Tools to aid navigation

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Abstract

The problem of disorientation brought about by hypertext navigation can be solved by efficient tools to aid navigation such as summaries, indexes or navigation maps. In the article we analyse the main tools to aid navigation used in the Internet web, going further into those which use knowledge representation to carry out their faction. We propose new ways of making navigation maps to favour access and understanding of information for hypertext environments in teaching-learning.

Key words

Hypertext, hypertext navigation, navigation map, representation of knowledge, design of hypertext, tools to aid navigation.

Introduction

The World Wide Web[1] service uses hypertext navigation[2] to access with ease the information available on remote computers, setting up an unending[3] web of inter-related documents. We need only click on an underlined word to obtain immediately[4] the document referred to. The web is highly ergonomic physically thanks to hypertext. However, in the cognitive field disorientation problems often come up when the reader activates available references constantly and in no specific order. It would seem that high physical ergonomics derive into a low knowledge ergonomics.

Hypertext is not a new invention. Its origins are to be looked for in works by Vannevar Bush (1945), during the forties, before computers were invented. Hence, any document on paper incorporates hypertext elements which allow breaking up linear, sequential reading. Footnotes are a representative example. For this reason, hypertext has often been defined as «the generalisation of footnotes». Hypertext emerges when constant access to references becomes the normal way of consulting a document.

During the eighties, different software have brought hypertext to fruition, making available to the general public the creation and reference to non-linear documents. The most popular was Hypercard, an excellent programme for creating hypertexts which Apple supplied for buying a Macintosh computer. On-line aids in any Windows programme are another example of widely used hypertext documents.

However, generalised use of hypertext has come about thanks to the Internet web where Bush's visionary has been implemented on commercial and technological bases which are completely different. The web is an open system and thus there is no need to buy a commercial programme in order to create, manage and consult hypertext documents.

This profound change in context brings about many advantages, but also some disadvantages. The main advantage is that there are no commercial or technological barriers to making and reading hypertext documents. Anyone can create their own web page. The main disadvantage is that often this absence of technological limitations has turned into an absence of quality in hypertext design of documents on the web.

One of the elements in which the lack of quality is most obvious is in the design of systems for aiding navigation such as menus, summaries, indexes or navigation maps. As we will see further on, the reasons for these difficulties are to be sought in a superficial representation of knowledge which these instruments imply when they are applied to the Internet web.

Before going on, and must clarify a few terms, as there is a certain amount of confusion about the concept hypertext and other concepts surrounding it. On the one hand, a hypertext is a digital document which takes advantage of computability to make it easier to access information by association, breaking the sequence forced by the paper support. On the other hand, hypertext is also a computer programme which makes it possible to create and read these new digital documents. Finally, the theoretic model, or model of organising information in a non-sequential way is also called hypertext.

To be precise, the term hypertext only has this latter meaning, as the hyperdocument is a digital document with hypertext features, and computer programmes for creating, modifying and consulting them are systems for creating hypertexts (SCH). However, these two latter terms are not much used and we must often identify the meaning of the term hypertext in context.

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[1] Henceforth «web».

[2] Reference to or reading a hypertext is known as navigation.

[3] In technology web is known as hyperlink.

[4] Unless the net is paralyzed.

Hypertext navigation

A hypertext is a digital document fragmented in units of information, called *nodes* or *pages*, which can be read non-sequentially by activating links available in these nodes. The links allow displacement of the reading point from one node to another and are normally in the shape of an underlined word or a graphic icon.

Hypertext navigation is the activity carried out by people consulting a hypertext and consists of advancing in the reading according to the decisions made at each instant on what information will be looked up according to the links available in each node. The result of navigation is a non-sequential reading of information, where the reader will have looked up only the information which seemed pertinent and in the order which seemed most adequate.

The freedom of readers of a hypertext to choose their own reading route often has a disadvantage, called cognitive excess, which occurs when the reader cannot control all the branches in any given system and is incapable of exploring all the routes offered (Codina, 1996:117).

According to Rosenfeld and Morville (1998), for ease of navigation and to avoid cognitive excess it is necessary to offer, always, precise indications as to the context where the user is placed and the links available in each node will allow, at the same time, a flexible access to new information.

The property of «context» in a hypertext is achieved by indicating in each node what information is directly or indirectly related to it. Therefore, users will always know what relation the active node has to the rest of the hyperdocument. On the other hand, the property of «flexibility» is directly related to the generic structures which make up the fragments of information with its links, such as the sequence, the rank and the web.

