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RESEARCH ARTICLE

Real Time Implementation of Malayalam Braille Document Recognition System

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Abstract

Visually impaired people are integral part of the society and it has been a must to provide them with means and system through which they may communicate with the world. Malayalam Braille document evaluation system is an effective way to reduce communication gap between visually blessed and visionless people. The project focuses on converting the Braille document to Malayalam text and audio output. Here the focus is to convert entire Braille document page instead of character by character conversion. Concatenative speech synthesis technique is used for audio generation. A speech corpus will be created with Malayalam syllables. The syllables will be selected character wise and concatenated to generate output. The software used for simulation is Quartus II and the programming language used is VHDL. Software implementation of the project is done using MATLAB and Cyclone II FPGA is used for hardware implementation.

Introduction

There are lots of people around us who are suffering with different types of disabilities. One of the most common disabilities among them is the people with lack of vision. Blindness is either acquired by birth or at later stages of life due to accident or some kind of disease. Invention of Braille language was a great blessing for these people. Blind people can read and write using this language. There are various limitations these people are facing. Firstly, even if Braille language exists for them for reading and writing, they cannot use this system for communicating with common people as they don't have Braille literacy. Secondly, lack of skilled trainers for teaching blind. Thirdly, it is not easy for those who lose their sight during later stages of life to learn Braille on their own. Without getting a proper training from childhood it will be difficult for them to learn Braille language.

According to 2001 census, there are 334,662 incurable sightless people in Kerala. Only few of them are getting proper rehabilitation. To assist this group of people and to reduce communication gap between visually blessed and visionless people a new system is introduced in this paper. This system focuses on converting Malayalam Braille document in to corresponding Malayalam text and speech. Here the input will be Braille document page image. And the output will be Malayalam text and speech. This will help the blind people to be independent and use Braille itself to communicate with common people. Those who lose their sight during later stages of life can use this system to learn Braille by themselves.

Malayalam Braille document recognition system

Malayalam Braille to text and speech conversion system is a novel system, which focus on converting entire Braille document to readable text instead of letter by letter conversion and display. In letter by letter conversion image of each letter has to taken individually and should be processed, which is very tedious and time consuming. And also for speech output, concatenative speech synthesis is used. This will help in generating pronunciation of an entire word instead of letter by letter pronunciation. So it sounds more natural and easily understandable.

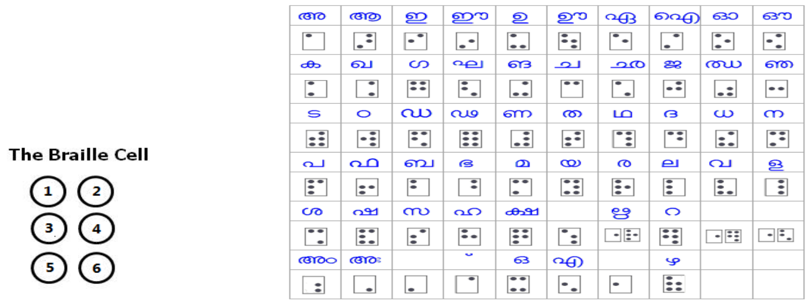

Figure 1: Single Braille cell (left), Malayalam Braille characters (right).

The proposed system has two major parts, image processing and speech synthesis. Image processing will help to identify the Braille text in the captured image. Speech synthesis focuses on converting the identified text to speech. The hardware required for this system are CMOS image sensor as image capturing device, FPGA for image processing, speaker for concatenative speech output and VGA display for displaying Malayalam text.

