iSTEP 2013: Development and Assessment of Assistive Technology for a School for the Blind in India

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Abstract

Assistive devices for the visually impaired are often prohibitively expensive for potential users in developing communities. This report describes field research aimed at developing and assessing assistive technology that is economically accessible and relevant to this population of visually impaired individuals. The work discussed was completed at the Mathru School for the Blind as part of the iSTEP internship program, which is organized by CMU's TechBridgeWorld research group. Eight CMU student interns were recruited to work on this project over the course of nine weeks in Bangalore, India. In particular, this report details the development of two affordable technologies that aid in the teaching of braille writing to visually impaired children. These tools were created through an iterative process that incorporated user feedback at different stages of design and development. Findings from this research indicate that such assistive tools can enhance the education experience for visually impaired children in India, and can also facilitate the teaching process for their educators. In addition to technology development, at the request of the local partner institution, researchers conducted training sessions at the Mathru School for the Blind to enhance teachers' computer literacy and skills. This report outlines the structure of these lessons for both sighted and blind individuals, as well as outcomes from the training sessions and feedback from participating teachers.

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Introduction

Braille is the primary mode of reading and writing for blind and visually impaired individuals. Worldwide, there are approximately 285 million visually impaired people, which includes 1.4 million children aged 0-4. About 90% of the world's blind live in developing countries, and of this population, it is estimated that fewer than 3% are literate [1][2]. These statistics are particularly concerning given the important role literacy plays in securing employment, good health, and general social well-being. More specifically, a recent survey conducted by the National Federation of the Blind Jernigan Institute in the United States revealed that data from their 500 respondents supported a correlation between the ability to read Braille and a higher educational level, a higher likelihood of employment, and a higher income [3]. In addition to basic reading and writing skills, blind students also experience challenges with interpreting graphical information that is encountered in subjects such as geometry and biology. Accessing this type of information is necessary to master scientific concepts in particular. In general, it is important for all children to receive an education that will allow them to develop and grow into independent adults. However, education for the blind in developing communities is often hampered by a lack of necessary resources and available schooling options. There is potential for interventions to support the education of blind children in underserved communities around the world.

To this end, the TechBridgeWorld (TBW) research group at Carnegie Mellon University (CMU) has partnered with the Mathru Educational Trust for the Blind (Mathru Trust) in Bangalore, India to develop assistive technological solutions that are economically feasible to enhance the education of blind children. In particular, TBW has worked with the Mathru School for the Blind (Mathru School) since 2006 and previously conducted field research at the school in 2006, 2008, and 2011. As a result of this collaboration, TechBridgeWorld developed the Braille Writing Tutor and the Stand-Alone Braille Writing Tutor, also known as the Braille Tutor technologies. The main objective of the Braille Tutor technologies is to teach the skill of writing braille using the slate and stylus through guided practice. TBW developed the Tactile Graphics software tool to enhance tactile literacy among blind students. The main objective of this tool is to reliably convert regular images into a form that can be affordably printed as tactile images on low-cost embossing devices meant only for printing braille text. Essentially, this tool translates images into a text format that can be printed using a low-cost text braille embosser.

The iSTEP (innovative Student Technology ExPerience) research internship was initiated by TBW to provide CMU students the opportunity to work on technology projects that to address needs of underserved communities. This report summarizes the work completed during the iSTEP 2013 internship, which consisted of work on three main projects: (1) further development of the TechBridgeWorld's Braille Tutor technologies, (2) development of software to print tactile graphics, and (3) teacher training. Work done with the first project mainly included improving code and designing and developing new modes for the two devices. The project on Tactile Graphics entailed enhancing an application previously created for the Mathru School by adding more features and functionality to it. Teacher Training was a project requested by the Mathru Trust to encourage teachers to operate computers independently, and included basic typing and computer skills instruction. In addition, through these training sessions teachers and staff were also instructed on how to operate new technological devices that were acquired by the Mathru Trust.

Contributions of This Work

This report is intended for assistive technology innovators, researchers and academics, and special educators who work with visually impaired students. Findings from this research offer meaningful insight into how to better design and implement technology for the educational enrichment of visually impaired students. The work detailed in this report is expected to contribute to improving the education of visually impaired students in developing communities. The technology developed and assessed will provide a basis for future work in the same field.

Outline of Report

This research report begins with background information on TBW, the iSTEP internship, our partner the Mathru Trust, and the Braille Tutor technologies. Related work is discussed next, followed by the main iSTEP 2013 projects, including Braille Tutor technologies, Tactile Graphics, and Teacher Training. The report concludes with a discussion on the long term assessment of these projects and potential future work.

Background

TechBridgeWorld

Founded in 2004, the TechBridgeWorld (TBW) research group innovates, adapts and implements technology to address challenges in developing communities across the world. Based in the Robotics Institute at Carnegie Mellon University (CMU), TechBridgeWorld applies their technical and research expertise to "bridge" the technology gap worldwide, with the goal of providing all people access to the transformative power of technology. TechBridgeWorld works with local partners to understand and realize each community's own vision of progress through the application of technology solutions that are locally suitable and sustainable.

iSTEP

The innovative Student Technology ExPerience (iSTEP) internship program is 10-week intensive summer internship opportunity that is open to undergraduate and graduate CMU students from the Pittsburgh or Doha campus. Initiated in 2009 by TBW, iSTEP has been running annually for five years now, with past projects in Tanzania, Bangladesh, Uruguay and Ghana. This year, iSTEP will be partnering with the Mathru School for the Blind located in Bangalore, India. iSTEP is a very rigorous and competitive program that attracts students who can demonstrate high levels of involvement, creative problem-solving skills, academic achievement, global mindset, broad outlook teamwork ethics, and cultural adaptability. Students selected for iSTEP gain a real-world, real-work experience through solving challenges in underserved communities across the world.

Mathru Educational Trust for the Blind

For all iSTEP 2013 projects, researchers worked in partnership with the Mathru Educational Trust for the Blind (Mathru Trust), which was founded in 2001 by Ms. Gubbi R. Muktha. The Mathru Trust is an entity funded by private donors who support the education and development of blind children in India. Shortly after its institution, the Mathru Trust went on to establish the Mathru School for the Blind (Mathru School) in Bangalore, the largest city in the Indian state of Karnataka. Ms. Muktha's inspiration to launch the Mathru School came from a tragedy in her own life that rendered her immobile for a few years due to a serious foot injury [4]. During her rehabilitation in India she encountered blind individuals who, she noted, relied heavily on others for help with day-to-day activities such as boarding the correct bus. Given her own struggles to become self-sufficient, she recognized a need for assisting the visually impaired to gain independence and a sense of self-worth. The Mathru School is dedicated to the growth, education and care of visually impaired and blind children, and encourages its students to reach their full potential and become valuable members of society.

Since its launch in 2001, the Mathru School has greatly surpassed Ms. Muktha's expectations, with it growing from very humble beginnings to a widely recognized and respected establishment. The school began with just one student and one teacher working in Ms. Muktha's residence. Today the school is housed in a 15,000 square foot, multi-building complex and accommodates a total of 90 students and eight teachers (some blind and some sighted) at the school. Most students at the Mathru School are from rural and impoverished areas of the state of Karnataka, and live in the residential hostels at the school. These residential facilities make it possible to enroll students who live in towns far from Bangalore. The Mathru School also provides a host of other facilities to students, including access to a library, recording studio, computer lab and Braille Writing Tutor room. Moreover, with generous donors and grants continuing to financially support the Mathru Trust, education at the Mathru School is offered at no cost to students, which enables the school to accept children from low income socioeconomic backgrounds.

The Mathru School provides a holistic education, teaching students basic life skills as well as traditional academic subjects for standards (grades) 1 through 10. Upon graduation, Mathru students possess the equivalent of a high-school degree in the U.S.A. Notably, students at the Mathru School qualify at the same level as their sighted peers in the Indian state of Karnataka, by successfully completing state-level examinations in order to graduate. The Mathru School employs creative and resourceful solutions to make information on a variety of subjects accessible to its visually impaired and blind students, so as to place Mathru students on an equal footing with their sighted peers. The government of Karnataka, however, exempts visually impaired students from math and science given the visual nature of those subjects. Instead, these students are tested on economics, sociology and political science. Although visually impaired students are required to complete final state-level exams by employing a scribe, the Mathru School focuses on teaching its students braille to enable their independence. Therefore, in addition to the subjects that their sighted peers study, students at the Mathru School also learn braille in English, Kannada (the local language) and Hindi.

Instruction at the Mathru School takes place in both English and Kannada, the local language of the Karnataka state in India. It is important to note that many of the students are not fluent in spoken English when they enroll at the Mathru School. Students also learn how to read and write braille, and lessons are primarily taught by dictating facts and procedures. Although more effective teaching methods may be available through the use of technologically advanced tools, such teachings aids are typically not economically accessible to the Mathru School and other schools in developing communities. The Mathru School is resourceful and strives to provide the best education possible to its students; however, the school is still limited in terms of resources and facilities it has access to. Therefore, affordable assistive technology can be invaluable to schools such as Mathru in developing communities across the world.

Braille Tutor Technology

Literacy has been shown to be a key factor in global development; however, the literacy rate of blind and visually impaired people living in developing communities is estimated to be less than 3%. In response to the need for enhancing literacy rates among the blind and visually impaired in underserved communities, TechBridgeWorld developed Braille Tutor technologies to help guide students on how to write braille. A participatory and iterative design process was utilized in the development of the the Braille Tutor technologies to ensure that these tools accommodate user needs and are compatible with ground level realities.

Braille

Note that much of the content in this section was derived from the PhD thesis of M. Beatrice Dias who is a co-author on this report [4].

The basic braille system consists of cells with six locations, referred to as “dots”. Different combinations of these dots represent the different letters of an alphabet. The six dots in a braille cell are aligned in three rows of two, and numbered as depicted in Figure 1. Braille is written by embossing a combination of these six dots onto a paper, and is read using tactile senses by running fingers along the page (left to right for English braille). For example, the letter ‘h’ in English is represented in a braille cell with dots 1, 2 and 5 embossed Figure 1. Therefore, when a person reads the letter ‘h’ in braille they should feel these three dots raised on the page within one cell space. To indicate the capitalization of a letter, the character should be preceded by given symbol. In the case of English braille, dot six would have to be embossed in the cell before the one in which a given letter appears [5]. A similar preceding symbol is required to distinguish between numbers and letters. Different languages have different character maps (*i.e.* an arrangement matching each character to a unique dot pattern), but typically use the basic six-dot system.

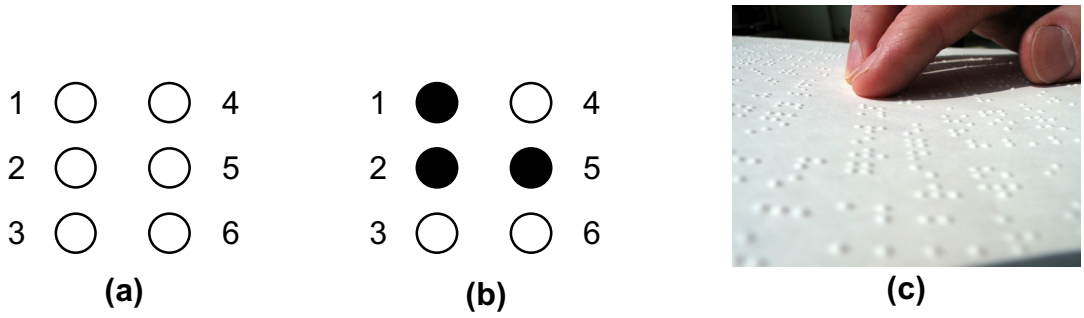


Figure 1. (a) Six-dot orientation of a braille cell for reading braille. (b) Unique dot pattern for reading the letter "h". The black dots would be embossed on a page. (c) Braille being read by running fingers along a page [6].

The Slate and Stylus Method for Learning Braille Writing

Note that much of the content in this section was derived from the PhD thesis of M. Beatrice Dias who is a co-author on this report [4].

In developing communities, the primary means for learning braille writing is the slate and stylus, which is substantially more affordable than advanced implements, such as the six-key braille typewriter (Brailler) [2]. The braille slate consists of two plastic sheets (hinged along one edge), where the top sheet has cut out rectangular sections in a grid-form to represent rows of braille cells, and the bottom sheet has indentations corresponding to the six dots in each of the braille cells on the top sheet (Figure 2). Braille paper is placed between the two plastic sheets of the slate, and different braille characters are embossed onto the paper using a stylus, which is a plastic implement with a metallic tip (Figure 2). The braille cell cutouts on the top plastic sheet of the slate guide the writer. In addition, each of these cell outlines is grooved in three places on either side to help identify the relative positions of the six dots within that cell. The special type of paper (*i.e.* braille paper) used with this tool is relatively thick compared to standard printer paper, and is not pierced by the stylus and is instead embossed.

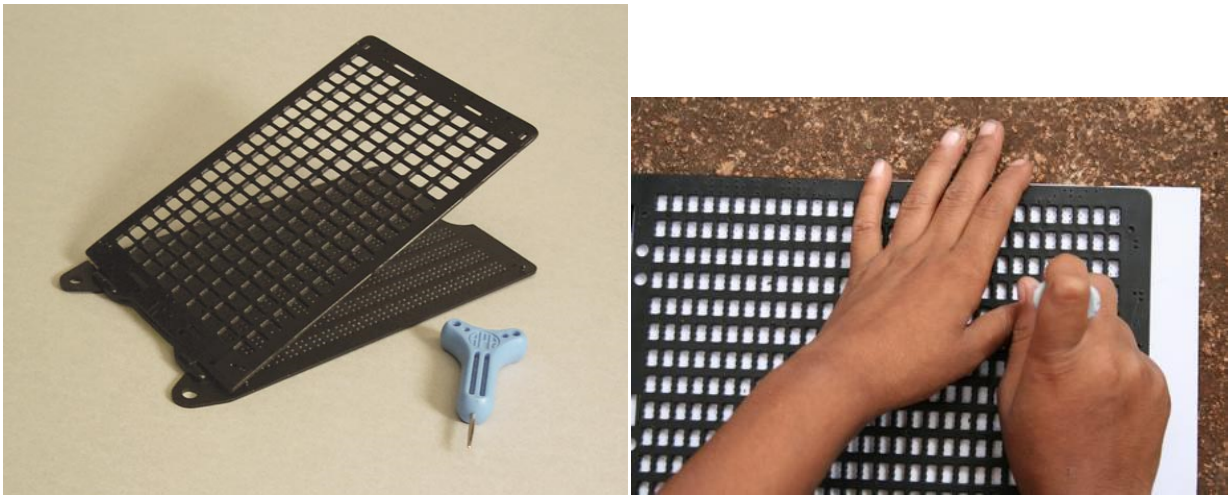


Figure 2. Images of a braille slate and stylus (left) [7] and a person writing braille using a standard slate and stylus (right) [8].

With the slate and stylus, braille has to be written in the direction opposite to which it is read. For English braille, this requires writing from right to left, such that when the paper is removed from the slate, it can be flipped over and read from left to right. Thus, to learn braille using the slate and stylus requires learning the

alphabet in two different orientations; the orientation in which it is read (left to right, for most languages), as well as its mirror image orientation in which it is written. This complicated process for mastering braille poses a significant barrier to literacy among the visually impaired in developing communities.

The Braille Writing Tutor

Note that much of the content in this section was derived from the PhD thesis of M. Beatrice Dias who is a co-author on this report [4].

The numerous challenges to achieving braille literacy in a developing community setting were identified through conversations and an extensive needs assessment conducted with the Mathru School for the Blind. To address the difficulties students face when learning to write braille, Kalra *et al.* developed a computer-based device (the BWT) that can be utilized to supplement the slate and stylus method of learning to write braille [2]. The BWT was designed to specifically teach braille writing skills that are necessary when using a slate and stylus, which remains the most affordable and ubiquitous braille writing tool in the world and is likely to remain so for the next decade or more. Thus, the BWT does not seek to replace the slate and stylus, but instead improve its impact by enabling more people to successfully master and use that system of writing braille. The user interface of the BWT is similar to a slate, but computing technology enables this device to provide audio feedback to the user and also detect errors in their braille writing. A standard stylus is utilized to interact with the device. In its current version, the BWT performs the following functions [9]:

- When a user makes an entry (writes) on the device, it provides immediate audio feedback by repeating the dot, letter or word entered.
- It offers corrective audio feedback when mistakes are made.
- The device selects braille practice exercises that suit the user's skill level, based on the type and number of mistakes made during the current user session.
- It offers educational games to make the user's learning experience more enjoyable.

The BWT can facilitate the very difficult process of learning to write braille using a slate and stylus, by providing immediate audio feedback to the user and thus enabling him/her to recognize and rectify mistakes. With a slate and stylus, a student will only be able to identify errors upon completion of an assignment, at which point the paper can be removed from the slate, flipped over and graded by a teacher [2].

Hardware

The hardware for the current version of the BWT is constructed from printed circuit board (PCB), acrylic plastic sheets and additional smaller elements such as buttons, screws and spacers (see Figure 3).

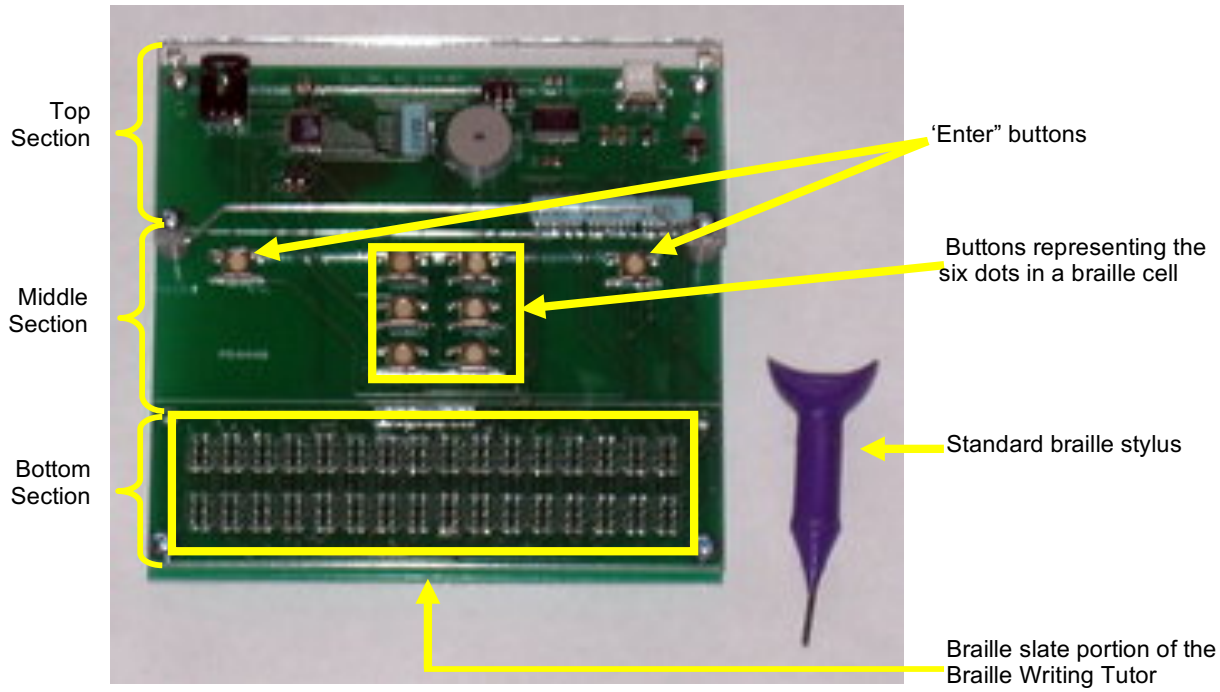


Figure 3. Main components of the current version of the Braille Writing Tutor [9].

Positioned in the top section of the BWT are, the microchip with firmware programmed onto it and a USB port to connect the device to a computer. The middle and bottom sections of the tutor comprise the primary user interface. In the middle section there are two "Enter" buttons on each side of the tutor, which enable the user to switch between modes in the software. The function of these two buttons is the same. Additionally, this section of the device contains six buttons positioned such that they represent the six dots in a braille cell. These buttons can be used by younger students to learn the concept of braille while their fine motor skills are still developing. The bottom portion of the BWT is built to match the design of a braille slate, with two rows of 16 braille cells that can be used to input braille characters with a stylus, just as would be done with a typical slate and stylus, except without the use of paper. When the stylus is inserted into these cells, it completes an electrical circuit, which sends a message to the computer to provide the appropriate audio feedback. The hardware for the BWT was originally designed based on feedback from teachers and testing at the Mathru School, and was refined through field tests in other developing communities around the world.

Software

The software for the BWT is primarily written in C++. This software enables the device to communicate with a computer and perform the array of functions described previously. Additionally, the software allows instructions and character maps to be easily changed to match different languages and local accents, by facilitating the adjustment of default settings.

The BWT has many educational modes for users to learn how to write, practice writing, and be quizzed on letters, words, and numbers. The software was designed to easily accommodate most braille languages (those with alphabets that have 2 to the power of 6 characters or less). Sample learning modes include: Learn Dots, Dot Practice, Learn Letters, Letter Practice, Learn Numbers (Nemeth Code), Arithmetic Practice, and Free Play. Basic learning modes are now available in many different languages including English, Arabic, Bangla, Chinese, French, Hindi, Kannada, and Kiswahili. The BWT also has modes for educational games. Several educational games have been developed for the BWT software including an animal sounds game, everyday noises game, hangman, dominoes, and music-maker, which are intended as a further motivation factor for learning to write braille.

