THE NAVIGATIONAL AND COGNITIVE PROBLEMS OF HYPERTEXT AND HYPERMEDIA

*Ms. D. C. Kuruppu**

The paper discusses cognitive problems of hypertext and hypermedia. Introduces hypertext and hypermedia systems, and discusses the design of hypertext system. Some of the problems and practical solutions that have been developed to help users are considered. These are relevant to the problems on the Internet. Concludes emphasising that hypertexts should be made user-friendly.

1 INTRODUCTION

1.1 Hypertext and Hypermedia

Over the last decade there have been considerable advances in the ways in which information can be stored, processed and delivered. Of particular importance are the developments in computer storage technologies and the various mechanisms by which people can interact with computer systems. These developments enable large volumes of information to be stored and displayed in 'electronic form'. Such information can be organized in a linear fashion or it can be organized into other, more sophisticated non-linear structures. Non-linear arrangement of textual materials is called 'hypertext'. Similarly, non-linear arrangement of multimedia information, a combination of text, images and sound, is known as 'hypermedia' [1,2].

1.2 Design of Hypertext and Hypermedia Systems

Hypertext systems allow the customization of documents in different layers of text in a hypertext document. It means that users can interact with the text at a number of different levels with differing amounts of detail being presented to different users or to the same user at different times. Hypermedia systems allow people to access

* Library, Faculty of Science, University. of Colombo, P.O.Box 1698, Colombo 3, Sri Lanka. E-mail: kuruppu@vidya.cmb.ac.lk

information in a sequence, volume, and format that best suits their respective needs at the time they access the information. They can change their access strategy each time, according to their convenience [3;4].

Herrstrom [3] noted that hypertext systems are most often designed as webs, which allow users to move virtually from anywhere to anywhere by association. The hypertext network can be regarded as a layered structure, that is, document network and concept network. The concept network is regarded as an index to the documents, as each document is linked in the network to those nodes that represent concepts to which it is related [5].

Documents stored in hypertext have active cross-references. A hypertext system is made of nodes and links, allowing for three-dimensional navigation through a body of data. A node usually represents a single concept or idea and is connected to other nodes by links. Either the hypertext system designer can predefine the links or the user(s) can establish the links as part of walking through the information space [6]. Both nodes and links can be typed, that is, tagged in a specific way, which allows them to be identified individually or as members of a set. Pools of information are collected, labelled and electronically stored as nodes in a database. The combination of the nodes and their connecting links form a hypertext network and is called a hypergraph.

Ellis [4] stated that the implementation of a hypertext document database is affected by four major issues - authoring versus browsing mental model and metaphor; search and navigation; data preparation (conversion of text to hypertext).

The database may incorporate both hierarchic and non-hierarchic links with different underlying structure being adopted to suit different applications. Links can be of two kinds:

- Structured link which maintains the underlying skeleton or basic structure of the hypertext, and

- User defined link which allows the user to create new associations in the hypertext.

The node from which a link originates is called the reference and the node at which a link ends is called the referent. They are also referred to as anchors. Links can usually be embedded in text and can then be edited and reviewed; links may also have attributes, which may be created, deleted or changed. In addition to their role as connecting points, the system designed as links can be used to

- connect a document reference to the document itself;
- connect a comment or annotation to the text about which it is written;
- provide organizational information;
- connect two successive pieces of text, or a piece of text and its immediate successors; and
- connect entries in a table or figure to descriptions, or to other tables or figures [7].

In the design of the system, movement from node to node in a hypertext is carried out via links. So, it is essential that the system recognizes the links and can follow them, and that movement between nodes can be done quickly and easily.

2 SOME NAVIGATIONAL AND COGNITIVE PROBLEMS AND SOLUTIONS

By combining the features of both hypertext and information retrieval systems, the system can present the user with information and guidance that its retrieval strategy suggests. Hypertext may supplement conventional methods of information retrieval by allowing users to discover retrieval cues that can be successively used for query formulation. Search facilities may supplement conventional hypertext by providing the user with a set of relevant nodes for graphical browsing [8]. Lucarella [5] pointed that hypertext uses machines to augment human cognition whereas retrieval systems use human knowledge in such a way.

Hypertext is non-sequential writing where each node contains some amount of text or data in other forms. The nodes are connected by directed several out-going links, each of which is then associated with some smaller part of the node. They follow the associated link to its destination node, thus navigating the hypertext network. Users can backtrack by following the links in the reverse direction. When interpreting the result of backtracking or the history of the list, Nielsen [9] chose the path to enable users to rely on their memory about their own navigation behaviour. In an earlier version, a facility was designed for readers to provide a direct backtracking jump to use structure-oriented backtrack. Thus, a user may jump to the starting point or an earlier link instead of backtracking one step at a time through a number of intermediate screens. But users did not quite understand the facility and found difficulties in using it. Therefore, the facility was removed from later versions of the hypertext system. In the earlier case it would appear that the designer attempted to devise a new apparently user-friendly system, minimizing the complexity of the user interface to the extent where users spent too much time reading instructions instead of reading the main text!

As already mentioned, hypertext allows users to access non-linear information. There is no 'right' way to use or access a hypertext. According to specific needs, users navigate the system by means of the links, embedded by the author or designer. Here, three major aspects are to be taken into account in setting up and use of hypertexts: design and presentation of data which will be both easy to use and easy to understand; determining user needs; reading non-linear documents that are devoid of traditional guiding mechanisms.

