*, 2000.
- Nichols, D. M., Pemberton, D., Dalhoumi, S., Larouk, O., Belisle, C., Twidale, M. B., "DEBORA: Developing an Interface to Support Collaboration in a Digital Library," *Proceedings of the 4th European Conference on Research and Advanced Technology for Digital Libraries*, 2000.
- Park, T., and Chon, K., "Collaborative indexing over networked information resources by distributed agents," *Distributed Systems Engineering*, 1(6), pp. 362-374, 1994.
- Resnick, P., Iacovou, N., Suchak, M., Bergstrom, P., and Riedl, J., "GroupLens: An Open Architecture for Collaborative Filtering of Netnews," *Proceedings of Conference on Computer Supported Cooperative Work*, 1994.
- Rodden, T., "A Survey of CSCW systems," *Interacting with Computers*, 3(3), 1991.
- Sidler, G., Scott, A., and Wolf, P. H., "Collaborative Browsing in the World Wide Web," *Proceedings of the 8th Joint European Networking Conference*, 1997.
- Speier, C., and Morris, M. G., "The Influence of Query Interface Design on Decision-Making Performance," *MIS Quarterly*, 27(3), 2003.
- Streeter, L. A., and Lochbaum, K. E., "Who Knows: A System based on Automatic Representation of Semantic Structure," *Proceedings of RIAO 88 Conference on User-Oriented Content-Based Text and Image Handling*, 1988.
- Twidale, M. B., Nichols, D. M., and Paice, C. D., "Browsing is a Collaborative Process," *Information Processing and Management*, 33(6), 1997.

Toward the Design of a Collaborative Browsing Interface (published in PACIS05)

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Abstract

Existing efforts on query interface design focus on single user and result in isolated information seeking process. In this research, we propose to design a collaborative browsing interface in which human users can easily retrieve information and identify people who have similar interests to ask for help, thereby enabling collaborative exploration on complex information space. In this paper, we present the issues and approaches of designing a collaborative browsing interface. Preliminary implementation experiences are also presented and discussed. These results provide system designers with guidelines of constructing query interfaces and demonstrate how query interfaces influence the performance of decision making.

Keywords: Query Interface, Human-Computer Interaction, Information Retrieval, Knowledge Management, Data Mining

1. Introduction

In today's hypercompetitive business environment, effectively collecting and manipulating information are critical organizational capabilities (Speier and Morris 2003). Many organizations accordingly invest in information technologies to maintain computerized repositories, which store procedures, reports, and work outcomes so that knowledge workers can use/reuse the materials for decision making. A few examples are: Buckman Laboratories' online comment system (Zack 1999), Chrysler's knowledge management system (Ruggles 1998), and SLIS's digital library system (Borner et al. 2000).

As the information environment becomes increasingly saturated, getting decision

makers' attention and helping them find and focus on the most relevant data becomes increasingly difficult (Davenport and Beck 2001). Developing query interfaces that can support efficient information seeking and decision making to overcome the problem of information overload has become critical. Research and practical efforts accordingly have devoted to the design of query interfaces for improving decision-making performance (Alavi and Leidner 2003; Speier and Morris 2003).

One prevailing assumption in the existing query interfaces, however, is that information seeking is basically viewed as an *individual* activity (Twidale et al. 1997; Nichols et al. 2000). In these systems, information seekers individually represent their needs, receive system responses, and refine their searches until responsive data points meet their own needs. There is no one to ask for help as they entered into a bewilderment of documents, and there is no means to capitalize from others' experiences.

At the same time, collaborative activities are often observed in physical information seeking and retrieval process (Twidale et al. 1997; Nichols et al. 2000). Information seekers often search for information by oral interpersonal communications with their friends or colleagues. They often ask their friends/colleagues for some required information or for advice and assistance on how to get it. Therefore, it is imperative to consider information seekers' need of consulting people in information seeking and retrieval process in designing a new query interface.

In this research, we propose to design a *collaborative browsing interface* to support navigation through complex information space. The remainder of this paper is organized as follows. In Section 2, we review research efforts in this context. In Section 3, we describe our approaches for designing a collaborative browsing interface. In Section 4, we present our experiences in preliminary implementation. In Section 5, we summarize this work and point out our future research directions.

