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An Improving Accuracy of an Image Binarization Using Quantization Algorithm

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***Abstract*— Image Restoration is one of the Image processing techniques. Image restoration techniques are used to improve the image appearance by application of a restoration process that use mathematical model of the image degradation. Image binarization is basic step in most of the image restoration techniques. The proposed system using Double Thresholding Quantize Binarization (DTQB) algorithm for image restoration. Double Thresholding method to detect and remove the noise from the document image and generate the two ternary images. Two ternary images are merging and get the new ternary image without noise and contain all the important edge of the document image. Quantize Binarization method to be applying for ternary image and get binarized accurate image. Double Thresholding (DT) method preformed based on two sub processes. First Sub process is text area detection using Canny Edge Detection method. Text localization is based on the canny algorithm. Second sub process is classification of the pixels close to the edges detected using Expectation-Maximization (EM) algorithm. The EM algorithm is a classical approach to estimating the parameters of a mixture model. Quantization algorithm used for reduce the pixel value of ternary document image to generating darker then the gray scale document image. Binarization is the process to select a threshold gray _level and set everything above that value equal to "1" and everything below the threshold equal to "0".**

***Keywords*— Image processing, image restoration, image edge detection, image binarization, quantization, Thresholding**

I. INTRODUCTION

Image processing is any algorithm that get holds on an image as input and given back an image as output. Image processing is a conversion of an image into digital form and perform some operations like Image Enhancement, Image Segmentation, Image Restoration, Image Compression and get enhanced image to extract some important information from it. Image Processing system images are in the two dimensional signals, and while applying existing set signal processing methods to them. Image Enhancement, Image Segmentation, Image Restoration, Image Compression are some of the most common image processing techniques.

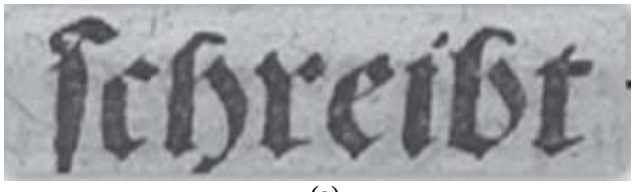
Image Restoration is the process of minimizing the effect of degradation of the observed image. It is based on accuracy of the degradation process and also a filter design. Image restoration is concerned with more extraction or accentuation of image features.

Image Restoration is the process of taking an image with little known and estimated degradation, then restoring it to its original appearance. Image restoration methods are used to improve the image appearance by application of a restoration process that use mathematical model of the image degradation.

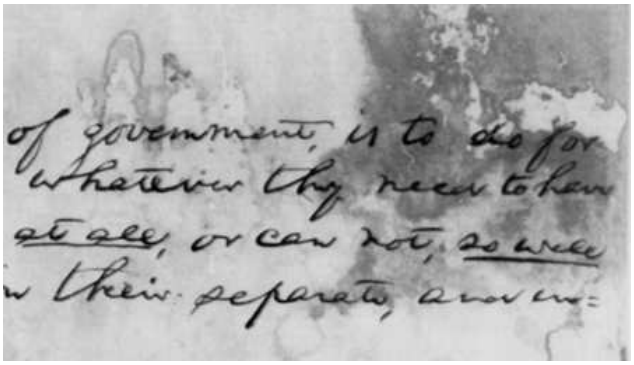
An adaptive image contrast establish document image binarization technique that is liberal to different types of document degradation. This technique is simple and robust, only few parameters are involved. Moreover, it works for different kinds of degraded document images. This technique used to make the local image contrast that is assess based on the local minimum and maximum.

Image binarization converts an grayscale image into black and white image. Binarization is used as a pre-processor before Optical Character Recognition (OCR). Most OCR packages on the market work only on binary level (black & white) images. Select a threshold value by using image binarization, and arrange all pixels with values below this threshold as black, and all other pixels as white. Finding one threshold is very difficult for compatible to the entire image, and in many cases even impossible. Adaptive image binarization is chosen for each image area is needed where an optimal threshold.

Binarization is one of the important steps in the image restoration. Image binarization separates the text areas from background areas, and it is used as a text localizing technique. Binarization is aimprotant in document processing its performance affects the entirely analytically the degree of success in a subsequent character recognition and segmentation. Binarization is not an easy task when processing degraded document images. Document Image Binarization is process thepreprocessing stage for document analysis and it's aims to separate the foreground text from the document background. A accurate and fast document image binarization technique is important for the following document image processing tasks.



(a)



(b)

Fig.1. Two degraded document images

II. RELATED WORK

A document image binarization technique using adaptive image contrast that addresses some issues. Adaptive image contrast is a merged the local image gradient and local image contrast the that is tolerant to text and background variation by different types of document degradations. An input degraded document image constructed by an adaptive contrast map. Canny's edge map is binarized and merged with Contrast map to identify the text stroke edge pixels. The document text is separated by a local threshold that is approximated based on the intensities of detected text edge pixels within a local window [1].

