

# Ameliorate Degraded Document Images Using Synergized Technique

K.LakshmiPriya<sup>1</sup>, K.Udhayalakshmi<sup>2</sup>

<sup>1</sup>Assistant Professor, Dept of MCA  
E.G.S.Pillay Engineering college, Nagapattinam, TN, India.

<sup>2</sup>Assistant Professor, Dept of MCA  
E.G.S.Pillay Engineering college, Nagapattinam, TN, India.

**Abstract**—Degraded document images are often suffered from different types of degradation that renders the document image binarization a challenging task. The handwritten text within the degraded documents often shows a certain amount of variation in terms of the stroke width, stroke brightness, stroke connection, and document background these are some of the issues in the degraded document images. A novel document image binarization technique that segments the text from badly degraded document images accurately. A novel document image binarization technique that addresses these issues by using synergized image contrast. The synergized 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. For a given document image, initially the contrast map is constructed. The contrast map is then combined with the improved Canny's edge map to identify the text stroke edge pixels. A new edge expansion model is presented for recovering broken edges of the words or characters on the front side. The document text is further segmented by a local threshold. Aim of this project is to extract clear textual image in simple and efficient manner.

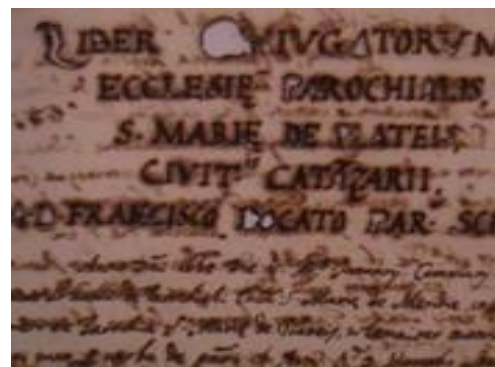
**Keywords**—Adaptive Image Contrast, Degraded Document Image Binarization, Document Analysis, Improved Canny's Edge Map, Post Processing.

## I. INTRODUCTION

A fast and accurate document image binarization technique is important for the ensuing document image processing tasks such as optical character recognition (OCR). 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. The color used for the object(s) in the image is the foreground color while the rest of the image is the background color. In the document scanning industry this is often referred to as bi-tonal. Binary images are also called bi-level or two levels.

This means that each pixel is stored as a single bit (0 or 1). The names black-and-white, B&W, monochrome or monochromatic are often used for this concept, but may also designate that have only one sample per pixel, such as gray scale images. In Photoshop parlance, a binary image is the same as an image in "Bitmap" mode. Binary images often arise in digital image processing as masks or as the result of certain operations such as segmentation, thresholding. Some input/output devices, such as laser

printers, fax machines, and bi-level computer displays, can only handle bi-level images.



(a)



(b)



(c)

Fig. 1 Examples of Degraded Document images (a)-(c) from DBICO 2009 Dataset and from Bickley diary dataset.

The degraded document images is still an unsolved problem due to the high variation between the text stroke and the document background, historical documents are often degraded by the bleed through where the ink of the other side seeps through to the front [1].

Document image binarization is often performed in the preprocessing stage of different document image processing related applications such as optical character recognition (OCR) and document image retrieval [2]. It converts a grayscale document image into a binary document image and accordingly facilitates the ensuing tasks. The segmentation of image is a very important step in OCR processing because processing of a segmented (binarized) image is less computationally expensive than processing its gray-level. The main purpose of edge detection is to significantly reduce the amount of data in an image, while preserving the structural properties to be used

for further image processing. Therefore at further step the Image segmentation is to suppress the background part of image and it also allows the OCR to concentrate on the extracted characters. The subsequent OCR steps of feature extraction and classification are affected by the segmentation quality, as degraded characters are difficult to process.

This project introduces the fusion of, Traditional text extraction along with extraction of clear text strings on the front side from the seriously sipping, dominating, overlapping and interfering images originating from the reverse side [4]. This paper presents related works and problems of our previous image binarization technique at first. An overview of the novel binarization technique and its functions are described in the next section. Additionally, the model and algorithms which are needed are illustrated.

