Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol. 45 No. 4 (2024)

Communication Tool to Translate Text into Braille for People with Visual and Auditory Impairments-A Survey

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Abstract

Braille is the most often used and favoured way of communication among these. The Braille system is designed to help people who are blind or deaf by arranging dots to represent numbers, letters, and punctuation. Braille is a universal language available in every language, including Esperanto. It is now used by six million blind people worldwide. In India, effective communication is crucial for exchanging ideas, assigning tasks, leading a team, fostering positive relationships, and other activities. Communication across international borders strengthens our capacity to confront human rights abuses in our communities. It is now simpler to draw attention to these abuses and secure worldwide assistance in the global fight against them. It can be challenging for people without hearing and vision impairments to communicate with one another. People who are deaf or blind have access to various particular languages, such as Braille, tactile signing, moon, etc. This essay focuses on the foundations and characteristics of Braille and English script. It also highlights studies conducted in several languages to translate it into Braille. There is also a discussion of various conversion algorithms and methods. It also discusses the pros and cons of converting English text into Braille, which should be highlighted. As there is very little literature available in English for those who are blind or visually impaired, more literature will be available if this research is done. The survey aims to identify and analyze the best model for effectively converting English text into Braille for blind people.

Keywords: *Language, Braille Language, Speech Recognition, Image Processing, Text Processing, communication tool*

1. Introduction

Out of the 6737.5 million people in the globe, 39.365 million are blind, 246.024 million have low vision, and 285.389 million have visual impairments, according to the World Health Organization (WHO) [1]. It is now possible to confirm or examine these people using camera-based products because of recent advancements in portable computing, computer vision, and digital cameras [2]. Braille language represents one of the writing systems visually impaired persons use to communicate. For persons with low eyesight and blindness, it aids in recognizing letters, words, or sentences [3]. It is embossed in writing via stylus and braille writers. It is essential to assist blind people by offering them the methods and technology they need to engage and communicate with others without needing eyesight [4]. Visually challenged people have good touch, hearing, and perceptions of hearing. As a result, they can easily employ the Braille system for communication based on their sense of touch [5]. The blind persons can then perceive these characters. A combination of six dots, organized in three rows and two columns, creates a Braille character. Studies reveal that the use of Braille is declining due to evolving educational trends, which has led to current criticism [6, 7]. Speech synthesis is one of many technologies currently available for use. It is safe to presume that sighted persons will employ ink-printed materials, while visually challenged, partially sighted, or blind individuals will use textured patterns [8]. There are important reasons for continuing with Braille. Literacy is reading, writing, and understanding written and spoken language. The Braille code enables blind persons to read, write, and understand written and spoken language [9, 10].

Electricity is denied to braille users when audio-only technology is used. Braille code is a quiet replacement for Braille that may not work in older situations. Speech synthesizers and interpreters restrict all forms of privacy while considering the local environment [11, 12].

Reading Braille code is precise. Speech synthesis, a braille substitute, could yield incomprehensible meanings. Words that the synthesizer is unfamiliar with, words that are misspelled or words that are pronounced differently depending on the context will cause problems [13]. Consequently, they endure a high risk of social exclusion and cannot utilize a lot of the information accessible across the world. In the modern world, many visually impaired people attempt to learn Braille [14, 15]. Humans with visual disabilities find many daily tasks, including essential communication, challenging. The primary goal of this project is to give deaf-blind individuals a low-cost portable communication tool so that any non-disabled person can speak with a deaf-blind person without difficulty. Analyze the methods, benefits, and drawbacks of the current papers that contribute to the braille system's improvement. Additionally, study English to braille conversion system to improve braille literacy.

2. Literature Review

Braille system is one of the communication systems visually impaired persons use. Megha Gadag and colleagues [16] created a revolutionary approach for converting Braille words to English to achieve accurate Braille character identification. After picture acquisition, the proposed system incorporates processes for pre-processing images, such as contrast enhancement and noise removal. SVM classifier and several pre-processing techniques are used.

An optical Braille Conversion (OBC) system with a grid was created by Majid et al. [17]. The grid-fitting method uses a computer to interpret scanned images from vintage hardcopy Braille alphabet documents, recognize them, and turn them into American ASCII text files. The words are generated and checked against the pertinent dictionary to produce the final product. The techniques used in this paper are easily adaptable to various applications for text mining and visual pattern identification. This method has advantages, such as the algorithm's ease of use and swift execution.

