OCR Image Enhancement & Implementation by using CLAHE algorithm

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OCR Image Enhancement & Implementation by using CLAHE algorithm

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ABSTRACT

India is the multi-languages country if any printed documents it has different texts with different languages. In this multi-languages nature, The Optical Character Recognition system is convent scanned text into an editable format. So, it is used to identify the different languages. The focus of this paper is discussing how to improve the feature of the image. The main challenge is the remove the noise and to improve the feature of image by using image enhancement techniques. As previously the image enhancement technique is regular Histogram Equalization(HE) algorithm is used in this up to mark not reached in order to increase the feature of the image contrast-limited adaptive histogram equalization(CLAHE) is used. By using this algorithm we can achieve and improve the image quality, this algorithm is used to Noise removal, contrast enhancement, binarization, etc. Enhanced images are automatically saved to the example output/ directory
Keywords: Optical Character Recognition tool, Image Enhancement tool

1. Introduction

Script recognition is a very main topic in image processing based automated Script analysis and identification. The main motive of script recognition is to translate people understandable documents to machine understandable codes. After completing the document image analysis next step of the OCR is very important that is pre-processing a technique in the pre-processing step used to remove the noise and blur in order to reduce the noise the image enhancement technique is used. Here the image-processing classifications are

- Image Restoration
- Image Enhancement
- Image Extraction

1.1 Image Restoration

The picture restoration is the basic step in OCR here the scanned document was stored in the database. There are different data bases available local types, Global type etc, in this paper am used take several different language documents like Hindi, English, Telugu, Tamil, Kannada etc. stored in local disk.

1.2 Image Enhancement

Picture Enhancement is basic step to enhance the recognition of document in images for human viewers and providing better input for the further image processing techniques like segmentation and recognition

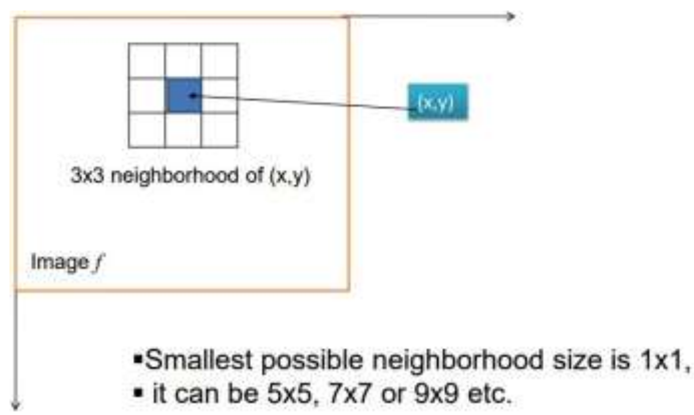
The main goal of enhancement is to improve the quality of the image which in the form of human perception. By using this picture enhancement noise image can be changed as understandable images.

Image Enhancement Techniques are

1. Spatial Domain (direct manipulation of pixels of the image)
2. Frequency Domain (modifying the Fourier Transform of an image)

Picture Enhancement in Spatial Domain

These techniques operate directly on the pixels. More efficient figures and requires less processing resources to implement Spatial Domain Process is defined by $g(x,y)=T[f(x,y)]$ here $f(x,y)$ is the input Picture $g(x,y)$ is the output Picture and T is an operator on f defined over a neighbourhood of point (x,y).



In the above figure shows 3*3 size pixels the center pixel shows $f(x,y)$ input image. The simplest case is thresholding where the strength outline is replaced by a step function, active at a chosen threshold value. In this case any pixel with a grey level below the threshold in the input image gets mapped to 0 in the output image. Other pixels are mapped to 255.

Other grey scale transformations are outlined in figure 1 below.

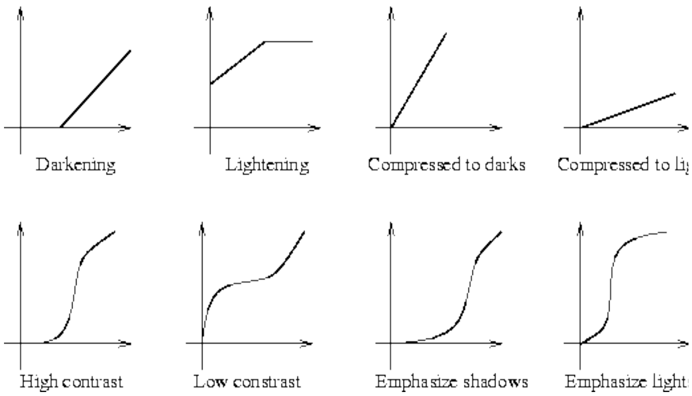


Figure 1: quality -scale variation

1.2Histogram Stabilization

Histogram Stabilization is technique for enhancing the appearance of images. For example the original image is taken as a dark image. Then its histogram would be skew towards the lower end of the grey scale and all the image detail is compressed into the dark end of the histogram. If we could `stretch out' the grey levels at the dark end to produce a more uniformly distributed histogram then the image would become clearer.