The software was also designed to use pre-recorded sound files for all feedback and instruction. This feature makes it simple to add customized sounds for each location allowing us to use locally recorded trusted voices with appropriate languages and accents, making the instructions easier to understand for the local students.

Furthermore, the software can adjust the instruction offered based on how the user responds to the testing modes of the tutor. For example, if the BWT asks the user to write the letter 'h', but the incorrect dot combination is entered, then corrective instructions are provided until the correct response is obtained. Furthermore, in the next round of testing, the user will be asked to write the letter 'h' again, since s/he incorrectly entered that letter the previous time. This form of customized instruction is very useful, especially for younger users. After each user session, however, the user's information is not stored, so user tracking is not possible with this version of the BWT.

Application

The BWT has been tested in several locations across the world (including India, Zambia and Tanzania) with positive feedback from users and indications of favorable effects on student learning (Figure 4) [9][10].

Figure 4. A student at the Mathru School in India interacting with the Braille Writing Tutor (left) [9], and a student and teacher in Tanzania interacting with the Braille Writing Tutor (right) [10].

The Mathru School adopted the BWT in the fall of 2006 and has been utilizing the device since that time. The original version of the BWT was designed to meet the needs of this particular school. Also, most of the curriculum included in the BWT was influenced by teachers and students at the Mathru School. Development continued and in the summer of 2008, a group of students from Carnegie Mellon's Technology Consulting in the Global Community (TCinGC) went to field test the improved BWT (Figure 5) [11]. Since conducting the first trials with the BWT at the Mathru School, the school has integrated the use of this tool into their classroom and other curricular activities, with a small space in a classroom at the Mathru School devoted to their use. The tutors are primarily used on the weekends by teachers to tutor struggling students, but students of all ages enjoy playing the games on them. "Hangman" and a game involving spelling out various animals based on their sounds are the most popular [12]. Enhancements in the summer of 2013 included adding modes such as "Hindi Learn Letters," "Kannada Learn Letters," "Maths Practice," "Braille Contractions," and "Everyday Noises Game," as well as general enhancements and improvements.

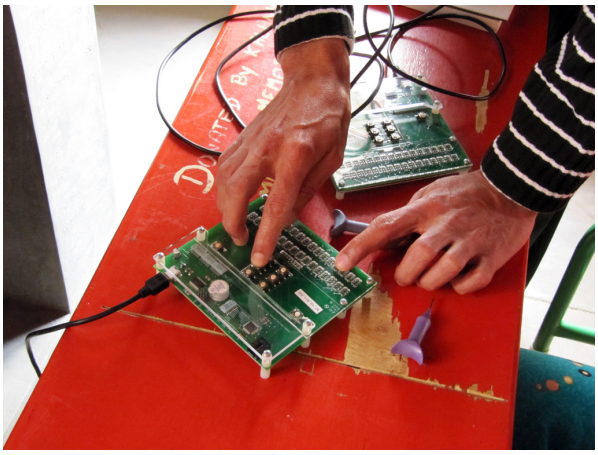


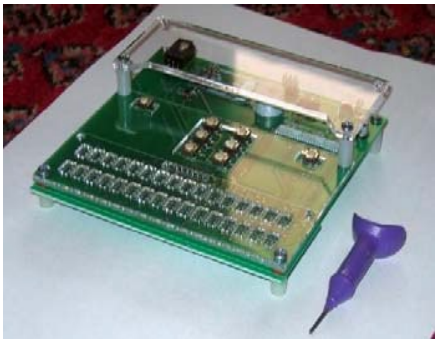
Figure 5. Version 2 of the Braille Writing Tutor.

The Standalone Braille Writing Tutor

The Stand Alone Braille Writing Tutor (SABT) is a relatively new version of the BWT. It was developed in response to feedback from various field tests of Version 2 of the BWT with partner communities around the world (Figure 6). Major feature developments on the SABT were motivated primarily by some of the contextual challenges that target communities encounter; specifically, the lack of access to reliable grid electricity supply and computers. Further content and user interface developments were also incorporated into the SABT prototype [11].

a)

b)



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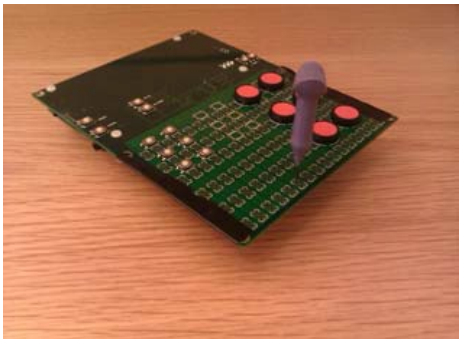

d)

Figure 6. Evolution of Braille Tutor technology (a) Conventional slate and stylus [13] (b) Students at Mathru using version 1 of the BWT (c) Version 2 of the BWT (d) Initial prototype of the Standalone Braille Tutor.

The SABT, as the name suggests, is a stand-alone version of the BWT. It retains all of the functionality of BWTv2 but also has on-board processing and power capabilities, thus eliminating dependence on a computer. The SABT design includes personalized headphone ports in lieu of on-board speakers. This allows multiple devices to be used in the same classroom with minimal interference between audio output from the different units [11]. The SABT also facilitates customization because it stores audio and configuration files on an easily accessible SD card. This allows for the potential to train instructors on how to modify content files for the SABT depending on what they want to make available to their students [14]. The SABT can be powered by: (1) four rechargeable or disposable AA batteries, or (2) USB power when connected to a computer. The device is designed to run for up to six hours with a fresh set of batteries [11].

The SABT (Figure 7) has a modular design with a main logic board and three separate interface boards: primary, intermediate and advanced. For the SABT's primary user interface six large buttons are incorporated to mimic an enlarged six-dot braille cell. The intermediate board has three sets of six medium-sized buttons (representing 3 different braille cells), and two rows of braille cells similar in size and shape to those on a braille slate. Finally, the advanced board has six rows of standard sized braille cells. These interface boards can be swapped out depending on the skill level of the student using the SABT [14].

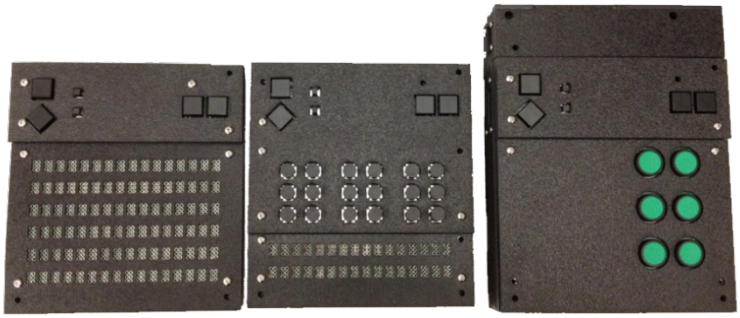

Figure 7. Three SABT user interfaces. From right to left: Beginner interface, Intermediate interface, and Advanced interface.

The SABT is a prototype and still under development. User testing conducted through the iSTEP 2013 internship provided valuable insight into possible enhancements that can improve the SABT's functionality, usability and effectiveness.

Related Work

The following section reviews previous work in the areas of education for visually impaired children and assistive technology for the blind. In particular, effective methods for teaching blind children as well as approaches to designing and implementing assistive educational technology for these students are examined in order to inform strategies for improving the BWT and SABT.

Several studies have been conducted to identify efficient methods for teaching blind students [15][16]. Some advocate that learning and playing need not necessarily be separate; having fun while learning is one of the best ways to motivate blind children to learn [17][18]. Children seem to learn more when the lesson is in game form [16]. Various studies have been done to help understand what kinds of interfaces are most suitable and beneficial for blind users [19][20][21]. Farnsworth examines the implications of instruction in and use of both uncontracted and contracted braille [19]. Uncontracted braille is the traditional form of braille where there is a one-to-one matching between letters of the alphabet and unique dot patterns; whereas contracted braille uses single dot patterns to symbolize common prefixes, suffixes, or phrases such as 'ing' or 'pre'. Uncontracted braille is typically taught first, and as students improve they progress to learning contracted braille. In particular, students who struggle with learning braille reportedly find it easier to use uncontracted braille rather than

contracted braille. The current version of BWT and SABT software only supports uncontracted braille, but modes related to contracted braille may be incorporated into future iterations of this technology.

Klingenberg studied a geometry course for elementary school blind students, in order to better understand whether and how multi-sensory learning plays a role in this scenario [18]. Two students from Norway ages 10 and 11 were observed during a course designed to allow the students to explore geometric shapes and create conceptual images of the shapes. Students were found to explore small hand-held objects by rotating them and experimenting with their point of balance. Touch was often used to gain a sense of dimension of these objects. The study also included the examination of larger objects in a gymnasium. Students often used the width of their arm or other aspects of their bodies to measure and get a sense for the shape and size of the objects. Interestingly, the study noted that students put their heads into large openings, not to measure the opening with their head, but to focus on how the sound differed inside the opening vs. outside [18]. In this way students used many senses in order to deduce the shapes given to them. This supports the idea that blind students use their other available senses when exploring new objects and learning new concepts. In the development of assistive technology, different forms of sensory feedback have been considered, such as audio and tactile. The more sensory feedback is provided, the better blind users are able to fully comprehend the information that is being presented [22]. Crossan, *et al.* examined interfaces that are easily accessed by blind users and concluded that having both haptic and audio feedback allows users to better access visual images compared to interfaces with only one sensory feedback method [22]. The BWT and SABT currently only provide audio feedback to users. Haptic feedback has been suggested to allow users to feel the letters they are entering on these devices; however, adding this feature may greatly increase their cost without commensurately enhancing the user experience of learning braille writing.

There have been several efforts in the past to use advancements in technology to make education more accessible to blind students. However, assessing these educational assistive technologies has been challenging due to the dynamic and volatile nature of the environments in which such studies take place, as well as the limited number of available participants for testing purposes [17]. As technology advances in scope and application, it is important for all people to be able to access the growing amount of information, capabilities and conveniences made available through these technologies [23]. Stevens, *et al.* discuss the difficulties in evaluating educational technologies for blind users, owing to the lack of a strong demarcation between the usability of the device and the understanding capacity of the user [17]. Students fall within a wide spectrum of intellectual capacity and also have varying levels of vision, both of which need to be, but are rarely accounted for when evaluating assistive educational tools. Thus, many devices are not accurately assessed, and as a result are not extensively used, remain in the prototype stage and slowly go into obscurity.

Another difficulty in making technical aids more accessible to the blind population is the cost involved. Despite having a multitude of features that help blind students learn with ease, many devices are highly priced. Piezoelectric braille cells are one such example [24]. These refreshable braille cells could possibly help teach braille and graphics to the blind. The average price of a single braille cell is $35 US dollars, and most commercially available refreshable braille displays feature a single line of 20 to 80 braille character, thus costing hundreds to thousands of dollars [25]. Since most of the world's blind and illiterate population lives in developing countries, such devices are prohibitively expensive [24]. Runyan, *et al.* describes the piezoelectric technology and a refreshable tactile graphics device prototyped by students at a Korean university in 2005 [24]. They also talk about the market demand for low cost, battery operated braille technology that consumes less power. Germagnoli, *et al.* describes another piezoelectric technology similar to the BWT, but created much earlier in 1993. This device could be connected to a computer to provide immediate vocal feedback and showed promise during testing, but was not developed beyond the prototype stage [26].

Cost of assistive devices is a very important factor when considering the circumstances and resources available to their intended users. Jenn Tang developed a braille learning platform for English and Chinese with the intention of providing an alternative to other, typically high cost braille devices. OntoBraillle@ RFID (OBR) includes braille practice and examinations. The platform pastes RFID tags to the back of braille blocks. When

the blocks are moved to the RFID tag reader, verbal feedback is heard. This allows students to understand how to verbalize the braille letter, allows the students' progress to be tracked, and also allows people such as parents who do not understand braille to access what the student is practicing [27]. One of the main goals of the OBR platform is to allow students to work independently of teachers.

Schools specifically designed for blind and visually impaired students use specific technology geared to make their learning experience the most meaningful and beneficial. However, in schools that primarily cater to sighted students, it may be difficult for visually impaired students to grasp all the same concepts as their sighted peers. This is particularly true with material such as drawings or equations pictured on the blackboard. In cases like these, technology such as the Interactive Whiteboard could enable visually impaired students to better understand the layout of the content presented on the whiteboard, and thereby comprehend the content as a whole [28]. A teacher first labels diagrams and other items on the board, and then the technology reads out this content to the user. This approach engages a visually impaired student's auditory rather than tactile senses to comprehend an image or graph. The Interactive Whiteboard technology could also be useful to schools such as Mathru that cater exclusively to visually impaired students.

Braille Tutor Technologies

In order to understand how the BWT and SABT are and could be implemented at the Mathru School as well as to identify possible technology enhancements, researchers conducted a series of technology assessments for both tools with teachers and students at the school. The first step was to determine existing challenges and issues associated with the technologies within the context of use at the Mathru School. These data were used to determine the best course of action for technology modifications, given the priorities of the school as well as the time and resource constraints of researchers.

Braille Writing Tutor Assessment

The BWT has been used consistently at the Mathru School since its introduction in 2006. In order to help master the concept of braille writing, all new students work with the BWT for at least two hours per week, while students who struggle with learning braille use the BWT more frequently. Teachers find it useful to introduce braille to students using the BWT, because it is a more interactive and engaging way for students to learn. Furthermore, student interest in braille seems to peak when using the BWT. Teachers also reported that additional time spent with the BWT improves the students' understanding of braille. When a student uses the slate and stylus section of the BWT, the device recognizes that the student is writing the correct letters, even if the student does not use a unique braille cell for each separate character. Alternatively, if that student was using a traditional slate and stylus and wrote all the letters in the same braille cell, the output would be illegible because the resulting embossed pattern would not correspond to the different letters, but rather a combination of all their corresponding dot patterns. Therefore, the BWT can act as a great tool for teachers to identify specific problem areas that their students have in terms of learning to write braille.

In order to assess current uses and challenges of the BWT at the Mathru School, researchers conducted a series of interviews with teachers and observations during teaching sessions with the BWT. Teachers felt that it was important for students to learn braille writing with a traditional slate and stylus, and therefore liked that the BWT had a section that mimicked a traditional slate. Currently, the BWT is primarily used with primary school students or as an introductory tool to learn braille writing. Teachers expressed interest in furthering the application of this type of technology to incorporate more advanced students and additional subjects including geography, algebra, science, and graphics. They would also like to have quizzes and games for students to review and be tested on material covered in class for all these different subject areas.

One challenge teachers experienced with using the BWT was related to the physical set up of the device and its connection to a computer. The classroom in which the devices are housed has limited space, and the BWTs are set up in one corner at the back of the room where there are two BWTs connected to two desktop

computers. Although teachers did not express any particular difficulty connecting the tutors to computers via USB cable, the limited portability of this configuration caused a few issues. First, this set up enables just two students to use the BWT concurrently while facing the back of the class; other students interact with the teacher and face the front of the class. Additionally, since this is a separate classroom altogether, all the students in a class need to be taken out of their regular classroom in order to use the BWT even though only two of these students will be able to actually interact with the technology. Thus, this set up is fairly disruptive and also produces a relatively discordant classroom atmosphere where most students are sitting idly while the teacher works with the two students using the BWTs, or where the teacher is speaking over the audio feedback from the tutors in order to communicate with students not using the technology. Teachers would instead prefer to be able to use the BWT in a more natural classroom setting and give students assignments that they could take home and practice. Another area of improvement identified by teachers involved the BWT's 'Animal Game' mode. In this game, when students are asked by the tutor to spell a word, such as "cat," the audio feedback does not specifically include the word "cat;" rather, the tutor simply plays the sound of a cat. Teachers believed the game would be more effective if it repeated the entire word along with its spelling; *e.g.* "cat, C-A-T, cat."

Standalone Braille Writing Tutor Assessment

Initial SABT user testing was conducted exclusively with teachers at the Mathru School; students were not involved at this stage of testing. The purpose of this initial testing was twofold: to gain feedback on (1) the physical design of the device, which is a departure from the form factor of the BWT, and (2) the new menu-driven user interface of the SABT. The SABT's primary user interface was the only one tested during this phase of assessment.

In general, teachers appreciated the SABT's portability compared to the BWT's computer-dependency. However, they identified a few concerns with regard to the physical design of the device. One criticism was that the buttons on the primary interface were too large for students. This issue is easily resolved by switching to the intermediate SABT user interface, which houses smaller buttons for more advanced students. The primary interface was designed for beginners who may need practice learning the placement of dots and letter patterns.

The headphone jack also proved to be challenging for visually impaired teachers to locate and use. One teacher commented that the recessed area around the headphone jack led one to believe that the headphone pin fit in line with the entire surface area; however, there is a smaller, 3.5mm jack that headphones must be plugged into. Additionally, although teachers thought headphones were convenient and would be useful for students in higher grades, teachers preferred to have speakers in classrooms when working with primary school children so that they can better monitor students' work and intervene at appropriate times.

The SD card was another problem area for teachers, who needed some practice before mastering the task of manipulating this physical, removable component of the SABT. Given that teachers will not need to take out the SD card very frequently, this feature should not pose a significant barrier to using the SABT.

The SABT's control buttons (ENTER, CANCEL, LEFT and RIGHT) were new elements for the teachers. There was some confusion regarding their usage during initial user testing. Almost all of the teachers expected the braille buttons to be functional immediately after hearing the menu item prompt; whereas, they were actually supposed to press the ENTER button to select a specific mode in order to enact the braille buttons. In general, the concept of entering and exiting modes proved to be challenging for teachers. However, it must be noted that at this point of testing teachers at the Mathru School were mostly accustomed to the BWTv2 interface, which uses an entirely different method to select modes. Thus, it is reasonable to assume that with some practice teachers should become comfortable working with the newer SABT interface. Additionally, it is worth mentioning that once the teachers navigated into a mode such as the Animal Game, they were able to use the SABT without too many issues. This was partly due to the fact that the functionality of the Animal Game and other modes remained more or less unchanged from the BWT, so teachers were able to leverage their experiences with the BWT to use modes on the SABT.

Technology Enhancements

Braille Writing Tutor Modifications

Based on findings from interviews and observations at the Mathru School, several possible BWT enhancements were identified and prioritized.

Identified Enhancements

- **Math Mode**: A popular request from teachers was the creation of a math mode for the BWT. Math classes for older students typically entail the teacher asking students a math question (verbally) and the students in turn writing their answers using a Taylor frame, which is a tool used to represent numbers tactilely with pegs on a slate. The teacher then goes around the classroom and manually checks each student's work. This approach does not teach students how to write numbers and operators in braille, whereas through the use of a BWT students would be able to learn numerical braille while responding to their teacher's questions. In addition to enhancing students' numerical braille literacy, teachers also envisioned the BWT's math mode would incorporate quizzes to test students on different arithmetic concepts (i.e. addition, subtraction, etc.).
- **Contractions Mode**: The current version of BWT software only supports uncontracted braille, which has a unique dot pattern for each individual character. Contracted (shorthand) braille, on the other hand, allows for a single dot pattern to represent a commonly used string of characters (e.g. the gerund suffix 'ing' for English). Contracted braille is typically taught after students have mastered uncontracted braille. To support this transition, teachers thought it would be useful to teach common braille contractions to older students using the BWT.
- **Modes for Kannada and Hindi Braille**: Kannada (local language spoken in Bangalore) and Hindi braille are also taught at the Mathru School in addition to English braille. Therefore, adding modes to support these languages as well was a commonly requested feature from the Mathru School teachers.
- **New Game Modes**: Since game modes on the BWT are fairly popular at the Mathru School, researchers investigated other possible game modes to add on to the technology. Teachers requested a game similar to the 'Animal Game' that asks students to identify everyday noises (e.g. trains, clocks, doors, etc.) as opposed to animals.

Enhancement Implementation

Prioritized enhancements for the BWT were adding new modes and resolving known coding errors in the software application. The five enhancements identified in the previous section were introduced as new modes for the BWT. These included modes for:

(1) Naming everyday noises – via the 'Everyday Noises' game mode,
(2) Practicing math – via the 'Maths[1] Practice' mode,
(3) Learning Hindi letters – via the 'Hindi Learn Letters' mode,
(4) Learning Kannada letters – via the 'Kannada Learn Letters' mode, and
(5) Learning braille contractions – via the 'Braille Contractions' mode.

The Everyday Noises mode helps students learn how to identify noises made by objects around them (*e.g.* telephones and trucks), and additionally allows them to apply and improve their braille writing skills as they have to correctly spell the names of the objects. Adding this mode was straightforward since developers simply created a modification of the Animal Game. Both of these game modes reduce to the form of playing sound files and requiring users to enter a word. The Animal Game mode itself was also enhanced at the teachers' request to include noises from wild animals such as tigers and monkeys.

