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Comparative Analysis of quality of Degraded Documents by using FAIR Algorithm

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Abstract - *Image binarization of degraded document is very difficult task because of different types of degradation over the document. Segmentation technique is the major technique used for separation of pixel values in black as foreground and white as background. To get clear image of degraded document image , there are multiple algorithms as well as methods are available . Many researchers have worked in this field of document image binarization technique. Still there is scope to get more recoverable image from degraded document. Binarization is a process which converts gray scale image into binary image. In degraded document image binarization, thresholding technique and Contrast image construction are the important techniques that are used for image binarization. Many binarization techniques has been proposed for this document binarization technique.*

Key Words: **Local Thresholding, Global Thresholding, Hybrid Thresholding, FAIR, Gaussian Filter**.

1.INTRODUCTION

Document images degradations occure due to the poor quality of paper, ink plot, fading, document aging. Binarization is process to obtain binarize image from any color image or gray scale image. In preprocessing stage , document image binarization can be performed. Document Images are analyzed in this staget and separation of background and foreground pixels can be done. Scanning and printing of the documents degrades the visibility of document images. Degraded document image restoration enhances the degraded noise in images. Document Image Binarization is the important technique for the segmentation of the text values from the background images. To extract the clear image, Separation of the pixel values into black as foreground and white as backgroung can be done. Document binarization is under research. Importance of historical documents is very great to us. Many efforts or programs at national and international level are organized to preserve a large number of historical documents such that it is a more efficient information access can be done. These historical documents are to be converted into digital form for convenient and easy storage and therefore majority of the projects are based on this. Severe degradations of historical documents quality is caused due to aging, chemical procedure of paper fabrication and storage conditions. So for restoration of the information contained in these documents,a technique called binarization is used. In document binarization process, thresholding[10] technique is well-known technique. Image binarization using thresholding has three types. Binarization of document images is a challenging task. It is very old problem for Document Image Analysis and Retrieval (DIAR). The aim of binarization is to classify the pixels of the image in two classes i.e. foreground and background.

1.1 Local thresholding binarization

In local thresholding binarization[2], image can be divided into sub-images blocks either statically or dynamically. Then threshold value for each block can be determined and converted it into black and white image depending on its local threshold value.

1.2 Global thresholding binarization

In Global thresholding[2] binarization, single threshold value for the whole image can be determined to convert the gray-level images into black and white image. Binarization of the document image converts 256 levels of grayscale information into two levels (black and white) image information.

1.3 Hybrid thresholding binarization

A new category of binarization techniques is hybrid thresholding. Algorithms belong to this thresholding combines the advantages of global thresholding[2] algorithms and local thresholding algorithms. This approach also removes their limitation to get accurate binarize image.

2. PROPOSED METHOD

The binarized output image is obtained by processing the input image in three following steps: preprocessing, main binarization, and postprocessing.

2.1 Preprocessing

In pre-processing stage[8], grey scale source image is converted into binarized image. Classification of background and text areas is done in this stage. This process describes the proposed document image binarization methods. Firstly, for a given a degraded document image, an adaptive contrast map is constructed and then canny edge map algorithm can be applied. The text is then segmented from the background based on the local threshold. This threshold value is estimated from the detected text stroke edge pixels. A post-processing is at the end to improve the document binarization quality.

At the end of this step, the structure of foreground and text is determined. However, the image is still noisy, and the strokes and sub-strokes have not been accurately binarized. Also, the binarization output is detected by some types of degradation. We therefore include additional steps to deal with them.

2.2 Main Binarization

FAIR means a fast algorithm for document image restoration. In this algorithm, the results of two different ternary images given by the S-FAIR algorithm are combined using two different thresholds values. The first ternary image is nothing but noise-free but without some important edges; the other ternary image contains each characters edges but with some additional noise.

The Canny edge detector[11] is an edge detection operator .This operator uses a multi stage algorithm to detect a wide range of edges in images. The main focus of this algorithm was to discover the optimal edge detection algorithm. In this situation, an "optimal" edge detector means:
1. Good detection - In the image as possible, the algorithm should mark as many real edges.

2. Good localization - Edges marked should be as close as possible to the edge in the real image.

3. Minimal response - A given edge in the image should only be marked once, and where possible, image noise should not create false edges.

The S-FAIR Subprocessing: The S-FAIR subprocess is based on a simple algorithm that can be divided in two main steps as follows-

1. A rough localization of the text is achieved in a first step using an edge-detection algorithm based on a modified version of the well-known Canny method.

2. In second step, pixels in the immediate vicinity of edges are labeled as text or background thanks to a clustering algorithm from the previous results.