To address these requirements, the synergized binarization technique needs a degraded document image as the input, and then this given image is binarized to carry out the upcoming tasks which are used to enhance the textual extraction from the given input. Therefore novel technique is combination of local contrast and local gradient along with this improved canny's edge detector and edge expansion algorithm [3].

The contrast map is constructed first; this is mainly focused on handling the bright text properly by introducing weight to the local contrast. Whereas in the improved canny's edge detector additional low level threshold is added to it to recover the weak edges of the foreground words and characters and an edge expansion model is to connect such broken edges in the overlapping /overshadowed area. These are the activities to be performed in processing stage [2]. The purpose of local threshold estimation is to extract or segment the text from the processed image, where as the final image should be smoothed by removing the unconnected pixel from its neighbor [1].

It makes use of the adaptive image contrast that combines the local image contrast and the local image gradient adaptively and therefore is tolerant to the text and background variation caused by different types of document degradations. In particular, this addresses the over-normalization problem of the local maximum minimum algorithm [1]. At the same time, the parameters used in the algorithm can be adaptively estimated.

This project mainly focused on the issues such as handling of bright text region, the detection of the edge in the overlapping and interfering region in case bleed through document images, the process of preserving the light stroke edges from deleting in case of the contrasting the image to higher levels. The smudged areas in the document can also be effectively retrieved by improved canny's edge detector.

Binary images are produced from color images by segmentation. Segmentation is the process of assigning each pixel in the source image to two or more classes. If there are more than two classes then the usual result is several binary images. The main advantage of this project is; It is simple, robust, and involves minimum parameter tuning. A local threshold for each document image pixel is

often a better approach to deal with different variations within degraded document images.

The overall architecture diagram in Fig.1 can be explained as follows.

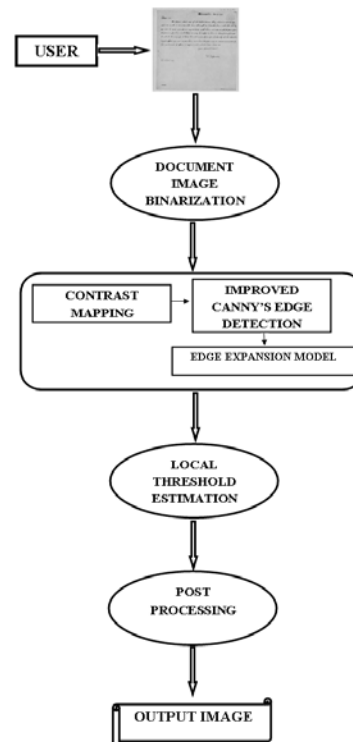


Fig 2 Overall Architecture.

## II. SYSTEM CONFIGURATION

### A. Pre-processing Module

The pre-processing of the image means that we are making the image to be prepared for further processing and ensure to perform the other tasks. The task to done in the pre-processing stage is Document image binarization, in which it converts a grayscale document image into a binary document image and accordingly facilitates the ensuing tasks such as document skew estimation and document layout analysis[5]. In the document image binarization, the page is considered as a collection of subcomponents such as text, background and picture.

The preprocessing is the important section in the document image analysis, because the image is to be processed in order to make use of the image for further proceeding of the steps that is to applied to the image according to the desired technique to be applied to it for the enhancement of the image. The outputs of the Document image binarizations includes only two colors black and white for background and foreground i.e. the object in the image.

The binarized image data is the use of bi-level information decreases the computational load and enables the utilization of the simplified analysis methods compared to 256 levels of grey-scale or color image information. The global methods use one calculated threshold value to divide image pixels into object or background classes, whereas the local schemes can use many different adapted values

selected according to the local area information [6]. We implement this by using local threshold value. The estimation of local threshold value will be explained in the following module.

### B. Processing Module

The document image binarization technique has been done with the following procedures; The binarized image is processed with the contrast operation to make the image legible for the detection of the text stroke edge pixel in the image using improved canny's edge detector at the end of this processing stage edge expansion model is applied to it to retrieve the broken edges in front side of the image, these are furnished briefly in the following.

