THE USE OF A CONVERSATIONAL STRUCTURE TO IMPROVE THE PREVIOUS BUTTON ON A WEB BROWSER

by

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1.0 Introduction

The World Wide Web is expanding rapidly and everyday it is being used by people with all types of background and technical expertise. As a result we must design World Wide Web browsers for a very varied audience and one where the majority will soon be non-technical users. This situation demands from Web browsers more robustness, flexibility and facilities that can help users to increase productivity during a browsing session. This presents a challenge for designers when picking metaphors and interface designs. One area where I believe the metaphor or model is not the appropriate is the Back button available in Web browsers. This button works at a very low level a provides little help in navigating the World Wide Web with efficiency.

The excessive use of the Back button is one of the situations that we believe is causing lower levels of productivity to users when they are navigating the Internet. The need to use the Back button in that way represents the lack of effective ways to return to points of interest already visited a specific time ago that can be useful for the user.

In this study I will concentrate on the problems related to the use of the Back button and how Internet Browsers can be modified to improve navigation in the World Wide Web. I propose that the relationships between different pages in the World Wide Web are similar to the structural relationships between Initiative-Response pairs in conversations.

I will study the relationships existing between pages in order to identify new functionality for Back-like buttons such as going back one page, one topic, or one site, or any other possibility that can appear during the research. I am going to study these tools with experimentation in order to determine if they have an effect on navigation.

This document is organized as follows. The first section is a review of the literature available on navigation through the last few years. The next section contains a detailed description of the problem that is under study in this Thesis. It also includes a description of the proposed solution and a general description of what I am planning to do through the development of this study.
2.0 Literature Review

2.1 The Issue of Navigation

In March of 1997, as part of the CHI 97 / ACM Conference, a workshop named Workshop on Navigation on Electronic Worlds took place to discuss Navigation problems. In that activity a great part of all the work done during the last two or three years in all the world related to Navigation in the World Wide Web was discussed. As stated on the workshop report the general definition of Navigation is *Moving oneself sequentially around an environment, deciding, at each step where to go on next based on the task and the parts of the environment seen so far.* [Jul97]

Based on this definition we can deduct about the need to take into account some important aspects of Navigation when we are going to design tools for Web browsers. The part that says, *Moving oneself sequentially around an environment,* represents a need for tools that facilitates that movement in a form that results adequate and easy for users. But by adding the expression, *deciding,* there are a lot of other implications that make the development of Web browsers a complex task. One of the aspects that is so important and problematic is the structural mapping that users creates when they are navigating. This mapping is generally inadequate. This is caused in part because of the representations provided by Web browsers and the way they works. Another aspect that is problematic too is the lack of effective tools to navigate. In the Internet browsers available today the users depends primarily on three interface buttons to navigate all the World Wide Web that represents essentially a one step moving operation. The most used one is the Back button. But users normally moves back to some specific points that are more than one step back away. This represents issues of unnecessary steps in navigating and unnecessary visits to pages that are not of interest to the user.

2.2 Articles reviewed

2.2.1 Spatial Knowledge and Navigation in Real and Virtual Environments

In the position paper presented by Stephen Hirtle at the Workshop on Navigation on Electronic Worlds, he recognized that Navigation in electronics worlds is problematic because of the variety of navigational strategies available, the varied goals of users and the problems related with the unrestricted topologies of the networks. The lack of identifiable neighborhoods and notable landmarks are part of the problem too. This situation contributes to the fact that users get in lost in the Web.

Hirtle compares the navigation in the Web with navigation in the physical world, focused on the cognitive structures and metaphors adopted by the navigators. Those structures and metaphors refer to the
spatial knowledge based on organizing principles such as hierarchies, reference points, rotational and alignment heuristics and others. He talks about a Theory of spatial information that must include:

- Theory of cognitive representation of space
- Theory of the use of spatial metaphors in the interface
- Theory of the storage of spatial data

In relation to this he suggests to develop different geometry or topologies to represent the differences in how space is encoded and accessed in a cognitive map and to provide aids in helping users structure space that allows them to differentiate neighborhoods. This should lead users to commit fewer errors and to have a greater satisfaction.

This suggestion has its value and is important but the problem is with the geometry or topologies that Hirtle refers to. The World Wide Web is complex in essence and it is not easy to think about a possible topology that provides a good mapping to the space. Another aspect is the how to give users identifications of neighborhoods or to provide something like a landmark. When users navigate on the Internet space there is no way to know the next step in the search, then there is no way to provide reference points or landmarks that give a clear idea of the path to follow.

