Reading Device for the Deaf and Blind in Real Time Speech: A Literature Survey

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ABSTRACT

Braille is a vital means of communication; it is a system for blind people, one of touch reading and writing in which Raised dots are impressions that represent the letters of the alphabet. It is an extremely important tool for blind people to educate themselves, and it is a critical component that supports not only educational advancement, but sub-consequently increases employment prospects. The blind should be taught Braille to be able to become literate, which is a necessity in today's world. Braille is a much harder language than sign, as there are a lot of combinations of the impressions of the six raised dots that are not easy to memorize. Visually impaired people are required to master skills to communicate through Braille text, which itself is really time-taking and cumbersome task. In addition, other people need to learn the same set of skills to understand and respond to the visually impaired person. We have devices that convert text to Braille language as well as real-time Braille to speech using Raspberry Pi camera and a Raspberry Pi. Other devices use FPGAs/Arduinos for converting speech to braille. This paper is a survey of different techniques that were used for the conversion of text to braille and vice versa, and an evaluation of the accuracy of these methods is done.

Keywords

Raspberry Pi, blind and deaf, FPGA, speech recognition, Arduino microcontroller, liquid crystal display and convolutional neural network

1. INTRODUCTION

In the 21st century, individuals are changing their contemplation. Day by day, it's being demonstrated that nothing is much stronger than the will of somebody. Regardless of whether he or she is genuinely tested or visually impaired, and so forth. This is in view of the cutting edge innovations. Furthermore, we are fortunate to live in a time of unrest over advances.

Technology has made human life addicted to comfort, but there are still disadvantaged groups that are struggling to find an innovative way to facilitate the communication process. According to the World Health Organization, about 285 million people are blind, 300 million are deaf, and 15 million are both blind and deaf. Communication plays an extremely important role in everyday life. But it is difficult for ordinary people to communicate with deaf-mute people, and vice versa. It is the only means through which we may share our thoughts or transmit a message, yet a person with a handicap finds it difficult to communicate with those who are not disabled.

Those with disabilities will almost certainly experience some form of social isolation.

Globally, at least 2.2 billion people have a vision impairment or blindness, of whom at least 1 billion have a vision impairment that could have been prevented or has yet to be addressed. They are typically required to read printed information in Braille and when that does not happen, it adds to a lot of difficulty, and to add to that, these people have limited access. Although there is a lot of electronic technology that can help them read, the costs are prohibitive.

Braille is an extremely important tool for blind people to educate themselves, and it is a critical component that supports not only educational advancement, but sub-consequently increases employment prospects. The visually impaired person uses the Braille system for reading or writing. The Braille system essentially creates a basic cell that consists of six radots, or impressions, that are embossed outwards and aligned in a domino pattern, and each Braille, or alphabet letter, is built up of combinations of dots from this basic cell.

The two most common forms of Braille are called Grade 1 and Grade 2, or uncontracted and contracted braille. Uncontracted Braille, Grade 1, or Alphabetic Braille is the most basic form of Braille. It uses all 26 letters of the alphabet and is often used by children or individuals who are first learning to read and write in Braille. With uncontracted braille, words are spelled out letter by letter. This form of Braille takes up a lot of space, and documents written in uncontracted braille will be very lengthy.

Contracted Braille, Grade 2, or Literary Braille is a more complex form that is typically learned after learning uncontracted braille. It is the most commonly used form of Braille. Contracted Braille is a system of "short cuts", where one letter might represent an entire word. There are letter combinations, or contractions, that represent whole words without spelling out each letter in the word. This method reduces the overall number of cells needed and the volume of pages required to print books and other written content. Contracted Braille takes up less space and improves an individual's speed in both reading and writing. This is the form of Braille you would see in public places.

For converting text to Braille language as well as real-time Braille to speech Raspberry Pi camera and a Raspberry Pi is used, which makes the captured image undergo a series of image pre-processing steps to locate only that part of the image that contains the text, removes the background and undergoes morphological operations to extract the Braille text. Other devices use FPGA /Arduinos

for converting speech to braille.

2. REVIEW OF LITERATURE

Braille, a universally accepted system of writing used by and for blind persons and consisting of a code of 63 characters, each made up of one to six raised dots arranged in a six- position matrix or cell. For blind - deaf people Braille remains the language necessary for literacy. Due to the unavailability of Braille printed reading materials, blind People in India are facing a daunting task while getting their formal education , achieving employment opportunities and making the differently disabled people feel independent and confident by seeing, hearing, and talking for them.

The system of embossed writing invented by Louis Braille gradually came to be accepted throughout the world as the fundamental form of written communication for blind individuals. The paper [1] (*Manzeet Singh and Parteek Bhatia,*2010) Concerned about the transliteration of English and Hindi text to Braille. The conversion is totally based on character matching as it accesses the look-up table that contains the corresponding Braille characters and print the corresponding Braille character. By this transliteration, it provides enough literature to visually impaired people, and they will have all that knowledge that they should have.

Braille formatting rules are complicated and can be difficult to automate. Electronic publishing has created a "moving target" as far as the increasing variety of the input formats to be adapted to Braille. [2] Later, (*Prachi Rajarapollu et al.,* 2013) which FPGA kit is used to convert input to English text and also display it on LCD. After decoding English text, it converts to audio. The FPGA Spartan 3 IC XC3S400 is a very fast, low power consuming, and efficient IC. One main advantage of the Spartan 3 IC is that we can adjust the internal hardware circuitry according to the software coding. The input is given to the FPGA through Xilinx Impact software and t h e corresponding text output is displayed on the LCD screen and then the program is stimulated, and downloaded onto the FPGA kit. In Paper [3] (*S.Padmavathi et al.,* 2013), convert a scanned Braille document to text, which can be read out to many through the computer.

