ORIENTATION OF BLIND USERS ON THE WORLD WIDE WEB

Mary Zajicek, Chris Powell, Chris Reeves*

The Speech Project, School of Computing and Mathematical Sciences Oxford Brookes University, Gipsy Lane, Oxford OX3 OBP, UK
Tel: +44 1865 484683, Fax: +44 1865 483666
Email: mzajicek@brookes.ac.uk

Royal National Institute for the Blind 224, Great Portland Street, London WIN 6AA

The aim of our work is to make the wealth of information on the World Wide Web more readily available to blind people. We wish to enable them to make quick and effective decisions about the usefulness of pages they retrieve. We have built a prototype application called BrookesTalk which we believe addresses this need more fully than other Web browsers. Information retrieval techniques based on word and phrase frequency are used to provide a set of complementary options which summarise a Web page and enable rapid decisions about its usefulness.

Introduction
This paper describes the results of evaluation of BrookesTalk, a web browser for blind users developed at the Speech Project at Oxford Brookes University. The aim was to evaluate the utility of the multi-function virtual menubar provided by BrookesTalk with blind users including those based at the Royal National Institute for the Blind.

The aim of the project is to provide a tool which will enable blind users to 'scan' web pages in the way sighted users do (Zajicek and Powell, 1997a) and find the useful information that is out there. BrookesTalk is designed to extract an information rich abbreviated form of a web page and present it using speech so that the blind user can make a quick decision as to whether the page will be useful or not. It also provides a means by which blind users can store particular sentences and mark places as they move around the web.

BrookesTalk Described
BrookesTalk is a small speech output browser which is independent of conventional browsers and also independent of text to speech software applications using Microsoft speech technology.

It includes the functionality of a standard Web browser for the blind (Zajicek and Powell, 1997b) such as pwWebSpeak(TM) in that it can break up the text part of a Web page into headings and links and read out paragraphs etc. However the main aim is to provide an orientation tool for blind users in the form of a virtual toolbar of functions that will provide different synopses of a Web page to help the user decide whether it will be useful to them or not.

Users can select from a from a menu of, list of headings, list of links, list of keywords, list of bookmarks, an abridged version of the page, a list of scratchpad entries, a summary of the page, and can also reach and read out chunks of text which are organised hierarchically under headings. It is expected that the user will pick tools from this virtual toolbar which complement one another for the particular type of page under review.

The list of keywords consists of words which are assumed (Luhn, 1958) to be particularly meaningful within the text. These are found using standard information retrieval techniques based on word frequency. Abridged text is also compiled of special sentences which have been isolated using trigrams.

The scratchpad allows users to send any sentence they are listening to, which they consider important or worth noting, to the scratchpad simply by pressing a key. They can then playback lists of sentences linked to particular pages.

The summary of the page includes author defined keywords, the number of words in a page, the number of headings and the number of links.

Keywords and Abridged Text Explained

Keywords

---

*Royal National Institute for the Blind 224, Great Portland Street, London WIN 6AA

The aim of our work is to make the wealth of information on the World Wide Web more readily available to blind people. We wish to enable them to make quick and effective decisions about the usefulness of pages they retrieve. We have built a prototype application called BrookesTalk which we believe addresses this need more fully than other Web browsers. Information retrieval techniques based on word and phrase frequency are used to provide a set of complementary options which summarise a Web page and enable rapid decisions about its usefulness.

Introduction
This paper describes the results of evaluation of BrookesTalk, a web browser for blind users developed at the Speech Project at Oxford Brookes University. The aim was to evaluate the utility of the multi-function virtual menubar provided by BrookesTalk with blind users including those based at the Royal National Institute for the Blind.

The aim of the project is to provide a tool which will enable blind users to 'scan' web pages in the way sighted users do (Zajicek and Powell, 1997a) and find the useful information that is out there. BrookesTalk is designed to extract an information rich abbreviated form of a web page and present it using speech so that the blind user can make a quick decision as to whether the page will be useful or not. It also provides a means by which blind users can store particular sentences and mark places as they move around the web.

BrookesTalk Described
BrookesTalk is a small speech output browser which is independent of conventional browsers and also independent of text to speech software applications using Microsoft speech technology.