The Maths Practice mode asks users to solve various arithmetic problems involving addition, subtraction, and multiplication. Code for this mode was newly developed as it was unlike any mode that had been previously

[1] Note: the subject math is typically referred to in plural form – maths – in most South Asian countries.

implemented for the BWT. However, adding this mode was relatively similar to adding a new set of character maps so that the software could recognize numerical braille input. This facilitated the technology development process for the math mode. Implementing the other three modes - Hindi Learn Letters, Kannada Learn Letters and Braille Contractions - posed more of a challenge since each of these required multi-cell input recognition.

Adding multi-cell capabilities to the BWT posed a technical challenge. There was a tradeoff between code infrastructure change and modularity. The two options considered were to alter the structure of how letters were processed in the code and minimize what future developers would have to include in their code, or alternatively, to minimize the overhead of restructuring, and to have future coding be a more involved process. After careful consideration, the latter option was chosen, as most languages do not have more than one or two multi-cell characters in them. The solution implemented involves code that checks if a character is multi-cell and allows the programmer to retrieve certain information such as the number of cells and bit masks. It is up to the developer however, to use these functions appropriately in the code.

In addition to the aforementioned five new modes, a few small features and changes were also incorporated to the general user interface of the BWT. These included:

(1) Features that allowed users to hear instruction sound files when the BWT software application is launched.
(2) A “main menu” sound file that plays whenever users exit a mode in order to let them know that they are back at the main menu interface.
(3) Corrective changes to the software that resolved backlog problems caused when buttons are pressed while instructions are playing. This backlog resulted in users momentarily losing control of the device and caused frustration. To resolve this problem the Voice utilities were modified to clear the queue of added events each time a sound file stopped playing. This option was relatively non-invasive to the existing code, and consisted mostly of making certain variables public to certain classes.

Standalone Braille Tutor Modifications

Based on findings from interviews and observations at the Mathru School, several possible SABT enhancements were identified and prioritized. Some of these enhancements had been previously noted by other field research teams, and were simply reinforced by findings at the Mathru School.

Identified enhancements

It was found that the SABT would primarily benefit from some improvements to its user interface. One teacher recommended normalizing the volume of the voice prompts and perhaps also using a uniform voice throughout each mode, if not across all modes. Teachers also requested a button for dot cancellation, something similar to a backspace key on a computer keyboard. User testing also revealed a few interface issues such as buttons getting stuck and menu items being skipped. These problems needed to be resolved before further testing.

Additional features that teachers requested for the SABT primarily consisted of updates that were in line with the enhancements identified for the BWT. The SABT currently has a mode that teaches students braille patterns for the English alphabet. Teachers said they would find similar modes in Hindi and Kannada useful as well. Also, modes to teach numerical braille and Nemeth code for mathematical expressions in braille were identified as enhancements to be implemented on the SABT. Similarly, adding a household sounds mode that helps students identify common sounds such as doors closing, vehicles passing by, telephones ringing, etc. was also a popular request from teachers. The teachers also suggested some changes in the Animal Game such as spelling out the name of the animal at the end, and having a reverse mode where students type in an animal’s name and learn what the animal sounds like. Furthermore, they suggested that the tutor should provide hints when a student makes the same mistake thrice, as well as enable users to hear the question again and skip questions in many of the existing modes.

Enhancement implementation

Since the SABT's user interface was somewhat of a departure from that of the BWT, teachers and students were required to learn how to navigate an unfamiliar setup. However, this learning curve was steepened by inconsistencies across SABT modes as well as the presence of bugs in the SABT software. Therefore, enhancing the user interface of the SABT was the first priority for development. Enhancements included resolving an issue that was registering multiple button presses even though the physical button was only pushed once. A dual-action for the CANCEL button (differentiated by the duration that the button is held down) was also introduced. When CANCEL is held down for 3 seconds or more, irrespective of the mode the user is currently in, the SABT goes back to the main menu prompt. Whereas, if CANCEL is pressed for less than 3 seconds it is used to perform mode specific functions such as answering yes/no questions within the mode or clearing cell contents.

SD card detection also posed a challenge to visually impaired users. Previously, when an SD card was not detected, the SABT gave no feedback to the user. Enhancements made to the device enabled it to play an error beep on loop to indicate a problem with the SD card, which in turn alerted the user to power down the device and re-insert the SD card.

The SABT's user interface was also standardized beyond the basic button-input level. A common user Input-Output (IO) library was created to provide uniform output for different types and modes of input (such as dots, cells, multi-cell characters, numbers and lines), and to accommodate more advanced features such as prompted dialogs.

A few new modes were also added to the SABT while some existing modes were expanded to include additional features. Newly added modes included Letter Practice in Hindi and Kannada, English Braille Contractions, and Basic Arithmetic Practice. The Animal Game mode was expanded to include separate sub-modes for learning and playing. The learn sub-mode gave students the animal name to spell and played the animal sound once it was spelled correctly. The play sub-mode was similar to the original Animal Game, and presented just the animal sound and asked students to identify the animal. All modes incorporated additional logic to help users follow a non-linear path through the modes by allowing them to skip exercises, repeat prompts, hear hints, and scroll between exercises.

Evaluation of Enhanced Braille Tutor Technologies

Iterative user tests were conducted at the Mathru School in order to determine the effectiveness of enhancements made to the BWT and SABT, and also to identify future goals for applying these tools at the Mathru School.

User Testing of Braille Writing Tutor Modifications

Objectives

The primary objective of user testing and evaluation was to determine if there was a need to enhance the modified BWT (menu, modes, etc.) to further improve its usability.

Participants

A total of four Mathru School teachers participated in the BWT research study. These participants were blind, literate in braille and taught braille at the Mathru School. As per CMU's Institutional Review Board (IRB) guidelines, consent was obtained from all participants.

Data Collection

Modifications made to the BWT were tested in stages. The initial user test included the new BWT menu setup. Participants were given instructions on how to use the menu to navigate between different modes. In order to assess their proficiency with the BWT, participants were then asked to demonstrate the newly added or changed BWT modes (*i.e.* Hindi Learn Letters, Everyday Noises Game, etc.), along with the original Letter

Practice mode. As modes and features of the BWT were developed, further user testing sessions were carried out. These additional sessions focused only on obtaining user feedback about the enhancements made to the BWT. Participant reactions to the quality of the audio output from the technology as well as their experiences navigating the menu and using the different learning modes were recorded and analyzed.

Results

Teachers generally found it easy to navigate through the user menu and thought that instructions were clear. With regard to the new math mode, two of the teachers were not keen on writing numbers using the BWT, which incorporated Nemeth code (a frequently used form of numerical braille) to represent numerical input. However, for one of these teachers the problem was with the form of Nemeth code used and was not necessarily related to the BWT. To address this concern, researchers switched to braille number codes, which were more familiar to teachers than Nemeth code. In terms of the speed of math instructions, teachers were split on whether the instructions should be slowed down or left unchanged. For the Hindi Learn Letters mode, most teachers thought instructions were delivered at a good speed, but should be in Hindi instead of English.

Teachers suggested adding a game related to arithmetic operators that reinforced lessons taught through the Maths Practice mode. There was also interest in a General Knowledge mode that could support fill-in-the-blank questions for older students and multiple-choice questions for younger students. Other recommendations from teachers included adding wild animal noises to the Animal Game and adding phones doorbell and vehicle noises to the Everyday Noises Game.

User Testing of Standalone Braille Tutor Modifications

Objectives

The primary objective of user testing the SABT was to understand whether this technology has the potential to be an effective tool for enhancing braille literacy among students at the Mathru School. Additionally, an important aspect of assessing the SABT is to identify and diagnose technical issues and limitations that manifest during real applications of the device. To this end, user testing was an opportunity to determine how the device performs in the field with target users. User tests also offered insight into possible modifications that can be incorporated into the SABT to render it a more useful and effective tool for the Mathru School.

Participants

A total of 31 Mathru School students and teachers participated in user tests with the SABT. Of these participants, four teachers and nine students were considered “expert” users, because of their prior experience with the BWT. The remaining 18 participants were Mathru School students, who were categorized as “novice” users since they had not previously worked with the BWT. Per CMU’s IRB guidelines, consent was obtained from all participants, including legal guardians for underage students. The “expert” students involved in the study ranged from 8th through 10th standard, and those in the “novice” category were from 1st through 5th standard. Students’ level of visual impairment ranged from low vision to complete blindness. Additionally, three of the participating teachers were blind, while the other was sighted.

Data Collection

At the time of this study, four teachers at the Mathru School were directly involved in teaching braille to students. These teachers were the first to test the SABT. Teachers were initially interviewed to assess their level of comfort and proficiency with using electronic devices, and learn more about their teaching experiences. They were then asked to interact with the SABT after being given only minimal instructions. During this phase of testing, a record was made of the amount of time and additional instructions teachers needed to begin independently navigating the SABT menu. Teachers were then given certain tasks to complete, such as navigating to the letter practice mode and completing the exercises. They were asked for their feedback on the following:

- The quality, accent, and speed of the device’s audio instructions,

- The menu navigation setup and the different learning modes,
- The housing of the device, and
- The layout of the buttons.

User testing for the SABT was also conducted with 27 students at the Mathru School (Figure 8). Nine of these students were considered “expert” users, while the remaining 18 were “novice” users. A braille teacher explained the layout of the buttons and the menu navigation method to the students. They were then asked to use the Letter Practice, Animal Game and Hindi modes, and answer questions about any difficulties that they encountered. The time taken to navigate between modes and the time students spent on each mode were measured and recorded, as was the number of times instructions needed to be repeated by either the teacher or the technology. Finally, during all user testing sessions, qualitative data on participant feedback as well as researcher observations were collected.

Figure 8. SABT user testing with Mathru School students.

Results

Results from SABT user testing sessions with teachers included the following:

- Only one of the four “expert” teachers seemed to easily and relatively quickly grasp how to use the SABT after exploring it for a few minutes, although even she ran into a few issues while completing specific tasks.
- Entering and exiting menus was challenging for some teachers.
- It was not obvious to all teachers that the select button needed to be pressed to enter a mode
- One teacher managed to enter letter practice mode, but then had some difficulty working in that mode.
- Teachers had mixed reactions to the size of the SABT buttons and the spacing between them; some had positive comment about these features, while others thought the buttons were too large.
- All teachers needed to be instructed on the purpose and function of the six buttons representing dots in a braille cell.
- One teacher commented that students might be hesitant to use the larger buttons because they resemble buttons on the Perkins Brailler. This same teacher said she expected the buttons representing a braille cell to be on the upper half of the SABT and therefore, assumed that buttons at the bottom were simply decorative.
- There was some confusion as to the purpose and function of the SABT’s Free Play mode, although teachers did eventually see some merit in introducing this mode to students.
- There was a request for built-in speakers for the SABT, because students may find it difficult to manage external speakers attached to the device.

- In terms of using speakers versus headphones, teachers agreed that the sound quality was better with the headphone, but thought that speakers would be more suitable for younger students so that the teacher would be able to hear what the student is doing. Older students and those more proficient in braille would find headphones more useful so that they can practice by themselves.

Feedback specifically related to the Animal Game mode included the following:

- The overall quality of audio output for this game (*i.e.* animal noises) needed to be improved, since some animals were not recognizable.
- Due for the most part to audio related issues, teachers had some difficulty interacting with this mode because they did not understand the instructions.
- One teacher in particular, struggled with following instructions for entering an animal name for this mode, in spite of repeated guidance provided by researchers. Her main point of confusion was with entering one letter of the animal name at a time; she instead spelled out the entire name of the animal and then hit ENTER, which resulted in the SABT registering an erroneous entry. This may be something that needs to be more explicit in the instructions for this mode.
- There were requests for a CANCEL button to undo an incorrect dot entry, as well as a REPEAT audio button to listen to the animal sound again.
- It was also noted that two teachers used both the left and right buttons on the menu scroll.

Figure 9. In context user testing of the English braille mode during English class at the Mathru School for the Blind.

SABT user testing with students (Figure 9), focused specifically on testing the size of the six buttons representing braille dots, the menu navigation buttons and the volume control buttons. In general, students were asked about how they felt using the new device and listening to the newly customized instructions. They were also asked to provide feedback on the Animal Game and Learn Hindi modes. Results from student testing included the following:

- All the nine “expert” students were in favor of the larger buttons on the SABT. In particular, students also found SABT easier to use than the BWT because of the larger size of the buttons. Only one student preferred to have smaller buttons.
- Similarly, all participating students found the menu buttons and the selection buttons easy to use. However, one student felt that using the MENU and SELECT buttons were confusing.
- The volume button at times obstructed students’ navigation to other buttons on the device.

- Students also liked the instructions on the device although they would prefer to increase the volume and pace of the instructions.
- In general, students found it easy to navigate between the SABT's various modes. However, regarding the Animal Game and Learn Hindi modes, students had difficulty understanding the instructions since they were too fast and hard to comprehend. For these modes, students preferred to have the instructions repeated.
- Students could not identify some of the animal sounds in the Animal Game mode.
- In the Hindi mode, students found it difficult to understand the instructions due to the accent of the voice used for this audio output. Students also preferred to have instructions read in English within the Learn Hindi mode.

Conclusions and Future Work

Braille Writing Tutor Findings

Overall, teachers at the Mathru School were satisfied with enhancements made to the BWT, including the new modes added as well as the fixes made to address errors previously encountered with the software application. They were especially pleased with the new menu interface, which allowed users to scroll through the available modes instead of remembering key combinations that mapped to certain modes (as was necessary in the previous interface). Users also enjoyed the addition of a fanfare sound clip that plays when s/he answers a question correctly.

Five principal modes were added to the BWT software:

(1) *Maths Practice*, which currently covers arithmetic operations (addition, subtraction, and multiplication). This mode uses braille number codes instead of Nemeth code, because only older students at the Mathru School know Nemeth code.
(2) *Hindi Learn Letters*, and
(3) *Kannada Learn Letters* which serves as a Hindi braille mode as well, because both languages are part of the Bharati braille system and only differ by one sound that is present in Kannada but absent in Hindi. Adding this mode also required multi-cell capabilities to be incorporated into the BWT software, since there is a character in Kannada that needs to be written in two separate cells. When writing this multi-cell Kannada letter, the BWT alerts the user that the character is multi-cell and explains which dots to enter in each cell. Once a user makes the correct entries in the first cell, the BWT says "good, next cell" and then anticipates input in the second cell.
(4) *Everyday Noises Game*, which is structured almost identically to the Animal Game, but replaces animal sounds with noises that everyday objects in their surroundings make. This change is beneficial not only because it helps students practice their braille writing, but also because it teaches them how to identify useful sounds such as vehicles passing by and the telephone ringing. The Animal Game was also enhanced by adding wild animal sounds to the software.
(5) *Braille Contractions*, which helps students learn braille contractions. The previous version of BWT software only supported uncontracted braille, which has a unique dot pattern for each individual character. Contracted (shorthand) braille, on the other hand, allows for a single dot pattern to represent a commonly used string of characters (*e.g.* the gerund suffix 'ing' for English). Contracted braille is typically taught after students have mastered uncontracted braille.

While significant progress was made on BWT development, there is still room for improvement. Potential future enhancements include:

(1) Offering more modes in Kannada and Hindi. Most existing modes cannot accommodate multi-celled characters, because the BWT software currently requires a bit mask to be mapped to a unique unicode character. If this restriction is removed students would be able to practice their Hindi and Kannada writing skills in the game modes as well as.

(2) Adding a comprehensive contractions mode so that older students can use the BWT to practice writing full sentences and paragraphs.
(3) Incorporate the ability to save and customize user sessions in order to track student progress and tailor BWT lessons to better suit the varying needs of students.

Standalone Braille Tutor Findings

Final development on the SABT was informed by in-context user testing conducted over the final two weeks of the internship. During these tests, the SABT was applied in a classroom setting where the teachers incorporated the device into their teaching. This offered more insight into possible ways in which this technology can serve as a teaching and learning tool for the Mathru School. Additionally, results from these user tests aided the final technology development phase that was focused on fine tuning the user interface and addressing any remaining bugs or errors in the software. Stabilizing the code and standardizing the user interface were key requirements for rendering the SABT more user friendly for Mathru School teachers and students.

At the end of the internship, two SABTs were left at the Mathru School with code capable of running previously developed modes such as Dot Practice, English Learn Letters, Animal Game, as well as newly developed and tested modes such as Hindi and Kannada Learn Letters, Maths Practice, and the Everyday Noises game. The audio on the device was also normalized to provide a more uniform user experience.

There is, however, still significant scope for further development on the SABT. A salient need is to add functionality so that teachers can create new or customize existing content, as well as enable user sessions to be recorded through a login process. In addition, only the primary SABT interface board was programmed and tested during this study. The intermediate and advanced interface boards still need to be tested and developed, with a specific focus on allowing multi-cell entry. There are also a few remaining coding issues that could not be isolated and resolved, and need to be addressed in future development. Additionally, user testing yielded recommendations for improving the SABT's hardware. This feedback included, adding on-board speakers, and modifying the placement of the volume buttons. These suggestions should also be explored in future work. Overall, however, the SABT was very positively received by Mathru School teachers and students who will continue to use this device and provide valuable longer term data to support future technology developments.

Tactile Graphics Project

Background

There are few tools capable of conveying visual concepts to blind students. This includes describing basic shapes to blind students, developing their tactile perception of images, and enabling them to experience the world using other available senses. Available assistive educational tools range from plastic molds, to embossed maps, as well as image-embossing printers. Such tools can be used to teach subjects such as mathematics, geography, physics and biology. Diagrams, charts, graphs, maps, and other visual displays are often necessary to master these subjects. Although the Mathru School is able to convey some of this information to its students through the resourceful use of affordable teaching aids, certain concepts are too visually complex to teach. Therefore, Mathru School students do not learn math and science beyond the basic lessons covered in lower grades.

Needs assessment findings at the Mathru School revealed a popular request for incorporating images into the school's curriculum. Teachers described many challenges they experience teaching subjects like mathematics, science, and geography, especially when trying to explain shapes, diagrams, maps, and the human anatomy. When local-language textbooks are translated into braille, pictures are omitted and references to them are deleted. Similarly, in the 1st and 2nd standards, images of basic shapes are removed and figures are omitted, and in 7th standard, pictures of internal organs such as the brain, lungs, and heart are omitted as well.

Furthermore, in 10th standard, students learn history and geography without the aid of maps. Additionally, researchers observed that students had a vast knowledge of facts, but were unable to explain or appreciate the meaning or context of certain geographical forms. To address some of these challenges, in 2008 TechBridgeWorld researchers initiated the Tactile Graphics project, which allowed users to convert an image to a text file that can then be printed using the Basic-D embosser available at the Mathru School. This enabled teachers and students to feel the outline of an image that was embossed on the page. However, this tool needed some enhancements in order for the school to include images in their curriculum. Thus, a research goal for the summer iSTEP 2013 included further expanding the Tactile Graphics project by creating a stand-alone application that can help teachers search and print images.

Related Work

In a study done by TBW at the Mathru School in 2008, it was found that including images in the curriculum would greatly increase the independence of the students and would make other subjects such as the sciences easier to grasp [29]. One possible application identified for the Tactile Graphics software that was originally developed by TBW was teaching English print. Having access to embossed images of the English alphabet would help students understand the concept of these letters. As shown by Dias *et al.*, further instruction can then be incorporated to teach students to write in print. In turn, learning how to write in print would enable many visually impaired students and teachers to sign documents and obtain services that would otherwise not be available to them. This application is only one of many that demonstrate how Tactile Graphics software could be beneficial to schools such as Mathru.

Blind students find it difficult to learn physical concepts such as conservation of mass or volume, directions and the configuration of a physical space. The size of a room may be perceived differently by a blind person compare to a sighted person. This causes challenges when teaching subjects such as geometry and geography to students who are blind. Studies on how blind students try to comprehend shapes and features have been conducted to better understand which teaching methods would best suit these students [18][23]. For the instruction of geography, Berla *et al.* examined how students learn different map features through various methods of instruction [30]. Through observing how students navigated of tactile maps, it was revealed that students are unsystematic in their approach and this often causes misconceptions about the location of different features. Berla *et al.* then developed a training method to teach children how to navigate a tactile map and understand what they are feeling. The training consisted of much repetition and specifically stressed the identification of certain distinct features that helped the student comprehend the map. This study surmised that the biggest problem with students' ability to understand tactile maps was that many have not had appropriate foundational training to build on for such exercises [30]. This phenomenon was also seen when training students on how to properly use the BWT or SABT. Once students have the ability to master the use of the assistive devices they will have the independence to practice on their own. The Tactile Graphics software has the potential to allow students to access pictures from the web such as the map of India or pictures of body parts. However, based on findings from Berla *et al.*, it is important to also develop a sound method of instruction to help students interpret the output from the Tactile Graphics technology, so as to ensure that users maximize benefits of this tool.

In their 2008 study, TBW found that the majority of students and teachers were able to recognize simple shapes most of the time [29]. For images such as an apple or the shape of India it was easier for students and teachers to recognize the shape if it was an outline rather than a filled in object; whereas, it was easier to identify basic shapes such as a pentagon or rectangle if the image was filled in [29]. The Tactile Graphics software modifications focused on for the research described in this report will take these preferences into account by choosing images that are easiest for students and teachers to identify.

