Document Transformation Infrastructure

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Abstract. Many people face barriers to accessing textual information due to visual, reading or language limitations. They need alternative formats to text such as Braille or audio. However, producing accessible formats is often expensive, time consuming, and requires special expertise and training. RoboBraille offers a cost-effective and timely manner to accessible material production. It provides fully automated conversion of text into a number of alternative formats, including mp3 files, Daisy full text/full audio, e-books or Braille books. As part of Prosperity4all project, RoboBraille will be adapted to fit into the overall technical architecture of the Global Public Inclusive Infrastructure (GPII), and interfaces for new conversion capabilities such as semantic structure recognition, text-to-sign language and language-to-language translation will be added.

Keywords: Accessibility, Document Transformation, Braille, e-books.

1 Introduction

Many people face barriers to accessing textual information due to visual, reading or language limitations. They need alternative formats to text such as Braille or audio. However, producing accessible formats is often expensive, time consuming, and requires special expertise and training [2]. For example, a Braille translator need to not only have a good knowledge of various document types, character sets and formats, but also know details about the device on which the text is to be displayed. In addition, readily available accessible materials are limited given that print-disabled people may need a diverse range of alternative formats.

RoboBraille offers a cost-effective and timely manner to accessible material production [2-4]. RoboBraille is developed jointly by Synscenter Refsnæs (the National Centre for Visually Impaired Children and Youth in Denmark) and Sensus ApS. It provides fully automated conversion of text into a number of alternative formats, including mp3 files, Daisy full text/full audio, e-books or Braille books. RoboBraille is a web and email based service. Through its website, users can upload a file for conversion such as a document, an image, or an image-only PDF. Based on the type of original file, the user can select an output format from a list of supported formats. RoboBraille will automatically process the file and convert it into the accessible

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format the user selected. In a short while, the final document will be sent to the user's email. RoboBraille is currently available free of charge, and users need not register to use the service.

RoboBraille offers four main categories of services [5]:

1. Braille services: Translation to and from Braille (contracted, un-contracted) in Danish, British English, American English, Italian, French, Greek, German, Icelandic, Norwegian, Polish, Portuguese and Spanish. Supported document types include text files (DOS and Windows), Microsoft Word documents (doc, docx, Word xml), html documents, rtf files, tiff, gif, jpg, bmp, pcx, dcx, j2k, jp2, jpx, djv and all types of pdf documents. Before the Braille document is returned to the user, it may be converted to a particular Braille character set based on user settings. Documents can also be returned in Unicode Braille or formatted in either text format or PEF (Portable Embosser Format).
2. Audio services: All document types listed in the previous section may be converted into mp3 files. Furthermore, RoboBraille is capable of converting well-structured Word documents (doc, docx, xml) into Daisy Talking Books complete with audio. Similarly, RoboBraille can convert docx documents containing math (written in MathType) into Daisy books witg spoken math. The audio conversion services currently include high-quality voices for the following languages: Arabic, Arabic/English bilingual, Bulgarian, Danish, Dutch (male, female), English/American, English/British, French, German, Hungarian, Italian, Lithuanian, Polish, Portuguese, Romanian, Slovenian Spanish/Castilian and Spanish/Latin American.
3. E-Book services: Most document types listed above may be converted into the popular EPUB and Mobi Pocket (Amazon Kindle) e-book formats. The service also supports conversion of documents into the EPUB3 format. Furthermore, EPUB may be converted to Mobi Pocket and vice versa. To accommodate users with low vision, the base line of the body text in an e-book may be raised to allow for more appropriate text scaling in mainstream e-book readers.
4. Accessibility services: Otherwise inaccessible documents such as image files in gif, tiff, jpg, bmp, pcx, dcx, j2k, jp2, jpx, djv and image-only pdf, as well as all types of pdf files can be converted to more accessible formats including tagged pdf, doc, docx, Word xml, xls, xlsx, csv, text, rtf and html. Word and rtf files are converted into text or tagged pdf files subject to the format specified by the user in the subject line, e.g., txt or pdf. PowerPoint files are converted into tagged pdf, web projects or rtf files.

