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Navigation design in informative hypertexts

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Abstract

Discussion of the elements and components of a navigation system in hypertext. Sets out the logical bases of links and hypertext navigation, presents an argument for the basic architecture of a hypertext information system, and advocates a model designed for hypertexts for information purposes.

Key words

Hypertexts, navigation, links, summaries, indices, information architecture.

Introduction

Publishing in the digital era and, more specifically, publishing on the Web implies, among other things, the design and construction of hypertexts. This work introduces a proposal for a system of hypertext navigation which attempts to facilitate access to information while avoiding the sense of loss (or in more technical terms, 'cognitive overload') which is so common in (some) interactive digital productions.

Since Nelson (1981) there has been great consensus, both among theorists and designers that the most common element of hypertexts is the fact that they consist of digital documents which allow non-linear access to the information contained within them. It is only when one steps beyond this affirmation that differences begin to appear, both in theoretical discussion and in the praxis of design.

The aim is not therefore to formulate a proposal with universal ambitions. On the contrary, it is believed that the navigation system presented in this work can only be useful in the following context:

- It should address online digital publications, i.e. those which are accessible and navigable on the Web.
- These publications should therefore be created with overtly informative aims (non-overt aims such as

persuasion, motivation or even confusion and lying are not entered into here).

It is clear that the territory which falls within the limits of these conditioning factors is vast, but the territory which is left outside is even greater, namely, digital productions for non-informative ends, e.g. narrative, advertising, poetry, mobilisers, etc. Digital publications designed for optical formats such as CD-ROM or DVD, are also deliberately left out, although it is clear that many of the factors which are discussed here could equally be applied to them.

What do we understand, therefore, by a digital publication, or by on-line hypertext for information purposes? This category includes examples such as on-line magazines e.g. feed <www.feed.com> or newsweek <www.newsweek.com>, museum web sites e.g. ArtMuseum <www.artmuseum.net>, projects such as the Centro Virtual Cervantes <www.cvc.org> which is discussed again later on in this paper, and the telematic and virtual community diploma Documentación Digital <docdigital.upf.es> of which the author is co-director.

What all these different kinds of production have in common are, in the author's opinion, the following:

- They make a large quantity of information available to the public, that is, the internaut.
- This information may be highly heterogeneous, thematically and morphologically.
- They offer various forms of accessing the information.
- The fundamental proposal, as has already been mentioned, is to transfer information or some kind of knowledge.

The enigma of hypertexts

Until the nineties, most of the writing about hypertexts maintained, either implicitly or explicitly, that they were characterised by enabling non-sequential access to information. For at least two decades, during the eighties and nineties, a characteristic of hypertext productions was that they did not give the reader any additional help to access the information, such as summaries or indices, but only a network of links motivated from cause/effect relationships to those of similarity or definiens/definiendum.

It is not surprising that the expression «cognitive overload» soon arose in reference to one of the sensations experienced by readers of the these productions, nor that experimental results clumsily showed that non-linear digital documents, formed by one or several networks of linked text blocks, turned out to be less efficient in the transfer of information and knowledge than the analogical documents formed by predominantly sequential standard reading texts (Mcknight, C.; Dillon, A.; Richardson, J. 1993).
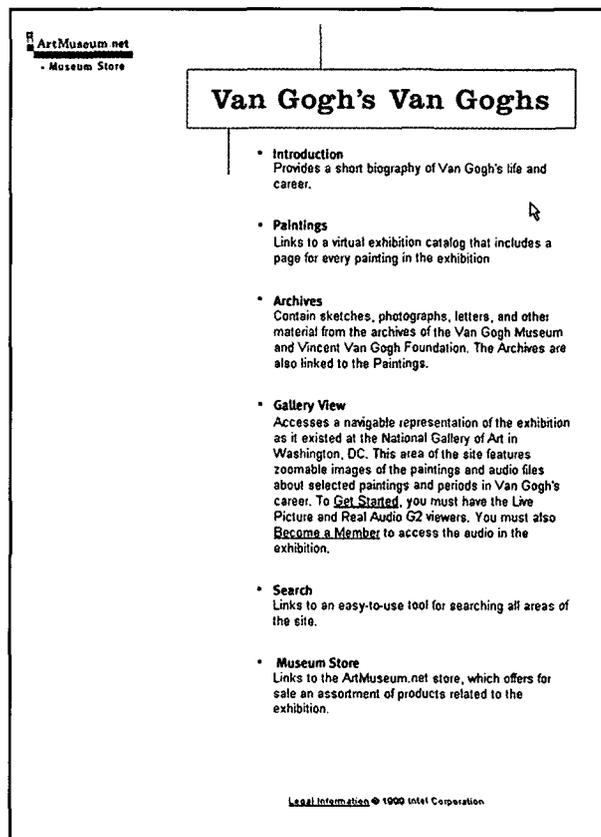

