

# Software Solutions of Braille Translators in Research Articles

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**Abstract.** A regional language is a language that is spoken in a particular area of a city, state, or country. Regional language is mainly spoken in smaller parts. It changes with the change in the religion, culture, and or economy of that region. Braille is the physical form of writing and reading used by vision-impaired or blind persons. It was developed in 1829 by Louis Braille. It is believed that barely two percent of the 70 million disabled persons have access to education in India. The present paper aims to discuss the research paper available related to Braille development in various Indian regional languages. In this paper, we only cover the introduction of each paper.

**Index Terms:** Braille, Punjabi, Regional Language, Disabled person.

## 1. INTRODUCTION

According to World Health Organization (WHO), 285 million peoples are Visually Blind , 39 million people are completely blind, 246 million peoples with low vision [4] in the world. It is believed that only 2% of the 70 million disabled persons have access to education in India. Children with disabilities in India are often left out of mainstream schools. It is firmly believed that regional languages have an important role in one's life.

Visually handicapped students could be sensible if exposed to text and electronic documents in the regional languages in depth and in a reasonable time. Blind students not able to turn pages of the book or use a highlighter to make notes. Hence, it is presumed that natural language processing techniques can help blind students meet their academic objectives if supported using regional languages. The basic motivation is to enable access to education for visually impaired children using ICT, so they may not be excluded from social participation.

The languages spoken in India are mainly from two major families. Indo-Aryan Languages are spoken by around 78% of people, and Dravidian Languages are spoken by about 19% of people. According to the census of 2001 of India, In India there are 122 major languages, and around 6000 other languages are spoken. According to 2001 Census 30 languages are spoken by more than a million native speakers, and 122 languages are spoken by more than 10,000 people.

As per Articles 344(1) and 351 of the Indian Constitution, the 8th schedule includes the recognition of the following 22 languages: Assamese, Bengali, Hindi, Manipuri, Marathi, Nepali, Odia, Sanskrit, Punjabi, Santali, Tamil, Telugu, Sindhi, Urdu, Gujarati, Kannada, Bodo, Dogri, Kashmiri, Konkani, Maithili, Malayalam..

## 2. BACKGROUND

### 2.1 Regional Languages

A regional language is spoken in a particular area of a city, state or country. Regional language is mainly spoken in smaller parts. It changes with the change in the religion, culture and or economy of that region. Twenty two scheduled languages are lists by the The 8th schedule of the Constitution of India.[1]1991 census recognised 1576 rationalised mother tongues, these are further grouped into language categories. According to 2001 Census of India, 30 languages are spoken by more than a 1,000,000 native speakers & 122 languages are spoken by more than 10,000.

### 2.2 Importance of Regional Languages

Regional languages are very important for the development of each individual, some of the importances are it connect us to our roots, it provides the knowledge of our culture, it helps to create a better society etc.

### 2.3 PunjabiLanguage

102 million persons worldwide speak the Punjabi language. This makes it the world's The tenth-most popular language (2010) [3]. It is the eleventh most widely spoken language in India and the most widely spoken language in Pakistan. The language is also significant in England, Canada, the U.A.E., the USA, Australia & Saudi Arabia. In India, Gurmukhi script is used to write Punjabi, whereas Shahmukhi is used in Pakistan. The Doabi, Majhi, Malwai, Multani, Powadhi & Pothohari are the major dialects of Punjabi. Punjabi is mainly spoken in Punjab, Chandigarh, Jammu, Delhi, Himachal Pradesh, Haryana, Rajasthan & Uttarakhand.

### Gurmukhi script (ਗੁਰਮੁਖੀ)

The Gurmukhi alphabet developed from the Landa alphabet[4] and was standardised by the second Sikh guru Shri Guru Angad Dev Ji, in the 16th century. The name Gurmukhi means "from the mouth of the Guru" and comes from the Old Punjabi word *guramukhī*.

### Features of Gurmukhi Script

It is written in horizontal lines from left to right.

