International Journal of Emerging Trends & Technology in Computer Science (IJETTCS)
Web Site: www.ijettcs.org Email: editor@ijettcs.org, editorijettcs@gmail.com
Volume 11, Issue 3, May – June 2022 ISSN 2278-6856

Conversion of Indian languages text into Braille Script and audio file: A Survey

Ganga Gudi[1], Dr Mallamma V Reddy [2]

[1] Department of Computer Science
Rani Channamma University
Belgavi, India.

[2] Department of Computer Science
Rani Channamma University
Belgavi, India

Abstract: ***In the digital era information can be obtained either in digital or virtual formats, and everyone benefits from it, but reading the digital data from an electronic device for visually impaired persons is difficult because of their disabilities. In order to read the data, they use the Braille script. It is difficult for them to read the day to today information which is happening around the world in a digitized form. This paper highlights the various research carried out by the researchers in the conversion of natural languages digitized (news) text particularly for Kannada, Telugu and Marathi into Braille Script and speech using Machine Learning algorithms.***

Keywords: Braille cell, Braille script, machine learning, speech synthesis.

1. INTRODUCTION

Innovations and new technologies are changing the world, as we are constantly surrounded by the technology, but visually impaired people are not completely benefitted by it. As the world has become more digitized, it is necessary to convert the documents digitally which will help visionless people to access the documents in different languages into Braille and also providing the voice output. As India is multilingual country where there are 22 official languages, English and Hindi are the languages which is used in most of the places. The literacy of visually impaired people is highly dependent on sensory learning system called Braille code systems that are widely used by many communities due to its simplicity and convenience of using it. Visual impairment is a major public health concern around the world [1]. Research indicates that out of 7.3 billion people, approximately 36 million are blind, 217 are MSVI, and a total of 253 million people worldwide are visually impaired. The research work focuses on visual impairments and looks into the possibility of using modern information technology to help this community. Impaired people write text using the Braille script. Braille is a network of interconnected cells in which visually impaired people read Braille documents with their fingertips in order to improve communication between visual learners and access mechanisms used by visually impaired people. [2]. These scripts are supported in a variety of languages like English, Hindi and Telugu. The papers' second section is about converting natural language text-to-speech. Speech synthesis is the process of obtaining person's voice or speech. It is used to convert written text into speech, which is carried out by a text-to-speech (TTS) system. Concatenative voice synthesis would be a type of speech synthesis in which human voice samples are reassembled into words and sentences [18].

This paper has been divided into following sections: Section II covers the details of Braille script and its properties. Section III describes the Braille Grade and its representation. Section IV gives the techniques which will convert the natural language text into braille script or vice-versa. Section V gives the techniques that is used for text to speech conversion with good audio quality.

2. BRAILLE SCRIPT

Visually impaired persons can utilize Braille script, which was created by Louis Braille. Blind and visually impaired individuals around the world utilize this writing and reading technique. All languages can be written and read in it since it's a code, not a language. It is a system which is composed of dots which are arranged in "cells". A cell is made up of six dots that are organized into two columns of three dots in 3x2 configuration as shown in Fig 1. There are 64 possible patterns of dots resulting from this combination, with each cell denoting a different letter, number, or punctuation mark. There are specific cell patterns for some words and letter combinations.

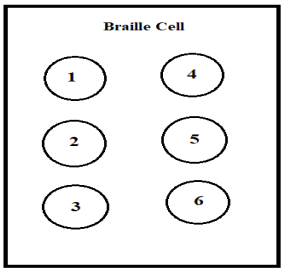

Fig 1: Braille Cell

The braille cell [3] dot was determined by sensory resolution of the person's fingertips. It is possible to calculate the horizontal and vertical distances between dots in a character, as well as the distance between cells representing words. Fig 2 shows the properties of Braille cell. The specification of Braille cell is:

- The dot height is around 0.5 mm high.
- There is a 2.5 mm gap between adjacent dots within a single cell.
- The distance between adjacent horizontal cell's first dot is 6 mm.
- The minimum distance between the initial dot in two adjacent vertical cell is 10 mm.

We use language to convey our thoughts onto papers, but blind people use braille to study and review the words written in natural languages.

