ACCESSIBILITY AND USABILITY IN ELECTRONIC TEXTS: WHAT DOES IT MEAN?

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Abstract: Visually impaired people have always experienced difficulties in reading texts, documents and books. However, the ability to obtain information independently is of crucial importance for visually impaired people, since it would give them access to a world which was previously closed to them in terms of access to educational tools, employment resources and information about personal interests and the latest information on a wide range of subjects. Electronic texts (e-texts) are potentially a viable solution. In this work we introduce the subject and describe the aim of the project "S.T.E.L.A.E.". This project focuses on books on cultural and scientific topics, which have particular problems in making information really accessible to blind people. We first discuss the theoretical and methodological basis of electronic texts, starting with problems in using e-texts. Then we propose a new model which includes specific elements linked to different reading typologies. Finally, a broader goal of this work is improving the quality of education in order to encourage online distance learning (i.e. so called e-learning), especially for visually impaired people.

Keywords: Accessibility, usability, e-book, e-text, e-learning, information access.

1. Introduction

Visually impaired people have always experienced difficulties in reading texts, documents and books. However, the ability to obtain information independently is of crucial importance for visually impaired people, since it would give them access to a world which was previously closed to them in terms of access to educational tools, employment resources and information about personal interests and access to the latest information on a wide range of topics.

Various modalities have been adopted to facilitate access by visually impaired people to information, news, magazines and books and to provide them with several different types of service. Books in Braille were the first to appear, but they were soon replaced in part by audio-books and finally by electronic texts. These formats are generally not equivalent in terms of efficiency. When providing an accessible book for blind people it is important to consider their reading goals. For instance, for a narrative book there are no significant differences between formats, other than the particular reader's preferences. Many users will choose an audio book rather than an electronic text for narrative.

However, a blind person will prefer the electronic format for a technical book in order to navigate the different sections more quickly. In addition, electronic text is increasingly preferred for applications such as extracting sections of text to be edited by the user and searching rapidly for words and sentences. For all these reasons, electronic books are being increasingly used for educational and employment purposes. It is therefore very important that electronic texts are both accessible and usable in order to facilitate reading and support the educational process. But, what is meant by saying that a book is accessible? When is a book both accessible and usable? In this work we discuss the main issues faced by a blind user reading an electronic text with assistive technology, such as a screen reader. The main goal of this investigation is analysis of the concrete difficulties encountered by a visually impaired reader in order to precisely define all the users' requirements, so that this information can inform the design process.

We use the term e-text (from "electronic text") for a text that is stored in electronic form. Thus an e-text can be a simple text, a more complex document, with title, paragraphs and subparagraphs, or an electronic book organised into chapters and sections. In other words, all these considerations and proposed solutions are relevant to a general e-text, seen as an individual work, as well as to more highly structured e-books. So, in this context the terms e-book and e-text can be used interchangeably. The format of many of the e-books available to visually impaired people can be fairly simple and easy to modify to give accessibility, as is often the case for narrative books. However, the format of an e-book can contain complicated explanations, graphs, tables and formulae, as in the case of scientific texts. In this case it is more difficult to create accessible and usable texts, since a complex network of alternative explanations and other complementary descriptions need to be included in the electronic format.

The project "S.T.E.L.A.E" (Scienza e Tecnologia per Libri Accessibili Elettronici, Science and Technology for Accessible Electronic Books), considered in this article, aims to obtain solutions to overcome the main obstacles to the creation of accessible and usable electronic books on cultural and scientific issues. The paper is structured as follows: an initial short description of the main accessibility and usability problems encountered by visually impaired users when reading electronic text is followed by discussion of the main features of an accessible e-text. Finally a possible model solution for structuring e-text interfaces to make them more accessible and usable is proposed and discussed.

2. Related Work

The group of print disabled people consists of people who cannot meet their information needs from standard printed material due to a visual impairment (low vision, blindness), dyslexia or a severe motor impairment that makes it impossible to handle books or magazines. Increasing numbers of people are using electronic documents and it is essential that print disabled people have access to electronic information.