Figure 1. Van Gogh exhibition at ArtMuseum <www.artmuseum.net> has been organised as hypertext with a hierarchical structure. The global summary contains the six main sections of hypertext. Note the Search section, dedicated to information access for information retrieval.

An important enigma appeared to be present here: if hypertext was a more advanced form of information publication with greater possibilities, why did it offer poorer results than analogical documents?

The reason for this poor performance seemed to lie in the way that the hypertexts of the time were designed, that is, pre-Web. At that time (the eighties and the begin-

ning of the nineties), the hypertext nodes tended to be fine-grained, that is, they were not far-reaching. They tended to support the construction of nodes containing a single concept and in practice, this meant the existence of nodes with one or two paragraphs. In addition, everything linked up with everything else, in other words, there was no establishment of priorities or strict hierarchical organisation of the links. Lastly, it was rare to find the use of any kind of link other than semantic ones. All in all, the result was disorientating to say the least.

Current recommendations tend to take the opposite view, or at least in the context of this work, i.e. the design of informative hypertexts, although there are those who would disagree (see the work of Arcadio Rojo –in Rojo, 1998– and in this paper).

A summary of what we might consider to be the current issues on this subject (Codina, 1998 and 2000; Neilsen, 2000; Rovira, 1999a and 1999b) follows thus:

- Nodes should be neither too big nor too small, but adequate for the hypertext proposal, content and public.
- Links should be rigorously prioritised and organised hierarchically. Everything should not link up with everything else. On the contrary, some measures to improve efficiency in the design of hypertexts conclude that the best-designed nodes are those with the fewest outward paths, although this is also relative depending on the specific function of each node.
- In addition to semantic links superimposed links should exist, i.e. links between meta-information and information, or between summary and content.

Therefore, our thesis is the following: hypertexts are a more advanced form of publication as long as they incorporate sequential forms of access and instruments for representing the information in addition to non-sequential paths. If hypertexts are not capable of subsuming the functions of text (this time without the 'hyper'), then they do not constitute a superior form of information dissemination, but simply a different one.

We maintain that, at least for informative ends, no hypertext can be truly efficient in its aim if it does not present the following characteristics:

- Facilitate non-sequential access to information.
- Superstructural representation of the information.
- Facilitate sequential access to information.

These three elements are generated in hypertext by means of links. Navigation is the result of their being activated by the action of a reader subject.

Moreover, the majority of hypertexts, except those containing trivial information, benefit from access to information through the retrieval of information, but this is, with apologies to Kipling, another story.

