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Phase Based Binarization of Ancient Documents Images

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ABSTRACT: The proposed method of binarization is by using phase information of documents which are ancient and which have been degraded and corrupted. Ancient documents may consist of many types of degradations, in which many environmental factors, improper handling of documents, and poor quality of paper cause degradation of documents. In this method we use three steps that are pre-processing, main binarization, and postprocessing. In the proposed research work, we attempted to recover damaged, corrupted and degraded images and documents by using binarization method. In this method, three steps were undertaken to recover the damaged, degraded documents. First, second and third steps used were pre-processing, main binarization and post processing respectively. In preprocessing, the denoising method proposed by Kovesi is used. For the main binarization process, two phase congruency features are used which are 1)the maximum moment of phase congruency covariance (I_M) and 2)the locally weighted mean phase angle (I_L). For the postprocessing enhancement process, a bleedthrough exclusion removal process is applied ,then guassian filter is used to further enhance the binarization output. The ground truth generation tool used to improve the performance of proposed model.

KEYWORDS: phase based binarization, ancient documents ,denoise image, canny edge map.

I. INTRODUCTION

Nowaday documentation plays very important role in day to day life. A Single paper of document had lots of importance. So it is necessary to save the document securely and permanently. We are throwing this project to enhance the image quality of old and degraded document which are really much important .There exist lots of handwritten and printed historical manuscripts in libraries and museums in the world including medieval manuscripts, author manuscripts, old newspapers, archives, etc. we can store that old and historical documents preserved enlarge quantities worldwide in digital form by using this digital image processing techniques .we are processing on image of document so we are using the digital image processing.

Binarization of document images is one of the important step in pre-processing of low quality scanned documents to save maximum subcomponents such us text, background and image . Binarization calculates the threshold value that differentiate object and background pixels. The main advantage of binary images is that it decreases computational load and increases efficiency of the systems. Binary images can be obtained from gray level images by binarization process. After binarization we apply post processing in that we use Gaussian filter which smoothen our output.

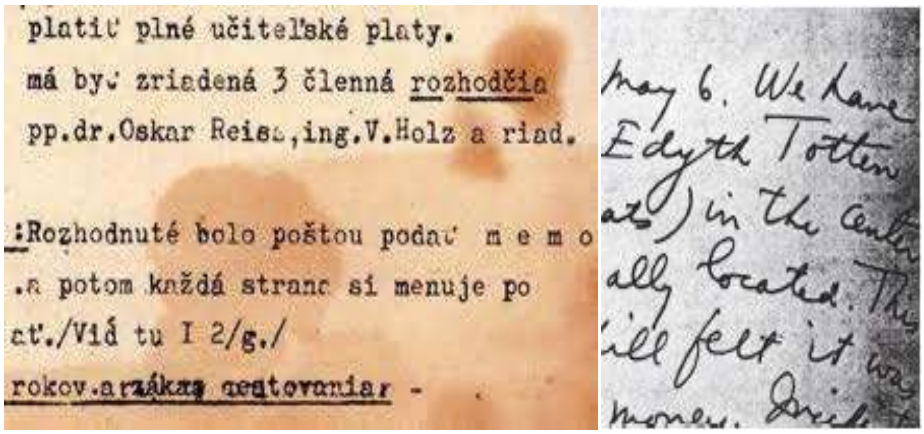

Fig 1 : Sample Document Images

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Hence at last we got the rectified enhanced document data. So we can store it in digital form permanently.

This method of binarization is proposed for the enhancement and binarization of ancient documents and manuscripts. There are three important and major steps for the proposed method of phase based binarization model. The three steps are 1)preprocessing; 2)main binarization; and 3)post processing. The first method of proposed method is preprocessing, in which phase preserving image denoising is perform. The resulting denoising image is incorporate with the canny edge image. These operations involves in the preprocessing of the proposed model.

The second and the most important step of the proposed model is the main binarization. In the main binarization, we use two phase congruency features. Phase congruency features are mostly used in image processing literature, finger-knuckle-print recognition, machine vision, palmprint verification,object detection and biomedical applications. Phase congruency features are used to process the foreground of the image.

