Making ETDS Accessible to the Visually Impaired and the Blind: A Project Under Way

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PUC RIO

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Abstract

Among the main objectives of the ETD programs in different institutions, one is making the contents of theses & dissertations available to the academic community. This availability knows no borders since digital libraries can be accessed on the Web by users all over the world. At the same time, there are users who can be very close to an ETD program, like students or faculty, but who have difficulties in accessing the contents of digital theses & dissertations. It is the group of blind or visually impaired persons.

This paper presents a project to make ETDs and the digital library that makes them available accessible to this group. It has been going on for a little over a year and results are partial. 'Navigation' on the systems and access to document contents are the focus. Current problems and solutions are presented, and results derived from new technologies are mentioned.

1. INTRODUCTION

This section addresses the motivation to start this accessibility project as well as explains the basic steps that were planned in 2006, when the project was submitted to a funding agency of the State of Rio de Janeiro. The proposal concerned ETDs that are texts with images, mathematical expressions, tables etc. – they are the digital versions of paper theses and dissertations (T&Ds). There was no focus on hypermedia and/or interactive works.

This work is divided in 6 sections. Section 2 presents the learning process of the project team and the new steps that were established for the activities to follow. Section 3 describes the problems that were identified and the partial results in solving them; it is followed by section 4 that describes the activities to find solutions to the problems.
Section 5 is devoted to the anticipation of problems that may occurr when multimedia ETDs are presented, as for example ETDs in hypertext and/or with interactive parts, like simulators. Section 6 comments the results and discusses the next steps of this project at PUC-Rio.

It is important to remark that problems can be caused by the fact that ETD collections may have items in different languages and even items in more than one language.

a. *Motivation*

Among the main objectives of ETD programs in different institutions, one is making the contents of T&Ds available to the academic community. This availability knows no geographic borders since digital libraries can be accessed by users from all over the world who access the Web.

A visit to the following two ETD union catalogs shows two examples of availability of ETDs.

* BDTD – Biblioteca Digital de Teses e Dissertações (http://bdtd.ibict.br/bdtd/), the Brazilian national consortium hosted by IBICT – Instituto Brasileiro de Informação em Ciência e Tecnologia (http://www.ibict.br/). Its database holds almost 68K ETD metadata records harvested from 77 Brazilian institutions. This example is important for this work because BDTD holds the largest collection of ETDs in Portuguese and is a reference for other Portuguese speaking countries.
* XCat NDLTD Union Catalog (http://alcme.oclc.org/ndltd/SearchbySru.html) a service offered by OCLC – Online Computer Library Center (http://www.oclc.org/). This is an international union catalog that yields access to over 413K ETD metadata records. The Brazilian records are made available from this system too.

ETDs are spread all over the world and read by students, faculty and researchers in any geography around the clock. At the same time, there are users who can be very close to an ETD program, like students or faculty, but who have difficulties in accessing the contents of digital theses & dissertations. It is the group of blind or visually impaired persons (persons with subnormal vision).

PUC-Rio's ETD program began in late 1999 and the first ETDs was published in May 2000. In August 2002, ETDs became mandatory. In May 2008, the digital library (Maxwell System – http://www.maxwell.lambda.ele.puc-rio.br/) offers more 3,800 ETDs from all graduate programs of the university.

Blind and visually impaired persons are active participants of the educational process at PUC-Rio, but before this project, there had not been active efforts to make ETDs easily accessible to this group.

Cátedra UNESCO de Leitura PUC-Rio (http://www.catedra.puc-rio.br/) is a project sponsored by UNESCO (http://www.unesco.org.br/) and devoted to reading activities. A faculty member of the Languages Department who works in the Cátedra suggested that the digital library and its ETDs be enhanced to be used by readers who do not have normal vision.

In January 2007, the work started after financial support was received from FAPERJ – Fundação Carlos Chagas Filho de Apoio à Pesquisa do Estado do Rio de Janeiro (http://www.faperj.br).

b. *Proposed Steps*

The proposal submitted to FAPERJ in 2006 addressed two problems: (1) enhancement of the accessibility of the digital library system to allow users to find the desired ETDs; and (2) make the contents of ETDs accessible.