In the following sections, we propose the basis for the logic of links and we set out the components of a proposal for information architecture which allows for a complete system of hypertext navigation.
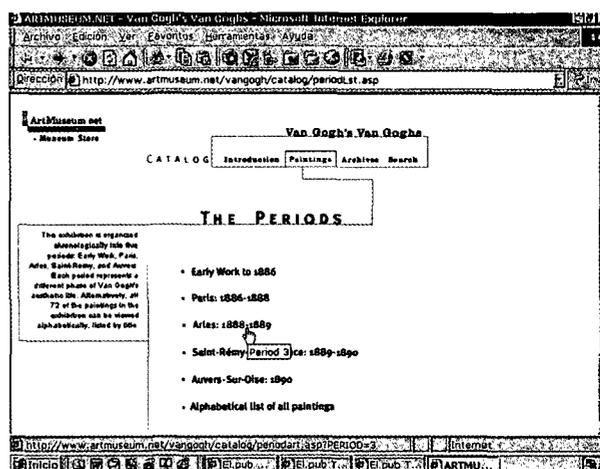

Figure. 2. A local summary in hypertext about Van Gogh. Notice the indication of context by means of a line joining the local summary with the item on which it depends hierarchically. We know where we are, where we can go and where we have come from.

The logic of links

Links are used to interconnect elements, sections or, more technically, nodes which form part of hypertext.[1] Elsewhere (Codina, 2000), we have presented the basis for the logic of hypertext links, and this forms the argument to be expounded here.

In our opinion, it is possible to identify a typology of links based on six criteria. This typology, if it is correct, will be fundamental for the designer of digital productions, as it provides a decision-making tool for establishing the navigational logic of the product.

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[1] In the theory of hypertext, nodes are referred to as those points which, when joined together, form the network or graph that constitutes hypertext. The concept of the node is independent of an any physical definition: nodes may be paragraphs in a document, illustrations, chapters or entire documents.

In any event, the six criteria we have identified for a typology of hypertext links are the following:

- The type of path which they provide.
- The logical principle to which they conform.
- The number of participating nodes or elements.
- The type of navigation that they create.
- The authorship.
- The mode of commutation between nodes which they give rise to.

The implication of the first criterion for the design of hypertext is simple, but at times forgotten: in order to warrant the name, hypertext must contain non-sequential links, but also, where the nature of the knowledge or information which is to be transferred so requires, sequential links.

The second criterion indicates that links may conform to one of two great logical principles: either the principle of generation of cohesion and structural recreation of the document (for which we propose the term structural links); or the principle of association and generation of sense (for which we propose the term semantic links). Structural links should not be confused with sequential links; one link may be structural but non-sequential.

What this means is that the designer of a hypertext publication ought to consider the need not only to establish structural links, whose job is to realise the structure of the hypertext, but also semantic links, that is, links which do not correspond to the logic of structural cohesion, but to a much more open kind of logic. In fact, the semantics associated with nodes in this kind of link may be as arbitrary as the author of the hypertext wishes them.

The third criterion reminds us of the logical possibility of there being 1:N or N:1 type nodes, i.e. from one to many nodes and from many modes to a single one, and not just 1:1 type nodes, as tends to be the case in hypertext documents coded in HTML.

For a long time, the 1:N type and N:1 type links have suffered severe difficulties in the context of the WWW. In particular, there are still no coding tools available for HMTL although it is hoped that they will be incorporated in future developments of XML and XHTML.

The HTML language does not provide any direct procedure for the realisation or resolution of the reverse link, i.e. for type N:1 links, enabling movement from a specific node to the n nodes which are linked to it.
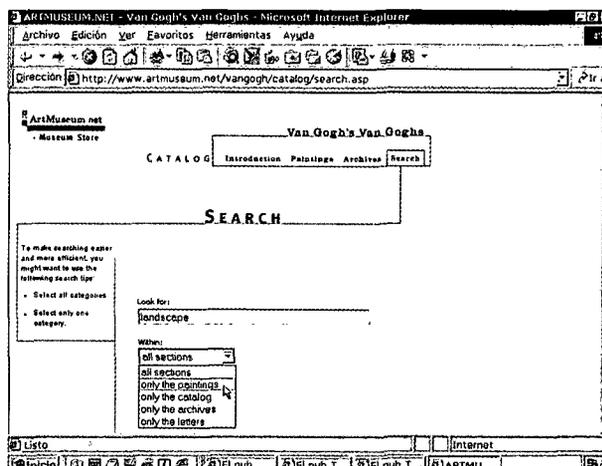

Figure 3. The search page allows access to information by criteria which are different and complementary to the navigation.