To create hypertexts with context and flexibility we must take into account three basic elements for the design of hypertexts which we will detail: the dimension of the nodes, the navigation structures and the tools to aid navigation.

Node dimension

A key point in construction of a hypertext is the dimensions of the fragments of information which make up the hypertext document, called nodes. Although it may seem that we are raising a secondary question, a large part of the discussions on what it is, or may become, a hypertext has as a reference the optimum extension of the fragments of information.

In the field of the theory of the hypertext there are several theoretical orientations which propose different types of nodes. According to classic theories of hypertext developed by Bush (1945), Conklin (1987), Engelbart (1963), Nelson (1974) and Landow (1991), hypertext is a non-lineal narrative structure with benefits which are superior to classic sequential narrative.[5] According to these authors, each node ought to develop just one idea or concept and the trend ought to be towards small nodes. There is no agreement to allow us to give exact numbers about ideal dimensions for a node, although the referent most used by these authors is the measure of a computer screen.

One of the basic premises in this line of theory is that readers of a hypertext will construct their own discourse as they link the fragments of information available in the hyperdocument. The reading routes are not pre-determined and readers, according to their knowledge and interest, will consult the nodes considered most appropriate at the time.

The proposition of the hypertext narrative is to break up the classic structure of a sequential discourse, with an introduction, followed by a development and conclusion. For these authors, the begetit of a hypertext is that it gives maximum potential to readers' freedom. To achieve this, the nodes must develop a single idea and add to the links which allow access to other fragments of semantically related information, which will once again have the same characteristics. Consequently, the longer the node, the longer sequential discourse it will contain and readers will have less capacity to navigate according to their interests.

There is a second line of theory on design of hypertext, which is in the majority, that conceives hypertext as a way of structuring information characterised by the possibility of carrying out non-sequential routes. From this perspective, the fragments of information which make up the hypertext can have diverse structure and dimensions, combining elements which are as diverse as paragraphs, chapters, complete sequential documents and other hypertexts. In opposition to the hypertext narrative, in the line of theory of the hypertext as structure, more potential is given to

[5] Please, have a look to Codina's article in these review.

sequential organisation of information as a useful complement, and often necessary, to other structures which are more correctly hypertext, such as rank or web complements. The web is an example coherent with the theories which consider hypertext as a way to structure information. The nodes, called pages, have different lengths and often contain sequential documents which are relatively long.

Navigation structures

According to how the fragments of information are related, we can identify three basic generic structures: sequential, rank and web. Rank or hierarchy structures link nodes and offer an overall view to more specific nodes where there is a wider development of issues than in the general node. However, often the rank structure is used to put in order the information contained in the hypertext, without the relationships between generic specific fragments of information being specially significant.

On the other hand, structures on the web always link nodes which have a meaning relation, be they complementary, contrasting, refuting, widening...

Finally, sequential structures link a node to the preceding one in a sequence that can be based on the development of a plot or can be the listing of different elements of the same kind. Rank organisation of links offers a good orientation to users, because ranking is an elementary organisation way used in different fields and is easy to recognise. However, navigation based exclusively on rank links gives very little flexibility and, therefore, it is highly recommended that we give alternatives to the rank route, overlapping the rank structure, and on the same set of nodes, other structures such as a sequential one or a semantic web.

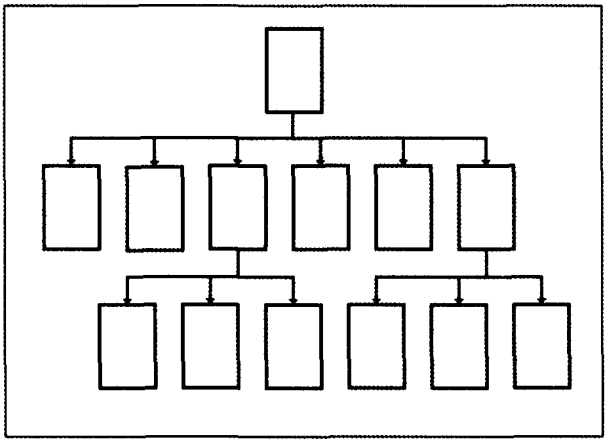

Figure 1. Basic rank structure of a two-rank-level hypertext. The first has six nodes and the second only developed in two branches with three nodes each.

