Web Accessibility through an Alternative Interface

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Abstract

This paper describes a novel approach to navigating and reading web page information for visually impaired people. The solution we propose gives the user a general overview of a web page content and makes the work with information easier. We use sound situated in 3D space and text-to-speech synthesis in order to provide more efficient interaction with web pages. We enable users to move around the elements of web page. Our primary effort is to make the content of a web page easier to comprehend and enrich it with information on logical connections and relations among individual web site elements. A group of visually impaired people compared of our work on mapping content to audio space with the utilities they commonly use.

1. Introduction

A lot of web materials is not accessible to visually impaired people because large amount of web pages fails to meet the accessibility requirements defined by the World Wide Web Consortium. Many web page designers use various automatic testers to validate the correctness of their code and compliance with W3C requirements. Different assistant technologies for web page reading, e.g. screen reader, obtain a lot of necessary information from the code and therefore its correctness is a useful condition to their proper functionality. However, testers also validate properties that have no bearing on accessibility. According to Blind Friendly Project [Uns07], which tries to contribute to web page accessibility for visually or otherwise imapaired people, one of the most important things are a subjective evaluation of pages by disabled people in co-operation with sighted specialists. There is big difference between users who use only sound to get web page information form page and users who can look at the page. Sighted users are mostly able to obtain an overview of the content at a glance and select those items which are important for them. It is caused by different size, font and color of individual elements of web page or by visual division of web page information. Screen readers provide to users text information in linear order and they are not interested in logical connections and relations among individual web site elements. They also do not deal with position of the information at the web page.

Besides information in text format, most web pages contain information such as images and tables, many of which are highlighted in color to capture reader's attention or because they are important. Therefore, sighted users can obtain not only content overview, but also an overview of the page structure at a glance. The order in which sighted users read items on web pages is different from the HTML representation order. However, HTML order is what the screen reader software for visually impaired users uses to present the web pages. Thus, it does not provide any overview equivalent to the “glance” and it does not inform the user about the importance of items located at the page [DSC*06].

2. Related Work

There are several projects that try to solve the problem of web page content representation for visually impaired people, to give the user a general overview of the web page content and to make the work with information easier. In the project Air-Client, see [DKG02], individual parts of pages are represented with the assistance of spatial sound by creating of hearcons in auditory interaction realm – Air. Project [MM05] is aimed to provide visually impaired internet user with spatial and navigation information with the help of speech, sounds and haptic device. Another method [Kol03] has been developed to identify small, common interaction design problems, and design and evaluate several solutions for each. The main idea of [RP*00] is to map all the digital documents (text and graphics) into a virtual sound space. It means to transform all document elements to sounds, which have accurate position in space. Project [CFS*96] describes development of an environment, which combines a spatial auditory display derived by processing sound sources with gesture and speech-based input techniques. Paper [WM06] describes WebTree structure, a tree view of internet documents, which provides an overview of web page objects.

3. Methodology

Our method takes web page elements analyses and evaluates them by relevant parameters. After the evaluation, we create a structure represented by a graph, which can be

searched through by keys and its individual vertices are objects or groups of objects which are located on the web page. Relevant sounds are assigned to them according to their importance, attractiveness, and position.

4. Design

In our project, object means an element of HTML page enriched by our added properties. We divide individual objects into groups according to their meaning (Figure 1).

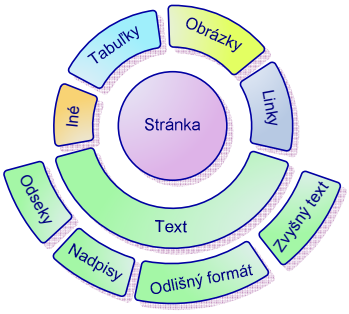

Figure 1: *Groups of web page objects*

This division and creation of objects is done by adapting and removing large amount of HTML elements, which are not important for us, because they are mostly used for graphics design. Then we assign the same type objects to a single group. We define two sets of properties for each object. The first set we obtain from HTML code of the web page and the second we define externally (in addition to our application). These external properties contain all the properties, which are not obtained from HTML code, e.g. importance or attractiveness of an object.