PUC-Rio's ETD collection is made of pdf files; there are no hypermedia and/or interactive works. For this reason, this case was not mentioned in the proposal. At the moment, if the worldwide ETD scenario is examined, there is no way not study this problem; this is the topic of section 5.

In 2006, all ETDs in the collection were in Portuguese except for one single case (a doctoral work) with two versions – one in Portuguese and a second in English. At the moment, ETDs in foreign languages are allowed as long as they have descriptive information (title, keywords and abstract) in Portuguese. The number of ETDs in foreign languages is no higher than 15.

Another characteristic of the collection is that most items are in Science and Technology, a fact that poses a problem related to dealing with mathematical expressions. The collection also contains other ETDs that can be problematic due to the large numbers of images; they are in Design and History.

The proposed work had two alternatives that were not mutually exclusive. They were both to be examined. The alternatives were:

- Use of software products to transform text into sound. This alternative could be used for both the system and the ETDs.
- Use of readers (human readers)[*] to transform text + expressions + images into audio files. This solution is that of creating audiobooks, with the advantages and disadvantages that come along.

It is easy to observe that both alternatives were based on changing text into voice (either by software or by humans). This is known a TTS – Text-To-Speech.

(*) The Portuguese language has two words for reader – *leitor* and *ledor*. They are synonymous, but in the Brazilian commmunity of person with some type of visual limitation *leitor* is used for a person who reads to himself/herself and *ledor* for a person who reads to other people.

The development of the project showed that there is not a unique solution to the problem because there is not one and only problem. The following sections will show the activities related to the alternatives and the changes that have been introduced in the project.

The identification of the main (parent) problems and the related (sub) problems came as a consequence of the learning process that is presented in the following section.

At the beginning of the project, the user of human readers was discarded for two reasons:

- The number of files would grow manyfold, because of the size of audio files. This would require a lot more storage space as well as digital object description.

- The generation of audio files would be an endless job since graduate programs produce T&Ds every year. If compared to the public universities in Brazil, PUC-Rio is a small university, but publishes an average of approximately 550 T&Ds per year.

2. LEARNING

The beginning of the project was devoted to learning the main problems of accessibility to ICT – Information and Communication technology solutions by blind and visually impaired persons.

The first and most important lesson that the Maxwell team learned is that there were two different main (parent) problems to be solved:

- Accessibity solutions for visually impaired persons – visually impaired persons in general do no use TTS solutions and, for this reason, the solution to satisfy their needs must be based on changes of the visual aspects of the system and of the files. After testing TTS solutions it is easy to understand the choice of visual solutions in the case they are possible – TTS is slower than reading, more limited (images, expressions, etc.) and more tiring. Over and above, there is the problem of the 'voices' for different languages; this problem will be addressed later.
- Accessibility solutions for blind persons – blind persons must rely on TTS solutions and this was one of the solutions originally proposed.

But each main problem had two different (sub)problems, so the work was divided in:

- Accessibity solutions for visually impaired persons:
  - 'Navigation' in the system in order to search and retrieve ETDs (**NV**)
  - Access the contents of the ETD files (**AV**)
- Accessibility solutions for blind persons:
  - 'Navigation' in the system in order to search and retrieve ETDs (**NB**)
  - Access the contents of the ETD files (**AB**)

In reality, there are two problems ('navigation' and access to contents) but two solutions must to be found for each one because some persons can use one and not the other. The abbreviations mean:

NB – 'Navigation' for the blind
AB – Access the contents of ETDs for the blind
NV – 'Navigation' for the visually impaired
AV – Access the contents of ETDs for the visually impaired

After the identification of the problems, it was possible to organize the different activities to be performed. They are listed below with the abbreviation of the problem(s) they address.

- Examine W3C – World Wide Web Consortium (http://www.w3c.org/) system development specifications that allow compliant TTS software solutions to be effective (**NB**)
- Search for and examine TTS (both proprietary and free) software solutions for the MS Windows and the Linux family operating systems (**NB**)
- Examine different ETD systems and verify how they respond to TTS products (**NB**)

- Work with visually impaired persons to identify the needs related to 'navigation' (**NV**)
- Examine web sites that are suited for the visually impaired following their recommendation (**NV**)
- Examine different ETD systems and verify how they fulfill the needs of visually impaired persons (**NV**)
- Search and examine TTS software solutions and how they operate for different file types with a special concern towards the pdf format (**AB**)
- Examine the accessibility features of the Adobe Reader both in terms of visual adaptations and the of Read Out Loud feature (**AV** & **AB**)

At this point different team members started working in each activity. Persons with both types of visual problems have been in touch with and helping the team.

