



INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X

(Volume2, Issue3)

Available online at: www.ijariit.com

DOCUMENT IMAGE BINARIZATION TECHNIQUE FOR DEGRADED DOCUMENT IMAGES BY USING MORPHOLOGICAL OPERATORS

Divya Jyoti¹, Bodh Raj², Arun Sharma³, Kapil Kapoor⁴

sharma.divya63@gmail.com¹, bodhraj.thakur@rediffmail.com², sharmaarun14289@gmail.com³, kapil_2770@yahoo.com⁴

Abhilashi Group of Institutions School of Pharmacy and Engineering & Technology, Mandi, Chailchowk, Himachal Pradesh.

Abstract: Segmentation of badly degraded document images is done for discriminating a text from background images but it is a very challenging task. So, to make a robust document images, till now many binarization techniques are used. But in existing binarization techniques thresholding and filtering is an unsolved problem. In the existing method, edge based segmentation can be done and Canny edge detector used. In our proposed technique, Image Binarization for degraded document images has being use Region based segmentation. Firstly, an RGB image covert into gray image then image filtering can be done on the basis of Wiener Filtering and Gaussian filter. Secondly, morphological operators use to discriminate foreground from background. Then Otsu and Sauvola's thresholding did for better results. Finally, proposed method results compare with the method used in DIBCO 2011 dataset. The evaluation based on few parameters like F-measure, PSNR, DRD and MPM.

Keywords: Filtering, Morphological operators, and thresholding.

I. INTRODUCTION

Document Image Binarization is the first process that occurs in document analysis and it is used for discriminating foreground text from document background. [1] Binarization is used as pre-processor before Optical Character Recognition. This technique converts the gray scale document image into binary document image. Image Binarization is classified in two main classes: (i) global and (ii) local. [2] Image binarization technique must be fast and an accurate for better document image processing tasks. Document Image Binarization techniques have been used from many years ago, but problem of thresholding exists till now because of high variation between text stroke and the document background. Therefore for an input image, some pre-processing stages should be used before text extraction. Out of which one stage is binarization technique. [3]

