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RESTORATION OF DEGRADED DOCUMENTS USING IMAGE BINARIZATION TECHNIQUE

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ABSTRACT

The segmentation of the text from the historical degraded image documents is a very challenging task because the variations between the foreground text and background text are hard to determine. In this paper we have implemented a new segmentation algorithm to analyse and extract the words from a degraded image; the process carried here is the image contrast which is adaptively found to solve the issue. Initially the contrast map is taken from the degraded document images. The combination of local image gradient and the local image contrast is the adaptive image contrast, and then it is converted to binary level and combined with canny edge detecting algorithm to extract text 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.

Keywords: adaptive image contrast, Binarization, Otsu threshold, canny edge detector.

1. INTRODUCTION

Most of the Tamil historical documents were originally written in Palm scripts. These documents are unreadable due to various reasons. In order to extract the message from those documents, the images of these historical documents are processed. Image binarization has been used to solve this issue. Even though binarization works effectively in extracting the message from the damaged documents, thresholding still remains as major issue. More clarity can be obtained by using the canny edge detector and OTSU thresholding in the post processing of the binarization process.

Edge detection is considered important in image segmentation. Here in this paper canny edge detector is used. 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 edge detector has a good localization property that it can mark the edges close to real edge locations in the detecting image. In addition to this, OTSU is used to enhance the thresholding process. Otsu's method is used to automatically perform cluster thresholding, and to reduce the gray level image into a binary image. The paper is formatted with section.2 explaining the related work. The proposed methodology is given in section.3 and its result in the section.4 following its discussion.

2. RELATED WORKS

a. Contour based image segmentation algorithm

In this paper, contour based image segmentation; object extractions play a vital role. In this method they implement morphological edge detector with region growing techniques. The first step involved here is image enhancement using morphological closing operation and detection process is carried out by morphological dilation using edge detector. Here they implement morphological operator in order to enhance the image over the edges and we implement region growing and region merging technique for detecting accurate edge extraction and to overcome image segmentation problems. Here, the input image is operated to a morphological closing operation and edge detector then we implemented region growing with region merging techniques in order to implement the image segmentation. This segmentation can be implemented only in the image then processed by using morphological operation in order to get a clear contour of the image.

b. An empirical method for thresholding selection

In this paper, the image is processed by using the thresholding output; here we used a typical thresholding method which is based on pixel portioning in an image into two clusters. In this paper they use empirical mode decomposition which is the special method to identify the optical threshold level in an image. This EMD algorithm is used to decompose any non linear and non stationary data into a numerical mode functions.

The main process involved in this EMD analysis is the decomposition of data into a finite intrinsic mode functions. This EMD employs directly to temporal space and does not work in frequency space which is an intuitive and adaptive to described the data with high efficiency. In this paper, the performance using this thresholding approach with various synthetic and real images is experimented. This proposed approach enhances an ensemble empirical decomposition in order to analyse the histogram of the image. This EMD algorithm can be used to decompose any nonlinear and non stationary data is converted into an finite intrinsic mode function.

c. Binarization of historical document image

In this paper, the Binarization techniques are used to retrieve the data's from the historical documents. Here using the local image maxima and minima the image contrast is determined. Generally in all the segmentation

techniques the property of image gradient is only taken but in this paper the image contrast is considered, which is more tolerant to the uneven illumination.In the techniques, initially the image contrast is found and using this the image pixel of high contrast which lie around the boundary is taken and from the high contrast pixels the estimation of local threshold is done to find the data'sclearly. This method is very efficient because this method could be used for different type's documentation.

3. METHODOLOGY

Document images often suffer from different types of degradation that renders the document image binarization a challenging task. Existing system presents a document image binarization technique that segments the text from badly degraded document images accurately. Here it estimates a document background surface through an iterative polynomial smoothing procedure. This method is simple, itcannot work properly on degraded document images with a complex document background. To overcome this, we propose a new technique in which an adaptive contrast map is first constructed for a given degraded document image and the text stroke edges are then detected through the combination of the binarized adaptive contrast map and the canny edge map. The text is then segmented based on the local threshold that is estimated from the detected text stroke edge pixels. Some post-processing is further applied to improve the document Binarization quality.

