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Technique for Conversion of Text Document into Grade 2 Braille Script

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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 projects a speech system model to support visually impaired or blind person in reading the text present on scanned printed text image and also transform recognized text into contracted Braille script. The experimentation of the algorithms was carried out on the text image dataset with different font style and size. Experimental results show that the projected method has a good performance on converting extracting text regions in an image to Grade 2 Braille Script.

Keywords: Braille conversion, Braille System, Visually Challenged people, Image Processing, Contracted braille system

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] 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 design, edit 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. 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.

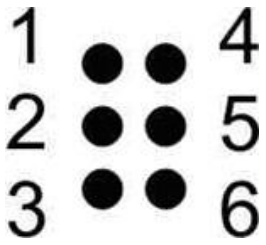


Figure 1: Braille Cell

Figure 2: English Braille Alphabets Sheet

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 Braillescripts 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. Figure 2 shows the English Braille alphabets sheets and figure 3 shows the Grade 2 Braille System.

Contracted braille [3] is used by more skilled braille users. It uses the same letters, punctuation and numbers as uncontracted (grade 1) braille, but also uses a contracted system or shorthand where groups of letters may be combined into a single braille cell Grade 2 braille was introduced as a space-saving alternative to grade 1 Braille. Also, there are part-word contractions, which often stand in for common suffixes or prefixes, and whole-word contractions, in which a single cell represents an entire commonly used word. Words may be abbreviated by using a single letter to represent the entire word, using a special symbol to precede either the first or last letter of the word while truncating the rest of the word, using a double-letter contraction such as "bb" or "cc", or removing most or all of the vowels in a word in order to shorten it. A complex system of styles, rules, and usage has been developed for this grade of Braille. Almost all books and magazines are printed in contracted braille.

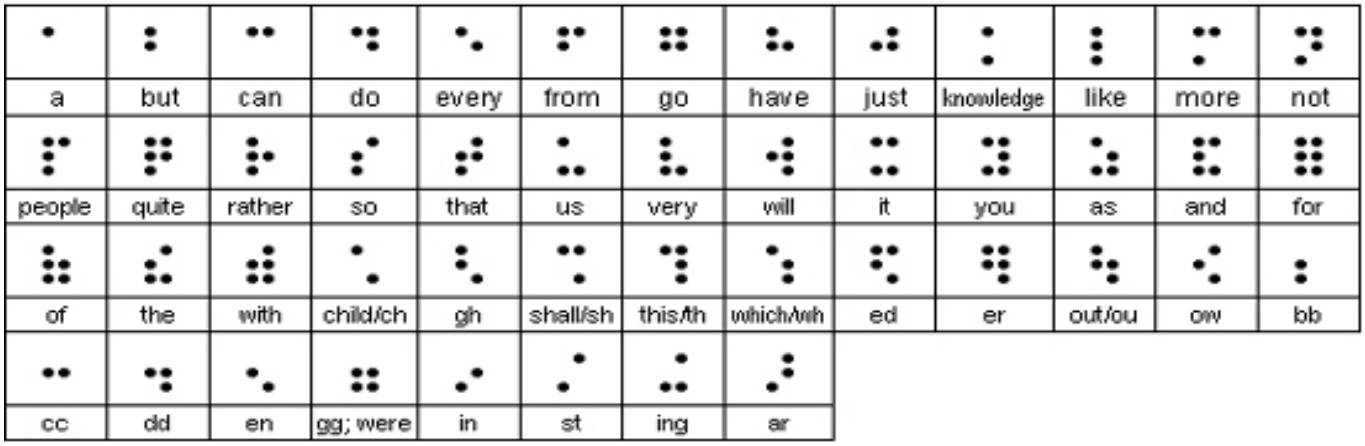


Figure 3: English Grade 2 Braille System

EXSTING SYSTEM

Roberto Netoa et.al [4] 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 [5] 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 [6] 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 [7] 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 [8] 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 [9] 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[10] projected a research on the recognition of Braille dots embossed on both sides of Braille document and it is 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 recognise a Braille cell in the Braille document. The proposed system achieved over 98.6% dot recognition accuracy.

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 4.