### 2.2.2 Hierarchical Graph - A Spatial Concept for an Efficient Organization of Spaces and Wayfinding

Adrijana Car, a researcher of the University of Vienna, talks about the importance of structured spaces too. [Car97] She refers to spaces like the Internet as information spaces. Her work is focused specially in the theory of Hierarchical Spatial Reasoning. Her suggestion establishes the use and application of the theory of Hierarchical Spatial Reasoning, with hierarchical graph, in other areas like the organization of information spaces and navigation in electronic worlds and the use of hierarchical wayfinding to improve performance in the processing of this large sets of spatial data. She expresses that the application of HSR in the design of information spaces appears to be an important issue if spatial metaphors are used. As established above these ideas have the problem of the complexity of the World Wide Web.

### 2.2.3 Navigation in Electronic Worlds

The problem referenced above is confirmed by the idea expressed by Mark Apperley, in which he says that the content and topography of the World Wide Web is constantly changing and the space covered is enormous. [Apperley97] In his article he mention that is common to all users of the Internet to ask themselves this questions:

- Where am I?
• Is there any information on X?
• How do I get back to Y?

He establishes the need for good navigation facilities that can increase the utility of the World Wide Web in addition to provoke better efficiency, effectiveness, and user satisfaction. In addition, there are some important issues in the representation of space that he aboard. Two of them are:

• Different users form different models of the same information spaces
• Space is dynamic, then any representation must also be dynamic

He suggests the implementation of a tree browser that seems to have the characteristics of an effective, dynamic interactive visualization tool that provide both a history and a look-ahead facility. Actually he is working in a model that implements these ideas. The tree browser under development integrates a set of representation techniques based on distortion-oriented display mechanisms including bifocal and fisheye techniques, together with a set of interaction techniques largely intuitive. The tree displayed includes details in nodes in which the user had express some interest while the others remains as icons or in some cases are suppressed because of no interest on them by the user. The tree changes and is adjusted while the user is browsing creating the situation of on-the-fly user adaptation.

This work and the ideas implemented are apparently good but again, there are probably problems with the complexity of the World Wide Web, in terms of the implementation of a specific structure like a tree. About the tool that provides a history and a look-ahead facility, it sounds to be impossible to look-ahead through the links in the Internet. There is not any algorithm that can predict the information available $n$ pages in a forward direction, from the links available in the actual page. Another thing is how easy is to manage an interface that has all the details that Apperley is implementing. There is a need for a lot of experimentation before confirming the advantages of this kind of interface.

### 2.2.4 Navigational Facilities for Large, Structured Web Spaces

Keith Andrews, form the Graz University of Technology in Austria, is working on a large-scale, Internet, hypermedia document management system from 1990 (Hyper Wave / Hyper-G). [Andrews97] This work is based on the crucial problem that establishes the need for a variety of different navigational facilities to move in large information spaces.

Andrews says that in spaces like the World Wide Web the information is structured in collections that are similar to hierarchies. Documents and collections can be related to different parent collections. The search process is restricted to the relevant collection and the members of a collection can be sorted by different criteria. In her work the different types of links (standard, annotations, inline and textures) are managed in a separate database allowing searches and the presentation of the relationships between links.
without retrieving any document. This is called a Graphical Links Map. The system has indexed metadata fields that include Authors, Titles and Keywords that allows boolean searches. They have a restriction attribute called Rights that allows the limitation of visibility of irrelevant links. She uses three navigational techniques:

- Hierarchical navigation or “tree walking” through collections
- Searching based on metadata
- Hyperlink navigation

The system includes a Harmony Local Map that is a graphical visualization of relationships between objects and the Harmony Information Landscape that is an interactive, three-dimensional visualization tool that shows the collection structure combining the view of the hierarchical structure with the view of the hyperlink relationships.

She is actually working on the creation of tools in Java to provide the Harmony functionality to standard Web browser and is planning to study the preference of users on the navigation tools included in Harmony.

The ideas of Keith Andrews are useful. They may be applied perfectly to closed systems in which the information space is totally under the control of the people of a company or something similar. But there will be problems with the World Wide Web. The first problem is that it is impossible to have a database of links for the Internet to manage collections and make searches easier. Another problem rises on the fact that the Internet is so dynamic. Then is not simple to maintain a database like this, in terms of the quantity of links that are constantly been added and deleted. In addition she talks about a facility that is similar to the look ahead facility presented in [Apperley97] but it has the problem already reviewed of impossibility to know what is available on the pointed pages in terms of the World Wide Web. On the other hand, there is an important idea that Andrews included in her work. This is the use of the idea of relevance between links in a page with a specific context and the context of the pages they are pointing to. This is an idea that we are already exploring in supporting the solution to be presented in this proposal.

