

Image Enhancement by using Histogram Equalization Technique in Matlab

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Abstract— Image enhancement is to process an image so the result will be more suitable than the original image. While in image processing there is collection of techniques which is used to improve the visual form of an image. The main goal of the image enhancement method is to enhance the look and feature of the image. The improve image gave us a clear image to the eye. And also Image enhancement techniques are application dependent. In this paper we used image enhancement techniques by using histogram equalization techniques in Matlab.

Keywords—Image enhancement; Histogram equalization; Image negation; Frequency domain

I. INTRODUCTION

Image enhancement is the most and commonly used area in all digital image techniques. The goal of image enhancement is to show the unknown details in an image or to increase the contrast in a low contrast image. When we change the form of one image to another form of image just like digitizing the image so at output degradation will take place. Mainly, the thinking behind enhancement techniques is to show the detail information or to highlight the features of image to increase the interests. You can apply image processing in every field where image are to be implicit and analyzed. Such as Image analysis in Medical Field, Satellite Image analysis, etc. There are three types of image enhancement which are as follows:

A. Spatial Domain

It refers to the image itself approach is based on direct manipulation of pixels in an image.

Mathematically: $g(x,y)=T[f(x,y)]_{(1)}$

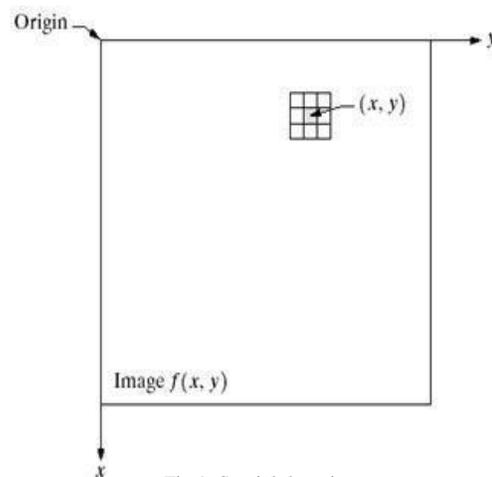


Fig 1: Spatial domain

B. Frequency Domain

It is based on to modify Fourier transform of an image.

C. Transforming Domain

Transformation domain techniques are suited for processing the image according to the frequency content [5].

II. MAIN METHODOLOGIES

A. Image Negation Method

In medical images making the major problem is the poor quality and contrast that's why medical images are expected more attention. For this purpose negative images are used to improve the poor quality and contrast of the image.

Mathematically: $S=L-1-r$ (2)
Where L = gray level range of the image r = input and s = output.

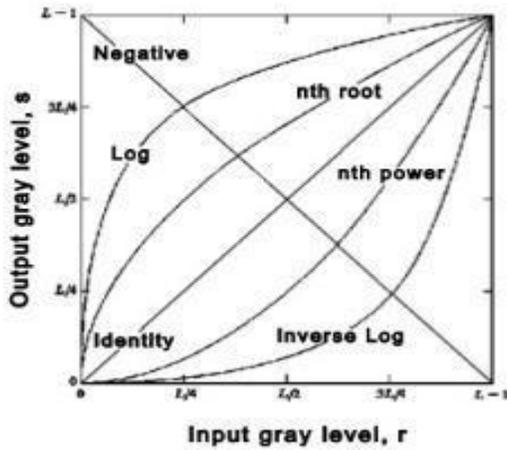


Fig 2: Negative Image Graph

B. Histogram Equalization Method (HE)

There are various schemes of enhancement are used such as filtering gray scale manipulation and histogram equalization (HE).Histogram Equalization (HE) is the image enhancement technique and it is most well known technique using for contrast enhancement because it is very simple method[6].

Here we have some different type of algorithms for (HE).

- Localized equalization
- Cumulative Histogram equalization
- Normalized cumulative Histogram equalization

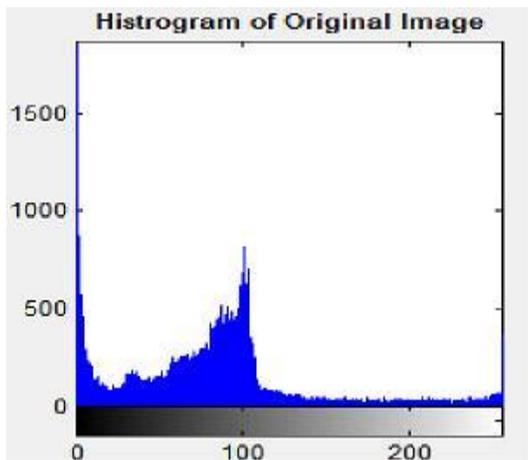


Fig 3: Histogram of Original Image

C. DWT (Discrete Wavelet Transform) based Method
It is a wavelet transform in which wavelets are sampled discretely[7].While aerial photographs which are taken from satellites act the visibility of these photographs can even reduce the visibility sometimes almost zero by an human eye because of conditions, fog etc. Human cannot see a lot of smoke that’s why useful information exists there in these conditions [1].