Fourthly, well-designed hypertext should contain two major types of navigation: superimposed and implied. Both of these forms of navigation are based, in turn, on their obligatory counterparts –superimposed links and implied links.

Implied navigation is carried out using links which are embedded or implied in the nodes themselves. Superimposed navigation takes place in the movement between one representational element (menu, summary, map, index) and a node, or vice versa.

This type of link is used to relate two quite different elements of hypertext: meta-information and information. A summary is an element of meta-information, whereas a specific node represented in the summary is information. A link between the summary of the hypertext and any of the other nodes representing it is therefore a superimposed link.

We say superimposed link because it is used to join something which, in a spatial metaphor, is above the hypertext, the summary and the index, and may be any part of that hypertext.

Implied links, on the other hand, are those which are found overlapping in the body of the text (or images) in the hypertext. In turn, as we have seen, implied links may be structural where they help to materialise the structure of the hypertext, or semantic, if they make associations between nodes from different sections or different hypertexts on the basis of some kind of similarity, cause/effect, etc.

Another important characteristic of links, highlighted in the fifth criterion, is the person who establishes them, since it is not only the author of the

hypertext who is able to establish links but also the reader.

In the first case they tend to be referred to as pre-defined, and in the second as dynamic, or put more simply, author links and reader links. Author links are considered to be predefined because they are fixed at the moment when the hypertext is created and it is assumed that they are therefore fixed permanently, or at least until the author revises the work.

Finally, with reference to the sixth criterion, a variety of links may be established according to the way in which the nodes are commuted with each other. In some specific cases, the destination node substitutes the initial node (substitution link), while in other cases the destination node may be superimposed in a new window without closing the first (superimposition link). That way, both nodes share the same screen, although each with a separate window, and they may be different in size, with only one of them active as a link.

Superimposition links are especially useful for showing bibliographic references and, in general, for the kind of clarifying texts frequently introduced by authors in the footnotes of conventional books.

The typology that we have examined gives rise to types or classes of node which are not self-exclusive. The best examples are the implied and semantic type nodes. All semantic nodes are implied, although not all implied nodes are semantic. Some structural links and some semantic links are non-sequential. However, any node may be an author node (except the reader nodes, of course), etc.

So, the only way to obtain a checklist when designing a system of links or when evaluating hypertext or planning a navigation system is to consider the links according to the range of possible criteria.

By way of synthesis and in an attempt to systematise the information, the following table sets out the criteria and different types of link which bring together the basic functions for each type. Using our typology, based on the six criteria discussed previously, 13 classes of link emerge. Naturally, this typology is open to discussion. The criteria are presented as questions which the authors, analysts or students of hypertext can ask themselves. The sub-classes indicated in each case are probably not exhaustive for that class, but we have included the largest or most significant ones.

Table 1. The logic of links (synthesis)

Criteria	Classes of links
Path What kind of path do links provide?	01. Sequential links 02. Non-sequential links
Logic What lies behind each link: the logic creation of cohesion or the logic of creation of sense?	03. Structural links 04. Semantic links
Grade How many nodes are present at each extreme of the link?	05. 1:1 Links 06. 1:N Links 07. N:1 Links
Navigation What mode of navigation do they give rise to?	08. Implied Links 09. Superimposed Links
Autorship Who establishes the links?	10. Author Links 11. Reader Links
Commutation How are initial and destination nodes commuted with each other?	12. Substitutio Links 13. Superimposed Links

The logic of navigation

The function of hypertext is to make available more advanced ways of reading digital documents, that is, ways which go beyond simple sequential reading. From this perspective, any kind of non-linear reading is considered to be a way of navigating for information. For the purposes of the ensuing discussion we also base our argument on work carried out elsewhere (Codina, 2000) which is followed up here.

