A SURVEY ON BINARIZATION TECHNIQUE

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ABSTRACT

Now-a-days, there are many activities which are depending on internet and there is huge need to shift all the activities which are performed by user towards the digitization of world. There are so many thesis and novels are exist which had been written many years ago and available in hard copies .But these documents are being degraded due to some natural or manual causes. Many of the document images are not in readable format. So, we need to separate out text from the degraded images. For this purpose, we will develop the system that can capable of separating the text from degraded images. In this proposed work, use of algorithms for separating foreground and background of image which includes image contrast inversion, edge estimation, image binarization and post processing of binary images is proposed. So, proposed system can able to separate out foreground text from background degradation after applying these algorithmic techniques. Therefore degraded documents will be enhanced in picture quality.

Keyword: *- Digitization, Degraded Image, Document Images, Binarization, Contrast Inversion.*

1. INTRODUCTION

In today's digital world , image processing techniques has a very wide scope. The image can be useful in many areas.There are many document images of the old novels and thesis which are very helpful for us in different researches but , due to non-maintenance these document images are being unreadable or degraded .Due to imperfections of scanning devices and instability of observed scene , captured images are blurred , noisy and of insufficient retrieving of data. These document images has becomes degraded images and we can not use them thoughthey are very useful to us for various purposes. Sometimes some document images are degraded manually due to which the quality of the document image is lowered and that useful image becomes not of any use for us. In ancient days all record was stored in paper format or document format. These old image has become an unreadable document due to their non-maintenance. In some of the cases due to some natural problems or manual problems the images get degraded. As these old documents are useful for us so there shouldbe an efficient robust technique for the recovery of these document images in which foreground text and background is not readable, so that it can be converted into the moreclear and readable format. For the efficient and accurate recovery of these degraded documents , we have proposed the new efficient image binarization technique. The Binarization process of document image is performed in the four main different stages of document analysis and document processing .And its main function is to separate out the foreground text from the document image background and to retrieve clear foreground text from degraded document images.For more degraded documents, an efficient and accurate document image binarization technique is important for the recovery of the document images by the help of processing stages such asContrast image conversion, edge detection , edge estimation, thresholding and post processing proces s. This technique uses the different gray scale method to find out the actual text strokes of the document image. The degraded imagesare the combination of foreground and background format.We need to separate out this background from the foreground text of document image. The proposed technique provides an accurate and efficient solution to separate foreground text from background. The document image is processed through the several stages which will produce the output image which is in more readable format.The efficient and accurate document image binarization technique is important for the recovering document image by the help of processing tasks such as Contrast

Inversion. Due to this contrast inversion the thresholding of degraded document images is solved. It was due to the high inter and intra variation between the text stroke and the document background in different document images. After contrast image construction in next stage we apply the grey scale method to detect the text strokes edges present inside these document images. As our proposed technique is mainly based on the novel documents. It is less effective on the images other than the novel images. After applying the grey scale method we need to estimate threshold value for each pixel. Depending upon these threshold value binarization method will be perform on the document image. This binarized image still contents some noise or background degradations. So we are applying post processing method on it. The post processing method will remove the all background degradations and noisefrom the image and it will produce the clear and readable image.

2. RELATED WORK

2.1 Bolan Su et al[3] Bolan Su et al. has studied a document image binarization structure that makes utilization of the Markov Random Field model. Structure isolates the document image pixels into three classes i.e. document background text, document fore-ground text, and uncertain pixels established binarization method.

2.2 Otsu[4] It is an efficient global thresholding method and was presented in 1979. It basically works on the histogram of an image. It considers the pixel values and the property to obtain segments. We need uniform pixel values of image, therefore this method does not look for the edges of the document image. Instead, it looks for the regions inside the segments that we want to segment. This method is not utilized in case of non-uniform background. Still, to get the rid of problems with non-uniform background, Otsu can be used in segments by using a moving window. Moving window moves from different regions and then thresholds are computed for each region. In case of overlapping moving window an average of thresholds is calculated.

