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Pre-Processing for Text Extraction System using Histogram Techniques

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Abstract -Now a days researchers are using natural images for their research work. *Natural images contain text also. Text* in natural *images* typically adds *meaning* to an object or *scene*. So extract the text from natural images is very important for applications which are processing with text. However, variations of text due to differences in size, style, orientation, and alignment, as well as low image contrast and complex background make the problem of automatic text extraction extremely challenging. Extracting text from an image can be done with image processing which deals with digital images. Extraction of text involves in different stages. They are named as preprocessing, detection, localization, extraction and recognition of the text from a given image. The aim of pre-processing is an improvement of the image data that suppresses unwanted distortions or enhances some image features important for further processing. So pre-processing is important stage to improve the image quality. This paper presents the existing histogram techniques for preprocessing and proposed a new technique named enhanced CLAHE which gives best contrast enhancement for natural scene images with text.

Keywords -Preprocessing, noise removal, image enhancement, histogram techniques, skew correction

I. INTRODUCTION

Text extraction is emerging and challenging era in the computer vision. Many techniques and algorithm have been developed to solve the problem of text extracted from natural scenes. Text which is embedded into the image contains semantic information which is used in many other applications such as information retrieval of complex images, robot navigation, useful for visually impaired persons, street signs, automatic read the sign board and use in so many other applications. Most of the research work in this area has been done only on printed text, a very few research is addressing the LED scene text. Scene text is difficult to extract due to blur image, variations in color, noise problem, complex background, discontinuity, poor lighting conditions, and variation in illumination. With rapid advances in information technology, detection and extraction of texts in images and related research into this area have become increasingly important. Text extraction is daunting because of non-uniformity in illumination, complexity of the backdrop, and differences in the size font & line-orientation of the text. Fig. 1 shows a natural scene image with text.

Image pre-processing techniques are mandatory for any image based applications and lies in its ability to remedy some of the problems that may occur due to some of the factors presented above. Extract text from natural scene images is performing some effective preprocessing techniques.

Fig. 1 :Natural scene text image

Image pre-processing techniques are mandatory for any image based applications and lies in its ability to remedy some of the problems that may occur due to some of the factors presented above. Extract text from natural scene images is performing some effective preprocessing techniques. That makes the text extraction system more robust mainly through accurate image enhancement, noise removal and skew detection/correction.

I.I. Pre-processing flow

The basic idea is to enhance the input image so that the accuracy of the text localization and recognition can be

increased. Fig.2 represents the pre-processing techniques before detecting text from natural scene image.

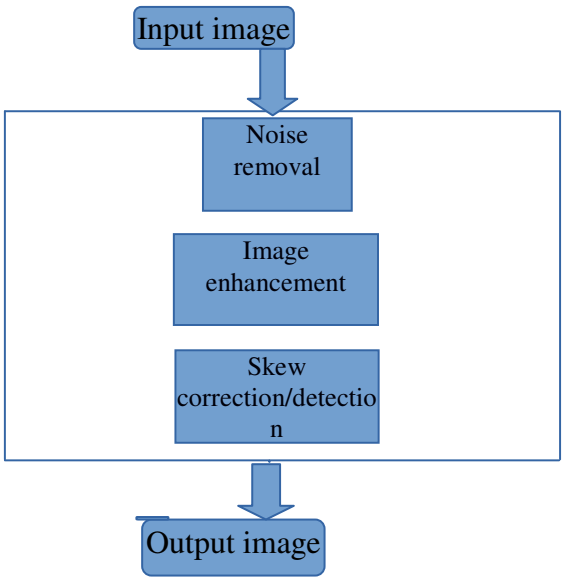

Fig. 2 :Pre-processing system

The techniques present in Fig. 2, few of those which may be used in text extraction systems. The rest of the manuscript will present some related works and techniques used during the preprocessing stage of a text recognition system in natural scene images.

II. LITRATURE REVIEW

The principal objective of image enhancement is to process a given image, so that the result is more suitable than the original image for a specific application. Image enhancement improves the quality of images for human perception by removing noise, reducing blurring, increasing contrast and providing more detail. This section will provide some of the techniques used in image enhancement.