RoboBraille also offers several auxiliary services:

5. Visual Braille services: To support the requirements of pharmaceutical companies, RoboBraille can create graphical Braille artwork based on the Braille codes of many European countries. Pharmaceuticals, printers and designers submit control files with the product name and strength, Braille number encoding regime and language codes. A subscription is required for these services.
6. RoboBraille Tools: A number of utility accounts support functions such as file partitioning; file conversion and file export to particular Braille character sets.

2 RoboBraille Interfaces and Formatting

2.1 Web Interface

The RoboBraille web form is the main interface to the RoboBraille service [5]. A location where it can be found is: www.RoboBraille .org. The form complies with the W3C WCAG2 guidelines and can be used by screen reader users and others with special needs. To convert a document, the user goes through a four-step process:

- Step 1: Select the file and upload it to the RoboBraille server. Alternatively, an URL or plain text can also be used as input.
- Step 2: Select output format of the document.
- Step 3: Provide options for conversion. These options are specific to the target format selected, e.g., contraction level and Braille code for Braille conversion, TTS language and speed for mp3 audio conversions and e-book format and base line font text size for e-book conversions.
- Step 4: Provide a valid email address. The result of the document conversion will be mailed to the email address provided.

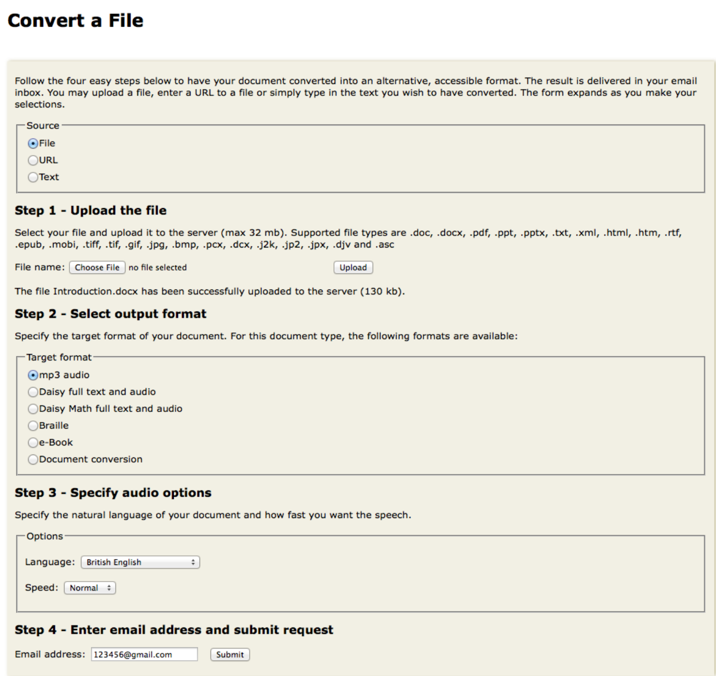

Fig. 1. The Robobraille Web Interface

2.2 RoboBraille Email Interface

The email interface was the original interface to RoboBraille. Users submit their documents to various email accounts in order to have the documents converted into alternate formats. Options are provided through the subject field of the email. In fact, the RoboBraille Web Form merely composes and submits an email to match the requested document conversion. Thus, all functions available through the web interface are available through email. The email interface even supports functions and options that are not made available through the web interface. The categories of email accounts available are:

- Braille
- MP3
- Daisy
- Daisy Math
- Accessibility
- e-book
- EPUB3
- RoboBraille tools

2.3 Formatting and Embossing Documents

Additionally, RoboBraille includes a number of facilities to convert character sets, format and emboss Braille documents. Internally, RoboBraille uses the OctoBraille character set, a Braille variant of the standard Windows 1252 character set also known as Latin 1.