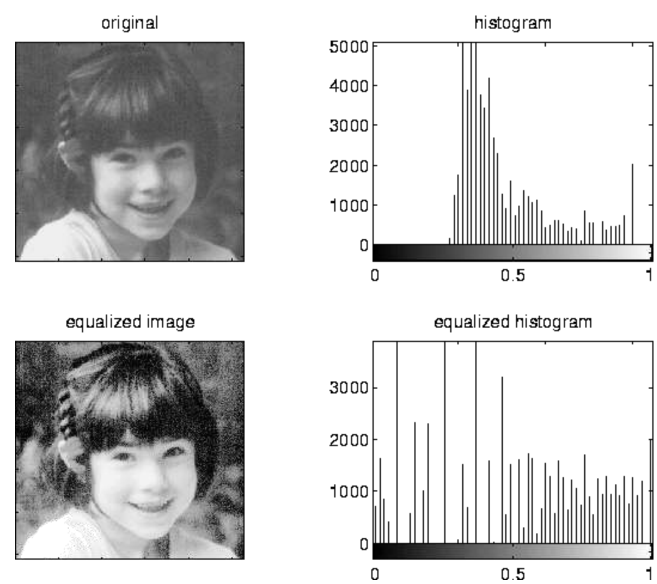


Figure 2: The dark image and its histogram, and the stabilized versions. Both images are quantized to 64 grey levels.

Histogram equalization involves finding a grey scale transformation function that creates an output image with a *uniform histogram* (or nearly so).

How do we determine this grey scale transformation function? Assume our grey levels are continuous and have been normalized in between 0 and 1.

We must find a transformation T that maps grey values r in the input image F to grey values s = T(r) in the transformed image $\hat{F}$.

It is assumed that

T is single valued and monotonically increasing, and

$0 \leq T(r) \leq 1$ for $0 \leq r \leq 1$.

The inverse transformation from s to r is given by

r = T-1(s).

If one takes the histogram for the input image and normalizes it so that the area under the histogram is 1, we have a probability distribution for grey levels in the input image Pr(r).

If we transform the input image to get s = T(r) what is the probability distribution Ps(s) ?

From probability theory it turns out that

$$P_s(s) = P_r(r)\frac{dr}{ds},$$

Where r = T-1(s).

Consider the transformation

$$s = T(r) = \int_0^r P_r(w)dw.$$

This is the cumulative distribution function of r. Using this definition of T we see that the derivative of s with respect to r is

$$\frac{ds}{dr} = P_r(r).$$

Substituting this back into the expression for Ps, we get

$$P_s(s) = P_r(r)\frac{1}{P_r(r)} = 1$$

For all s, where $0 \leq s \leq 1$.Thus, Ps(s) is now a uniform distribution function, which is what we want.

Discrete Formulation

To determine the probability distribution of grey levels in the input image.

$$P_r(r) = \frac{n_k}{N}$$

where nk is the number of pixels having grey level k, and N is the total number of pixels in the image.

The transformation now becomes

$$s_k = T(r_k) = \sum_{i=0}^{k} \frac{n_i}{N} = \sum_{i=0}^{k} P_r(r_i).$$

Note that $0 \leq r_k \leq 1$, the index k=0,1,2,…..255 ,and $0 \leq s_k \leq 1$

The values of s_k will have to be scaled up by 255 and rounded to the nearest integer so that the output values of this transformation will range from 0 to 255. Rounding of s_k to the nearest integer will mean that the transformed image will not have a perfectly uniform histogram.

Image Smoothing

The aim of image smoothing is to diminish the effects of camera noise, spurious pixel values, missing pixel values etc. There are many different techniques for image smoothing; we will consider neighborhood averaging and edge-preserving smoothing.

Neighborhood Averaging

Each point in the smoothed image, $\hat{F}(x,y)$ is obtained from the average pixel value in a neighborhood of (x,y) in the input image.

For example, if we use a 3*3 neighborhood around each pixel we would use the mask

1/9	1/9	1/9
1/9	1/9	1/9
1/9	1/9	1/9

Each pixel value is multiplied by 1/9, summed, and then the result placed in the output image. These processes continue until every pixel has been covered. That is, the image is *convolved* with this smoothing mask (also known as a spatial filter or kernel).

Smoothing attenuates the higher frequencies in the image. Edge preserving smoothing

Neighborhood averaging or Gaussian smoothing will tend to blur edges because the high frequencies in the image are reduced. An alternative approach is to use *median filtering*. Here we set the grey level to be the median of the pixel values in the neighborhood of that pixel.

The median m of a set of values is such that half the values in the set are less than m and half are greater. For example, suppose the pixel values in a 3*3 neighborhood are (10, 20, 20, 15, 20, 20, 20, 25, 100). If we sort the values we get (10, 15, 20, 20, |20|, 20, 20, 25, 100) and the median here is 20.

The result of median filtering is that pixels with outer values are forced to become more like their neighbors, but at the same time edges are maintain. Of course, median filters are non-linear. Median filtering is in fact a morphological operation.

Figure 3: Image of Genevieve; with salt and pepper noise; the outcome of averaging; and the outcome of median filtering.

