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Document Image Binarization Technique with Minimum Number of Parameter Settings

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Abstract— ***Document Image Binarization aims to segment the foreground text from the document background. Segmentation of text from badly degraded document image is difficult due to inter or intra variation between document background and foreground text. In this approach first, contrast of the input degraded document image is enhanced before an adaptive image contrast map is constructed for the same. Then this contrast enhanced RGB image is converted to HSV image. After that, this HSV document image is subjected to gamma correction. At the end of gamma correction this HSV image is converted to RGB image. Then this gamma corrected RGB image is converted to gray-scale image .Finally, an adaptive image contrast map is constructed for the gamma corrected gray-scale image. Contrast map is then binarized and combined with the canny's edge map to identify the text stroke edge pixels. The document text is further segmented by a local threshold .Proposed system decreases the number of parameter settings. . This technique has been tested on some popular datasets (DIBCO and H-DIBCO)consisting of several bad quality document images and shows performance similar or close to the best performing methods reported in these two.***

Keywords— Document Image Binarization, Adaptive image contrast, Gamma correction, HSV image, Image gradient

I. INTRODUCTION

The objective of Document Image processing is to recognize the text & graphics components in image of documents and to extract intended information from them. Document image binarization is usually performed in the pre-processing stage of document analysis and it aims to segment the foreground text from the document background and it converts a gray-scale document image into a binary document image.As more and more text documents are scanned, fast and accurate document image binarization is becoming increasingly important for the ensuing document image processing tasks such as optical character recognition. Segmentation of a text from a badly degraded document image is a difficult task. Therefore, this research work focuses to develop a document image binarization technique which produces good binary result for document images with better visual quality.

(a) (b)

Fig 1: Degraded document images taken from DIBCO series datasets

The proposed methodology focuses on an improved adaptive image contrast based document image binarization technique for degraded document image. The main aim of this approach is to enhance the image contrast in order to detect the text stroke edges accurately before an adaptive contrast map is constructed for the same. In this approach the parameter γ which is the parameter for calculating the power function is automatically calculated for each input degraded document image .Here, before the construction of adaptive image contrast map for the input degraded document image, the input degraded document image is subjected to contrast enhancement and gamma (γ) correction .Hence, the proposed approach solve the over-binarization problem due to stroke variation.

II. PROPOSED METHOD

A. Contrast Enhancement

Contrast of the input degraded RGB document image is enhanced.Image enhancement is the improvement of digital image quality. Contrast enhancement automatically brightens images that appear dark or hazy, and applies appropriate tone correction to deliver optimal quality and clarity. The major advantage of contrast enhancement is that it preserves mean brightness without losing image features.

B. Gamma Correction

The contrast enhanced RGB image is converted to HSV image. Then this HSV image is subjected to gamma correction. The local image gradient will play major role when gamma is large and the local image contrast will play major role when gamma is small. In the proposed work, gamma correction of the image is done with the help of saliency map and L0-image gradient decomposition.

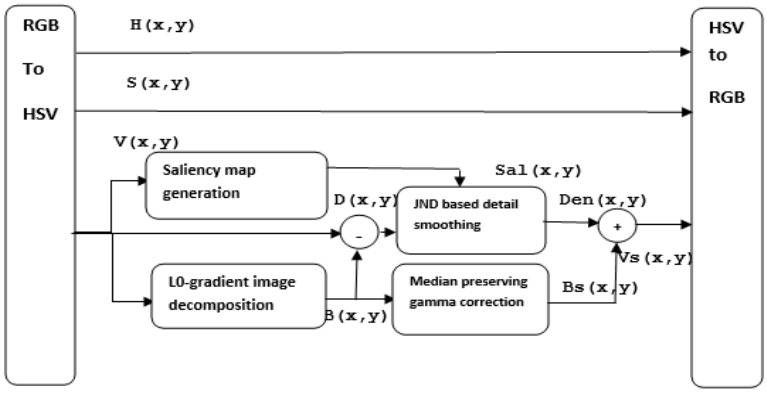

Fig 2: Method of gamma correction

Implementation of the gamma correction includes Saliency map generation, L0-gradient image decomposition, Median preserving gamma correction and JND- based detail smoothing. The saliency map which integrates the normalized information from the individual feature maps into one global measure of conspicuity. A constrained L0-gradient image decomposition is used to separate base layer and detail layer. Afterwards, a median preserving gamma correction is used for compensation and a JND-based smoothing for detail enhancement.

