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A Braille Transliteration on Tamil Vowels and Consonants Text Image

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Abstract

Speech and text is the significant intermediate for human communication. People who have partial vision or blind person can get information from speech. The Braille encoding system represents textual documents in a readable format for the visually challenged persons. This paper presents a research work for converting the Tamil vowel and consonants text present on printed text image to editable text and also transform recognized text into Braille script. The experimentation of the algorithms was carried out on the Tamil text image dataset and results show that the projected method has a good performance.

Keywords: Tamil Text, Braille conversion, Braille System, Visually challenged people, Image Processing

INTRODUCTION

The Braille encoding system represents textual documents in a readable format for the visually challenged persons. As there is a shortage of Braille compatible reading materials, visually challenged people face trouble in necessities like education and employment. Reading text documents is difficult for visually challenged people in various circumstances. Visually impaired persons can read only by use of Braille script. The majority of printed works does not include braille or speech versions. There is a need of a system for automatic recognition of text documents to braille and speech to reduce communication gap between the written text systems used by sighted persons and access mechanisms through which visually impaired people can communicate.

BRAILLE SYSTEM

Braille [1,2,3] is a tactile writing system used by visually challenged people. Braille is a system of raised dots that can be read with the fingers by people who have low vision or blind. Braille is named after Louis Braille, the French man who designed Braille symbols are formed within units of space known as Braille cells. A complete Braille cell comprises of six raised dots arranged in two parallel rows each having three dots. The locations of dot are recognized by numbers from one through six and it is shown in the figure 1.

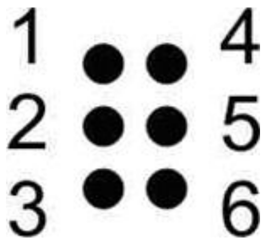

Figure 1: Braille Cell

Sixty-four combinations (2^6) are possible using one or more of these six dots. A single cell can be used to denote an alphabet letter, number, punctuation mark, or even an entire word.

Grade 1 Braille transliterates Braille by changing the letter with the Braille character and is generally used by the beginners. The disadvantage of Grade 1 Braille is that Braille characters are larger than ordinary letter. Grade 2 Braille are contractions and it permits to save space and increase reading speed. But translating a text into Grade 2 Braille needs special training and education.

Grade 3 Braille includes many more extra contractions. It is rarely used for books. Grade 4 Braille scripts are used by very few people. It is a shorthand script. Grade 4 scripts are used by blind people as shorthand to follow oral conversation. **Bharati braille** or **Bharatiya Braille** (“Indian braille"), is a braille script for writing the languages of India. Bharati braille alphabets use a 6-dot cell with values based largely on English Braille. Figure 2 shows the Tamil Braille alphabets sheet.

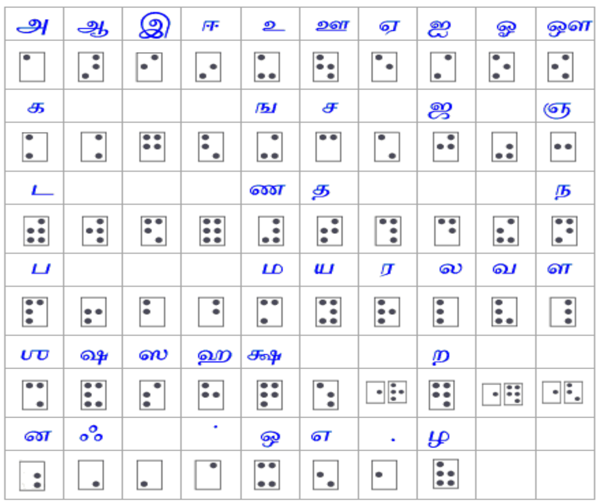

Figure 2: Tamil Braille Alphabets Sheet

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TAMIL LANGUAGE

Tamil is a language with a long and ancient literary tradition, first Indian language to be declared a classical language by the Government of India in 2004. Tamil is a Dravidian language spoken mainly in southern India and Sri Lanka, and also in Malaysia, the UK, South Africa, Canada, the USA, Singapore, France, Mauritius, and many other countries.

The Tamil script has 12 vowels 18 consonants and one special character, the *ayudha ezhuthu*. The complete script, therefore, consists of the 31 letters in their independent form and an additional 216 combinate letters, for a total of 247 combinations of a consonant and a vowel, a mute consonant, or a vowel alone. The compound letters are formed by adding a vowel marker to the consonant.