2.3 J. Kittler and J. Illingworth [5] They proposed an algorithm which is used in case of a discriminant object from background in gray scale images. Background and object class conditional probability density functions are assumed to be normal distributions. This algorithm resolves the Gaussian density fitting problem with minimum error and works by assuming the variance of Gaussian density function as unequal. Error for the fusion of two Gaussians is classified by using a histogram. Kitler method finds the optimal threshold at which the probability of classification error is minimum.This method is satisfied if the object and background are precisely differentiated in terms of grey levels.

2.4 J.Sauvola and M.Pietikainen [6] They proposed a local thresholding algorithm. Local threshold is calculated by computing local standard deviation and local mean. Sauvolas method is an alteration of Niblacks method which is guaranteed to give enhanced performance on documents with uneven illumination, light texture and large variations.

2.5 J. Bernsen [7] Bernsen's method computes the local threshold value by using the mean value of the maximum and minimum intensities of pixels inside a window. This threshold works appropriately just when the contrast is huge.

2.6 S.Lu, B.Su and C.L.Tan [8] S.Lu,B.Su and C.L.Tan presented a document binarization technique that makes use of the document background surface and the text stroke edge information. In this technique, an iterative polynomial smoothing procedure is first implemented to estimate a document background surface efficiently. The stroke edges are then detected based on the local image variation within the compensated document image by using estimated document background surface. Finally, the local threshold is estimated based on the detected stroke edge pixels within a local neighbourhood window. The method was tested and compared with a number of reported document thresholding methods.

A. Conclusions from Literature Survey

- Many degraded documents do not have a clear bimodal pattern, so global thresholding not suitable.
- When we deal with ink bleeding, in this method the segmentation of text is easy when the text strokes on back side or background are weaker as compared to front side or foreground text. But when the back side text or background was dark as compared to front side text or foreground text the existing system cannot classify text stroke correctly in the foreground text.
- The existing system was dependent on high contrast pixel on large scale. So it has high chance of introducing error if background of degraded document consist of certain amount pixel or noise that have high contrast and also dense. So it introduces error due to this noise.

3. SYSTEM OVERVIEW

3.1 Breakdown Structure: The breakdown structure of the proposed system gives the details of different tasks in the implementation process Binarization technique for efficient recovery of Degraded Document Images. The breakdown structure of proposed system shown below in Fig 1.