Through image processing, Urooj et al. [18] proposed text translation of scanned Hindi documents to Braille, a single form of communication for those with visual impairments. The test images should first be divided into lines, words, and letters, and the relevant letter should then be translated into Braille code. After receiving input, the method reads test papers letter by letter and maps the characters in the appropriate Braille code. People who are blind or visually impaired will have simple access to Hindi literature thanks to the results because there aren't many Braille textbooks available.

Using SVM Classifier, English Grade 2 braille was converted to English text utilizing various pre-processing procedures developed by Arun Kumar [19] and colleagues. Digital cameras are used to pre-process and collect braille images. Specific characteristics are extracted by segmenting the scanned images. To recognize Braille characters, SVM Classifier and PCA feature extraction were employed.

. Blind persons may decode symbols using their fingertips to detect the presence or absence of dots. The capability of neural networks to translate scanned text from English into Grade I Braille was created by Mohammed et al. [20]. A minimally structured artificial neural network is designed and tested to translate English letters into grade I Braille coding.

Namrata et al. [21] provide a thorough process for scanning photographs and converting them to Braille. The scanned pictures are pre-processed, made grayscale, and then transformed into binary images using an adaptive threshold function. Google's robust Tesseract Optical Character Recognition (OCR) engine sends a binary image for text recognition. Then, the text is transformed into a digital Braille format with six dot cells.

A suitable learning platform was created by Bijet et al. [22]. for the Braille pattern that emphasizes native language to benefit the general public and the visually impaired. Using image segmentation, Braille language is used by blind people as a form of communication and is translated into regular text in many languages such as Odisa, Hindi, Telugu, and English. These persons communicate the information that anyone decodes. The reverse

translation of native languages, including English, to Braille is discussed in detail in this essay. The practical characteristics of software and hardware are defined by processing speed, accuracy, and efficiency.

Anbarasan et al. [23] are developing a program to translate natural language into English braille using the provided PDF input. The images are turned into text to save the visually impaired person's time by removing unnecessary images from the.pdf file. The user is then given access to the transformed text as a preview, allowing them to make any necessary edits from the uploaded.pdf input. After the text has been translated into Braille, the user may obtain the result in PDF format. They are, additionally, creating audio files from text so that blind people who don't understand Braille can hear the pdf's contents. Therefore, this program is more beneficial for those who are blind in helping them learn from various materials.

In a collection of spelling examinations from braille-reading students in grades 1-4, Robert et al. [24] evaluate the application of braille abbreviations with a focus on those that lead to morphological structural mismatches. It proves that morphology is essential for beginning braille readers. Discuss the possible effects of our results on braille pedagogy, development, and research.

Utilizing the English Braille Grade-1 database and powerful machine learning methods, Sana Shokat et al. [25] created a system for identifying patterns in English Braille. The English Braille Grade 1 dataset is collected using touch-screen technology. The dataset is split into two groups utilizing 26 Braille English letters for easier viewing. A position-free blind text-entering technique is applied to create the fake data. Some feature extraction and machine learning techniques are used for Braille to English character identification. The feature extraction technique based on Reconstruction Independent Component Analysis (RICA) produced better results. Additionally, a statistical analysis is done to support the importance of the findings.

Manzeet et al. [26] are worried about the Braille transliteration of text in Hindi and English. Blind individuals use Braille, a dotted scheme, to read and write. Talk about the many teaching methods, including Braille and audio, for blind individuals. A chart is utilized as the database for this transliteration, and mapping was completed for the related Braille form. The transformation of English to Braille is a response to the increasing demand for the Braille code, which facilitates blind children's education. Increasing use of English as a second or additional language, the variety of presentation strategies employed in printed textbooks, computer-assisted translation, and globalization-supporting resource sharing. Braille is now easier to understand for all parties involved and easier to read and write for blind people because of the intrinsic change in English to Braille transliteration, which is generally subtle for literary Braille and most evident for scientific and mathematics notation. The English to Braille Transliteration is perfect for students who attend regular schools, those who speak English as a primary or additional language, and blind learners from underdeveloped nations. The summary of the literature survey is shown in Table 1.