2.2.5 Navigation metaphors and social navigation in information spaces

Another researcher that gives special importance to the idea of a structured World Wide Web is Andreas Dieberger and he expressed the corresponding theory in the article: Navigation metaphors and social navigation in information spaces [Dieberger97]. To Dieberger there are two important problems that need to be attended. In the first one he expressed that we are not using the full potential of the metaphors in navigating. In the other he establishes that the phenomenon of social navigation is not attended. When he talks about social navigation he refers to the phenomenon that is emerging in the Internet, characterized by the free sharing of links to specific sites in form of lists or references or other
forms. Dierberger think that we need to understand the social navigation in order to begin the development of tools that support it better.

About metaphors he defines them as mappings from a source domain to a target domain. Navigation is a mapping from the user’s need and a spatial structure to activities. To work with this mapping he introduces a structured called the city metaphor. The city metaphor is rich in sub-metaphors. It is a collection of concepts that are very useful for structuring and navigation metaphors. The city has some limitations but there are certain structures that are great source domain for metaphors, for example, buildings and rooms as containers, and doors as links that can be open, close or slightly open.

This idea has its merits but as he says there are some limitations involved that probably include the way to implement this, the possibility of the creation of incorrect mappings by the user, the complexity of World Wide Web and others.

2.2.6 Task-centered Navigation in Web-accessible Dataspaces

In this article there are some important problems identified that affects users directly. [Doerry97] They include the following:

- Users has difficult in maintaining orientation
- Users are confused when they are in multi-step processes
- Users are confused in knowing how their current activities relates to an overall goal
- Users are confused in how to return to previous steps in the process

In the article the suggestion proposed is to explore a Task-centered Model of navigation. To support this the justification expressed is that movement on the Web can occur in terms of a conceptual structure of tasks that the user “is doing”. There is desirable to have a dynamic representation of users' current position within the conceptual task/sub-task hierarchy. The problems with this suggestion, as the article establishes are the constraints that cause the Web environment in terms of the interface capabilities.

2.2.7 Adaptive Navigation Support in Educational Hypermedia: a Prospect for WWW

Returning to the idea of relevance already referenced above, the professor Peter Brusilovsky, from the Carnegie Mellon University, suggests a method for navigation on the Web that uses the Adaptive Navigation Support (ANS) approach to provide directional assistance to the user. This work is based on the idea of how relevant is a page pointed by a link to the user’s goal during a search. [Brusilovsky97] The idea is to create an Adaptive Hypermedia System capable of altering the content or appearance of a
hypermedia node or link based on dynamic understanding of concepts by users. He has implemented these ideas in two Web-based educational systems and identify the following techniques to explore:

- Direct guidance >> system can determine which is the most relevant node to go next based on user’s goal and other parameters
  - Problem: too directive; no choices for user
- Sorting (Adaptive ordering) >> ordering links on a page, putting the most relevant ones at the top for easy access
  - Problem: only for non-contextual links; bad for indexes, contents and contextual links
- Hiding >> hide those links irrelevant at the moment restricting the navigation space
  - Problem: “can provoke the formation of incorrect mental models of the hyperspace”
- Adaptive annotation >> adds a kind of comment to a link (text, icon, color, font, size) informing the current state of nodes behind the link (visited/not visited/to visit)
  - Problem: no

Brusilovsky has the suggestion of using Adaptive annotation on a Web browser for better navigation. He says it is applicable to any kind of links, supports stable order of links and do not produce incorrect mental maps. After some experimentation with the implementation of this concept he conclude that annotations on links increased efficiency. The number of navigation steps, repetitions of previously studied concepts and previously visited tasks are significantly reduced the navigation was less difficult. As stated before, some of the supporting ideas for the solution presented in this proposal include the idea of relevance and the use of annotations but in a way that differs partially from the one described by Brusilovsky.

### 2.2.8 Navigation in Electronic Worlds-Do or Die

This article has the particularity of giving us a group of guidelines that can be useful in the process of designing interfaces for Navigation on the World Wide Web. [Czerwinski97] Mary Czerwinski from Microsoft Corporation presented this article.

