A Review on Gujarati Braille Character Recognition

Nancy K. Patel[1], Krupali J. Patel[2], Hardik Vyas[3], Jigna Solanky[4]
Babu Madhav Institute Of Information Technology,
Uka Tarsadia University,Maliba Campus, Gopal Vidyanagar, Bardoli, Gujarat, India.

Abstract

Blind people are also important part of the society. Braille Script is used for visually impaired people to read and write. Braille Character Recognition Research is done in various Languages but less work is done in Gujarati Language. In this paper concentration is done on Gujarati and Braille script. It also focuses on various literatures for the conversion from Braille to different languages and highlights methods used for conversion.

Keywords

Braille Script, Braille Character Recognition, Gujarati Language, Optical character recognition

Introduction Gujarati Script

It derived from Devnagari script. Gujarati has combination of constants and vowels. There are 36 constants and 11 vowels available. This is denoted by attaching symbol of vowel to the constant. Every vowel has a unique symbol, called vowels modifiers. Examples of Gujarati constants, vowels, matras, other symbols and some of the conjucts are as shown in figure 1.

Fig 1: Gujarati Script

Braille Script

Louis Braille developed a Braille script in 1829 [4] which enable the blind people to read through touch using a series of raised dots which can only be read using the fingers as shown in figure 2.

Fig 2: Reading Braille character

Braille characters or "cell" consist of six dots. Dots coordinated in a rectangular shape designed in 3 X 2 rectangular matrix having three rows with two dots each as shown in figure 3.

Fig 3: Dots designed in Braille cell [7]

For the six positions, a dot may be raised at any combination. Therefore, $2^6=64$ combinations are available [2]. Distance is measured in four ways as shown in figure 4.

Horizontal Distance (HD) = 0.5 mm (0.02 inches)
Vertical Distance (VD) = 2.5 mm (0.1 inches)

Distance between Horizontal (DBH) = 3.75 mm (0.15 inches) Distance between Vertical (DBV) = 5.0 mm (0.2 inches) [2].

Fig 4: Braille mesh with standard distances between two cells & between two dots in one cell

In Braille Script, two types of documents are present: single sided and double sided. If double sided braille script is used then in that there are two types of dots available as shown in figure 5.

Recto Dot: Front page dots are known as recto dots.

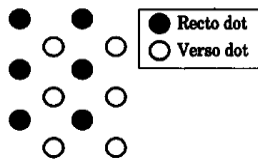Verso Dot: Dots which are back side of the page are called verso dots.

Fig 5: Types of dots in Braille cell [5]

Fig 6: Braille characters for Gujarati Language

Braille used for Indian languages are called Bharti Braille and it is written as shown in figure 6.

Phases of Braille character recognition

There are several stages that need to be followed for Braille character recognition as shown in figure 7.

❖ **Image Acquisition:**

Using a flat-bed scanner, images of single sided embossed Braille documents is taken. Without the need to carry out complex modifications, the scanner can be used with any other application.

❖ **Image Pre-processing:**

In Pre-processing, first of all conversion of RGB image to Gray-scale image is done. Formula for covert RGB to gray level is as follow

$gray = 0.2989\,R + 0.5870\,G + 0.1140\,B$
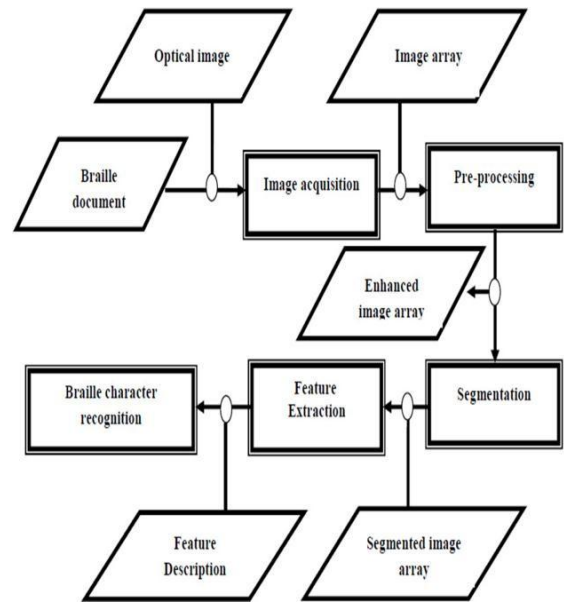
Fig 7: Steps to recognize Braille character

A darker frame around the borders usually contain in the resulting image that may disrupt subsequent processing steps. Hence, we perform the standard image cropping.

❖ **Image enhancement:**

To highlight specific image features is the main goal of image enhancement. The main features of image are the dots and their relative location. Few image enhancement techniques are performed to make these dots bold and easier to localize in subsequent steps.

• Noise Reduction: Noise is eliminated by average filter.

• Contrast Enhancement: To concentrate on the intensity range around the dots intensity levels.

❖ **Image Segmentation:**

To separate the desired dots from the background image segmentation is used. Image compliment is performed to obtain well-defined dots, after that image dilation is performed to dilate the dots. At last Binarization step is performed to separate the dots from the background.