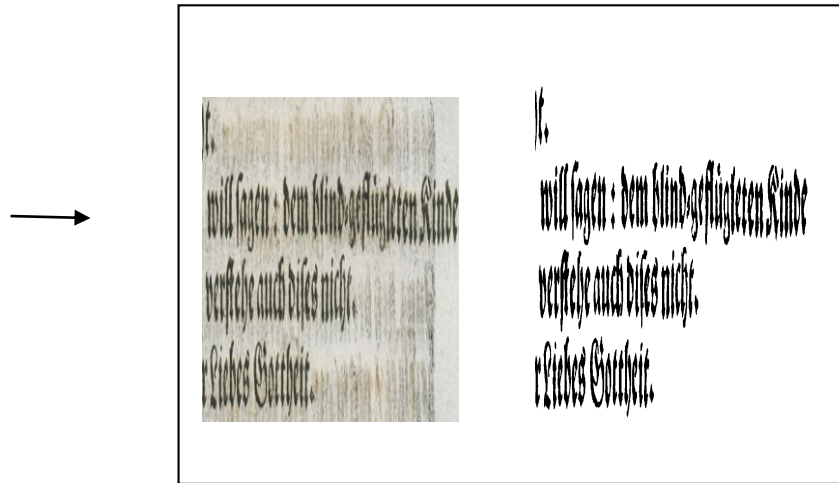


Figure1 (a): Example of Binarization

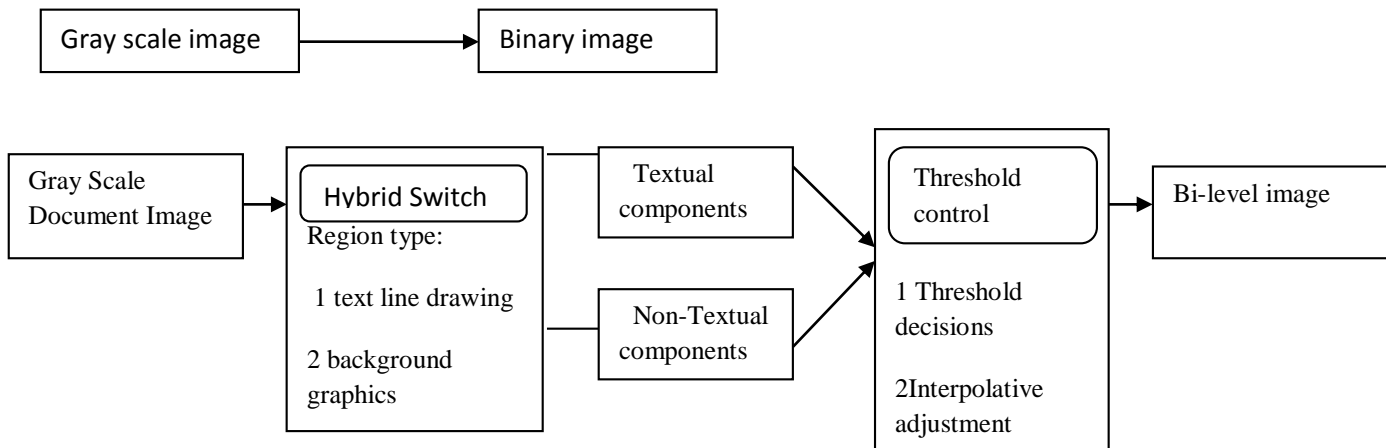


Figure1 (b): Overview of the binarization algorithm

As shown in Fig1 (a) the process of changing a gray scale image into binary image is known as Binarization. In the Fig1 (b) describes general approach of the binarization processing flow. [2]A Binary image processed better than a gray scale image. As shown in Fig1(c) Processing of documents that are of very low quality like historical documents because of leaking ink from opposite side of the page or general degradation of the paper and ink, background noise and variation in contrast and illumination are also found.



Figure1(c)

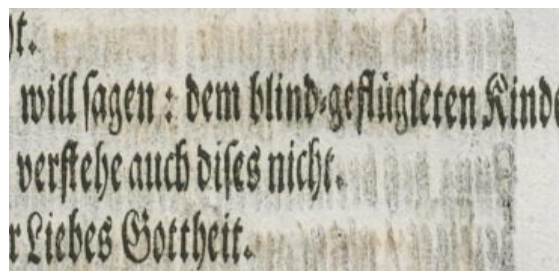


Figure 1(d)

In Fig1 (d) the variation present in handwritten text causes degradation due to stroke width, stroke brilliance, stroke connectivity and document background. [4] Due to all these reasons or say degradations tends to induce thresholding errors.

In this paper our proposed document binarization technique extends our existing adaptive contrast mapping method and techniques used in latest DIBCO2011. The proposed method is more reliable, simple and efficient. It can be able to control complex documents that contain many degradations but with minimum parameter tuning. It makes use of morphological operators instead of canny edge detector because region based segmentation is capable to segment both inner and outer edges to preserve pixel strokes.

The rest of this paper is explained as follows. In Section II overview of the current state of binarization techniques. In Section III our proposed method is explained. Then in Section IV shows experimental results. Then Section V describes conclusions.

II. RELATED WORK

There are so many techniques that are introduced for document image binarization. As we know, in binarization we convert gray scale image into binary one. For this purpose image segmentation is required. Thresholding is best, accurate and high processing speed segmentation approach to monochrome image. Till now various binarization method exists and explained below in tables:

YEAR	AUTHOR'S NAME	TECHNIQUE USED	DESCRIPTION
1979	Otsu [5]	Automatic Optimal Thresholding Selection	<ul style="list-style-type: none"> Optimal Threshold is naturally selected based on global property but not on local property. It can be used for picture segmentation so that maximum separation can be done between resultant classes of gray levels.
1985/1986	Kapur & Niblack [6]	Maximum Entropy Algorithm	<ul style="list-style-type: none"> By using this algorithm there are two possibilities to separate the histogram of the image. Out of which one can define object and another define background.
1999	Solihin, Y. and C.H. Leedham [7]	Histogram Based Global Thresholding	<ul style="list-style-type: none"> This procedure is also called Integral Ratio. It is based on two level thresholding approach in which each pixel of handwritten image can be divided into three parts: foreground, background and fuzzy area between them. We can decide whether a pixel lies in foreground or background on the basis of Native IR and Quadratic IR.
2000	Yang and Yan [8]	Logical Adaptive Thresholding	<ul style="list-style-type: none"> It use Logical thresholding method for binarization of seriously degraded complex background gray scale images. It cannot affect useful information.
2000	Sauvola's [2]	Adaptive Document Image Binarization	<ul style="list-style-type: none"> The evaluation of local threshold is based on estimation of local mean and local standard deviation.

