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A Review on Document Binarization Techniques and Related Developments

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ABSTRACT: Now a day's more emphasis is given on improvement of degraded document images. There are certain reasons behind the document degradation such as, smearing of text, spreading of unbalance illumination, ageing effect, noise occurred from background side etc. In this regards, Image document binarization technique plays a significant role and is utilized in improvement of quality of images associated in text. In particular, it operates for extraction and segmentation of text from the document flipside. Since last few decades, variety of binarization techniques was proposed however, it has been observed that no any technique is capable to remove all types of degradation. However, with certain merits and demerits various binarization techniques are used for the enhancement in quality of images. In present paper, summary of data which comprises various improved binarization techniques is presented.

KEYWORDS: Document binarization, Document analysis, Image processing

I. INTRODUCTION

Old remarkable documents are culturally quite important and significant [1, 2]. In most cases, these documents are present in the form of hand written. As these are historic documents the issue of their long lasting is crucial. Their quality starts to degrade with respect to time and finally becomes unreadable. Due to such type of degradation further process of maintenance/rewritten is required which is costly. However, with the advent of technology transformation of such culturally and scientifically important document into well accepted form of digital is possible [3]. Varieties of scientific techniques are available for the transformation of handwritten into compatible digital form [4]. Optical Character Recognition (OCR) is most popular technique and is use to access and store the information in the form of digital text [5]. As the old documents which are written by hands preferably experiences different types of degradations. More importantly in case of long time preservation of documents effect of environment plays a significant role in the degradation of documents such as, fungus. The aforesaid and other crucial issues present in most of documents are difficult for OCR for accurate recognition and total removal. Bearing all these issues in mind scientific community has explored various techniques to overcome problems associated to document degradation. Recently, there has been growing interest in transforming these documents into digital forms, which converts them to digitally readable text that requires scanning, extracting text, and storing them in a database [6].

Before to going to details of the summary of various binarization techniques it is quite important to recognize the type of degradation and defects associated to historically essential document. Various types of issues and artifacts which are usually seen in case of document degradation are summarized in figure 1. The main aim of the present paper is to collect necessary scientific information related to development in document binarization techniques.



Fig. 1 commonly observed degraded defect types in historic documents.

II IMAGE BINARIZATION TECHNIQUES

This section deals with detail summary of various document binarization techniques. Table 1 is given below for the comparison with published literature. Last few decades ago Otsu's [7] technique was introduced, and which was later became more famous. It operates on the principle of global thresholding and this technique known to be more effective in comparison with other techniques.

In 1986, W. Niblack [8] brought solution with the help of technique called Niblack. Using rectangular window movement over the grey level image the calculation of threshold has been done in this technique. One of significant drawback of Niblack's method is the presence of 'noise' in the region of non text. Preprocessing as well as post processing techniques are necessary for removal of this noise. More robust method as per as variance is concerned is proposed by Sauvola [9]. In comparison to Niblack technique this technique is found to be significantly enhanced, particularly, when documents have illuminated unevenly, presence of large variations etc. Sauvola method works on the principle of calculation of value of local threshold. More detail of this technique indicates the involvement of standard deviation. The main significant drawback of Sauvola technique is low process speed. In addition, values of free parameter and size of window are crucial and sensitive parameters.

Bernsen [10] came with the method which was tailored version operates on intensities of pixels. In particular, values of mean for lower and higher intensities have been considered with local threshold. Further, by optimizing the mean value of intensity of pixel value of threshold is usually fixed. This technique is not suited for the documents with compounded background. The issue of aforesaid (Bernsen method) technique has been resolved by LMM method [11]. Normalization factor and local image contrast are the key parts of this technique. The method comes out with local image contrast and normalization factor. This technique works on the principle of contrast measurement of image in particular from bright and dark region. However, this technique is found to be not appropriate for the bright background with bright text [11].

As the technological advancement is continuous process Gatos's [12] technique came with solution of problems associated with the LMM technique. The main aim of this technique is to work on the image binarization and this technique is found to be much capable for improvement of quality of degraded document. Calculation of background intensities is the key factor of this technique. The estimation of background surface with original image is the initial part of this technique and application of thresholding technique is later one. In comparison with other aforesaid techniques the present method is quite easy and known for document binarization however; it is not capable for the images with low resolution.

A scientific technique for improvement of degraded document with merits such as highly efficient and less computational difficulty has been proposed by Pai et. al. [13] in 2010. In this method, several blocks are created with the help of separation of the document image. Threshold value has to be taking into consideration while the binary image formation. This method is more popular for portable electronic devices which usually have computational as well as memory constraint.

Table 1. Comparative table of published literature

Sr. No.	Name of author	Key parameter	Merits	Demerits	ref.
01	Otsu	Variance	particularly good for documents which are constantly illuminated	time consuming particularly for the complex level	7
02	Niblack	standard deviation and mean	text is recovers completely from the images which are degraded	presence of ‘noise’ in the region of non text. Pre-processing as well as post processing techniques are necessary for removal of this noise	8
03	Sauvola et.al.	standard deviation and local mean	significantly enhanced, particularly, when documents have illuminated unevenly	significant drawback is low process speed. In addition, values of free parameter and size of window are crucial and sensitive parameters	9
04	Bernsen	operates on intensities of pixels	main focus is on intensities of pixels	This technique is not suited for the documents with compounded background	10
05	Su et.al.	local lower and higher intensities	directly works on the principle of contrast measurement of image	this technique is found to be not appropriate for the bright background with bright text	11
06	Gatso et.al.	background intensities	easy and known for document binarization	it is not capable for the images with low resolution	12
07	Pai et.al.	mean, standard deviation, image intensity	highly efficient and less computational difficulty	This method is more popular for portable electronic devices which usually have computational as well as memory constraint	13
08	Su et.al.	local image gradient and local image contrast	quite easy to use and robust in nature	This technique requires further enhancement in some images of document image binarization competition dataset	14

For the purpose of improvement of degraded documents B. Su and S. Lu [14] have come with enhanced solution. The over normalization problem usually occur in method in reference [11] have overcome by this technique. This is possible with the help of local image gradient and local image contrast. For this technique a very little tuning of various factors is needed. In addition, this technique is quite easy to use and robust in nature.

III CONCLUSION

The present paper deals with summary of research work done in the area of image binarization. This comprehensive report will also help the individual for the selection of appropriate technique as per the need. The collection involves the systematic approach towards the solution of problems associated with document binarization. Commonly observed degraded defect types in historic documents have also been discussed in the present paper. A series of techniques also comprises of several advantages and disadvantages. It is also found that, there is necessity for the quick and precise method which will suitable for all types of degraded documents. Further, it should also be capable

for the selection of appropriate technique according to the type of type document as well as type of degradation which may result into the better performance. The present report has great scientific and technological importance and will definitely be the interest of broad audience in the area of document binarization.

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