Mainly used to write Punjabi Language.

There are total 35 + 6 symbols

No upper case or lower case concept of letters in Gurmukhi script.[5].

## 2.4 Braille

Braille is a physical form of writing & reading used by vision impaired or blind persons Louis Braille developed it in 1829. 62 patterns can be created with the help of 6 dots. Each character is written with the help of 6 dots[6].

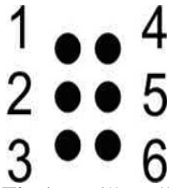


Fig.1. Braille cell

Bharati Braille/Bharatiya Braille/Indian Braille is a Braille script for writing the Indian languages. When India gained independence, almost 11 scripts for Braille were used. By 1951, Bharati Braille came into existence, and it became a standard for Indian languages. For the Punjabi language, Punjabi Braille is used to represent the Braille alphabet.[7]

Version 3.0 of the Unicode Standard introduced Braille in September 1999..

## 3. REVIEW METHOD

The review written in the paper based on the paper published in the following list of sources. That contains information on Braille in various regional languages

- Springer
- ScienceDirect
- IEEE explore
- Taylor and Francis
- ACM Digital Library
- Wiley Online

### 3.1 Review Planning

The review includes the databases search, the research questions and the search strings used to search for relevant studies. E-databases were searched & the studies extracted were reported. The search strings needed titles with keywords like "Braille" and "Regional languages,". The lack of studies on Braille in regional languages is the primary motivation behind this review.

### 3.2 Sources of information

For thorough literary analysis, a broad viewpoint is necessary. A suitable group of papers and databases must be picked before the review begins to increase the likelihood that the findings are highly relevant. The following E-databases were searched to write the review.

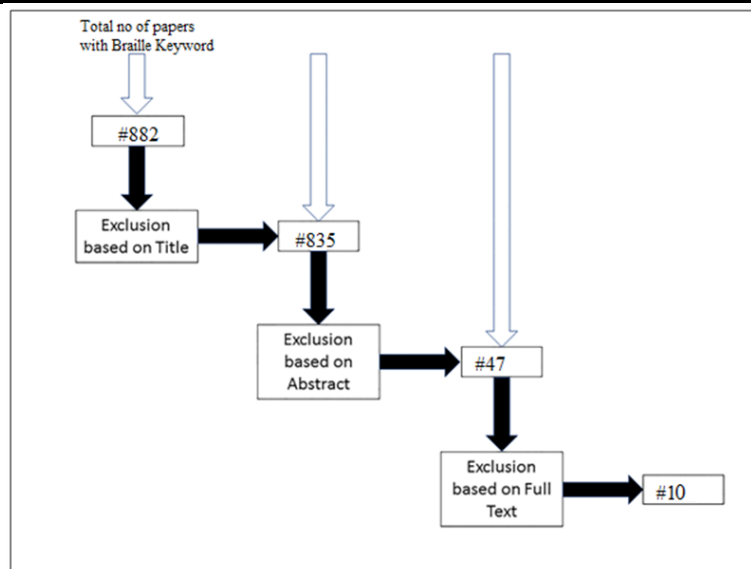
- Springer (<https://link.springer.com/>)
- ScienceDirect (<https://www.sciencedirect.com/>)
- IEEE explore (<https://ieeexplore.ieee.org/Xplore/home.jsp>)
- Taylor and Francis (<https://www.tandfonline.com/>)
- ACM Digital Library (<https://www.acm.org/publications/digital-library>)
- Wiley Online (<https://onlinelibrary.wiley.com/>)

### 3.3 Search criteria

In mostly all the searches, the keyword "Braille" is included in the abstract. From the previously mentioned e-resources, we tried to extract as much relevant content as possible. Because our evaluation focuses on Braille's evolution in India's regional languages, several well-known research publications were left out. We only include papers written in English in our study because of the language and script constraints. To find relevant studies initial filtration is used on the abstract and titles of the studies.