For visual quality of digital image of dynamic range to record it without any lighting and uniform condition we used a compression algorithm which is based on wavelet.

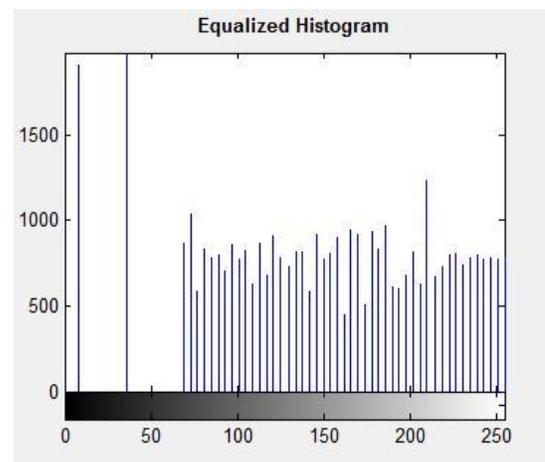


Fig 4: Histogram of Enhanced Image

D. BPHE Method (Brightness Preserving Bi Histogram Equalization)

A new extension of bi- histogram equalization called Bi-Histogram Equalization with Neighborhood Metric (BHENM) [8].The bi histogram equalization first convert the image into two sub images. The first one is the set of samples less than or equal to the mean of the image while the second one is the set of samples greater than the mean image. After this the BBHE equal the two sub parts based on their histogram respectively. The second part of the image is equal over the image and the mean of the first part of image is equalized to the mean by the over range from the mean respective histogram. The preserving of the mean brightness is occurring by the resulting the equal sub images which are bounded with each other with the input mean [2].

III. ENHANCEMENT PARAMETERS

Depending on the parameter value we can agree on at which point an image is enhanced.

A. Mean Square Error

It is denoted by “ $MSE = \frac{1}{MN} \sum_j \sum_k (f_{j,k} - g_{j,k})^2$ ”⁽³⁾

“j”= sum over, “k” =denotes the sum over all pixels, “m” =number of rows, “n”= number of column of each image[9].

B. Peak Signal to Noise Ratio (Psnr)

While in (8 bpp) images

$$Psnr = 10 \log_{10} \left(\frac{255^2}{Mse} \right)$$

It is measure of logarithmic, and to intensity our brains give the impression to take action logarithmically. The human observers will virtually indistinguishable two images when the Psnr is larger or equal to 40db.

C. Structural Content (SC)

Mathematically

$$SC = \frac{1}{MN} \sum_m \sum_n [I_1(m,n) - I_2(m,n)]^2$$

Image is of poor quality when the large value of (SC) appears.

D. Average Difference (AD)

$$AD = \frac{1}{MN} \sum_m \sum_n |I_1(m,n) - I_2(m,n)|$$

If the image quality is poor so it means the average difference value is large.

E. Absolute means brightness error (AMBE)

The variation among original and enhanced image and is given as

Mathematically

$$AMBE = |E(x) - E(y)|$$

F. Contrast

Contrast defines the variation among Minimum and Maximum level of intensity.

IV. APPLICATIONS

The major application is the use of this code in the field of biometrics, medical science and high-atmosphere.

A. Medical science

In medical imaging technology we used this program for to get the clear and improved image of the examination etc. For example, if we have a low contrast image or not clear image

just like blur image so we can use this technique to clean it and ready it for actual investigation. Also histogram equalization technique is used for it to improve the image form of a blur or low-contrast image just like an X-ray collected image etc.

B. Biometrics

For clear result of fingerprints the histogram equalization technique can be used.

C. Satellite and High-Atmosphere

This technique is also we use for unclear images which are captured in satellites so they need heavy processing to get or extract the data from it. By this technique we can get the clear and improved data of images which are taken from spacecrafts so then they will be easy to investigate.

V. PROBLEM DESCRIPTION

In this MATLAB code we are going to work on a problem which is common in medical field where we often get unclear and under processed images for examination purposes. It is actually an image enhancement program which will solve the problem of poor image quality obtained by devices in medical imagery field. Where we aim on doing is that we are going to take a grey-scale image of an object like in our example we will used a blur and unclear x-ray image and will try to enhance its features by creating its histogram, negative and equalized histogram as well as to obtain higher order detailing in the image so that precise examination could be done by this method. Problems which we are will solve in this paper are as follows:

Enhance the visual appearance of image

Increase contrast

DE blur image

A. Coding Explanation

Here we will show how we code our project which is as follow:

Gui_histogram

Gui_histogram(Figure file)

Myhist

Myhist1

The main goal of our paper is to code easy with detailing knowledge so that other users can understand it easily now we will explain what we did in this paper. We choose MATLAB because it is easy and its coding is better as it is easier to understand and work on image processing because of MATLAB built-in digital image processing toolbox for advanced work on image processing. In this code we first used the “UIGETFILE” syntax in file “myhist” to get any random image file for its processing ([file path] =UIGETFILE (*.*) ; f=imread (file) ;

We made our program easy to understand for everyone. For image reading we used command “imread” in any format but we have to write the “jpg, bmp etc” to load it in the program. Now to get the plot of histogram we used “subplots” command through this command we will get the subplot of histogram equalized (HE) image. Another file named “myhist1” in which we used the function of histogram equalization (*function [hist_eq,hist_img]=myhist1(img,jpg etc)* to get its size also used if else statement to see if the image falls under the value 3 then store image in variable.

