# SCRIBE: A Model for Implementing Robobraille in a Higher Education Institution

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**Abstract.** The provision of alternate formats for students with print-based disabilities can be challenging. Producing educational material in alternate formats is often time consuming, expensive and requires special knowledge and training of staff. Therefore, in most settings, students are dependent on others, such as disability service personnel or external producers, to obtain their academic materials in their preferred accessible format. Even with these resources available, students may still encounter delays in receiving their alternate formats in a timely manner. For example, a student receiving an inaccessible version of a hand-out or other academic content from a professor on a Friday afternoon may be required to wait until the next business week to receive an accessible version of the document as most institutions or external providers do not run their alternate format production centres seven days per week, year-round. The RoboBraille service offers fully automated conversion of text into a number of alternate formats allowing the individual student to be independent. This paper describes how the RoboBraille Service was turned into a self-service solution for students at Stanford University, called the Stanford Converter into Braille and E-Text – or SCRIBE. The overall purpose of SCRIBE is to encourage students to become self-sufficient by simplifying the production of accessible formats.

**Keywords:** Alternate formats, accessibility, self-sufficiency, conversion, educational material, print-based disability, Braille, MP3, DAISY, e-books, student independence.

## 1 Introduction

The provision of alternate formats for students with print-based disabilities is a standard practice at nearly all higher-education institutions. Disability services offices often develop policies and procedures for their alternate format programmes as well as invest in computers, software applications, and staff training to assist in the

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document conversion process. Despite such support, for students requesting their academic materials in alternate formats, obtaining accessible versions in a timely manner and in the format preferred by the student can be challenging. Additionally, a student may wish to use different document formats depending on the nature of the academic material and their preferred assistive technology or mobile device. As students change the manner in which they interact with their academic information, it is necessary for institutions to consider alternative options to successfully meet student needs.

Disability services offices often manage an alternate format production facility at the institution focusing on the conversion of academic materials for students with print-based disabilities into a variety of document formats, including Braille, e-text, tactile graphics, and large-print. Additionally, campus computer labs may include several computers with various software-based assistive technologies and alternate format applications allowing students to interact with their academic materials at these locations. Even with these resources available, students may still encounter delays to receiving their alternate formats in a timely manner. For example, a student who receives an inaccessible version of a hand-out or other academic content from a professor on a Friday afternoon may have to wait until the next week to receive an accessible version of the document as most institutions do not run their alternate format production centres seven days per week all year long. And while campus computer labs may offer software applications to assist with alternate format creation, such applications generally require training and familiarity in order to produce a usable version by the student.

With these challenges in mind, in 2011 the Office of Accessible Education/Schwab Learning Center at Stanford University implemented a pilot project to develop a simple web-based, document conversion system supporting the production of accessible formats for students with print-based disabilities as well as the conversion capabilities to document formats for emerging mobile devices. The system was based on RoboBraille [1 - 3] and the objective was to create an online solution to promote student independence while delivering alternative media accurately, timely and in student-preferred formats.

## 2 RoboBraille

RoboBraille is a web and email based service capable of automatically transforming documents into a variety of alternative formats for the visually and reading impaired such as Braille, structured audio books in Daisy format, plain mp3 files, e-books and more. RoboBraille can furthermore convert otherwise inaccessible documents such as scanned images and image-pdf files into more accessible formats. RoboBraille is available free of charge to all non-commercial users and users need not register in order to use the service. RoboBraille supports the Braille codes and contraction regimes of many national Braille systems and includes audio support for many European languages as well as for many other languages such as Arabic, American English and Latin American Spanish.

Originally a Danish service developed jointly the National Danish Centre for Visually Impaired Children and Youth and Sensus ApS, a research-based private consultancy company, RoboBraille has been validated throughout Europe with financial support from the European Commission in order to verify its technical, commercial and cultural viability. Building on the European results and supported by public and private donations, the RoboBraille team is currently engaged in several international projects aimed at improving the service in terms of quality and functionality, and expanding its geographical coverage. The objective is to create an unlimited supply of accessible material to anyone, anywhere with a need.