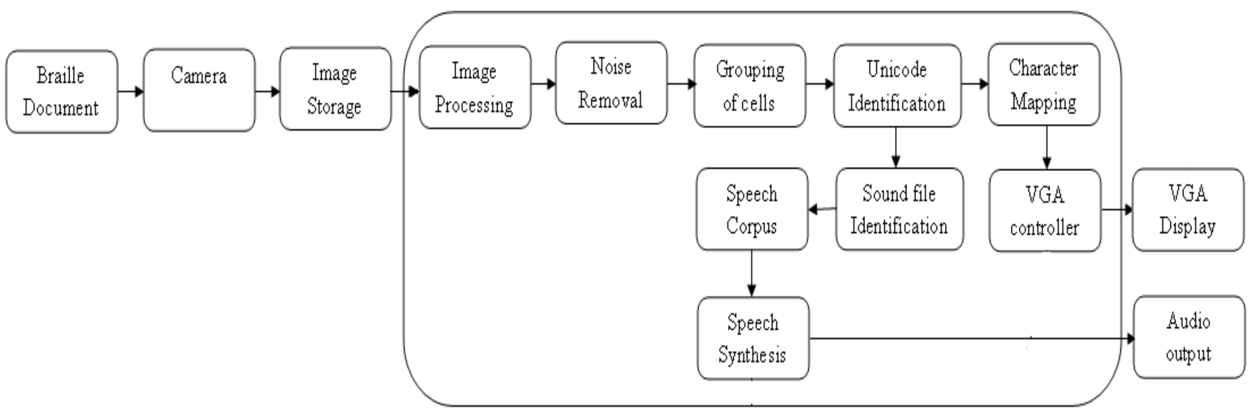

Figure 2: Proposed system block diagram

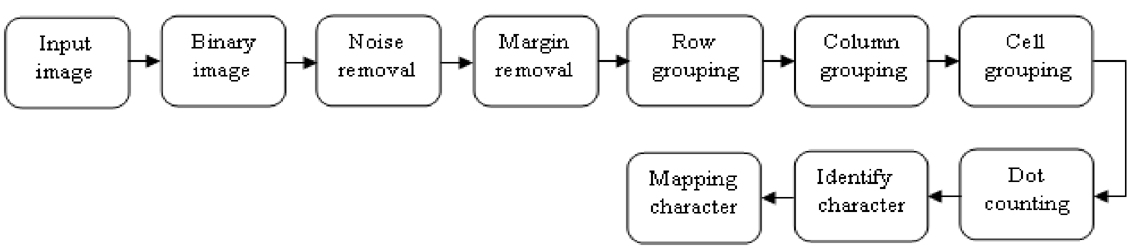

Figure 3: Braille to text conversion

To capture image, CMOS image sensor is used. Since it has in-build A/D convertor the output will be fully digitized. Figure 3 shows Braille to text conversion steps. This image will be converted to binary image by calculating the threshold using histogram analysis. The binary image is then processed to remove noise incorporated while image capturing. Noise pixel is identified by checking neighborhood pixel for each pixel considered. Based on the neighborhood pixel the target pixel will be changed accordingly. Once the noise is removed next the region of interest has to be identified. Based on this the margins will be identified which has to be removed. The margins are identified based on the starting and ending of the page content.

Figure 4 shows the identification of margin and how this margin is identified based on pixel for processing. Ones represent the presence of dot and zeros represent absence of dot. Based on the row and column matrix obtained from the image the dots will be grouped in rows and columns. Figure 5 shows grouping of dots in row, column and in to cell. The row and column grouping of dots is done to identify the Braille cell. The cells will be grouped based on the spacing between dots. The spacing between dots of two different Braille cell in adjacent row will be different from that of spacing between dots of a single Braille cell. This characteristic will be used for cell grouping.

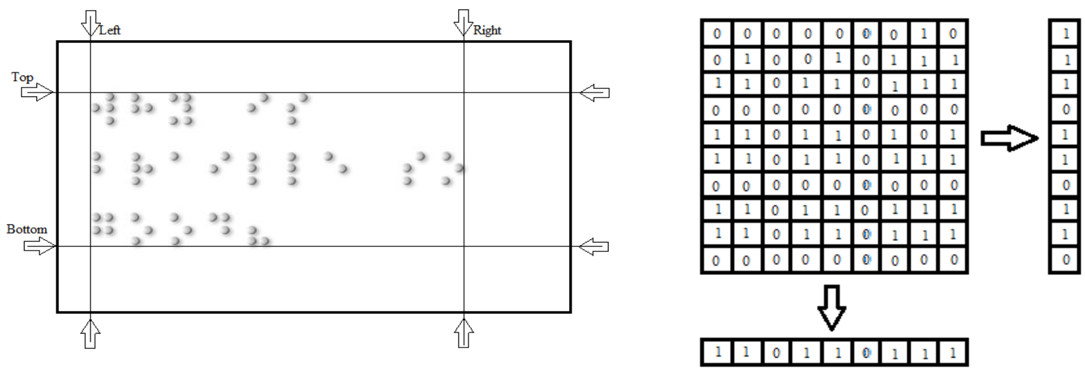

Figure 4: Margin is marked on the document(left), pixel based identification of dots(right).