1.3 Image sharpening

The goal of image sharpening is to enhance detail that has been blurred (perhaps due to noise or other effects, such as motion). By using image sharpening, we want to enhance the high-frequency components; this indicates a spatial filter shape that has a high positive component at the centre (see figure 4 below).

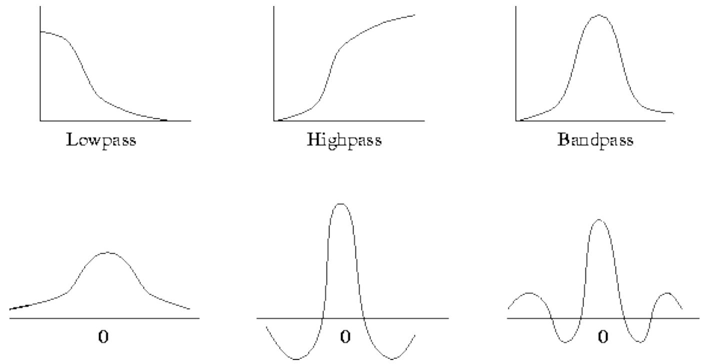


Figure4: Frequency domain filters (top) and their corresponding spatial domain counterparts (bottom).

Spatial filter that achieves image sharpening is given by

-1/9	-1/9	-1/9
-1/9	8/9	-1/9
-1/9	-1/9	-1/9

Since the sum of all the weights is zero, the out coming signal will have a zero DC value (that is, the average signal value, or the coefficient of the zero frequency term in the Fourier expansion). For display purposes, we want to add an offset to keep the result in the 0…255range.

High boost filtering

High pass filtering in terms of subtracting a low pass image from the original image, that is,

High pass image = Original image - Low pass image.

However, in so many cases where a high pass image is required, we also want to retain some of the low frequency components to aid in the interpretation of the image. Thus, subtracting the low pass image from original image. Here the original image is multiply with the amplification factor (A) ,we will get a *high boost* or *high frequency emphasis* filter. Thus,

$$\begin{aligned} \text{High boost} &= A.\text{Original - Low pass} \\ &= (A-1).(\text{Original}) + \text{Original - Low pass} \\ &= (A-1).\text{Original} + \text{High pass.} \end{aligned}$$

Now, if A = 1 then it is simple high pass filter. When A > 1 part of the original image is retained in the output.

A simple pass filter for high boost filtering is given by

-1/9	-1/9	-1/9
-1/9	ω/9	-1/9
-1/9	-1/9	-1/9

$$\omega = 9A - 1$$

2. EXISTING SYSTEM

To reveal these documents safely in public domain such as libraries, it is important firstly to enhance their clarity, visibility and improve the (feature) quality. To remove the noise and increase image quality appropriate filtering methods need to be developed. Further, there is a need to apply appropriate image enhancement techniques to enhance the feature of these documents. Image Enhancement improves the clarity of images for human viewing, removes blurring and attenuates the noise and increases contrast for revealing more details .Here the Global contrast enhancement may not be suitable for images of local details are necessary containing varying lighting conditions. it is possible to overcome limitation by using CLAHE

2.1 PROPOSED SYSTEM

The proposed methodology provides CLAHE method for local contract enhancement and it is useful in several computer visions, pattern recognition applications.

CLAHE consist in performing the histogram equalization of non-overlapping sub-areas of image, using interpolation to correct inconsistencies between borders. CLAHE has two important hyper parameters: the clip limits (CL) and number of tiles (NT).

This, method improve its appearance for interpretation and also increase the performance of subsequent tasks (image analysis, segmentation) of image or document.

Hardware Requirements: Processor - Intel core i3

RAM - 2GB Hard Disk - 20 GB

Software Requirements: Tool - MATLAB R2016 Operating system - Windows 7, 8

3. RESULTS

Hear the input image is noisy image in that there is impulse, salt& pepper noise image is given as input image by using CLAHE algorithm it removes the noise of the image

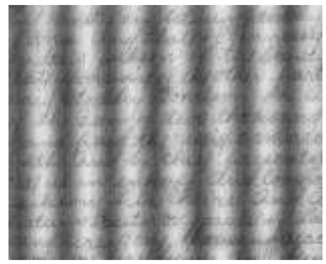
In the below images the first image tajmahal is noisy image is taken as input image and the output image does not having noise

Original noisy image (impulse/salt-and-pepper noise) Enhanced image

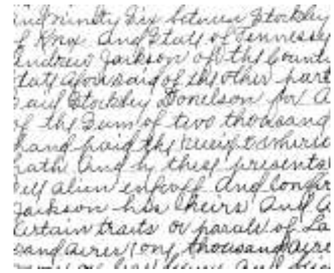
Input image

output image

Original noisy image Enhanced image



Input image



output image

4. CONCLUSION

The design meets the requirement of real-time image/video applications and is suitable to be employed in end-user camera equipment. In the future the illumination adjustment may be used to get the enhanced image in video. The experimental results demonstrate that our design requires the least computation load and achieves comparable performance in objective metrics and subjective image quality as compared with other image enhancement methods. by using this technique is easy to analysis next steps of OCR

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