3. PROBLEMS & PARTIAL SOLUTIONS

This section is divided in two subsections. The first is devoted to accessibility solutions to visually impaired persons and the second does the same but addresses solutions to blind persons. The two subsections present problems & partial solutions to both 'navigation' in the systems and access to contents in pdf files. The term partial solution is used because this is a project under way and, at the moment, there are no final answers to the problems.

a. *Accessibility Solutions for Visually Impaired Persons (Subnormal Vision)*

Subnormal vision is defined in the OMD – Online Medical Dicitionary published by the University of Newcastle Upon Tyne (http://www.ncl.ac.uk/) as:

Vision considered to be inferior to normal vision as represented by accepted standards of acuity, field of vision, or motility.

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http://cancerweb.ncl.ac.uk/cgi-bin/omd?vision,+subnormal
May 3, 2008
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The underlined words have the following meanings in OMD:

Vision – <ophtalmology> The act or faculty of seeing, sight.
Acuity – <ophtalmology> The clarity or clearness, especially of the vision or hearing.
Motility – <biology> The ability to move spontaneously.

The word field is used in the sense of a region in space.
The term subnormal vision is very broad and, for this reason, there are different types and degrees of subnormal vision. The evolutions of different cases are quite distinct too. Some persons are born with subnormal vision while others acquire it at early age or later on in life. In some cases the problem is stationary but in others it can be in evolution and seeing may become more difficult everyday.
Many persons with subnormal vision can use computers without TTS solutions. They rely on two functions of ICT based systems and products: (1) increasing the sizes of the writing and the images on the screen; and (2) changing the contrast of the screens to dark (black or navy blue) background and light writing (white or light yellow).
These functions must be considered in terms of 'navigation' and access.

ϕ 'Navigation'

When 'navigation' is considered, there must be functions on the system to allow users to increase the size of the writing and images, and to change the contrast patterns.

These functions must be clearly displayed in order that users can easily find them. The icons that represent them must be unambigous.

Many Windows users also rely on the tools provided by the web browser and the OS – the magnifier and the zooming functions, as well as the possibility of changing contrast. They are specially useful for the steps that are necessary previously to reaching the web site. The option of changing colors is not very useful because there is no control on how some types of text and links turn out.

A visit to two web sites designed and implemented to be used by all kinds of users is suggested. The first one belongs to IBC – Instituto Benjamin Constant (http://www.ibc.gov.br/). IBC is a school (from kindergarten to high school) for the blind and visually impaired; it is public and belongs to the Ministry of Education of Brazil. The second is that of the Lattes Platform (http://lattes.cnpq.br/) of CNPq – Conselho Nacional de Desenvolvimento Científico e Tecnológico (http://www.cnpq.br/) of Brazil. CNPq is the Brazilian counterpart of CNRS – Centre National de la recherce Scientifique (http://www.cnrs.fr/) in France, the NSF – National Science Foundation (http://www.nsf.gov/) in the United States and the Research Councils UK (http://www.rcuk.ac.uk/) in the United Kingdom. Both allow enlargement of the writing - IBC has many levels of font enlargement while Lattes has only 3. Both change contrast to dark background and light writing.

ϕ Access

This part of the project addresses access to the contents of the ETD files in pdf format.

Adobe® Reader® (http://www.adobe.com/) has a set of accessibility tools that can be configured by the user. They allow customization of colors, reading order and reading history of the document, and can be set from the 'Document' option on the menu. Document zoom can be performed at the navigation bar on top of the text area.

These accessibility tools seem to address the needs of users with subnormal vision.

ϕ Comments

As far as navigation is concerned, part of the solution comes from products – web browsers, Adobe® Reader® and others. There is product that deserves being mentioned, it is called MAGic® developed by Freedom Scientific (http://www.freedomscientific.com/). This is a screen magnification product that is quite popular.

Another part of the solution comes from the development of the system as the examples showed. The project funded by FAPERJ has the objective of yielding access to ETDs, but the whole system (Maxwell v. 4) will comply with the specifications.