The third step of the proposed model is the postprocessing which is nothing but the enhancement process. In the enhancement process we first apply bleedthrough exclusion process and then guassian filter for enhance the output and to separate the background and foreground.

Another important part of the paper is ground truth tool which is also called as PhaseGT. PhaseGT provides the benchmark for the models. The result of our proposed model can be compare with the ground truth values of images. The PhaseGT is the semi automatic approach to ground truthing of images of any language. The PhaseGT works in automatic as well as manual form. In this ground truthing it uses the users information as priori information. Then, the user selects regions in this output that contain binarization errors. PhaseGT offers alternatives for those regions, which the user selects. The user can also use brush tools to manually label pixels of interest. This is a very appealing option, because it saves the user time and simplifies GT creation at the same time.

II. METHODOLOGY

In this paper , three steps plays an important role . in this section we will see the detail processing of the three steps. The three steps of the binarization model is 1)preprocessing 2) main binarization and3) post processing. The detail methodology is discussed below in this section:

2.1 Preprocessing

In the preprocessing , we used denoised image instead of original input image. The denoised image is obtained by the Kovesi's phase preservation image denoising method. The kovesi's image denoising method is described in the phase congruency features. The original image may be in the color format so we need to convert it into grey image. After conversion of an image ,denoise image is obtained by using average filter. And normalized denoised image is obtained by linear image transform. This approach is useful for removing noise and degraded parts of images. Then the otsu's method applied on the normalized denoise image , but the problem in this method is that it misses weak strokes of the images that's why we also use canny edge detector on the original image. Then we combine the output of otsu's method and output of canny operator after that we compute convex hull image .

At the end of preprocessing, the structure of foreground and text is determined. Although, the image is still noisy, and the strokes and sub-strokes have not been accurately binarized. Also, the binarization output is affected by some kind of degradation. We therefore include additional steps to remove them.

2.2 Main binarization:

The most important step of the proposed method is main binarization ,which is based on the two phase congruency features.

The two phase congruency features are a)the maximum moment of phase congruency covariance(Iм) and b) the locally weighted mean phase angle (I_L).

2.2.1 Maximum Moment Of Phase Congruency Covariance (Iм)

Here maximum moment of phase congruency covariance is used to separate the background from the foreground, basically Iм map is derived by its edge strength. It uses values between 0 and 1, where small value indicates weaker edge and larger value indicates stronger edge.

So, The maximum moment of phase congruency covariance(Iм) can be defined as,

$$I_m = {}^{max}_{r} PC_{2Dr}(x)$$

Where, $PC_{2Dr}(x)$ is two dimensional phase congruency which can be stated as,

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$$PC_{2Dr}(x) = \frac{\sum_p W_r(x)\left[A_{pr}(x)\Delta\emptyset_{pr}(x) - T_r\right]}{\sum_p A_{pr}(x)}$$