Images form an important part of the curriculum in any level of education. In 2005, Ladner *et al.* observed that blind students in math, science and engineering (MSE) were challenged by the lack of sufficient accessible images to supplement their curriculum. From previous research, they understood that the use of tactile graphics was one of the best ways to make images accessible to blind students in MSE. Through their study

they observed that in 2005, tactile graphics were created mainly manually. Both sighted and blind people participated in image transcribing. Ladner *et al.* developed a tool to automate image translation to tactile graphics. Their tool, the Tactile Graphics Assistant (TGA) took any image from MSE textbooks that were quite complicated, perform segmentation, create outlines and then separate out text from the image using optical character recognition (OCR). This served as a handy tool for transcribers, making it easier for them to edit and translate images into tactile graphics. However, although these images are effective and legible by touch, they require a more expensive graphics braille printer to develop.

Implementation

The new project implemented in the last few weeks of the iSTEP 2013 internship was an extension of TechBridgeWorld's Tactile Graphics projects from the summer of 2008. The technology resulting from that project converted images into ASCII files and then utilized the Mathru School's text printer to print braille images. As a follow up on this work, students in the spring 2013 15-239 class at CMU developed a web application which would let the user browse through images, select the ones they wanted and then print them. However, Mathru School teachers were not familiar with using an internet browser, and moreover, the internet connection at the school was intermittent and limited. To address these challenges, for this project, researchers implemented a stand-alone application with more accessibility features to enable blind teachers to use it with the help of JAWS and keyboard shortcuts. The teachers at the Mathru School, both sighted and visually impaired, were not familiar with searching for images via Google Images and downloading them. Therefore, the application designed also helps users select the best image from a pool of possible candidates. The software first searches for the image in the library, based on specified key words. If the search criteria have no matches in the library, the application then searches Google Images and fetches relevant images that the user can print. The resulting printed tactile images would include the title of the image captioned at the top of the page, allowing a blind person to identify the image. A group of volunteers at the Mathru School showed interest in including image-puzzles in their magazines, where the answers to the puzzles are revealed at the end of the magazine. To support this endeavor, an option to enable or disable printing the image caption was included in the updated Tactile Graphics software.

The user interface for this application was developed using Java Swing[2], with most of the background image processing conducted in Python. Figure 10 depicts a screen shot of the user interface. Since software already existed to convert an image into a tactile graphic, the goals of this particular project were to streamline the conversion process by creating an offline graphical user interface (GUI) and adding capabilities for the program to automate image selection. The resulting solution was a stand-alone application that allowed users to search, select and print tactile versions of the desired images. Users begin by entering key words into a text box entry field to begin the search process. In the event that a sighted person uses the application and wishes to view images to choose from, this user can select the "CHOOSE FROM 5 IMAGES" button, which displays the top five relevant images resulting from a Google Image search for line drawings matching the given key words. The "TAB" key can be used to shift between the buttons and the text box entry fields on the GUI. The user can also select any image from their computer's hard drive and convert those into ASCII text files using the "BROWSE" button. The small radio button at the top of the application screen can be selected to disable printing the image caption along with the tactile graphic. This radio button is not accessible through the keyboard to prevent blind users from accidentally clicking on it. Once the user selects an image, s/he can click on the "GENERATE" button to create the text files using three different image filters. These filters are used to make the image more translatable to text (i.e. transform the image into a line drawing in different ways). The user can then click on "SELECT FOR PRINT" button if the resulting tactile version of the image is acceptable. Alternatively, sighted users have the option to browse through the three different filtered tactile image previews using the "NEXT" button, and click on "COMPARE" to see the three images juxtaposed along with the original image. Once the user selects an image for printing, the particular file is stored under the name of the search string in the out folder. The user can also use search criteria containing multiple words. This these case, the algorithm removes

[2] https://en.wikipedia.org/wiki/Swing_(Java)

all the special characters in the search string and utilizes Google Images to locate files that match the multi-word search string. When the image for printing is finalized, the associated ASCII file is opened in a simple text editor from where the user can print the tactile graphic using WinBraille[3].

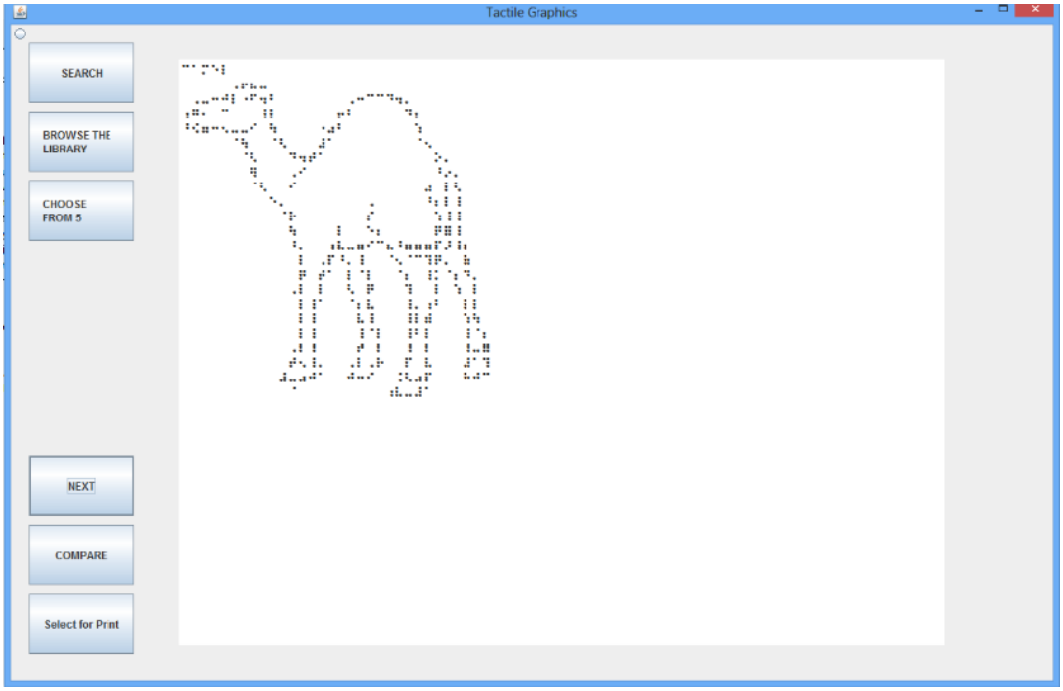

Figure 10. Tactile Graphics User Interface. A camel was pulled from Google images, the text file was generated, and then the braille dots corresponding to the text were put in place of the text to create a braille image of a camel. An image caption was also generated.

To automate image selection for users who may need this feature, a Python script was written to use Google Images to search for and download 10 images matching the search criteria. Including the captions "line drawing" and "coloring page" in the search query proved to be effective in generating optimal results. So, these captions were incorporated into the application software. The Python code also contained a heuristic to select an optimal image from several available options in the event that a user is not able to.

For the purposes of the Tactile Graphics output, simple line drawings without any extraneous images (*i.e.* background) are the most appropriate. To detect background images, the algorithm uses four separate metrics. The first two metrics are the number of unconnected components and the number of components that do not overlap. These are included to identify separate components in the image. Counting the number of unconnected components is done with a modified floodfill algorithm that follows each line that it finds, marking it as "seen," and keeping track of how many distinct lines there are. Detecting the number of non-overlapping components uses the same floodfill algorithm, but also keeps track of a bounding box for each shape and calculates the proportion of overlap between the bounding boxes. An image is penalized for a lower proportion of overlap, as less overlap is indicative of multiple objects. The third metric used is filled-pixel-density, which is a final check for complexity. The logic behind this is the idea that the more detail an image has, the higher proportion of pixels will be filled. All three of these metrics are calculated for all images resulting from the original search. Next, the algorithm runs through scores for each image under the three different metric categories, and determines which images have a score that is less than the mean score for that category. An image with a score greater than one standard deviation from the mean is deemed "better" and will be selected. Through experimentation, it was found that if an image score is further than one standard deviation below the

[3] http://speech.di.uoa.gr/libaccess/Material/WinBrailleUsersManual.pdf

mean in multiple categories, it is more likely to be a poor match for the search criteria. Therefore, the algorithm makes the more conservative choice to discard these images. The final metric factored into the automated image selection algorithm is the image's original rank on Google Images. If the algorithm cannot detect a clear-cut "best" image based on the first three metrics alone, it will default to the result ranked #1 from the Google Images search.

User Testing and Evaluation

Researchers were not able to complete a formal user testing for the Tactile Graphics software during their time in the field. Instead, a remote data collection strategy was implemented so that teachers could report their feedback on application directly to TechBridgeWorld via email or phone communications. Researchers did however, train teachers on how to work with the application, and documented any feedback and observations resulting from this training session. This feedback will serve as a basis for technology upgrades that TBW can undertake in future projects.

Conclusions and Future Work

The Tactile Graphics project was well received when presented to end users. The Mathru School is able to use their computer lab to browse and select images they require. The school plans to incorporate this tool and the tactile graphics it produces in the life skills classes, where students will be taught to identify images of everyday items. A volunteer group also plans to publish these graphics in their magazine (Manthan) as puzzles. They hope to publish five graphics (*sans* captions) every week and ask readers to try and identify them.

Mathru School teachers also expressed interest in adding some features to the user interface for this application, including the ability to resize images as well as add guidelines to help blind users to interpret the displayed image. They also suggested storing images according to general categories within the image library; *e.g.* birds, furniture, vehicles, etc., so that they could opt to print all images in a given category when needed. Eventually, the image library generated by the Tactile Graphics application will be hosted on the Mathru School's website; thus, making this resource accessible to blind schools all over the world.

Teacher Training

A final endeavor undertaken as part of iSTEP 2013 was to train Mathru School teachers on how to work with common computer applications including email and MS Word. This was a task request by the school to help increase teachers' level of comfort with computing technology in general. In addition, this work supported efforts to sustain the use and effectiveness of the assistive technology enhanced and developed throughout the summer. If teachers are more proficient and familiar with technology, they will be more likely to incorporate these tools effectively in their classes. Thus, teacher training was considered part of capacity building to supplement the technology projects initiated by TechBridgeWorld.

Identified Needs

An initial assessment was conducted with the eight teachers who were signed up for training to understand their current level of computer literacy and any other skills they wished to learn. The teachers had a very basic knowledge of computers with some having more experience than others. They expressed a desire to learn to type faster, use Microsoft Word (Word), browse the internet, and send emails. Three of the teachers were visually impaired and five were sighted. Thus, two different methods of instruction were necessary to cater to these two groups of teachers. General training focused on basic computer literacy and went through two phases. The first phase focused on improving typing efficiency and speed. The second phase focused on Microsoft Word, including creating and formatting a document. In addition to general training, two of the teachers were provided with (1) training to use the Mountbatten Writer Plus Brailler (Mountbatten), and (2) basic internet training, covering utilizing search engines and sending emails.

Training Description and Outcomes

Teacher training involved training Mathru School teachers on computer skills as well as administrative staff on how to use the new technological devices the school recently acquired. Training outcomes for the visually impaired teachers and sighted teachers were very different since each group had varying needs and knowledge of computers. In order to provide more individualized instruction, sighted teachers and blind teachers were trained separately during most sessions. It should be noted that teacher attendance and the number of training sessions offered per week were not always consistent, due to the various scheduling challenges and competing commitments for teachers and staff. In addition, the usability of the computer lab was often compromised by power failures. Therefore, time spent on training sessions is approximated for the purpose of discussion in this section.

Sighted teachers needed a basic foundation in keyboarding before other computer skills could be introduced. The trainers utilized a freely available typing tutor program, RapidTyping [31] to assist with teaching typing skills. This application was well-designed and provided several levels of typing exercises, starting from basic finger movements and ending with typing long passages. RapidTyping could also track the progress of multiple users and offer both mid-exercise and cumulative feedback. The first week and a half of training focused on very basic typing skills such as hand position and proper finger keystrokes. By the end of the keyboarding session, the teachers' typing skills improved enough to progress to typing in MS Word. The next couple of weeks were spent covering basic Word skills such as opening, saving, and formatting documents. By the end of the Word session, the sighted teachers could successfully create a question paper for the students using Word, transfer the document to the computer that is connected to the braille printer via pin drive, and print the document. Due to time constraints and the lack of Wi-Fi in the the Mathru School computer lab, internet training for the sighted teacher group was not covered.

Similarly, for visually impaired teachers, the first week and a half focused on improving their typing efficiency using RapidTyping. However, while this program was an extremely useful tool for sighted teachers, it was incompatible with the JAWS. Nevertheless, since most of the blind teachers were already fairly proficient at typing, this did not pose a significant challenge during training. By the end of the typing session, they became much more efficient in typing and could type much more quickly with fewer mistakes. Basic Word training was not necessary with this group of teachers because they were already proficient in this application. Instead, trainers provided instructions on how to create the basic layout of a question paper and taught more advanced Word and computer navigation skills. At the conclusion of training, teachers were able to type and format a question paper on Word, transfer the document to the computer connected to the braille printer via pin drive, and print the document.

Recently, a Mountbatten Brailler[4] was purchased by the Mathru School, per the recommendation from a distributor. It is a smart, hard-copy Braille device that also uses Bluetooth to communicate wirelessly with iOS "Smart Ready" devices. However, the school was unsure as to how best to utilize this device and solicited the assistance of TechBridgeWorld for this task. In response, iSTEP interns conducted a few training sessions with two teachers from the school. With Mountbatten training (Figure 11), the two teachers were trained separately; the first teacher taught how to use the tool as well as train other teachers on how to operate the device. In turn, she was responsible for training the other blind teacher while one of the trainers monitored the session for additional instruction and support. The Mountbatten has many functions, all of which could not be covered during training sessions with teachers. Training focused on typing and embossing documents, saving documents within the device, transferring documents to and translating documents with a computer, and using the basic built-in commands. With the first teacher, the trainer began with step-by-step instructions and gradually encouraged the teacher to work more independently by providing instruction only when absolutely necessary. A document containing basic commands for the Mountbatten Brailler was printed in braille to enable the teachers to practice using the device independently. At the conclusion of the Mountbatten training, the two

[4] http://www.mountbattenbrailler.com/

teachers were able to use the device on their own to emboss documents, enter and use basic commands such as text alignment, saving, transferring, and translate typed documents using a computer.

Figure 11. A Mathru School for the Blind teacher learning to use the Mountbatten Writer Plus Brailler.

Internet training took place towards the end of the internship and therefore, a sufficient amount of time could not be devoted to training the teachers on this skill. Furthermore, it was difficult to streamline instruction because each webpage is unique and has a different layout. The two teachers signed up for this session were instructed at the same time. Since the computers were not Wi-Fi enabled, an internet dongle was used; however, the application for the dongle was not JAWS accessible, so the trainers needed to create an automated script to connect or disconnect the internet. This script was only added to the two computers in the BWT classroom, which limited the visually impaired users to using the internet in this particular room.

The Mozilla Firefox web browser was used exclusively for instruction and the trainers began by creating email accounts for the two teachers using Gmail. Teachers were then taught how to compose and send emails, and how to navigate throughout the basic HTML version of Gmail. The default view was set to the basic HTML version of Gmail in order to simplify navigation. Additional training sessions involved learning to use JAWS screen reading software and to read received emails. Repetition with the previous tasks ensured independent use and navigation of email. At the conclusion of internet training, teachers were capable of independently connecting the internet dongle, opening the Firefox web browser, navigating to Gmail, and sending and receiving emails. Due to lack of training time, however, blind teachers still needed some help from a sighted individual in order to master internet and email navigation skills.

Recommendations for Future Work

The blind teachers that were trained had previous typing and computer experience. However, this may not be the case for all blind teachers that work at the Mathru School. For this reason as well as for teaching students keyboarding skills, it may be useful to develop an affordable (or ideally, free) keyboarding software in the future to specifically cater to the needs of blind keyboard users. A proposed solution to this challenge is the development of a typing tutor that mimics a tried and tested tutor such as RapidTyping, or any other freely available established tutor. However, in addition to displaying the letter to be typed, the application should also read out the letter. This eliminates the need for a second person to read out words or sentences to type or the need for a teacher to alternate between reading text and then typing it out. Such an application can either be developed or recommended as a feature addition to existing, established open source typing tutor projects.

Conclusions

A collection of documents will be left at the Mathru School for both sighted and blind individuals and will be provided in both print and virtual formats. These documents offer basic instructions related to computer skills needed for Windows XP and Microsoft Word 2007. Additionally, these user manuals provide guidance on how to use the Mountbatten Brailler, as well as navigate the Mozilla Firefox web browser and Gmail. Since the skill levels of new teachers may vary, these documents aim to be applicable to users of all skill levels, and also serve as a resource for teachers to reference if they forget how to execute a specific task. Finally, these documents will act as a supplement to help current teachers train new teachers, and thus, make sustain the benefits of this first training session with teachers.

Longer Term Assessment of Projects

Objectives

The objectives of a long term assessment of the BWT and SABT are to ensure the usage of the devices continue to be beneficial to the users and to understand how the devices affect the abilities of the users.

Related Work

This section will provide information on previous work that has been done regarding the evaluation of assistive technology used in the education of students with disabilities.

In order to assess the many factors for evaluation of assistive technology, the following outcome measurement areas (in no particular order) could be considered [32].

- **Clinical results**: This refers to the academic results of users who interact with any technology aids, before and after the aid has been introduced [32][33][34][35]. This is perhaps the most common area of objective evidence that is used in measuring the effectiveness of any intervention.
- **Functional status**: The performance of the equipment, its durability and its dependability are important factors that come under this area of observation [33]. It also keeps track of the lifetime of the device, which will depend on its usage by consumers.
- **Manipulation of equipment**: This refers to the way in which the device is most commonly used by consumers. It includes their satisfaction and comfort with the interface, as well as the device's operability in the long run. Note that for a short term analysis the learnability of the features of the device would also be important to note under this category [33].
- **Management and maintenance of equipment**: This refers to the on-site management necessary to maintain the assistive technology [35].
- **Support environment**: This includes background factors that influence the consumer's usage of the device, as well as demographics about the focus group that is under observation [32].
- **Cost**: This includes the monetary cost of purchasing, maintaining and managing the device [32][33][34][35].

Several studies make the case that both objective and subjective data must be collected from the focus group in order to obtain data on the metrics listed above [35]. With respect to educational aids, academic results are the most commonly collected quantitative data. However, qualitative data pertaining to the user's subjective opinions on the equipment should also be amassed, through interviews, observations, and user testing. This will highlight many improvements that can be made to the user interface and offer insight that cannot be gleaned from quantitative data alone. Also, there could be confounding factors that affect quantitative data, but are not necessarily reflected by the numbers. Whereas, often times, supplementary qualitative information can reveal the impact of these factors. Additionally, it is suggested that for users with disabilities, constant personalized assessments must be carried out to obtain the most accurate results [35].

It must be kept in mind that during the process of data collection for outcome measurement, an effort must be made to isolate the effect of assistive technology [32]. This is, however, a difficult task with any intervention with human subjects in uncontrolled environments. For example, changes in the behavior of users or in their performance could be due to a host of other factors, including a switch in classroom interactions or a change in teaching techniques used in the classroom. In most such cases, combining quantitative and qualitative results can help offer a more accurate view of the true impact of the technology intervention.

Careful consideration should also be given to the focus group that is under observation to monitor the usage of the assistive technology. Smith asserts that a well-defined focus group is more likely to get accurate results from outcome measurement [32].

Approach to Evaluation

Evaluation templates for both the BWT and SABT have been created for the Mathru School. These templates were printed in braille and provided to the blind teachers who will be using both devices. After each teaching session using these tools, teachers will fill out the templates, save their responses, and once a month, email these documents to TBW for review. This remote data collection model was necessary to sustain the monitoring and evaluation of these assistive technologies implemented at the Mathru School.

Conclusions and future work

Using the long-term assessment template created by the iSTEP research team, Mathru School teachers will be able to keep track of any irregularities found during the use of the BWT and the SABT. This will also help in improving the built-in user interfaces of these devices in the future. Moreover, this long-term assessment will offer better insight into user behavior and more accurate data in general upon which to base future technology enhancements and developments.

Overall Conclusions

Many technology enhancements and tasks were successfully accomplished over the course of 10 weeks through the iSTEP 2013 program. Five new modes were added to both the BWT and SABT: Hindi Learn Letters, Kannada Learn Letters, Maths Practice, Braille Contractions, and Everyday Noises Game. Additionally, slight changes were made to the existing Animal Game. A contraction mode was started for the SABT, but was not completed. The Tactile Graphics Project successfully pulls images from Google Images and translates them into text files (that outline the image) that can be printed using the Mathru School's basic braille printer. The BWT, SABT, and Tactile Graphics Project are all currently in working condition and teachers have been trained on how to work with each of these technologies. Initial teacher training was completed for both sighted and blind teachers, and Mathru School teachers now have basic typing, Microsoft Word, and printing skills. However, there are opportunities to build on these skills and expand teachers' overall computer literacy levels. Two of the Mathru School's blind teachers were taught how to use the Mountbatten Writer Plus Brailler, navigate the internet via Mozilla Firefox and use Gmail. For the most part, the work completed during the ten-week internship addressed the Mathru School's needs, and strengthened TechBridgeWorld's partnership with the school. Thus, iSTEP 2013 laid the groundwork for many future assistive technology project collaborations between TechBridgeWorld and the Mathru School.

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Appendix

Teacher Training Documents

Document for Sighted Individuals

IMPORTANT: The following document was made to be used independently of the final report. The table of contents within the document is not correct.