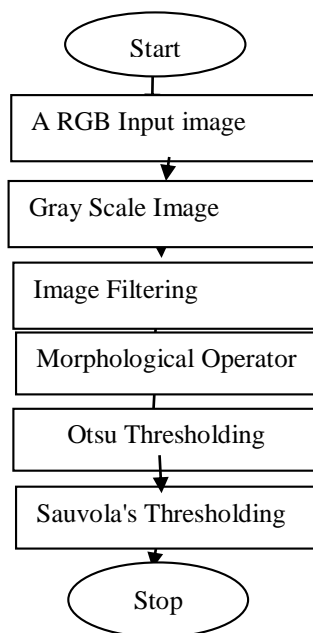
2001	Randolph [9]	Binary Domain Approach	<ul style="list-style-type: none"> • It can be used for enhancement in Fax documents. • A directional filter bank has been used which is capable for smoothing of edges and contours.
2003	Wu et al [10]	Multi-stage Global Thresholding	<ul style="list-style-type: none"> • In first stage global thresholding technique used. • In second stage refinement of threshold value can be done. • It is used for both simple and complex images that have different shading like postal envelopes.

Table 1: Various Document Binarization Techniques used up to 2003 year

III. PROPOSED METHOD

In our proposed scheme we take the RGB degraded image document as an input image. Firstly, convert RGB image to gray scale image document and binarized that image and get binary one. Then, image enhancement can be done by using filtering technique. After that morphological operators can be implemented for region based segmentation.

Flow Chart for Proposed Scheme



A. RGB To Gray image Conversion

RGB is a device-dependent color model. The fundamental reason for the RGB shading model is for the sensing, representation and presentation of pictures in electronic systems. To form a color with RGB, three light beams must be superimposed. [18]

B. Image Filtering

Image processing is a vast field that contains so many tasks like compression, filtering, feature detection, enhancement and classification. [19] We need to enhance the visibility of the document image. Denoising is one of the methods used for the removal of noise. A document to be examined can itself be debased with noise. Sometimes, scanning itself presents some noise. [20]

C. Morphological Operators

The meaning of morphology is to describe the properties of the structure and shape of any objects. Morphological operations operate on Sets. In mathematically morphology, sets represent objects in the image.

Opening and Closing derived from basic Dilation and Erosion operations. The opening of X by Y is obtained by the erosion of X by Y, followed by dilation of the resulting image by Y:

$$X \circ Y = (X \ominus Y) \oplus Y \dots \dots \dots (3)$$

The closing of X by Y is obtained by the dilation of X by Y, followed by erosion of the resulting structure by Y:

$$X \bullet Y = (X \oplus Y) \ominus Y \dots \dots \dots (4)$$

D. Thresholding

Digital image is composed of finite no of elements; each has distinct location and value. [27] These elements are called pixels. To convert and get binary images from gray images thresholding has been done. [28] Thresholding is the first preprocessing scheme that can be used before document analysis. [29]

IV. EXPERIMENTS AND DISCUSSION

Our objective is that we can analyze the performance of our proposed method and compare the result with another method that can be used in DIBCO dataset 2011. In current thesis, the proposed work is that I will try to implement existing system using morphological operators. I will do region based segmentation instead of edge based segmentation.

A. Parameter used:

For evaluation there are few parameters that can be use to check the Binarization performance like F-Measure, Peak Signal to Noise Ratio (PSNR), Distance Reciprocal Distortion (DRD) and Misclassification Penalty Metric (MPM).

F-Measure:

It is a measure of a test's accuracy. It assumes both the precision *p* and the recall *r* of the test to compute the score.

$$F \text{ Measure} = 2 \cdot \text{precision} \cdot \text{recall} / (\text{precision} + \text{recall}) \dots (5)$$

p is the number of correct results divided by the number of all returned results and *r* is the number of correct results divided by the number of correct results that should have been returned. F measure achieves its best value at 1 and worst score at 0.

Peak signal-to-noise ratio (PSNR):

PSNR is a term for the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation.

To compute the PSNR, the block first calculates the mean-squared error using the following equation:

$$MSE = \sum_{MN} \frac{[I_1(m, n) - I_2(m, n)]^2}{M * N} \dots \dots \dots (6)$$

Misclassification penalty metric (MPM)

The Misclassification penalty metric MPM evaluates the prediction against the Ground Truth (GT) on an object-by object basis. Misclassification pixels are punished by their distance from the ground truth object's border.

$$MPM = \frac{MP_{FN} + MP_{FP}}{2} \dots \dots (7)$$

d_{FN} and *d_{FP}* denote the distance of the *i*th false negative and the *j*th false positive pixel from the contour of the text in the GT image.