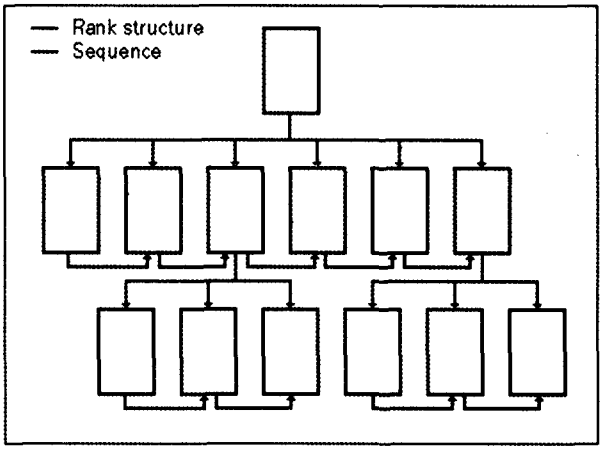

Figure 2. Basic rank structure with an overlapping sequential structure.

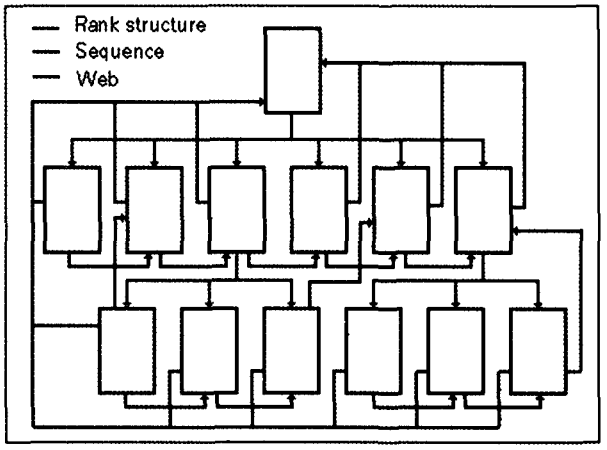

Figure 3. Basic rank structure with a sequential structure and another on web overlapping.

Tools to aid navigation

A tool to aid navigation is any mechanism which makes it easy for users to make decisions when activating the links in a hypertext to advance in navigation. There are many kinds, from the simplest, such as the return button, to complex deployable menus which show the contents of the whole hyperdocument. The main ones are the following ones:

- Return button
- Labelled Links

- Record of nodes visited
- Node marking
- Rank branch
- Summary
- Index

The *return button* allows us to undo the last hypertext visit. On the web, it is supported by the navigator itself and can be found on the upper button bar. Thanks to this option, we can say that all web links are two-way. Besides, if we click repeatedly on this button, we can go back along the whole route. It is a basic tool, as very often there is not enough information to foresee if the node we are going to contains interesting information or not. Thus, we can activate the hypertext jump, visit the node it refers to and, if the contents do not interest us, click the return button.

Going back and forth can be avoided by *labelling links*, a tool to aid navigation which allows increasing information on the destination node offered by the original node. The labelled links contain an explanatory phrase which is activated when the cursor is put on the underlined word or the graphic icon of the link. Its function is to inform readers to avoid going into pages with no interest to them.

The *record of nodes visited* is a navigation tool also supported by the navigator which makes up the list, in chronological order, of all nodes visited by users. Each item on the list is a link which allows us to go back to visited pages.

Another option on navigators in general use is node *marking*, which allows us to store the address of an active node to access it directly in the future. It is a basic tool on the web, as Internet has an enormous number of hyperdocuments which are difficult to control without effective upkeep of an address book or bookmark.

Some latest-generation web pages have a rank *branch*. This tool is a representation of the node routes we would have to follow to arrive at a specific page if we followed the rank structure of the hyperdocument. Each node is represented by its title as an active word, and in this way there are two benefits offered: information on the rank branch where the page is to be found and a direct jump to any page on a higher level. Yahoo searcher-index incorporates this simple and effective tool which makes navigation along the rank link structure easier (fig. 4).

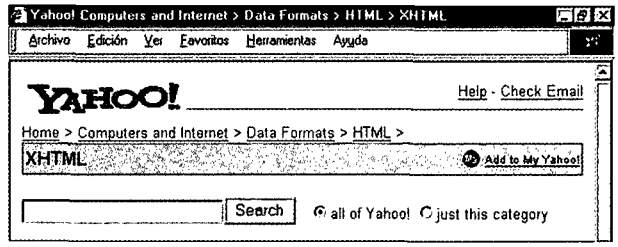

Figure 4. Example of a rank branch <http://www.yahoo.com>.