Genarally, Text information extraction system applies some basic process like binirization, filtering, resizing, conversion and etc to make the uploaded image in simulation. Yin et al., [16] and Neumann et al., [6] never uses any pre processing techniques for text extraction. Most of text extraction work [5], [7] uses transformation functions for pre-processing. Huang et al., [4] form an algorithm for text extraction based on image gradient difference to capture the change in texture. Gllavata et al., [3] applied transformation function to change the color space and thresholding method to spread luminance values throughout the image and increase the contrast between the possibly interesting regions and rest of the image. Some other pre-processing techniques and related works are discussed in the following sections.

II.I Noise removal

Digital images are prone to various types of noise. Noise is the result of errors in the image acquisition process that result in pixel values that do not reflect the true intensities of the real scene. There are several ways that noise can be introduced into an image, depending on how the image is created. The advancements in technology produced image acquisition devices with better improvements. While modern technology has made it possible to reduce the noise levels associated with various electro-optical devices to almost negligible levels, there are still some noise sources which cannot be eliminated. Images acquired through modern sensors may be contaminated by a variety of noise sources. By noise, refer to stochastic variations as opposed to deterministic distortions, such as shading or lack of focus. There are different types of noise that are related to the electronic capturing devices or the light source used such types of noise are photon, thermal, On-Chip electronic and quantisation. For noise removal use various filters such as medican filter, wiener filter, gaussian filter etc are used. Apart from these many other techniques are available.

A common manifestation of noise in binary images takes the form of isolated pixels, salt-and-pepper noise or speckle noise. In grey-level images or median filters and low-pass filters such as average or Gaussian blur filters proved to eliminate isolated pixel noise. Gaussian blur and average filters are a better choice to provide smooth texture to the image. On the other hand, periodic noise which manifests itself as impulse-like bursts which often are visible in the Fourier spectrum can be filtered using notch filtering. Simulate a real-life image that could be blurred due to camera motion or lack of focus. The image could also be noisy due to random disturbances. The images have been restored by the use of Wiener deconvolution, Inverse deconvolution and Richardson–Lucy algorithm. The above three methods are famously used to remove the noise from image.

Image deconvolution methods are used to estimate the latent image from the degraded image. They can be divided into two categories, non-blind and blind deconvolution. In non- blind deconvolution, the image can be restored through an error minimization process. The Weiner deconvolution and the Inverse deconvolution are the two commonly used methods, within this category. Richardson – Lucy deconvolution is an algorithm which is based on iteration process. Its performance in the presence of noise is found to be superior to that of other deconvolution algorithms[12],[13]. Asit kumar et al.,[1] used Lucy-Richdarshan algorithm to remove the noise from natural images.

II.II Contrast stretching

Contrast is an important factor in any subjective evaluation of image quality. Contrast is created by the difference in luminance reflected from two adjacent surfaces. In other words, contrast is the difference in visual properties that makes an object distinguishable from other objects and the background. In visual perception, contrast is determined by the difference in the colour and brightness of the object with other objects. Our visual system is more sensitive to contrast than absolute luminance; therefore, we can perceive the world similarly regardless of the considerable changes in illumination conditions. Many algorithms for accomplishing contrast enhancement have been developed and applied to problems in image processing. The level of contrast in an image may vary due to poor illumination or improper setting in the acquisition sensor device. Therefore, there is a need to manipulate the contrast of an image in order to compensate for difficulties in image acquisition. The idea is to modify the dynamic range of the grey-levels in the image. A technique that could work in this case is called histogram processing, to stretch the pixel values of a low-contrast image or high-contrast image by extending the dynamic range across the whole image. Histogram processing is used in image enhancement and can be useful in image text extraction and segmentation processing. A histogram simply plots the frequency at which each grey-level occurs from 0 (black) to 255 (white). Scanned or captured images may have a limited range of colours, or are lacking contrast details. Enhancing the image by histogram processing can allow for improved detail, but can also aid other machine vision operations, such as segmentation. Thus, histogram processing should be the initial step in preprocessing. Histogram equalisation (HE) and adaptive histogram equalization (AHE) are two methods widely used to modify the contrast of an image to produce a much better image. Seokjun et al., [14] proposed an enhanced method for text extraction and improve the text detection performance by using contrast-limited adaptive histogram equalization (CLAHE).

II.II.I Histogram equalization

Histogram equalization [9] is one of the well-known method for enhancing the contrast of given images, making the result image have a uniform distribution of the gray levels. It flattens and stretches the dynamic range of the image's histogram and results in overall contrast improvement. HE has been widely applied when the image needs enhancement however, it may significantly change the brightness of an input image and cause problem in some applications where brightness preservation is necessary. Since the HE is based on the whole information of input image to implement, the local details with smaller probability would not be enhanced.

