Binarization of Document Images

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ABSTRACT

A binary image is a digital image that has just two possible values destined for each pixel. In general two colors are used for a binary image i.e. black and white. Binarization is one of the most important pre-processing step which consists to divide foreground and background of document images. Image binarization is the method of division of pixel values into double collections, black as foreground and white as background. The average mean filter applied for image filtering. Triangular fuzzy logic method is best contrast enhancement method. Edge detection done by morphological operator in this paper. Thresholding has formed to be a well-known method used for binarization of document images. Global and local thresholding well-known technique for binarization. To improve the quality of the output binary image, Bradley method used in local thresholding. After binarization of document image, to discover the values of parameters. Parameters like PSNR, F-measure, NRM, MPM and DRD.

Keywords
Binarization, Local Thresholding, Global Thresholding, Document image

1. INTRODUCTION
Digital image processing is a very important turf in image processing. Images are process using algorithms. In digital image processing large number of algorithms can be used to avoid the troubles. Troubles like noise, signal distortion can be avoided. Image segmentation is a process of separating a digital image into different segments so as to analyze it properly. The very first step of image segmentation is pattern recognition and image analysis. Image segmentation techniques are based upon two approaches: 1) Detection of discontinuities and 2) Detection of similarities. Detection of discontinuities includes algorithms like edge detection. Partition of an image depends upon sudden changes in intensities. Detection of similarities comprise algorithms like area based segmentation methods and thresholding. In this approach image is partition according to the resemblance among the regions and some predefined criterion. Document images, as an alternate of paper documents, mainly consist of common cryptogram such as handwritten or machine-printed characters, cryptogram and graphics [1]. In many practical applications, used to keep the content of the document, so it is enough to represent text and diagrams in binary format which will be more efficiently transmit and processed as an alternative of the original gray-scale image. It is vital to threshold the document image dependably in order to extract useful information and make additional processing such as character recognition and feature extraction, more than ever for those poor quality document images with shadows, non-uniform elucidation, low gap, large signal-dependent noise, spread and blotch. For that reason, thresholding a scanned gray-scale image into two levels is the necessity step and also a dangerous part in mainly document image study systems given that any error in this stage will broadcast to all later phases. Document Image Binarization aims to segment the foreground text from the document background and is perform in the preprocessing period for document analysis. For the subsequent document image processing responsibilities such as optical character recognition (OCR), a quick and exact document image binarization technique is vital. Although document image binarization has been urbanized for numerous years, the thresholding of degraded document images is motionless an uncertain problem outstanding to the high inter/intra difference between the document background and the text caress cross wise dissimilar document images. Document image binarization theater a key position in document processing given that its presentation affects the amount of achievement in succeeding quality segmentation and recognition. In general, image binarization is categorized in two chief classes: (i) global (ii) local. Binarization is a pre-processing step for document analysis and it is used to subdivision the foreground text beginning the document background. This method ensureearlier and correct document image processing responsibilities. Mainly document investigation algorithms are build based on fundamental binarized image information. The use of bi-level in orderto decrease the computational consignment and help in using beginner's analysis methodcompare to 256 level of grey-scale or colour image information. Document image thoughtful method need reasonable as well as semantic satisfied conservation designed for thresholding. Although document image binarization has been calculated for several years, the thresholding of images is silent a demanding under taking appropriate to the lofty difference between the text fondle and the document background [1]. For an input image, several processing stage should be used previous to the text withdrawal. Individual of the steps include binarization.

1.1 General idea of binarization
Binarization of document images is avital step for a document study scheme. In this course, every the foreground pixels of an input document image are certain a single tag although all extra pixels (backdrop) are specified one additional tag. A document that has been degraded payable to also by the attendance of different background pattern and noise or non-uniform illumination circumstances throughout its electronic exchange is hard to binarize and repeatedly accessible approach fail to make available a practicable binarized image [1] of them towards additional dispensation. An inconsequential condition of appropriate application such as optical character recognition (OCR), explain examination, document recoveryand so on. The accurate foreground pixels as black pixels and no background pixel artificial by confident degradation must be twisted black. Truly, together foreground and background image pixels of such documents might get artificial outstanding to changeable temperament of background color, shade, spread, arrogant, difference in brilliance etc. The paper color of older documents get cast a shadow as its period grow, and at the similar instance a desertion result increase for the color of its foreground