Vowels (Fig 3) are also called the 'life' (*uyir*) or 'soul' letters. Together with the consonants (*mei*) which are called 'body' letters. **Consonants** (Fig 4) are called the "body" (*mei*) letters. The consonants are classified into three categories: *vallinam* (hard consonants), *mellinam* (soft consonants), and *itayinam* (medium consonants).

āytam ஃ is pronounced as "akku" " and is classified in Tamil grammar as being neither a consonant nor a vowel

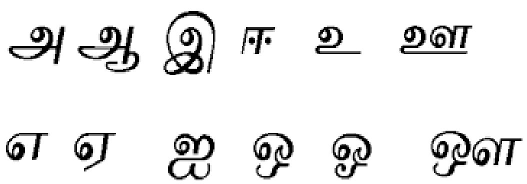

Figure 3: Tamil Vowels

1) tam

Figure 4: Tamil Consonants

EXSTING SYSTEM

Gayathri et.al [4] discussed research work projected earlier for recognition the Southern Indian braille script from a Braille document**.** Roberto Netoa et.al [5] presented a research on camera reading for Blind People. A pre-processing of the image was carried out and a combination of CIColorControls and CIColorMonochrome filters were used to enhance the results. The AVSpeechSynthesizer class was used to obtain the synthesis of voice desired for the application.

Akshay Sharma et.al [6] presented a system to build an assistive system that support blind people by separating text and its conversion to audio from a scanned document image. Connected component labeling approach was used to localize the text on text image. Concatenative synthesis based on Software Development Kit platform was used and this system was operated through a speech-based user interface to scan the text content and to control speech parameter.

Aaron James et.al [7] proposed a research for transforming text in to speech output. A recognition process was done using Raspberry Pi device and speech output was listened. Using Tesseract library, the image would be converted into data and the data detected would be pronounced through the ear phones using Flite library.

Mallapa at,al [8] introduced a model for reading the document text and hand held objects for supporting the visually impaired people. Identification of text process was based on stroke orientation and edge distributions. Adjacent character grouping was done to compute candidates of text patches prepared for text classification. Off-the-shelf OCR was used to achieve word recognition on the identified text regions and converted into speech output for blind users.

Santhoosh et.al [9] presented a research to Tamil braille character recognition based on camera assistive device, an embedded system bulit on Raspberry Pi board. As a first step the captured image was converted to gray image and the image was cropped according to the requirement. Adaptive thresholding technique was used to separate the Braille dots from the background. Morphology techniques were used to enhance the image and binary search algorithm was used to correct if any de-skewing in the image. Dot parts were detected from the image and equivalent braille character was recognized using matching algorithm. The methodology used in this paper was experimented on Thirukkural Braille Book and achieved a result of more than 90% accuracy.

Bijet et.al [10] proposes a research work to convert Odia, Hindi, Telugu and English braille documents into its corresponding language. The algorithm used the technique of histogram analysis, segmentation, pattern recognition, letter arrays, data base generation with testing in software and dumping in using Spartan 3e FPGA kit which defined the dot patterns for the alphabets.

Shreekanth et.al [11] projected a research on the recognition of Braille dots embossed on both sides of Braille document and it was carried out by scanning the document only one side. The algorithm began by converting the colour image to the gray scale image. The output image retained only the light areas of the protrusions and depressions and eliminating the dark regions. The impulse noise was eliminated using the median filtering approach. The output image contained only the recto and verso dot components. The morphological dilation was performed on the filtered image in order to increase the area of the dot and this was more effective for increasing the area of the verso dot as compared to recto dot. In order to differentiate between the recto and verso dot the eight-connectivity property of the pixel relationship was employed. The thresholding operation was performed on the basis of the eight connectivity based pixel count value to differentiate between the recto and verso dots. After the separation of the recto and verso dots the grids were constructed discretely for the front and back sides of the document. The grid construction was used to recognize a Braille cell in the Braille document.

PROPOSED METHODOLOGY

This research proposes a successful Grade 1 Braille to Grade 2 Braille conversion system and it includes i) Text Extraction, ii) Text Segmentation, iii) Feature Extraction, iv) Classification, v) Grade 1 Braille script conversion and the main part of research is conversion of Grade 1 Braille script to Grade 2 Braille conversion. The flow of proposed system is shown in fig 5.