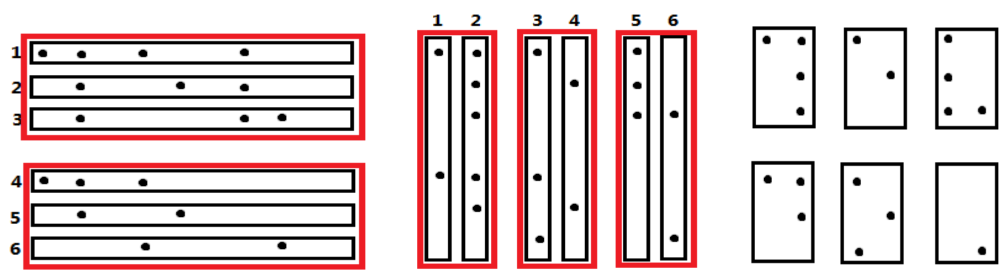

Figure 5: Grouping of dots in row, in cloumn and grouping of cell.

Once the cell is identified then it will be evaluated for presence and absence of dots. Presence of dot will be represented as 1 and absence as 0 and a six digit binary number will be generated with this. This position value will be used to identify the unicode corresponding to each character. Figure 6 shows an example of identification of position value based on dot position in different character.

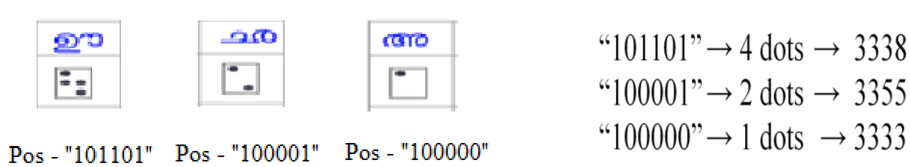

Figure 6: Position value and Unicode identification based on dot position.

Based on number of dots, the characters are grouped to reduce the delay in identifing the unicode. So maximum number of character coming in a group is 16. So to identify a character there is no need of traversing the entire 56 characters. If number of dots present are equal to 5 then the corresponding character will be searched in group of 5 dots. This reduce the delay significantly.

In case of malayalam character there is independent and dependent vowel. If the vowel comes after a consonant then it has to be converted to dependent vowel. Unicode correponding to independent and dependent vowel are different. By the identification of unicode the image processing part will be completed. Now this unicode will be used to select the syllable level sound file from speech corpus. Speech corpus is created with syllable level sound files. These are recorded files instead of synthesised ones to provide more natural sounding artificial speech. The figure 7 shows the text to speech conversion steps. Unicode will be preprocessed to obtain the sound file name. Once the sound file name is identified the corresponding sound file will be selected from speech corpus. It will be concatenated based on the space character. Space character is used to separate one word from another. So sound files corresponding to a single word will be combined together. For each consonant character there are 15 combination of sound syllables with the combination of vowels. Figure 8 shows how these filenames are assigned and an example for identifing the required file name.

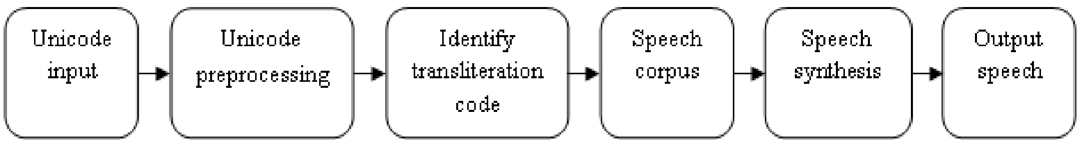

Figure 7: Block diagram for text to speech conversion.

ക	+	ാ	=	കാ	=>	3349	+	1	=	33491
ക	+	ി	=	കി	=>	3349	+	2	=	33492
ക	+	ീ	=	കീ	=>	3349	+	3	=	33493
ക	+	ു	=	കു	=>	3349	+	4	=	33494
ക	+	ൂ	=	കൂ	=>	3349	+	5	=	33495
ക	+	ൃ	=	കൃ	=>	3349	+	6	=	33496
ക	+	െ	=	കെ	=>	3349	+	7	=	33497
ക	+	േ	=	കേ	=>	3349	+	8	=	33498
ക	+	ൈ	=	കൈ	=>	3349	+	9	=	33499
ക	+	ൊ	=	കൊ	=>	3349	+	10	=	334910
ക	+	ോ	=	കോ	=>	3349	+	11	=	334911
ക	+	ൗ	=	കൗ	=>	3349	+	12	=	334912
ക	+	ം	=	കം	=>	3349	+	13	=	334913
ക	+	ഃ	=	കഃ	=>	3349	+	14	=	334914
ക	+	്	=	ക്	=>	3349	+	15	=	334915

പഊവ് => 3370 + 3338 + 3381 + 3405

പ => 3370

ഊ => 3338

വ => 3381

് => 3405

3370 + 3338 => 33708 => "പൂ"

3381 + 3405 => 338115 => "വ്"

Figure 8: Sound file name identification method (left) and sound file selection example (right).