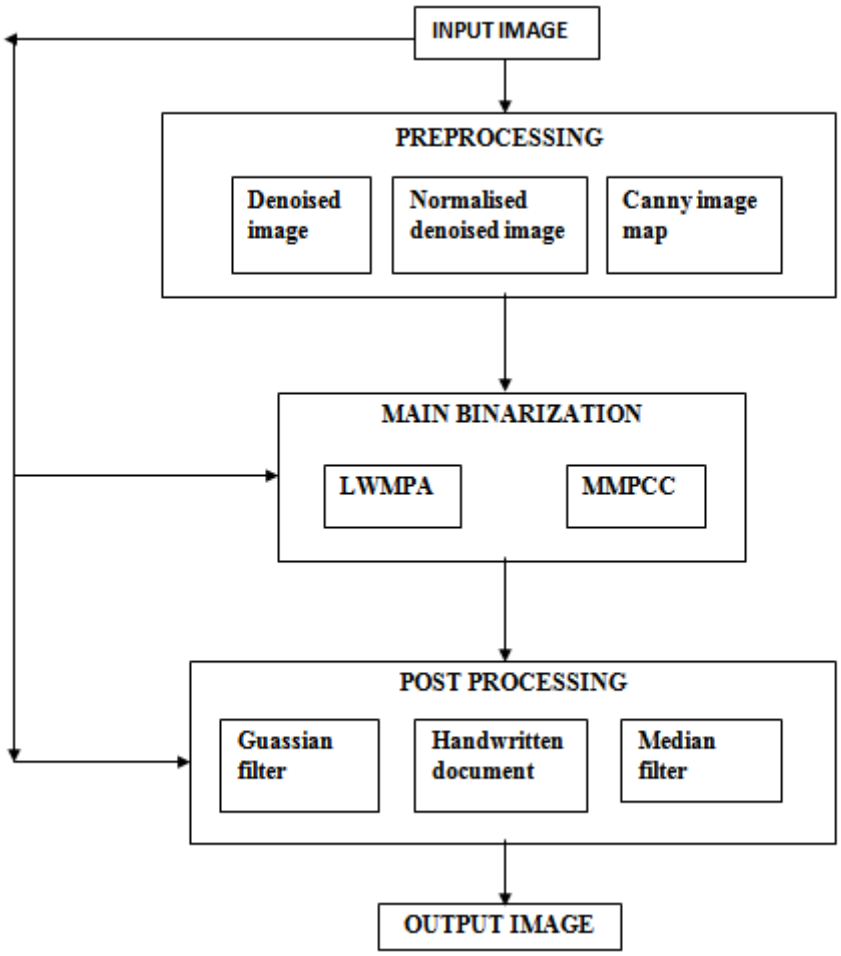

Fig 2: Flowchart of the Proposed Binarization Method

This step can even be used in badly degraded documents, where it can reject majority of badly degraded background pixels by Means of a noise modeling method. To achieve this, we set the number of two dimensional log-gabor filter scales ρ to 2 , and used 10 orientations of two dimensions of log-gabor filters r. in addition, the number of standard deviations k used to reject noises as estimated as follows,

$$k = [2 + (\alpha \times \frac{\sum_{n,m} I_{Otsu,bw}(n,m)}{\sum_{n,m} I_{pre}(n,m)})]$$

Where α is a constant (we are using α = 0.5); $I_{Otsu,bw}$ is the binarization result of Otsu's method on the input image; and I_{pre} is the output of the preprocessing step.

2.2.2 Locally Weighted Mean Phase Angle (I_L)

The two-dimensional locally weighted mean phase angle (I_L) is obtained using the summation of all filter responses over all possible orientations and scales:

$$I_L(x) = \arctan\left[\sum_{p,r} e_{pr}(x), \sum_{p,r} o_{pr}(x)\right]$$

We consider the following assumption in classifying foreground and background pixels using I_L:

$$P(x)= P(x) = \begin{cases} 1, & I_L(x) \leq 0 \\ 0, & I_L(x) > 0 \; and \; I_{Otsu,bw}(x) = 0 \end{cases}$$

where P(x) denotes one image pixel; and $I_{Otsu,bw}$ denotes the binarized image using Otsu's method. Because of the parameters used to obtain the I_M and I_L maps, I_L produces some classification errors on the inner pixels of large foreground objects.

2.3 Postprocessing

In the last step of this model , which is postprocessing we apply the enhancement processes. Firstly bleed through removal process. Bleed-through degradation is not only due to ink's seeping through the pages of documents after long periods of storage, but also due to the paper porosity, to the chemical quality of the ink, or to the conditions of digitalization. Then, adaptive guassian filter is used for enhancement of the binarization output and this step is also used to separate the background from foreground.

III. CONCLUSION

The information of phase for input image using the image binarization method and removal of robust phase-based features from that image are needed to build a model for the binarization of ancient documents. Depends the structural operations preprocess the input image and then, main binarization is performing the phase congruency features. In post-processing, a proposed gaussian and trimmed median filter has been needed for remove noise, unwanted lines, and interfering patterns. A Gaussian filter was helpful for separating the both foreground, background objects, and also improving the final binary output. The manual correction is reduced based on this tool which is involved in ground truth generation. The application of phase-derived features, the stable behavior of document images, to other cultural heritage discipline can be maintained for long time. So, they are very useful to future generation to follow the ancient culture and their traditions. And also our historical documents can be saved.

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