Input - The system accepts scanned document images as input

Stage 1: Preprocessing - Preprocessing is necessary for efficient recovery of the text information from scanned image. A text extraction algorithm [12,13] was presented to preserve text area and remove non-text area. The method was based on gamma correction method and positional connected component labeling algorithm [14,15]. The experimental results exposed that the technique could discover and extract the text areas in the image with an accuracy of 96%.

Stage 2: Segmentation - As a next stage, a segmentation algorithm [16] was applied to separate the text components from the output image obtained after stage1. The image was separated into row text images by using maximum and minimum row position of the text components. The algorithm computed expected component width size and if the component size exceeds the computed value, the algorithm splits the component at the calculated junction point. Each text component was separated as an individual text component image and the position details of the components (line, word) were stored in a text file. The final result is a set of text components images.

Stage 3: Feature extraction - The most important step involved in recognition is the selection of the feature information of the text component. Identifying relevant information from raw text data image that characterize the component images distinctly. The algorithm selects a set of features like height and width of the character, slant line, vertical line, horizontal line, arcs, loops, similarity appearance etc

Input: Tamil Character image

Output: Features

- ***Step 1 :*** *Perform horizontal Split on the text section image in to three equivalent parts. Identify any horizontal line found in each row*
- ***Step 2 :*** *Perform vertical Split on the text image in to three equivalent parts. Identify any vertical line found in each row*
- ***Step 3 :*** *Identify any Slant Lines present in the Text image*
- ***Step 4 :*** *Split the image into 4 quadrants and discover the number of loop in each Quadrant*
- ***Step 5 :*** *Only the loop of the image (LI) is taken and it is filled with the foreground color. The image LI is divided into equal four quadrants and number of pixels in each quadrant are calculated.*
- ***Step 6 :*** *calculate the total number of pixels in the character image*
- ***Step 7 :*** *Find out the identicalness' of the character image*
- ***Step 8 :*** *Calculate Height, Width Ratio of the image*
- ***Step 9 :*** *Stop the Procedure*

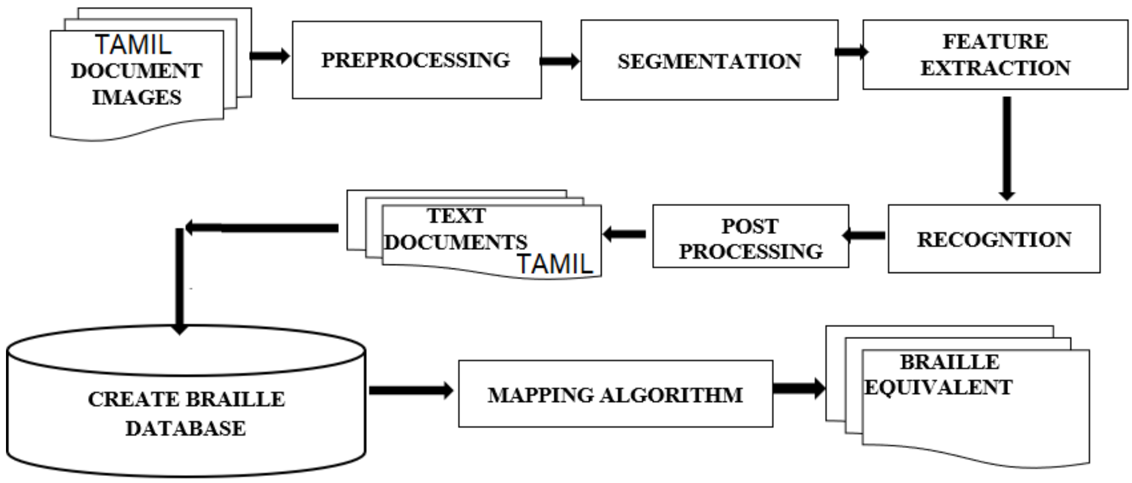

Figure 5: Flow of the Work

Stage 4: Classification - This stage is the main stage of text recognition system and it uses the features extracted in the previous stage to identify the text components. The text recognition algorithm uses a Multilayer Perceptron Neural Network trained with back propagation algorithm. Neural Network is designed of each size 40-90-85-5 for recognizing the vowels (12) and consonants (18).

