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Efficient Segmentation Technique for Restoration of Degraded Images

Syed Hussain Basha[1], M. Vanitha Bai[2], K. Satish Kumar[3], G. Suresh[4], G. Lavanya[5]
[1,2,3.4.5] *ECE, JNTUA*

Abstract: ***The process of extracting text from degraded document images is a very difficult task because of high inter/intra variations between document background and foreground. In this paper we propose a better document image binarization technique which can restore all kinds of degraded images and in this technique we use Adaptive image contrast. This Adaptive image contrast is a combination of local image contrast and local image gradient. To estimate colour in foreground and background we prefer local image contrast and to estimate objects in the picture, its magnitude, its direction we use local image gradient. In our project we first construct an Adaptive contrast map from local image contrast and local image gradient which is then binarized and combined with canny edge map by which we can identify text stroke edge pixels next its output is segmented by using local threshold segmentation based on intensities of detected text stroke edge pixels within a local window.Our project is very simple, efficient and involves minimum parameters using. This proposed method is applied on DIBCO 2009, 2011 and handwritten DIBCO 2010 and achieved accuracy of about 93.5%,87.8% and 92.03%.***

Important Topics: Binarization, Adaptive Image Contrast, Local Image Contrast, Local Image Gradient, Detection of Text Stroke Edges, Pixel Classification, Thresholding.

I. INTRODUCTION

The main aim of our project is separate foreground text from background document. One of the accurate and fast binarization techniques for document image processing is Optical Character Recognition (OCR).

Some of the variations like stroke width, stroke brightness, stroke connection bleed through, imaging artifacts create document thresholding error. These above mentioned variations made degraded document binarization a big challenge across different document images. In order to overcome this issue International Conference on Document Analysis and Recognition(ICDAR) 2009 & 2011 and International Conference on Handwritten documents conducted Document Image Binarization Contest(DIBCO) and Handwritten Document Image Binarization Contest (H-DIBCO).Some of the international research groups participated in DIBCO 2009 with background estimation as there segmentation algorithm. Some other research groups participated in H-DIBCO 2010 as there local maximum-minimum method. This contest got successful and obtained various algorithms for restoration of degraded document images.

In this paper we proposed a document binarization technique which is an extension to previous local maximum-minimum method and method used in DIBCO 2011.This technique is very simple and efficient it makes use of Adaptive Image Contrast which is a combination of local image contrast and local image gradient. This proposed method overcomes the over normalization problem of the local maximum minimum algorithm.

II. LITERATURE SURVEY

There are so many thresholding techniques for document image binarization, one of them is Adaptive Thresholding which estimates a local threshold for each document image pixel. In this Adaptive Thresholding Technique we use window based adaptive thresholding. Here we take a window as mask and it is applied over entire degraded document image. Thus in this way segmentation is done but the drawback of this technique is thresholding performance depends heavily on window size and character stroke width. Other approaches reported like binary subtraction,texture analysis, decomposition method etc. In Bernsen method, local contrast is defined $C(i, j) = Imax(i, j) - Imin(i, j)$(1) Where c(i,j) denotes contrast of image pixel *Imax*(i,j) and Imin(i,j) denotes maximum and minimum intensities within local neighbour window of (i,j).If the local contrast is smaller than threshold ,the pixel is set as background directly orelse it is set as text or background by comparing with mean of *Imax*(i,j) and Imin(i,j) .This method is simple but won't work if the background is very complex

With a little modification of above equation,we have local image contrast as

$$C(i, j) = Imax(i, j) - Imin(i, j)/ Imax(i, j) + Imin(i, j) + e \quad (2)$$

Here e is positive but very small than is added if local maximum is equal to 0.Compared to Bernsen's contrast in equation 1, local contrast in equation introduces normalized factor which compensates image variations within document background but it creates over normalization problem. This is its drawback to overcome it equation 2 is modified and it is used in our proposed method.

III. PROPOSED METHOD

Here adaptive contrast map is constructed initially then text stoke edge pixels are detected by combining binarized adaptive contrast map and canny edge map. Its output is then segmented based on the local threshold that is found from the detected text stroke edge pixels. Some post-processing is done to improve the document binarization quality.