Table 1 Summary of the related works

Author	Year	Algorithm	Advantage	Disadvantage
Gadag, [16]	2016	Support Vector Machine (SVM)	Most efficient tool Executes quickly	Slow performance Less accuracy
Babadi, [17]	2011	Grid-based optical Braille conversion (GOBCO) algorithm	Algorithm is straightforward Enables blind and visually impaired people to use fax machines	Noise environment High false rate
Parvathi [18]	2017	Principal Component	Less false rate Less execution time	Need heavyweight paper

		Analysis (PCA)	High speed of execution	
Arun Kumar, [20]	2023	Support Vector Machine (SVM)	Tesseract text extraction from photos is a beneficial procedure	Extremely high maintenance costs The error rate is high
Hassan, [20]	2011	Artificial Neural Network (ANN)	Enables sighted people who are not Braille-literate to comprehend hard-copy Braille documents	Use more paper to print the exact information
Samal, [22]	2015	Field Programmable Gate Arrays (FPGA)	Supports blind and low-vision individuals in recognizing letters, syllables, or words	Limited applications, High cost
Shokat, [25]	2022	Reconstruction Independent Component Analysis (RICA) and PCA	Many priceless paper documents are typically scanned and saved as backup images.	Poor picture processing High false rate

There are numerous websites and applications for braille translation. However, most of them charge a significant monthly fee, don't have a great user experience, and have made their services less accessible. Such software ought to be accessible to everyone who requires it. Some existing braille systems could be more effective because errors happen when converting the acquired image to Braille. Additionally, picture capture and conversion into Braille are not advantageous for them. Scanning braille images takes time, and transformation calls for particular care. There is a substantial mistake rate in the memorialization and visualization of blind people. Most of the 63 cells of the Standard English Braille match a letter of the Roman alphabet or a punctuation mark. A small group of cells called contraction will reflect brief phrases or syllables commonly used in English. There are numerous websites and applications for braille translation. However, most of them charge a significant monthly fee, don't have a great user experience, and have made their services less accessible. The existing works employ an SVM classifier, Braille script, a keyboard, and a recording device as input, and they output the appropriate English alphabets. Making error-free Braille for complicated materials is still challenging. Due to the small size of each image in the English database, memory use needs to be improved. Communication gap is the main issue in blind and duff people. The biggest drawback of the current method was that when users uploaded PDFs and photos, a preview was displayed once they converted them into Braille. Additionally, poor picture processing, limited applications, and extremely high maintenance costs are the disadvantages of the braille conversion system.

3. Methodology

Researchers have discovered that visually impaired children taught by sighted teachers may misunderstand what is meant by phrases that are broken up differently in print and braille. Reading sophisticated or technical documents could be more challenging because braille can only represent some characters and symbols equally well. Producing or obtaining braille products could take longer since they frequently call for specialized tools or services. Many techniques, such as SVM, K-nearest neighbor, PCA, etc, are developed to enhance the communication tool but still have to improve the problems of noise, large time consumption, low accuracy, high false rate, and high cost. So, we conduct research with deep learning because it uses a lot of data and multiple

layers of algorithmic processing to gradually teach a computer to learn independently and carry out human-like tasks like speech recognition and prediction. An optimization-based deep learning is created to identify and translate English characters into Braille characters. The designed model separates noisy and noise-free characters. Then, place the actual characters and produce an output for each character. Finally, the neural network's output creates the appropriate Braille character per the Braille rules. The built Brail characters should be readable in both noisy and noise-free environments. A meta-heuristic optimization is applied in the neural network phase to enhance the communication performance. The neural network output is used to make Braille characters using the MATLAB application.

4. Conclusion

The study explains that an average amount of research is done to convert texts from different languages into Braille. However, converting English text to Braille still needs more precise effort. Therefore, inexpensive devices are created to help those who are blind. Literature for people with vision impairments will increase if work is done in this area. It will be beneficial for those who are blind or visually impaired as well as for those who are connected to them and are interested in learning about the Braille language. In the future, creating effective optimization-based neural network models will enable printouts of English text to be converted to grade 1 Braille, illuminating the gloomy lives of blind people due to the quick and accurate translation into Braille. Small solenoids need less power. Some systems use the smallest solenoids possible, but with technological developments, the size can lowered even further.

Compliance with Ethical Standards

Conflict of interest

The authors declare that they have no conflict of interest.

Human and Animal Rights

This article does not contain any studies with human or animal subjects performed by any of the authors.

Informed Consent

Informed consent does not apply as this was a retrospective review with no identifying patient information.

Funding: Not applicable

Conflicts of interest Statement: Not applicable

Consent to participate: Not applicable

Consent for publication: Not applicable

Availability of data and material:

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Code availability: Not applicable

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