2. Literature review

As noted by Twidale et al. (1997), collaborative activities which are often observed in physical information seeking and retrieval process can be classified into three types. The first type of collaborative activities is personal interaction which occurs during the information seeking and retrieval process. An information seeker may ask an individual or a group for some required information or for advice or assistance on how to get it at any time before or during a search. The second type of collaborative activities is the sharing of search product. An information seeker may pass

information of a successful search to other appropriate users or add various kinds of information to the document records for enhancing the documents from which others can benefit. The third type of collaborative activities is the sharing of search process. Many searches are similar or even identical to those which have already been done many times before. New users therefore may ask experienced users how they find related information to speed up their search progress.

To support the first type of collaboration in information seeking and retrieval process, communication tools, such as electronic mail, online chatting, and videoconferencing, etc., are increasingly used (Twidale et al., 1997). A number of CSCW tools have been developed to support group communication, cooperative query formulation, and cooperative browsing of results (Hymes and Olson, 1992; Rodden 1991). The Who-Knows system (Streeter and Lochbaum 1988) and several expertise recommendation systems (McDonald and Ackerman 2000; Sidler et al. 1997) have also been constructed to help user find a group of people who have experiences on the topic of interest. This form of collaboration has been extended by interacting in a virtual reality environment where both information and users are visualized (Benford and Mariani 1994; Chalmers 1995; Crossley and Davies 1999).

As second type of collaborative activities, an information seeker who comes across some interesting information may pass them on to known individuals. Recommendations of this kind increasingly occur today, mainly through the medium of e-mail (Twidale et al., 1997). A number of systems that intend to provide recommendation to similar but unknown individuals have also been developed (Goldberb et al. 1992; Kantor 1993; Pesnick et al. 1994; Shardanand and Maes 1995). These systems look for relevance among users by observing their interest profiles and recommend the target user items that appear in the profiles of those users that exhibit the strongest relevance to the target user. Also, some systems which allow users to attach annotations, such as link (Kanto 1993; Park and Chon 1994), free-text comments (Cohen 1994), keywords (Brewer and Johnson 1994; Davis and Huttenlocher 1995), or ratings (Maltz 1994), to enhance the value and accessibility of information resources have also been constructed.

In addition to sharing search result, the third type of collaborative activities-sharing search process-has been supported by existing systems. In (Mobasher et al. 2000), search patterns which are extracted from search processes are utilized to help users find relevant information. A growing number of systems further utilize visualization techniques to display search processes and thus support their sharing. ARIADNE,

proposed by Twidale et al. (1997), allows users to observe, record, and analyze others' navigation histories to facilitate their information seeking tasks. StarWalker, proposed by Chen et al. (1999), spatially visualizes both information and users to form a virtual world. Users within the same neighborhood are made visible and thus can communicate with each other.

3. Collaborative browsing interface

In this research, we focus on the design of query interface. Based on the studies on collaborative activities, we have developed a system, *Collaborative Browsing Interface*, abbreviated as CBI, to support collaborative interactions between decision makers. In this section, we start with the description of the overall architecture of CBI and close with the detailed approaches.

3.1. System architecture

CBI provides a browsing interface, in which a work-oriented subject directory is provided. Documents that are often accessed together tend to be related to the same work and thus belong to the same category. Therefore, the work-oriented subject directory is learnt by looking at the work associations of the documents. Specifically, we analyze the usage data to find the work associations of the documents. Since a growing number of information systems provide WWW interfaces, their usage data are recorded in Web usage log. Therefore, we make use of Web usage logs to cluster documents for building a work-oriented subject directory. Based on the work-oriented subject directory, collaboration mechanisms are added to the CBI system.

The overall architecture of CBI, shown in Figure 1, consists of two basic components: off-line and on-line subsystems.