A. Contrast Image Construction

To overcome the over normalized problem created in equation 2 we do some modifications in equation 2 and obtained a local image contrast which is stated as

$$Ca(i, j) = \alpha C(i, j) + (1 - \alpha)(Imax(i, j) - Imin(i, j))(3)$$

where C(i, j) indicates the local contrast in Equation 2 and (Imax(i, j) − Imin(i, j)) means local image gradient that is normalized to [0, 1].α is the weight between local contrast and local gradient that is controlled depending upon the document image statistical information. Ideally, the image contrast will be assigned with a high weight (i.e. large α) when the document image has significant intensity variation. Thus our proposed binarization technique depends more on the local image contrast which can capture the intensity variation in a well manner and thus we can obtain better results. Otherwise, the local image gradient will be having a high value. The proposed binarization technique depends more on image gradient and in order to avoid the over normalization problem of our above method, we model the mapping from document image intensity variation to α by a power function as follows: where *Std* denotes the document image intensity and γ is a pre-defined parameter which can be selected from [0,∞].Therefore, the local image gradient will play the major role in Equation 3 when γ is large and the local image contrast will play the major role when γ is small. Thus contrast map is created by using local image contrast and local image gradient.

B. Text Stroke Edge Pixel Detection

Firstly we detect text stroke edge pixels by using canny edge detection next by using Otsu's global thresholding algorithm we extract stroke edge pixels correctly. Canny edge detection output and Otsu's global thresholding outputs are combined then we get combined map. By this combined map we can detect text stroke edge pixels accurately.

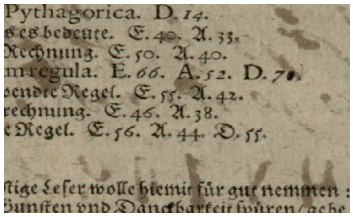
C. Local Threshold Estimation

In this local threshold estimation we use Edge Width algorithm which is described below. Initially the combined map is scanned horizontally row by row and edge pixels are defined such than if intensity value is equal to 0or less than 0 it is considered as background and if intensity value is equal to 1,it is considered as edge. Now low intensity pixel values are removed by comparing it with following pixel next to it in the same row of combined map. Match the remaining adjacent pixels in the same row into pairs and calculate distances between the two pixels in pair. With these pixels intensity value distance we will construct a histogram

D. Post Processing

The output of Edge Width Estimation can be improved by using post processing algorithm. Here we first first isolated foreground pixels that do not connect with other foreground pixels. Next, the neighbourhood pixel pair that lies on same side are paired. One pixel of the pixel pair is therefore labelled to the other category if both of the two pixels belong to the same class. Lastly, same single-pixel artifacts along the text stroke boundaries are filtered out by using various logical operators

IV. SIMULATION RESULTS



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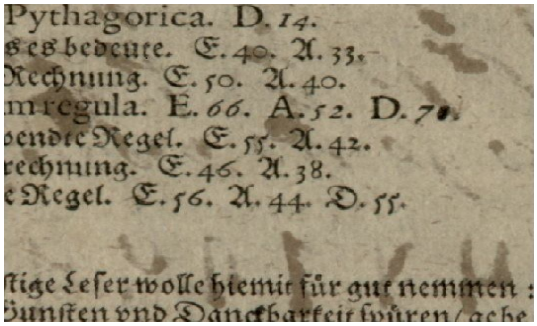
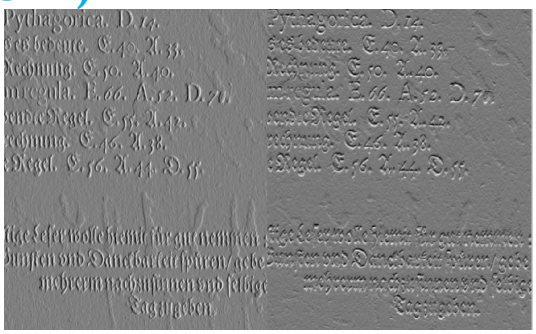
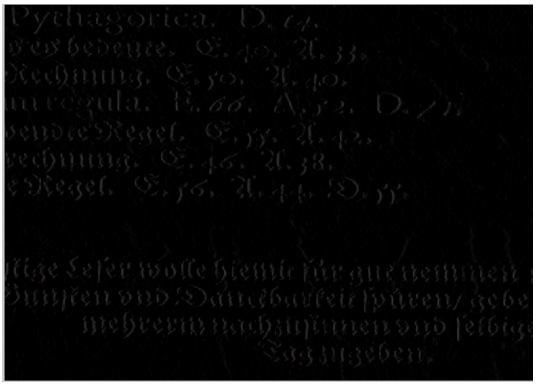
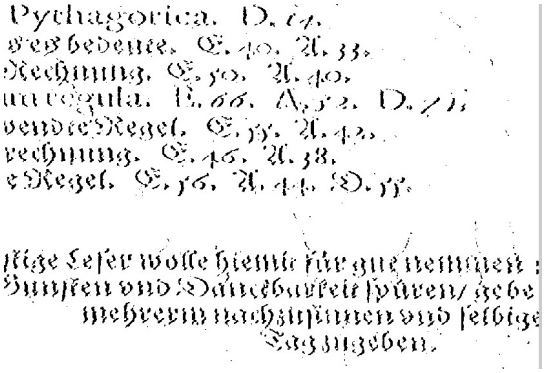
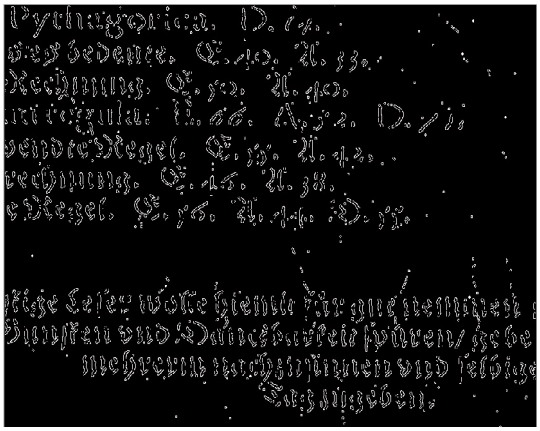
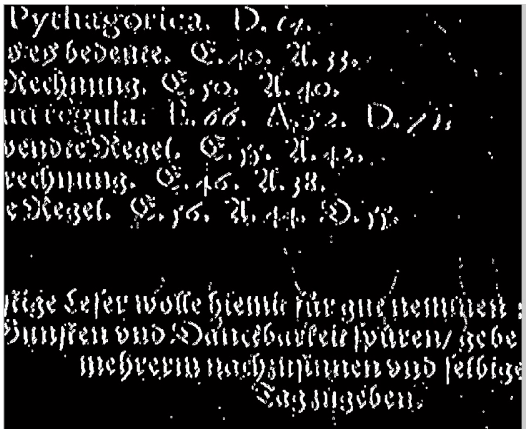