Combining commercial text-to-speech, text-to-Braille and OCR software and open source Daisy authoring and e-book conversion, RoboBraille currently serves some 1-2,000 daily user requests from all over the world.

## 3 The SCRIBE System

In order to be able to offer educational material in alternate formats 24/7 and to support students being independent, the Office of Accessible Education/Schwab Learning Center at Stanford University implemented a customised version of the RoboBraille Service during the fall of 2011. Built upon the RoboBraille engine, SCRIBE is a customised implementation intended to improve the availability of alternate formats to students with print-based disabilities. Figure 1 below shows the main user interface of the SCRIBE system [6]:

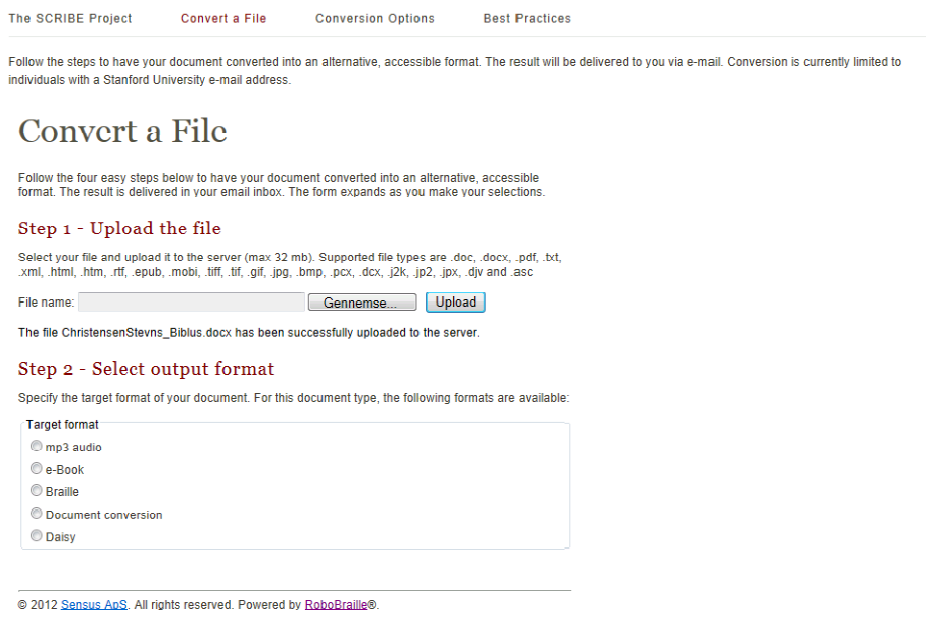


**Fig. 1.** The SCRIBE user interface showing the first two (of four) steps of converting documents into alternative media

Through an accessible web-based interface, a student can upload a file for conversion into different alternate formats. Depending on the original file type, a student may select from a variety of output formats, including mp3 audio, e-book, Braille, full-text/full audio Daisy or document conversion. Image-based files, such as image-only PDF documents, JPEG, or TIFF, undergo a separate optical character recognition (OCR) process to convert the document from an image format into a text-based version.

Once converted, the final document is sent to the student via email making it simple to deliver the accessible file to computers, tablets and smartphones. No training or familiarisation on the use of the OCR software is required from the student and the system is available outside of normal business hours.

SCRIBE is implemented as a customised version of RoboBraille. As such, a set of RoboBraille agents have been set up to manage the conversion of documents into alternative media. The RoboBraille agents have been configured with Microsoft Office 2007 for document conversion, Sensus Braille 4 for Braille transcription [4], Calibre e-book management for e-book conversion, Daisy Pipeline for Daisy conversion and three NeoSpeech voices for audio support. A designated agent handles all OCR conversions using ABBYY FineReader 10 Corporate Edition. In addition to the RoboBraille and OCR agents, the SCRIBE system is composed of a web server (Microsoft IIS 7.5), a mail server (hMailServer) and an ftp server (Argosoft FTP). All agents are running 32-bit Microsoft Windows 7 and hosted in a virtual environment using WMWare ESXi. At this time, access to the system is currently limited to members of the Stanford community with a valid institutional email account.