Firstly, we define individual objects and their properties needed to design our graph structure from page data. We determine all the properties that our objects have in common in order to give a general overview of the web page content and to provide better orientation on the page.

Our data structure is represented by a graph, into which we can insert and approach individual vertices according to given rules. Initial vertex of the graph always represents the web page and it keeps the information about page title. Edges, which originate from the initial vertex, connect it to vertices that represent groups of objects: Links, Images, Tables and Text. From these vertices, we can go by edges to individual objects, which belong to the current group. Text vertex can have no more than four edges - besides the edge connecting it to the initial vertex. These edges lead to sub-groups vertices. Any other nodes connected with sub-groups vertices represent individual objects, which belong to sub-groups. In our data structure, also logical connections and relations among objects are represented.

After the user runs the program and writes desired URL address, the source code is read, an object is created, and added to the data structure for every element. The title of the web page is read to the user after creation of structure and finally a page overview, which consists of four groups of objects, is created. Spatial sounds help the user to understand this overview.

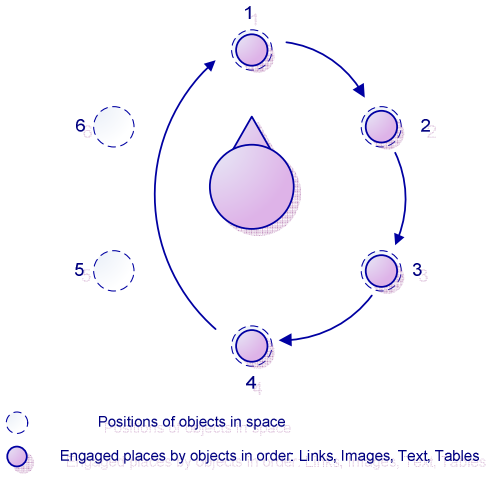

Figure 2: *Placement of objects groups in space after the web page is loaded*

After the web page is loaded, the user can move among individual groups which are placed in a circle, starting from the position directly in front of him or her (Figure 2 illustrates the described situation.). There are up to six objects in the circle and after the last object, user can move again to the first one - the movement is cyclic.

When the user selects one of these groups by keys, there will be six or less objects in the circle, which belong to the selected group. If the group has more than six objects, they are divided into levels with six objects. Level, to which a particular object is assigned, depends on object's properties, especially on its importance. If there are more than six objects with the same importance value, they are sorted by their attractiveness. Where these criteria are not sufficient for unique division, objects are sorted by order of their creation in our structure.

In the following, we describe individual situations, which can happen by selecting different objects from our data structure.

Link – when we select this object, the web page URL address is loaded from the source of link. Title of page is read to the user and four groups of objects which were newly created appear. The process is the same as loading the first page, which we already discussed. In order to make the search of links faster we allow jump to the link after writing its first three letters.

Image – when we select this object, information about it is read once more.

Text – after selection of this object, the screen reader reads the actual text. When we select text, which belongs to sub-group for headings, after pressing the key, the whole text belonging to this heading is read. Text which was read is inserted to memory to allow copying of individual parts of this text, if needed.

Table – when user selects a table, he or she reaches the first cell in the table. Each cell of the table contains relevant objects. User can select individual cells by keys and move

among them. When one selects the cell object, one of the cases described above takes place. By selecting a table we obtain information on how many rows and columns are there which is useful for better orientation. If some item fills more columns or rows, screen reader reads it to the user. It also reads row's or column's header for relevant table's cell. If the table does not contain the same number of columns per row, screen reader warns user about it.

If the user wants to browse a new URL address, it can be directly written after pressing specific key. During the writing process, individual letters are read to let the user know, what was written. So the user can correct mistakes easily. The loading process of web page is represented by sound which moves from the left (begin state) to the right (end state).

Our program has a multi-purpose environment. It will be used for testing by visually impaired people, but it will also be used for presentation of our work for well sighted people. The environment (Figure 3) contains a text field to enter a web page address, which is confirmed by enter button. Finally, there is a large graphic area with four tabs.