A binarization method based on the pixel, to generalization of image edge pixels. Pixel-intensity differences in a small neighborhood used for computing the pixels are characterized by transition values. To adjust the threshold of several binary threshold methods which calculate the gray-intensity thresholds, it is using the gray-intensity variance and mean of the pixels in the transition set. Transition functions that can be specialized in any specific image used to compute the transition values . Using N2 neighborhoods, max-min function associates high values to the transition pixels in comparison with no-transition pixels. An accurate threshold value computed by quantize method, which selects representative samples of both foreground and background sets [6].

Binarization is the first processing stage of Documnet analysis. The numerous techniques for binarization have been produced can vary in quality and then often proven sensitive to the settings of one or more control parameters. Tuning parameters offers both potential and risks re-wards. Selecting the parameter values that perform best for a given image can lower binarization error by substantial amounts as compared with a static set- ting suitable for generic images. On the other hand, poorly chosen parameter values can sabotage the result: the potential losses in binarization quality generally dwarf the potential gains. This method has introduced a stability heuristic criterion that helps to choose suitable parameter values for individual images. The approach hypothesizes that good parameter values are marked by low variability in the binarization solution with respect to changes in the parameter values [8].

Canny algorithm used in extract the object's contour by setting some appropriate parameters. Otsu algorithm to calculate the high threshold value which is to the Canny algorithm, and then this high threshold value can be used in the Canny algorithm to find the document image object's edge. The Otsu algorithm can be implemented in selecting the threshold value which can be used to improve the effect of extracting the edge of the Canny algorithm, and it obtains the expected result finally [9].

A new technique for the validation of document binarization algorithms. Its implementation and can be performed on some binarization algorithm using this method, since it need some binarization stage. Comparing the resulted image with the original document using the efficient document binarization method[10].

Document image binarization is to convert a gray-scale image into a binary image. Binarization is the basic step of document image analysis. Image binarization separate text areas from background areas, so it is used as a text localizing technique. Binarization is important process in document processing, its performance an affects quite difficulty the degree of success in a subsequent character recognition and segmentation. Binarization is difficult task, when processing degraded document images.

III. PROPOSED METHOD

In previous image binarization technique they used methods like Otsu, Sauvola, Shafait's methods for the image restoration. A FAIR algorithm: a fast algorithm for document image restoration. The proposed system is based on the double threshold edge detection method that makes possible to find small noise.

S-FAIR algorithm using two different thresholds are high and low threshold values to generate ternary images. These two images are merged forwarded to FAIR algorithm. The high threshold ternary image is contains of noise-free but without some important edges, and the low threshold ternary image considers each character's edges but with some additional noise. Combining these two images, to detect problematic areas where some differences occur between the two ternary images.

The proposed system using same process of FAIR algorithm but using Quantize Binarization algorithm for replacing Postfiltering method. Starting from the Image Pre-processing step to convert RGB image to Grayscale image. Double Thresholding (DT) method to produce the ternary image. This DT method preformed based on two sub processes. First Sub process is text area detection using Canny Edge Detection method. Second sub process is classification of the pixels close to the edges detected using Expectation-Maximization (EM) algorithm.

Quantization is the process of minimizing the image data by eliminate some of the unit data by mapping group of data points to a single point. The simplest method of gray-level reduction is Thresholding. Binarization to select a threshold gray_level and set everything more than that value equal to "1" and everything lower than the threshold equal to "0".

A. **Double Thresholding of image**

Double Thresholding module can be divided into two sub modules. They are,

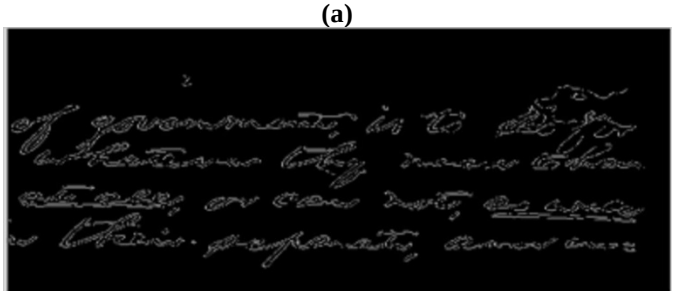
1. Text Area Detection

2. Model Estimation and Class Determination Around Edges

1. **Text Area Detection**

Text locating is based on the Canny algorithm. The given result of this edge detector is determined by the two parameters THl and THu. which correspond to the lower and upper thresholds of the given document image process. Concerned on a text document with suboptimal values and Canny algorithm normally precedence to several kinds of problems.