Several attempts have been made to develop specialised formats, especially for people with a visual impairment. One of these is a by-product of the Daisy consortium, which is working on producing a standard for talking books (under the assumption that the audiocassette is going to disappear soon), but includes navigational information or even the full text of the book in the same document. In fact, typical audio talking books do not allow the reader to navigate the book easily. Usually the reader can listen from beginning to end, but no other options are available (such as a reader who has already read chapters 1 and 2 going to chapter 3), resulting in frustration and wasted time. DAISY is the acronym for Digital Accessible Information SYstem, and members of the DAISY Consortium (DAISY, 2006) are dedicated to making DAISY books accessible worldwide. The DAISY standard allows the producing agency full flexibility with regards to the mix of text and audio, ranging from audio-only, to full text and audio, to text-only. Thus, Hybrid books can be made available in the DAISY format. Reading a Daisy book requires specific hardware devices or a particular software package to be used. We prefer to use a more common electronic format: X/HTML books. Our proposal for X/HTML books gives a Web-based electronic format which the reader can access with a familiar browser and well-known assistive technology commands. In addition, we are proposing a Web-based service for generating various output formats for e-text, such as X/HTML, TXT, a simplified version to be read by a PDA and a version ready to be printed in Braille. Although they use a different approach, Chen et al. (2005) discuss the automatic generation of e-text online.

In addition, our approach aims to consider an e-text (or e-book) as a Learning Object to be embedded in an e-learning system. Distance education can provide good opportunities for the education of people with disabilities. Legal and technical aspects of e-texts are discussed by Edmonds et al. (2004). As we believe that an X/HTML format is more appropriate for use in an e-learning platform, our solution is large Web-based. Additionally the user interface plays an important role in facilitating interaction by the user. Therefore, specific user interfaces for e-text should be designed to improve the reading process for particular users. Sun et al. (2004) discuss a possible user interface to support reading for comprehension. In our work we investigate one possible user interface and layout to provide accessible and usable e-text for blind and low vision users.

3. Reading an e-text: the problems

In this section we discussed the problems encountered by visually impaired people (blind and low vision) when reading an electronic text. A visually impaired person interacts with the operating system and its applications through assistive technology. A blind user works with a screen reader and low vision user with a magnifier. As when reading a Web page (Leporini and Paternò, 2004; Leporini et al., 2004,) the main problems encountered by a visually impaired person when interacting via these assistive technologies can be summarised as follows:

- Lack of context – When navigating with a screen reader (or a magnifier) the user is only able to access small portions of a text at any one time and may lose the overall context of the current content shown on the screen.
- Information overload – Often several unchanging portions of the content (such as menu, index and any repeated information) may overload the system, as the user has to read through all the items nearly every time the text is read, thus slowing down content exploration.
- Excessive sequencing in reading the information - The command for navigating and reading may force the user to access the content sequentially. For instance, long tables can make reading frustrating.

Due to the drawbacks described above, reading a document can be somewhat laborious. For example, let us assume that this paper is available in the following formats: TXT (only text), or PDF or poorly structured HTML (e.g. with no heading styles). In order to find the main sections of the document, a blind user can try to look for numbered sections by searching for "1.", "2.", "3.", and so on; if the paragraphs were numbered, the reader could get an idea of the document structure by searching for progressive paragraph numbers. Although this approach would allow users in find the main sections of the document, it is not at all suitable. On the other hand, if sections and pages were not numbered, all the drawbacks described above would have a negative impact on both Web page navigation and reading e-text. Even if a document is available in a format considered accessible, such as TXT, PDF or HTML, the reader can still find it difficult to read it efficiently. In fact, when reading a document or a book, users need to be able to glance at it to obtain an overview of its main components and features (such as sections, sub-sections and length). Furthermore, the user should be able to browse by page or by chapter, access notes and comments. Readers should have the same options when reading an electronic text as when reading a paper document. When reading a document sequentially (line by line), the user may only obtain an idea of the document structure after reading the entire text. However the inclusion of appropriate features, such as heading styles, when the document is prepared, enables the reader to obtain an overview of the content. As an illustration, Figure 1 presents all the section titles in this paper. Lastly, it should be noted that reading a PDF document with a screen reader is often slow and heavy going. Based on these considerations, we decided to investigate how an e-text could be designed and structured in order to make a document (or book) easy to read. In particular, the S.T.E.L.A.E. Project is aimed at structuring and developing books with particular features (e.g. scientific books with a complex structure).