### 3.4 Planning the Review

The short review process includes the introduction of all the papers that are related to Braille in regional languages. Searching the research papers by using relevant search strings from various journals and conference proceedings, identifying the related studies. The overall study selection procedure is shown in Fig1.



**Fig. 2:** Available Papers in the journals

In total, we get 882 papers from the above-written resources when we search with the Braille keyword, and we get 835 papers by rejecting 47 papers based on Titles. After reading abstract we selected 47 papers, and by reading the full paper out of 47, we selected 10 papers based on the regional language Braille system. Numerous well-known research articles were left out in the review due to limited scope.

### 3.5 Exclusion Criteria

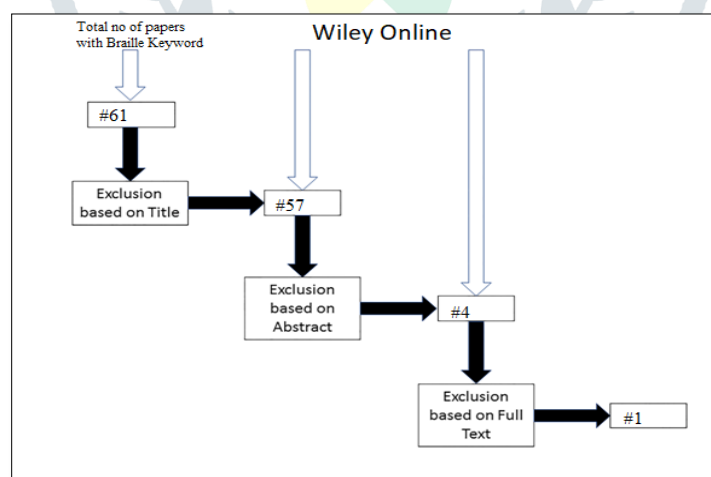
The Exclusion criteria were divided into the following three stages.

- **Stage I:** In the first stage, the search strings were used under the "abstract" part, but it gave many irrelevant results. So, according to the title, 835 articles were left behind for further analysis.
- **Stage II:** Then the "abstract" of the rest of the articles is studied, the related papers are included, and others were neglected from the record. After this stage, 47 articles were left behind.
- **Stage III:** During this stage, the full paper is studied. After this stage, 10 articles are left.

## 4. RESULT

The following figures show the result of each source after the exclusion of papers/articles based on title, Abstract and reading full papers.

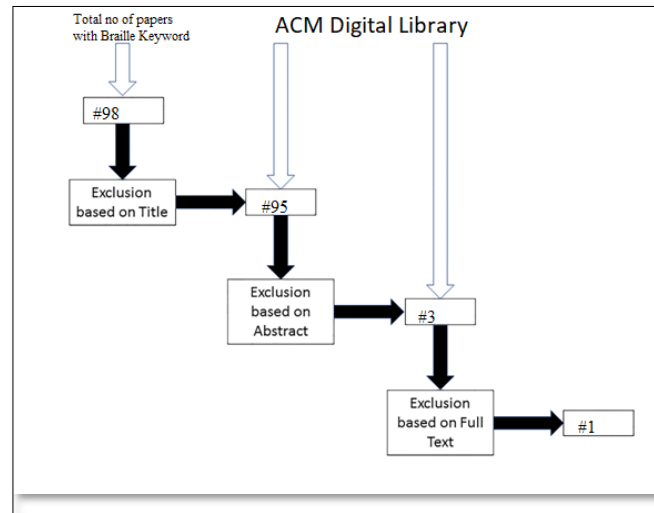
### 4.1 Source Wiley Online



After the Exclusion of papers/articles based on title, Abstract and reading full papers 1 article is left to discuss.

**Paper Title: Towards a computerised Arabic Braille environment[10]:** This paper was written by AbdulMalik S. Al-Salman and Hend S. Al-Khalifa. Authors explain the design & implementation of Arabic Braille environment presented in this work (ABE). The reader will also learn about the ABE's functionality and distinctive characteristics in this study. Arabic-speaking visually impaired persons all across the world can use the ABE Braille environment programme. According to the article, the ABE system has characteristics like translating Arabic text to Braille, Text to speech of Braille text, a Simplified interface for easy access by sighted Arabian people, Online help etc.