mechanism. A further general hard state occur for documents together side of which are type or handwritten with idea of the backside printing on the front side. The feature of document image degradations has typically two diverse nature one of which is global and the further is local. In the later case, the degradation value differ in different part of the similar document side. The complexity is additional grave while one or both of the foreground and background mechanism have several colors [1]. Binarization method is useful to document images for discerning the textbook from the background based on unpolluted thresholding and filter joint among image dispensation algorithms. Image binarization is the procedure of division of pixel standards into double collection, black as foreground and white as background. Thresholding has shaped to be a famous method used for binarization of document images. Thresholding is additional separate into the global and local thresholding method. In document through identical difference release of background and foreground, global thresholding has created to be most excellent method. In degraded documents, where widespread background noise or dissimilarity in difference and intensity exist i.e. here exist various pixels that cannot be smoothly categorize as foreground or background. In such cases, local thresholding has important above obtainable technique. The major purpose of this episode is to calculate the dissimilar image binarization technique to discover the gap in accessible technique. A binary image [1] is a digital image that has immediately two possible values intended for each pixel. Generally, two colors are designed for a binary image i.e. black and white though some two colors can be used. The shade used for the substance in the image is the foreground shade although the relax of the image is the background shade Binary imagery [2] often happen in image processing as mask or as the result of various operation as segmentation and thresholding. A small number of input/output devices, for example, laser printers, bi-level computer displays, are intelligent to now feel bi-level images. Binary images are produced beginning color images by segmentation. A variety of approach as well as technique were developed to get better documents images value. Binarization is one of the mainly vital pre-processing steps which consists to divide foreground and background of documents images. It converts a gray-scale document image into a binary document image.
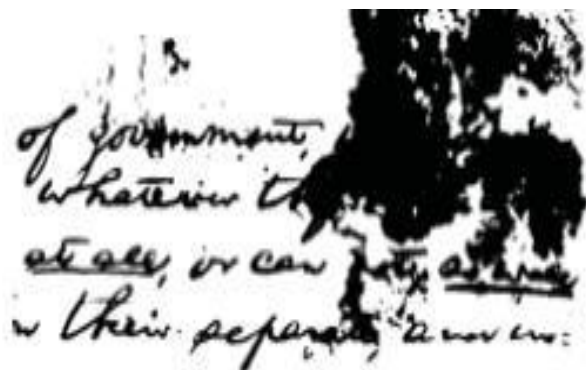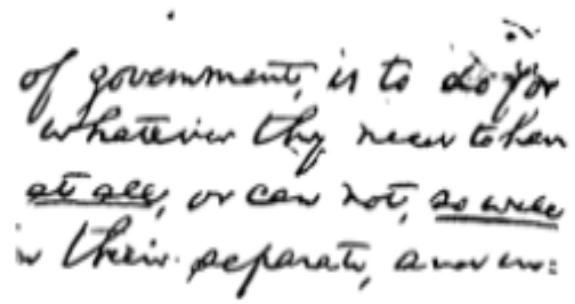

Fig 1. (a) Input Image [3]

Fig 2. (b) Binarized Image [3]