4. What is an Accessible and Usable Text?

4.1 Accessibility Features

Document accessibility, even when the document is written in an appropriate electronic format, is not necessarily guaranteed and considerable work has gone into producing guidelines for making e-texts accessible. Digital books and documents are produced in many different formats for a number of

different reasons. Publishers usually work with electronic formats which are oriented to typographic features, such as Xpress and Indesign.
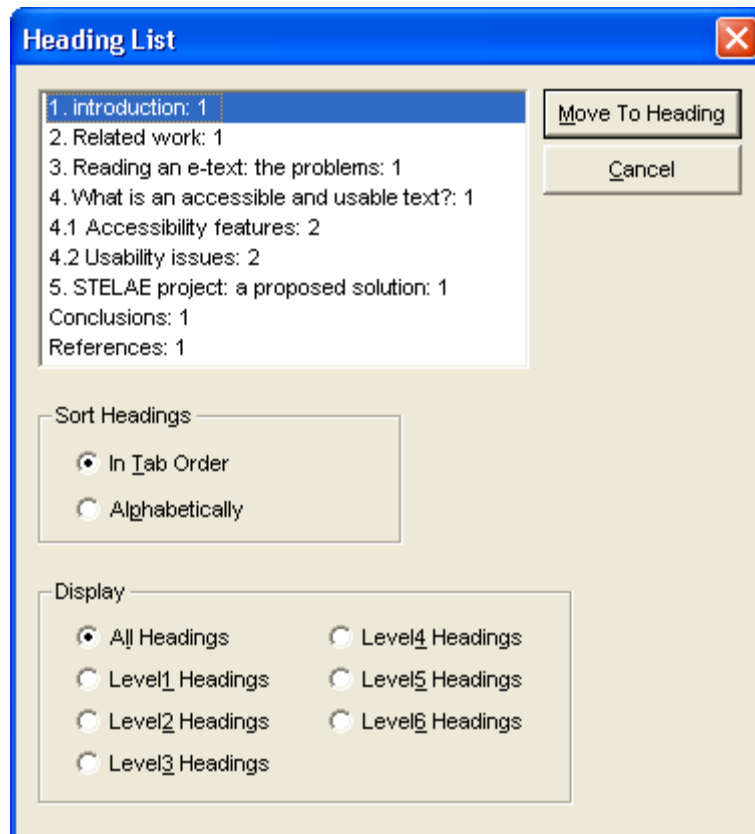

Figure 1 – An example of a list of section titles of this work obtained by a specific Jaws command

A book written by XPress or Indesign is available in a digital format, but it is not automatically accessible. For a book to be accessible, it should have a number of specific features. The main features which make e-texts accessible to blind readers can be summarised as follows:
- The electronic format should be recognisable as text (e.g. TXT or X/HTML) by a screen reader or magnifier; or the specific reader required for working with a particular format (e.g. DOC or PDF) should be accessible by assistive technologies.
- All figures or graphs should have appropriate alternative descriptions.
- Tables or diagrams should be well-structured so that they are read correctly when sequentialized by the screen reader.

All these features should be considered when writing a document. As discussed above, books available in digital format, such as XPress or Indesign format, and designed by publishers, are not automatically accessible. The specific software used for designing the book may offer the option of exporting functions to generate accessible electronic formats, such as TXT, HTML and PDF. When the e-text has been converted to TXT or PDF format, only the first accessibility feature is applied. Designers should follow appropriate procedures in order to obtain fully accessible documents. In fact, some features cannot be obtained automatically by using software and human participation is required, for instance, for writing figure descriptions or structuring tables and diagrams appropriately.

4.2 Usability issues

In previous sections we discussed the main features an e-text requires in order to be considered accessible. However, additional usability features are required to make a document or book easy to read,. This raises the issue of how the usability of an accessible e-text can be improved for visually impaired users. In this section we address specific questions related to the usability of the interface of an e-text considered by the project "S.T.E.L.A.E.".

As already discussed in section 3, a visually impaired reader should be able to interact as they wish with an e-text. This requires consideration of a number of issues when adapting an accessible document (or book) to make it easier to read. Both accessibility and usability should be considered. In particular, the main usability features for improving accessible e-texts are the following:

- Titles of sections or paragraphs should be clear and easily identifiable; for example, for e-text in HTML or DOC format, sections could be marked by using heading styles (e.g. head1, head2, <h1>, <h2>, etc.). This feature is very useful, as it allows the screen reader to be given a specific command to list all the sections of the document.
- The e-text should have a local (for a document) or general (for a book) index. An index can help the user obtain an overview of the e-text and, in particular, to skip quickly to a given section. This feature could also be useful in TXT format where heading styles cannot be applied.
- Notes and commands should be clearly linked to the content to which they refer.

These usability features cannot be applied to all the formats used for accessible documents, but can be used with DOC, X/HTML and accessible PDF. It should be noted that these features could significantly improve reader interaction and should therefore be included when writing a document or adapting a book.