Input image

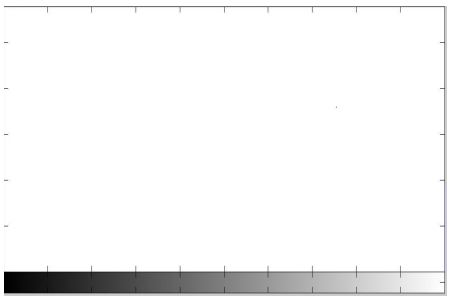

gradient map

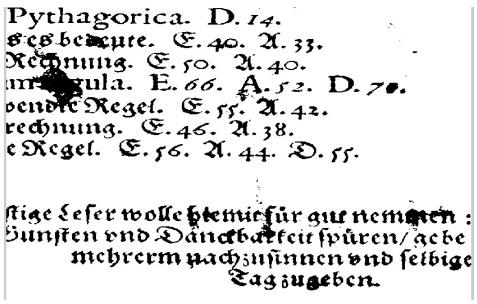

Adaptive contrast map


binary contrast map


Canny edge map


combined map


Histogram image


restored black and white image

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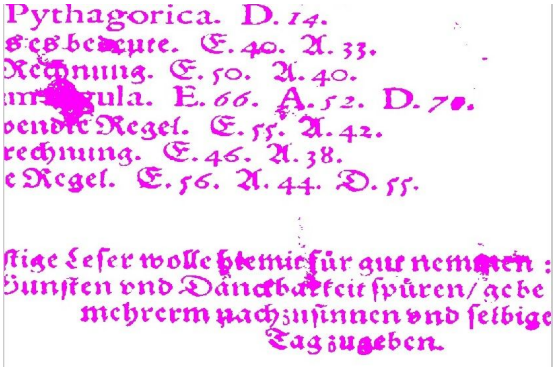

Restored coloured image

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PSNR=
   53.2854

 Precision =   0.81609
 Recall =   0.07121
 F-measure (%) =  13.09833
 Sensitivity =   0.07121
 Specificity =   0.50884
 BCR =   0.29002
 BER (%) =  70.99765
 F-measure of sens/spec (%) =  12.49296
 Geometric Accuracy =   0.19035
 pFMeasure (%) =  19.54055
 NRM  =   0.70998
  DRD  = 246.83268
 MPM (x1000) = 490.38214