The final objective of hypertexts is to give the reader the opportunity to read by following associative relations between the nodes. To navigate for information is a good metaphor to describe the sensation which is experienced when one scans a determined mass of information in this way, either following some kind of thread or route which has been pre-established by the author of the hypertext, or following random paths, or establishing ad hoc relations along the way.

In any of these procedures, the metaphorical idea of navigation comes to mind as soon as we pass from one section of an electronic document to another (or from one document to another). This activity generates a powerful illusion of physical displacement, as if it were the reader who moved from one point to another, as if the laws of physics had relaxed for a

moment allowing the reader to undertake instantaneous movements between distant points of cyberspace, without involving either inertia or acceleration.
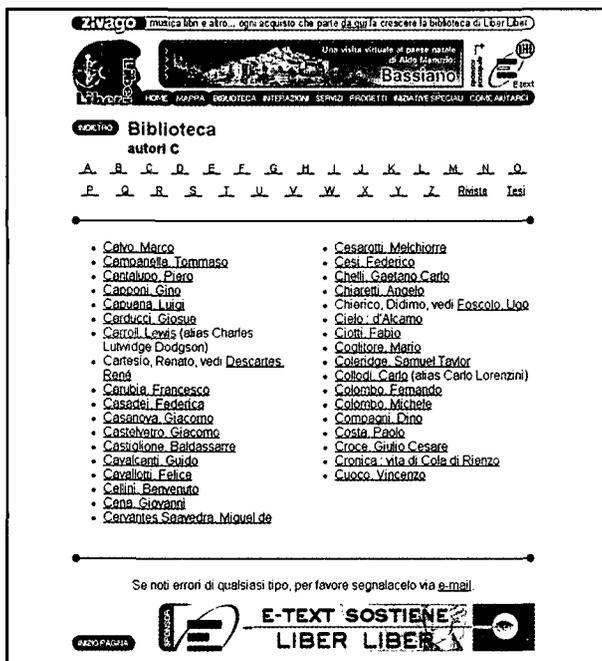

Figure 4. The Italian LiberLiber project <www.liberliber.it> for digital books contains, in addition to a summary (fig. 5), an index of works and an index of authors (in the image).

The point is that on reading the digital document, the need to navigate becomes compulsory for two fundamental reasons. First, because the two dimensional nature of the computer monitor creates a limited space for information. The monitor is comparable, then, to a moveable window which has to focus on the part of the information that we want to read, moving it in every possible direction within the imaginary space. Secondly, when reading digital publications, the three dimensions of the real world are lost, and so therefore are all the physical clues related to the dimensions of the documents, such as volume and weight.

Be that as it may, the hypertext reader expects to find similar tools in an electronic book and their incorporation in a two-dimensional surface, with (almost) instantaneous displacements between an index entry and the following chapter also suggesting the idea of navigation.

The System of Navigation (SN from here on) of hypertext may be seen as an emerging property whose

characteristics depend, in turn, on the nature of the nodes, links and anchors used by each hypertext. In principle, it is useful to point out that the SN of hypertext has a double function: it gives access to the information, as we know, but it also gives contextual orientation.

For the authors, navigation is the materialisation of their conception of hypertext, and even their conception of the world, since the apparent freedom of movement that can be found in many navigation systems is, in fact, limited to the form in which the author conceives the theme or themes of the hypertext.

For the reader, navigation is a decision-making process which involves intuition as much as trial and error. Intuition is involved because the reader has to take decisions without having access to all the information on the pros and cons of activating a particular link at a given time. In fact, there is very little more mysterious than the result of clicking on certain hypertexts.

Figure 5. The summary of LiberLiber.

Unless uncertainty has been deliberately incorporated in the author's design, thus pursuing noninformative ends in the Web page, the best outcome would be for the author of a digital publication to try to pass on as much information as possible as a result of clicking on a link. The aim would be to minimise as far as possible the components of intuition, trial and error that are inherent in navigation.