II.II.II Adaptive histogram equalization(AHE)

AHE is an extension to traditional Histogram Equalization technique. Unlike HE, it operates on small data regions (tiles), rather than the entire image. The contrast of each region is enhanced, so that the histogram of the output region approximately matches the specified histogram. The neighboring regions are then combined using bilinear interpolation in order to eliminate artificially induced boundaries [9]. In adaptive histogram equalization, the main idea is to take into account histogram distribution over local window and combine it with global histogram distribution. The size of the neighbourhood region is a parameter of the method. It constitutes a characteristic length scale contrast at smaller scales is enhanced, while contrast at larger scales is reduced. When the image region containing a pixel's neighbourhood is fairly homogeneous, its histogram will be strongly peaked, and the transformation function will map a narrow range of pixel values to the whole range of the result image. This causes AHE to over amplify small amounts of noise in largely homogeneous regions of the image [15].

II.II.III Contrast Limited Adaptive Histogram Equalization (CLAHE)

CLAHE is an adaptive contrast enhancement method. It is based on AHE, where the histogram is calculated for the contextual region of a pixel. The pixel's intensity is thus transformed to a value within the display range proportional to the pixel intensity's rank in the local intensity histogram [1]. CLAHE, proposed by Zuierveld et al [17] has two key parameters: block size (N) and clip limit (CL). These parameters are mainly used to control image quality, but have been heuristically determined by users. CLAHE was originally developed for medical imaging [15]. CLAHE also had been claimed to improve the contrast better in the natural scene images [2], [8],[10] and [11] .

II.III Skew detection/correction

Due to the possibility of rotation of the input image and the sensitivity of many document image analysis methods to rotation of the image, document skew should be corrected. Skew detection techniques can be roughly classified into the following groups: analysis of projection profile, Hough transform, connected components, clustering, and Correlation between lines techniques. The survey by Hull and Taylor, investigated twenty-five different methods for document image skew detection. The methods include approaches based on Hough Transform analysis, projection profile, feature point distribution and orientation- sensitive feature analysis. The survey concluded that most of the techniques reported a range of up to 0.1 degrees accuracy, evidencing a strong need for further work in this area to help show the strengths and weaknesses of individual algorithms. Therefore, the choice of using a skew

detection/correction technique depends on the application and the type of images used.

III . PRE-PROCESSING IN TEXT INFORMATION EXTRACTION (TIE) SYSTEM

At first, it is important to change the RGB image to grayscale image for extract in the text from scene image quickly. The proposed system is used rgb2gray function for changed the RGB image to grayscale image. Noise removal technique is important in TIE system. In the proposed work Lucy richdarshan algorithm [1] is followed to remove the noise from natural scene images. The proposed work did not follow skew correction and detection because the experimental images are road signals. Generally road signal images did not have the skewed text. CLAHE algorithm is used for contrast enhancement which may give good contrast enhancement. So the enhancement in CLAHE algorithm may give best result. The following section converse about proposed technique for contrast enhancement named enhanced CLAHE. Original image is converted to grayscale image for reducing the complexity of enhancement.

III.I Enhanced Contrast Limited Adaptive Histogram Equalization (CLAHE)

CLAHE, proposed by Zuierveld et al [17] has two key parameters: block size (N) and clip limit (CL). The value, at which the histogram is clip-limit, depends on the normalization of the histogram and thereby on the size of the neighborhood region. Contrast of the image should be controlled by setting the clip-limit value. In CLAHE, block-size is one of the parameters. If a block-size is decreased, the contrast of an image is decreased too. So, it is found that the choice of block size and clip limit is very crucial for optimal enhancement using CLAHE. Seokjun et al., [14] used the value for system ,a clip limit 0.02 and a block size to 16x was chosen. In this proposed system N and CL are calculated automatically. In proposed system, N is computed from the maximum entropy of the image. Input image is subdivided into NxN matrix. CL is calculated from maximum height in the histogram of the image. At last, contrast enhanced image is obtained by applying CLAHE algorithm which uses automatically calculated value of N and CL.