In the article Czerwinski establishes that attention to navigational issues in electronics worlds must be afforded in the design process. She and her group at Microsoft (the Interactive Media Group of Microsoft) were made research on this area. The research was based on successive usability studies using a combination of low fidelity prototypes, higher fidelity online prototypes and existing online service providers. Some dependent measures were used such as location accuracy, navigation time, accuracy and completeness of users’ memories of their traversal paths, etc.
The results of the researches made revealed that the product design should facilitate navigation by using visually salient landmarks in the form of spatial objects of interest, labels, buttons, headings and icons. From those researches they identify several guidelines that provide an overview of design techniques and elements that can be used to support spatial learning and navigation. Some of them are the following:

1. Simplify the virtual "landscape" for the user so spatial knowledge can be more easily learned.
   1.2. Make all choices within an image map fit in one screen.
   1.4. If a navigation bar contains both links to places and access to tools, make sure the design highlights the difference between these button groups.

2. Make the user aware of where they are at all times.
   2.1. Metaphors can be very helpful in communicating the organization of a space. If you choose to use a metaphor, carry it throughout the navigation design. Otherwise, the lack of consistency will actually impede its effective use.
   2.3. Every time a place is mentioned, it should be called the exact same thing.
   2.5. Make sure that users can recognize changes as they navigate from one area to the next.

3. Make the user aware of where and how to travel in the space.
   3.1. Create a persistent navigation structure to guide users to a home base at both the major, intermediate, and minor levels of your site organization.
   3.2. Never assume that users can just use the Back button to get out of locations on the web. At the same time always assume that some of them will use the Back button instead of the button you have created to get them out.
   3.3. Never assume that all readers will be arriving at a new location from the same place.
   3.4. Avoid navigational dead ends.
3.0 Methodology

3.1 Problem Description

The navigation in the World Wide Web can be seen as a group of tasks that is complex in essence because of its magnitude. Part of this complexity is directly related to the fact that the WWW is constantly growing, probably in an exponential way. But this is not the only reason that causes the WWW complexity. Another one is the problems found continuously by the users with the different browsers available and the way the Internet works today.

There are some problems related to this. One of them is that users cannot avoid repeating an access to some pages that they do not need to access again. For example, if a user is going through different links in order to find some information and decides to go back to a specific point with the purpose of exploring for the information in another way, the only choice available is to use that back button repeating the access to all the pages already visited until the desired one is found. After all this process then the user can go over another path.

In the browsing programs available today the history list of the visited pages is organized in a sequential form in accordance to the order in which they were accessed. This situation causes that the use of the back button is restricted to going back step by step. The user is forced to pass through all the pages already visited and this is inefficient because there is no way of going directly back to the specific desired page.

During a browsing session a user can want to go back to one of three different types of pages already visited causing three different situations. The first one is if the user wants to go to the previous page in which case the existing mechanism of the back button is probably the most appropriate one. The second situation occurs if the user want to return to the first page visited during the browsing session in which case there is the option to use the home button. The third situation is if the user wants to go to some specific page that is between the home page and the last one visited. In this case there is not any tool available that can allow the direct access to the desired specific page except for the use of the back button in a sequential way passing through all the pages between the actual and the desired one. This third case is the one that we are exploring in this research.

In the month of December of 1997 a small study was made in which a group of students (including me) conducted a user testing that evaluates the interface of the Nestcape Navigator Program and some other functionality of the Internet. This work was made as part of the course Usability Engineering in the Computer Engineering Department, at the University of Puerto Rico - Mayagüez Campus. In this study the performance of only eight users were analyzed. However, there are some interesting results that can give us an idea of the magnitude of the problems described above.
The Figure 1 shows the frequency in which users perform an action of each kind. In this we can see that the back button bar has a great percentage of use in comparison to other operations from the total amount of actions performed. Obviously, the amount of links and search operations combined accessed is greater, but it is considerably important the fact that the back operation occurs 59% of the links + search operations. This implies that about one half of the pages accessed in a complete browsing session probably does not have the information needed by the user. In addition, this is a direct cause for repetitions of already viewed pages. These results reflect only the part of the study that analysed the use of search. They do not reflect other results included on the study. [UserTesting97]

In terms of this repetitions the study reflects that from a total of 198 steps, 42 were direct cause for a repetition. This is a 21% of the total steps. The back button operations reflect a 36% of the total steps. But probably the most meaningful value is that the back steps were apparently causes of repetitions. This means that if we reduce the number of back steps, we can reduce the repetitions of pages and consequently the general performance of the users can be improved. Of course, this can occur if the number of steps needed to achieve a searching task is reduce significantly.