While working with persons with subnormal vision at PUC-Rio, the Maxwell team learned that all possible tools can be combined. The combination is a function of the of web site or of the document in use; it is defined according to the environment and the individual needs.

Accessibility solutions to persons with subnormal vision are not the most difficult problem.

b. *Accessibility Solutions for Blind Persons*

Blind persons rely on TTS products to independently access the computer. If systems and documents are not properly developed, TTS products do not fulfill their mission. This causes an annoying situation since either access is not suitable or human help is required.

In this area, there are many unanswered questions and many problems to be solved.

The work started by examining TTS products. TTS was defined in the introduction and means Text-to-Speech. Both Windows and Linux based solutions were sought.

Before addressing 'navigation' and access to documents, it is important to remember the project aimed at access to ETDs in pdf format. For this reason, all TTS solutions were examined in their capability of reading such format. When this was not possible, an alternative solution may be suggested by combining with it the Read Out Loud feature of the Adobe® Reader®.

The following TTS products were examined:

- DOSVOX developed by Núcleo de Computação Eletrônica (http://www.nce.ufrj.br/) of Universidade Federal do Rio de Janeiro (http://www.ufrj.br/) in Brazil
- JAWS® – Job Accessibility with Speech developed by Freedom Scientific in the USA
- LINVOX developed by Núcleo de Computação Eletrônica (http://www.nce.ufrj.br/) of Universidade Federal do Rio de Janeiro (http://www.ufrj.br/) in Brazil
- ORCA development led by the Accessibility Program Office of Sun Microsystems Inc. (http://www.sun.com/access/) in the USA with contributions of many others (http://live.gnome.org/Orca/Contributions/)
- Virtual Vision developed by MicroPower (http://www.micropower.com.br/) in Brazil
- Window-Eyes developed by GW Micro (http://www.gwmicro.com/) in the USA

Table 1 shows the main features of the previous products. It is not conclusive due to the fact the Maxwell team focused on the most popular products that could eventually suit the needs of the project. When search started, other products were found, examined and discarded due to some type of limitation.

	OS	Languages	pdf	Web pages	Acquisition	Misc
DOSVOX	W	pt-BR	N	Only text with WINVOX	Free	(5)
JAWS	W	Many	Y	Y – W3C compliant	Commercial	
LINVOX	L[1]	pt-BR	N	To be used with ORCA[4]	Free	
ORCA	U, L	Many	N	Y	Free	(6)
Virtual Vision	W	pt-BR, en, any SAPI-5 voice	Y[2]	Y[3]	Commercial	
Window-Eyes	W	Many	Y[2]	Y – W3C compliant	Commercial	

Table 1 – Characteristics of TTS products

Observations:

(1) Kurumin Linux + Wine Windows emmulator (http://www.winehq.org/) + DOSVOX
(2) Special action required to start reading pdf files
(3) Problems with frames
(4) V3 (to be used with ORCA) under development
(5) Some office applications; Braille printer formatting

(6) Magnification; Braille display control

DOSVOX was considered for the analysis because it was the first product (early 1990s) to have a Brazilian Portuguese voice synthesizer and, at the same time, it is free – for these reasons, there are many DOSVOX users in Brazil. The limitation of not reading pdf files is overcome in one of two ways: (1) saving as a txt file (an option of the Adobe® Reader®); and (2) using an Internet site that does the same. After the analysis, DOSVOX was not considered as a solution to the project because the team wanted to keep it simple (not add another step to access) and also due to the nature of T&Ds that require a lot more sofistication to screen reading due to mathematical expressions, images, graphics, etc.

The decision was to experiment JAWS® as the TTS product; it is quite popular among blind people. It can be used for both 'navigation' and access to contents.

At the same time, the Adobe® Reader® has the Read Out Loud feature that allows pdf files to be read. This can be useful if a reader users another TTS product that does not read pdf files; it alows a combination of solutions and is independent of the OS of the machine. The Read Out Loud feature is solution to access to contents.

ϕ 'Navigation'

'Navigation' is a difficult process even when the web sites are developed according to the W3C specifications. This is due to the large number of pulldown menus that require a long time to be read. Some sites that the Maxwell team tested had three levels of menus.