5. STELAE Project: a Proposed Solution

As described in section 4, considerable effort may be required to made a document or book fully accessible and usable. However, it may be relatively simple to apply all the proposed features to a narrative or story book, as the content consists mainly of pure text with no components which require special consideration. Therefore, it is generally possible to adapt the content of this genre of books or texts to make it accessible and usable without any great difficulty. However, producing accessible and usable e-text on scientific or cultural themes is considerably more difficult. In particular, this genre frequently contains several non-text objects which have to be adapted. In addition, a narrative text is generally read sequentially from start to finish whereas a non-literary text may be used for reference or educational purposes. It is therefore very important to make books on scientific and cultural themes available in a suitable format as far as possible.

The main goal of the S.T.E.L.A.E. (Scienza e Tecnologia per Libri Elettronici Accessibili) project is deriving solutions for creating accessible and usable scientific and cultural e-books. Texts about computer science, mathematics, chemistry, economics, and related subjects have many components and parts which it is not easy to make accessible and usable for visually impaired readers. Therefore, one of the main goals of the STELAE project is investigating the accessibility and usability of this type of text. In particular, the project considers an appropriate layout and technical methodology to make e-books usable for a number of different purposes (including Braille printing, simple text formatting and interactive navigation). In particular, an XML-based methodology, which facilitates the use of different layouts, which are appropriate for the purposes mentioned above, is proposed.

Specifically, the STELAE project considers the following aspects:
a) *Document structure* - An XML-based document structure for specifying the main components and attributes of an e-text (including page, title and sections) will be proposed; this structure will be used for generating the final document version to be given to the user.
b) *Output layouts* - A set of layouts for the final version of the e-text will be proposed and tested with end-users; layouts vary according to the modalities in which the document or book will be read (e.g. Web browser, PDA, Braille printing, and so on).
c) *Web-based service* - A technical Web-server solution to use for generating appropriate layouts for different devices will be developed; users will be able to choose the reading modality (for instance, online version, Braille print, PDA device); the Web server will adopt the appropriate layout. In addition, users will be able to save the e-text in the preferred format (e.g. X/HTML, TXT, PDF, for instance ready to be printed in Braille).
d) *User profile* – The option for analysing and storing user profiles and customizations will be added to Web service functionalities, so that the user-interface for the e-text can be adapted to the abilities and skills of the reader. This functionality is very important for improving the user interaction by taking into account the user's characteristics.

With regards to layouts, the project is investigating one possible user interface for an e-text which takes account of readers' preferences. User testing with blind and low vision users will be carried out to evaluate a group of e-text prototypes based on the proposed layouts. The main features to be considered for an e-text layout are:

1) *Interface structure* - Does the user prefer a document structured in a single page, or does he/she prefer a text split into several pages? What is the best position for an index on the page? Prototypes will be developed taking into account all the features an e-text should have in order to be easy to read. The main usability principles – effectiveness, efficiency, and satisfaction - will be considered when choosing which prototypes to test and when testing them.

2) *Multimodal non-text content* – An investigation will be carried out of the format to be used for non-text components. One possibility is the use of multimodal objects: audio (e.g. mp3 format), appropriate and detailed descriptions, and, when required, haptic or paper format. This issue is very important, because it can be useful for providing complex content in an accessible format. For instance, a mathematical or chemical formula could be read by an expert to give audio format; or a complex diagram could be rendered in haptic modality.

3) *Figures, graphs and tables* – Specific proposals will be made for appropriate ways to insert descriptions of figures and tables. When a long and complex table is inserted into the document, the user is constrained to read all the table; if the reader wants to skip it – because he/she only wants an overview or is only reviewing the paper – it is not possible to do this quickly, unless the screen reader is able to provide specific non-basic commands. An improvement might be obtained by putting the complex table onto another page and linking it to the main page; this would allow the user to decide whether or not to read the table. Similar issues hold with regards to careful descriptions for graphs or figures.

All these aspects will be considered in designing user interface layouts. Finally, specific guidelines and criteria will be proposed for making a document or book both accessible and usable for visually impaired readers.

6. Conclusions and future work

The paper has discussed accessibility issues in e-text design. In particular, we have presented the main goals of the "S.T.L.A.E." project: how to make scientific and cultural e-books (i.e. e-text with several non-text components with potential accessibility problems) accessible and usable. The solution proposed in the project is XML and Web based. We believe that an XML structure can be useful for organizing a document to improve its handling properties. Thus, our approach starts with an XML document, which can then be used to generate different types of layouts according to the reader's preferences and assistive device use. A Web-based service can be used to do this. However, structuring an e-book which has already been produced in a typographical format, usually by publishers, (e.g. XPress) is still an open question and will form the subject of our further research..

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