Algorithm for enhanced CLAHE

Step 1: For n=0 to n=32 calculate entropy[n].
Step 2: Set N to the value for which entropy[n] is maximum.
Step 3: For each sub-image compute the histogram
Step 4: *set the clip level from high peak value of the histogram*
Step 5: Divide the input image into an NxN matrix of sub-images
Step 6: For each pixel in the input image, apply the CLAHE algorithm (by using CL and N which are calculated automatically)
Step 7: obtain the output image by enhanced CLAHE

IV. RESULT AND DISCUSSION OF CONTARST ENHANCEMENT FOR A SCENE TEXT IMAGE

In order to achieve higher recognition rates, it is essential to have an effective preprocessing stage, therefore; using effective preprocessing algorithms makes the text extraction system more robust mainly through accurate image enhancement, noise removal, skew detection/correction. Classical methods for contrast enhancement, noise removal and skew correction are discussed. Lucy richdarshan algorithm is used for removing noise from image and the output image obtained by Lucy richdarshan algorithm takes as input for contrast enhancement. A set of quality metrics such as, Peak Signal to Noise Ratio (PSNR), Signal to Noise Ratio (SNR), Structured Similarity Index (SSIM) and Mean square error (MSE) are used to measure the quality of enhanced image with respect to original image.. So ahigher PSNR value indicates the higher quality of the image (better). Here we have taken more than hundred images for experiment. Experimental images had given better result for enhanced CLAHE then other three methods called Histogram equalization(HE), Adaptive HE, CLAHE. With the intention of analyse the performance of proposed technique, the proposed and existing algorithms are applied to the road signal image as shown in Fig.3(a).


Fig.3(a)originaimage **(b) Gray Scale image**


(c)HE **(d) AHE**

(e)CLAHE **f)Enhanced CLAHE**

Original image is converted to grayscale image using rgb2gray function shown in Fig.3(b).The above images in Fig.3 (c), (d), (e), and (f) highly depicts that the proposed algorithm provide an efficient results for the given image than the existing algorithms.

Table 1 shows that the result of quality metrics for each techniques which are used to enhance the contrast of a scene text image. Table 1 shows the result for above image.

Table 1 : Quality metrics and techniques used to enhance the contrast of a scene text image

TECHNIQU-ES / MET-RICS	SNR	MSE	PSNR	SSIM
HE	15.2	0.978	17.6	16.5
AHE	16.8	0.911	18.8	17.2
CLAHE	17.3	0.892	20.5	19.3
Enhanced CLAHE	18.5	0.876	22.7	21.6

(HE - Histogram Equalization, AHE - Adaptive Histogram Equalization, CLAHE - Contrast Limited Adaptive Histogram Equalization , SNR - Signal to Noise Ratio, SSIM - Structured Similarity Index, MSE - Mean Square Error, PSNR - Peak Signal to Noise Ratio)

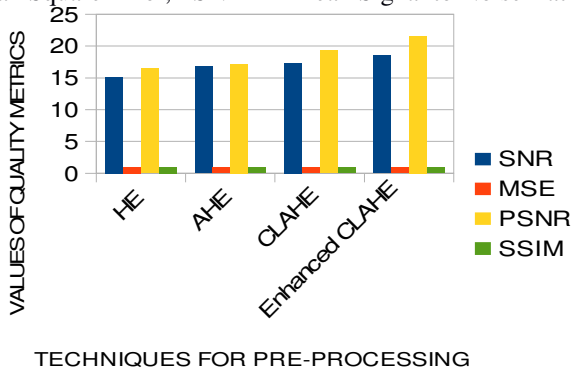

Fig 4.Performance Comparison between Techniques in different metrics

The Fig.4 depicts the result of different algorithms implemented in a road signal image. based on the table values. According to the chart, enhanced CLAHE shows the highest performance.

V. CONCLUSION

Each application may require different preprocessing techniques depending on the different factors that may affect the quality of its images, such as those introduced during the image acquisition stage. Image manipulation/enhancement techniques do not need to be performed on an entire image since not all parts of an image is affected by noise or contrast variations; therefore, enhancement of a portion of the original image maybe more useful in many situations. This is obvious when an image contains different objects which may differ in their brightness or darkness from the other parts of the image; thereby, when portions of an image can be selected, either manually or automatically according to their brightness such processing can be used to bring out local detail. In conclusion preprocessing is considered a crucial stage in text extraction systems from natural scene images and without it the success of such systems is not guaranteed.

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