SN, in turn, has to give a contextual orientation to the reader's situation and to the qualitative characteristics of the document, or hypertext space that is being explored.

In order to satisfy the two preceding functions, and assuming the possibility of sequential paths

which must always be available, the optimum SN of hypertext should include a minimum of three different subsystems, namely, summaries, indices and orientation tools.

Our hypothesis is that, leaving aside systems of visualising information,[2] there are two and only two main types of representation of the content of a digital publication: the summaries and the indices. Or, to put it another way, any representation of information based on the use of signs or texts may be reduced to the abstract model of a summary or an index, without posing a danger to its graphic appearance or implementation technique (statistical menus, graphic menus, HTML, Java, etc.).

Summaries

A summary is a reduced model of the hypertext, in exactly the same way as the map of a territory is a reduced model of the territory it represents, and that is why in certain places the summary as referred to as the map or even the navigation chart. To continue this analogy, in the same way as one can draw up different kinds of maps for the same territory –political, physical, demographic, etc.–, one can draw up different kinds of summaries from hypertext, although in this case the summaries do not necessarily correspond to different kinds of content, but to different kinds of representation: textual, graphic, interactive, etc.

In any event, summaries, as systems representing the content of digital publications have the following characteristics: they are synthetic, analogical and direct.

They are synthetic because they express the content in a synthetic rather than analytical way (this can be better appreciated in comparison with indices). They are analogical because structurally they follow the same form as the publication which they represent. In addition, they are a kind of representation of information which conforms to the following scheme, [section > content]. (Indices, on the other hand have the opposite structure: [content > section], as we shall see further on).

Diverse types of summary exist. The main type consists of a list of the sections or main nodes in the hypertext. Other summaries may conform to other criteria, for example, there may be a summary of illustrations, tables, graphics or case studies containing hypertext.
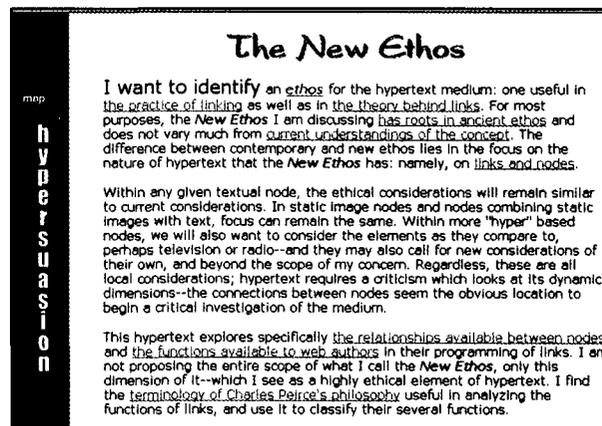

Figure 6. A typical narrative-inspired hypertext: Hypersuasion and the New Ethos, by Jeff White <www.bsu.edu/classes/whyte2/hyper/theory/>. It does not contain a summary, but it has many links embedded in the text, forming a semantic network.

Moreover, particularly complicated sections may have local summaries. Sometimes, in rather fascinating, but somewhat unnecessarily obscure terminology, fisheye view maps are cited instead of local summaries, and birds-eye view maps instead of global summaries.

Nothing prevents a summary from assuming graphic form, including maps or diagrams, while remaining a summary. What is important is that the summary, map or navigation map, whatever one wishes to call it, represents the hierarchical or systematic structure of the hypertext in a synthetic form, which is ideally all-embracing and comprehensible at a glance (or, in any case, with the minimum of cognitive activity).

Summaries may be coarse or fine grained according to the grade or scale of description of the content of the document to which they apply. For the same reason that a territorial map on a scale 1:1 would be useless, a map so fine-grained as to be the same as the contents of the document itself would also be useless. Summaries, therefore, should strike a balance between the need to offer a sufficiently global vision and the need for detailed information.

It is important to realise that a summary is still a summary even though it may use text, graphics or audio, or a list of static sections or dynamic sections which vary according to the choice of the user.