2. PROPOSED METHODOLOGY

The proposed scheme is a gray scale document image and the output is its binarized image. In the pre-processing phase, the input image is curved using an Average mean filter. In the contrast enhancement triangular fuzzy logic method applied for contrast. In the proposed method morphological operator used for edge detection. A local thresholding method to categorize the outstanding pixels into foreground and background pixels. To improve the quality of the output image Bradley method used in local thresholding technique. The proposed method presented block diagram defined following in Fig 2. Each block diagram defined briefly as following.
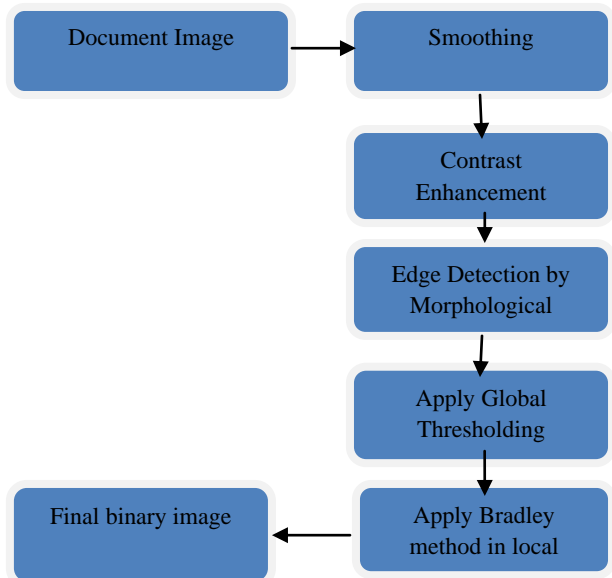

Fig 2. Block diagram of planned method

2.1 Smoothing

Degraded document images are frequently artificial among rough intensity, shade, spread, damage and so on. Smoothing is useful to get well partly beginning such degradation. Here, 5x5 Average mean filter used smoothing the document image. It is single of the mainly accepted blurring method.

2.2 The global thresholding technique

The global thresholding technique compute a most favorable threshold for the complete image. This technique want little computation and labor healthy in effortless cases. But fail in compound backgrounds, such as non-uniform shade and broke illuminate background [4]. These methods are typically not apposite for document images, since they do not have a clear outline that separate foreground text and background. The global techniques the most efficient is Otsu's technique.

Otsu's method applies clustering analysis to the gray scale data of input image.

2.3 The local binarization techniques

The local binarization technique is situation of diverse thresholds for unusual target pixels depending on their neighborhood/local information. Normally, these techniques are aware to background noises due to great discrepancy in casing of reduced illuminate documents [4].Bradley method is the best method to improve quality of the binary image in local binarization technique.

3. EXPERIMENTAL RESULTS

The proposed method on the DIBCO 2009 and DIBCO 2011 opposition dataset. The anticipated method among various fine recognized thresholding method of binarization, they are global thresholding and local thresholding. Surrounded by the global techniques the mainly well-organized is Otsu's method [6]. Otsu's method apply clustering analysis to the gray-scale information of input image and models two cluster of Gaussian sharing of pixels of the image. The calculation of local threshold (i.e., for each pixel individually) is based on inference of local mean and local standard difference. Bradley method used in local binarization technique. After binarization of document image calculate the parameters. Parameters like F-Measure, PNSR, NRM, MPM and DRD for the performance measurement. In current paper read five document images in MATLAB. Convert each document image into binary image and after that calculated the parameter value like PSNR, F-Measure, NRM, MPM and DRD of each document image. These Measures are defined below.

3.1 Peak signal-to-noise ratio (PSNR)

PSNR is a relation between the maximum possible power of a signal and the power of humiliating noise. Advanced values of PSNR represent higher similarity between two images.

$$\text{PSNR} = 10\log_{10}\left(\frac{R^2}{\text{MSE}}\right)$$

$$\text{Where MSE} = \sum_{MN} \frac{[l1\,(m,n) - l2\,(m,n)]^2}{M*N}$$

3.2 F-Measure

It is a calculate of a testcorrectness. It consider both the accuracy p and the recall r of the test to calculate the achieve. P is the number of accurate results divided by the number of all return results and r is the number of correct results divided by the numeral of accurate results that should have been return. The calculate can be interpret as a prejudiced average of the precision and recall, where an F-measure reach its best value at 1 and most evil score at 0. The established F-measure is the harmonic indicate of precision and recall.

$$\text{FM} = 2.\,\text{P}.\,\text{R}\big/_{\text{P}+\text{R}}$$

3.3 Negative rate metric (NRM)

The negative rate metric NRM is base on the pixel-wise mismatches among the GT and calculation. It combine the false negative rate NRFN and the false positive rate NRFP. It is denote as following.

$$\text{NRM} = \frac{\text{NR}_{\text{FN}} + \text{NR}_{\text{FP}}}{2}$$

The binarization quality is improved for lower NRM.