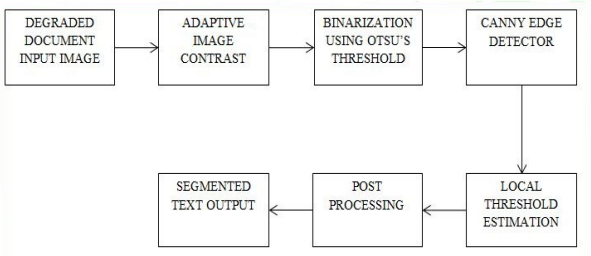

Figure-1. Block diagram.

A. Adaptive image contrast

The adaptive image contrast is a combination of the local image contrast and the local image gradient that is too learnt to text and background variation caused by different types of document degradations.

B. Otsu threshold

Otsu's thresholding method is used for automatic binarization level decision, based on the shape of the histogram. The algorithm assumes that the image is composed of two basic classes: Foreground and Background. It then computes an optimal threshold value that minimizes the weighted within class variances of these two classes in which it minimizes the class variance to determine the binarization level. It automatically performs the clustering-based image thresholding, or, the reduction of a gray level image to a binary image.

C. Canny edge detector

The Canny edge detector is effectively an edge detection operator which uses a multi stage algorithm to detect a wide range of edges in images. The main aim of this algorithm was to discover the optimal edge detection algorithm. In this situation, an "optimal" edge detector means:

- good detection - the algorithm should mark as many real edges in the image as possible.
- good localization - edges marked should be as close as possible to the edge in the real image.
- minimal response - a given edge in the image should only be marked once, and where possible, image noise should not create false edges.

The Canny Edge detection algorithm runs in 4 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. Final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge.

D. Post processing

The binarization result is further improved by post processing. The isolated foreground pixels that do not connect with other foreground pixels are filtered out to make the edge pixel set precisely. 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 and hence the image is segmented.

4. SIMULATION RESULTS

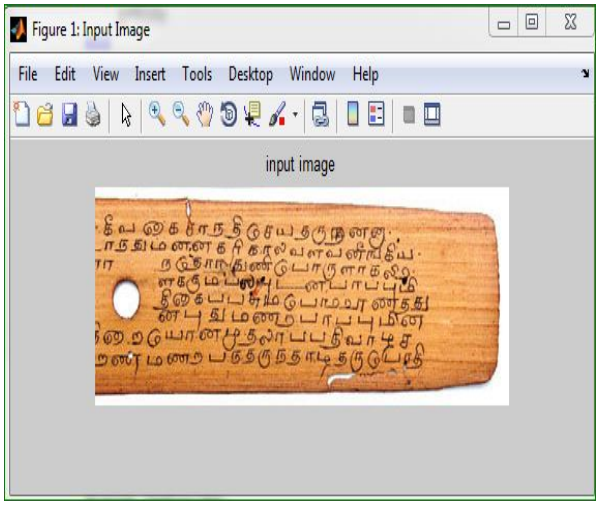

Figure-2. Input image.

The input image is converted here into grey scale image with the size of 512*512. This conversion is done in order to apply some mathematical conditions. By this conversion there is no noise occurrence in the input image.

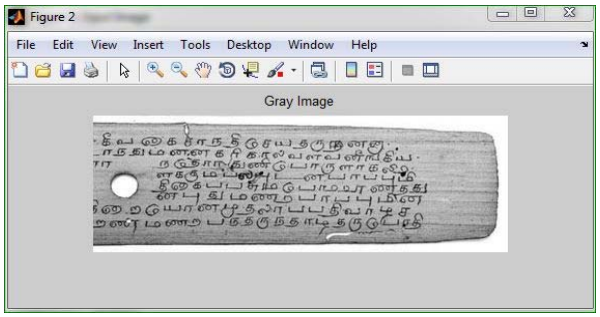

Figure-3. RGB to grey.

To the grey scale image here we apply canny edge algorithm to the extract the boundary clearly.

The human visual system is sensitive to contrast than luminance. The contrast is determined by the difference between the color and the brightness of the object.