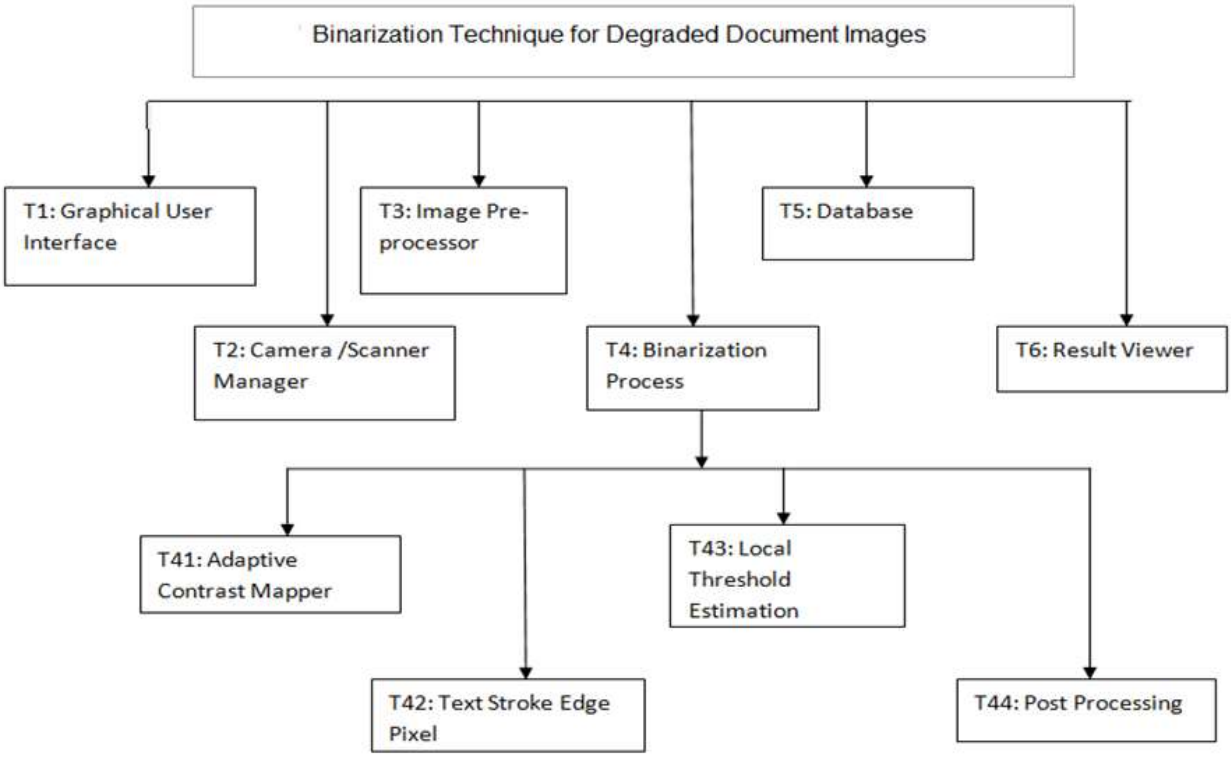

Figure 1: Breakdown Structure

- **T1 Graphical User Interface**: Here we need to create GUI which will provide user to select input image and view output.
- **T2 Camera or Scanner Manager**: This module will take responsibility to capture image with the help of camera hardware or scanner.
- **T3 Image Pre-processor**: This module will take care of initial activities to be perform on input images like convert into gray scale and filtering of image to remove noise.
- **T4 Binarization Process**: The more details about the T41, T42, T43, and T44 is explained in subsequent sections.
- **T5 Database Manager**: This module will take care of all the data coming to and going from database. All other modules will communicate with this module to perform any data related activities.
- **T6 Result viewer**: This module provides the function of viewing the result and saving result in our database.

3.2 Contrast Image Construction: The Contrast Image Construction is an initial step of Binarization technique. The purpose of the contrast image construction is to detect the stroke edge pixels of the document text combination of local image gradient and local image contrast.Adaptive image contrast is a combination of local image gradient and local image contrast. These are important factors which are used for segmentation of foreground text from the document background . We can do this because document text usually has certain image contrast with respect to the neighbouring document background. We are going to use the following formula to determine adaptive local image contrast. The below formula removes the drawback of over normalization from existing system.

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

Where,

1. C (i, j) : local contrast of image of pixel (i,j).
2. (Imax (i; j)- Imin(i; j)) : local image gradient.
3. α: weight between local contrast and local gradient.

The above equation results in proper contrast maps of document images with different types of degradation. Ideally, the image contrast i.e. α will be assigned with a high weight especially when the document image has significant variation in intensity. So that the presented binarization technique depends more on the local image contrast that can Capture the intensity variation well and hence it produces better results. The purpose of the contrast image construction is to detect the stroke edge pixels of the document text properly.

3.3 Text Stroke Edge Pixel Detection: The constructed contrast image has a clear bimodal pattern, where the adaptive image contrast computed at text stroke edges is obviously larger than that computed within the document background. We therefore detect the text stroke edge pixel candidate by using OTSU's global thresholding method. For the contrast images shows a binary map that extracts the stroke edge pixels properly. As the local image contrast and the local image gradient are evaluated by the difference between the maximum and minimum intensity in a local window, the pixels at both sides of the text stroke will be selected as the high contrast pixels. The binary map can be further improved through the combination with the edges by edge detector, because edge detector has a good localization property that it can mark the edges close to real edge locations in the detecting image.

3.4 Local Threshold Estimation: The text can then be extracted from the document background pixels once the high contrast stroke edge pixels are detected properly. There are two characteristics which have been observed by analyzing different kinds of document images,

1. The detected text stroke pixels and text pixel are closed to each other.
2. There is difference between intensity of the high contrast

stroke edge pixels and the surrounding background pixels. So we can extract the text of document image which is based on the detected text stroke edge pixels. In this we are calculating the mean value. Here we are using the Edge width estimation algorithm as stated below:

Algorithm 1 Edge Width Estimation

Require: The Input Document Image *I* and Corresponding Binary Text Stroke Edge Image *Edg*
Ensure: The Estimated Text Stroke Edge Width *EW*

1: Get the *width* and *height* of *I*
2: for Each Row *i* = 1 to *height* in *Edg* do
3: Scan from left to right to find edge pixels that meet the following criteria:
   a) Its label is 0 (background);
   b) The next pixel is labeled as 1(edge).
4: Examine the intensities in *I* of those pixels selected in Step 3, and remove those pixels that have a lower intensity than the following pixel next to it in the same row of *I* .
5: Match the remaining adjacent pixels in the same row into pairs, and calculate the distance between the two pixels in pair.
6: end for
7: Construct a histogram of those calculated distances.
8: Use the most frequently occurring distance as the estimated stroke edge width *EW*.