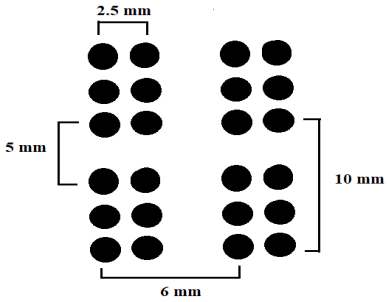

Fig 2: Braille cell dimensions

3. BRAILLE GRADE

Many researchers begin by examining basic dot combinations for letters, punctuation, and the numbering system. Based on the physical properties' braille script was classified into three grades: Grade1, Grade 2 and Grade 3 [4]. Fig 3 represents the Grade 1, which is also called as Alphabetic Braille. It is widely used as a letter-by-letter transcription with in a cell which represents letter, number, punctuations or special character. Grade 2 is also called as contracted braille or literary braille. Word is represented in a short as compared to Grade 1. By making it a widely used Braille grade, various groupings have been created to represent basic words. Most of the script or books are written in Grade 2 as it requires less space as compared to Grade 1. Grade 3 consists of various non-standardized shorthand. These grades will help researchers to understand the basics of braille and further enhance their work in the respective filed.

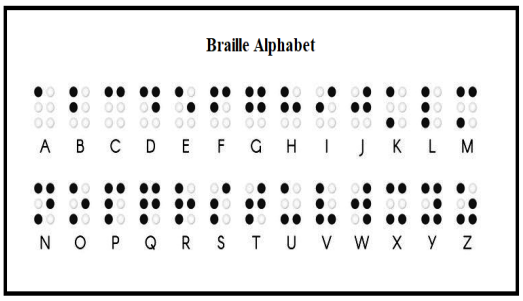

Fig 3: Braille Alphabet

4. CONVERSION OF NATURAL LANGUAGE TEXT INTO BRAILLE SCRIPT

Braille script is the mode of communication that is used by the low vision individual. It is difficult for them to read the digital data. Conversion of natural language text into braille will help them to access the data of different language as well store the data in the form of Braille and audio files digitally. This survey paper provides the review of some of the research work related to the conversion of various types of natural language text to Braille or vice-versa as follows:

1. Nikisha B Jariwala and Bankim Patel [5] have addressed about conversion of Gujarati text into Braille. They have given the challenges that are faced for converting the Gujarati text to Braille and a low-cost technology to be developed for to visually impaired people.
2. U. Beg, K. Parvathi, and V. Jha [6] have translated Hindi into Braille script which helped visually impaired people to read a wide range of Hindi literature. Using Image segmentation process, they have created a database for Hindi characters and using Principal Component Analysis method they matched the fragmented characters with generated database. Mapping tables were used to store the characters in the cell which will help to reduce the storage space into 187 x 128 pixels. This scheme requires fewer coding techniques as it matches the characters with created database.
3. Vishwanath Venkatesh Murthy et. al [7] have developed a model for optical Braille identification, a feature extraction approach which is used to locate, extract, and convert Braille cells from one-sided Indian language Braille documents using an N-Gram Language Model (OBR). Braille cells are placed in the form of a grid box to map the filled dots, which are then compared to a dataset to translate into the required text. Word Sequence Prediction Using N-gram Language Models for Braille Cell Extraction and Conversion Errors.
4. S. Shetty et. al [8] have presented Kannada text transliteration to Braille and vice versa that converts Braille word that is fed into a specialised functionality to generate a print copy on Braille paper. The device accepts Kannada text as input and uses a conversion method to convert it to

the corresponding Braille code. It generates UTF-8 code for the Kannada text corpus before mapping it to braille output.

5. Vinod Jha and K. Parvathi [9] proposed an SVM-based HOG feature vector and classifier. These images are captured and converted to binary images. The binary image is then segmented in order for the SVM classifier to identify the characters. The recognised class of the character is mapped with the corresponding Unicode. This step can also be used to generate an OCR. Furthermore, the detected words' Unicode is combined with the corresponding Braille code, which is in the form of a binary code.

6. S. Padmavathi et. al [10] provides a way to read out text from a Braille document that has been scanned. The dots and noise in the Braille papers are enhanced and reduced before they are printed. Braille cells are segmented and the dots from each cell are retrieved and converted into a number sequence. Speech synthesisers can be used to speak the mapped and converted text. Typing a Braille character is mapped to the alphabet and spoken out.

7. BijetMaynoherSamal et. al [11] presented Odia, Hindi, Telugu, and English Braille publications which were converted into their native language in a study project. Histogram analysis, segmentation, pattern recognition, letter arrays, and data base development with software testing and dumping onto a Spartan 3e FPGA kit were all used in the process to design the alphabets' dot patterns.