(a)



(b)

Fig. 2. (a) and (b) Detecting Edge of images using Canny Edge Detection Method

Edge detection step consists only of a localization of the text's position and is followed by a labeling process that increases the estimation's precision. The estimation of TH is obtained by appealing the Otsu algorithm to the gradient magnitude computed using the Canny method. From the threshold T0 computed by the Otsu method, to define THu = k*TH0, where k is the only parameter of the sub process. The second threshold THl is usually computed from THu by a simple linear relation: THl = α*THu, with α usually chosen in [0.3, 0.5].

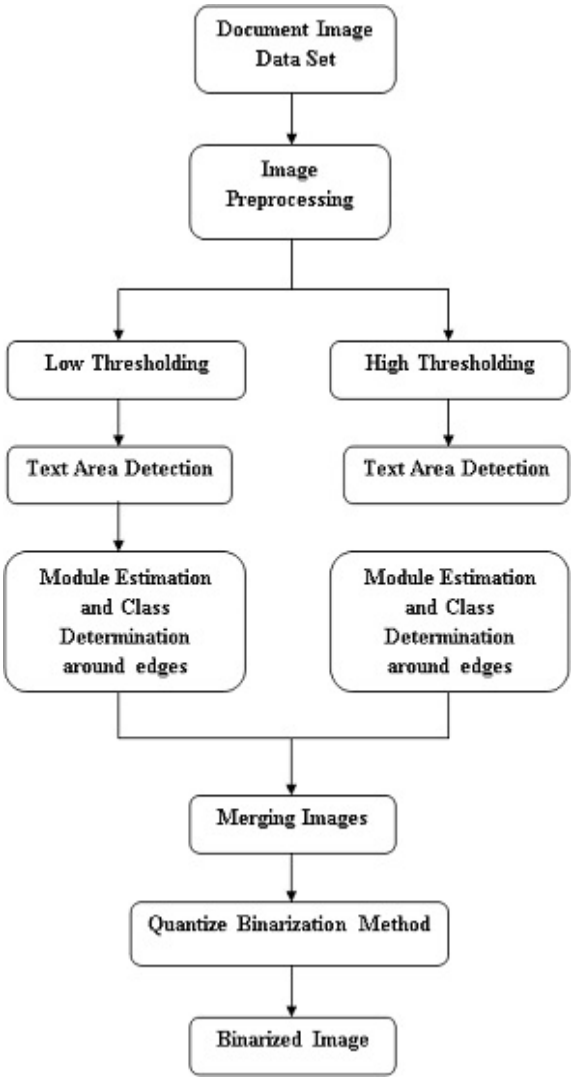


Fig. 3. System Architecture

2. **Model Estimation and Class Determination Around Edges**

Expectation-Maximization algorithm is devoted to the organization of the pixels close to the edges previously detected. To define this observational model as a slow varying underlying image disturbed by a centered white Gaussian additive noise.

The EM algorithm is a classical approach to estimating the parameters of a mixture model. EM algorithm is carried out by iteratively applying the following two steps:

Expectation step (E-step) computes the expected value, with respect to the conditional distribution of z given o, of the log likelihood function $\log(P(o,z|\Psi_s))$, where Ψ_s is the parameter vector of the model computed at pixel s, $o = \{o_i \mid i \in N_s\}$ and $z = \{z_i \mid i \in N_s\}$.

Maximization step (M-step) estimate Ψ_s by maximizing $Q(\Psi_s \mid \Psi_s^{(q)}) = E_{z|o,\Psi_s}^{(q)}[\log(P(o, z \mid \Psi_s))]$.
The final class of a pixel i is estimated by Eq.(1):

$$z_i = \begin{cases} unknown, & \text{if} \quad \min_{s\in\{edge\}} d(i,s) > n/2, \\ 0, & \text{else if} \quad \tilde{t}_i^{\,t} < \tilde{t}_i^{\,b}, \\ 1, & \text{else,} \end{cases} \tag{1}$$

where d(i ,s) is the city-block distance between pixels i and s, and n is the size of the window N(s). All the pixels of the image close to edges are labeled either "text" or "background", the other pixels are temporarily labeled as "unknown".

To obtain the double Thresholding, introduce a new parameter (K = 1.0) to modify the parameter of the two sub processes. The low threshold k^l is selected to get all the edges of the text $k^l = 1.4*K$. The high threshold k^h is taken equal to 1.66*K to limit noise influence.