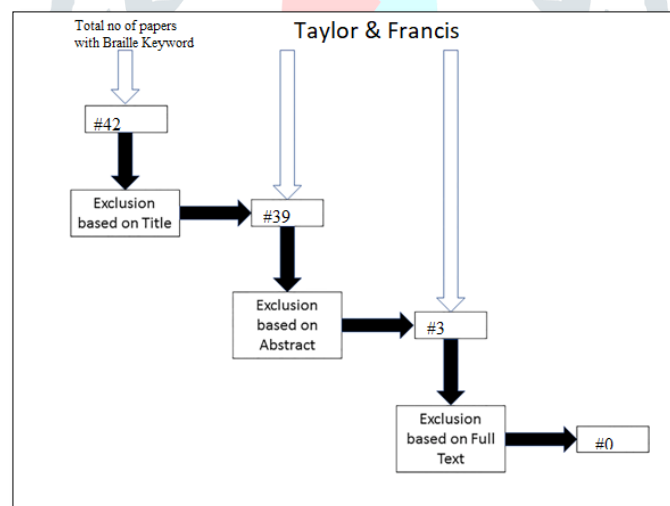
#### 4.2 ACM Digital Library



After the exclusion of papers/articles based on title, Abstract and reading full papers, 1 article left to discuss.

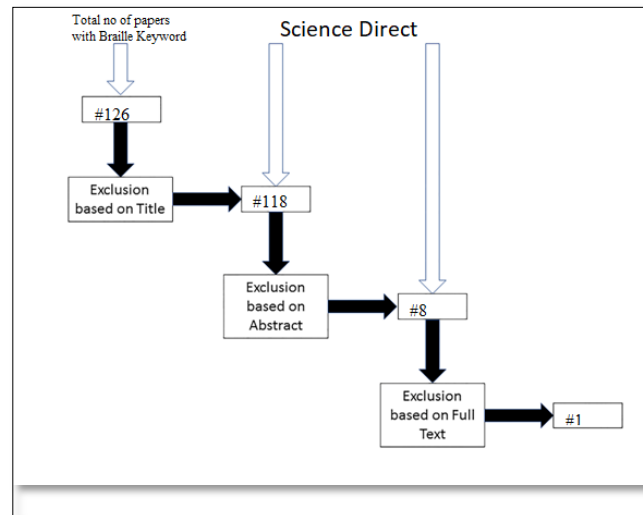
**Paper Title: A Speech Enabled Indian Languages Text to Braille Transliteration System[11]:** This paper was written by Tirthankar Dasgupta and Anuparn Basu. The authors explain the design and implementation of a speech enabled bidirectional automatic Indian text to the Braille system. According to the authors, the system can transliterate a text document both forward and backwards. This will assist in enhancing India's low literacy rate & give more information to the visually impaired. System is linked to Indian language TTS system that offers immediate audio feedback in response to a selected text. The authors also explore the Dzongkha script's various elements and how it differs from other Indian languages or English scripts.

#### 4.3 Taylor & Francis



After the exclusion of papers/articles based on title, Abstract and reading full papers no article is left to discuss.

