Graphical Tool to Simplify the Navigation and Web Accessibility

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Abstract

Navigation is the least understood aspect of web accessibility for many web developers, but is the most important for providing users with disabilities equal access to the web. It seems that the ability of users with disabilities to navigate over the web is not dependent on the graphical complexity, but on the markup used to create the structure of the website. Therefore, it's necessary to design some software helpers to help all users to mark themselves in space during a session of navigation. It provides a map of visited sites, thus giving an explicit representation of virtual space. Various levels of visualization are set up to make the map more visible and less overloaded.

1. Introduction

Using the Web has increased in last years. Its presence on the Internet has attracted the attention of researchers. The availability of browsers for multiple computing platforms, many of them distributed for no cost, combined with new avenues for accessing the Internet allows even novice computer users with limited resources to make use of the wide range of services and information available on this global computer network.

To help users orient themselves in a hypertext web, browsers often provide a list of the documents a user has visited, a way to move forward and backward along previously traversed links, and a quick way to return to a home document. These navigation aids are essential in helping users manage the huge store of information available on the web. Hypertext links encourage users to explore related topics and references to other works from within a document. Although the backtracking aids and history list are helpful navigation tools, users often have trouble revisiting a page that was previously viewed in a session. This problem becomes acute after many invocations of the backtracking shortcuts. Users of hypertext systems often find themselves eagerly following hypertext links deeper and deeper into a hypertext web, only to find themselves "lost" in the sense that they are unable find their way back to previously visited pages. This difficulty in revisiting previously viewed pages may discourage users from engaging in such exploratory behavior. It is hoped that the addition of the graphic history view will encourage exploratory behavior and help users navigate the web more easily in general

2. Navigation Process Difficulties

The Web is an open, evolving, heterogeneous and non-moderated space of information. It has problems related to any navigation in a large hypermedia system. Also it contains problems specific to choices and routing through heterogeneous information.

Problems faced while browsing the Web can be characterized as disorientation and cognitive overload [21]. Disorientation [18] is due to the fact of loosing the link between the subject being searched for and the information shown on the screen. Disorientation is caused by the absence of reference points that the users can use as they travel through the Internet. They need to know where they came from, where they are and how to move from one place to another. Three types of problems have been observed:

- The users do not know what to do due the fact that they do not know how a hypertext system works.
- The users are unable to understand the concept of the system.
- The users have lost the navigation link.

The cognitive overload happens with a user who has only a screen to work with. This user has to know the information shown is associated with what. Many decisions have to be taken while going through a hypermedia: which link to follow, how to retrieve the ones that are of interest among the links already visited or to be visited.

The user should be able to find the information being searched while moving from one page to another by following the different links. These tasks of searching for what is needed require accessing the information in smart way. This means that we need to have the capabilities to go from one place to another, identify the document reached, evaluate it, to save it or memorize its address, and related to other documents and information.

It is very common to notice that during the use of hypermedia, the user, after few minutes of search, does not know where he really is with respect to the different notions he went through. We reach a point where we start to move from one page to another or from one site to another without gaining anything new even if some of pages and/or site may contain relevant information. This is not going to improve the knowledge of the learner [17].

Working with the Web may lead the user, from one link to another, to a page that has very little to do with the subject being searched for. The information read, that is not related to a specific cognitive project is forgotten very quickly. Meanwhile we forget other pages that we have consulted earlier which contained information that is of interest to us. We activated a link that we taught it would allow us to get more information about the topic. This action took us further away from the subject because we kept following other links. Before we noticed it, we lost track the pages that interest us. After a half-hour of search, we turn off our computer with the impression that we went through a lot of material without learning any thing new [15], [16].

3. Navigation Help

Navigation help can be of two different ways: The first way is concerned with the construction of web sites. A construction method should be adapted to make it easy for the user to access and search the sites. In [17] for example, the author proposes to limit the depth decomposition of the page to four levels. This means that only three nodes can be active at the same time. In addition, each screen should have about five active links. In order to be clear and efficient links to general ideas of dependant information are favored. This approach of construction will result into hypermedia with a simple structure, which is more efficient. The inconvenience of this method is that the user has to split for example a design of complete course into subsections, which are accessed separately. But we can always links these subsections to each other indirectly.