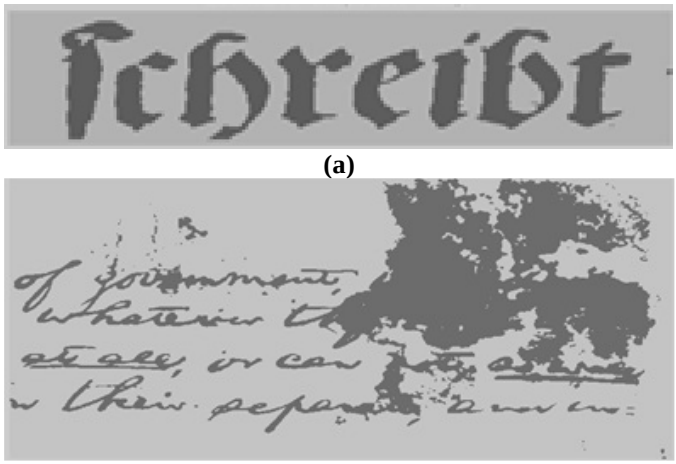
B. **Merging of two images**

The two foregoing results are then merged into a ternary image by, respectively, relating the numerical values 1, 0.5, and 0 to the symbolic labels "text," "unknown," and "background," and then computing the new ternary image Im as Eq.(2),

$$I_m = \max(I_{k^l}, I_{k^h}). \tag{2}$$

C. **Quantize and Binarization of image**

Quantization is the process of minimizing the image data by eliminates some of the unit data by mapping group of data points to a single point. The simplest method of gray-level reduction is Thresholding. Binarization to select a threshold gray_level and set everything more than that value equal to "1" and everything lower than the threshold equal to "0". This systematically turns a gray_level image into a binary (two_level) image and is frequently used as a pre-processing step to taking out of object features.



(a)

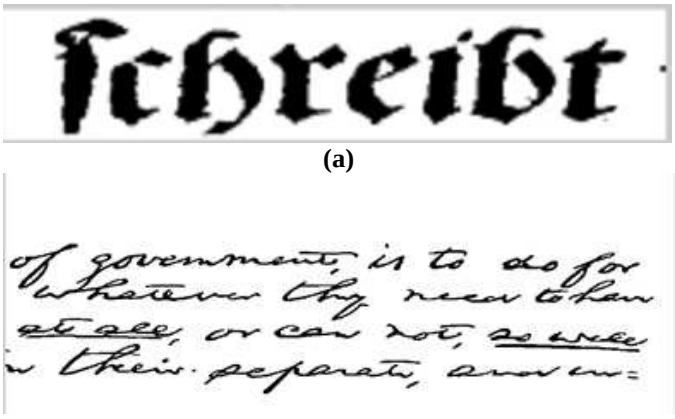
(b)

Fig. 4. (a) and (b) Quantized Grayscale Images

Extraction of a connected area can be done very quickly by using a connected component algorithm. Although this method is less accurate than Su's, this step is both quick and satisfactory in terms of binarization quality. The estimation of the label assigned to the resulting area depends on the labels of its neighboring pixels, which, by definition, are all known.
This estimation is achieved by applying Eq.(3):

$$z_I = \begin{cases} 1(\text{text}), & \text{if} \quad N^t > \beta.N^b, \\ 0(\text{background}), & \text{else,} \end{cases} \tag{3}$$

Where N^t and N^b are, respectively, the number of text and background pixels in the boundary of the *I*th area and β is a weighting used to adjust the sensitivity of the algorithm to the text.



(a)

(b)

Fig. 5 (a) and (b) Final Binarized Images

Fig. 5 shows the image binarization to make document image more accurate and easy to read. Text areas separated from background areas using the image binarization method, and text locating technique used this method. Select a threshold value by using image binarization, and arrange all pixels with values more than the threshold as white, and lesser than than the threshold pixels as black.

Document image binarization is to convert a gray-scale image into a binary image. Binarization is the basic step of document image analysis. Image binarization separate text areas from background areas, so it is used as a text localizing technique. Binarization is important process in document processing, its performance an affects quite difficulty the degree of success in a subsequent character recognition and segmentation. Binarization is difficult task, when processing degraded document images.

The proposed System is to produce very accurate document Image Binarization. It is a simple to implement and computation time is less than the existing system. Quantize Binarization method to generate the quantize grayscale image into binarized image.

IV. CONCLUSIONS

The present a novel technique called Double Thresholding Quantize Binarization (DTQB) algorithm, which improve the document image accuracy for removing noise and the basic Thresholding method is used for binarized the image. The main parameter is directly linked to text detection sensibility and gives good results in most cases. The proposed system is efficient for various types of images (manuscript, typewritten, natural scene) and can cope with different contents. The proposed system also used to reduce the execution time of the image binarization.

Future Enhancement, to develop algorithms for parallel architectures and speed up computation time of the image restoration to combine the different image binarization techniques.

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