The feature set has been analyzed using back propagation neural network. A MLP network of 40-90-85-5 figure 5 structures had been used.

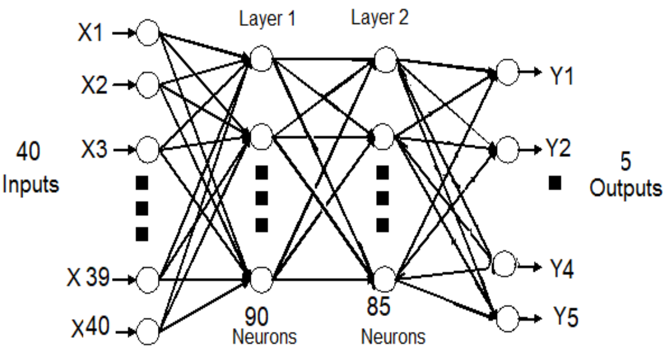

Figure 5: Architecture of Neural Network

The 40-attribute set which had been normalized is fed into each of the 40 input nodes. And finally, the output nodes represent the binary equivalent of the position of the recognized letter. For example, letter "அ" is in first position so the binary equivalent of 1 i.e. "00001" recognizes the letter. Similarly, letter "ச" is recognized by "01111". Table 1 shows the binary equivalent of output nodes of MLP and its corresponding Tamil alphabet.

Table 1: Output Nodes and its Corresponding Tamil Alphabet

Output Nodes	Tamil Alphabet	Output Nodes	Tamil Alphabet
00001	அ	10000	ஞ
00010	ஆ	10001	ட
00011	இ	10010	ண
00100	ஈ	10011	த
00101	உ	10100	ந
00110	ஊ	10101	ப
00111	எ	10110	ம
01000	ஏ	10111	ய
01001	ஐ	11000	ர
01010	ஒ	11001	ல
01011	ஓ	11010	வ
01100	ஔ	11011	ழ
01101	க	11100	ள
01110	ங	11101	ற
01111	ச	11110	ன

The network was trained by batch learning using a learning rate of 0.3, error tolerance of 0.01, 2000 learning cycles, random initial weights (range -1 to +1) and a momentum factor of 0.75. Out of 10500 samples, 5500 samples had been used for training the network and the rest were used for testing yielding an error rate of 4.3%.

Stage 5: Post Processing - In this stage, the particulars of the text position calculated by the stage 2 is used to form the characters produced by the neural network into editable text file. Open-source speech synthesizer was used on text file for audio conversion.

Stage 6: Braille Conversion system - The second part of the system is a Braille Mapping. The algorithm reads the output neural network and finds the equivalent Braille character for the corresponding output node nodes using the mapping table (Table 2).

Table 2: Braille Mapping Table

Output Nodes	Braille Equivalent	Output Nodes	Braille Equivalent
00001	⠁	10000	⠒
00010	⠜	10001	⠾
00011	⠊	10010	⠼
00100	⠔	10011	⠞
00101	⠥	10100	⠝
00110	⠳	10101	⠏
00111	⠢	10110	⠍
01000	⠑	10111	⠽
01001	⠌	11000	⠗
01010	⠭	11001	⠇
01011	⠕	11010	⠧
01100	⠪	11011	⠷
01101	⠅	11100	⠸
01110	⠬	11101	⠻
01111	⠉	11110	⠰

EXPERIMENTATION

The experimentation of the algorithms was carried out on the data set consisting of vowel and consonant of Tamil text images. Some of the experimental results are shown in the Table 3.

Table 3: Tamil Text and its Equivalent Braille Alphabet

Text Image	**Braille Equivalent**
ச	⠉
இ	⠊
வ	⠧
ஏ	⠑
அ	⠁
ள	⠇

Tamil text Recognition rate achieved is 95.7% and the accuracy rate of converting braille from recognized text is 100%.

CONCLUSION

This proposed approach presents an algorithm to assist visually impaired or blind person in reading the Tamil text present on printed text image. Experimental results show that the proposed method has a good performance on converting text regions in an image into Braille Script. The research work converts only Vowel and Consonant set of Tamil language to braille script and this work can be further developed to recognize Tamil compound alphabets present in an image and convert it to equivalent braille system.

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