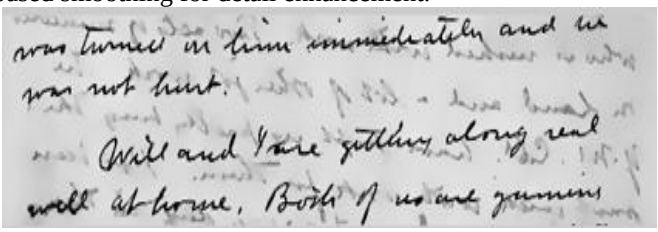

Fig 3.Gamma corrected image of fig1(a)

Then, an adaptive image contrast map is constructed for the gamma corrected image. Text stroke edge pixel candidates are determined using Otsu's global thresholding method. The binary map is further improved by combination with Canny's edge map. Combined edge map contains pixels from both high contrast image pixel map and Canny's edge map. To estimate the local threshold within a local window the size of the local window should be determined.

The local window size can be estimated from the stroke width. The algorithm for edge width estimation calculate the most frequently distance between two adjacent edge pixels in horizontal direction and use it as the estimated stroke width. The foreground text is then segmented from the document background using this threshold.

III. RESULT AND ANALYSIS

In the existing document image binarization technique γ is a predefined parameter which is ultimately refers to the contrast difference between foreground and background therefore for each input image we have to specify correct value for the gamma parameter according to the output we need. In the existing system γ was fixed arbitrarily corresponding to each image. The gamma parameter has an important role in controlling the power function. The local image gradient will play the major role when γ is large and the local image contrast will play the major role when γ is small. But in the proposed approach, value for the gamma parameter is calculated automatically for each input degraded document image using a gamma correction method. Therefore, in this approach image is subjected to gamma correction before contrast map is constructed for the same.

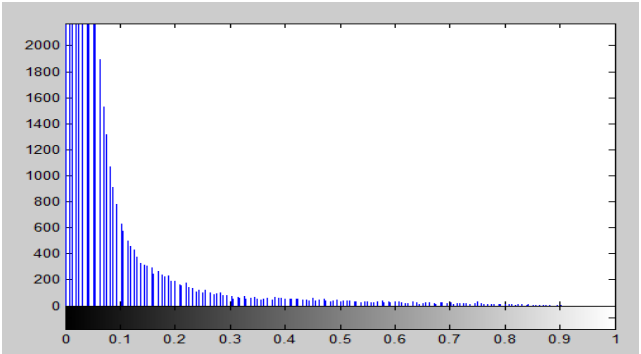

Fig 4:Histogram of document image in Fig 1(a)

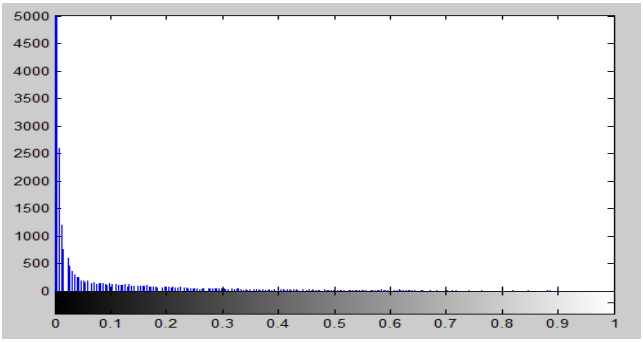

Fig 5:Histogram of document image in Fig 3.

The above histograms show that, there is a distinct contrast difference in the histograms. In the gamma corrected image there is a suppressed background data and it can be seen in the steep histogram of the gamma corrected image. In the previous histogram values are spread across the graph .This shows that there are several pixel values all over the image range from 0 to 256.But in the histogram of proposed approach (histogram of gamma corrected image) the background is unified into 1 or 2 pixel values closer to white. This makes the binarization and ultimately optical reading accurate.

IV. CONCLUSION

This research work proposes an improved adaptive image contrast based document image binarization for degraded document images. The proposed system is simple, efficient and also with minimum parameter settings. The important portion of this enhanced system is the gamma correction of the input image and contrast image construction of this gamma corrected image. Hence, we can automatically determine gamma value for each input image .Therefore, main advantage of the proposed approach is that, it decreases the number of parameter settings. The proposed approach also solve the over-binarization problem due to stroke variation.

The final resultant document image still contain some noises it can explore in the future. In addition, the local window should be set around 2EW because a larger local neighborhood window will increase the computational load significantly. But the large window size will help to reduce the local window size. Therefore, setting up of large window without increasing computational load can be performed in the future.

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