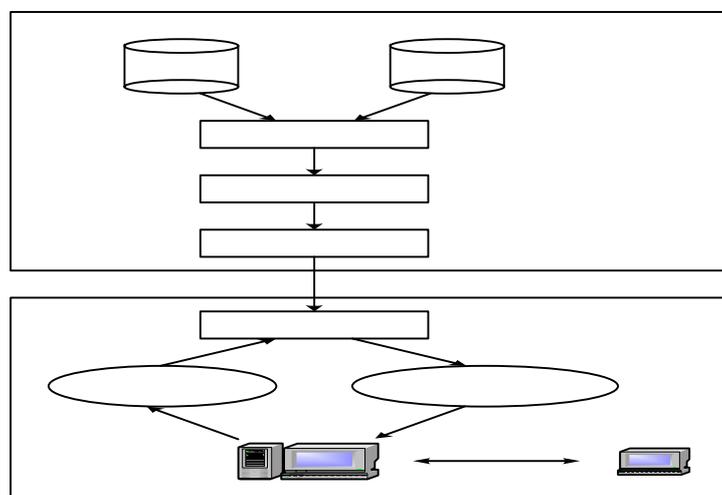


Figure 1. The overall architecture of CBI

Off-line subsystem

The goal of the off-line subsystem is to extract the semantic structure of documents and build a work-oriented subject directory. Accordingly, the subsystem comprises three sequentially executed tasks: the data preparation task, the document clustering task and the category labeling task. In data preparation task, the raw Web usage logs are converted into a set of user transactions. In document clustering task, we examine the converted data to partition documents into a set of clusters. In the cluster labeling task, each cluster obtained from the document clustering task is labeled.

On-line subsystem

The goal of the on-line subsystem is to provide the interfaces to interact with users in real time. Therefore, as a user logs onto the system, the on-line subsystem provides the designed interface, which consists of four windows: an information directory window, a document list window, a document browse window, and a chatting window, to the user. Figure 2 shows a screenshot of the collaborative browsing interface. In the information directory window, a list of topics are displayed, and users choose a document cluster by click on the respective topic. Documents of the selected cluster are rendered in a linear list in the document list window. The selected document is displayed in the document browse window. Also, in the designed interface, each user is equipped with an avatar. The avatars of users who are currently reading the same document or documents in the same cluster are displayed in the chatting windows. For example, suppose Angel, David, and Bob are currently reading some documents in the image cluster, David and Bob will appear in Angel's chatting window. By doing so, users can readily find others who are performing similar work or have similar

interests. When users encounter difficulties in learning from the documents, they can readily turn to those who are reading related documents and have the potential to help. Users might also be stimulated to generate new ideas and attach reviews or comments after discussing with others. People who involve in the same project can even create a connection (i.e., a chatting room) to share their experience or do their project collaboratively.

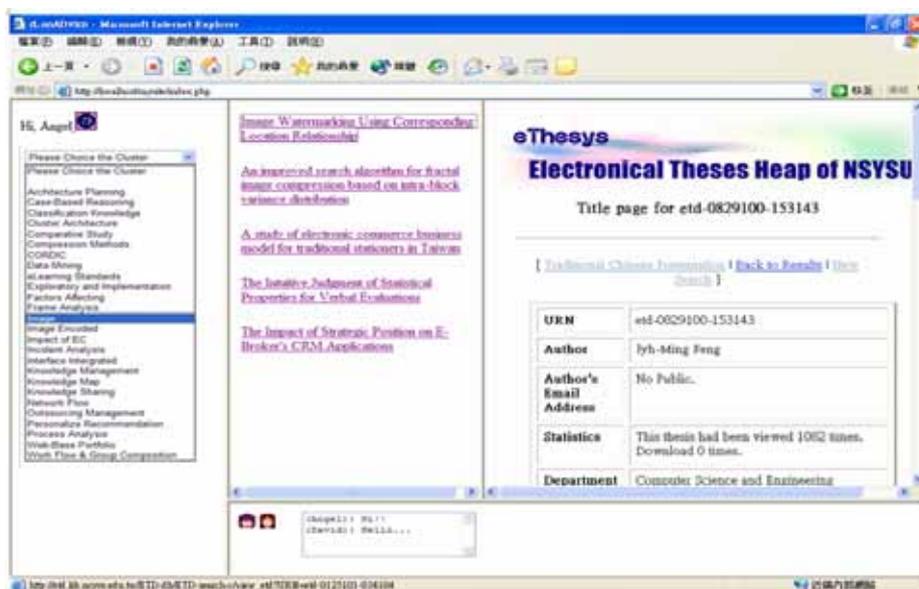


Figure 2. A screenshot of the collaborative browsing interface

3.2. Detailed approaches

The tasks conducted in the off-line subsystem are described in detail in this section.