The second way is to provide a set of computer-aided tools that will allow the client user to navigate the web with ease using his/her preferred browser. The general browsers, Netscape or Internet Explorer propose some functionality such as history, and bookmarks but these kinds of help are insufficient for the user needs. In addition, the users of a hypertext system create different representations.

Many computer-aided systems to help the users to browse the Internet have been proposed in the literature. Among them are Nestor [1], Mawa [20] Broadway [7], FootPrints [25], Hypercase [13], and Letizia [11]. A comparative study of some of these tools is available in [7]. Nestor and Broadway are the closest to our design of computer-aided tools to navigate the Internet.

Nestor browser runs under Windows on PC Computer. Nestor main screen is divided into two windows. In the right window a classical browser based on the component ActiveX Internet Explorer is displayed. A graphical and interactive help window is displayed on the left. A map is drawn automatically as the user browses the Internet. The user can edit this map, and can use it to go directly to a site that he visited before. This navigator is built to achieve the following two main goals: help the trainee to become an active leaner and make the browsing easy because most of the users have little experience with Internet. It is important to help them make full use of their experience [1]. Nestor is a complete and excellent navigator. It is a very good tool to build the navigation map. However, Nestor is plate form dependent, it works only under Window with Internet Explorer. Also it does not keep track of the time factor.

Broadway is an assistant tool for navigation of the web that uses case reasoning to recommend pages for visit according to the behavior of the current user. Broadway can be accessed by a group of users and supports indirect cooperation. The system keeps track of four parameters related the users' navigation. These parameters describe the address, the content, the explicit evaluation and the ratio of display of each web page visited. Thy will be the base to extract useful cases to be used in the future. The evaluation of a sequence of pages gives an indication of the behavior of the user being observed. The index model used allows the modeling of these types of cases. Broadway is extended with a new tool that keeps track of the user behavior in a large number of variables. A detailed and flexible behavior management is possible due to the extensive observation combined with the indexing model [21]. Broadway does not include the navigation time as a user parameter. But it remains a very good tool to model the user behavior during a browsing session.

4. Software Architecture

In order to allow the user to keep track of time and to know where he/she is, we have designed and implemented a computer-aided system for navigation of the web [4]. This system, which is implemented in Delphi, can be used with any browser (Netscape, Internet Explorer or other). The main screen is made up of many windows. Its kernel is made up of two important modules: one is to collect the different URL addresses and the other is to build and interact with the graphical map and the management of navigation time [3] [5]. The user has access to a dictionary containing the frequently used words in Internet that may not be understood. Also help for the system can display in a separate window. This tool is designed to satisfy guidelines of accessibility of the W3C recommendation for disabled authors and learners especially with mobility impairments.

In order to guarantee that our system is independent of the browser, the way we recuperate the addresses of the sites/pages visited is using a proxy server. This proxy server seats in between web clients and information servers using different protocols (see Figure 1). It is used to pass the information from one end to the other. The client sends each user's request to the proxy server, which will respond directly if it has the information in its cache, or it will pass the request to the destination server. The proxy server keeps a copy of each document it sends in its cache. This copy is kept for variable amount of time. This way if a document is requested and is available in the cache of the proxy there is no need to get it from the destination server. The management of the cache is done based on the following parameters: date of the last time when the document was updated, maximum time that a document can spend in the cache and for how long has the document been in the cache without being used. This service, which is transparent to the user, makes the responses to the user requests more efficient. It also reduces the traffic on the network.

The proxy server receives the requests from the browser, rearrange them if needed and sent them to the module that is responsible to build the map. This server is installed locally on the user's machine to serve as a link for HTTP requests. The browser has to be configured to use this proxy server. Each HTTP request will be intercepted and sent by the proxy after extracting the necessary information (address requested, elapsed time since the last time this address was requested) and saves it. This data is stored in a file that will be used by the module responsible for building the map later on.

5. Graphical Map for Navigation

The development of a graphical map and its use as a computer-aided tool for web browsing is based on the studies of cognitive processes that happen during the navigation of distributed hypermedia. It is a graphical representation at the same time of conceptual and geographical search path followed by a user while searching for a particular topic. The Navigation map that we designed is based on the idea used in conceptual maps [7].

A conceptual map is a new way of representing the relationship between a set of knowledge and the nature of this relationship. It is a graphical representation of links among different concepts about the same topic. It should evolve with the knowledge of the trainee.