When the W3C specifications are not followed, 'navigation' becomes impossible. A very typical example of problem happens with combo boxes – they are identified by the TTS product but the fields to choose from can not be read; the combo box becomes useless.

Many times the TTS product 'gets lost'; it can not identify the different regions of the page to keep reading.

It is important to make it clear that the Read Out Loud feature is not proposed as a solution to 'navigate' because it was developed for the pdf format.

ϕ Access

Both JAWS® and Adobe® Reader® Read Out Loud function were examined to read the ETD files. In order to understand the difficulties in accessing ETDs with TTS products, three different sets of problems must be identified:

• Problems whose origin is the nature of ETDs

Suppose that only digital versions of paper T&Ds are considered; multimedia works are ruled out at this point of the project.

Even with such assumption problems arise. They come from the nature of scientific work. ETDs can contain images, graphics, mathematical expressions, footnotes, references, citations, etc. In most countries, T&Ds have some description (title, keywords and abstracts) in a language that is not that of the document, not to mention works that may be written in more than one language, as for example T&Ds in the areas of literature and translation.

These problems do not exist when most fictitious literature is considered. In this case, simpler TTS products do not show limitations. This is one of the reasons why DOSVOX is still very popular in Brazil.

- Problems whose origin is the generation of the files using the authoring tool and the conversion to the pdf format

Scientific texts are generated by authors who use ICT authoring tools, specifically word processors. These products have characteristics that help both the conversion and the screen reading processes. Some examples are the use of styles, bullets and numbering.

Up to this stage of the project, Word®, an authoring product developed by Microsoft® (http://www.microsft.com/) has been the only tested; it is the most widely used by students at PUC-Rio. Other products will be examined later on.

The pdf format has tags to identify document formatting or a special behaviors. Some examples are: (1) Bibliography entry element <BibEntry>; (2) Quote entry element <Quote>; (3) Code entry element <Code>; (4) Figure entry element <Figure>; (5) Formula entry element <Formula>; (6) Link entry element <Link>; (7) Note entry element <Note>; and (8) Reference entry element <Reference>.

An accessible pdf document must have tags to indicate its structure. Adobe® has published a guide [1] on how to create accessible pdf documents; it is complete and very useful. An interesting article on the accessibility of pdf files [2] is published at the WebAIM – Web Accessiblity in Mind (http://www.webaim.org/); it is very practical and easy to understand and apply.

The tags are the guide for the TTS products to read the documents. Documents that are not properly tagged will not be read in a comprehensible manner. When the pdf file is generated, it must include the addition of tags.

Students can generate tagged pdf files from MS Windows if PDFMaker is used. The use of PDFMaker is specified in the FAQ found at (http://www.adobe.com/products/acrobat/pdfs/acrobat_it_faq.pdf).

Specific problems occur when there are formulas, graphs, charts, images, etc. Although there are tags to identify them, TTS products can not read their contents. For this reason, authors should include a descriptive text to be read by the screen reader.

A serious problem was encountered related to the language(s). When a doc document is converted into pdf, the language information is not preserved, unless there is only one language. In the case of multiple languages it is necessary to edit tags' language properties. This problem has a big impact on ETDs due to the description that they may have in a second language; this is very common in works whose language is not English, they may have a description in English.

An important document to help users of accessible documents [3] was published by Adobe®; it is the counterpart of [1].

- Problems whose origin is the behavior of the TTS product

The two TTS solutions that were examined to access contents presented different behaviors in some situations.

The first problem concerns tha languages of the different voices to read the documents.

Adobe® Reader® Read Out Loud feature uses, as default solution, the synthesizers that come with the Windows system – Microsoft SAPI (Speech Application Programming Interface). In the case other languages are installed, they will be recognized and used.

In Windows XP, the standard is Microsoft SAM – Speech Articulation Module, (http://www.microsoft.com/speech/speech2007/speechdevarticle.mspx) a male voice in American English; it is built on SAPI5. Previous Windows versions use SAPI4.

For voices in other languages there are three options: (1) Buy from vendors; (2) Install SAPI4 (if not yet installed) and use free SAPI4 voices; (3) Use free SAPI5 voices. Some

SAPI4 free voices can be downloaded from ByteCool (http://www.bytecool.com/voices.htm). Free voices for SAPI5 can be found at eSpeak (http://espeak.sourceforge.net/). The eSpeak speech synthesizer supports many languages but not all are fully developed; Portuguese is already available.

