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Adaptive Image Contrast with Binarization Technique for Degraded Document Image

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ABSTRACT
Segmentation of text from badly degraded document images is very challenging tasks due to the high inter/intra variation between the document background and the foreground text of different document images. In this paper, we propose a novel document image binarization technique that addresses these issues by using adaptive image contrast. The Adaptive Image Contrast is a combination of the local image contrast and the local image gradient that is tolerant to text and background variation caused by different types of document degradations. In the proposed technique, an adaptive contrast map is first constructed for an input degraded document image. The contrast map is then binarized and combined with Canny's edge map to identify the text stroke edge pixels. The document text is further segmented by a local threshold that is estimated based on the intensities of detected text stroke edge pixels within a local window. The proposed method is simple, robust, and involves minimum parameter tuning.

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I. INTRODUCTION

Document image binarization (threshold selection) refer to the conversion of a gray-scale image into a binary image. It is the initial step of most document image analysis and understanding systems. Usually, it distinguishes text areas from background areas, so it is used as a text locating technique. Binarization plays a key role in document processing since its performance affects quite critically the degree of success in a subsequent character segmentation and recognition. When processing degraded document images, binarization is not an easy task. Degradations appear frequently and may occur due to several reasons which range from the acquisition source type to environmental conditions. Examples of degradation influence may include the appearance of variable background intensity caused by non-uniform intensity, shadows, smear, smudge and low contrast. The Adaptive Image Contrast is a combination of the local image contrast and the local image gradient that is tolerant to text and background variation caused by different types of document degradations. In the proposed technique, an adaptive contrast map is first constructed for an input degraded document image. The contrast map is then binarized and combined with Canny's edge map to identify the text stroke edge pixels. The document text is further segmented by a local threshold that is estimated based on the intensities of detected text stroke edge pixels within a local window. The proposed method is simple, robust, and involves minimum parameter tuning.

II. EXISTING SYSTEM

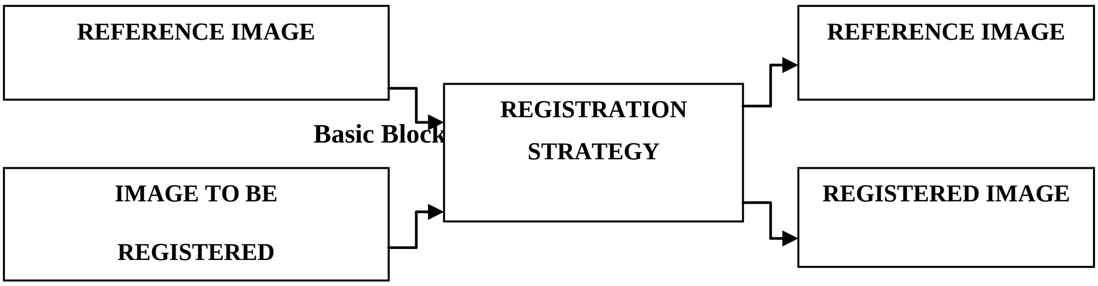
The early window-based adaptive thresholding techniques proposed in "Adaptive document image binarization," estimate the local threshold by using the mean and the standard variation of image pixels within a local neighborhood window.The local contrast method proposed in Bernsen's "Dynamic thresholding of gray-level images," is simple and depends upon the maximum and minimum intensities within a local neighborhood windows of an image pixel (i,j) respectively.

III. PROPOSED SYSTEM

In this paper we process the images through adaptive wiener filter for removing additive random noise in both images, first we overcome significant differences between the histograms of images to be registered, an histogram equalization of image 2 using the histogram counts of image 1 is performed prior to the application of the Wiener filter. In this way, the Wiener filtering on images allows both for the reduction of the image detail, as well as to the smoothing of the histogram, which becomes spiky due to the histogram equalization step. Finding peaks and valleys of histogram of image1, among that find deepest valley between two highest peaks it act as threshold for image segmentation, after segmenting the images into objects we are going to calculate area, perimeter, axis ratio, fractal dimension for each and every object and find cost function by using that parameters, plot the data cost function data in boxplot for finding matched objects. After that we are going to estimate rotation and shift of unregistered image with respect to base image and registering base image with unregistered image.