In Bernsen's method image contrast is defined as

$$c(i,j) = I_{max}(i,j) - I_{min}(i,j)$$

where C(i,j) denotes the contrast of an image pixel (i, j), Imax(i,j) and Imin (i, j) denote the maximum and minimum intensities within a local neighbourhood windows of (i, j), respectively. If the local contrast C (i,j) is smaller than a threshold, the pixel is set as background directly. Otherwise it will be classified into text or background by comparing with the mean of Imax (i, j) and Imin (i, j). Bernsen's method is simple, but cannot work properly on degraded document images with a complex document background.

But the proposed system contrast is defined as

$$c(i,j) = \frac{I_{max}(i,j) - I_{min}(i,j)}{I_{max}(i,j) + I_{min}(i,j) + \varepsilon}$$

Where ε is a positive but infinitely small number that is added in case the local maximum is equal to 0. Compared with Bernsen's contrast in Equation 1, the local image contrast in Equation 2 introduces a normalization factor (the denominator) to compensate the image variation within the document background.

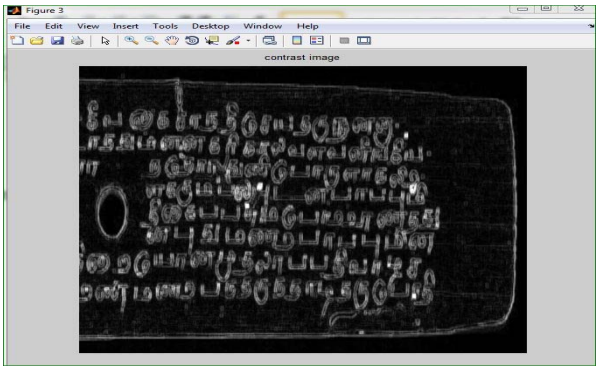

Figure-4. Local image contrast.

An image gradient is a directional change in the intensity or color in an image. The image gradient has been widely used for edge detection and the text stroke edges of the documental images effectively. To extract only the stroke edges properly, the image gradient needs to be normalized to compensate the image variation within the document background. (Imax (i,j) – Imin (i, j)) is refers to the local image gradient that is normalized to [0, 1].

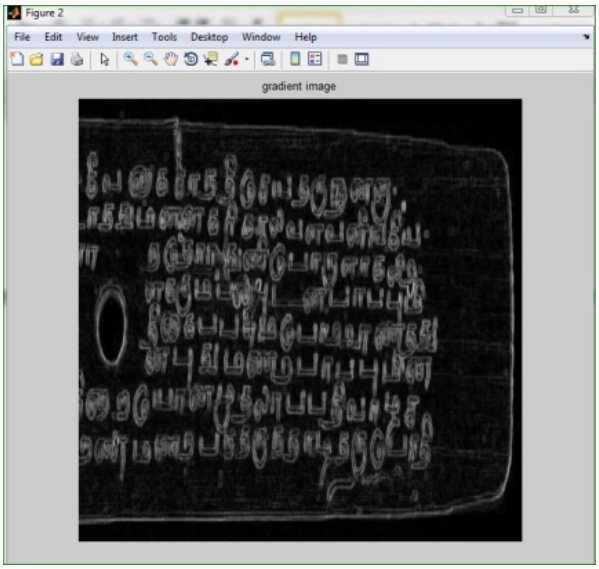

Figure-5. Local image gradient.

To overcome this over-normalization problem, we combine the local image contrast with the local image gradient and derive an adaptive local image contrast as follows:

$$c\_a(i,j) = ac(i,j) + (1 - a)(I\_max(i,j) - I\_min(i,j))$$

where C(i, j) denotes the local contrast in Equation 2 and (Imax(i, j) - Imin(i, j)) refers to the local image gradient that is normalized to [0, 1]. The local windows size is set to 3 empirically. The proposed binarization technique relies more on image gradient.

We model the mapping from document image intensity variation to α by a power function as follows:

$$\alpha = \left(\frac{std}{128}\right)^{\gamma}$$

Where Std denotes the document image intensity standard deviation and γ is a pre-defined parameter. The power function has a nice property in that it monotonically and smoothly increases from 0 to 1 and its shape can be easily controlled by different γ .γ can be selected from [0,∞], where the power function becomes a linear function when γ = 1.