JAWS® comes with many languages, among them there is Brazilian Portuguese.

The second problem is also related to language. It happens with Adobe® Reader® Read Out Loud – it reads with the voice that is set on the preferences of the user and disregards the language property of tags. This is a serious problem with documents in more than one language. JAWS® identifies language properties in all levels of the text structure, thus it can switch from one language to the other as long as the voices are installed.

A third type of problem comes from the use of symbols, since products may not deal well with them. One example is $\geq$ (equal or greater than) that JAWS® reads as equal and Adobe® Reader® Read Out Loud does not read.

When there are formulas, Adobe® Reader® Read Out Loud tries to read the characters and it is very confusing; JAWS® seeks the alternative text, if there is not one, it tries to read the characters and the same problem occurs.

Problems in the reading order of texts were quite frequent and intervention on the document was required. This was particularly true when footnotes were used – both TTS products had problems in reading them.

Drawings that are created with a drawing tool of the word processor are identified as an special structure element and an alternative text is read (in case it exists). Otherwise, problems occur.

The problems identifed up to this point indicate that:

Authors should create documents having accessibility in mind. If they do use tags, equation and drawing tools, and alternative texts, problems can considerably be reduced.

This will lead to a change in the habits of authors, a problem that will be addressed in the following section.

ϕ   Comments

Making scientific documents accessible to blind people is a big challenge. There are problems to be solved both in terms of accessing web sites and digital libraries, and in terms of searching, retrieveing and accessing the contentsw of documents.

c.   *Comments on Problems & Partial Solutions*

At the moment, the Maxwell team is examining ETD programs all over the world to check:

- The 'navigation' conditions on the institutional web sites;
- The 'navigation' conditions and the search & retrieve functions of the digital library systems;
- The accessibility of the ETD documents.

The analysis is performed to verify accessibility for both cases (users with subnormal vision and blindness).

4. NEW SOLUTIONS

At this stage of the work, it seems that there are quite a few problems to be addressed, but at the same time there may be many solutions.

While talking to one of our blind students, she told the Maxwell team how wonderful it is to be able to read a newspaper by herself. She can access magazines and newspapers without help from her family or friends. This is a higher level of independence that technology has brought; it was unthinkable 10 or 20 years ago.

At the same time, there is a lot of work to do concerning accessibility of scientific documents in general.

As far as ETDs are concerned, there is a set of actions that can de taken at the university level. Some suggestions are:

- Present accessibility as a key issue in terms of Open Access to information – besides being public, an ETD must be read by all. Most students and faculty are not sensitive to this problem.
- Instruct authors on how to create accessible documents and try to convince them that the additional work they will have is worthed.
- Make the web site and the digital library accessible so that users can 'navigate', search and retrive ETDs.
- Add elements to the metadata set of the digital library to identify accessible ETDs in order to avoid frustration of users who may find and retrieve records but who can not read the works.

The first two actions are the most difficult, specially because students are a renewable stock and the actions must continuously be taken. The third and the fourth depend on the ETD program administrators and are easier to implement.

Another area to explore is the use of other solutions than TTS when scientific documents are considered. Some interesting results were found during the search for alternatives.

One is AsTeR – Audio System for Technical Reading [4]. This was a Cornell University Doctoral dissertation by TV Raman. The author is a blind mathematician and defined his work as 'a computing system for rendering technical documents in audio'. A demo of his work can be found at http://www.cs.cornell.edu/Info/People/raman/aster/aster-toplevel.html.

The Government of the United States has an agency called FedStats that makes statistics from more than 100 agencies available to citizens. A very interesting white paper [5] was published with recommendations to make web sites available to all persons, in order to comply with federal legislation. This white paper is an excellent guide.

Current technology offers blind people Braille Displays. A definition of a Braille Display can be found at http://www.deafblind.com/display.html:

What is a **braille display?**

A braille display is a tactile device consisting of a row of special 'soft' cells. A soft cell has 6 or 8 pins made of metal or nylon; pins are controlled electronically to move up and down to display characters as they appear on the display of the source system - usually a computer or braille note taker. Soft braille cells have either 6 or 8 dot pins depending on the model. Advanced braille code features 8 dot braille, but most will probably only use the 6 dot code. Dots 7 and 8, if present, can be used to show the position of the cursor in the text or for European 8 dot braille. They can also be used for advanced maths work and for computer coding.