IMAGE REGISTRATION : Image registration is the process of overlying two or more images of the same scene taken at different times, from different viewpoints and by different sensors. The major purpose of registration is to remove or suppress geometric distortions between the reference and sensed images, which were introduced due to different imaging conditions, and thus to bring images into geometric alignment. Image registration is a crucial step in all image analysis tasks in which the final transformation is obtained by combining various data sources. Typically, registration is required in remote sensing, as in multispectral classification, environmental monitoring, image fusion, change detection and weather forecasting, in medicine, as in combing computed tomography (CT) and nuclear magnetic resonance (NMR) data to obtain more complete information about the patient, monitoring of tumor growth, treatment verification, and in computer vision, as to target localization and automatic quality control. Image registration can be defined as a determination of one-to-one mapping between the coordinates in one image space and those in another, such that points in two image spaces that correspond to the same scene point are mapped to each other. In case of image to scene registration, image coordinates are mapped to the corresponding points in the scene. As an example of a 2D image, for a rigid-body transformation, the transformation parameters *Tp* in (1) consist of three parameters, two shifts (*tx*, *ty*) and a rotation θ

$$T_p(x, y) = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} tx \\ ty \end{bmatrix}$$



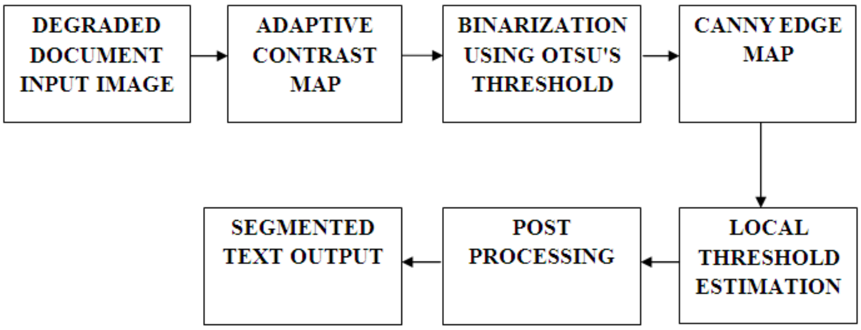
Basic Block

IMAGE SEGMENTATION: Generally image segmentation means separating background and foreground image. Thresholding is the simplest method of image segmentation. From a grayscale image, thresholding can be used to create binary images**.**

ORIGINAL IMAGE

IV. THRESHOLD EFFECT USED IN IMAGE

Below procedure indicates the general image segmentation procedure. First of all take gray image (black and white image) and calculate threshold using gray threshold function. Second segment the gray image using im2bw command



Adaptive Contrast Enhancement : In this method, a new intensity is assigned to each pixel according to an adaptive transfer function that is designed on the basis of the local statistics (local minimum maximum as well as local average intensity). The local min/max/avg of a pixel can be simply defined as the minimal, maximal and averaging intensities within a local window of a fixed size. This is straight forward to implement but it has two problems. First, it takes a lot of time to search for the local min/max or compute the local aver- age for each pixel. Secondly, the computed min/max maps always manifest some block-lie artifact. In the following we will compute the local min/max/avg maps using a propagation scheme.

Document Image Binarization : Document Image Binarization is usually performed in the preprocessing stage of different document image processing related applications such as optical character recognition (OCR) and document image retrieval. It converts a gray-scale document image into a binary document image and accordingly facilitates the ensuing tasks such as document skew estimation and document layout analysis. As more and more text documents are scanned, fast and accurate document image binarization is becoming increasingly important.

OTSU'S Method : Otsu's method is used to automatically perform clustering-based image threshold or the reduction of a gray level image to a binary image. The algorithm assumes that the image to be threshold contains two classes of pixels or bi-modal histogram (e.g. foreground and background) then calculates the optimum threshold separating those two classes so that their combined spread (intra-class variance) is minimal. The extension of the original method to multi-level threshold is referred to as the Multi Otsu method.

Canny edge detector : The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. Canny's aim was to discover the optimal edge detection algorithm.