8. Sana Shokat et. al [12] has explained about a survey paper which concentrated on the technological support available to the visually impaired person. They have given the comparison based on scanned and touch-based input of scripts to natural language using various machine learning techniques such optical character recognition, Turing machine and feature extraction. These comparison helps us to understand the strength and weakness of the various applications.

9. G. G. Devi and G. Sathyanarayanan [13] have developed an algorithm for speech system model to help low vision person to read the English characters present on the image and convert them into Grade 2 Braille script.

10. I. G. Ovodov [14] proposed a method based on semantic considerations, a technique for augmenting machine-generated labelling information. Machine annotations for unlabeled training data have been used to increase machine learning efficiency.

11. P. Kaur et. al [15] presents Devanagari Hindi Braille which was converted to text. After translating Hindi Braille to text using a sequence-mapping strategy and a deep-learning-based method, the paper was presented in two parts. Using voice samples that correlate to the Hindi vowels and consonants, they've turned Hindi text into speech for the second step of the process.

12. AbdulMalik S. Al-Salman [16] has designed a system which will help user to enter the braille data into the computer and convert them into the normal text, which can be taught to both visually impaired and normal sighted people in one classroom. Further it can be re-translated into other languages.

13. T. D. S. H. Perera et. al [17] developed an Optical Braille Translator system that can convert Sinhala Braille into Sri Lankan or Grade I English Braille into English language with a 99 percent accuracy. Using the OBT technology, visually impaired and sighted people may communicate more easily.

14. V. S. Dharme and S. P. Karmore [18] have explained about building and implementing a suggested system architecture for visually impaired persons, which includes an efficient text-to-Braille translation method.

15. K. Kulkarni et. al [19] designed real-time text communicator. Image processing methods and braille script conversion were utilized to process images captured in real time by the microcontroller. The Braille system has the potential to be used to tactile activities.

5. CONVERSION OF NATURAL LANGUAGE INTO SPEECH

Sighted person can communicate with the digital world using different Input/Output devices, while a visually disabled person has to use a special designed devices or programs to interact with devices. Braille is the only mode of communication for them. Speech synthesis will help them to extract the speech from the document digitally. This survey paper provides the review of some of the research work related to the transcription of text to speech.

1. Parmesh Kaur et. al [20] presents conversion of Braille script to speech for Hindi language. They used two techniques: traditional and deep learning approaches. Two methods were used to implement the traditional technique: contouring and SVM. If the thresholds were not changed for each image, the conventional method was more accurate.

2. Lakshmi Sahu et al. [21] presented a corpus-driven text-to-speech (TTS) system based on the concatenative synthesis approach for Hindi & Telugu languages.

3. Dhananjaya M S et al. [22] have used MATLAB to present an algorithm that requires less memory space and retrieves data (speech coefficients) faster.

4. Damodar Magdum et al. [23] have explained data collection and recording methodologies for the Hindi Text to Speech system. They have described the process of creating a speech corpus, beginning with text data crawling and progressing through sorting, capturing, and analysis. The speech corpus that results is used in the Hindi Text-to-Speech system.

5. Archana.M et al. [24] have described a model which extracts Braille code from the image, which is then mapped with the Tamil database and converts them into the voice messages using Python in Natural Language Processing (NLP) which could be examined on a computer.

6. Sharavana K et al. [25] researchers have developed a device that converts text from hardcopy to Braille in real-time. A camera captures an image of any page in a book, detects the text and converts this text into audio and also into refreshable Braille characters. The goal of text recognition is to convert the recognized text into desired format (audio or Braille).
7. A Joshi et al. [26] developed a system which converts text to speech in one of south Indian language called Kannada. Researcher have divided the Kannada text into the smallest numbers of individual words and later combining them with the sound using recorded speech stored in the database.