Data preparation

Although Web usage logs have the potential of providing useful knowledge in clustering documents, the raw data contained in logs cannot be used without proper preprocessing. Therefore, we first convert raw Web usage logs into a set of user transactions before performing document clustering task. To prepare data from the Web usage logs, we follow the heuristics adopted by our previous work (Hwang et al. 2003). The approach contains three sequential steps: data cleaning, user session identification, and transaction identification. The objective of data cleaning is to prune out unwanted Web log records and to add back missing Web log records. The objective of user session identification is to divide the access logs of each user into

individual sessions. For two records with different IP addresses, different browser software or operating system, a reasonable assumption to make is that they belong to two different user sessions. In addition, the time interval between two consecutive requests in a user session should not be too long. We use 30 minutes as the default timeout period, which has also been adopted by many commercial products. When a time interval between a usage record and the previous one exceeds 30 minutes, a new user session is assumed to start. Finally, a user session is further divided into a number of transactions, each of which represents a semantically meaningful unit. We make use of previous searching or browsing conditions specified in parameters to divide user sessions into a set of transactions.

Document clustering

We adopt ARHP (Mobasher 2000) to cluster documents into a set of categories. This approach starts with the identification of large itemsets, each of which contains documents often accessed together in transactions. Each such large itemset is then viewed as a hyperedge with a weight. Then the hypergraph partitioning algorithm is applied to partition the set of documents into disjoint clusters of documents. Documents in the same cluster are more “similar” in the sense that they are more likely to be accessed together in the same transaction. To reflect the fact that a document may indeed interest two groups of users, we adopt the same heuristic as used in (Mobasher 2000) in adding back documents to clusters, resulting in overlapping clusters. Specifically, for a given hyperedge, if the percentage of its vertices in the cluster is more than a threshold, the other vertices are added back.

Cluster labeling

Associating clusters with labels or themes allows an information seeker to readily find interested documents. The cluster digest algorithm proposed by Lewis and Ringuette (1994) is adopted in the CBI system. This algorithm evaluates the Information Gains of each term with respect to each cluster to quantify the effectiveness of using the term to classify documents. For each cluster, the K terms with largest Information Gains are chosen to label it.

4. Implementation and Evaluation Plan

We empirically test the CBI system by using the document set of NSYSU-ETD, which is an electronic theses system at National Sun Yat-sen University in Taiwan. NSYSU-ETD is running on PC Solaris 2.7 and using Apache 1.3.9 as the Web server. Since the operation of NSYSU-ETD in May 2000, it has collected more than 5000 electronic theses. Until February 2005, these theses have been browsed more than

4,500,000 times and downloaded more than 1,400,000 times. We analyzed the usage log of NSYSU-ETD to develop the collaborative browsing interface.

Currently, a pilot study is performing in our project. We have eight subjects; all of them are graduate students. The involved subjects are shown a brief, ten-minute demonstration of the system, and then they are randomly assigned into two groups. Three subjects are involved in the first group to complete a relatively sample task, and the other five subjects are involved in the second group to complete a more complex task. At the end of the experiment, all participants are asked complete a final questionnaire to elicit their experience.

From the final questionnaire, overall, the tested participants showed a good understanding of the concept of collaborative information browsing, and they were able to easily navigate through the information space to find documents. Also, several issues as well as improvements of the interface are identified and suggested by participants. First, most participants expressed their privacy concerns. Recording and spreading user's navigation information raises the privacy issue. They suggested that if the extent to which the navigation data is shared can be decided by the user, there would be less privacy concern. Also, some participants suggested that it would be desirable to allow multiple foci showing in the information space. The comparison of different information is often necessary in the process of decision making, particularly in collaborative environment. Finally, showing more status information is also suggested, which may help reduce user's disorientation.

5. Conclusion

The designed collaborative browsing interface offers a novel approach to browsing information. In the interface, user can easily browse documents and find other users who have similar interests to ask for help. People who involve in the same project can even share their experience or perform their work in a collaborative environment. Hereafter, we will engage in the investigation on the issues of privacy, comparison, and disorientation. Also, more sophisticated lab experiments will be performed to test the effectiveness of the proposed collaborative browsing interface.

References

- Alavi, M., and Leidner, D. "Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues," *MIS Quarterly*, (25:1), 2003.
- Benford, R. S., Snowdon, D., Greenhalgh, C., Ingram, R., Knox, I., and Brown, C.