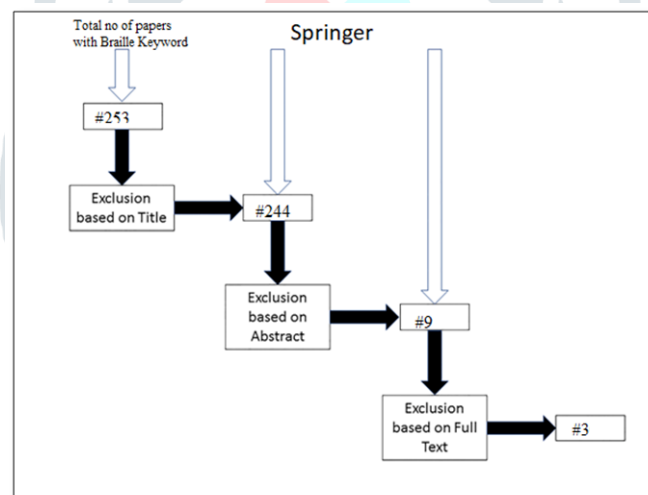
## 4.4 Science Direct



After the exclusion of papers/articles on the basis of title, Abstract and reading full papers, 1 article is left to discuss.

**Paper Title: A Bi-directional Bi-Lingual Translation Braille-Text System[12]:** This paper was written by AbdulMalik S. Al-Salman. This study describes a bi-lingual & bi-directional Arabic Braille translation system that do not require any costly equipment. The software is designed and implemented to translate native languages, such as English & Arabic, into the Braille System & vice-versa. Other capabilities of this software include the ability to input into the computer for visually challenged persons, a retranslation of a Braille code to another language, and more. The user interface in Arabic is simple. Being able to incorporate any natural language, voice feedback, bi-directional translation, and direct Braille writing etc.

## 4.5 Springer



After the exclusion of papers/articles on the basis of title, Abstract and reading full papers 3 articles are left to discuss.

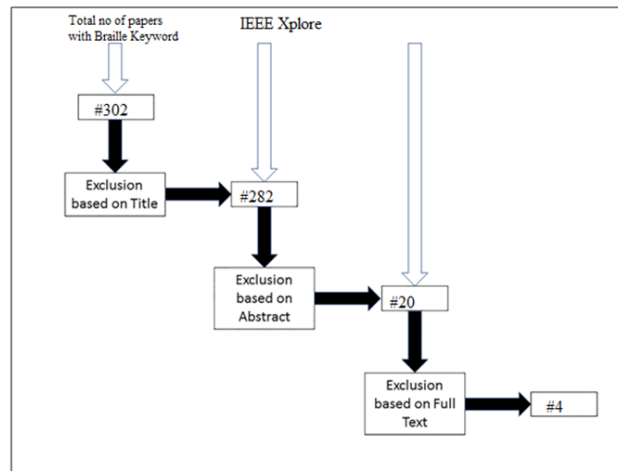
**1 Paper Title: Chinese to Braille translation based on Braille word segmentation using statistical model [13]:** This paper was written by Wang, Xiangdong & Yang, Yang & Zhang, Jinchao & Jiang, Wenbin & Liu, Hong & Qian, Yueliang., The authors suggest a Chinese-Braille translation system in this study. In this method, a statistical machine learning-based Braille word segmentation model is trained on the basis of Braille corpus. The stage of Chinese word segmentation is skipped in favour of performing Braille word segmentation directly using the statistical model. Instead of setting rules for syntactic and semantic information, this method employs statistical model to learn the rules invisibly and automatically. An algorithm for merging the findings of Chinese and Braille word segmentation is also proposed to increase performance. For Braille word segmentation, the suggested method achieves a precision of 92.81 percent, outperforming current approaches that use the segmentation-merging scheme.

**2 Chapter Title: Speech, Text and Braille Conversion Technology [14]:** This paper was written by Hoffmann, R., This chapter explains the various conversion technologies available for text, speech, and Braille. With the inclusion of steps to convert text into Braille for Braille users, these enable technologies allow speech into text, for the creation of a letter, and text into voice, for reading a book. The writers also go through the fundamentals of Braille conversion technologies in this chapter.

**3 Paper Title: Complete Forward and Reverse Text Transcription of Odia Braille and Hindi Braille [15]:** This paper was written by Jha, V., Parvathi, K., The main focus of this work is on the translation of Odia electronic documents into Braille and vice-versa. The

Braille code created is compatible with any printer's Braille embosser. For translation, a Unicode of Odia letters and a Braille code mapping table were created. The performance of this method is also tested in Hindi. According to the writers, the findings of the reverse translation of Braille to the text were likewise verified and determined to be satisfactory.