3.5 Post Processing: In Post Processing stage, initially the isolated foreground pixels that do not connect with other foreground pixels are filtered out to make the edge pixel set precisely. Second, the neighborhood pixel pair that lies on symmetric sides of a text stroke edge pixel should belong to different classes (i.e., either the document background or the foreground text). One pixel of the pixel pair is therefore labeled to the other category if both of the two pixels belong to the same class. Finally, some single-pixel artifacts along the text stroke boundaries are filtered out by using several logical operators. After deriving the initial binarization result from above the method that binarization result can is be enhanced further as described in below Post processing procedure algorithm. It is stated as below:

Algorithm 2 Post-Processing Procedure

Require: The Input Document Image I , Initial Binary Result B and Corresponding Binary Text Stroke Edge Image Edg
Ensure: The Final Binary Result Bf
1: Find out all the connect components of the stroke edge pixels in Edge.
2: Remove those pixels that do not connect with other pixels.
3: for Each remaining edge pixels (i, j): do
4: Get its neighborhood pairs: (i-1, j) and (i+1, j); (i, j - 1) and (i, j+1)
5: if The pixels in the same pairs belong to the same class (both text or background) then
6: Assign the pixel with lower intensity to foreground class (text), and the other to background class.
7: end if
8: end for
9: Remove single-pixel artifacts along the text stroke boundaries after the document thresholding.
10: Store the new binary result to Bf.

4. PROCESS STATE DIAGRAM

The Process State Diagram shown in fig 2 gives various states and their respective output proceeding for next state as an input. It describes various states and their respective outputs upto to the final output generation state which gives recovered image from input image.

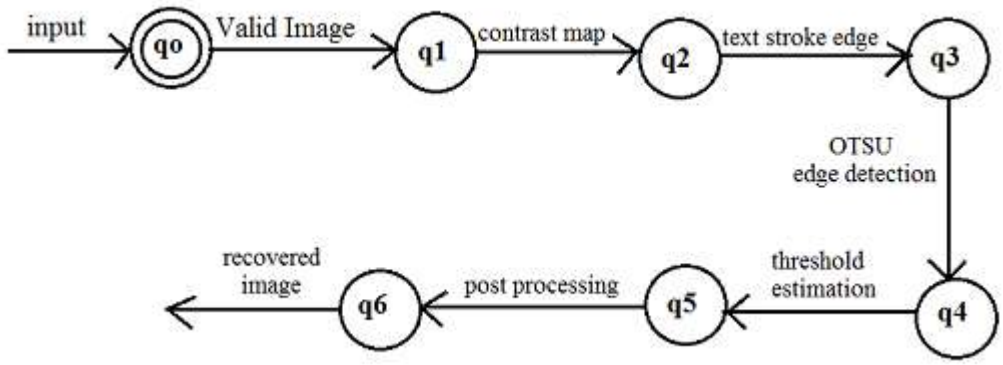

Figure 2: Process State Diagram

Where,
qo is state of accepting input.
q1 is state of generating adaptive contrast map.
q2 is state of detecting text stroke edge.
q3 is state of generating edge map using OTSU method.
q4 is state of threshold estimation.
q5 is state of post processing.
q6 is output state gives recovered image.

5. CONCLUSION

In this paper, the simple binarization method is discussed, which produces clear output as the original document. It can be work on many degraded images. This technique uses contrast enhancement along with threshold estimation. We introduced new module post processing which will remove the background degradations found in the binarized image. In this technique we are going to use grey scale method to create outlined map around the text. The output of this systemproduces separated foreground text from collided background degradation. For that we have maintain the contrast level at min and max level. This will help to make more clear and readable output. In the future work, Segmentation of text from badly degraded document is possible. Efficiency of above technique is better than any other existing method. It is possible to recover badly degraded document.

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