- “VR-VIBE: a virtual environment for co-operative information retrieval,” *Computer Graphics Forum*, (14: 3), 1995.
- Boner, K., Dillon, A., and Dolinsky, M. “LVis- Digital Library Visualizer,” *Proceedings of the 4th International Conference on Information Visualization*, 2000.
- Brewer, R. S., and Johnson, P. M. “Toward Collaborative Knowledge Management within Large Dynamically Structured Systems,” *Technical Report CSDL-TR-94-02*, Department of Information and Computer Sciences, University of Hawaii, 1994.
- Chalmers, M. “Design perspectives in visualizing complex information”, In *Visual Database Systems 3: Visual Information Management*, 1995.
- Chen, C. “Information Visualization and Virtual Environments,” Springer-Verlag, London, 1999.
- Cohen, E. S. “Review-based Information Services: Lessons Learned from the Boston Restaurant List,” *Proceedings of the 2nd International World Wide Web Conference*, 1994.
- Crossley, M., and Davies, J. “The Knowledge Garden,” *BT Technology Journal*, (17:1), 1999.
- Davenport, T.H., and Beck, J.C. “The Attention Economy,” *Harvard Business School Press*, Cambridge, MA, 2001.
- Davis, J. R., and Huttenlocher, D. P. “Shared Annotation for Cooperative Learning,” *Proceedings of Computer Support for Collaborative Learning*, 1995.
- Goldberg, D., Nichols, D., Oki, B. M., and Terry, D. “Using Collaborative Filtering to Weave an Information Tapestry,” *Communications of the ACM*, (35:12), 1994.
- Hwang, S.-Y., Hsiung, W.-C., and Yang, W.-S. “A WWW Prototype of Literature Recommendation Service in Digital Libraries,” *On-Line Information Review*, (27:3), 2003.
- Hymes, C. M., and Olsen, G. M. “Unblocking Brainstorming through the Use of a Simple Group Editor,” *Proceedings of the Conference on Computer Supported Cooperative Work*, 1992.
- Kantor, P. B. “The Adaptive Network Library Interface: A Historical Overview and Interim Report,” *Library Hi-Tech*, (11:3), 1993.
- Lewis, D. D., and Ringuette, M. “Comparison of two learning algorithms for text categorization,” *Proceedings of the 3rd Annual Symposium on Document Analysis and Information Retrieval*, 1994.
- Maltz, D. A. “Distributing Information for Collaborative Filtering on Usenet Net News,” *MSc Thesis*, Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, 1994.

- McDonald, D. W., and Ackerman, M. S. "Expertise Recommender: A Flexible Recommendation System and Architecture," *Proceedings of the ACM Conference on Computer Supported Cooperative Work*, 2000.
- Mobasher, B., Dai, H., Luo, T., Nakagawa, M., and Witshire, J. "Discovery of Aggregate Usage Profiles for Web Personalization," *Proceedings of the WebKDD Workshop*, 2000.
- Nichols, D. M., Pemberton, D., Dalhoumi, S., Larouk, O., Belisle, C., and Twidale, M. B. "DEBORA: Developing an Interface to Support Collaboration in a Digital Library," *Proceedings of the 4th European Conference on Research and Advanced Technology for Digital Libraries*, 2000.
- Park, T., and Chon, K. "Collaborative indexing over networked information resources by distributed agents," *Distributed Systems Engineering*, (1: 6), 1994.
- Resnick, P., Iacovou, N., Suchak, M., Bergstrom, P., and Riedl, J. "GroupLens: An Open Architecture for Collaborative Filtering of Netnews," *Proceedings of Conference on Computer Supported Cooperative Work*, 1994.
- Rodden, T. "A Survey of CSCW systems," *Interacting with Computers*, (3:3), 1991.
- Ruggles, R. "The State of the Notion: Knowledge Management in Practice," *California Management Review*, (40:3), 1998.
- Shardanand, U., and Maes, P. "Social information filtering: algorithms for automating 'word of mouth'," *Proceedings of the International Conference on Human Factors in Computing Systems*, 1995.
- Sidler, G., Scott, A., and Wolf, P. H. "Collaborative Browsing in the World Wide Web," *Proceedings of the 8th Joint European Networking Conference*, 1997.
- Speier, C., and Morris, M. G. "The Influence of Query Interface Design on Decision-Making Performance," *MIS Quarterly*, (27:3), 2003.
- Streeter, L. A., and Lochbaum, K. E. "Who Knows: A System based on Automatic Representation of Semantic Structure," *Proceedings of RIAO 88 Conference on User-Oriented Content-Based Text and Image Handling*, 1988.
- Twidale, M. B., Nichols, D. M., and Paice, C. D. "Browsing is a Collaborative Process," *Information Processing and Management*, (33:6), 1997.
- Zack, M. "An Architecture for Managing Explicated Knowledge," *Sloan Management Review*, (41:1), 1999.