A number of additional functionalities were added to the core RoboBraille engine to satisfy the functional requirements of the project: Support for the American Braille code and US Braille paper formats had to be implemented; the university furthermore required a web interface to the service as opposed to the traditional email-based interface to RoboBraille. Finally, the SCRIBE system had to support conversion into the most popular e-book formats. Likewise, some components were removed from RoboBraille as part of the customisation. These mainly include the multilingual aspects of the service such as the multilingual user interface, the range of available TTS voices and the support for multiple Braille codes and contraction regimes. As a consequence, the SCRIBE user interface is only available in American English, the TTS voices have been limited to three American English voices and Braille support has been reduced to Grade 1 and Grade 2 in the North American Braille code. Furthermore, ABBYY FineReader Corporate Edition is utilised in SCRIBE as opposed to ABBYY Recognition Server 3.0 currently used in RoboBraille.

## 4 Advantages and Results of Implementing SCRIBE

Following the launch of SCRIBE in 2011, students have the options of requesting alternative media from the Office of Accessible Education or use the SCRIBE self-service platform. SCRIBE is not limited to students with print-based disabilities but is available to the entire Stanford community. Usage figures from the initial four months

of operation suggest that students find the document conversion and mp3 conversion features of SCRIBE especially useful. Table 1 below summarises the usage split between the different services offered by SCRIBE during the period November 2011 to February 2012:

**Table 1.** Usage split by SCRIBE function. November 2011 – February 2012

| SCRIBE function | Percentage | |
|---|---|---|
| Document conversion | **58%** | |
| Mp3 conversion | **34%** | |
| - of which NeoSpeech Julie | | 30% |
| - of which NeoSpeech Paul | | 3% |
| - of which NeoSpeech Kate | | 1% |
| E-book conversion | **6%** | |
| - of which Mobi Pocket | | 3% |
| - of which ePub | | 3% |
| Braille | **2%** | |
| Daisy | **-** | |
| Administrative | **2%** | |

The self-service approach of SCRIBE appears to offer a number of technological and service-related advantages as well as advantages of a more principle nature. Based on experienced from early stage use of the SCRIBE system, advantages in the areas of scalability, availability and flexibility, privacy and extended support have been derived.

**Scalability:** The SCRIBE system is unique in its approach to providing multiple conversion system in an efficient and effective manner. Converting text files into mp3 audio using computerised text-to-speech as well as performing OCR functions can require significant CPU processing requirements. Such computational processing generally requires a mid- or high-level computer to perform these tasks efficiently. Purchasing multiple physical machines can be costly, both in terms of hardware and the requisite office space. Rather than multiple physical computers, the SCRIBE system is built upon multiple virtual machines with each virtual system hosting a "conversion agent" to process files. As the OCR and the creation of audio files from text-to-speech programs can increase CPU requirements, the advantage of the virtual machine model is that additional computing and CPU resources can be directed to the appropriate virtual machine as needed.

Additionally, the existence of multiple virtual machines ensures that during periods of high usage there are several "conversion agents" available to process files into the desired output formats. A virtual machine model also has the advantage of decreasing the overall footprint required for numerous physical computers and releasing office space for other production needs. In order to expand upon text-to-speech, OCR, or document conversions capabilities within the SCRIBE system, system administrators can easily clone more virtual machines with the requisite appropriate software licenses to support any increased demand rather than purchase and deploy additional hardware solutions.