The underlying idea behind a summary is always the same: it is a map of a document and, as such, recre-

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[2] By visualising information we understand the techniques consistent in visual representarion of information which is inherently textual.

ates and imitates the form of the document in some way. In fact, we are all familiar with summaries. The so-called indices of book chapters, as we have attempted to show, were the first summaries produced in the history of social communication. We could, if we so wished, use attractive, fascinating names for their equivalents in the world of digital publishing, such as navigation charts, but if we are true to ourselves, we will see that they are still summaries, exactly the same as the summaries in books.

So, once we have understood what summaries are, and all that they have in common with forms of analogical publication, such as books and magazines on paper, we are in a good position to ask ourselves how we can construct hypertext summaries so that they benefit from the advantages of digital media.

In digital publications it is not essential to use summaries of different grain in the same way it is on paper, but they should be able to exploit the properties of digital media in order to achieve, where appropriate, global summaries (birds-eye view) and detailed summaries (fish-eye view).

In particular, many Internet publications give their front page a very coarse grained summary, but on advancing through the hypertext, global options become hidden and local options are expanded.

Indices

An index is a list of the items contained in a digital publication. These items tend to correspond to the subject areas that are dealt with in the hypertext. In such cases, each theme or concept is expressed using a word or phrase. These words or phrases when ordered alphabetically form the entries of the index.

Indices may represent the themes and concepts that are present in a document, as has been mentioned previously, but they may also take the names of the people, places, organisations, etc., mentioned in the document. Naturally, the availability of different indices e.g. thematic, onomastic, geographical, etc., may be useful, but it may also be useful to bring them all together in a single index, normally referred to as a dictionary index.

The main characteristics of indices are diametrically opposed to those of summaries. In particular, indices are analytical, semantic and inverse.

They are analytical (as opposed to synthetic) because, in contrast to summaries, they may be (and

in fact ought to be) exhaustive. Indices can present different levels of granularity, but a coarse grain index makes little sense. For that reason, an index tends to contain hundreds or thousands of entries.

Indices are semantic rather than analogical because the items in the index do not respond to the structure of the document, but to the subject areas, concepts, ideas, entities, etc., mentioned or dealt with in the document.

So, the fact that a document has 10 sections or chapters is totally irrelevant for the index. The number of themes and concepts dealt with in the document, according to the level of detail of the index, may be greater by the order of one or more, as we have seen. Moreover, while summaries are presented systematically, that is, after chapter 1 follows 1.1, then 1.2 etc., indices are ordered alphabetically. Consequently, the fact that two entries are next to one another in a summary means that they are close together in the content or that they form part of the same local group. The fact that two entries are placed together in the index, however, does not mean that they correspond to adjacent sections.

Finally, indices are inverted type informative structures, because they follow the [concept – section] structure. That is, in an index we start with the concept in order to get to the section in which the concept is contained. In a summary, the reverse path is taken. We have to scan through the various sections or nodes to see which concepts they include, and we therefore start with the section in order to reach the concept.

In the world of on-line digital publications we can go to Bubl <www.bubl.ac.uk> to illustrate the concept of the index on a Web site. In fact, once in the Links section, we can follow the hierarchical structure that represents the Dewey system or, alternatively, activate the Subject menus option, which leads to the alphabetical indices of both in coarse and fine grain respectively.

The summary reproduces the form of the document and, because of its structure [section – concept], where the same concept appears in several sections, the whole summary must be scanned in order to find each occurrence of the concept. Moreover, we can only see those cases in which the concept coincides with the title of a section or chapter.

Conversely, in an index, there is a single entry for each concept, even where this concept occurs several times in various chapters (this is referred to as "unique

term"), that is, a term which has only one entry although it occurs many times), so that one can see at a glance which pages or nodes contain information about a specific theme or concept. This would not be possible without an index.

While in an analogical document, each index entry indicates one or more pages where the concept in question appears; in the case of hypertext, each entry is associated with the group of nodes containing the corresponding concepts.