The web page can be viewed in four different ways using tabs. In the first tab called "Web page", there is the common page representation. The second tab includes HTML code of the web page. "Graph" and "Visualization" demonstrate annotated and translated HTML code of the web page created by our program. In "Graph", there is text representation of this structure and in "Visualization" we can find the graphic representation of the structure. This graphic representation consists of basic geometrical figures.

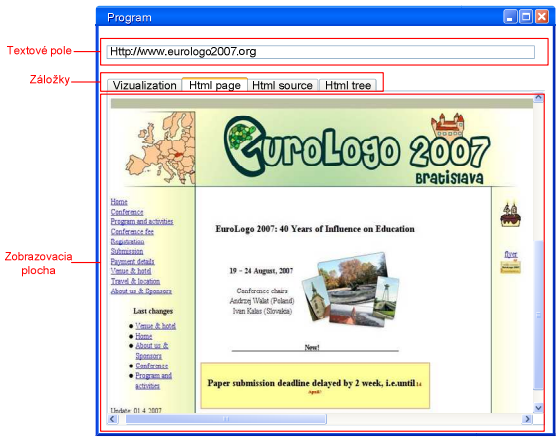

Figure 3: *Program environment*

Visually impaired people can browse the annotated and translated web pages using keyboard and sound. The tabs are useful only for a user that whant to monitor the work of visually impaired people.

5. Evaluation of program - results

Our primary concerns during the program testing were to find out if our designed division of page into individual objects is correct, whether users think that this program is useful for them and how they perceive work with the program. Considering the way, how the program was proposed and created, improvement proposals additional functionality are simple to implement.

We tested our program in collaboration with Visual Centre at Comenius University, FMFI in Bratislava, which gave us the opportunity to test.

6. General overview of the web page

Visually impaired people perceive the web page as groups of data, which follow one another in linear succession. To large extent, this is caused by their inability to form an idea about the web page as sighted people see it, but in fact, it is not necessary for them. For them, it is essential to select all the important data from the page. Majority of available software packages used by visually impaired people for working with internet and computer at all, cause the linear perception of data. Disadvantage of this method – especially when browsing a large web site – is that the users do not have the possibility to obtain an overview of the whole page, they cannot perceive the page as data structure and recognize relations among the individual page objects.

Our program overcomes this barrier by data structure, which is enriched with information on logical connections and relations among individual web site elements. The strongest point of our methodology during the testing was that it gave the user a general overview of the web page content and data search similar to the linear one but it did not try to force the image of how sighted people see the web page and what the position of data is. One of the most frequently asked user questions was why the individual objects are ordered in a circle. We decided on this order because it allows an easy use of sound for representation of positions of individual objects at one level. It makes user orientation easier and it also speeds up selection of desired object. Furthermore, if we know the web page, which we are browsing, we can directly approach the desired object by skipping several levels of object sextets with keys.

7. Testing and improvement proposals

During the testing of our program we found out that the users were able to familiarize themselves with program environment easily and control it quickly. At first, the work with objects and their groups was slightly confusing for users. They did not always remember where they were in the structure. In order to help, we offer information on position in data structure read by screen reader. The control of program by keys seems to be a very good and natural solution. When we tested individual web page elements, we observed the following:

- **Tables** – when browsing tables, it would be helpful to get information on number of columns and rows of current table for better orientation. According to users, it is useful to differentiate between tables by their functionality – to inform whether the table is at the page because of the page design or whether it is a regular table also seen by sighted user.
- **Bullets** – it is better not to group all the bullet items and sub-items into one vertex of graph, but to divide them

into objects and sub-objects connected to the original object.

- **Text** – it is good to keep the text in the memory and allow copying of its parts.
- **Links** – for faster search for specific links - if we know the page and/or what we want to search for - it is useful to sort links by alphabet or to allow user to jump to link after writing of first three letters. It was very helfull to have sound to represent its progress of page loading.

8. Conclusions & Future work

According to users who helped with testing, our data structure gives a good overview of web page data and content, which is missing in linear way of browsing.

We have not considered browsing of forms yet, but we have some ideas from users on how to approach this. It is not necessary to hold the information on visual aspect of the form on the page. The crucial thing for users is to fill out the form correctly and not skip any items. The visual image of the page is not important to them. An appropriate solution is to adapt the browsing to the linear method they use when they work with computer.

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