6. CHALLENGES FOR CONVERTING BRAILLE SCRIPT TO TEXT

According to the literature, there is a need for converting natural language news text to braille script in various languages. Researchers aims to design, develop and implement model that converts text to Braille which leads to few challenges in converting from different Indian languages to Braille Script are:
1) Natural Language Text recognition rates are heavily reliant on character segmentation; however, a classifier that recognizes the word directly can be designed, eliminating the need for character segmentation.
2) In the English language, for example, characters are represented in both uppercase and lowercase, and both are represented in different cyphers. Braille cell has six dots, it represents with only 64 characters where separate cyphers are not used. For example, if the phrase is a string of letters and numbers, such as a password or registration number, then Braille script lacks such distinct characters.
3) In Kannada language, for example consonants are combined with vowels which forms the compound characters and mapping of these characters with Braille should give correct output. In Kannada language bijectional constants (Ottaksharas) are used which combine two or three characters together.
4) Special characters can be found in all languages.
5) The research must be tailored to the needs of the people who will be contacted. Commercialization of research should occur, and all visually impaired people should be able to afford it.
In this section, we present the challenges that has been faced by researchers while converting the text to Braille Script.

7. CHALLENGES FOR CONVERTING BRAILLE SCRIPT TO VOICE

Braille is the only mode of communication for visually impaired people. Converting these Braille Script to voice will make them more self-reliant. But there are few challenges which will faced while converting text to voice:
1) It should read the token clearly and identify specialized token with proper utterance.
2) Mapping of proper phonetics should be done.
3) Converting text to speech should be done with a proper meaning to the statement.
4) The type of the statement to be identified. For example, if the is declarative, interrogative or exclamatory.
5) The technology should be able to handle different dialect.
6) Proper filtering to be done to remove the noise from the speech.
7) Special characters and symbols like '#', '*', '+', '%' causes different kinds of problems. For Example, the expression '3-5' can be read as 3 to 5 or 3 minus 5 or 3 or 5.

8. CONCLUSION

This survey paper describes the considerable amount of effort has been done in conversion of natural Indian languages text to Braille script as well as speech. In the literature survey, it is found that there is an opportunity to improve the accuracy of algorithms for converting natural languages text to braille script, which will be useful for blind people. Conversion of text will assist them to read the text in different languages into Braille script and can also use in the form speech as required. This will also help to store the data digitally and access when required.

References

[1.] K. S. Anuradha and S. Thelijjagoda, "Machine translation system to convert Sinhala and English Braille documents into voice," 2020 International Research Conference on Smart Computing and Systems Engineering (SCSE), 2020, pp. 7-16.
[2.] G. G. Devi and G. Sathyanarayanan, "Braille Document Recognition in Southern Indian Languages– A Review," 2018 Fourth International Conference on Advances in Electrical, Electronics, Information, Communication and Bio-Informatics (AEEICB), 2018, pp. 1-4.
[3.] M. Hanumanthappa and V. V. Murthy, " Optical Braille recognition and its correspondence in the conversion of Braille script to text — A literature review," 2016 International Conference on Computation System and Information Technology for Sustainable Solutions (CSITSS), 2016, pp. 297-301.
[4.] Josephine Stella ,Krishna S Valsan , (2018) " Text to Braille Conversion: A Survey " , International Journal of Management and Applied Science (IJMAS) , pp. 15-18, Volume-4,Issue-1.
[5.] Nikisha B Jariwala, Bankim Patel, "Conversion of Gujarati text into Braille: a review", " 2015 International Journal of Innovations & Advancement in Computer Science", 2015, pp. 59-64.

[6.] U. Beg, K. Parvathi, and V. Jha, " Text translation of scanned Hindi document to braille via image processing ", Indian Journal of Science and Technology, vol. 10, p. 33, 2017.

[7.] Vishwanath Venkatesh Murthy, Ravi Kumar K, M Hanumanthappa, " N-Gram Language Model to Predict the Word Sequence in a Degraded Braille Document ", 2020 International Journal of Innovative Technology and Exploring Engineering (IJITEE), ISSN: 2278-3075, Volume-9 Issue-4.

[8.] S. Shetty, S. Shetty, S. Hegde and K. Pandit, " Transliteration of text input from Kannada to Braille and vice versa", 2019 IEEE International Conference on Distributed Computing, VLSI, Electrical Circuits and Robotics (DISCOVER), 2019, pp. 1-4.

[9.] Vinod Jha, K. Parvathi, " Braille Transliteration of Hindi Handwritten Texts Using Machine Learning for Character Recognition ", 2019 International Journal of Scientific & Technology Research, Volume-8, Issue-10, pp. 1188-1193.

[10.] S. Padmavathi, Manojna K.S.S, S. Sphoorthy Reddy, D. Meenakshy, " Conversion of Braille To Text In English, Hindi and Tamil Languages ", 2013 International Journal of Computer Science, Engineering and Applications (IJCSEA) Vol.3, No.3, pp. 19-32.