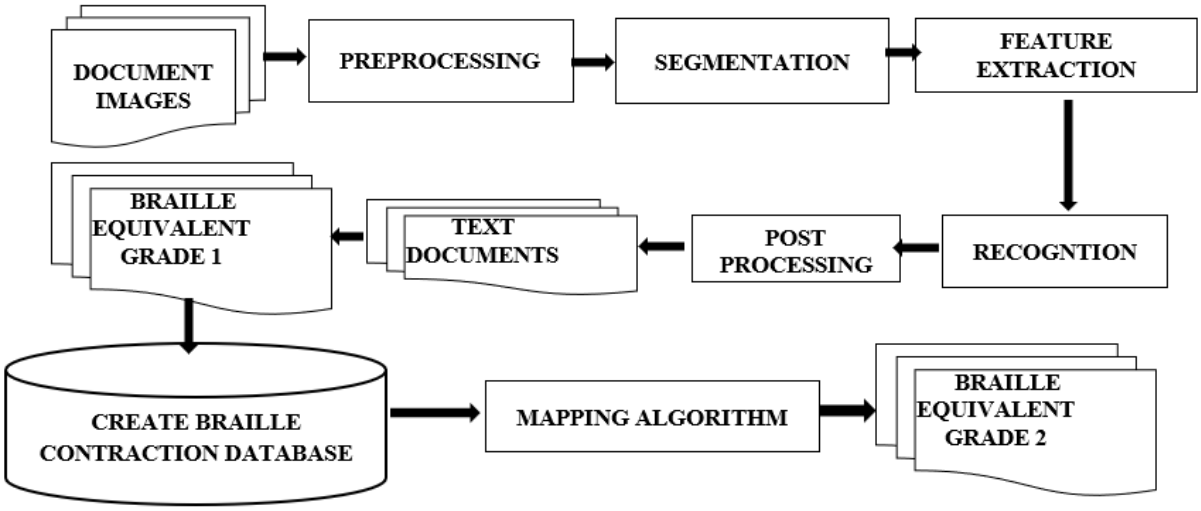


Figure 4: Flow of the Work

Input - The system accepts scanned document images as input

Stage 1: Preprocessing – Suppressing the non-text background details - Preprocessing is necessary for efficient recovery of the text information from scanned image. A text extraction algorithm [11,12] 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 [13,14]. 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 [15] 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 feature extraction [16] stage analyzes a text segment and computes a set of features that can be used to uniquely identify the text segment based on attributes like loops, horizontal lines, vertical lines, slant lines etc.

Stage 4: Classification - This stage is the main decision-making stage of text recognition system and uses the features extracted in the previous stage to identify the text components. The text recognition algorithm [17] used a feed-forward Multilayer Perceptron Neural Network trained with back propagation algorithm. Two neural networks named as NNUC and NNLC were designed of each size 42-80-75-26. One for recognizing the uppercase text and one for recognizing lowercase characters. To allow the input image of mixed case texts, the features vector of the text component was given as the input to the two networks NNUC and NNLC and the output of NNUC and NNLC were analyzed to select the output node.

The noise which was not been removed by the text extraction and segmentation algorithm was successfully identified by the text recognition algorithm and removed. This improved the accuracy of the result.

Stage 5: Post Processing - As a post processing stage, the details of the text position produced by the Text Position Details (TPD) algorithm was used to organize the characters produced by the neural network into editable text file. The output of the recognition algorithm is treated with an open-

source spell checkers to achieve more accuracy. Recognition rate achieved is 98%. Open-source speech synthesizer was used on text file for audio conversion.

Stage 6: Grade 2 Braille Conversion system - The second part of the system is a Braille Mapping algorithm which reads word and check whether there exists equivalent Braille Contraction using the Grade 2 mapping database. If exists the equivalent contraction word is replaced otherwise the corresponding Braille cell is replaced for each recognized English character.

EXPERIMENTAL RESULT

The experimentation of the algorithms was carried out on the ICDAR data set consisting of 500 various images and manually prepared training dataset with different font style and size. Some of the experimental results are shown in the Table 1.

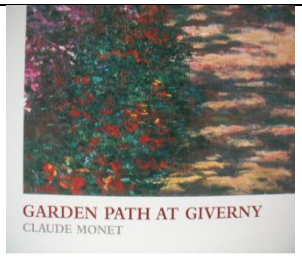
Image No	Images	Corrected Output using spell checkers	Grade 2 Braille Script
Image 1		Department of Computer Science	⠠⠙⠑⠏ ⠷ ⠉⠕⠍⠏⠥⠞⠑⠗ ⠠⠎⠉⠊⠑⠝⠉⠑
Image 2		Tesco Diets lose a stone in B weeks GO	⠠⠞⠑⠎⠉⠕ ⠠⠙⠊⠑⠞⠎ ⠇⠕⠎⠑ ⠁ ⠎⠞⠕⠝⠑ ⠊⠝ ⠃ ⠺⠑⠑⠅⠎ ⠠⠛⠕
Image 3		Join our facebook group	⠠⠚⠕⠊⠝ ⠳⠗ ⠋⠁⠉⠑⠃⠕⠕⠅ ⠛⠗⠕⠥⠏
Image 4		GARDEN PATH AT GIVERNY CLAUDE MONET	⠠⠛⠜⠙⠑⠝ ⠠⠏⠁⠞⠓ ⠠⠁⠞ ⠠⠛⠊⠧⠑⠗⠝⠽ ⠠⠉⠇⠁⠥⠙⠑ ⠠⠍⠕⠝⠑⠞
Image 5		EMERGENCY DOOR CONTROL	⠠⠑⠍⠑⠗⠛⠑⠝⠉⠽ ⠠⠙⠕⠕⠗ ⠠⠉⠕⠝⠞⠗⠕⠇

Image No	Images	Corrected Output using spell checkers	Grade 2 Braille Script
Image 6		FORUMS ENTER	⠠⠠⠍⠕⠗⠥⠍⠎ ⠠⠠⠢⠝⠞⠑⠗
Image 7		Example Image	⠠⠢⠭⠁⠍⠏⠇⠑ ⠠⠊⠍⠁⠛⠑
Image 8		TESCO RACE FOE LIFE CANCER RESEARCH UK	⠠⠠⠞⠑⠎⠉⠕ ⠠⠠⠗⠁⠉⠑ ⠠⠠⠋⠕⠑ ⠠⠠⠇⠊⠋⠑ ⠠⠠⠉⠁⠝⠉⠑⠗ ⠠⠠⠗⠑⠎⠑⠁⠗⠉⠓ ⠠⠠
Image 9		EMERGENCY STOP	⠠⠠⠢⠍⠻⠛⠢⠝⠉⠽ ⠠⠠⠎⠞⠕⠏
Image 10		WASINGTON	⠠⠠⠺⠁⠎⠊⠝⠛⠞⠕⠝

CONCLUSION

This proposed approach presents an algorithm for speech system model to assist visually impaired or blind person in reading the text present on scanned printed text image and also convert recognized text into Grade 2 Braille script. Experimental results show that the proposed method has a good performance on converting extracting text regions in an image to Braille Script. The research work converts only English Character set to contracted braille script and this work can be further developed to recognize multilingual text in an image

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