Carnegie Mellon University

Computer Training Materials for Sighted Individuals

By Maddie Gioffre, iSTEP intern *July 9, 2013*

The following document contains basic instructions for how to execute basic tasks using a computer. The objective of the document is to provide a necessary supplement to aid in the training of teachers on basic computer skills. Only very basic tasks and skills are covered. In addition to instructions on basic computer skills, a sample question paper section is included to help teachers structure their question papers as well as a section for sighted users to instruct blind users how to use a computer and other devices independently. The document includes instructions for the following operating systems, programs, and technological devices unless otherwise noted:

1. Windows XP
2. Microsoft Office Word 2007
3. Gmail
4. Mozilla Firefox Internet Browser
5. Tata Photon Plus Internet Dongle
6. Mountbatten Writer Plus Brailler

If you have any comments, questions, or concerns please contact TechBridgeWorld at **info@techbridgeworld.org**

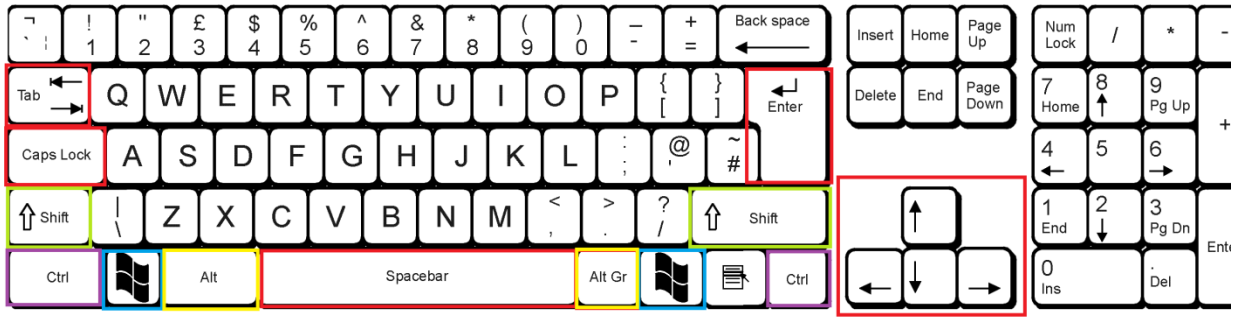
iSTEP
iNNOVATIVE STUDENT TECHNOLOGY EXPERIENCE

TECHBRIDGEWORLD

Contents

Computer Basics for Sighted Individuals

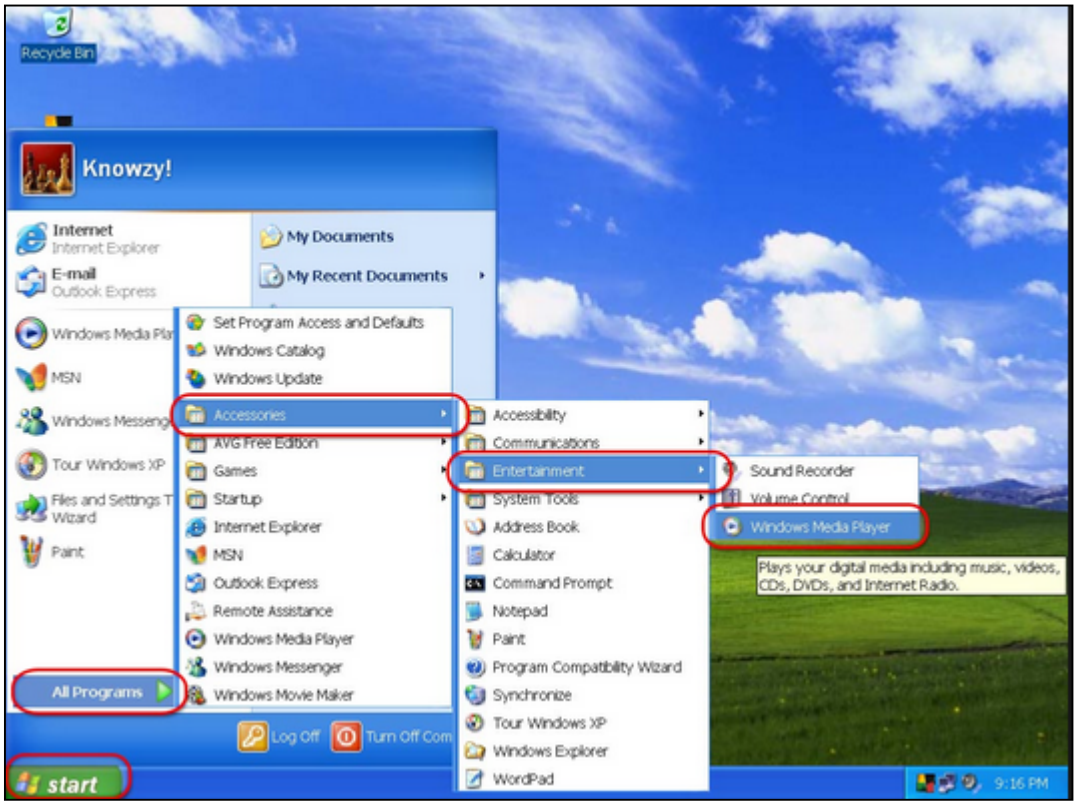
Keyboard



- **Spacebar:** When pressed provides a space between words.
- **Tab:** Indents (moves start of text to the right) on the page to signify a new paragraph. Using tab is the equivalent of approximately 14 spaces
- **Caps Lock:** When pressed once makes all typed letters capital. When pressed again, all typed letters return to lower case.
- **Enter:** When pressed returns the cursor to a new line.
- **Arrow Keys:** Use to navigate around screen.
- **Shift:** Press and hold shift and type a letter to capitalize a single letter. Press and hold shift and type a number to type a symbol that is pictured above the number. Shift is often used in keyboard shortcut commands.
- **Ctrl:** The control key is often used for keyboard shortcut commands.
- **Alt:** The Alt key is often used in keyboard shortcut commands.
- **Windows:** Opens the start menu at the bottom left-hand corner of the page.

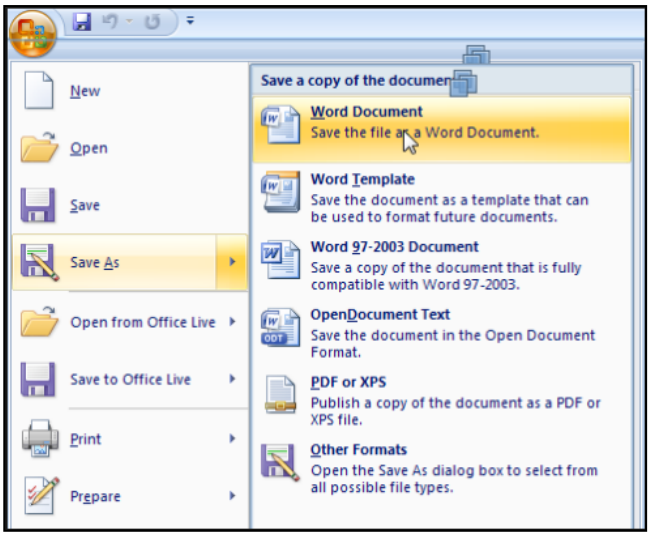
Word

1. Open a new document
    - Click on Windows Start Menu (bottom left-hand corner of screen)
    - Look for and click on Windows Microsoft Word 2007
    - If not in menu, click on All Programs
    - Look for Microsoft Office
    - Click on Windows Microsoft Word 2007

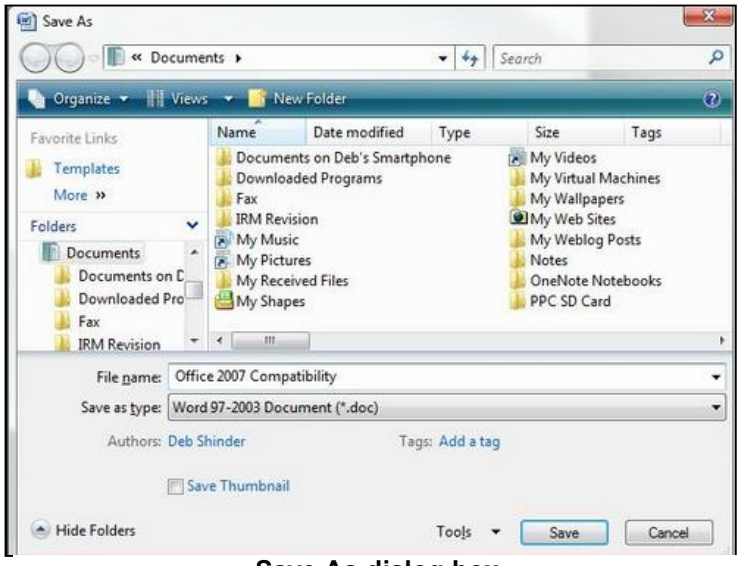


The screen will look very similar to this, but will not be identical

2. Save a document
    - Click on the Windows logo (upper left)
    - Hover over Save As
    - Click on Word Document
    - A dialog box will appear
    - Name the document
    - Click Save

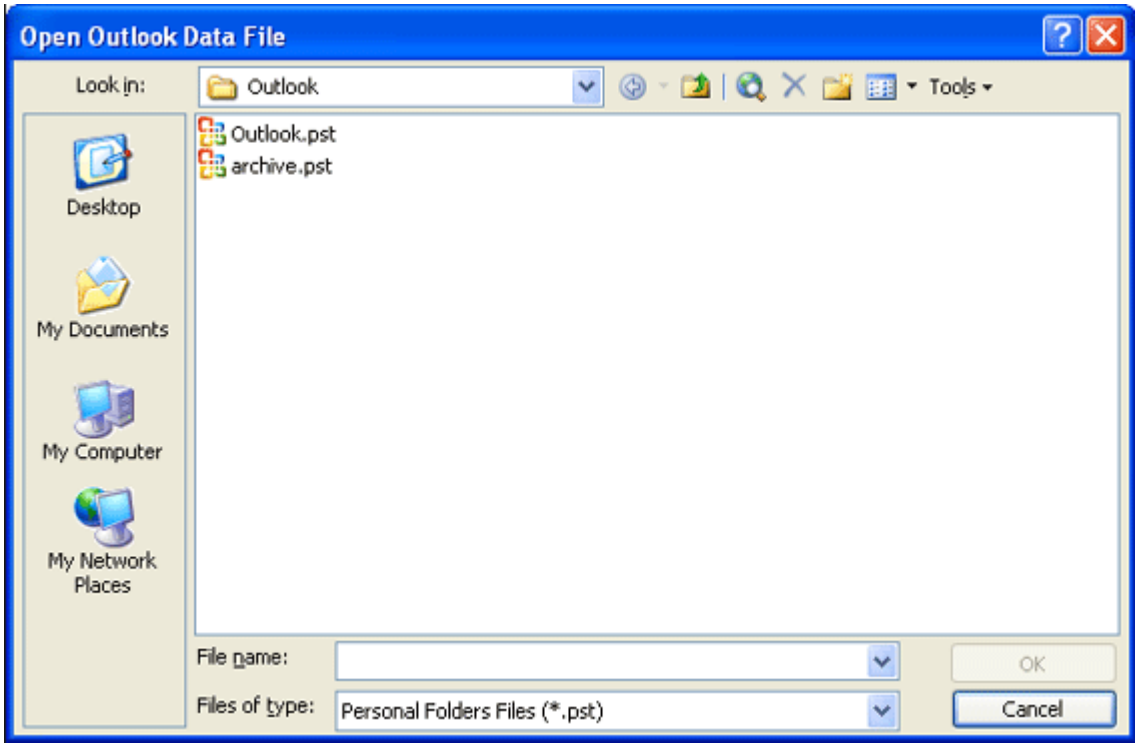


Saving menu



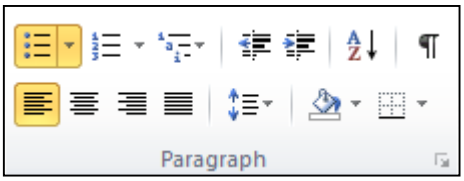
Save As dialog box

3. Open an existing document
    - Double click on my documents on the desktop
    - Use the drop down menu at the top of the dialog box to select the folder or double click on the folder in the dialog box
    - Double click on the file



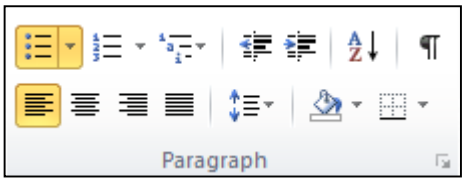
The My Documents Dialog box will look very similar to this, but the files and the text at the very top will be different

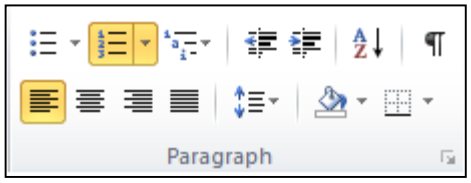
4. Alignment
    - Click on the Home tab on the top of the Word document
    - Under the section Paragraph select left, center, or right alignment in the bottom left corner of the section



5. Formatting font
    - Highlight the font you wish to format
        i. Click and drag cursor over text to highlight
    - Click on the Home tab on the top of the Word document
    - Look under section Font
        i. In the bottom right corner of the section you can change the font color
        ii. In the bottom left corner of the section you can change the font to **bold,** *italic,* or underlined
        iii. In the top left corner you can change the type and size of the font

6. Bullets and numbering
    - Click on the Home tab on the top of the Word document
    - In the Paragraph section you can select bullets (top left corner icon) and numbering (one icon to the right of bullets)





Typing tutor

1. Opening typing tutor
    - Click on the Windows Start Menu in the bottom left hand corner of the screen
    - Look for and click on Rapid Typing Tutor
    - If it is not in the initial menu, click on All Programs
    - Find Rapid Typing Tutor and click on the file with the picture of the fish next to it
2. Change skill level
    - In the top left corner select the drop down menu that shows the current skill level
    - Click on the desired skill level (a check should appear next to the desired skill level)

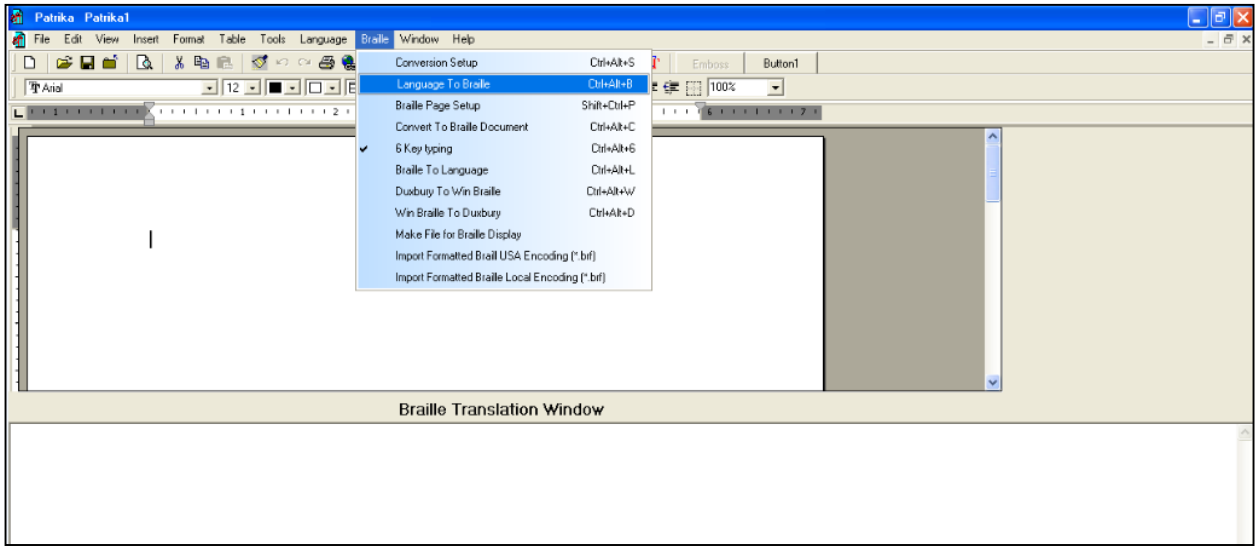
Piano

1. Opening the piano
    - Click on the Windows Start Menu in the bottom left hand corner of the screen
    - Look for and click on VMPK
    - If it is not in the initial menu, click on All Programs
    - Find and click on VMPK
2. Songs:
    - twinkle twinkle: dd jj kk j hh gg ff d jj hh gg f jj hh gg f dd jj kk j hh gg ff d
    - happy birthday: ssdsgf ssdshg ssjhgfdhhfsds
    - come little children: ggll ;;l bbjj hhhhg llb jjb lllb jjh ggll ;;l bbjj hhg
    - london bridges: hjhgfgh dfg fgh hjhg fgh dh fs
    - mary had a little lamb: zapa zzz aaa zff zapa zzzz aazap

- old macdonald: ssso ppo ffdds ssso ppo ffdds sssoo sss ss s ss s ssss ss ssso ppo ffdds

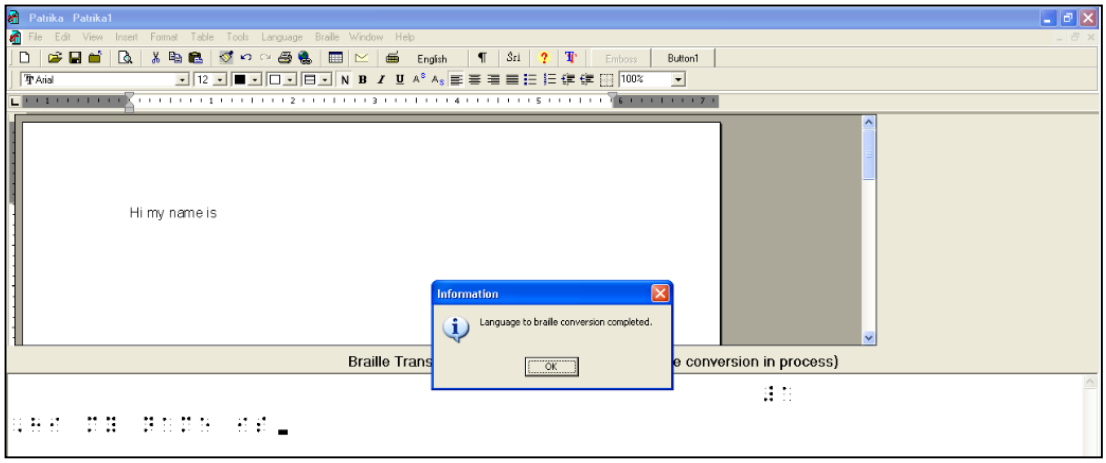
Braille Printer

1. Copy the text you wish to print (2 ways)
    i. highlight all of the text by clicking and dragging across the text, right click (a menu will appear), select Copy
    ii. press CONTROL + A to selcet all text, press CONTROL + C to copy text
2. Open Patrika by going to the Windows Start Menu
    i. If Patrika is not located in the initial menu, hover over All Programs and find Patrika in this menu
3. Paste the copied text into the Patrika window (2 ways)
    i. right click and select Paste
    ii. press CONTROL + V
4. Translate text (2 ways)
    i. On the top of the screen, hover over braille until a drop-down menu appears. Then select Language to braille
    ii. press CONTROL + ALT + B



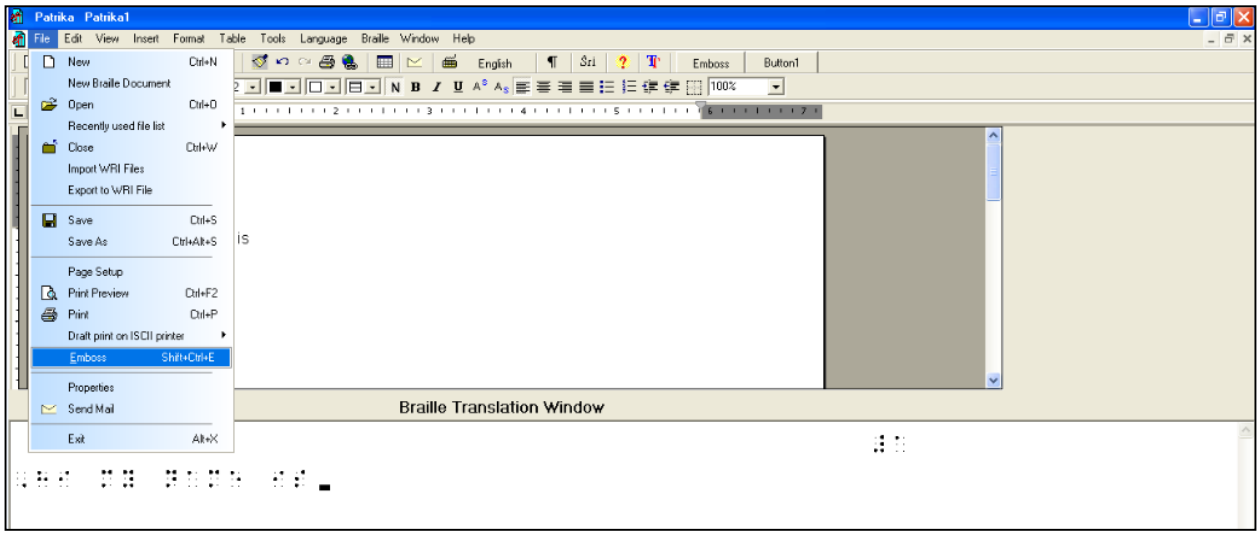
Translation menu

5. A dialog box appears. Click OK.



Dialog Box

6. Turn printer on. The switch is located on the left side of the wooden box.
7. Emboss the text (2 ways)
    i. On the top of the screen, hover over File until a drop-down menu appears. Then select Emboss.
    ii. press CONTROL + SHIFT + E