Canny Edge Detection Algorithm

The algorithm runs in 5 separate steps:

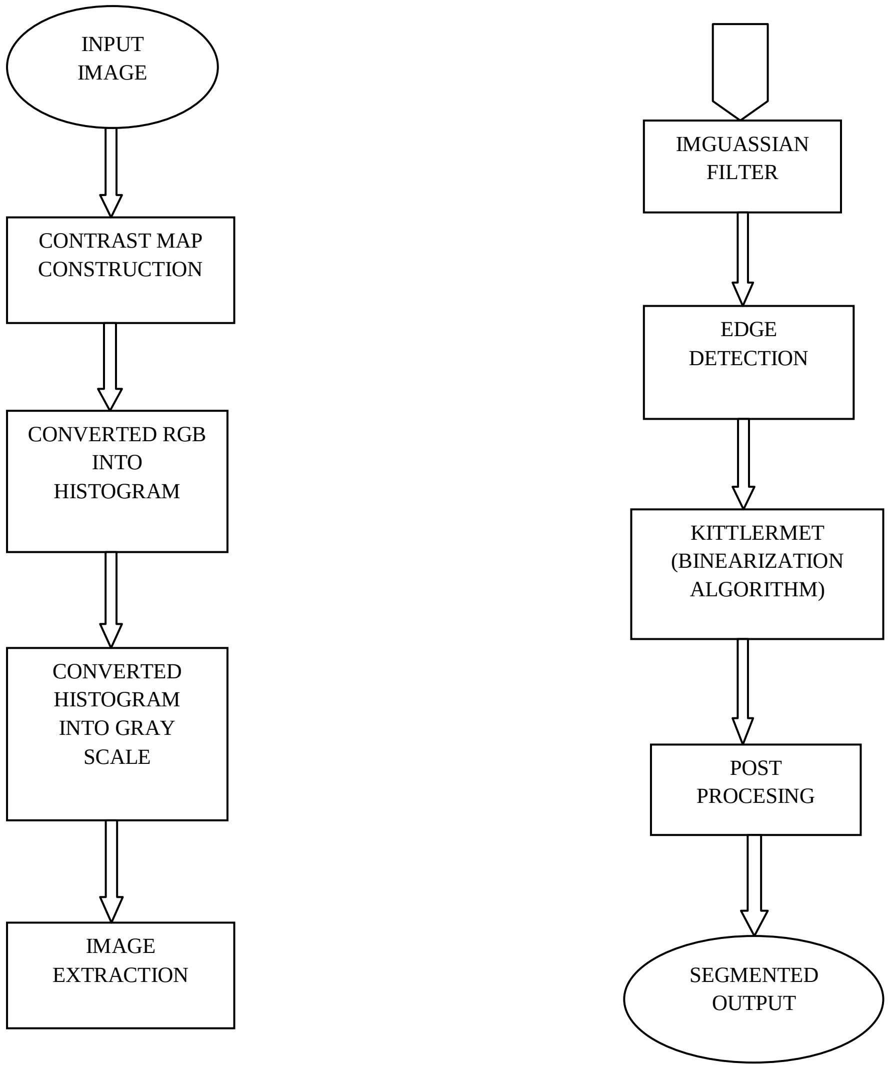
- Smoothing: Blurring of the image to remove noise.
- Finding gradients: The edges should be marked where the gradients of the image has large magnitudes.
- Non-maximum suppression: Only local maxima should be marked as edges.
- Double thresholding: Potential edges are determined by thresholding.
- Edge tracking by hysteresis: Final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge.

Local Threshold Estimation : The text can then be extracted from the document back- ground pixels once the high contrast stroke edge pixels are detected properly. First, the text pixels are close to the detected text stroke edge pixels. Second, there is a distinct intensity difference between the high contrast stroke edge pixels and the surrounding background pixels. The neighborhood window should be at least larger than the stroke width in order to contain stroke edge pixels. So the size of the neighborhood window W can be set based on the stroke width of the document image under study, EW, which can be estimated from the detected stroke edges.

