A SMART SYSTEM FOR SUPPORTING BLIND PEOPLE IN EDUCATION

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Abstract

Access to school continues to be challenging to most learners with visual and hearing impairments, irrespective of the government’s commitment to scale up efforts to support them at various levels of education. Deaf blindness affects students’ progress and well-being.

This paper presents a methodology for assisting the inclusion system in education. In this context, the present work focuses the development of a Text-to-Braille application for the blind and deaf and its ultimate purpose is the development of a mobile application that allows a blind user to read text that is written on the classroom board along with regular sighted-hearing students. The proposed system improves the deaf and blind student’s ability to access and connect with people and the environment.

Keywords: Assistive technology, Braille, Deafblind.

1. Introduction

Deafblindness is the blend of blindness and deafness in single person. Person who are deafblind suffer from both visual and hearing problems. The disabilities of such individuals are very high. Based on the severity of impairment, the people with visual and hearing disabilities are categorized into four types as deaf blind narrowly defined, Deaf and severely visually impaired, Blind and severely hard of hearing, Severely vision and hearing impaired.

There are four categories based on how the deafblind people acquired deafness and blindness. They are Congenitally Deafblind, Congenital Deafness and Acquired Blindness, Congenital Blindness and Acquired Deafness, Acquired Deafness and Blindness. There are an estimated 285 million visually impaired people worldwide [WHO12]. Of those, 39 million are legally blind and 246 million have low vision. 90% of the world's visually impaired live in developing countries.
1.1 Challenges Faced

Humans learn the whole thing about the world by means of their vision and hearing. Vision and hearing are the important sensory paths by which usually humans interact and communicate with others. Recognising people and knowing things around us is very essential for day to day activities. For people who are deaf and blind interaction and communication by normal means is impossible. Both visual and hearing impairments affect the capability to communicate, improve personal relationships and gaining knowledge. Deafblindness affects human progress, happiness and comfort. Deafblindness mainly affects the education of students. The combined effects of visual and hearing loss segregates students from people and the surroundings. Education is the only means for reducing such segregations. The major challenges faced by the education system are to build the deaf and blind students’ abilities in communication, concept development and social competence.

1.2 Academic History of Deafblind Education

Robert Smithdas became the first deafblind person to obtain a Master’s degree. He attended college with the support of a 1:1 attendant and volunteers who made certain that all his textbooks and exams were available to him in braille. In today’s world there are a number of deafblind students who are counterfeiting their own way through education programs without the support of a 1:1 attendant. Many of the deafblind students are often not given a chance to live up to high expectations. For deafblind students, their access to other areas of the curriculum that focus on developing social skills, independent living and travel skills, and vocational exploration opportunities are limited at best.

1.3 Education System for Deafblind

Deafblind students have to face many obstacles like low expectations, inadequate support services in their way to access academic achievement. Students who are deafblind use many forms or methods for communicating with others. Some use presymbolic communication forms such as body movements, touch, objects, pointing, natural gestures and eye gaze. Other students who are deafblind use symbolic communication forms that include signed communication and finger spelling (both visual and tactile), print, braille, electronic or computer-activated voice-output devices, and speech.

1.4 Inclusion System in Education

Now-a-days there has been a shift into inclusion. Inclusion is to offer services to deaf and blind children in a regular school, ensuring that all the support systems are in place. Inclusion refers to the educational process that wishes to
extend to the maximum the opportunity of deaf and visually impaired children to attend regular mainstream classrooms.

1.5 Existing Technologies used by Visually Impaired

Enlarging hardware and software, speech-access systems, refreshable braille, note takers, braille embossers, and optical character recognition (OCR) readers are the technologies commonly used by the visually impaired people.

A. Enlarging Hardware and Software: The most commonly used method of assisting individuals with visual impairments is magnification. These use large computers monitors and software’s to enlarge the contents for visually impaired people. While these devices and software programs for the computer are helpful to some low vision users, they are not the best solution for others.

B. Speech-access Systems: The most familiar form used by blind people to access to computer is speech access. Speech-access systems use speech synthesizers to provide access to information on the screen and verbal verification of what is being input from the keyboard. The most commonly used software’s are Talking word processor software and screen reading software. The purpose of talking word processor is to immediately convert the information that is input into the computer into audio and is provided for the visually impaired people. The purpose of screen readers is to provide immediate auditory feedback of the entire screen including menu bars and prompt lines. As using mouse requires vision, most blind people use a standard QWERTY keyboard for inputting information into the computer.