Finally, the summaries and indexes have the same use in the digital world as in paper documents. They make access easier to document (or hyperdocument) information beginning from a global contents representation. A summary or table of contents is a list of the main units of the hyperdocument ordered according to their disposal in the document. An index is the list of the concepts, peoples' names, geographic names... discussed in the hyperdocument and in alphabetical order.

Navigation bars, menus (deployable or not), sequences of internal links, navigation maps... are different kinds of summaries present in hypertexts in general and on the web specifically.

For example, it is very common for a first page on a web site to contain a menu of main units. Sometimes, there are fixed-format menus on a colour band to the left of the page. As there is no pre-established route, the rank structure of the menu offers reference paths needed to decide the aim of navigation and to orient users in case of sporadic breaks in the chosen route.

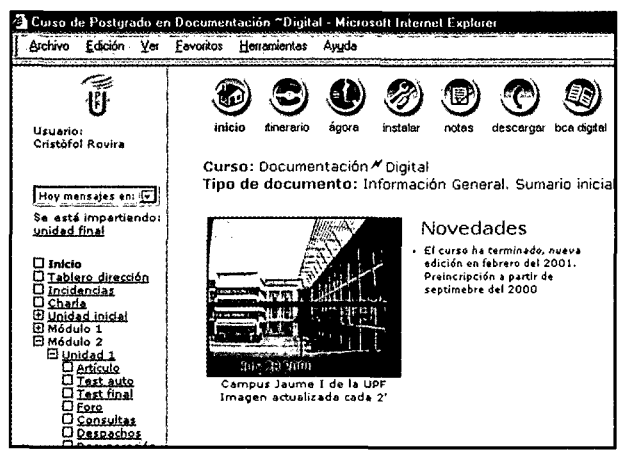

Figure 5. On the left, example of a deployable menu which shows complete contents of a web site. At the top of the page, a summary in graphic icon bar shape. Digital classroom for the Postdegree Course in Digital Documentation <http://docdigital.upf.es>.

Normally, web page menus only show rank levels. It is difficult to find web sites with an overall content representation by means of completely developed menus or navigation maps showing all pages and their links graphically (fig. 5).

Another kind of summary is the "fish-eye map". In this map we can see a web of nodes surrounding the active node. The nodes conceptually closer are represented in more detail than the ones further away.

The indexes in the hypertext are functionally identical to indexes on paper documents, although they incorporate some advantages derived from the automatic processing offered by the computer (fig. 6). The most obvious is that items on the list are hypertext links allowing direct access to the area of the hyperdocument where the concept is discussed. But it is also possible to order the list by different criteria (alphabet, chronology, themes...) on user demand or that the author can generate an index automatically according to frequency of words in the hyperdocument.

For the aims of this paper, it is very interesting to classify the tools to aid navigation as a representation of knowledge they implicitly contain (table 1). For example, a return button, a labelled link or the record of nodes visited are not, in any case, a representation of knowledge. However, a summary, an index and a rank branch are text or graphic representations of knowledge contained in the hyperdocument and which carry out their orienting function thanks to this representation. The summary and the index are fixed global representations and the rank branch is a partial representation which depends on the active node.

Table 1. Classification of tools to aid navigation as a representation of knowledge and navigator support

Tool to aid navigation	Representation of knowledge	Supported by navigator
Sumary	Yes	No
Rank branch	Yes	No
Index	Yes	No
Return button	No	Yes
Labelled links	No	No
Record of nodes visited	No	Yes
Node marking	No	Yes

Representation of knowledge for aid to navigation

Tools to aid navigation based on representation of knowledge carry out their orienting function by showing the concepts discussed in a hyperdocument and their relationships, and also offer information access instruments and context indicators.

For example, a deployable menu shows the rank relationships among the concepts discussed in the dif ferent nodes; the menu item s are hypertext links for access to each node represented (access instrument), and the active node shows up marked in bold face to let users know where they are (indication of context) (fig. 5). In an index, relations between concepts are like cross-references with indications such as «see also» or «see».

Graphic navigation maps are instruments in which representation of knowledge leads us to the ultimate consequence by showing rank, sequential, or semantic relations among the nodes of a hypertext by means of lines (fig. 7).