Hypertext allows readers to make their own decisions about which links are to be followed and in what sequence. It does not force a strict decision about whether any given idea is either within the flow of a paper's stream of thought or outside of it [7]. Baird [10] noted that hierarchical structures offer both the author and the reader a recognisable way to proceed. However, links should also be provided for lateral movement, and the satisfaction of tangential information needs.

To investigate a number of user interface options in hypertext system, Nielsen [9] and others designed a prototype system in the form of a hypertext. It was implemented on an Apple Macintosh with hypercard as the programming system. To get a feel for their hypertext system, the reader is encouraged by screen dumps of a session with the system and thus constituted a kind of printed demonstration or guided tour. Hypertext is a very dynamic form of a human-computer interaction and can only be fully appreciated in an interactive environment. However, even the prototype system gives a better understanding of the system than a traditional description. The hypertext system has two navigational dimensions: a linear dimension to move back and forth among the text pages within a given node, and a non-linear dimension used for hypertext jumps. Two different animation techniques are used to reinforce user's understanding of these two dimensions, when shifting from one screen to another. To help user's navigation, recognising locations is also facilitated by the dramatically varying graphical designs used for different elements of the system, such as, the front cover, the main text, and literature references. This minimized the risk that user will be confused about these different parts of the information space.

The earlier version of the system relied on more subtle differences in graphics design but nobody actually seem to have noticed these subtle design differences, and so they were removed in the redesigned system [1]. The differences in graphical design are intended to reduce the homogeneity problem in on-line text. In hypertext containing more nodes it might not always be possible to rely only on distinct graphical design, so certain forms of variation might still be needed. Homogeneity is desirable because it emphasizes the book metaphor and readers can assimilate information faster when they encounter a familiar format.

Ellis [11] indicated that the database would consist of bibliographic descriptions of items with their references, the individual items being connected by citation and other types of link. Works by the same author or in the same journal, or citations to a particular work or author, could be identified by links, while providing other forms of presentation such as contents pages of journals, or publishers' lists in separate linked nodes.

Moon [12] noted that it would be useful to provide facilities for users to indicate the document type and its likely use and attach comments to the links. Ellis [11] also pointed out that the relationships and facilities would enable a searcher to interact more flexibly with the database than is possible with conventional systems.

The book metaphor seems to be limited in the conceptual models of the search potential of hypertext and non-linear navigation of the information space. So, Nielsen [9] suggested that the book metaphor should be avoided in future hypertext designs.

Conklin [7] suggests that the system to be effective not more than a couple of keystrokes or mouse movements should be necessary for the user to follow a single link, and that only one or two seconds delay should occur between the user's requesting the information and display of information.

Disorientation has been widely reported as a serious problem for users of hypertext databases because users find that they forget where they are, and how and why they got there. Conklin addressed the issues of disorientation and cognitive overhead, and a number of tools have been developed for hypertext navigation to alleviate the problems. Now, many hypertext systems provide graphical browsers, web views, paths or some other facility. Graphical browsers help reduce disorientation by providing a two dimensional spatial display of the hypertext network. They also help minimize cognitive overhead by showing a small part of the network. Usually the browser will be accompanied by global or zoom facilities to enable the user to identify the portion of the network to be displayed. Paths and filters can also help to reduce user disorientation in hypertext networks and for the user to work more effectively with the hypertext. Paths guide the user through the hypertext along and filters enable user to skip quickly from node to node in the network without having to examine the full contents of each node traversed. Consequently, users can navigate with minimal problems.

Current hypertext systems provide sophisticated user interface tools that enable the reader to inspect the node contents and to navigate

through the network for selecting the path to follow, on the basis of interests emerging along the way. Many systems also provide facilities for the user to add links reflecting her/his association criteria [5]. People find hypertext most useful when they examine in a sequential manner.

3 CONCLUDING REMARKS

My personal view on this issue is that hypertext should also make users feel that they can move freely through the information according to their own needs with short response times and low cognitive load when navigating. There should also be more flexibility in the interaction of the user with the database, and the user should be given guidance for effectively navigating the information resource.

REFERENCES

1. Nielsen, Jakob. *Hypertext and hypermedia*. London: Academic Press; 1990.
2. Barker, Philip. *Exploring hypermedia*. London: Kogan Page. 1993.
3. Herrstrom, David.S.; Massey, David.G. Hypertext in context. In *The society of text* / Ed. by Edward Barrett. Cambridge, MA., USA: MIT Press; 1988, p. 45-58.
4. Ellis, David. *Progress and problems in information retrieval*. 2nd Edition. London: Library Association; 1996, p. 122-143.
5. Lucarella, Dario. A model for hypertext based information retrieval. In *Hypertext: concepts, systems and spplications* / Ed. by A Rizk and others. Cambridge: Cambridge University Press,; 1990, p. 81-94.
6. Carlson, Patricia Ann. Hypertext and intelligent interfaces for text retrieval. In *The society of text* / Ed. by Edward Barrett. Cambridge, MA., USA: MIT Press; 1988; p. 45-58.
7. Conklin, J. Hypertext: a survey and introduction. *IEEE Computer*, 20(9); 1987; 17-41.
8. Marchionni, G.; Shneiderman, B. Finding facts *vs* browsing knowledge in hypertext systems. *IEEE Computer*, 21(1); 1990; 70-80.
9. Nielsen, Jakob. The art of navigating through hypertext. *Communications of the ACM*, 33(3); 1990; 297-321.