It includes the functionality of a standard Web browser for the blind (Zajicek and Powell, 1997b) such as pwWebSpeak(TM) in that it can break up the text part of a Web page into headings and links and read out paragraphs etc. However the main aim is to provide an orientation tool for blind users in the form of a virtual toolbar of functions that will provide different synopses of a Web page to help the user decide whether it will be useful to them or not.

Users can select from a from a menu of, list of headings, list of links, list of keywords, list of bookmarks, an abridged version of the page, a list of scratchpad entries, a summary of the page, and can also reach and read out chunks of text which are organised hierarchically under headings. It is expected that the user will pick tools from this virtual toolbar which complement one another for the particular type of page under review.

The list of keywords consists of words which are assumed (Luhn, 1958) to be particularly meaningful within the text. These are found using standard information retrieval techniques based on word frequency. Abridged text is also compiled of special sentences which have been isolated using trigrams.

The scratchpad allows users to send any sentence they are listening to, which they consider important or worth noting, to the scratchpad simply by pressing a key. They can then playback lists of sentences linked to particular pages.

The summary of the page includes author defined keywords, the number of words in a page, the number of headings and the number of links.

Keywords and Abridged Text Explained

Keywords

---
The following examples of keyword extractions were found for three different Web pages shown in Table 1.

Table 1. Examples of Keyword Extractions

<table>
<thead>
<tr>
<th>Document title</th>
<th>Total no. of words</th>
<th>Keywords</th>
<th>Document subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thinking of getting a border collie?</td>
<td>1174</td>
<td>border, collie, people, collies, dog, exercise, dogs</td>
<td>Information for prospective border collie owners</td>
</tr>
<tr>
<td>Comet Hale-Bopp Home Page (JPL)</td>
<td>772</td>
<td>comet, hale, image, January, images, vodniza</td>
<td>Information about comet Hale-Bopp</td>
</tr>
<tr>
<td>Dennis’ Information Retrieval Page</td>
<td>279</td>
<td>information indexing, IR pages, index search, engines</td>
<td>General information about information retrieval and links to related sites</td>
</tr>
</tbody>
</table>

An evaluation of the usefulness of keywords compared with headings or links is given in the next section.

**Abridged Text**

When keywords are used contextual information imparted by the position of a word in a sentence is lost. Extraction of three word key phrases or trigrams preserves some word position information. The technique is based on 'Word level n-gram analysis' in automatic document summarisation (Rose and Wyard, 1997). To provide a measure of similarity, groups of words appearing together rather than individual words are compared.

To reduce the number of word-level mismatches due to the normal changes in spelling required by grammar, each element of a trigram was assigned the stem of a word rather than the word itself. The trigrams presented were ranked by frequency.

Table 2 Trigram

<table>
<thead>
<tr>
<th>Frequency</th>
<th>content words</th>
<th>Keywords</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>equal opportun polici</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>equal opportun and</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>servic deliveri and</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>it is commit</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>is commit to</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

The RNIB Web page 'Equal Opportunities Policy', a 238 word document, gave the five trigrams of frequency > 1 shown in Table 2. High frequency trigrams occur twice, low frequency trigrams once, providing at first glance little to distinguish between them. Many of the words in the trigrams are noise words which are required for grammatical correctness and are not content bearing.

A summation of frequency of trigram, number of content words in the trigram and number of keywords in the trigram appears as the score for the trigram in Table 2, which also shows key trigrams for the 'Equal Opportunities Policy' page.

Abridged pages were created by computing the key trigrams of a page, according to score, and then creating a page consisting of the sentences in which the trigrams appeared. Abridged pages on average worked out to be 20% of the size of the original text and, unlike keyword lists, are composed of well formed (comprehensible) sentences.

**Evaluation**

**Keyword Evaluation**

Preliminary experiments were performed to assess the usefulness of the keyword list as an indicator of page content compared to the headings list or the links list. Headings and keywords in particular were judged to be roughly comparable in that they provided a list of indicating words or short phrases.
The argument for incorporating keywords in the BrookesTalk menubar is that it provides more flexibility for the user in summarising the Web page. If the author has truly encapsulated the meaning of subsections of the page in headings then headings should provide a significantly better indicator of page content than keywords. However headings are often represented as images which do not provide speech output, or are eye-catching rather than informative. In this case keywords could provide a better summary. The aim of BrookesTalk is to provide flexibility with a range of tools to aid orientation which can override many of the vagaries of Web page authoring.

