Volume 5, Issue 12, December 2015 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Gurmukhi Text Detection and Localization in Natural Scene Images

Dharam Veer Sharma*
Assistant Professor,
Department of Computer Science,
Punjabi University Patiala-147001, India

Sukhdev Singh
Assistant Professor,
Department of Computer Science,
Multani Mal Modi College Patiala, India

Abstract: ***Automatic text extraction from image is attracting interest of researchers due to its numerous applications. The present research work is aimed to detect and localise the Gurmukhi text region in the image. Text detection in natural scene images is a complex task due to varying text sizes, style and layouts. Moreover, the image background itself is creating complication in detecting text and non text region. The proposed algorithm is based on morphological and cellular automata representation of image information. Natural scene images contain images of sign boards, notice boards and banners. The image dataset contains 2000 images which are tested by the proposed system. The analysis of the proposed system is done by precision and recall parameters. The overall precision rate is 75.64% and recall rate is 73.74%.***

Keywords: Detection, localization, morphological operators, cellular automata, canny edge.

I. INTRODUCTION

Automatic text extraction from image is an emerging field in computer science. It has numerous applications such as system to overcome language barrier to understand the contents written in foreign language form information or sign boards, navigation system to help visually impaired people to walk freely on streets, automatic caution board reader for drawing attention of a driver to traffic signs, historical document preservation system. The present research work is an attempt to develop an application to extract text in Gurumukhi script from natural scene images. The proposed algorithm is able detect and localise the text region in the image. The text extraction from natural scene images is a challenging task and is comparably complicated than traditional text extraction system for scanned documents (OCRs). The factors contributing to the complexity of the text extraction system include: Unpredicted background and non-uniform background, Orientation of the text (horizontal, vertical, curved),Non-uniform text color, Presence of text like patterns, Word Skewness, Prospective projection of words , Blurredness of image, variation font style, size.

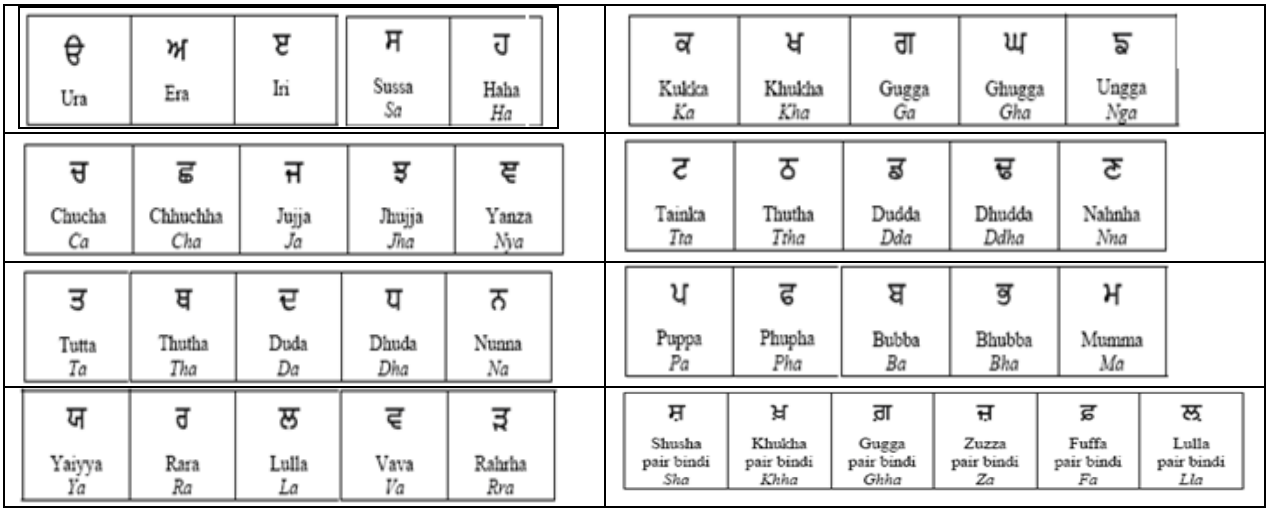
In literature, A very few work has been reported on Indian scripts. Most of the work is found on Machine Printed document Images and handwritten document images of Indian scripts (Devanagari, Gurmukhi, Bangla, Tamil, Telugu, Oriya, Gujarati and Kannada). G S Lehal et al. [1] developed a system for recognition of machine printed Gurmukhi script. The system performed the segmentation in three successive stages namely line segmentation, word segmentation and character segmentation. The horizontal and vertical projection profiles were used for segmentation of line and words respectively. The different structural features of Gurmukhi script such as Number of junctions with the headline, Presence of Sidebar, Presence of a loop, Aspect Ratio were considered for recognition. The overall recognition rate of the proposed system reported as 96.6 % with speed of 175 character/ seconds. M. K. Jindal et al.[2] proposed new algorithm to segment touching Gurmukhi characters in middle zone. The proposed algorithm successfully segment characters which contained 92-95% touching characters and showed recognition rate of 91%. D.Sharma et al. [3] proposed Gurmukhi recognized system for Isolated handwritten Gurmukhi using Neocognitron. T K Boaz et al.[4] introduced method for localisation of Kannada text from video frames. The method was based on multiple frames interrogation approach in which frames were integrated on the basis of characteristic like character location, edge distribution and pixel contract. The Rober's edge detection was used to create edge image and morphological operators are used to filter text and non text regions. The experiment result showed 92.00 % accuracy. Roy et al.[5] presented off-line Oriya handwritten numerals recognition system based on neural network based classifier. Overall accuracy of the system was 94.81%. Ved Agnihotri et al. [6] proposed Devanagari hand written text recognition system. This system extracts Zone directional feature from character images and convert into chromosome bit string of length 378.