B. Testing on Competition Dataset

In this part, we can compare our proposed method result with another techniques result that used in DIBCO 2011 dataset. This method includes Otsu's method, Sauvola method, Niblack method, Brensen's method, Gatos et al.'s method, LMM, BE, LELO, SNUS, HOWE

methods and also Bolan Su Adaptive Contrast Mapping method. Therefore, total 16 document images. Table I shows the evaluation results as follows:

Methods	F-Measure (%)	PSNR	DRD	MPM
OTSU	82.22	15.77	8.72	15.64
SAUV	82.54	15.78	8.09	9.20
NIBL	68.52	12.76	28.31	26.38
BERN	47.28	7.92	82.28	136.54
GATO	82.11	16.04	5.42	7.13
LMM	85.56	16.75	6.02	6.42
BE	81.67	15.59	11.24	11.40
LELO	80.86	16.13	104.48	64.43
SNUS	85.2	17.16	15.66	9.07
HOWE	88.74	17.84	5.37	8.64
BOLAN	87.8	17.56	4.84	5.17
Proposed	91.5	20.89	3.37	1.31

Table I: Evaluation Results Of the Dataset of DIBCO 2011

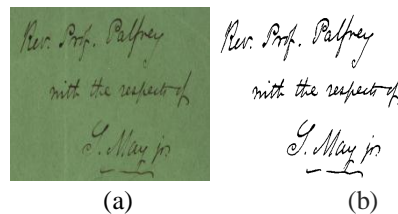


Figure3 (a) Binarization results of the sample document image (HW 08) (a) Input Image (b) Proposed Method Image

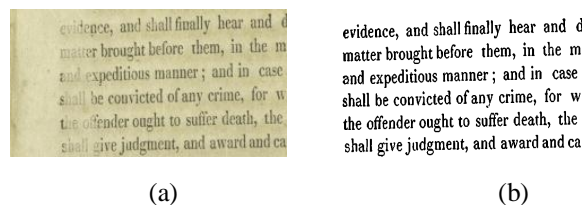


Figure3(b) Binarization results of the sample document image (PR 08) (a) Input Image (b) Proposed Method Image

C. DISCUSSION

There are so many parameters are used in our proposed method to check the ability to remove the different kinds of degradation in an input document images. Firstly, our proposed technique makes the document images stable and noise free. Secondly, region based segmentation

gives better performance instead of edge based segmentation. Third, our proposed techniques extract foreground from background by using morphological operators.

V. CONCLUSION

This paper presents an image Binarization technique for degraded images by using morphological operators. The proposed method is easy, more reliable and an efficient way. The proposed method makes use of morphological operators then Otsu and Sauvola's thresholding. The output can compare with DIBCO 2011 dataset on the basis of PSNR, F-measure, DRD and MPM.

REFERENCES

- [1] George Nagy, "Twenty years of document image analysis in PAMI," *IEEE Transactions on Pattern Analysis and Machine Intelligence* 22.1, pp. 38-62, 2000.
- [2] Jaakko, and Matti Pietikäinen Sauvola, "Adaptive Document Image Binarization," *Pattern Recognition* 33.2, pp. 225-236, 2000.
- [3] Keechul, Kwang In Kim, and Anil K. Jain Jung, "Text information extraction in images and video: a survey," *Pattern recognition* 37.5, pp. 977-997, 2004.
- [4] Yefeng Zheng, "Handwriting identification, matching, and indexing in noisy document images," 2005.
- [5] N. Otsu, "A threshold selection method from gray-level histograms," *IEEE Trans. Systems, Man, and Cybernetics*, vol. 9, pp. 62-66, 1979.
- [6] J., P.K. Sahoo, and A.K.C. Wong Kapur, "A new method for gray-level picture. Thresholding using the Entropy of the Histogram," *Computer Vision Graphics and Image Processing*, vol. 29, pp. 273-285, 1985.
- [7] Y. and C.G. Leedham Solihin, "Integral Ratio: A New Class of Global Thresholding Techniques for Handwriting images," *IEEE Trans. on PAMI*, vol. 21, pp. 761-768, 1999.