The conceptual map is also a computer-aided tool for navigation. It allows a hypertext reader to see on the screen the titles of information units and the links that connect them in a form of a network. It is drawn with a goal in mind, within well-defined references, and according to a graphical representation suitable for browsing problem.

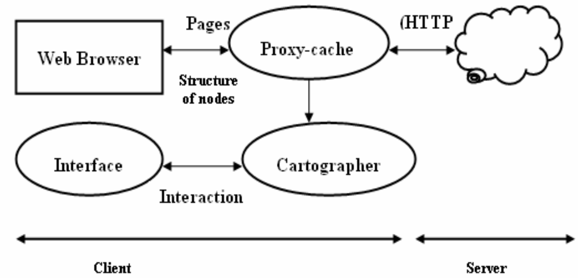

Figure 1: Software Architecture

5.1 Graphical Representations

Browsing the Web implies the manipulation of huge amount of information. The major role of the graphical interface of system developed for this purpose is to make this information easy to comprehend by the users. This is based mainly on the graphical representation of the different pieces of information and the relations connecting these pieces together. The graphical interface between the users and the system is a way to construct the image of the system. A review of the literature indicates the existence of many graphical representations. So it is necessary to study and classify these different representations.

The taxonomy developed in [23] is based on the notion of the user's actions. The classification proposed emphasizes the nature of actions (direct or indirect selections), their levels (single, group, and attributes and objects integrity) and their effect on the graph, on the representation and the transformation or organization of the objects selected.

The study proposed by [9] classifies representation techniques in five categories: geometric, network based, hierarchy, pixel oriented, and iconic. This approach has the disadvantage of mixing construction and graphical tools used as classification criteria, which makes it very difficult to characterize some systems.

The approach described in [19] is based on the type of data represented and the low level task performed by the user on this data. The author then listed different graphical representations used for each type of data. He also identifies seven task types that the graphical representation should favor. The high level tasks that are independent of the data being manipulated are: general view of the information, zooming, filtering, getting the details, link representation together, having a history of actions performed, and extracting part of the information so that it can be used by other applications. Three of these points (general view of the information, zooming, and getting the details) are considered during the conception of the representation.

In [2], the authors propose to characterize the graphical representation based on a chosen point of view about the data but not on the type of data. A point of view is defined by deciding what is necessary out of the data that should be given to the users based on his needs to perform his task in a satisfactory manner. If we are unable to characterize in a precise way the object's activities then the graphical representation should be flexible enough to detect one or many points of view that are suitable to accomplish the task. For a set of data we might have more than one point of view depending on how the data is considered. These points of views might complement each other for the purpose of the user's activities. So it necessary to be able to represent simultaneously many views which means we should choose a graphical representation guided by multiple points of view. This corresponds to multiple views discussed in [12] and [24]. This multiplicity should be taken as a factor during the design of an interface that can adapt itself to different tasks.

5.2 Choice of Graphical Representation

The navigation map gives the possibility to keep track of path followed by the user while browsing the web. The map is modeled by a directed graph. Each page address (URL), the topic or title of the page, and the time spent connected to this page are kept in the nodes. The map is displayed upon request of the user at any stage of the browsing.

A directed graph representation of the map is most suitable for its visualization. Each node contains the name and the information of the page visited. The information kept should be in such way that it does not affect the clarity of the graph. The nodes are connected to each other to indicate the fact that the user has moved from a specific page to another. The nodes should be displayed on the screen in a way that all are visible and with minimum edges intersection.

To choose the best representation of the map, we looked into different techniques (available in the literature) to display graphs. Also we kept in mind the specific properties of our graph and the different operation that are performed on it. We found that the tree representation is the most suitable for our case. In this approach, all the nodes are drawn. The information represented in the graph is very easy to read. The user can modify this representation as it is explained later. The system allows the user to display different information as a part of the tree. The user can selectively display document titles, URLs, or a thumbnail image for each node. When the mouse is placed over a node in the tree, the title and URL of the document appears near the mouse. A user can recall a document in the tree by double-clicking on a node in the tool window.

5.3 Manipulation of the map

In addition to the automatic graphical map generation representing the visited pages, the system allows the drawing of the map from a list of identifiers of pre-selected pages. Also the user can follow the map evolution by creation, deletion of any link or reorganization of the graph, or do only a read of the map for a simple task. All actions that are performed and amount time spent on each page are saved and used for evaluation. This information can be shared among a group of users.