#### 4.6 IEEE Xplore



After the exclusion of papers/articles on the basis of title, Abstract and reading full papers 6 articles are left to discuss.

**1. Paper Title: Analysis of Bangla-2-Braille Machine Translator [16]:** This paper was written by Syed Akhter Hossain, Lora Annanya Biswas and Md Iqbal Hossain. In this paper, the authors explain the Bangla to Braille translator System. They use Discrete Finite Automata (DFA) to implement a Bangla to Braille machine translator (DFA). Authors used a structured and state elimination strategy to construct and evaluate regular expressions from the DFA created for a Bangla to Braille machine translator. The authors claim that the results of testing the generated phrases for Braille language rules were adequate. The DFA for a Bangla-2-Braille machine translator is investigated in this paper, and regular expressions are created utilising the state elimination method.

**2. Paper Title: Automatic System for Text to Braille Conversion [17]:** This paper was written by Adrian Moise, Gabriela Bucur, and Cristina Popescu. The authors of this paper describe the creation of an automatic method for converting computer-generated text to Braille. A microcontroller is attached to a particular device that can be use by blind people in the system. A software-based paradigm for implementing FSM (Finite State Machines) has been devised for this system. The authors created and completed a project that convert text into Braille, which was then read by output device. Letters (small and capitals), digits, punctuation marks, and other special characters are converted by the software, but quotation marks & apostrophes are not converted. This is the limitation of the project.

**3. Paper Title: DESIGNING OF ENGLISH TEXT TO BRAILLE CONVERSION SYSTEM: A SURVEY [18]:** This paper was written by Mr Vrushabh S. Dharme, Mrs S. P. Karmore. The Automated value Thresholding algorithm is presented the work while converting text to Braille. Various strategies are also evaluated in terms of economic effectiveness, low mistake rate, and hardware implementation. The authors of this paper discovered that the Automated value Thresholding algorithm is best suited for designing and implementing a proposed system architecture for visually impaired people that provides an efficient way of converting text to Braille while maintaining flexibility, portability and low cost. At the time of publication, the research work described in this report was still in its early stages.

**4. Paper Title: A SYSTEM FOR FAST TEXT-TO-BRAILLE TRANSLATION BASED ON FPGAS [19]:** This paper was written by Xuan Zhang, Cesar Ortega-Sanchez and Iain Murray. The authors of this paper describe a fast text to Braille translator system based on FPGAs (field programmable gate arrays). This translator perform the translation in hardware rather than software. An FPGA with a large programmable resource was used to execute the quick translation, and an algorithm proposed by Paul Blenkhorn was improved to do the fast translation. An extremely high-speed IC hardware description language was used to describe the translator (VHDL). The test findings demonstrate that the hardware-based translator outperforms Blenkhorn's original approach in terms of throughput while producing results equivalent to commercial software-based translators.

#### 5. CONCLUSION

From the above analysis, we came to know that there is a huge scope of research on Braille in regional languages. In India, there are many regional languages, but as we analysed, the work to convert text written in a regional language to Braille or vice versa was started in many languages. Still, improvement is needed to achieve the required target.

#### References

- [1] MHRD, India, "Constitutional provisions relating to Eighth Schedule," Link: [http://mha.nic.in/hindi/sites/upload\\_files/mhahindi/files/pdf/Eighth\\_Schedule.pdf](http://mha.nic.in/hindi/sites/upload_files/mhahindi/files/pdf/Eighth_Schedule.pdf) Articles 344(1) and 351 of the Constitution. 2004.
- [2] UNESCO, "The Improvement in the Quality of Mother Tongue - Based Literacy and Learning, Bangkok: UNESCO." 2008.
- [3] Swaran Lata, Swati Arora, "Exploratory Analysis of Punjabi Tones in relation to orthographic characters : A Case Study," Technology development for Indian Languages, pp. 3-7.
- [4] Harjeet Singh, Ravinder Khanna and Vishal Goyal, "Comparative Study of Standard Punjabi and Malwai Dialect with regard to Machine Translation," An International Journal of Engineering Sciences, vol. 8, pp. 109-118, June 2013.