3 RoboBraille Translation Process

Fogure 2 shows the RoboBraille Braille translation process. Prior to translation, Word and RTF files are converted into text. Depending on the size of the file, the traffic and server workload, a result is typically returned to the user in a matter of minutes of submitting a request for translation. RoboBraille assumes that the source document is written in the standard Windows character set for Western Europe (ISO 8859-1/Latin 1/Windows codepage 1252). Furthermore, the system supports automatic conversion of older ASCII documents with the file-type .asc to Windows text files. Once translated, the document is returned in OctoBraille 1252, a Braille adaptation of the standard Windows character set used in Western Europe developed by Synscenter Refsnæs [6] Since few Braille devices share the same character set, RoboBraille can convert the translated document into a range of different formats to accommodate Braille note takers and embossers. Such conversion is achieved by specifying the name of the Braille character set in the subject line to the email.

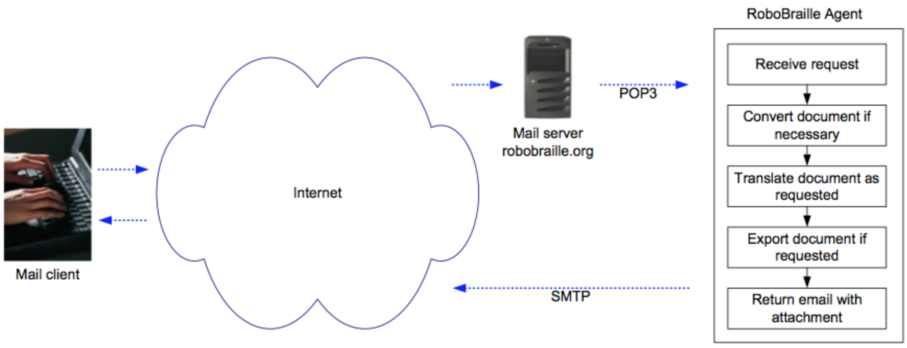

Fig. 2. RoboBraille Braille Translation Process. From [1].

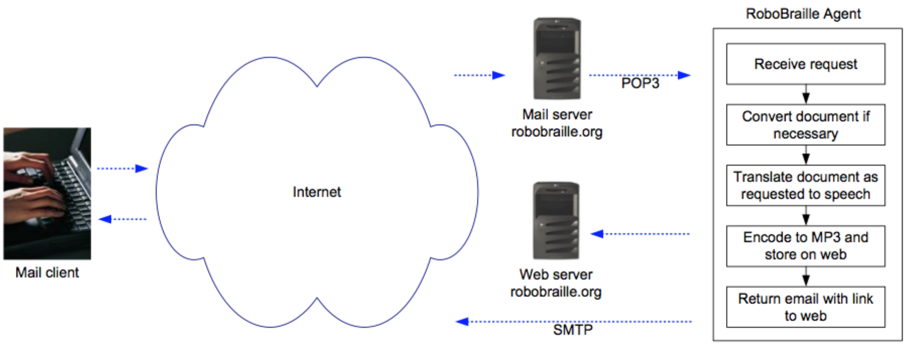

Fig. 3. RoboBraille text-to-speech translation process. From [1].

Likewise, the user may request a document be translated into synthetic speech. The process is similar to that of Braille translation, although some of the steps are different. The illustration below illustrates how a user may use the RoboBraille service to translate a document into synthetic speech:

First, RoboBraille translates an attached document into a WAVE file. WAVE files are rather large and unsuitable for transmission via the Internet. Therefore, the WAVE file is subsequently encoded and compressed into an MP3 file. The resulting audio file is copied with a unique name to the web server using FTP, and a link to the file is returned to the user.

4 RoboBraille and the GPII

Prosperity4All is a four year project funded by the European Commission under the 7th Framework Programme (FP7) that seeks to build the Global Public Inclusive Infrastructure (GPII) [7]. During the project, RoboBraille will be adapted to fit into the overall technical architecture of the project, and interfaces for new conversion capabilities such as semantic structure recognition, text-to-sign language and language-to-language translation will be added.