C. Refreshable Braille: Refreshable braille is a means by which information that is presented visually on a computer monitor is captured and presented to the user in a braille format through the mechanical action of tiny electronic driven plastic pins that emerge from the device to form braille characters. The term refreshable is used because the display refreshes itself immediately following the cursor on the monitor. Braille display - hardware devices that show up to one computer line at a time in Braille. As the user moves around the computer screen, tiny solenoid pins on the display raise and lower to form the Braille character of each computer screen character. Braille Writer-a special typewriter that produces immediate text in Braille as it is being typed. It is the most common mid-tech device used for typing in Braille. Electronic Braille typewriters- a tool is a combination of Braille Writer and electronic note-taker. It produces an immediate hardcopy of Braille, allowing prior insertion and proofreading of text.

D. Note Takers: Note takers are small lightweight electronic devices that can be used for a variety of purposes. Information can be inputted into these devices using either the standard QWERTY keyboard or braille keyboards. Files can be accessed straight from these devices via speech or downloaded into computer word processing or braille
translation programs in order to further manipulate the information with the computer. Note takers can be used as braille to print or print to braille translators.

E. Braille Embossers and Translation Software: Braille embossers or braille printers, create the embossed raised characters in order to create braille text. They produce braille copies of information stored in the computer in a text format. Embossers are usually used along with braille translation software that will convert text files into a braille format. There are braille translation programs available for literary braille, braille music, and for the Nemeth Math Code (Edwards & Lewis, 1998). Braille music translation software is also available that will convert standard music notation into The Music Braille Code from scanned copies of the music.

F. Optical Character Recognition Software: This software works in conjunction with a scanner to capture and convert text into an electronic format that can be accessed through speech, large print, a refreshable braille device, an embosser, or by using braille translation software (Edwards & Lewis, 1998).

2. Literature Survey

In [1] Camera Reading for Blind People, an application is presented which performs image to speech conversion. The mobile phone will capture the image which can be the text from book or a piece of text on wall, then processed through Optical character recognition (OCR) which recognizes the text from image data and converts them into digital data. Text-to-speech (TTS) is then used to convert text in digital format to be synthesized into human voice and played through an audio system.

Teaching music to blind children [2] presents a practice for teaching music to blind children using Musibraille software. Specific functions were added to the Musibraille software for supporting the activities of basic music education.

The assistive software, useful and necessary tool for blind student's abilities development [3] have made survey using questionnaire from students belonging to special school and published results for appreciation of the importance of assistive technology and the assistive software used by them. The results show that the blind children find very efficient learning through using assistive technology and software.

Multi-View Platform [5]: An Accessible Live Classroom Viewing Approach for Low Vision Students, presents a platform for low vision students to use their smart phone camera or tablet to capture and view the lecture visuals such as whiteboard or presentations in magnified views. Accessibility of Web and Multimedia Content [6] presents a summary of a short course on techniques to help design more accessible Web and multimedia content for people with
different types of disabilities. The paper also discusses how accessibility issues affect users with different types of
disabilities by including examples and issues with text, images, audio, video, structural elements and navigation.

UbiBraille [7] presents the designing and evaluating a Vibrotactile Braille-Reading Device which consists of six
vibrotactile actuators that are used to code a braille cell and communicate a single character by simultaneously
actuating the user’s index, middle and ring finger of both hands. The paper has also evaluated the timing conditions
for character and word reading.

Learning technologies for people with disabilities [8], the author presented the basic concepts of e-accessibility,
universal design and assistive technologies, with a special focus on accessible e-learning systems. The author has also
presented the recent research works conducted in our research Laboratory LaTICE toward the development of an
accessible online learning environment for persons with disabilities from the design and specification step to the
implementation.

In [9] The OntoBraille@RFID (OBR) platform adopts ontological theory to retrieve Braille knowledge to facilitate
learning, and a low-cost RFID for Braille character identification. This system is equipped with a voice device so
students can learn independently. OBR is also equipped with administrative functions so parents can monitor the
students’ learning progress. In contrast to currently available Braille learning devices, this new system can
automatically expand the Braille database. Results from trials suggest that OBR can significantly improve the
learning outcome for blind students.

Development of a compact dielectric elastomer actuator suitable for Braille application is reported in [10]. The actuators are fabricated from commercially available silicone tubes. The tube has
been rendered mechanically anisotropic through asymmetric levels of applied pretension in circumferential and axial
directions in order to direct the actuation strain in the axial direction of the actuator. Key performance parameters,
such as displacement, force, and response time of the actuator are investigated. The test results demonstrate the
potential of the compact, lightweight, and low cost dielectric elastomer as actuators for a refreshable full page Braille
display.

3. Proposed System

3.1 Components of Proposed system

A. The Wearable Device/Camera

To make the device convenient to use and portable, we designed it to be wearable and fitted with a camera of
sufficient resolution. The resolution needed to be high enough to allow a large image size and low enough to allow
image processing at an optimum efficiency and speed. This device could be a phone’s camera or an external webcam that could wirelessly transmit the data to the user’s phone.