This is completely different from TTS, because text on the computer is transformed to a tactile device; it goes to a different sense than hearing. But, the final use is mechanical, like regular Braille, because there are pins controlled by the computer. At the same time, since it is Braille based, it has the same limitations and disadvantages in dealing with mathematics using Braille. Phil McCain addresses the problem of not having a standard mathematical representation in Braille in his article [6] on making mathematics available on web and to blind people.

In section 3, one of the TTS solutions was ORCA. This product also supports Braille displays; it uses BRLTTY (http://mielke.cc/brltty/). BRLTTY is defned as 'a background process (daemon) which provides access to the Linux/Unix console (when in text mode) for a blind person using a refreshable braille display. It drives the braille display, and provides complete screen review functionality. Some speech capability has also been incorporated.'

Tactile devices are seeked using ICT solutions too, but the idea is to go beyond textual information or mathematical expressions supported by Braille.

Haptic ('hap-tik)

a*dj*. Of or relating to the sense of touch; tactile.
[Greek haptikos, from haptesthai, to grasp, touch. (1890)]

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The Haptic Community Web Site
http://haptic.mech.northwestern.edu/HapticResearch.html
May 18, 2008
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Last November, an article [7] was published on a project funded by NSF. This project aims at developing a graphical 'haptic' display. The project is named A Dynamic Tactile Interface for Visually Impaired and Blind People.

According to Prof. Ilona Kretzschmar, a faculty at The City College of New York and the team leader, the idea is 'to develop a viable dynamic tactile interface that allows graphic and pictorial information to be presented in real time in tactile rather than visual space'. The 'haptic' display will include a touch screen to that commands can be executed by pressing specific areas.

When results of this project are available (not before three years), a real breakthrough will occur because information will not be restricted to Braille dots. The graphical display will allow users to 'feel' graphics, images, expressions, etc. The control of the display, to be executed by electric signals, will be at pixel level.

A comment is important at this point. Some of the difficulties that TTS products present are derived from the nature of some types of information. TTS products operate in a linear

way, well adapted to texts, but not suited to bidimensional information as formulas, images and graphs. The graphic tactile display will yield bidimensional information.

5. MULTIMEDIA ETDs

As ETDs became more popular, students and their mentors have found out that their works do not have to be digital versions old style printed T&Ds. Unfortunately, this is not the case a PUC-Rio. NDLTD has stimulated creative works and every year, at the ETD Conference, creative ETDs are awarded recognition for their innovations.

The use of multimedia can add problems to accessibility because there may be a animations, digitized video and/or interaction. Still images are a problem at the moment since they require textual descriptions for TTS products to read them; the problem with moving images seems to be much bigger. If interactivity is present, the problem grows even bigger.

Multimedia ETDs may introduce a problem to deaf or hearing impaired persons due to the eventual use of sound tracks. If interactivity exists, then the problems of persons with limited movements will have to be considered in addition to the problems of 'navigation' on the Internet. This is not in the scope of this project but is something that the ETD community must keep in mind.

6. COMMENTS AND NEXT STEPS AT PUC-Rio

This article presented an exploratory study of accessibility of ETDs by blind and visually impaired persons. It identifieed problems and solutions that are currently available. It suggested actions that can be taken at the university level and technological solutions that are under development.

There is a lot to study and to do! At PUC-Rio, the next steps towards the end of the FAPERJ funded project are:

* Develop all v 4 of the Maxwell System compliant to W3C specifications so that all system enviroments can be used by persons who are blind or visually impaired. The original proposition was only for the digital library.
* Add metadata elements to the database model to identify works that can be read by TTS products.
* Contact the Dean of Graduate Studies to support the efforts of stimulating students to write accessible ETDs.
* Examine other authoring tools and how they convert to pdf.

In the long run, the team plans to engage on projects related to multimedia works. This is not the case of PUC-Rio's ETDs, but the Maxwell System holds many learning contents that are multimedia, interactive and/or animated. The objective is to make other contents accessible.

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