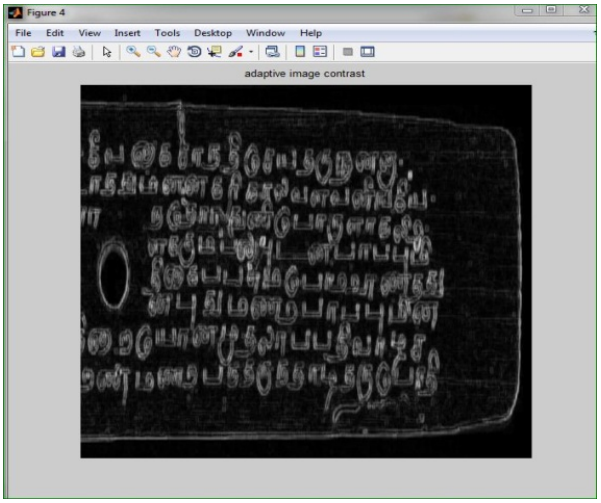

Figure-6. Adaptive image contrast.

A binary image is a digital image that has only two possible values for each pixel. Typically the two colors used for a binary image are black and white though any two colors can be used.

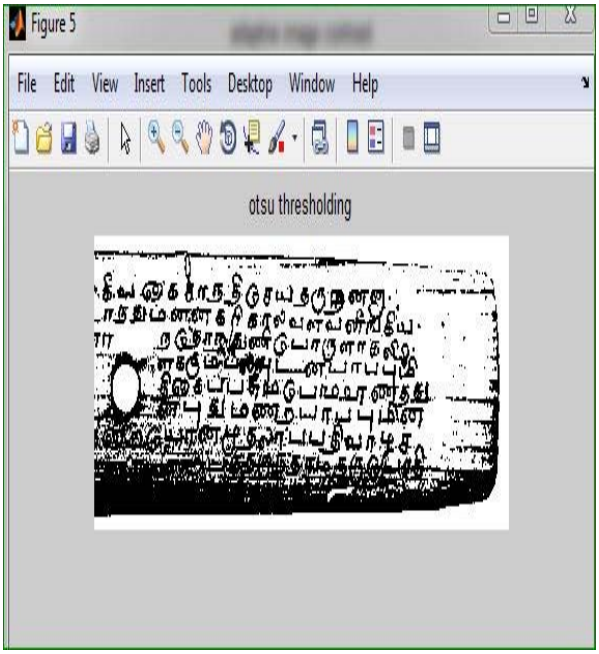

Figure-7. Otsu threshold.

OTSU is redirected from Operational Test Support Unit. It is automated through threshold value in the image. This OTSU thresholding is based on the histogram of the input image. Otsu thresholding is a simple yet effective global automatic thresholding method for binarizing gray scale images such as foregrounds and backgrounds.

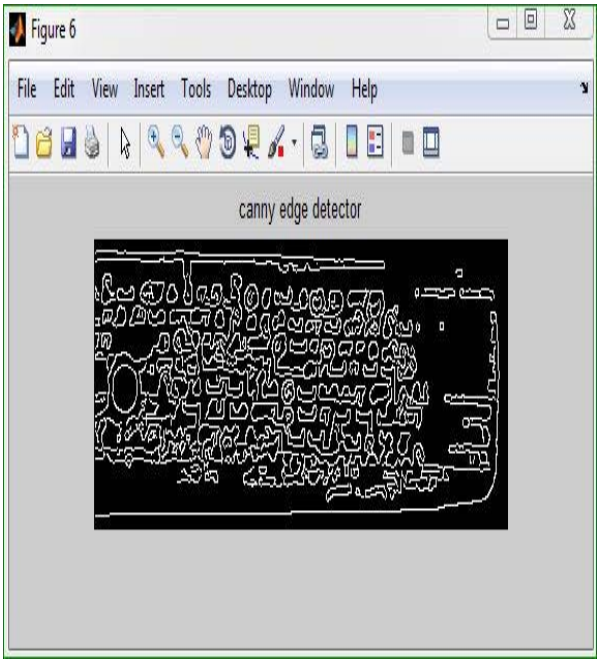

Figure-8. Canny edge detector.

5. CONCLUSIONS

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. It makes use of the local image contrast that is evaluated based on the local maximum and minimum and it has been tested on the various datasets. Experiments show that the proposed method outperforms most reported document binarization methods in term of the PSNR, etc.

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