Embossing

Instructions for Teaching Blind Users

General

1. Filter keys- prevents repeated keystrokes
    - Hold down right shift key until dialog box appears and press enter
2. High contrast- easier for low vision students/teachers to see computer screen
    - Left ALT key + left SHIFT key + PRINT SCREEN
3. Move between open programs
    - Press and hold ALT and use TAB to navigate between programs
4. Find files or folders
    - WINDOWS + F
5. Display desktop
    - WINDOWS + D
6. Move between different task panes in a program
    - F6
7. Open Systems menu to minimize, maximize, close
    - ALT + SPACE
8. Close a window
    - ALT + F4
9. Save document on pindrive
    - F12 (You will hear “save as dialog”. You are located in a textbox where you change the name of the file.)
    - TAB to navigate until you hear “mathru 03’s Documents”
    - Use arrow keys until you hear “Untitled”
    - ENTER
    - TAB until you hear “File name colon edit”
    - Type name of file
    - TAB until you hear “save”
    - ENTER
10. Restarting and shutting down computer
    - WINDOWS + U
    - To restart press R
    - To shutdown press U
11. Restarting JAWS
    - WINDOWS + R
    - Type jaws12
    - ENTER

Word

1. Open word
    - WINDOWS + R
    - type winword
    - ENTER
2. Left aligned
    - CONTROL + L
3. Center aligned
    - CONTROL + E
4. Select all
    - CONTROL + A
5. Copy text
    - CONTROL + C
6. Paste text
    - CONTROL + V

7. Save document
    - CONTROL + S
8. Open saved document
    - CONTROL + O
    - type file name
    - ENTER
9. Open new blank document
    - CONTROL + O
10. Display Save As dialog box
    - F12
11. Change format of bullets and numbering
    - SHIFT + F10 (a menu will show)
    - Use up and down arrow keys until you hear bullets
    - Use right arrow key to select that option
    - Use arrow keys to find roman numerals (or any other format)

Braille Printer

1. Copy text from word document
    - CONTROL + A
    - CONTROL + C
2. Open Patrika
    - WINDOWS
    - Use arrow keys until you hear “Patrika”
    - ENTER
3. Paste text into Patrika
    - CONTROL + V
4. Translate Language to Braille
    - CONTROL + ALT + B
    - ENTER
5. Print
    - Turn switch on side of printer
    - SHIFT + CONTROL + E
    - ENTER

Creating a Gmail Account and Using Gmail:

1. Press CONTROL and L. Type “gmail.com” and press ENTER.
2. Press SHIFT and TAB until you hear “Create an account.” Press ENTER. This will take you to a webpage to create a Gmail email account.
3. Once the page loads, press TAB until you hear “Name First.” Type your first name here and press TAB.
4. Next you will be located in the second text box. Type your last name or surname here and press TAB.
5. Next you will be located in the third text box. This is where you create your username. Usually a username is some form of the users name. For example, my name is Maddie Grace Gioffre and my username is mggioffre. Press TAB. If you hear “Someone already has that username,” this means you must modify your username to make it unique. Press SHIFT and TAB and then type a new username. For example, if you typed “aditya” and after pressing TAB you hear “Someone already has that username,” you could change the username to adityakodkany24.
6. Once you have typed a username and pressed TAB without hearing “Someone already has that username,” you can type your password. Your password must be eight characters in length and can include both letters and numbers. Your password should be something easy to remember, for instance your initials and birthdate. As an example my password could be mg042793. Press TAB once you have entered your password. When you type your password JAWS will say “Star” instead of reading the letter. This is so anyone around you won’t be able to see or hear your password and log in to your email account.
7. In this text box you should re-type your password. This is to make sure that the password you had typed before matches. Press TAB. If you hear “These passwords don’t match,” it you should press

SHIFT and TAB until you hear “Create a password”. Type the password again. Press TAB. Re-type the password. Press TAB.

8. Use the down arrow to open a drop-down menu of months. Use the up and down arrows to navigate until you hear your birthday month. Press ENTER. Press TAB
9. Type the date of your birthday. Press TAB
10. Type the year of your birthday. Press TAB
11. Use the down arrows to open a drop down menu of genders. Use the up and down arrows to select your gender. Press TAB twice.
12. Press the right arrow key and then type your mobile phone number. (If you do not have a mobile phone number, do not type anything.) Press TAB
13. This text box will ask you to enter your current email address. If you do not have a current email address you can ignore this text box. Press TAB
14. You will hear “Skip this verification (phone verification may be required). Ignore this and press TAB.
15. This next part is verification to make sure you are not a robot. To do this you have to type letters that JAWS has trouble reading. It will be easiest to have a trusted sighted individual enter these letters for you. Once entered, press TAB.
16. This next box is used to identify your location. If you are in India, you do not need to change it, so press TAB. If you are not in India, press the down arrow to open a drop-down menu. Use the up and down arrows until you hear the correct location. Press ENTER. Press TAB.
17. The next part is agreeing to Google’s Terms of Service. You have to do this in order to create an account. Press SPACEBAR.
18. Press TAB three times or until you hear “Google may use my account information to personalize +1’s on content and ads on non-Google websites.” The check box is already checked. If you do not want Google to use your account information to personalize ads, uncheck the checkbox by pressing SPACEBAR.
19. Press TAB two times or until you hear “Next step.” Press ENTER
20. You will be taken to a new webpage. Press TAB many times until you hear “Take me to my account”
21. This will take you to a complex version of your email account to go to the simple version of your email account press INSERT and F7 and use the up and down arrow keys until you hear “Set Basic HTML as Default.” Press ENTER. If this does not work, you may have to have a sighted individual select the link at the top of the page that says “Set Basic HTML as Default.”
22. You are taken to your Inbox, which is a webpage that contains all of the email messages you have received.

Compose and send an email in Gmail

1. To send an email press SHIFT, ALT, and C. This will take you to a new webpage and JAWS will begin to read the webpage which you do not need to hear. Press CONTROL to make JAWS stop reading.
2. You will be located in the “To” text box. Type the email address of the person you are sending the email. For example, if you are sending an email to me type mggioffre@gmail.com. Press TAB
3. You are located in the “Cc” text box. If you want another person to see that you are sending this email, but the message is not directly for them type their email address here. This text box is not often used and can be skipped. Press TAB.
4. You will be located in the “Bcc” text box. This is very similar to the “Cc” text box, but the person you send this to will not be able to see the email address of the other person it was sent to. “B” stands for blind. Again this text box is not often used and can be skipped. Press TAB
5. This next button is the “Choose File” button. This is to add attachments to an email. An attachment would be an MS Word document. You do not need to an attachment to every email you sent. Press TAB twice. If you do not need to send an attachment. Press ENTER if you would like to send a document. An Open Dialog box will appear, similar to the Open Dialog you use in MS Word. Navigate to the document the same way you would to open a word document. Press ENTER. The file may take a few minutes to upload. Press TAB.
6. You will be located at a button called “Attach more files.” If you would like to attach more files, press ENTER and follow the previous instructions on selecting a file. To continue to the body of the email press TAB.
7. You will be located in the text box wear you can type the email message. Start your email message with the name of whom you are sending the email. For example if you are sending the email to me start by typing “Dear Maddie,” Press ENTER twice. Type the message. Press ENTER twice. Sign the

email by typing something like “Best regards,” or “Sincerely,”. Press ENTER. Type your name. Press TAB to go to the send button.

8. Press ENTER to send the email. Once the email is sent, you will be taken directly back to your inbox.

Navigating through your Inbox and reading emails

1. The inbox is set-up as a table with 5 columns and however many rows as there are emails. The first column of the table is a checkbox. The checkbox can be selected by pressing SPACEBAR. You would do this if you wanted to delete an email. It will be very unlikely that you ever have to delete an email. If you would like to delete an email, check the check box by pressing SPACEBAR and then press SHIFT and 3. The second column of the table always contains the name of the person who sent the email. The third column contains the subject of the email and the first few words of the body of the email. The third column is always a link and JAWS says link before reading the subject of the email. The forth column contains the date the email was received.
2. Press CONTROL and HOME to go to the first row, first column of the table. Press X to read the sender of the first email.
3. Press CONTROL, ALT, and the right arrow to navigate to a column to the right. JAWS will read what is located in each column and at the end will say which column you are located in. Press CONTROL, ALT, and the left arrow to navigate to a column to the left.
4. To move up or down columns (from one row to another, but remaining in one column) press CONTROL, ALT, and the up or down arrow keys.
5. To open and read an email, navigate to the third column of any email by using CONTROL, ALT, and the left and right arrow keys. You will hear JAWS say “link” before reading the subject of the email. Press ENTER. You will be taken to a new page containing the email message. Press H until JAWS reads the subject of the email. Then press INSERT and DOWN ARROW. JAWS will read the header of the email which contains email addresses and things that are unimportant. You need to pay attention to everything JAWS says after “Link show original.” Once you the entirety of the email and JAWS seems to be reading things that don’t matter, you can make JAWS stop by pressing CONTROL.

Piano

- WINDOWS
- use arrows to find VMPK
- if you cannot find it using arrows find “All Programs”
- ENTER
- use arrows to find VMPK
- ENTER
- Twinkle Twinkle: dd jj kk j hh gg ff d jj hh gg f jj hh gg f dd jj kk j hh gg ff d
- Happy Birthday: ssdsgf ssdshg ssjhgfdhhfsds
- Come Little Children: ggll ;;l bbjj hhhhg llb jjb lllb jjh ggll ;;l bbjj hhg
- London Bridges: hjhgfgh dfg fgh hjhg fgh dh fs
- Mary Had a Little Lamb: zapa zzz aaa zff zapa zzzz aazap
- Old Macdonald: ssso ppo ffdds ssso ppo ffdds sssoo sss ss s ss s ssss ss ssso ppo ffdds

Sample Question Paper

Mathru Educational Trust for the Blind

05-07-2013

Subject: General Knowledge

Total Marks: 15

I. Fill in the blanks. [1*5 = 5]
1. There are ---- seconds in one minute.
2. Lion is the king of ----.
3. Lotus is our ----.
4. Gandhiji is the father of our ----.
5. Fish live in the ----.

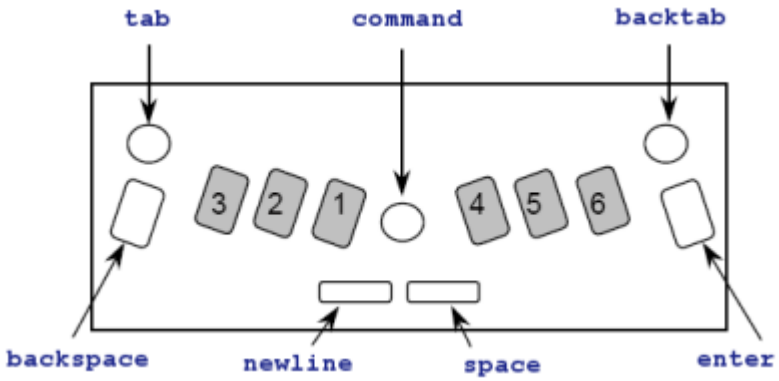
II. Answer the following questions. [1*5 = 5]
1. Which is our country?
2. Which is our state?
3. Who is the father of our nation?
4. Who wrote our national anthem
5. Who is known as Netaji?

III. Match the following. [1*5 = 5]

1.	Crow	Bird
2.	Dog	Animal
3.	Mango	Fruit
4.	CoconutTree	
5.	Brinjal	Vegetable

Mountbatten Brailler Instruction

IMPORTANT: The following material is a condensed version of the original user manual. If there are tasks and functions not covered in this content, consult the original user manual. Also the following has instructions for blind users, but can be modified for a sighted individual. Anywhere it asks to find File or Device using a keyboard, a sighted individual can use the mouse to hover over the toolbar at the top of the page where is says "File" "Device" "Tools" and "Help." A sighted individual can then select the desired function from the dropdown menu and using the mouse to click on it. The following instruction is intended to help sighted individuals teach blind individuals how to use the Mountbatten brailler independently.



Brailler Keyboard interface

- Turn on and off
  - There is a switch on the front, bottom, left of the brailler that turns the brailler on and off
  - A voice should notify you that the brailler is turned on and whether or not it is charging
- Loading paper
  - First method:
    - Lift the lever (located on the top right of the brailler)
    - Feed paper into slot on back of brailler until paper is just under the embossing head and adjust margins as needed
    - Flip lever to down position
  - Second method:
    - Lift the lever (located on the top right of the brailler) and adjust margins
    - Insert paper underneath small rollers and under embossing head
    - Flip lever to down position
- Removing paper
  - Lift paper lever and pull paper out of brailler
  - Paper eject commands
    - **`newline + enter`**
    - type letter p **`+ space`**
- Commands
  - Press command button (circular button in the middle of the six buts corresponding to the Braille dots)
  - Type command
  - Press **`enter`** (oval, right-most button)
  - Commands:
- Navigating the page
  - **`newline + space`** (move down page in same column)
  - **`newline + backspace`** (move up page in same column)
  - **`tab`** (move right 5 spaces)
  - **`backtab`** (move left 5 spaces)
  - **`space`** (move one position right)
  - **`backspace`**(move on position left)
- Formatting commands
  - **`Letters ce`** (centers Braille)

        - press **newline, command,** type letters **ce, enter**
        - enter command again to turn off

    - **letters ra** (aligns Braille to right hand margin)
        - press **newline, command,** type letters **ra, enter**
        - enter command again to turn off
- Writing Braille
    - Press the corresponding dots simultaneously to produce the desired Braille letter
- Correcting and editing
    - **backspace + space** (replaces a character with a space)
    - **backspace + correct dots** (replaces a character with your desired character)

- Increase the force of the embossing head for thicker paper
    - **command, backtab**
    - You will hear "Up one". This increases the force by one. Try typing. If Braille isn't embossed enough, press **command, backtab** again.
    - Repeat until Braille is at desired emboss level
- Decrease the force of the embossing head for thinner paper
    - **command, tab**
    - You will hear "Down one". This increases the force by one. Try typing. If Braille isn't embossed enough, press **command, tab** again.
    - Repeat until Braille is at desired emboss level
- Writing Braille files in memory
    - Make a file
        - **command** button, type **begin [name file], enter**
            - Example: **command,** type **begin testfile, enter**
        - You will hear "OK." Now everything that is typed is saved in the filename that you specified
    - Close a file
        - **command** button, type letters **end, enter**
        - You will hear "OK." Now the file is closed and whatever is being typed is not being saved
    - Changing a file
        - **command** button, type letters **append [name of file to append], enter**
            - Example: **command,** type letters **append testfile, enter**
        - Now you can modify the file. Modifications will begin where the last Braille was typed.
    - Rename a file
        - **command** button, type letters **rename [original name of file] [new name of file]**
            - Example: **command,** type letters **rename testfile newtestfile**
    - Delete files
        - **command** button, type letters **del [name of file], enter**
            - Example: **command,** type letters **del testfile, enter**

    - Recover a deleted file before switching brailler off
        - **command**, type letters **undel, enter**

Using MB-Comm Software for Translation

IMPORTANT: The following instructions are for Windows XP operating system. The only computer where the operating system would be different and thus the instructions to execute the following tasks would be different is on Ms. Muktha's computer in her office.

1. Plug cable into USB port on the left side of the computer screen. It is the second whole from the top and you may have to flip the cable if it doesn't go in smoothly on the first try.
2. Open the MB-Comm program

i. Press the WINDOWS key
ii. Use the arrow keys until you hear “MB-Comm”
iii. Press ENTER
iv. When the program is open you will hear “Edit read only. Type in text.”

3. Connect the brailler
   i. Press the ALT key to select the toolbar menus
   ii. Use the right and left arrow keys to navigate between the File, Device, Tools, and Help menus
   iii. When you hear “Device” use the down arrow to choose an option to select
   iv. When you hear “Connect Mountbatten” (this is the first option) press ENTER
   v. A dialog box will appear
   vi. Use the TAB key to navigate until you hear “OK”. Press ENTER
   vii. Another dialog box will appear
   viii. Use the TAB key until you hear “Continue”. Press ENTER
   ix. You will hear beeping noises coming from the brailler. This means the brailler is connecting. When you hear “Edit read only. Type in text” again, this means the brailler is connected
4. Display a file from the brailler before saving it
   i. Press the ALT key to select the toolbar menus
   ii. When you hear “File” use the down arrow. When you hear “Display File from Mountbatten…” press ENTER (You will hear beeping noises coming from the brailler)
   iii. A dialog box will appear. Use the tab key to navigate until you hear “Mountbatten Directory List”
   iv. Use the up and down arrows to navigate between files until you hear the file you want to display
   v. Press the TAB key twice to navigate or until you hear “Display”. Press ENTER. You will hear beeping from the brailler and “Edit. Type in text”. This window will only allow you to view what was typed by the brailler. You cannot edit it.
   vi. Press the down arrow to have JAWS read what is displayed.
5. Clear the display window without saving
   i. Press ALT and then use the right and left arrow keys until you hear “File”. Then use the down arrow until you hear “Clear Display Window…”. Press ENTER
   ii. A dialog box will appear asking you “Do you wish to save display?”. If you don’t want to save the display, use the TAB key until you hear “No”
6. Save a displayed file
   i. Press ALT and use the right and left arrow keys until you hear “File”. Then use the down arrow until you hear “Save Display to File…”. Press ENTER
   ii. A dialog box will appear. Type a name for the file. Press ENTER
7. Receive and Save a file from the Mountbatten without displaying the file
   i. Press ALT and use the right and left arrow keys until you hear “File”. Then use the down arrow until you hear “Receive and Save File from Mountbatten…”. Press ENTER
   ii. A dialog box will appear. Use the TAB until you hear “Mountbatten Directory List”.
   iii. Use the up and down arrow keys until you hear the name of the file you wish to save.
   iv. Press the TAB key twice or until you hear “OK”. Press ENTER
   v. Another dialog box will appear. Type a name for the file. Press ENTER
8. Print a file that was saved
   IMPORTANT: This must be done on Ms. Muktha’s computer because it is the only computer currently connected to a printer. The document you would like to print must be saved on a pin drive and then transferred to Ms. Muktha’s computer.
   i. Find My Documents either from the desktop or by pressing WINDOWS and then using the arrow keys.
   ii. Type the first letter of the name of the document and then use the arrow keys until you hear the document.
   iii. Press ENTER. You will hear the name of your file then “dash notepad”. Your file is open and can be edited.
   iv. Make sure the printer is turned on. The ON button is located on bottom right of the top face of the printer and is the long rectangular button on the bottom row of buttons.
   v. To print without editing, press CONTROL, P. Then press ENTER

Document for Blind Individuals

Computer Training Materials and Computer Basics
By Maddie Gioffre, iSTEP intern
TechBridgeWorld, Carnegie Mellon University
July 9, 2013

The following documents contain basic instructions for how to execute basic tasks using a computer. The objective of the documents is to provide a necessary supplement to aid in the training of teachers on basic computer skills. In addition to instructions on basic computer skills, a sample question paper document is included to help teachers structure their question papers as well as a documented for sighted users to instruct blind users on keyboard shortcuts. The documents include instructions for the following programs:

7. Windows XP
8. Microsoft Office Word 2007
9. Mozilla Firefox Web Browser
10. Gmail
11. Tata Photon Plus Internet Dongle
12. Mountbatten Writer Plus brailler

If you have any comments, questions, or concerns please contact TechBridgeWorld at **info@techbridgeworld.org**

Useful Keyboard Shortcuts and Settings

General:

12. Filter keys- prevents repeated keystrokes
    - Hold down right shift key until dialog box appears and press enter. This takes about 8 seconds
13. High contrast- easier for low vision students/teachers to see computer screen
    - Left ALT key + left SHIFT key + PRINT SCREEN
14. Move between open programs
    - Press and hold ALT and use TAB to navigate between programs
15. Find files or folders
    - WINDOWS + F
16. Display desktop
    - WINDOWS + D
17. Move between different task panes in a program
    - F6
18. Open Systems menu to minimize, maximize, close
    - ALT + SPACE
19. Close a window
    - ALT + F4
20. Save document on a pendrive
    - F12 (You will hear “save as dialog”. You are located in a textbox where you change the name of the file.)
    - TAB to navigate until you hear “mathru 03’s Documents”
    - Use arrow keys until you hear “Untitled”
    - ENTER
    - TAB until you hear “File name colon edit”
    - Type name of file
    - TAB until you hear “save”
    - ENTER
21. Restarting and shutting down computer
    - WINDOWS + U
    - To restart press R
    - To shutdown press U
22. Restarting JAWS
    - WINDOWS + R
    - Type jaws12

- ENTER

Word:

12. Open word
    - WINDOWS + R
    - type winword
    - ENTER
13. Left aligned
    - CONTROL + L
14. Center aligned
    - CONTROL + E
15. Select all
    - CONTROL + A
16. Copy text
    - CONTROL + C
17. Paste text
    - CONTROL + V
18. Save document
    - CONTROL + S
19. Open saved document
    - CONTROL + O
    - type file name
    - ENTER
20. Open new blank document
    - CONTROL + O
21. Display Save As dialog box
    - F12
22. Change format of bullets and numbering
    - SHIFT + F10 (a menu will show)
    - Use up and down arrow keys until you hear bullets
    - Use right arrow key to select that option
    - Use arrow keys to find roman numerals (or any other format)

Braille Printer:

6. Copy text from word document
    - CONTROL + A
    - CONTROL + C
7. Open Patrika
    - WINDOWS
    - Use arrow keys until you hear “Patrika”
    - ENTER
8. Paste text into Patrika
    - CONTROL + V
9. Translate Language to Braille
    - CONTROL + ALT + B
    - ENTER
10. Print
    - Turn switch on side of printer
    - SHIFT + CONTROL + E
    - ENTER

Connect to Tata Photon Plus Internet Dongle

IMPORTANT: The Tata Photon Plus Internet connection for blind users is only available on the two computers in the Braille Writing Tutor room. To setup addition connections accessible to blind users refer to the section “Tata Photon Plus Internet Connection Setup for Blind Users.”