**Availability and Flexibility:** Rather than wait for a document to be processed into an accessible format by the alternate format production office, there is now an institutional model demonstrating a new concept in the acquisition of accessible formats by students with print-based disabilities. The SCRIBE is system is available 24/4 and students can request as many different alternative formats as they wish. Similarly, students can convert extracurricular material and other material not necessarily offered by the alternate format production office. As students begin using various assistive technologies, mobile devices, and document formats, it is necessary for institutions to consider new methods to meet the unique academic needs of this student population. Alternate format production offices will remain a key component in producing accessible formats for students at higher education institutions; however, a web-based alternative, such as the SCRIBE system, may provide a simple and efficient platform for meeting student alternate format demands.

**Privacy:** By relying on alternate format production offices to convert material into alternative formats, students loose the privacy granted everyone else. By offering a self-service solution such as SCRIBE, students can maintain their privacy of what they are reading.

**Extended Support:** While alternate format production offices may be available to students at academic institutions, this is not necessary the case when students graduate and find a job. However, the need to convert material into alternative formats is likely to remain amongst print-impaired graduates. By offering a self-service solution such as SCRIBE, academic institutions are capable of extending the service they offer to students beyond the period when the students are enrolled at the institutions.

## 5 Conclusions and Future Activities

In 2011, the SCRIBE system was successfully implemented as a pilot project at Stanford University and a phase 2 has been planned for 2012. Although usage figures are still low compared to RoboBraille, the number of SCRIBE users and user requests submitted to SCRIBE is increasing monthly. Print-impaired students as well as other students, faculty and others within the Stanford community now have access to a self-service solution capable of automatically converting a wide range of document types into alternative media.

Based on the experienced from the implementation and initial period of use, the following conclusions can be made:

**Technical Challenges:** During the implementation, a number of technical challenges were experienced. Some were overcome during the project whereas others were postponed to subsequent phases of the project. Several virtualisation platforms were tested during the project before settling on VMware, as this supported sound-card emulation for the text-to-speech conversions. For OCR production, ABBYY FineReader 10 Corporate Edition was implemented as a (somewhat stable) “waterfall” conversion model, where the input file is passed from one conversion “hotfolder” to the next as each output format is created. Subsequent investigations have identified the possibility to move away from a "waterfall" model with ABBYY

Finereader while still creating the necessary output formats. Amongst challenges that were postponed is the implementation of support for conversion of Microsoft Word documents containing math formula into full-text/full audio Math Daisy projects. The project furthermore experienced license restrictions regarding the use of TTS voices. Because of these restrictions, SCRIBE currently only supports American English and the audio service is only available on one of the three RoboBraille agents in operation.

**Ideas for Improvements:** Obviously, the project spawned a number of ideas for improvements to the system. Amongst these are support for conversion of Microsoft Word and PowerPoint documents into tagged and accessible PDF, conversion of Microsoft PowerPoint into alternative formats, auto-editing of scanned documents for features such as headings and optional hyphens prior to conversion, and improved system monitoring. These features are expected to be included during phase 2 of the SCRIBE project and will subsequently be rolled into RoboBraille thereby making the improvements available for a larger educational and public community.

**Spreading Interest:** The potential of SCRIBE as a means for self-sufficiency and independence amongst print-disabled students is demonstrating the capacity to implement a localized version of the RoboBraille platform, and other academic institutions are currently considering how they may implement versions of the system on their own.

The perspectives in using the RoboBraille Service a customised, self-service solution are numerous. Because of the simplicity of the user interface in combination with the multiple conversion possibilities, a solution similar to SCRIBE is well suited for number of educational institutions, such as schools, colleges and universities. The web interface can be customised to fit the exact needs of the individual setting in terms of style and colour, name, user management, conversion possibilities and languages. This allows the students to be self-sufficient when it comes to simple conversion whilst retaining their privacy. The diversity in output formats accommodates a number of different modern platforms, e.g. tablets and mobile devices and puts the student in charge of managing his or her own alternate format production.

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