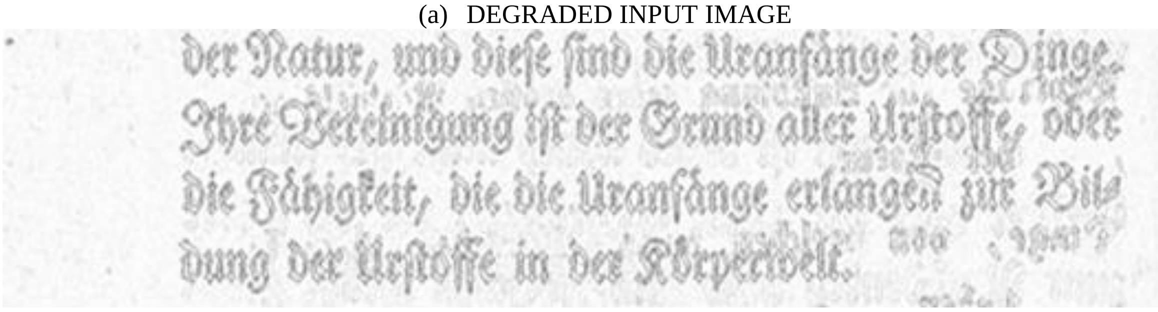
Post Processing : Problems with a picture that require some post processing. Cleaning and sharpening techniques can reduce noise, increase contrast, tighten the crop of the image, and make other small changes to the way the picture appears. Image post processing can also involve removing things from the frame when they don't belong or distract. A wildlife photographer, for example, might not want a radio tracker implanted on a bird's wing to be visible, because it could take away from the image. In post processing, the photographer can carefully edit it out.

Contrast Image : The image gradient has been widely used for edge detection and it can be used to detect the text stroke edges of the document images effectively that have a uniform document background. On the other hand, it often detects many non stroke edges from the background of degraded document that often contains certain image variations due to noise, uneven lighting, bleed-through, etc. To extract only the stroke edges properly, the image gradient needs to be normalized to compensatethe image variation within the document background . The local contrast evaluated by the local image maximum and minimum is used to suppress the background variation. In particular, the numerator (i.e. the difference between the local maximum and the local minimum) captures the local image difference that is similar to the traditional image gradient .The denominator is a normalization factor that suppresses the image variation within the document background. For image pixels within bright regions, it will produce a large normalization factor to neutralize the numerator and accordingly result in a relatively low image contrast. For the image pixels within dark regions, it will produce a small denominator and accordingly result in a relatively high image contrast. However, the image contrast in this is a typical limitation that it may not handle document images with the bright text properly. This is because a weak contrast will be calculated for stroke edges of the bright text where the denominator will be large but the numerator will be small. To overcome this over-normalization problem, we combine the local image contrast with the local image gradient .

Text Stroke Edge Pixel Detection : The purpose of the contrast image construction is to detect the stroke edge pixels of the document text properly. The constructed contrast image has a clear bi-modal 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 a binary map by Otsu's algorithm 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 Canny's edge detector, because Canny's edge detector has a good localization property that it can mark the edges close to real edge locations in the detecting image. In addition, canny edge detector uses two adaptive thresholds and is more tolerant to different imaging artifacts such as shading . It should be noted that Canny's edge detector by itself often extracts a large amount of non-stroke edges without tuning the parameter manually. In the combined map, we keep only pixels that appear within both the high contrast image pixel map and canny edge map.The combination helps to extract the text stroke edge pixels accurately.



(a) DEGRADED INPUT IMAGE


der Natur, und diese sind die Uranfänge der Dinge.
Ihre Vereinigung ist der Grund aller Urstoffe, oder
die Fähigkeit, die die Uranfänge erlangen zur Bil-
dung der Urstoffe in der Körperwelt.

(b) GRAY SCALE IMAGE
(c)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dung der Urstoffe in der Körperwelt.

(c) BACKGROUND SUPRESSED RECOVERED TEXT IMAGE

IV. CONCLUSION

This paper presents an adaptive image contrast based document image binarization technique that is tolerant to different types of document degradation such as uneven illumination and document smear. The proposed technique is simple and robust, only few parameters are involved. Moreover, it works for different kinds of degraded document images. The proposed technique makes use of the local image contrast that is evaluated based on the local maximum and minimum. The proposed method has been tested on the various datasets. Experiments show that the proposed method outperforms most reported document binarization methods in term of the F-measure, pseudo F-measure, PSNR, NRM, MPM and DRD.

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