Elapsed time is 132.066192 seconds.
>>
```

PARAMETERS VALUES

V. CONCLUSIONS

This paper introduces a versatile picture differentiate based report picture binarization system that is tolerant to assortment of archive debasement, for example, uneven enlightenment and record spread. The proposed system is simple and vigorous, just couple of parameters are included. It works for various types of corrupted record pictures. It makes utilization of the nearby picture differentiate that is assessed in view of the neighbourhood most extreme and least.

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Mr Syed Hussain Basha has pursued his B.Tech AL-Habeeb College of Engg &Tech .He completed M. tech from Shadaan College of Engg & Tech .Presently he is working as assistant professor in the Dept of ECE BITS-KNL.

Mr M.Vanitha Bai is pursuing her B.Tech from BITS-KNL in the department of ECE

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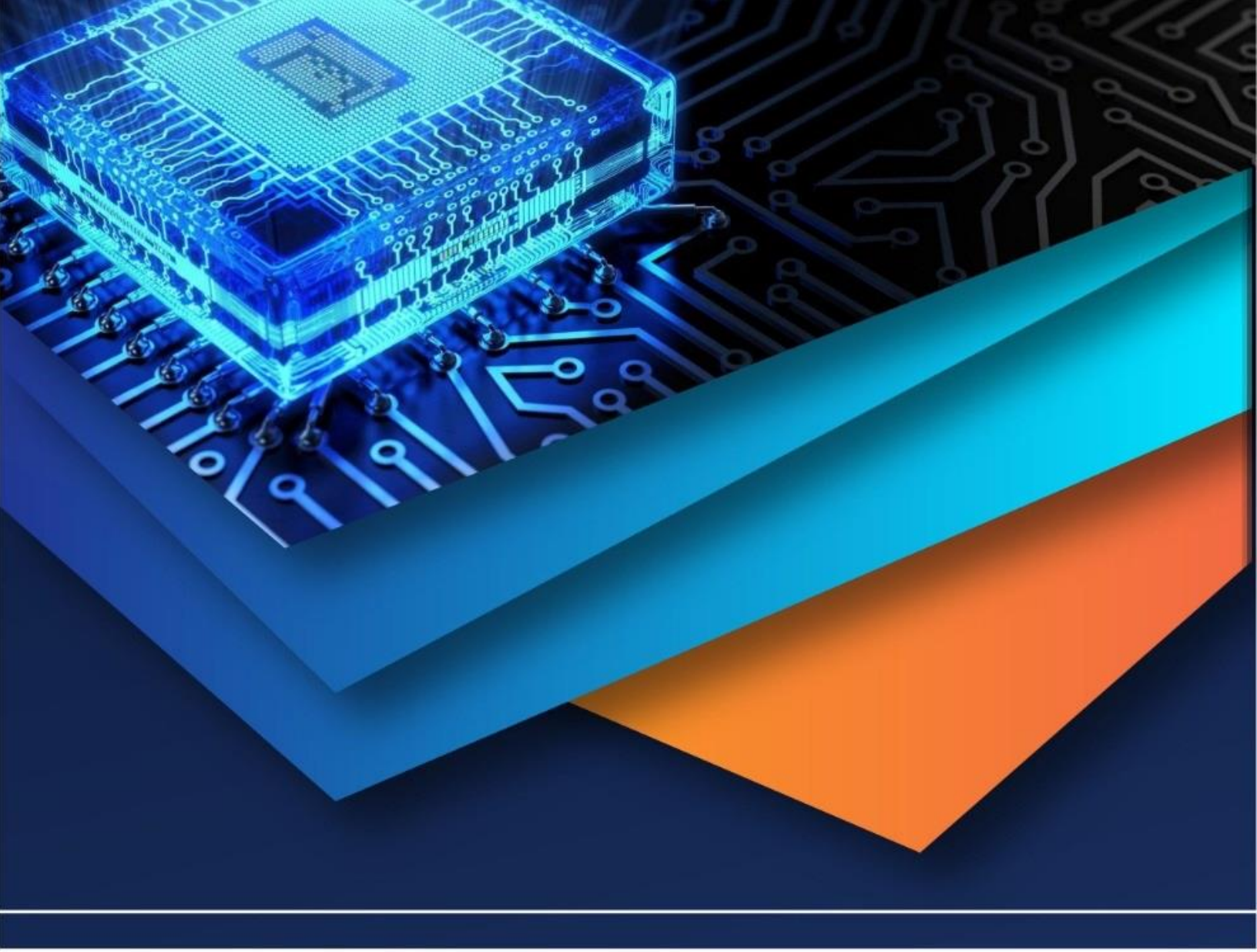
Mr K.Satish kumar is pursuing his B.Tech from BITS-KNL in the department of ECE

Mr G.Suresh is pursuing his B.Tech from BITS-KNL in the department of ECE

Miss G.Lavanya is pursuing her B.Tech from BITS-KNL in the department of ECE



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