3.4 Misclassification penalty metric (MPM)

The Misclassification penalty metric MPM evaluate the fore cast beside the Ground Truth (GT) on an object-by object base. Misclassification pixels are penalize by their distance from the ground truth object's limit.

$$\text{MPM} = \frac{\text{MP}_{\text{FN}} + \text{MP}_{\text{FP}}}{2}$$

A low MPM achievedenote that the algorithm is high-quality at identify an object's border.

3.5 Distance Reciprocal Distortion Metric (DRD)

It is an inevitable to introduce visible artifacts when a binary image has been watermark embedded or data hided. Therefore, an effective visual distortion measure is a must for performance comparison or evaluation of such an application. A number of single-letter images are used to study distortion in binary document images. Sum the distortion as seen from each flipped pixel visited to get the distortion in g(x, y) as

$$\text{DRD} = \frac{\sum_{K=1}^{S} \text{DRD}_K}{\text{NUBN}}$$

Where NUBN is to estimate the valid area in the image and it is defined as the number of non-uniform 8 X 8 blocks in f(x,y). The total pixel numbers M x N is not used in the denominator because uniform areas are common in binary document images and they may have a significant effect on the distortion value if used. The Distortion *DRDk* measured for this flipped pixel $g[(x,y)_k]$ is given by

$$\text{DRD}_K = \sum_{i,j}[D_K\,(i.j) \times W_{N_m}\,(i,j)]$$

The degraded document images such as old news paper documents (Fig.7), handwritten document image , DIBCO 2011 image samples (Fig.1) and a few other degraded images together from different source. The results on these later samples are defined below table and figure.

**Table1. Comparative results of the DIBCO 2009 and DIBCO 2011 dataset**

Document Images	Parameters					Elapsed time
	PSNR	FM	NRM	MPM	DRD	
DIBCO 2011 data samples	16.6171	89.4333	0.0930	5.8515e-04	4.2389	5.127091 sec
Handwritten document image	17.4951	86.8991	0.1092	1.9873e-04	3.0919	4.433440
historical handwritten document image	20.7391	90.1391	0.0809	4.7735e-05	2.4568	7.465510 sec

Handwritten image of DIBCO 2009	16.6473	91.2855	0.0575	0.0065	3.9495	17.335406 sec
Old newspaper sample	15.0086	89.8697	0.0860	0.0034	4.7583	3.661603 sec

Parameters F-Measure, PNSR, NRM, MPM and DRD for the presentation dimension. In current paper calculates parameters like PSNR, F-Measure, NRM, MPM and DRD of each document image. The new Document Image Binarization Contest (DIBCO) detained below the structure of the International Conference on Document Analysis and Recognition (ICDAR) 2009 & 2011 and the Handwritten Document Image Binarization Contest (H-DIBCO) detained below the structure of the International Conference on Frontiers in Handwritten Recognition demonstrate current labors on this subject.
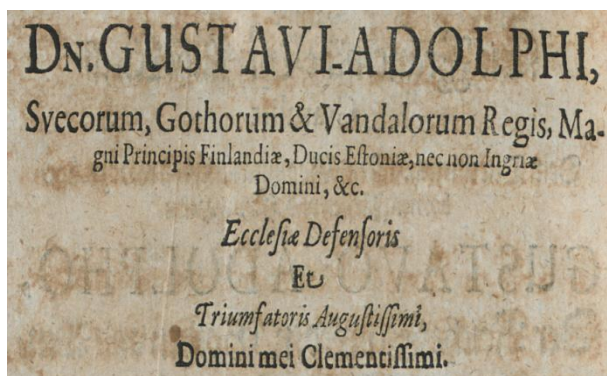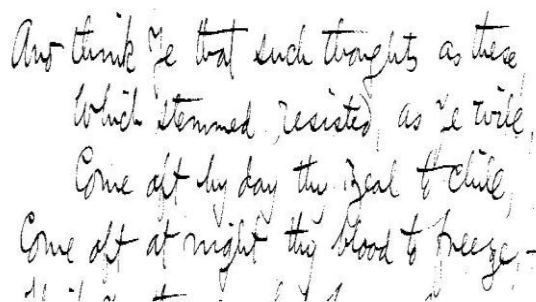