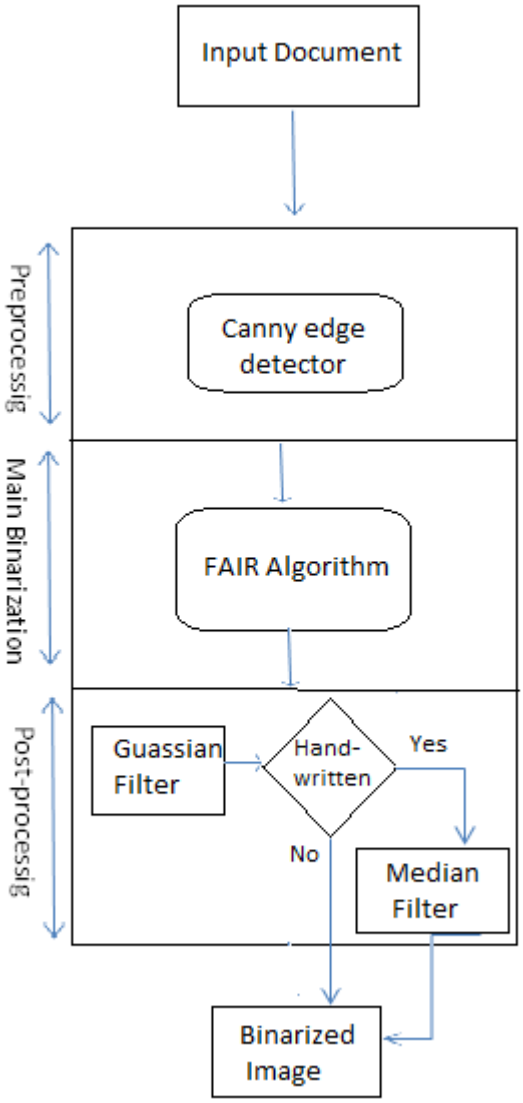

Fig -1: Architecture of Proposed Model

2.3 Postprocessing

In this step, binarization results can further be improved . A Gaussian filter[4] is applied on the printed document image which enhances the binarization output and separates background from foreground . Median filter and gaussian filter combinely applied on the handwritten image to remove

background noise and objects[5]. In this process, the areas of problems are estimated and the noise can be removed by using filters. firstly, the foreground pixels that do not connect with other foreground pixels are filtered out. Secondly, if the pixels on symmetric sides of any of the pixels belong to same class i.e. foreground or not. If both pixels belong to same class but center pixel belong to another class then that pixel will be assigned as foreground pixel.

3. COMPARATIVE ANALYSIS

Some measurements of the image quality are to be computed for comparing the results of different binarization approaches. For Image quality achievement, there exist different methods for the measurement. The FAIR Algorithm has been applied on the DIBCO Series Dataset. This Dataset includes various collection of the images which has several degradations. The empirical discrepancy methods are the methods which use difference between a binarized image and ground truth image. This method compares and evaluates the performance of binarization algorithms. Preprocessing, Main Binarization and postprocessing these steps has been applied on these images.

Table -1: Comparision of The Performance of The Proposed Method against Other Methods

Algorithm	FM	PSNR	NRM	MSE	Recall	Precision
Proposed	91.31	20.43	0.06	655.55	0.87	0.94
LMM[5]	**91.06**	**18.50**	**6.5**	**402.22**	**0.86**	**0.93**
PC[7]	**88.43**	**17.03**	**4.3**	**721.58**	**0.80**	**0.86**
BE[1]	**91.23**	**18.65**	**4.3**	**384.67**	**0.85**	**0.92**
Sauvola[9]	**80.14**	**14.52**	**4.7**	**719.67**	**0.79**	**0.88**
Ms Gb Sauvola[6]	**89.64**	**17.76**	**3.7**	**492.62**	**0.84**	**0.90**
AdOtsu[3]	**91.61**	**18.80**	**5.2**	**408.43**	**0.89**	**0.93**

To compare the quality of these images after the binarization process, various measures are evaluated that are following:

F-measure(FM), Peak Signal to Noise Ratio(PSNR), Negative Rate Metric(NRM), Mean Square Error(MSE), Recall and Precision.

3.1 F-Measure

F-measure (FM) is the harmonic mean of precision and recall. F-measure[12] is calculated at the pixel level.

F _Measure = (2*Recall*Precision)/(Recall + Precision)

3.2 PSNR

The PSNR[12] is defined as,

$PSNR = 10 \log(C^2/MSE)$

Here, C is a constant that denotes the difference between foreground and background. This constant is set to 1. MSE is the mean square error.

3.3 NRM

The NRM is based on the pixel-wise mismatches between the GT and prediction. It combines the false negative rate NRFN and the false positive rate NRFP.
It is denoted as follows:

NRM = (NRFN + NRFP)/2

where,

NRFN = NFN/(NFN + NTP)

and

NRFP = NFP/(NFP + NTN)

NTP denotes the number of true positives, NFP denotes the number of false positives, NTN denotes the number of true negatives, NFN denotes the number of false negatives. In contrast to F Measure and PSNR, the binarization quality is better for lower NRM[12].

3.4 Recall

recall = TP/(TP +FN)

where, TP denotes true positive, FN denotes false negative[12].

3.5 Precision

precision = TP/(TP +FP)

where, TP denotes true positive, FP denotes false positive[12].

3.6 Execution Time

The run time of the proposed method evaluated by performing the experiments on Intel Core i3 processor of 1.70 GHz CPU with RAM 4.0 GB. The algorithm is implemented on Windows 7. It takes 55725 ms to operate.

4. CONCLUSIONS

The new binarization method based on the FAIR algorithm is implemented. This algorithm is faster algorithm for the image restoration. It is very easy to implement and simple in principle. This algorithm gives very good results as compare to other methods. Text detection and thresholding is also

evaluated. This helps to give best results. This algorithm is efficient for various types of images.

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