The user has also the possibility to save, print or reopen the map constructed during a navigation session. He has also access to the log report during a session that will allow him to do a self-evaluation and to be able to follow his progress during a training period or a search for information. It is also possible to have report indicating the daily interactions and the time spent connected to each site (see Figure 2 and Figure 3). The graphical map can be used to share information within a group of learners in a cooperative learning environment [1] [7]. Each user can benefit from the experience of the other members of the group [22].

6. Experiments

These tools presented here were in response to certain browsing problems. There are a number of computer-aided tools that give the possibility to the learners to experiment. We concentrated on the problem of disorientation and putting some reference points. During the experiment, the use of usual browsers, such as Internet Explorer or Firefox, by novice users while solving a pedagogic task, is observed.

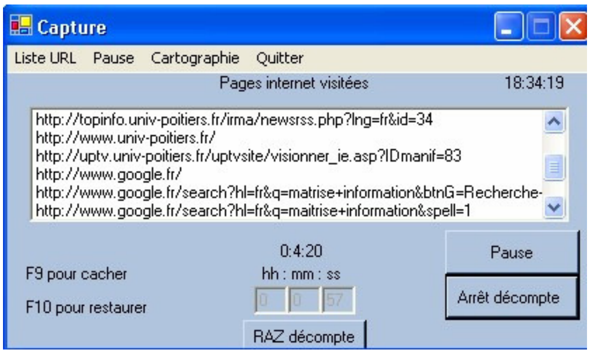

Figure 2: Display of URL List

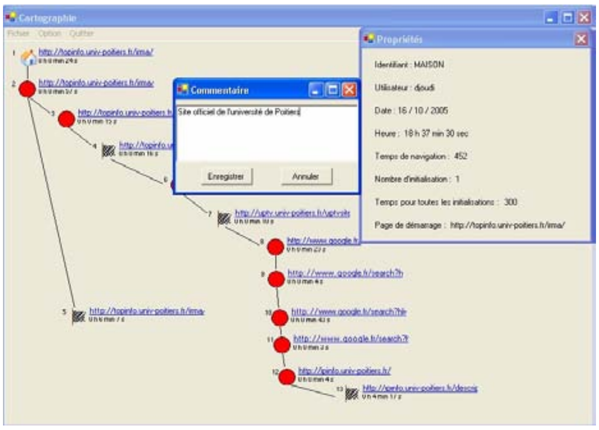

Figure 3: Display of the Map and Time Spent

We have tested the set of tools developed in a real practical sessions in cooperation with a teacher and his students [9]. This testing was done in a course about the new information and communication technologies in general and about the web in particular. There were about 100 second year university students, aged from 19 to 22 years. Their major is earth science and all had some experience with some browser. They used the Internet to search for information before. This is a limited experience because we have only the strict minimum needed equipment. Also the connection equipment is not suitable for heavy use.

The experimental environment is made of: free access to the educational server (self-learning mode) as a complement to the course taken in a regular class. A guided access to the course according to a plan, prepared by the teacher, which is made of a set of documents on the educational server and some links to public documents available on the web.

The collection of information about a particular topic from the Internet and the structure of this information into a personnel or group document will be submitted to the teacher using the browsing map.

The proxy architecture made it possible, while using the tools, to display on the screen the browser on one window, the sequence of site and the navigation map on another. This solution helps to reduce the cognitive overload of the users.

For the teacher the graphical map can be considered as a tool to analyze the content of what is being taught, to have a better structure of the programs and manuals, and to build a plan of the course. The preparation of a guided tour with comments helps to get the new learner to start. These guided tours allow a simple browsing without limiting the freedom of exploring. They include some public documents available over the Internet and some local documents prepared for pedagogical purpose.

7. Conclusion

Tools developed help to solve many navigation and web accessibility problems according to the objectives stated earlier. For example, we think that the system makes it easier for people with disabilities to view and navigate web content. We plan to allow the user to add comments about each site or page visited. This is a simple way to personalize its path. [1].

Another goal is to evaluate the system in a web accessibility environment. This will allow us to measure the success of our tool in simplifying the browsing procedures for people with disabilities.

We are currently working on improving our navigation help tool and developing other tools that are helpful to learners using the web within a platform for distance education [10].

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