[11.] BijetMaynoherSamal, K.Parvathi, Jitendra Kumar Das, "A Bidirectional Text Transcription Of Braille For Odia, Hindi, Telugu And English Via Image Processing On FPGA" ,IJRET: International Journal of Research in Engineering and Technology, Volume 4, Issue 7 , July-2015,eISSN 2319-1163, pp 483-494.

[12.] Sana Shokat, Rabia Riaz, Sanam Shahla Rizvi, Khalil Khan, Farina Riaz, Se Jin Kwon, "Analysis and Evaluation of Braille to Text Conversion Methods", Mobile Information Systems, vol. 2020, Article ID 3461651, 14 pages, 2020.

[13.] G. G. Devi and G. Sathyanarayanan, "Braille Document Recognition in Southern Indian Languages–A Review," 2018 Fourth International Conference on Advances in Electrical, Electronics, Information, Communication and Bio-Informatics (AEEICB), 2018, pp. 1-4.

[14.] I. G. Ovodov, "Semantic-based Annotation Enhancement Algorithm for Semi-supervised Machine Learning Efficiency Improvement Applied to Optical Braille Recognition," 2021 IEEE Conference of Russian Young Researchers in Electrical and Electronic Engineering (ElConRus), 2021, pp. 2190-2194.

[15.] P. Kaur, S. Ramu, S. Panchakshari and N. Krupa, "Conversion of Hindi Braille to Speech using Image and Speech Processing," 2020 IEEE 7th Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON), 2020, pp. 1-6.

[16.] AbdulMalik S. Al-Salman, “A Bi-directional Bi-Lingual Translation Braille-Text System”, Journal of King Saud University - Computer and Information Sciences, 2008, pp. 13–29.

[17.] Perera, T.D.S.H. and Wanniarachchi, W.K.I.L., Optical Braille Translator for Sinhala Braille System: Paper Communication Tool Between Vision Impaired and Sighted Persons (November 26, 2018). The International Journal of Multimedia & Its Applications (IJMA) Vol. 10, No. 1/2/3, June 2018.

[18.] V. S. Dharme and S. P. Karmore, "Designing of English text to braille conversion system: A survey," 2015 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), 2015, pp. 1-6, doi: 10.1109/ICIIECS.2015.7193267.

[19.] K. Kulkarni, A. Mahajan, Y. Zambre, F. Belwadi, S. Killedar and A. Marathe, "Text Detection and Communicator Using Braille for Assistance to Visually Impaired," 2019 IEEE Pune Section International Conference (PuneCon), 2019, pp. 1-5.

[20.] P. Kaur, S. Ramu, S. Panchakshari and N. Krupa, "Conversion of Hindi Braille to Speech using Image and Speech Processing," 2020 IEEE 7th Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON), 2020, pp. 1-6.

[21.] Sahu, Lakshmi et al. “Hindi & Telugu Text-to-Speech Synthesis (TTS) and inter-language text Conversion.” (2012).

[22.] M. S. Dhananjaya, B. N. Krupa and R. Sushma, "Kannada text to speech conversion: A novel approach," 2016 International Conference on Electrical, Electronics, Communication, Computer and Optimization Techniques (ICEECCOT), 2016, pp. 168-172.

[23.] D. Magdum, M. S. Dubey, T. Patil, R. Shah, S. Belhe and M. Kulkarni, "Methodology for designing and creating Hindi speech corpus," 2015 International Conference on Signal Processing and Communication Engineering Systems, 2015, pp. 336-339.

[24.] Archana.M, Dhivya.S, “Qualitative Analysis Framework for Converting Braille to Voice using Image Recognition”,” 2019 International Journal of Recent Technology and Engineering, 2019, pp. 5713-5717.

[25.] Sharavana K , E Sivasubramanian , Arpitha N, Monish M Gowda, Gajanan Manjunath Naik , Vijayalakshmi, “Real-Time Text to Braille and Audio Convertor”, “2020 International Research Journal of Engineering and Technology”,”2020, pp. 2869-2878.

[26.] A. Joshi, D. Chabbi, Suman M and S. Kulkarni, "Text to speech system for Kannada language," 2015

International Conference on Communications and Signal Processing (ICCSP), 2015, pp. 1901-1904.