(a)
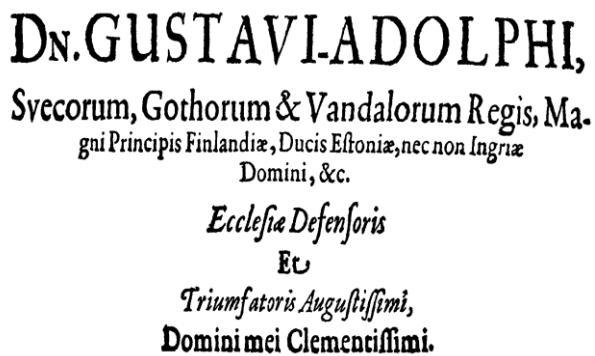
(b)

Fig 3. Some results of DIBCO 2011 data sample (a) Original degraded data sample (b) Input binarization image
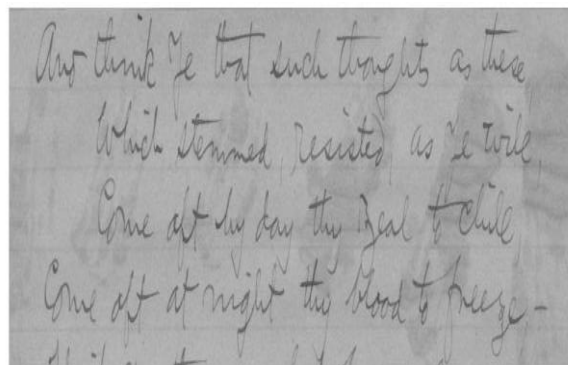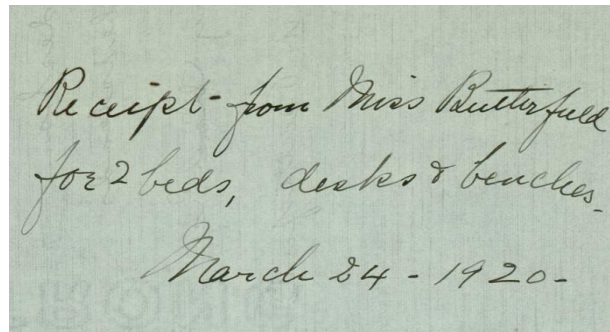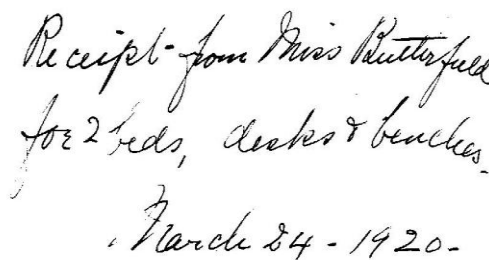

(c)

(d)

Fig 4. Some outcome on handwritten document image sample (c) original degraded handwritten image and (d) binarized images.
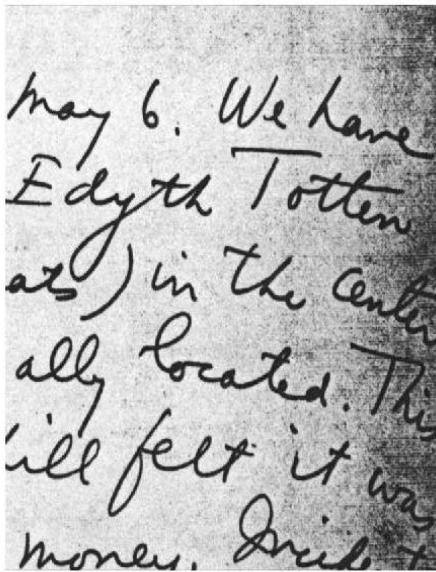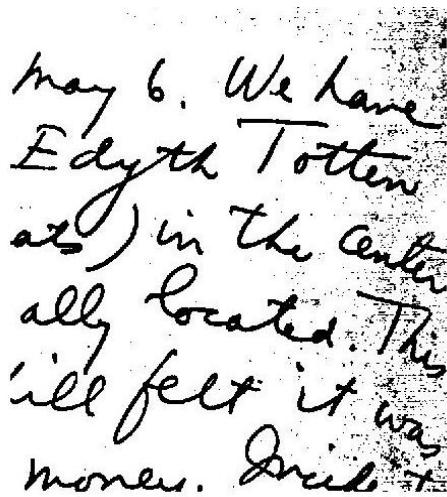