1. Plug the Internet Dongle into a USB port on the CPU. It is located on the front face of the CPU and is a rectangular hole roughly the size of the part of the Internet Dongle that is being plugged in.
2. Wait until you hear JAWS say “Photon Plus.”
3. Press the WINDOWS key
4. Use the up and down arrows until you hear “Connect.” Press ENTER
5. It may take a few minutes to connect and for the Mozilla Firefox internet browser to open
6. Once it is open, you will hear “Mozilla Firefox” and then JAWS will begin to read the entire page. You do not need to listen to everything JAWS is reading, so press CONTROL to make JAWS stop reading the webpage.

Mozilla Firefox Internet Browser General Navigation:

1. Navigate to webpage such as Gmail, which is an email service
    - CONTROL + L
    - Type www.gmail.com
    - ENTER
2. Navigate around page
    - TAB
3. Open a link (JAWS will say “link” before all text that is connected to another webpage)
    - ENTER
4. Go back to the previous webpage
    - ALT + Left arrow key

Creating a Gmail Account and Using Gmail:

23. Press CONTROL and L. Type “gmail.com” and press ENTER.
24. Press SHIFT and TAB until you hear “Create an account.” Press ENTER. This will take you to a webpage to create a Gmail email account.
25. Once the page loads, press TAB until you hear “Name First.” Type your first name here and press TAB.
26. Next you will be located in the second text box. Type your last name or surname here and press TAB.
27. Next you will be located in the third text box. This is where you create your username. Usually a username is some form of the users name. For example, my name is Maddie Grace Gioffre and my username is mggioffre. Press TAB. If you hear “Someone already has that username,” this means you must modify your username to make it unique. Press SHIFT and TAB and then type a new username. For example, if you typed “aditya” and after pressing TAB you hear “Someone already has that username,” you could change the username to adityakodkany24.
28. Once you have typed a username and pressed TAB without hearing “Someone already has that username,” you can type your password. Your password must be eight characters in length and can include both letters and numbers. Your password should be something easy to remember, for instance your initials and birthdate. As an example my password could be mg042793. Press TAB once you have entered your password. When you type your password JAWS will say “Star” instead of reading the letter. This is so anyone around you won’t be able to see or hear your password and log in to your email account.
29. In this text box you should re-type your password. This is to make sure that the password you had typed before matches. Press TAB. If you hear “These passwords don’t match,” it you should press SHIFT and TAB until you hear “Create a password”. Type the password again. Press TAB. Re-type the password. Press TAB.
30. Use the down arrow to open a drop-down menu of months. Use the up and down arrows to navigate until you hear your birthday month. Press ENTER. Press TAB
31. Type the date of your birthday. Press TAB
32. Type the year of your birthday. Press TAB
33. Use the down arrows to open a drop down menu of genders. Use the up and down arrows to select your gender. Press TAB twice.
34. Press the right arrow key and then type your mobile phone number. (If you do not have a mobile phone number, do not type anything.) Press TAB
35. This text box will ask you to enter your current email address. If you do not have a current email address you can ignore this text box. Press TAB
36. You will hear “Skip this verification (phone verification may be required). Ignore this and press TAB.

37. This next part is verification to make sure you are not a robot. To do this you have to type letters that JAWS has trouble reading. It will be easiest to have a trusted sighted individual enter these letters for you. Once entered, press TAB.
38. This next box is used to identify your location. If you are in India, you do not need to change it, so press TAB. If you are not in India, press the down arrow to open a drop-down menu. Use the up and down arrows until you hear the correct location. Press ENTER. Press TAB.
39. The next part is agreeing to Google's Terms of Service. You have to do this in order to create an account. Press SPACEBAR.
40. Press TAB three times or until you hear "Google may use my account information to personalize +1's on content and ads on non-Google websites." The check box is already checked. If you do not want Google to use your account information to personalize ads, uncheck the checkbox by pressing SPACEBAR.
41. Press TAB two times or until you hear "Next step." Press ENTER
42. You will be taken to a new webpage. Press TAB many times until you hear "Take me to my account"
43. This will take you to a complex version of your email account to go to the simple version of your email account press INSERT and F7 and use the up and down arrow keys until you hear "Set Basic HTML as Default." Press ENTER. If this does not work, you may have to have a sighted individual select the link at the top of the page that says "Set Basic HTML as Default."
44. You are taken to your Inbox, which is a webpage that contains all of the email messages you have received.

Compose and send an email in Gmail

9. To send an email press SHIFT, ALT, and C. This will take you to a new webpage and JAWS will begin to read the webpage which you do not need to hear. Press CONTROL to make JAWS stop reading.
10. You will be located in the "To" text box. Type the email address of the person you are sending the email. For example, if you are sending an email to me type mggioffre@gmail.com. Press TAB
11. You are located in the "Cc" text box. If you want another person to see that you are sending this email, but the message is not directly for them type their email address here. This text box is not often used and can be skipped. Press TAB.
12. You will be located in the "Bcc" text box. This is very similar to the "Cc" text box, but the person you send this to will not be able to see the email address of the other person it was sent to. "B" stands for blind. Again this text box is not often used and can be skipped. Press TAB
13. This next button is the "Choose File" button. This is to add attachments to an email. An attachment would be an MS Word document. You do not need to an attachment to every email you sent. Press TAB twice. If you do not need to send an attachment. Press ENTER if you would like to send a document. An Open Dialog box will appear, similar to the Open Dialog you use in MS Word. Navigate to the document the same way you would to open a word document. Press ENTER. The file may take a few minutes to upload. Press TAB.
14. You will be located at a button called "Attach more files." If you would like to attach more files, press ENTER and follow the previous instructions on selecting a file. To continue to the body of the email press TAB.
15. You will be located in the text box wear you can type the email message. Start your email message with the name of whom you are sending the email. For example if you are sending the email to me start by typing "Dear Maddie," Press ENTER twice. Type the message. Press ENTER twice. Sign the email by typing something like "Best regards," or "Sincerely,". Press ENTER. Type your name. Press TAB to go to the send button.
16. Press ENTER to send the email. Once the email is sent, you will be taken directly back to your inbox.

Navigating through your Inbox and reading emails

6. The inbox is set-up as a table with 5 columns and however many rows as there are emails. The first column of the table is a checkbox. The checkbox can be selected by pressing SPACEBAR. You would do this if you wanted to delete an email. It will be very unlikely that you ever have to delete an email. If you would like to delete an email, check the check box by pressing SPACEBAR and then press SHIFT and 3. The second column of the table always contains the name of the person who sent the email. The third column contains the subject of the email and the first few words of the body of the email. The third column is always a link and JAWS says link before reading the subject of the email. The forth column contains the date the email was received.

7. Press CONTROL and HOME to go to the first row, first column of the table. Press X to read the sender of the first email.
8. Press CONTROL, ALT, and the right arrow to navigate to a column to the right. JAWS will read what is located in each column and at the end will say which column you are located in. Press CONTROL, ALT, and the left arrow to navigate to a column to the left.
9. To move up or down columns (from one row to another, but remaining in one column) press CONTROL, ALT, and the up or down arrow keys.
10. To open and read an email, navigate to the third column of any email by using CONTROL, ALT, and the left and right arrow keys. You will hear JAWS say "link" before reading the subject of the email. Press ENTER. You will be taken to a new page containing the email message. Press H until JAWS reads the subject of the email. Then press INSERT and DOWN ARROW. JAWS will read the header of the email which contains email addresses and things that are unimportant. You need to pay attention to everything JAWS says after "Link show original." Once you the entirety of the email and JAWS seems to be reading things that don't matter, you can make JAWS stop by pressing CONTROL.

Piano:

- WINDOWS
- use arrows to find VMPK
- if you cannot find it using arrows find "All Programs"
- ENTER
- use arrows to find VMPK
- ENTER
- Twinkle Twinkle: dd jj kk j hh gg ff d jj hh gg f jj hh gg f dd jj kk j hh gg ff d
- Happy Birthday: ssdsgf ssdshg ssjhgfdhhfsds
- Come Little Children: ggll ;;l bbjj hhhhg llb jjb lllb jjh ggll ;;l bbjj hhg
- London Bridges: hjhgfgh dfg fgh hjhg fgh dh fs
- Mary Had a Little Lamb: zapa zzz aaa zff zapa zzzz aazap
- Old Macdonald: ssso ppo ffdds ssso ppo ffdds sssoo sss ss s ss s ssss ss ssso ppo ffdds

Mountbatten Brailler Instruction:

IMPORTANT: The following material is a condensed version of the original user manual. If there are tasks and functions not covered in this content, consult the original user manual.

- Turn on and off
  - There is a switch on the front, bottom, left of the brailler that turns the brailler on and off
  - A voice should notify you that the brailler is turned on and whether or not it is charging
- Loading paper
  - First method:
    - Lift the lever (located on the top right of the brailler)
    - Feed paper into slot on back of brailler until paper is just under the embossing head and adjust margins as needed
    - Flip lever to down position
  - Second method:
    - Lift the lever (located on the top right of the brailler) and adjust margins
    - Insert paper underneath small rollers and under embossing head
    - Flip lever to down position
- Removing paper
  - Lift paper lever and pull paper out of brailler
  - Paper eject commands
    - newline + enter
    - type letter “p” + space
- Commands
  - Press command button (circular button in the middle of the six buts corresponding to the Braille dots)
  - Type command
  - Press enter (oval, right-most button)
  - Commands:
- Navigating the page
  - newline + space (move down page in same column)
  - newline + backspace (move up page in same column)
  - tab (move right 5 spaces)
  - backtab (move left 5 spaces)
  - space (move one position right)
  - backspace(move on position left)
- Formatting commands
  - Letters “ce” (centers Braille)
    - press newline, command, type letters “ce”, enter
    - enter command again to turn off
  - letters “ra” (aligns Braille to right hand margin)
    - press newline, command, type letters “ra”, enter
    - enter command again to turn off
- Writing Braille
  - Press the corresponding dots simultaneously to produce the desired Braille letter
- Correcting and editing
  - backspace + space (replaces a character with a space)
  - backspace + correct dots (replaces a character with your desired character)
- Increase the force of the embossing head for thicker paper
  - command, backtab
  - You will hear “Up one”. This increases the force by one. Try typing. If Braille isn’t embossed enough, press command, backtab again.
  - Repeat until Braille is at desired emboss level
- Decrease the force of the embossing head for thinner paper
  - command, tab
  - You will hear “Down one”. This increases the force by one. Try typing. If Braille isn’t embossed enough, press command, tab again.
  - Repeat until Braille is at desired emboss level

- Writing Braille files in memory
    - Make a file
        - command button, type “begin [name file]”, enter
            - Example: command, type “begin testfile”, enter
        - You will hear “OK.” Now everything that is typed is saved in the filename that you specified
    - Close a file
        - command button, type letters “end”, enter
        - You will hear “OK.” Now the file is closed and whatever is being typed is not being saved
    - Changing a file
        - command button, type letters “append [name of file to append]”, enter
            - Example: command, type letters “append testfile”, enter
        - Now you can modify the file. Modifications will begin where the last Braille was typed.
    - Rename a file
        - command button, type letters “rename [original name of file] [new name of file]”
            - Example: command, type letters “rename testfile newtestfile”
    - Delete files
        - command button, type letters “del [name of file]”, enter
            - Example: command, type letters “del testfile”, enter
    - Recover a deleted file before switching brailler off
        - command, type letters “undel”, enter

All Commands
To execute a command, press the command button, type the desired command from the list below, press enter.

1. Turn command button on and off
    - newline, space, tab, backtab
2. Center text
    - ce
3. Right align text
    - ra
4. Change line spacing
    - ls [number]
    - number ranges from 1 to 3
5. Eject page (2 ways)
    - np
    - newline, enter
6. Enable and disable correction capabilities
    - cor
7. Turn embossing on and off (This can be used if you would like to type a file to be saved on the device, but you do not want it to physically emboss on paper)
    - em
8. Page numbering
    - pn [number to begin page numbering]
    - Example: pn 1
9. Begin a new file
    - begin [filename]
10. Close a new file
    - end
11. Append an existing file
    - append [filename]
12. Rename an existing file
    - rename [name of existing file] [new filename]
13. Delete an existing file
    - del [filename]
14. Emboss a file that is stored in memory
    - emb [filename]
15. Turn continuous paper feed on and off
    - cp
16. Turn caps lock on and off
    - cap
17. Turn back translation on (Enables the translation of Braille to written English on the computer)
    - busb

Graphics
Change to graphics mode command: gf (This makes the space between dots and lines reduced)

Heart
1. s, e, l, wh
2. gh, space, space, ar
3. space, e, i

Teddy Bear
1. space, ow, o, :, :, ow, o
2. space, s ow, o ow, o, wh
3. space, gh, space, e, l, space, ar
4. ow, s, space, space, space, space, wh, o
5. in, gh, space, space, space, space, ar, en
6. e, l, e, :, :, l, e, i

Sailboat
1. space, 456, ch
2. space, 456, space, ch
3. space, 456, space, space, ch
4. er, full cell, full cell, full cell, full cell, n

Using MB-Comm Software for Back Translation

IMPORTANT: The following instructions are for Windows XP operating system. The only computer where the operating system would be different and thus the instructions to execute the following tasks would be different is on Ms. Muktha's computer in her office.

9. Plug cable into USB port on the left side of the computer screen. It is the second whole from the top and you may have to flip the cable if it doesn't go in smoothly on the first try.
10. Open the MB-Comm program
    i. Press the WINDOWS key
    ii. Use the arrow keys until you hear "MB-Comm"
    iii. Press ENTER
    iv. When the program is open you will hear "Edit read only. Type in text."
11. Connect the brailler
    i. Press the ALT key to select the toolbar menus
    ii. Use the right and left arrow keys to navigate between the File, Device, Tools, and Help menus
    iii. When you hear "Device" use the down arrow to choose an option to select
    iv. When you hear "Connect Mountbatten" (this is the first option) press ENTER
    v. A dialog box will appear
    vi. Use the TAB key to navigate until you hear "OK". Press ENTER
    vii. Another dialog box will appear
    viii. Use the TAB key until you hear "Continue". Press ENTER
    ix. You will hear beeping noises coming from the brailler. This means the brailler is connecting. When you hear "Edit read only. Type in text" again, this means the brailler is connected
12. Display a file from the brailler before saving it
    i. Press the ALT key to select the toolbar menus
    ii. When you hear "File" use the down arrow. When you hear "Display File from Mountbatten…" press ENTER (You will hear beeping noises coming from the brailler)
    iii. A dialog box will appear. Use the tab key to navigate until you hear "Mountbatten Directory List"
    iv. Use the up and down arrows to navigate between files until you hear the file you want to display
    v. Press the TAB key twice to navigate or until you hear "Display". Press ENTER. You will hear beeping from the brailler and "Edit. Type in text". This window will only allow you to view what was typed by the brailler. You cannot edit it.
    vi. Press the down arrow to have JAWS read what is displayed.
13. Clear the display window without saving
    i. Press ALT and then use the right and left arrow keys until you hear "File". Then use the down arrow until you hear "Clear Display Window…". Press ENTER
    ii. A dialog box will appear asking you "Do you wish to save display?". If you don't want to save the display, use the TAB key until you hear "No"
14. Save a displayed file
    i. Press ALT and use the right and left arrow keys until you hear "File". Then use the down arrow until you hear "Save Display to File…". Press ENTER
    ii. A dialog box will appear. Type a name for the file. Press ENTER
15. Receive and Save a file from the Mountbatten without displaying the file
    i. Press ALT and use the right and left arrow keys until you hear "File". Then use the down arrow until you hear "Receive and Save File from Mountbatten…". Press ENTER
    ii. A dialog box will appear. Use the TAB until you hear "Mountbatten Directory List".
    iii. Use the up and down arrow keys until you hear the name of the file you wish to save.
    iv. Press the TAB key twice or until you hear "OK". Press ENTER
    v. Another dialog box will appear. Type a name for the file. Press ENTER
16. Print a file that was saved
    IMPORTANT: This must be done on Ms. Muktha's computer because it is the only computer currently connected to a printer. The document you would like to print must be saved on a pin drive and then transferred to Ms. Muktha's computer.
    i. Find My Documents either from the desktop or by pressing WINDOWS and then using the arrow keys.
    ii. Type the first letter of the name of the document and then use the arrow keys until you hear the document.

iii. Press ENTER. You will hear the name of your file then “dash notepad”. Your file is open and can be edited.
iv. Make sure the printer is turned on. The ON button is located on bottom right of the top face of the printer and is the long rectangular button on the bottom row of buttons.
v. To print without editing, press CONTROL, P. Then press ENTER

Sample Question Paper

Mathru Educational Trust for the Blind

05-07-2013

Subject: General Knowledge

Total Marks: 15

IV. Fill in the blanks. [1*5 = 5]

6. There are ---- seconds in one minute.
7. Lion is the king of ----.
8. Lotus is our ----.
9. Gandhiji is the father of our ----.
10. Fish live in the ----.

V. Answer the following questions. [1*5 = 5]

6. Which is our country?
7. Which is our state?
8. Who is the father of our nation?
9. Who wrote our national anthem
10. Who is known as Netaji?

VI. Match the following. [1*5 = 5]

6.	Crow	Bird
7.	Dog	Animal
8.	Mango	Fruit
9.	CoconutTree	
10.	Brinjal	Vegetable

Setting up Tata Photon Plus Connection for Blind Users

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The following details the instructions on how to set up the Tata Photon Plus connection for blind users. Currently at the Mathru School there are two computers with this capability already and they are located in the Braille Writing Tutor room. The instructions are best suited for a technical person who is comfortable with creating automated scripts.

1. Install the software and drivers bundled with the Tata Photon Plus.
   This should happen automatically when you connect the device to the computer, but if setup does not automatically run, open My Computer
2. Open a command prompt window and run *rasphone -a*
   a. "Dial-Up"
   b. Telephone number: #777; Destination Name: "Photon Plus" (or anything else you want)
   c. Username: internet; Password: internet
3. In the command prompt window, run *rasphone -e "Photon Plus"*
   a. Under the "Options" tab, uncheck "Prompt for name and password...", "Include Windows logon..." and "Prompt for phone..."
4. Create 2 .bat files on the Desktop (or wherever is convenient for the user)
   a. Name one "connect.bat" and its contents should be *rasphone -d "Photon Plus"*
   b. Name the other "disconnect.bat" and its contents should be *rasphone -h "Photon Plus"*.
5. The user can now use the 2 batch files to connect and disconnect from the Internet.

Mathru School Facebook Instructions

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Mathru School Facebook page Instructions

1. Go to www.facebook.com
2. Type in your email and password and click the login button.
    a. Email: mathru_india@yahoo.co.in
    b. Password: raghavm
3. You are now logged into Ms. Muktha's account and are viewing the welcome page
4. On the panel to the left of the screen, you will see a link titled "Mathru Educational Trust for the Blind". Click it. You will now be on the Mathru Main Page.

TO WRITE/RESPOND TO **MESSAGES**:

Messages on facebook are similar to emails on other platforms. From the Mathru Main Page, one of the sections on the admin panel is Messages. You can click on "see all" and reply to peoples messages by clicking on their names and typing out a response.

TO CHECK **NOTIFICATIONS**:

Notifications are facebook's way to let you know when something significant has occurred. You will be informed of things such as when a person likes your page or when someone comments on your page. From the Mathru Main Page, one of the sections on the admin panel is notifications. You can click on "see all" to see the activity that has been happening on your page. If you click on a specific notification, you will be taken to the location of the notification to see in context.

TO **ADD PICTURES**:

From the Mathru Main Page, scroll down past the Admin Panel to where the large images of Mathru and its students are. This is the banner and profile image and will be the first thing visitors see when they go to your page. Just at the bottom of that section is a link "Photos". Click on it. You will be directed to a new page.
To add a single image, click the button on the top right called "Add Photos". From here, browse your computer for the image you want to add.
To add several pictures just make sure to click several images when browsing your computer. This can be done by holding down the CTRL button on the keyboard when clicking the images.

TO WRITE ON YOUR **WALL**:

From the Mathru Main Page, scroll down past the Admin Panel to where the large images of Mathru and its students are. This is the banner and profile image and will be the first thing visitors see when they go to your page. Just under that section on the left half is a box that says "Write something…". Once you write something and then click "Post", it will show up in its own box and people who view your page will be able to see it.