Result

The system is implemented using both MATLAB and cyclone-II FPGA. The FPGA implementation is done using VHDL language. A GUI has been created to capture input image. The Unicode identified from the captured image is saved in a file as shown in figure. This Unicode after processing will be written as character to another text file. This Unicode will be further processed to obtain the transliteration code for selecting the sound files. The concatenated sound file output will be synthesized and saved. This can be played from the GUI window.

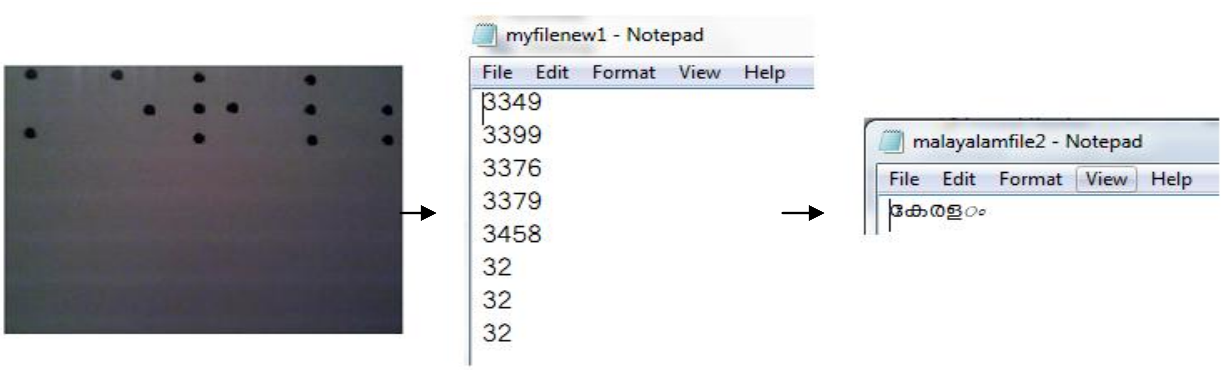

Figure 9: Input image converted to corresponding Malayalam text.

There are mainly six sections in this implementation including image capturing, image preprocessing, character identification, Malayalam character mapping, display and audio processing. For simulation purpose the input image is given as 160x120 binary images. But for hardware implementation input image is captured using CMOS image sensor with a picture size of 356x292 pixels. Figure 10 and 11 shows the identification of row and column having one. Based on the index obtained grouping will be done.

Figure 10: Identification of row having ‘1’

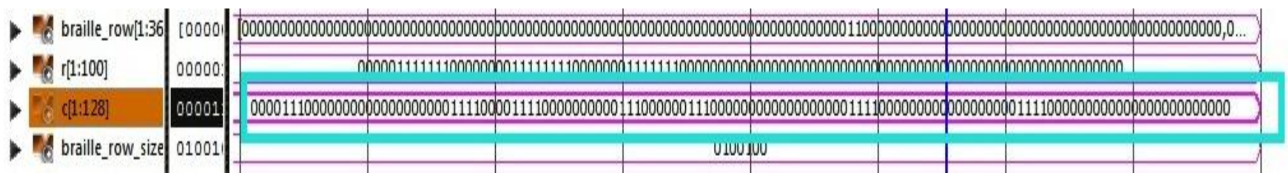

Figure 11: Identification of column having ‘1’