The paper [4] (*Harikrishnan Ramachandran et al.,* 2020) proposes the implementation of a prototype device that enables one-way communication using a microcontroller-based technology. This will be a text- braille conversion system that will make use of portable technology and Arduino circuit boards to provide the required means of communication. The code for the conversion to Braille from Text is written for the Arduino microcontroller that is used. The text is taken from a keyboard in real time, and then the rotation of the motors creates the required braille impression, which can then be sensed by the user. However,i n the paper [5] (*Swathi Subhash et al,* 2020),the speech input is recognized using the speech recognition tool. This is later converted to text. After the conversion, the text is identified and converted to Braille. The Braille code obtained can be used to convert the speech directly into Braille code, which can be used as a note for future reference. Used python speech recognition package for conversion.

In paper [6] (*T. Anbarasan et al.,* 2020), an application that will convert natural language into English Braille language from the uploaded PDF input , using Natural Language Processing (NLP) and Object detection, the images are converted into text that describes the scenario of the image, which will save the time of the visually impaired person by feeling unwanted images in the PDF file.

Faizan B. Patel et al., in 2020 [7], present the look associated implementation of a device that will convert the input voice from the mobile application to Braille code and show it on a liquid crystal display. This device is often a medium for learning for youngsters with disabilities or blind folks will b e able to write it severally while not facilitate something. *Rhea Sawant et al.,* in 2021.

[8] (*Viswanath Venkatesh Murthy,M Hanumanthappa,*2021) proposes a new technique of translating the Braille cells embossed on the plate to a natural language English character, which can be easily distributed over a network to make it globally accessible. Initially, Braille documents are scanned and preprocessing techniques like adaptive histograms and Laplacian filters are applied to augment the dots by eliminating the noise. Cell information is translated to a 3x2 matrix with binary values of 0's and 1's representing absence and presence of dots in a cell. Convolutional Neural Network is used for feature extraction, classification and Regression Tree (CART) classifiers are utilized to recognize the character.

3. COMPARISON

We have come across different methods used for conversion of text to braille and vice versa, bridging the communication gap between those who are visually impaired, and those with vision. A tabulation of these data will enhance our understanding. Table 1 gives the summary of the review.

4. FINDINGS

Due to unavailability of Braille-printed reading materials, blind people are facing a daunting task while getting their formal education and achieving employment opportunities. Thus we are providing a reading device for visually impaired people. In various Braille types, we used Grade 1 Braille for conversion so that it was easy for conversion. There are many devices for converting text to Braille. Our device visualizes the converted input text extracted from real time to Braille. The prototype of real-time text communicator in the form of Braille actuations. For display we used Arduino to convert the characters to signals and displayed using solenoids.

5. CONCLUSION

There are so many methods to convert text to Braille and vice versa. It attempts to bridge the communication gap between those who are visually impaired and those with vision. Using different types of Braille, conversion is done. From the studies, we come across the methods in a way that i s b e t t e r t h a n the previous ones used. We see that the comparison table furnished below gives a better understanding of the different techniques used by different authors.

Table 1. Comparison of different Methods used for Conversion.

S. No	Publication	Methodology	Metrics Used	Result Obtained
1.	Automated Conversion of English and Hindi Text to Braille Representation 2010. [1]	Access the look–up table for matching of characters in the input string with the look–up table characters.	Grade 1 Braille was used for Look up table.	It is 100% accuracy for the grade 1 Braille and is working with 99% accuracy for Hindi.
2.	FPGA-Based Braille to Text & Speech for Blind People – 2013. [2]	Record of voice-LED and MIC Use an FPGA(IC XS3s400) Kit for conversion.	Braille Grade 1 is used.	Text output is displayed on the LCD screen
3.	Conversion of Braille to Text in English, Hindi, and Tamil Languages – 2013. [3]	Image enhancement and filtering. The Braille cells are segmented and extract text from the pattern vectors.	Grade 2, an addition of abbreviations; and contractions, along with letter-by-letter transaction	Each Braille document is decoded manually and compared with the system results
4.	Text to Braille Conversion System– 2020. [4]	Arduino is used for converting the Braille to signals, and six metal servo meter rods are used for display.	Grade 1 Braille was used for conversion.	Implements with 96% accuracy,and it displays the corresponding Braille text on the device.
5.	Speech to Braille Convertor for the visually impaired using Python– 2020. [5]	Speech recognition tool for recognizing speech. Conversion using English to Braille.	Uses English Braille for the conversion of text.	The converted text is compared with Braille database and the output obtained with around 95% accuracy.
6.	Real-Time Text to Braille and Audio Convertor– 2020. [6]	By using natural language processing (NLP) and by using Object detection and conversion take place.	Grade 2 Braille is used for conversion.	Convert natural language into Braille text preview option for user.
7.	Speech to Braille Language Encoding for Blind People – 2020. [7]	Interfacing of LED and Buzzer for recording. Use Microcontrollers for conversion.	Grade 2 Braille is used for conversion	Listening to the voice input from the mobile app and displays on the screen.
8.	Translation of the Six Tuple Grade-1 Braille Alphabet to the English Alphabet– 2021. [8]	Image Enhancement and filtering. The Braille cells are segmented and Extract text. Classification and Regression Trees (CART) classifier is used for recognizing the character.	Grade 1 Braille is used for conversion.	The results of accuracy parameter correctly recognized alphabets after mapping

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