In the Prosperity4All project, the capabilities of the RoboBraille service will be extended in a number of ways: Through an open-source adaptation, third parties will be enabled to establish media conversion services and to integrate such conversion services with other systems. Through modularization and coupling it to the Prosperity4All/GPII infrastructure, the Prosperity4All crowdsourcing mechanisms will allow third party researcher, developers or commercial concerns to contribute new conversion capabilities as either free or paid modules or improved modules thus allowing it to grow with resources beyond the Robobraille project itself. By coupling it to the auto-personalization from preferences" (APfP) capability it is possible to have materials sent to an individual be automatically transformed before delivery.

The RoboBraille agent will be reimplmented in a set of modules that support crowdsourcingX2 (support for crowdsourcing by both developers and users) and that can be deployed in the Cloud4all/GPII auto-personalization from profile" (APfP) infrastructure. This activity will include breaking the current RoboBraille agent functionality into a number of discreet document transformation components, establishing uniform interfaces to commercial and open source third party technologies (Microsoft Office, Daisy, e-book, OCR, TTS), and development of suitable, adaptable user interaction components (web, mobile, mail, API).

This modularization will enable both the direct incorporation of this functionality with the overall Cloud4all/GPII APfP infrastructure as well as the ability to bring crowdsourcing to bear on the continual improvement of this both by RoboBraille and by student/professor researchers, developers, and others. By making the modules separable and focused we can also engage gamificiation effects in that individual modules (new or better) can be tackled by an individual or group that could not hope to even learn the system as a whole. For example, a Ph.D. student working on machine vision might create a new module for OSR that would allow the system to handle pages with more complicated layout – advancing the usefulness of the whole infrastructure which could then transform those materials into accessible formats that the machine vision student doesn't even know exist.

At the same time – the new engine will be developed so that it can be replicated so that it can stand alone behind firewalls. The activity will be based experienced from the implementation of bespoke versions of RoboBraille at academic institutions [2], and well as in the financial and pharmaceutical sectors.

This activity will include specification and implementation of a stand-alone version of the document transformation engine as well as a specification and implementation of a set of interface components This activity will be based on experiences from the implementation of bespoke versions of RoboBraille at academic institutions [2] , as well as in the financial and pharmaceutical sectors.

This activity will include specification and implementation of a stand-alone version of the document transformation engine as well as a specification and implementation of a set of interface components to allow third parties to integrate existing systems with the document conversion service. This ability has proven to be essential not only for companies wishing to make internal documents available freely to employees with disabilities while maintaining their confidentially and security behind corporate firewalls, but also for government agencies who face the same problem with social benefit information which they need to make accessible both to consumers and to employees while maintaining strict control of the information. The implementation will be designed to handle these and similar situations. to allow third parties to integrate existing systems with the document conversion service.

Currently, even highest quality commercial OSR (optical structure recognition) engines have trouble dealing with some types of tabular, math and science Materials. One particular problem is sparsely populated tables that do not have lines and that span across pages with headers and footers. Such tables can be common in materials sent to consumers. However it is impossible for them to make sense of them if they cannot see them. They're also hard to decipher if highly enlarged. Part of the Prosperity4All project will be to explore machine vision techniques to see if this can be resolved. We will also collaborate with external researchers and to see if a means for better processing of math and science materials can be identified and coupled with the system using its new (to be implemented) modular approach.

This project will also couple, for the first time, language translation capability with the accessible format transformation engines. This will allow individuals to not only get materials accessible form, but also in a language that may be easier for them to understand. As part of this, RoboBraille will develop the capability to attach text to sign language translation engines so that materials can be presented in sign language for those who would find the material easier to understand that form as soon as sign language translation modules are available and for the languages in which they are available. (Note: This project is not proposing to create a text to sign language translator.)

This project also seeks to, for the first time, combine document transformation technologies with media access technologies to create a combined system/process that could be used to make next-generation books with embedded video accessible.

5 Conclusion

RoboBraille was initially developed in an attempt to make Braille easily available to anyone with a need. It now offers audio, e-book, and accessibility services as well. It has been successfully used in educational and commercial environments. RoboBraille is widely used within Europe and is now being adapted to fit in to the GPII. Interfaces for new conversion capabilities such as semantic structure recognition, text-to-sign language and language-to-language translation are to be added.

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