You can change from status to Photos here and this is another way to upload photos. Here you also have the option to upload an album. This is just like a folder that holds several photos that you would like to group together.

TO COMMENT/RESPOND TO **COMMENTS**:

Once a post is made, you can hover over it. On the right you can click the pencil icon to delete or edit the post, or on the bottom left of the post you can click "comment". This is a way to add comments or replies to the relevant post.

TO CHANGE **PROFILE IMAGE**:

From the Mathru Main Page, scroll down past the Admin Panel to where the large images of Mathru and its students are. This is the banner and profile image and will be the first thing visitors see when they go to your page. The smaller image to the bottom left is the profile image. To change this image, hover over the current image and click the “Edit Profile Picture” button. From there, click either “Choose from Photos” or “Upload Photo”. This will allow you to either pick an image that you have on facebook already or pick an image that is on your computer, respectively. Remember that your profile image is what people will see on their accounts associated with all your activity, so choose carefully.

TO CHANGE **BANNER PHOTO**:

From the Mathru Main Page, scroll down past the Admin Panel to where the large images of Mathru and its students are. This is the banner and profile image and will be the first thing visitors see when they go to your page. The large image spanning the entire width is the banner. To change this image, hover over the current image and click the “Change Cover” button. From there, click either “Choose from Photos” or “Upload Photo”. This will allow you to either pick an image that you have on facebook already or pick an image that is on your computer, respectively. Remember that your banner image is shown only on your page to attract the eye of potential visitors, so choose carefully. Also note that this image is very wide so make sure to pick an image that fits well.

TO CHANGE **INFORMATION** SUCH AS THE ABOUT AND CONTACT:

From the Mathru Main page, click the “Edit Page” button near the top right of the screen. From the drop down menu, click on “Edit Settings”. On this new page you will see a panel on the left of the screen. Click on “Basic Information”. Here you can edit any of the fields. Be sure to scroll to the bottom of the screen, and click the button “Ave Changes” when you are done making any edits.

Winbraille Instructions for Contractions and Page Numbers

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The following details instructions for changing contracted and uncontracted braille settings for embossing on Mathru's embosser using the standard version of the Winbraille software.

Contractions:

To change the contractions settings, the language rule file needs to be changed in the profile settings. To do this:

- First close all open WinBraille documents (don't forget to save)
- Go to the Profiles tab and then click on Manage Profiles
- A window will open asking you which profile you want to change. Choose Basic-D (the only option available) and click Edit.
- A window will open allowing you to change the profile settings. Choose the "Translation" category.
- Then use the drop-down menu at the top to choose which contraction rule file you need:
    - Choose american_g1 for uncontracted, open Braille
    - Choose american_g2 for contracted Braille
- Then save changes, close the Manage Profiles window and use WinBraille.

Page Numbers

To change settings about the page numbers, the header settings must be changed in the profile settings. Most of the steps will be the same as changing the contraction settings:

- First close all open WinBraille documents (don't forget to save)
- Go to the Profiles tab and then click on Manage Profiles
- A window will open asking you which profile you want to change. Choose Basic-D (the only option available) and click Edit.
- A window will open allowing you to change the profile settings. Choose the "Headers" category.
- There will be text boxes that you can fill in for the headers and footers: 3 for odd pages (left, center, right) and 3 for even pages. There will also be a guide that says that %b must be typed for the Braille page number.
- Since we want the page number on the right side of the header (top right of the page), we should enter %b in the box with says Right Header for both odd and even pages.

Mathru Website Permissions

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The following list contains the instructions on how to access Joomla, cPanel, and Mathru's email. Included is the username and password for each program to allow Mathru to alter and update their website independently.

Joomla:
Joomla is a Content Management System (CMS) used for the Mathru School website (mathrublindschool.org). Its main function is to edit the way webpages, links and menu items are organised and displayed on the site. It also controls any components that are added to the website, like a video player, search bar, news feed, etc.

To access the Joomla control panel, go to mathrublindschool.org/administrator
Log in using the credentials:

Username: mathru_joomla
Password: raghavm

cPanel:
cPanel is a backend service provided by the server hosts. It can be used to access the actual files that are stored on the server (automatically generated by Joomla or manually stored).

To access the cPanel page, go to mathrublindschool.org/cpanel
Login using the credentials:

Username: inlyprvg
Password: %E;Yc@KQ

Mathru Email:
To read and write emails using an @mathrublindschool.org email address go to mathrublindschool.org:2095
Current user credentials:

Username: admin@mathrublindschool.org
Password: raghavm560064

Additional users can be added at any time.

Long Term Assessment Documents

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The following templates detail the information on the BWT and SABT the teachers will send to TechBridgeWorld. The blind teachers have been given hard copies of the document and have been trained on how to respond the questions and save the documents in the folder on the desktop.

BWT Template for Teachers

Braille Writing Tutor: Please answer the following questions in a document after each training session. Save the file on the desktop of the left computer in the Braille Writing Tutor room in a folder called "Braille Writing Tutor Reports"

Student Name:
Class:
Date:
Teacher Name:

1. How many times did the Braille Writing Tutor need to be reconnected before it could be used?
2. How many times did the Braille Writing Tutor speak without a button being pushed?
3. How many times did the Braille Writing Tutor stop responding?
4. How much time was spent using the Braille Writing Tutor?
5. Which modes were used while using the Braille Writing Tutor?
6. Please describe any difficulties, if any, that the student encountered.

SABT Template for Teachers

Stand Alone Braille Tutor: Please type an MS Word document with the following information after each training session. Save the file on the desktop of the right computer in the Braille Writing Tutor room in a folder called "Stand Alone Braille Tutor Reports"

Student Name:
Class:
Date:
Teacher Name:

1. In what room was the Stand Alone Braille Tutor used?
2. How many times did the Stand Alone Braille Tutor have no sound when the device was turned on?
3. How many times did the Stand Alone Braille Tutor speak when the button was not pushed?
4. How many times did the Stand Alone Braille Tutor stop responding?
5. How much time was spent using the Stand Alone Braille Tutor?
6. Which modes were used while using the Stand Alone Braille Tutor?
7. Please describe the difficulties, if any, the students encountered while using the Stand Alone Braille Tutor.
8. Did the Stand Alone Braille Tutor lose during this session or did the batteries need to be replaced?

Braille Writing Tutor User Guide

by Madeleine Clute, iSTEP 2013 Intern
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Introduction

This document contains a brief description of the main menu and each mode of the Braille Writing Tutor, followed by any related instructions.

Starting the tutor

To start the tutor, make sure it is plugged into the USB port, and then find the BT program in the windows start menu. This should launch the tutor, and you should hear it say "starting braille tutor." In the event that the computer cannot find the tutor, it will play a sound, and you should exit the program and un-plug and then re-plug the tutor in the USB port. If the computer does find the tutor, it will start giving instructions on how to use the main menu.

Main Menu

The main menu allows you to scroll through the options for modes. You move between options using buttons 1 and 4 as "forward" and "back" buttons, and press the select button when you hear the mode that you would like to enter. To re-enter the main menu from any activity, hold down the select button, and push dot 1 before releasing.

Learn Dots

This mode teaches students the numberings of the dots on the Braille Writing Tutor. It will ask them to find different dots and will tell them when they have pushed the correct dot.

Dot Practice

This mode asks students to enter various patterns of dots. It will say which dot was pressed after a dot is pressed. There is no need to push the select button when a pattern is done, the tutor will know that it is done.

Learn Letters

This mode teaches English letters. It first instructs the students which dots to push for certain letters, and then will quiz the students on the letters they have learned.

Letter Practice

This mode will ask students to enter simple combinations of letters. After each letter has been entered, the students should push the select button.

Animal Game

This game quizzes students on different animal sounds. It will play an animal sound and ask the student to spell out the name of that animal. At any time, if you hold dot 3 down and then press "select" before releasing, it will spell out and say the name of the animal. After this, you will need to start writing the animal name from the beginning. To spell out an animal, press the proper dot patterns for each letter, and then hit the slect button.

Everyday Noises Game

This game quizzes students on different sounds they might hear during their daily lives. It will play a sound and ask the student to spell out the name of the object that makes that sound. At any time, if you hold dot 3 down and then press "select" before releasing, it will spell out and say the name of the object. After this, you will need to start writing the object's name from the beginning. To spell out an animal, press the proper dot patterns for each letter, and then hit the slect button.

Learn Numbers

This mode is like learn letters, except it teaches Braille number codes. It does not require students to enter the numerical sign first.

Arithmetic Practice

This mode quizzes students on addition, subtraction, and multiplication problems. It will ask you to choose your mode for the type of problems you would like, and then it will ask you to choose your level of difficulty. The easiest level will typically have 1 digit answers, the medium level will typically have 2 digit answers, and the highest level of difficulty will typically have 3 digit answers. Once a question is asked, the student is expected to first enter in the numerical sign (dots 3,4,5,6), and then each digit one by one. The tutor will say the name of the dot that was just pressed, and will know when a full number has been entered--there is no need to push select to enter an answer. The tutor will give feedback when a digit has been correctly entered. At any point, a student can press the select button to repeat a question.

Learn Letters Kannada

This mode is nearly identical to the English Learn Letters except it teaches Kannada Braille. This mode also serves to teach Hindi Braille as it is the same as Kannada Braille, but Kannada Braille has 3 additional characters. The only difference in using this mode is that there is one multi-cell character. The tutor will say "multicell character" and then give the patterns for both cells. The user then will have to enter in the first cell, and then the second cell patterns. The tutor will give audio feedback when a cell has been entered correctly.

Hangman

The purpose of this game is to guess the mystery word by guessing which letters the dashes are supposed to be. It will say that the word is "dash dash dash dash", and then ask you to guess a letter. Enter a letter in which you think the word contains, and press select. If the letter is in the mystery word, it will fill in the dashes that were supposed to be that letter. For example, if you guessed "T" and the word was "NOTE," then it would now say the word is "dash dash T dash." If you guess a letter that is not in the word, it will tell you that you have made a mistake. The goal of the game is to guess the mystery word with as few mistakes as possible.

Stand Alone Braille Tutor User Guide

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Introduction

The Stand Alone Braille Tutor or SABT is an educational tool for visually impaired students. It is designed to supplement instruction in the classroom by providing exercises that help students learn and practice writing in Braille. It is similar in functionality to the Braille Writing Tutor or BWT that has been at Mathru for the past several years. However, unlike the BWT, it does not need to be connected to a computer to function. Instead, it is a portable and battery powered device. As a result, it can also be used inside the classroom.

Physical Description

The device is shaped like a cuboid. To place the SABT correctly, make sure that it is lying flat on the table and that the smooth short surface of the SABT faces towards the user's body.

Top Surface

The top surface of the SABT has a total of 12 buttons - 6 Braille dots and 6 control buttons.
The 6 Braille dots are in the form of a grid of 6 large buttons. They are located near the bottom-right of the SABT. Dot 1 is near the top-right of the grid and dot 6 is near the bottom-left of the grid. The 6 control buttons are located near the top half of the device.

Near the top-left, there are 2 buttons - Enter and Cancel. The Enter button is square in shape, and the Cancel button is diamond in shape. They are used to select and leave modes, enter and clear Braille characters, etc. The Cancel button is located directly below the Enter button.

Just to the right of the Enter and Cancel buttons, there are Volume Up and Volume Down buttons, which are used to adjust the volume on the SABT. The Volume Down button is located directly below the Volume Up button.

Near the top-left of the device, there are Left and Right buttons. They are used to change modes in the Main Menu, switch between letters and cells, etc.

Left Surface

The left surface of the device has a power switch near the far edge of the device. The device is switched on when the switch is in the position closer to the user. A headphone port is located next to the device. Either speakers or headphones can be plugged into this port.

Far Surface

On the far surface of the device, facing away from the user, there is a SD memory card slot and a USB port. The SD memory card slot is located on the left side and when the SD card is inserted into it, a part of the card juts out of the device. The slot is spring-loaded, so pushing in will cause the card to pop out. The card can be reinserted by pushing it in again till a clicking sound is heard. The card is rectangular in shape and is in its correct orientation to be inserted when the short edge with the cut-off corner is nearest to the user.

The USB port is to the right of the far surface and can be used to optionally power the device via a computer.

Bottom Surface

The bottom surface of the device allows the user to replace the SABT's batteries. The SABT runs on 4 standard AA sized batteries. Make sure that the batteries are inserted in the correct orientation. Do not mix and match batteries.

Turning on the SABT

To start the device, make sure the device is in the correct orientation and switch on the SABT. If the device turns on successfully, an introduction prompt should be heard. If instead of hearing the prompt, a clicking

sound is heard, check to make sure the SD card is inserted properly and reinsert the card if necessary. If no sound is heard, check the speakers/headphones. If the speakers/headphones are OK, check the batteries on the SABT and replace if necessary.

After hearing the prompt and waiting for around 10 seconds, the main menu prompt will play. In the main menu, the Left and Right buttons can be used to scroll between modes and Enter can be pressed to select a mode. To return to the main menu from any mode, Cancel can be long pressed (for about 3 seconds). In case the SABT stops responding to any key input, the device can be restarted by turning it off and then on again.

Mode Instructions

Dot Practice

This mode helps the user learn the arrangement and corresponding numbering of dots in a Braille cell while writing. The SABT sounds out the dot number to be pressed and the user must then press the corresponding dot to continue to the next dot. If the user answers incorrectly, the device repeats the dot to be pressed. Long press Cancel to return to the main menu.

Letter Practice

This mode helps the user learn English letters. On entering this mode, the user can press dot 1 to learn letters and press dot 2 to practice letters.

- In learn letters, the SABT goes through the alphabet in order, sounding out letters and corresponding dot patterns and waiting for correct input from the user.
- In practice letters, the SABT picks letters in random order and asks the user to give the pattern. After 3 mistakes, the SABT tells the user the correct pattern.

Once a mode has been selected, the SABT starts playing letters and patterns.

- Press Enter after entering the pattern for a letter. If the pattern is correct, the SABT moves to the next letter, otherwise it repeats the letter for the user to try again.
- Press Cancel to clear the pattern and try again.
- Press Left to hear the pattern again.
- Press Right or press Cancel two times to the help menu. In the help menu:
- In the help menu, press Enter to skip to the next letter.
- In the help menu press Cancel to try again.
- In the help menu press Left and Right to scroll between letters. Then press Enter to select that letter for practice
- Long press Cancel to go back to the main menu

Hindi Letter Practice

Hindi letter practice is very similar to the letter practice mode. It too, has 2 submodes for learning letters and practicing letters. The only difference is that there are some multi-cell Braille letters in Hindi. So the way to enter answers is different. The first pattern for a letter must be input to the first cell, the second pattern to the second cell and so on. Initially the SABT is on the first cell.

- Press Left or Right to go the next or previous cells respectively.
- Press Cancel to clear a cell.
- Press Enter after completing all cells for a letter. If the pattern is correct, the SABT moves to the next letter, otherwise it repeats the the letter for the user to try again.
- Press Cancel two times for the help menu. The help menu is identical to the help menu in letter practice.

Kannada Letter Practice

This mode is very similar to the Hindi letter practice mode, except instead of Hindi letters, the user practices Kannada letters. Also, the instructions are given in Kannada. Please refer to the instructions for the Hindi letter practice mode.

Free Play

The free play mode lets the user practice spelling letters in English.

- The user can press the pattern for any letter and then press Enter to hear the letter.
- If the user presses a pattern that is not a letter, then the device tells the user that they pressed an invalid pattern.
- Long press Cancel to go back to the main menu.

Animal Game

This mode helps the user learn spellings and sounds for animals. On entering this mode, the user can enter A to play the animal game and enter B to learn animal sounds. The user must press Enter after entering A or B.

- In the play animal game mode, the user hears the sound for an animal, must identify the animal, remember its spelling and write the name of the animal. This gives lets the user practice spelling and also associating animal sounds to animal names.
- In the learn animals mode, the user is told an animal name, and must spell it out and after they successfully spell the word, they hear the animal sound. This way the user can associate the name of the animal, it's spelling and the sound it makes.

Once the mode has been selected, the SABT will either play an animal word or an animal sound.

- To enter the name for an animal, the user must enter the pattern for each letter and then press Enter. If the user makes a mistake, the device lets the user try that letter again.
- If the user makes 3 mistakes in a row, the SABT tells the user the spelling for the animal.
- If the user makes 6 mistakes in a row, the SABT tells the user the dot pattern for each letter.
- Press Cancel to go back to select between the animal game and learning animal sounds.
- Press Right to skip the animal. Then press Enter to skip the animal or press Cancel to try again.
- Press Left to hear the animal sound or name again.
- Long press Cancel to go back to the main menu.

Everyday Noises Game

This mode is very similar to the animal game mode, except that instead of animal sounds, the user practices everyday noises. Please refer to the instructions for that mode.

Hangman

Hangman is a game that lets the user practice spelling words. In this game, the user is supposed to guess the spelling for a randomly selected word.

- Initially the SABT reads out the number of letters in the word in the form of blanks.
- The user then guesses a letter by entering the pattern and then pressing Enter. If the letter exists in the word, then the SABT plays the word again, replacing "Blank" with the letter wherever it is found in the word.
- If the letter does not exist in the word, the SABT asks the user to try again. The user can make a maximum of 6 mistakes before the device tells the user what word they missed. After completing a word, it moves on to another word.
- Long press Cancel to go back to the main menu

Two Player Hangman

Two player hangman is similar to hangman. The main difference is that instead of guessing a random word, one player enters a word for the another player to guess.

- The first player must enter the word letter by letter, pressing Enter after each letter and then pressing Enter once again when the word is complete.
- If the word is valid, the device can then be handed to the next player. If it is not, the first player must try to enter a word again.
- Once the SABT is handed to the next player, they then press Enter. The SABT then plays out the correct number of blanks and then the second player can continue playing hangman as usual. Refer to the hangman mode instructions.

Number Practice

This mode is very similar to the learn letters mode, except that instead of letters, the user practices numbers and the number sign. Please refer to the instructions for that mode.

Maths Practice

This mode lets the user practice 3 basic arithmetic operations: addition, subtraction and multiplication.

- The user must first select one of these operations by pressing dot 1, 2 or 3, respectively.
- The mode has 3 difficulty levels: easy (1 digit answers), medium (2 digit answers) and difficult (3 digit answers). The user must press dot 1, 2 or 3, respectively.
- The answer entry in this mode is similar to Hindi letter practice, please refer to that mode for instructions. The only difference is that the user must enter the number sign in the first cell and then their answer in the following cells.
- The help menu, accessed by pressing Cancel two times, is also different.
- In the help menu press Enter to skip the question.
- In the help menu press Cancel to try again.
- In the help menu press Left or Right to hear the answer.

Tactile Graphics Library User Guide

by Poornima Kaniarasu, iSTEP 2013 Intern
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Starting up:

Please click on the image icon on the desktop named “TG”

Usage:

- The stand alone application starts up with focus on the text box into which the user can enter text and press enter which would automatically start up the search.
- In case a sighted person uses it and wishes to have choices to pick from, they can use the "CHOOSE from 5 images" which picks out the top 5 images from google search of line drawings for the particular string.
- The user can use tabs to shift between the buttons and the text boxes.
- The user can select any image from their computer to convert to ASCII text file using the "BROWSE" button.
- Once the user selects an image, clicking the "GENERATE" button would create the text files using 3 different image filters.
- The user can then click on "SELECT FOR PRINT" button if the braille image is desirable.
- They can browse through the 3 filtered braille image previews using the "NEXT" button
- Clicking on "COMPARE" lets the user see the 3 images juxtaposed along with the original image.
- Once the user selects an image for printing, the particular file is stored in the name of the search string in the folder “C:\out”.
- It also has the image caption at the top
- The application automatically opens up the notepad file with the image that the user can use for printing.

- The user can copy the text from the notepad file to Patrika to print it by clicking on Emboss . Select all of the text (CONTROL and A). Copy the text (CONTROL and C). Open Patrika by going to the Windows Start Menu (WINDOWS key) and using the arrow keys until you hear “Patrika”. Press ENTER. Paste the text into Patrika (CONTROL and V)
- Translate to Braille: CONTROL, ALT, and B
- Print: CONTROL, SHIFT, and E
- The user can click on the search string again to start a different search

The user can also search multiple words, the algorithm removes all the special characters in the search string and lets Google handle the multi-word string with its suggestions. The application plays a small music once the image is ready. If the application does not respond for a long time, closing it and restarting it might help.

User Interface

Search box: The cursor is on the search box once the application opens up. The user can enter the name of anything they want to search for and press enter. This brings up the image the user wants to print.

Search button: The user can also click on the search button instead of pressing enter.

Browse button: The browse button is used to select an image from the image library.

Choose from 5 button: Sighted users if they wish to pick from a set of 5 images manually, they can click this button. Double clicking the image helps you select the image.

Radio button: There is a small radio button at the top which when clicked disables caption of the image. The radio button is not accessible through the keyboard hence avoiding blind users accidentally clicking on it.

Generate button: Generate button is used to generate the braille image.

Compare button: The user can use this button to compare the braille image generated using different image filters. They can’t however pick the image from the window. They need to press “Next” again to scroll to the desired image.

Select for Print button: The user can click on this button to open up the text file to be printed.