User's perception of the usefulness of the representation was measured by asking them to evaluate the usefulness of describing a Web page using the three different types of summary representations, headings, links/anchors, and keywords.

Twenty subject users were shown the different representations for six different Web pages. The pages were chosen to maximise variability. Subjects gave a score between 0 and 5 for each representation. The sum of the scores for each representation, together with the percentage of the total score it represented, was taken to give an indication of its effectiveness, results are shown in Table 3.

We see that users perceived that keywords provide a considerable improvement on the use of links to orientate users to Web pages. Headings gave the best score but the score for keywords was not significantly different.

Table 3. Scores for different representations

<table>
<thead>
<tr>
<th></th>
<th>Total Score</th>
<th>Percentage of available marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headings</td>
<td>406</td>
<td>58.09</td>
</tr>
<tr>
<td>Anchors</td>
<td>313</td>
<td>45.24</td>
</tr>
<tr>
<td>Keywords</td>
<td>392</td>
<td>55.28</td>
</tr>
</tbody>
</table>

Usability And The BrookesTalk Environment

The prototype BrookesTalk was used by a group blind users including those at the Royal National Institute for the Blind (RNIB). User acceptance was no problem as this group were committed to finding out what software is available for blind people. They were all technically able although our ultimate goal is to develop software for non technical users so that all blind people can use the Web.

Earlier versions of BrookesTalk required TextAssist software for the speech synthesis. This often required patching in Windows'95 and caused discouraging technical complications before getting started. BrookesTalk was then re-written to run on the Microsoft Speech engine for Windows'95. While increasing portability the speech engine currently uses a lot of precious disc space. Both versions are available.

BrookesTalk uses different voices for conceptually different parts of a Web page. This was appreciated by most but described as irritating by one. We plan to make different voices optional in the future.

BrookesTalk runs without any visual display at all and does not run with another browser open. Users felt it would be useful to have the visual equivalent of the spoken page available at the same time so that sighted co-workers could be called in for clarification or work co-operatively with the blind user.

Evaluating The Functionality Of BrookesTalk

Users were observed to rely heavily on one function rather than move between different summarising representations. They had been encouraged to try using the different functions to complement one another as they provide different views of the page. Users said that they usually know what type of page they are searching for, research work, entertainment, product details etc They therefore know how useful headings are likely to be and can use keywords accordingly.

Surprisingly one user orientated himself by using the movement between links key 90% of the time. We had not anticipated that he would build his conceptual model of the page by looking at what was behind it. This approach will be investigated fully!

The abridged version of the page received most criticism. The trigram analysis could easily pick out the wrong trigrams as being significant and important headings were frequently left out of the summary. The algorithm for picking trigrams is not very stable it can easily be influenced by irrelevant words. It was suggested that trigrams should carry some kind of semantic weighting if they appear in the title or...
headdings.
The scratchpad worked well and provided an easy way of saving important sentences from the page. As yet sentences are linked to pages and a new scratchpad must be started with each new page. Users suggested that sentences could be tagged as related to search themes. In this way sentences from several different pages could be grouped by theme.

Conclusion
Initial evaluation highlighted the potential usefulness of features designed to improve navigation, such as the use of keywords and page summary. Blind users emphasised the potential of a tool such as BrookesTalk to sort through what they referred to as the 'increasing pile of paper that arrived on their desks' during the working day. Methods used to translate HTML formatting to speech could easily be applied to other formatted documents.
They felt that the product is fairly accessible for this stage of its development; but some problems exist with accessing links. Useful aspects included vocal notification of HTML markup (i.e. if text is a heading, alt-text etc.) and being able to move between headings and start speech from specified points in the text. By incorporating usability at such an early stage in the development process the system is more likely to meet user needs, with the next step being a more structured approach to obtaining feedback. This will allow faster communication of problems and improvements, ensure all functionality is assessed and highlight potential new areas of development.

References
Zajicek M., Powell C., 1997b, 'Enabling Visually Impaired People to Use the Internet', IEE Colloquium 'Computers helping people in the service of mankind', London