B. Processing Stream of data

The data stream of images or video feed from the webcam could be transmitted continuously to a phone via Bluetooth 4.0 and the processing would take place from the phone. The received images would need to be processed.

C. Image to Text: We employed a specifically designed algorithm for detecting and tracking text in digital video. Our system implemented a scale-space featured extractor that feed an artificial neural processor to detect for and record the positions text blocks. The text tracking scheme consisted of two modules: a sum of squared difference (SSD) based module to find the initial position and a contour-based module to refine the position. We tested the same with a variety of feeds to test and prove that our algorithm could detect and track text robustly. Our image to text converter system applied a polynomial surface fitting technique for the object recognition within an image. The information such as colour depth, which is embedded inside the pixels or bits of colour that form the image are decoded and a structuring correlation regression algorithm were used to compensate for the loss of data which may have occurred due to low resolution of the image being sampled. Automatic document or formatted text layout extraction and segmentation were performed by using a spatial configuration of various text and image segments that were stored inside segments of 2D boxes or arrays of data. These segmented layouts were then analysed using specific tests. Each segment or box was assigned a unique label that acted as the primary key, which helped in identification.

The information hence gathered was transferred to an OCR (Optical Character Recognition) module after conversion to an XML interface thereby greatly accelerating its efficiency by allowing a label to be used to recognize text segments and identification of only those parts of the document which have text present in them. The OCR module hence successfully extracted the text present in the image and converted them into the correct text format denoted by their respective ASCII Values. The output quality would vary according to the original image quality and the FPS (frames per second) that are required to be processed by the device. In cases where the FPS is high, accuracy might have to be compromised in order to increase speed of computation and conversion to text.

D. Text to Braille: The text hence decoded could be stored in a temporary database in the form of a large 2D array that could be accessed in parallel for conversion to braille code.
Reference chart is used for letters or mnemonics that correspond to a particular arrangement of dots in each grid. On the basis of this chart all the converted text is stored in a buffer. This buffer data is sent to the hardware device that is connected via a micro-controller like an Arduino.

E. The Hardware Device

The device consists of a mat like layer of 6-dot boxes, a rocker-button similar to that used for volume, to allow the user to scroll up or down. The user connects his phone to the micro-controller as soon as he comes in its proximity and is directed to the seat that is designated to him, where the hardware device is set up already for him. For this, a Bluetooth Module is used, that is connected with the Arduino Mega Board. As soon as the user is seated, the hardware system integration with the phone begins as a process. The hardware screen keeps auto-scrolling and the devices make it private.

With the added benefit, the user does not necessarily need to scroll manually. The line he reads completely is stored in a temporary device buffer.

F. The Internet Integration

The data recorded can be transmitted to an online database or server that can be used by him for future reference by loading the same page from the app. For this, we employ a Wi-Fi Module with a connection to the user based database. To transmit the data from the hardware device, the device waits for the user to scroll down, past a particular line and then performs the transmission for that set of data.

3.2 Construction and Working of Hardware Device

The device shall be composed of small dots or pins that may be constructed from metal or nylon, that are placed on an electronic sheet that is in turn connected to the micro-controller. This would make it a digital Braille display and allow us to refresh it. Each set of 6 dots will be grouped together. The signal sent to this microcontroller would make specific dots to rise due to current inflow to them. The signal sent in to the micro-controller would come in from a smartphone that would process an image to text and then to their respective braille representation. The traditional Braille displays are of six dots but we could use a new standard of 8 dots i.e. six for the actual braille character and two below these six to denote the cursor position and the font of the text. Using the rocker-button, the user may scroll to the line or location he requires or shift between the files that he wishes to access using the smartphone.
Fig. 3.1 Flow Diagram for the proposed system.

4. Conclusion

The device may not only test for text but may also be designed to suggest the student to correct his orientation with respect to the blackboard or notify him that the teacher has entered the class and the subject topic of that lecture. Eventually the blind students may be able to write notes on this application/device too and store the same for future reference. The hardware mat may be carried around by the student and be used for all classes that he attends or it may be like a special desk and chair designated to him.

5. References


5. Lauren R; Milne; Cynthia L. Bennett; Shiri Azenkot; Richard E. Ladner., “BraillePlay: Educational Smartphone Gamesfor Blind Children” In the proceedings of the 16th international ACM SIGACCESS conference on Computers & accessibility, 2014,

6. André Pimenta Freire; Raphael Winckler de Bettio; Elaine das Graças Frade; Fernanda Barbosa Ferrari., “Accessibility of Web and Multimedia Content: Techniques and Examples from the Educational Context”, In the proceedings of the 19th Brazilian symposium on Multimedia and the web, 2013


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