A summary always maintains an analogy with the structure of the hypertext: if the hypertext has 10 main sections, the summary will have 10 main entries. If the hypertext has a hierarchical structure, the structure of the summary will also be hierarchical, etc.

On the other hand, the index has no limitations a priori, since it only meets the need to present the concepts or items present in the document, but not that of representing its structure. The index may be ordered alphabetically, with simple entries, or with a formula of entries + subentry(ies), responding to a pre-coordinated logic of the order theme – >subtheme- >subsubtheme...

It may respond to the need to represent the concepts (themes) present in the document or in the hypertext, or the need to represent proper names, or place names or all of these, ordered alphabetically or chronologically. Moreover, indices may contain forwarding instructions such as See (to move from different synonyms to the same concept) and See also (to move from one concept to another related concept), etc. The following table brings together the characteristics of both types of information representation.

Table 2. Summaries versus Indices

Summaries	Indices
- Analogical representation	- Semantic representation
- Synthetic	- Analytical
- Typically, tens or hundreds of entries	- Typically, hundreds or thousands of entries
- Direction is from section to concept	- Direction is from concept to section(s)
- To get an overall vision	- To find out which themes are covered where
- No forwarding	- Forwarding «See» (relating synonyms) and «See also»... (relating concepts)

- Systematic: subthemes grouped under a the same theme at a higher level	- Conceptual: concepts listed, typically in alphabetic order
- Brings together sections in the same theme at a higher level with a unifies entry, but impedes localisation of specific information	- Breaks down the separate sections or components in the same global theme, but allows selective recovery with minimum effort

Bringing everything together

Through the previous points an attempt has been made to rationalise the conceptual elements of information architecture which, in our opinion, can resolve the main problems of organising and navigating any kind of hypertext, without visual conditioning, for information purposes. Our proposal is based on the consideration of the logic of links, the logic of navigation and the assumption of two well-distinguished levels of hypertext:

– The infrastructural level, constituted by the network of nodes which forms, in itself, the content of the hypertext.
– The superstructural level, constituted, in turn, by two well-distinguished classes of superstructure: summaries and indices.

Finally, although it does not form part of the navigation system, a system for information retrieval should be added to the two mentioned above. In the following table we attempt a synthesis of our proposal:

Table 3. Elements of a System of Navigation

Summaries	Global
	Local
Indices	Analytical indices
	- general
	- by name
	- by theme
	- by place, etc.
Orientation	Indication of situation:
	- Context: Where am I?, Where I can go?, What are the adjacent?
	- History: Where have I already been?
Links and navigation	Links from:
	- Any node to the global summary of the hypertext
	- Any node to the indices

- Any node to adjacent nodes: immediately before, immediately after, above in the same section, last in the section
- Any node to the local summary, where there is a significant relation: semantic, associative, cause/effect, etc
- Any node to the local summary, where appropiate
- One node to the other node(s) where there is a significant relation: semantic, associative, cause/effect, etc.

Types of path which should facilitate the system of navigation:
- Structural: Between hypertext sections or nodes
- Semantic: between nodes which are associated for some reason
- Sequential
- Non-sequential
- Superimposed: from meta-informations (summaries, indices) to information
- Implied: through links included in the content of the node
- Random

Conclusions

It is probable that, through trial and error, and always supposing the availability of limitless funding and time, of course, one could reach the same conclusions as those presented here.

The only advantage of our proposal, therefore, is that it offers authors of hypertexts conscious paths for design, rather than having to resort to intuitive design or trial and error, since we doubt that anybody has limitless amounts of either money or time.

This proposal is independent not only of the method elected for their visual designs, but also of the methods used to decide when or why a link should be included or what should be linked with what, although it includes elements which help to decide both.

Finally, we have tried to offer the basis of a rationalisation of the intervening elements in the design of hypertexts, which may help to give project teams a common vocabulary and conceptual system, so that when they believe that they are talking about the same thing, they really are talking about the same thing.

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