- i) *Contrast Mapping*: It is get implemented after the image has been binarized. It make bright region brighter and dark region darker for identifying the edges of text stroke pixel [7]. Here adaptive image contrast technique is used which is the combination of local image contrast and local image gradient. It is calculated by evaluating the difference between the maximum and minimum intensities of pixel range value of the image. In addition to it some constant is added which is the weight between local contrast and local gradient that is controlled based on the document image statistical information. In order to overcome the weak contrast region of the image [6]. The use of the local image contrast removes many light text strokes improperly in the contrast map. Whereas the use of local image gradient is capable of preserving those light text strokes.
- ii) *Improved Canny's Edge Detector*: Canny's edge detector is chosen to identify the text stroke edge pixel as it has a good localization property that it can mark the edges close to real edge locations in the detecting image and it is also used to suppress unwanted interfering strokes. Its double-threshold method could provide us the selection of the front stroke edges and its candidates. First of all the image is smoothed by Gaussian convolution. Then a simple 2-D first derivative operator is applied to the smoothed image to highlight regions of the image with high first spatial derivatives. Edges give rise to ridges in the gradient magnitude image. Then it tracks along the top of these ridges and sets to zero all pixels that are not actually on the ridge top so as to give a thin line in the output, a process known as *non-maximal suppression*. Although the Canny edge detector allows us the find the intensity discontinuities in an image, it is not guaranteed that these discontinuities correspond to actual edges of the object. *Low-threshold1* is often selected to detect "strong" interfering strokes would be regarded as the foreground edges. In order to connect weaker foreground edges and reduce the risk of linking noisy edges detected in the low-level threshold stage, we lower the low-threshold (*denoted as low-threshold2*) and superimpose orientation constraint

on edge linking. The combination of the two strategies of *low-threshold1* and *low-threshold2* could be recommended to our problem [4].

- iii) *Edge Expansion Model*: There are other edge breakages that are many pixels apart whose gradient magnitude is weak, thus, an edge expansion model is here proposed to connect such broken edges [7]. In this model, the Cartesian plane is divided into 16 sectors corresponding to 16 different edge extension directions. A new edge expansion model is presented for recovering broken edges of the words or characters on the front side. To determine the edge extension direction, the information stored in the neighboring pixels of a broken edge point may be used. We should do is to take some more nearby pixels into consideration. We should do is to take some more nearby pixels into consideration. Here two more neighboring pixels of P1 other than P0 (we call them P2 and P3) are picked and they are assigned a lower weight than P1 for their indirect connections with P0. In case P1 has only one neighboring pixel other than P0, one neighboring pixel of P2 is picked as P3 [4].

	P3	P2	P1	P0

- iv) *Local Threshold Estimation*: The high contrast stroke edge pixels needed to be detected properly if we want extract the text from the document background. The local threshold is estimated by using the mean and standard deviation of intensity of the detected text stroke edge pixel neighborhood window  $W$ . The neighborhood window should be at least larger than the stroke width in order to contain stroke edge pixels [1]. So the size of the neighborhood window  $W$  can be set based on the stroke width. The stroke width is estimated as follows, First the edge image is scanned horizontally row by row and the edge pixel candidates are selected [8]. If the edge pixels, which are labeled 0 (background) and the pixels next to them are labeled to 1 (edge). The stroke edge width  $EW$  can then be approximately estimated by using the most frequently occurring distances of the adjacent edge pixels.

### C. Post-Processing Module

The isolated foreground pixels that do not connect with other foreground pixels are filtered out to make the edge pixel set precisely [9]. 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 [1].

### III. CONCLUSION

In this paper we have described design and tentative implementation of a Document image binarization. It mainly focus on the problem which is often present in degraded document images, they are analyzed and rectified by using the synergized technique and adaptive image contrast technique. Whereas the adaptive contrast technique which is able to detect the bright text background, here the combination of local contrast and local gradient is simple and robust. The improved canny's edge detection used here is for the gradient estimation is the non-trivial in document processing, the double threshold value used to find the text stroke edge pixel in the interfering areas of the image. The post processing module is used to smooth the image and finally gives the perfect, clear and exact text from the degraded document images. This gives the efficient and enhanced technique of canny's edge detector.

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