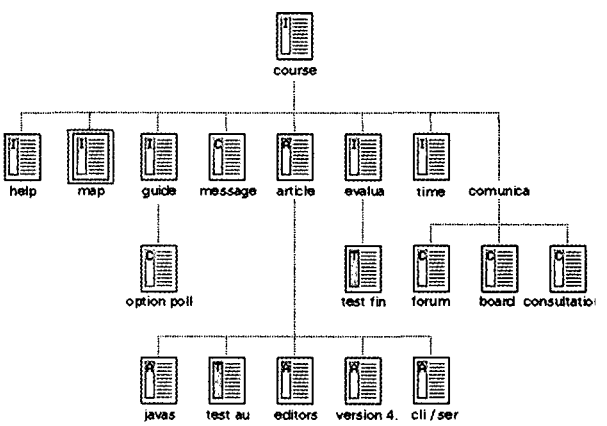

Figure 7. Example of a navigation map. The nodes are represented in different colours showing the type of information they contain. The links are represented by lines of dots and an active node is marked with a red square. Digital classroom of Postdegree Course in Digital Documentation <http://docdigital.upf.es>.

However, it is important to distinguish between two complementary aspects of the items in a navigation map in a hypertext. On the one hand, each item is a concept which has a relation to other map or summary concepts, but on the other, it is the information node where this concept is developed.

From the theoretic perspective of the hypertext narrative, these two aspects are fused, so that each

fragment of information develops a single concept and the available links implement semantic relations of this concept to the rest of the hyperdocument. In this case, carrying out a navigation maps consists of «photographing» this set of nodes and its hypertext links, a photograph which will coincide with a representation of knowledge of the hyperdocument to semantic concepts and relations.

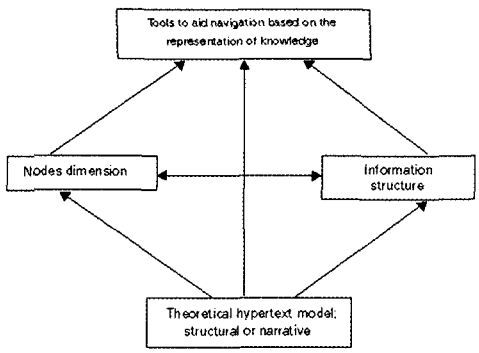

Figure 8. Factors which condition the design of tools to aid navigation.

The hypertexts constructed from the theoretical perspective of the hypertext as a structure (as in the Internet web), contain navigation maps designed along the same principles as «node photography» used in narrative hypertext. However, nodes of this kind are often very long and, therefore, a map item represents a fragment of information which contains a great many concepts. The result is a kind of map with very generic relations which do not go any deeper into the representation of knowledge.

A possible solution for this situation is to construct a new kind of navigation map in which maximum priority is given to representation of knowledge showing the concepts discussed and their semantic relations independently of the nodes where this develops and the hypertext links available. Our proposal is to widen the classic concept map with the concepts discussed in the extended nodes and their semantic relations.

The lack of exact coincidence between the concept representation and the representation of information structure will not imply a problem if we take the following steps:

- Design the access instruments to information, associating a link to each map item which allows access not only to the node but also to the paragraph where the concept referred to is developed.
- Design the map graphically with two types of relations, those which represent a semantic link between two concepts of the same node between which there is no hypertext link, and those representing a semantic link between concepts of two nodes where there is also a hypertext link.
- Do not represent concept relations between two nodes that do not correspond to a hypertext link.[7]
- Show explicitly that a group of concepts is developed in a specific node.

These types of maps are specially indicated for teaching-learning hypertexts where two types of apparently contradictory needs are to be integrated.

On one hand, the didactic contents are organised in relation to their logical structure[8], but on the other there is a very common practice of organising learning contents in linear sequences, according to psychological criteria. For example, they often begin from the simpler contents and advance to the more complex; at other times they begin with the more general concepts and go to the more specific.

A hypertext with extensive nodes and a navigation map which also represents concept relations of the nodes' interior would allow showing both the learning sequences and the structure of logical relations of the didactic contents. In this context, the representation of knowledge is used to make navigation easier and also to promote understanding and learning.

Conclusions

Cognitive excess in hypertext users is a problem of hypertextual navigation which can be solved by efficient tools to aid navigation based on the representation of knowledge such as summaries, indexes or navigation maps.

Tools to aid navigation designed and used on the Internet web do not widen the representation of knowledge, because many concepts developed on long pages are not part of the maps or summaries. We need to widen the navigation maps so that they also contain

[7] If an interesting relation between two unlinked nodes is detected, it would be necessary to generate this link before including it in the navigation map.

[8] Above all at universitary level.

these hidden concepts in such a way that the representation of knowledge and representation of information structure are two layers of the same map but without fusing.

These wider maps are especially indicated in contexts in which it is necessary to promote access to information and its understanding, as in teaching learning fields, where learning sequences combine with logical structuring of the discipline to be taught.

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