❖ **Feature Extraction:**

In this phase extraction of the relevant information from the image for interpretation of the letters and words is performed.

❖ **Braille Cells Recognition:**

According to the features extracted in the previous stage Braille cell recognition can be done. Major step of this phase is to compose meaningful

letters. It aims to obtain letters and words by grouping the dots based on the location information. So to form words cell recognition is necessary.

Literature Review

Following are the reviews of the literature related to the Braille Character Recognition:

Aisha Mousa, Hazem Hiary, Raja Alomari, and Loai Alnemer [1] proposed a full system to recognize characters for a single sided Braille document. They proposed a method from image acquisition until Braille cell recognition. It includes image acquisition, image preprocessing for noise removal, image segmentation, feature extraction and character recognition. Their system achieved 94.39% dot recognition accuracy.

Nikisha B. Jariwala and Bankim Patel [2] have introduced Gujarati language and Braille script in detail. They have also focused on several researches and challenges need to be considered for different languages to convert it into Braille.

Xulio Fernández Hermida, Fernando Martín-Rodríguez [3] decided to make optical character recognizer for Braille code. They used adaptive thresholding and skew angle detection to implement their system. They achieved satisfactory result.

Bhattacharya K., Mjumdar S. [4] defines a system which converts Braille image to a computer readable form from text. They have worked on double sided Braille script document. They faced problem of degradation of dots and grids where Braille characters are positioned. But they have achieved good result.

Jan mennes, Lus van tichelen [5] has developed a system that converts Braille code to Computer readable form (Text). Braille printing house can reproduce text using an electronic braille embosser.

Srinath S, C.N. Ravi Kumar [7] try to identify the different works carried out by researchers to optically recognize the Braille characters and to convert them into their equivalent normal language notation.

S. Padmavathi, Manojna K. S. S, Sphoorthy Reddy .S and Meenakshy. D [9] have proposed method to convert scanned Braille document to text which can be read out to many through computers. Braille documents are preprocessed and segmented

to extract dots from each cell and converted into number sequence. They are mapped to appropriate alphabets of the language. The converted text is spoken out through speech synthesizer. They also provide a mechanism to type Braille characters through the number pad of keyboard. The typed Braille character is mapped to alphabet and spoken out.

Salah C. and A. Ranjith Ram [10] design a system that will transliterate Malayalam scanned books and magazines in to Braille. The proposed system deals with a printed Malayalam text to Braille transliteration system which includes a Malayalam optical character recognition system (OCR) and Malayalam to Braille mapping.

Mohammed Y. Hassan, Ahmed G. Mohammed [11] have defined the ability of the neural networks to be used for translating scanned text pages, books or lectures from English language into Braille; so that blind people can deal with it. They got satisfactory result.

B.l.Shivakumar, M. Rajasena thipathi [12] developed a tool for English to Braille Conversion and it is displayed in various styles based on client/server concept.

Hardik A. Vyas, DR. Paresh V. Virparia [13] describes the characteristics of Gujarati script and Braille language. They also focused on the problems related to the recognition of the Gujarati Braille characters. They have also discussed detailed literature review related to the Braille character recognition.

C. M. Ng, V. Ng and Y. Lau [14], a group at the Hong Kong Polytechnic University implemented an optical Braille recognition technique using edge detection to translate Braille into English or Chinese text. They have achieved good result.

M. Maloo and Dr. K. V. Kale [15] provide the reasons for researchers to work for recognition of Indian scripts. In the paper various scripts along with their special properties, their feature extraction and recognition techniques are described.

Problems

Braille language consist of cell which represents single character and in single cell 6 dots are there so possible combinations are 64 characters but problem is Gujarati language consist of 75 characters and There are some identical characters

in Gujarati Braille. So while writing Gujarati Braille following assumptions are to be considered.

- Digit identifier # character is used to differentiate between digits and letters in Gujarati Braille as Representation of ૦-૯ digits in Gujarati Braille is similar to consonant or vowels. i.e. Representation of ૧ is similar to અ and so on.

- In Braille there is nothing like half or compound characters. They don't have separate character to specify them. So 4th dot is identifier to indicate that the following character is half character. i.e

ત + વ = ત્વ

- In Gujarati Braille some characters are combinations of more than one character cells. So they are to be identified as single Gujarati Character at the time of recognition i.e.

ક = ક+ર, ગ્ = ગ+ર.

- Pronunciation of the words matters in building of Braille word. It is spelled as it is pronounced .i.e.

જઈએ

Conclusion

Braille system allows blind people to read and write. In this paper, we discussed basics of Braille script, Gujarati script, Steps to recognize Braille character and Problems while recognizing it. We also focus on literatures for Conversion of Braille character cells into various languages. There is less amount of work done in Braille character recognition. And till now we did not found any literature for Gujarati Braille character recognition. So we will carry out work on Gujarati Braille character recognition which will be helpful and beneficial for the visually impaired people.

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