As established before, the above results refer to a small study. However, the belief is that these results are not so far from the true or inclusively are worst than the values obtained. There are researches that confirm these situations and a lot of people that can speak about their own experiences in problematic searches.

### 3.2 Proposed Solution

The proposed solution is to add some annotations to HTML links in order to identify the kind of relationship that exist between the page and the page to which the link points. This kind of annotation is not visible for the user. As part of this it is possible to identify preliminary about three types of
There is possible that more relationships can be found in the future. The relationships already identified are the following:

- **Related** - the link points to a page that has some relation with the page that contains it
  
  Example:
  
  Page: Earth's atmosphere
  
  Link on this page: Clouds

- **Unrelated** - the link points to a page that does not have any relation with the page that contains it
  
  Example:
  
  Page: The Spanish Civil War in the Basque Country
  
  Link on this page: Sarrera Orria (A Basque Newspaper)

- **Subtopic** – the link points to a page that contains information that is a subtopic of that on the page that contains the link
  
  Example:
  
  Page: Computers As Tutors: Solving The Crisis In Education (The entire book)
  
  Link on this page: Section IV - Computer Advantages (Chapters 9 - 17)

Based on the kind of link, the **back** button can be enhanced to acquire some types of different functions. But it can be a good idea to assign each function to a new button creating in that way an enhanced interface of the browser. The functions under consideration are:

- **Back Previous** – to go to the last page visited; the same function that has the existing **back** button

- **Back Previous in Topic** – the same functionality of the **Back Previous** but do not allow going back out of the topic actually accessed; go back only to a page with a related topic

- **Back Previous Topic Last Page** – to go to the last page of the last unrelated topic visited

- **Back Previous Topic First Page** – to go to the first page of the last unrelated topic visited

- **Back Up One Level** – to go to the last page visited that corresponds to a topic for which the actual page is a subtopic

The idea with this is to generate a more complete set of navigational tools that allows users to have some additional functionality that help them to work in a better way. We think that these ideas can help users positively. But there are possibly a lot of situations to explore.
In order to successfully achieve this, the idea is to take advantage of the annotations that will help in the identification of where a new topic begin or when the page of a link is related to the one with the link, in the design of the different types of back buttons.

The experiment to be done is focused in the idea of determining if the addition of new buttons to a browser has any effect on how users work with it. The effect will be measure especially in terms of some of the following values:

- Number of times that user accessed the back button
- Number of times that repetition of pages occurred
- Number of steps needed to complete a task

These values will help in determining if the browser with the added functionality is better than the browser without the new buttons.

The implementation of all of these ideas will be done with the help of a Model of Conversational Structure. This model known as Modular Dialogue Units (MDU), is based on the use of Initiative-Response pairs. These pairs or units are comparable to functions because they are called and return a value. I propose that the structural relationships between Initiative-Response pairs are similar to those between different pages on the Web.

We can clearly see the implementation of pairs or units in the application of a back-previous-topic-first-page button. The following list shows two types of relations between pairs in dialogs that are possible and how they can be seen for the purpose of the selected solution:

1- (I R) (I R) probably non related
2- (I (I R) R) related

As we can see the second one can be seen as the situation in which the link represents a related page. The user initiates this part of the conversation by pressing a link, then if the topic is related to the topic in the page the computer initiate a related topic access showing the corresponding page. If the back button is clicked the computer response by returning accessed to the page visited at the beginning of the first initiation.

This ideas are going to be analyzed in detail and tacked into account in the design of a browser program that is going to be used on an experiment in order to determine the effectiveness and efficiency of the proposed solution.
3.3 Plan of Work

An Experiment will be performed in which the performance of users with the interface of the updated browser will be measure in terms of the amount of repetitions, the use of the new buttons and the back button, the satisfaction of the users and other aspects.

A. Hypothesis:

The implementation of different types of back buttons with different functionality as part of the interface of Internet browsers will decrease the amount of repetitions that occur in the process of a searching task and reduce the use of the single step back button.

B. Details about the steps to do:

• Experiment design
• Identification of the people to be used
• Orientation
• Testing with a not updated browser and with the updated one

Use of two different topics, alternating them with the type of browser is probably necessary in order to achieve a compensation that normalize the results as much as possible. The idea of recording the sessions of work of each user is under consideration and if the Thinking Aloud Technique is necessary for the process. Another aspect under consideration is the use of a questionnaire or only an informal interview.

• Tabulation of results
• Report preparation with conclusions and recommendations
4.0 Bibliography