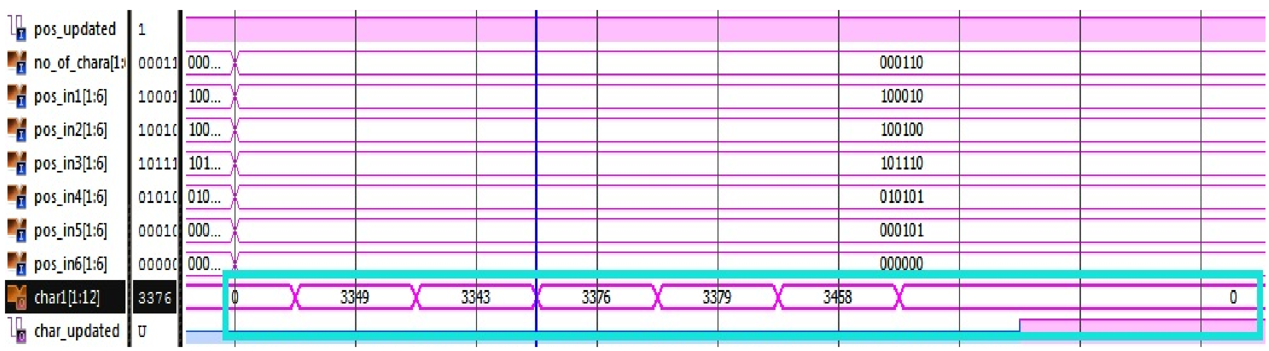

Figure 12: Unicode identification

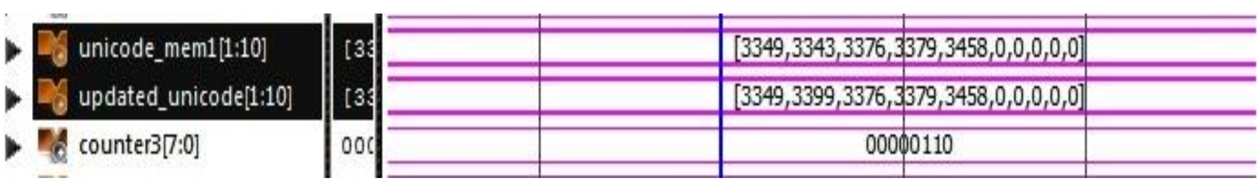

Figure 13: Modified Unicode value

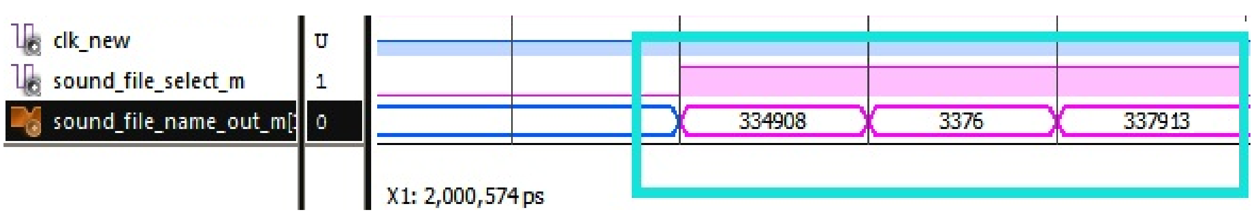

Figure 14: Sound file name selection

The position value identified for each Braille character is shown in figure 12. Here pos_in1 to pos_in6 represents the six digit binary value corresponding to each character. Char1 represents the Unicode identified for each of these binary values. In this values obtained the Unicode corresponds to that of independent vowels. For example, the input Braille image corresponds to word “കേരളം”. Malayalam Braille script does not use dependent vowels as in word “കേരളം”. Instead it will be written like “ക+ഏ+ര+ള+ം”. So the Unicode obtained initially corresponds to this. Since we use dependent vowels in Malayalam writing script, the Unicode obtained has to be modified accordingly. The modified Unicode is shown in figure 13. Here the Unicode corresponding to “ഏ” will be converted to that of “േ◌”.

This modified Unicode will be used for VGA display. This will be further processed to obtain the sound file names corresponding to the word. The above word has three syllables corresponding to കേ, ര and ളം . The sound filenames corresponding to that are shown in figure 14. The syllables corresponding to this filenames will be selected from speech corpus and will be concatenated. Figure 15 shows the implementation result. The word corresponding to the Malayalam Braille is displayed on the monitor.

Analysis & Synthesis Summary	
Analysis & Synthesis Status	Successful - Fri Aug 07 19:47:52 2015
Quartus II 32-bit Version	13.0.0 Build 156 04/24/2013 SJ Web Edition
Revision Name	vga_top
Top-level Entity Name	vga_top
Family	Cyclone II
Total logic elements	2,604
Total combinational functions	2,563
Dedicated logic registers	198
Total registers	198
Total pins	56
Total virtual pins	0
Total memory bits	0
Embedded Multiplier 9-bit elements	0
Total PLLs	1