The propose algorithm is able to detect text in natural scene image using morphological operators and cellular automata. There are approximately 2000 images which normalized to 480 x 640 sizes for testing of the proposed method. The overall precision rate is 75.64% and recall rate is 73.74%.

II. GURMUKHI SCRIPT

Gurmukhi is world's 14th most widely spoken languages. The Gurmukhi has 56 different characters in all, of which, 3 are vowel carriers, 38 consonants, 9 vowels, 3 half vowels, and 3 half characters. Following Table1 shows alphabets of Gurmukhi script.

Table 1: Gurmukhi Alphabets



The first three consonants are called vowel consonants or semi consonants or "Matra Vahak", due to their inherent property that they are never used in words without any 'Laga' or 'Vowel'. The next two consonants are classified as root class consonants (Mul Varag)

III. TEXT DETECTION AND LOCALIZATION

The proposed algorithm for text detection and localization is processed the image in phase manner. The input image is processed to create edge image. The various morphological operations are performed on edge image to highlight the text region in the image. Once the regions are highlighted, filtration for text and non text region is performed. The proposed method for detection of text in natural scene images is implemented into following three phases:

Phase1: Preprocessing for text detection

(i) Apply Binarisation algorithm
(ii) Create edge image using edge detection technique

Phase2: Apply morphological Dilation Operators

(iii) Apply morphological Erosion (Shrike non text region)
(iv) Apply morphological Dilation (Grow text region vertically and Horizontality)
(v) Detect text region using filtering technique

Phase3: Post processing:

(vi) Apply Horizontal and Vertical profiles of different regions in the image. Compare mean horizontal and mean vertical projection profiles, if region is marginal small or large then discard the regions.
(vii) Preserve the coordinate values of candidate text regions and draw a rectangular box bounding the text region.

The morphological operators are mathematical tools applied on black and white image. The proposed system incorporates Erosion and Dilation tools [7-12]. Erosion is used to shrink non text regions whereas Dilation is used to grow text region in the images. Cellular automata are another mathematical tool in which many regular cells combined together to produce complicated patterns [8-9]. It is a complex model which uses a regular lattice to represent image data.

IV. RESULTS AND ANALYSIS

The performance metrics recall and precision are used to evaluate the performance of the proposed algorithm.

- Recall metric: It gives significance of correctness of the system [10]. which is determined by the following formula.

$$R = \frac{\text{No. of correctly detected rectangles}}{\text{No. of rectangles in doubles}} \quad \text{Eq.1}$$

- Precision metric: The precision metric specifies about number of false alarms[11] as shown in Eq2.

$$P = \frac{\text{No. or Correctly detected rectangles}}{\text{Total Number of detected rectangles}} \quad \text{Eq.2}$$

The proposed text detection and localization algorithm are evaluated for performance using Eq.1 and Eq.2. Table2 shows results of statistical analysis.

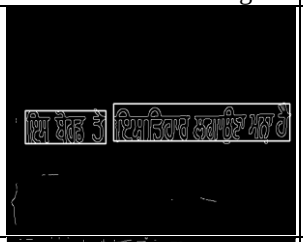
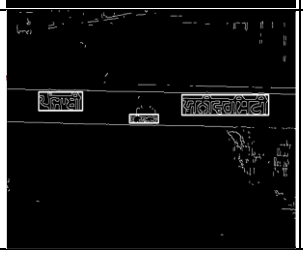
Table2 : Statistical analysis of the text detection algorithm

Sr. No.	(N)	(N1)	(N2)	Recall $=N_1/N$	$P=N_1/(N_1+N_2)$
1	15	13	3	0.867	0.813

2	7	6	4	0.857	0.600
3	4	4	0	1.000	1.000
4	7	7	2	1.000	0.778
5	7	7	2	1.000	0.778

Where, N = No. Actual text region in image, N1= No. of text region detected, N2= No. of text region wrong detected, Recall(r)=N1/N and precision(p)=N1/ (N1+ N2).
There are approximately 2000 images which normalized to 480 x 640 sizes for testing of the proposed method. The overall precision rate is 75.64% and recall rate is 73.74%.

Table3. Shows visual results of proposed algorithm applied on natural scene images.

Input Image	Detected image	Input Image	Detected image
			
			

V. CONCLUSION

The performance of Text recognition system is heavily depends on the performance of the text detection system. The detection of text in natural scene images is a complicated task due to varying background color, font size and text like patterns. The proposed system is robust system which can detect Gurmukhi text from complex natural scene images. The system is tested on 2000 images. The overall precision rate is 75.64% and recall rate is 73.74%.

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