(e)

(f)

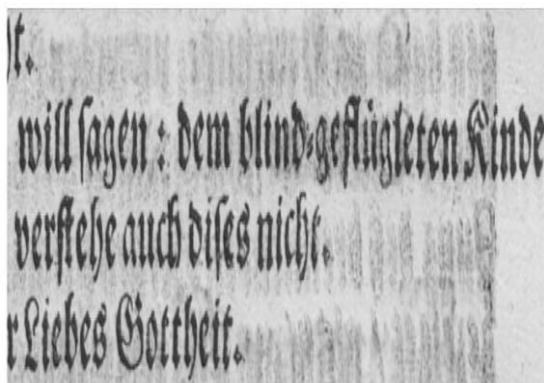**Fig 5. (e) Colored backdrop historical handwritten degraded image (f)Input binarization image**

(g)

(h)

Fig 6. Some outcome of DIBCO 2009 handwritten data sample (g) original handwritten data samples (d) binarized image.

(i)

(j)

4. CONCLUSION

This paper has focused on the document binarization technique. Document binarization is a type application of apparition processing. The main objective of this paper to binarization on a diversity of set of document images and improve the value of parameters like PSNR, FM, NRM, MPM and DRD. In this paper also calculate the elapsed time of each document image. These include historical documents, old news papers and handwritten samples of DIBCO 2009 and DIBCO 2011 competition. In this paper global threshold value of the first stage. Otsu's method applied in global threshold to take care of the maximum noise. Second stage is local threshold. Bradley method applied for improve quality of the binary image in local technique. Finally to get binary images.

5. FUTURE SCOPE

In this paper, to calculate a variety of parameters like PSNR, FM, NRM, MPM and DRD are implemented. In which also compute elapsed time. The accomplishment is done on MATLAB tool using filter algorithms, and threshold technique. In future someone can use some other techniques to apply same intend with compact time and better parameter to confirm the quality of development.

6. REFERENCES

[1] P. R. Marpu, M. N. (2010) "Enhanced evaluation of image segmentation results" Journal of Spatial Science, Volume No 55, pp 55–68.

[2] H. Ben Ameur, G. C. (2011) "Image segmentation with multidimensional refinement indicators" Inverse Problems in Science and Engineering,Volume No 19, pp 577-597.

[3] Antonio Fernandez-Caballero, M. T. (2012) "Display text segmentation after learning best-fitted OCR binarization parameters" Expert Systems with Applications, pp4032-4043.

[4] Barun Biswas, Ujjwal Bhattacharya and Bidyut B. Chaudhuri, "A global–to–local approach to binarization of degraded document images" 22nd international conference on pattern recognition, 2014.

[5] Gaceb, Djamel, Frank Lebourgeois, and Jean Duong. " Adaptive Smart-Binarization Method: For Images of Business Documents." Document Analysis and Recognition (ICDAR-2013), 12th International Conference on IEEE, 2013.

[6] Bolan Su, Shijian Lu, and Chew Lim Tan, "Robust image binarization Technique for degraded document

image" IEEE Trans. Image Process, Volume No 22, Issue No. 4, april 2013.

[7] J. Bernsen., 1986, "Dynamic thresholding of gray-level images", Proc-International Conference on Pattern Recognition, pp.1251-1255.

[8] Bency Jacob and Prof. S. B. Waykar (October 2014)' "A Survey On Binarization Of Historical Degraded Documents" in IJIFR- Volume No 22 and Issue No 4.

[9] S. Vishnupriya, P. Saranya, E. Elangovan, "A novel approach for document image binarization" International conference on advanced computing and communication system (ICACCS-2015), 2015.

[10] Kuljeet Singh, Gurinder Singh, "Remove noise from scanned handwritten de-graded document images using trends and technology (IJCST-2016), Volume No 4, Issue No 2, Mar-Apr 2016.