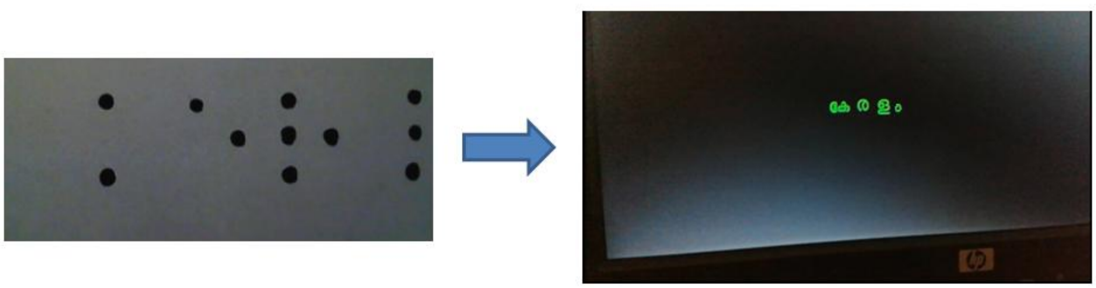

Figure 15: Real time implementation of Malayalam Braille Recognition system result

Conclusion and Future work

Real time implementation of Malayalam Braille recognition system is a novel method to assist the blind people who use Malayalam language for communication. Here the Braille document image is captured using CMOS image sensor and the data in the document is converted to Malayalam text and audio output. One of the major problems faced by visually impaired people is the difficulty in interacting through written communication with visually blessed people. It is hard for visually blessed people to understand Braille. The implementation of this project has reduced this problem. It also helps the people who become blind in the later stages of life to learn Braille by themselves. This also helps to reduce the biggest challenge the blind people are facing, that is lack of skilled teachers to educate them.

The system is implemented in both MATLAB and cyclone II FPGA. And here we have focused to convert the entire Braille page instead single character. The output audio generated also focus on pronouncing the entire word. This is done by concatenating the audio files of different characters in a word that has been identified. This will be a great advantage for blind to learn Braille by themselves. It also reduces the problem blind are facing in expressing themselves through Braille, as the common people cannot understand it. Here in FPGA implementation due to limited memory only few syllables that are required to implement the algorithm has been recorded. So as an extension to this a database with whole required syllables can be created for FPGA. This will help in speech conversion of any Malayalam Braille document. In the existing Malayalam Braille system there is limitation in using many syllables as there are only 64 combinations possible. A modified Braille system with all characters and symbols possible can be created and the algorithm also can be modified to include all these characters and symbols.

References

Bhaskar, M.K.. (2014). Novel Methodology for Kannada Braille to Speech Translation using Image Processing on FPGA. Advances in Electrical Engineering (ICAEE), 2014 International Conference , pp.1-6, 9-11.

Shreekanth, T., Udayashankara, V. and Arun Kumar, C. (2014). An Unit Selection based Hindi Text To Speech Synthesis System Using Syllable as a Basic Unit. IOSR Journal of VLSI and Signal Processing, 2014, vol.4, Issue 4, Ver. II ,pp.49-57.

Dasgupta, T. and Basu, A. (2009). A Speech Enabled Indian Language Text to Braille Transliteration System. Information and Communication Technologies and Development (ICTD), 2009 International Conference, pp. 201 – 211.

Ito, K., Itoh, K., Kiyota, K. and Ezaki, N.(2007). Development of Pen-based Note-Taking System for Blind People. Innovative Computing, Information and Control, 2007. ICICIC '07. Second International Conference, pp.8,8, 5-7.

Saravanan, C.(2010). Color Image to Grayscale Image Conversion. Computer Engineering and Applications (ICCEA), Second International Conference, pp - 196 – 199.

Jia Yin, Lirong Wang and Jie Li. (2010). The Research on Paper-Mediated Braille Automatic Recognition Method. Frontier of Computer Science and Technology (FCST), 2010 Fifth International Conference on , pp.619-624, 18-22.

AlSalman, A., El-Zaart, A., Al-Salman, S. and Gumaei, A. (2012). A novel approach for Braille images segmentation. Multimedia Computing and Systems (ICMCS), 2012 International Conference, pp.190-195, 10-12.

Wajid, M., Abdullah, M.W. and Farooq, O. (2011). Imprinted Braille-character pattern recognition using image processing techniques. Image Information Processing (ICIIP), 2011 International Conference , pp.1-5, 3-5.

Shanjun Zhang and Yoshino, K. (2007). A Braille Recognition System by the Mobile Phone with Embedded Camera. Innovative Computing, Information and Control, 2007. ICICIC '07. Second International Conference, pp.223-223, 5-7.