- [5] Kartar Singh Siddharth, Renu Dhir and Rajneesh Rani, "Handwritten Gurmukhi Character Recognition Using Statistical and Background Directional Distribution Features," *International Journal of Computer Science and Information Technologies*, vol. 2(3), no. 6, pp. 1036-1041, 2011.
- [6] Farhan Bodale, Uddhav Bhide and Dilip Gore, "Braille Translation," *International Journal of Research in Advent Technology*, vol. 2, no. 4, p. 372-376, 2014.
- [7] Perkins, "World Braille Usage," National Library Service for the Blind and Physically Handicapped Library of Congress, UNESCO Washington, D.C., Third edition, 2013.
- [8] Joga Singh, "INTERNATIONAL OPINION ON LANGUAGE ISSUES: Mother Tongue is the Key to Education, Knowledge, Science, and English Learning," pp. 1–22, 2013.
- [9] Manzeet Singh and Parteek Bhatia, "Automated Conversion of English and Hindi Text to Braille Representation," *International Journal of Computer Applications*, vol. 4, no. 6, pp. 25–29, 2010.
- [10] S. Al-Salman and S. Hend Al-Khalifa, "Towards a Computerised Arabic Braille Environment," in *Software Practice and Experience*, John Wiley & Sons, 2003, p. 497–508
- [11] T. Dasgupta and A. Basu, "A speech enabled Indian language text to Braille transliteration system," 2009 International Conference on Information and Communication Technologies and Development (ICTD), 2009, pp. 201-211
- [12] S. Al-Salman, "A Bi-directional Bi-Lingual Translation Braille-Text System," *Journal of King Saud University - Computer and Information Sciences*, Volume 20, 2008, p 13-29
- [13] Wang, Xiangdong & Yang, Yang & Zhang, Jinchao & Jiang, Wenbin & Liu, Hong & Qian, Yueliang. (2017). Chinese to Braille translation based on Braille word segmentation using statistical model. *Journal of Shanghai Jiaotong University (Science)*. 22. 82-86. 10.1007/s12204-017-1804-x.
- [14] Hoffmann, R. (2008). *Speech, Text and Braille Conversion Technology*. In: Hersh, M., Johnson, M. (eds) *Assistive Technology for Visually Impaired and Blind People*. Springer, London. [https://doi.org/10.1007/978-1-84628-867-8\\_14](https://doi.org/10.1007/978-1-84628-867-8_14)
- [15] Jha, V., Parvathi, K. (2018). Complete Forward and Reverse Text Transcription of Odia Braille and Hindi Braille. In: Saeed, K., Chaki, N., Pati, B., Bakshi, S., Mohapatra, D. (eds) *Progress in Advanced Computing and Intelligent Engineering. Advances in Intelligent Systems and Computing*, vol 563. Springer, Singapore. [https://doi.org/10.1007/978-981-10-6872-0\\_12](https://doi.org/10.1007/978-981-10-6872-0_12)
- [16] S. A. Hossain, L. A. Biswas and M. I. Hossain, "Analysis of Bangla-2-Braille machine translator," 2014 17th International Conference on Computer and Information Technology (ICCIT), 2014, pp. 300-304
- [17] A. Moise, G. Bucur and C. Popescu, "Automatic system for text to Braille conversion," 2017 9th International Conference on Electronics, Computers and Artificial Intelligence (ECAI), 2017, pp. 1-6
- [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
- [19] X. Zhang, C. Ortega-Sanchez and I. Murray, "A System for Fast Text-to-Braille Translation Based on FPGAs," 2007 3rd Southern Conference on Programmable Logic, 2007, pp. 125-130