The main part of this program lies in the “Gui_histogram” file where we have to used various functions to show and read images as well as to load the images with the figure file it is a collection of functions to call and handles to get the input values get. We can also call it for the negative image function from an external “m file” to process the output for a negative of image as well. We have also used the “hist callback” command for image call back functions as well as to process the image [6]. It also contains the image file type structure that is “jpg and bmp”.

VI. RESULTS

For brighter image, the histogram extend on the right side while for, darker image it will extend on the left side. If the quality of image is better than better the histogram. Histogram Equalization techniques is used for enhancement of poor

contrast image. In some exact condition, the background is about to washed out. In this satiation, Histogram Specification is the finest approach. The authors have taken the X-RAY skull and compare.

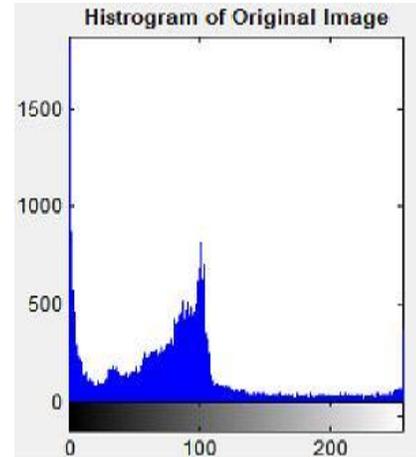


Fig 5.Original image

Here we took the histogram of the original image so as it is shown below in the image it extend towards the left side so it means that it is dark image.

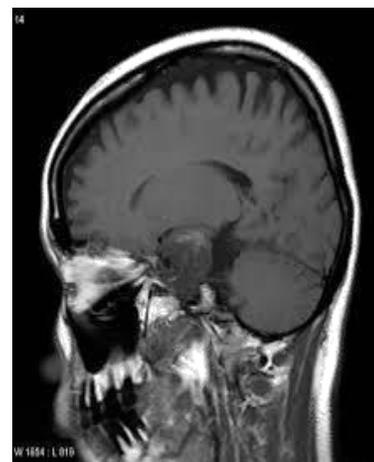


Fig6.Histogram of original image

Negative image are used to obtain photographic negative of an image so below is the negative image histogram.

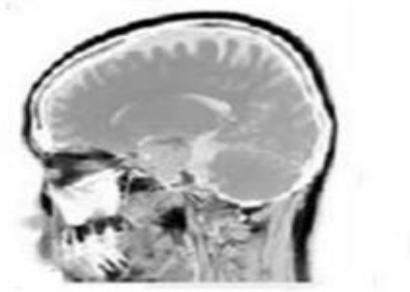


Fig 7.Negative image

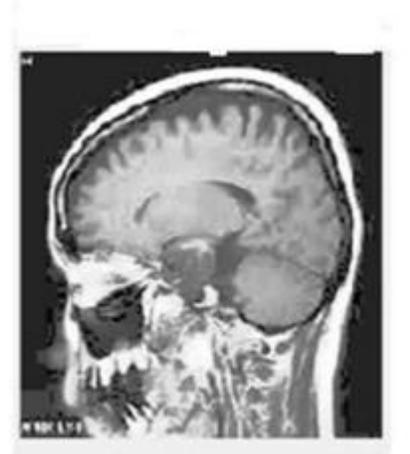


Fig8. Equalized image

As you see the upper image which is equalized image we were going to take the histogram of it. After the histogram it extend towards the right side which you can see below it means that it is bright image.

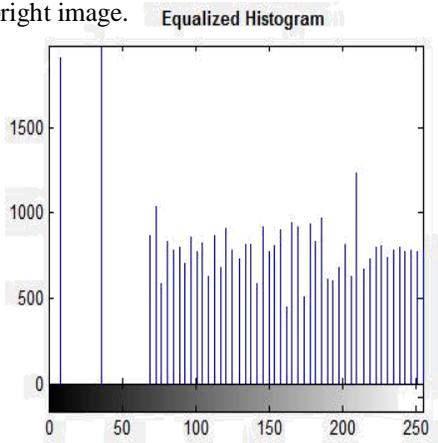


Fig 9.Histogram of Equalized image

VII. CONCLUSIONS

Image Enhancement is very easy simple and most interested area among all the techniques of digital image processing. The major goal of image enhancement is to give us detail which is hidden in an image. In this paper we used image of X-RAY grayscale image on which we apply the histogram and get the equalized histogram. So from here it could be conducted that image enhancement is a vast array of techniques and gave us very easy way to enhance any image just like low contrast image or blurred by using this technique we can make the image visible and sufficient for examination purposes. In our future work we will study these techniques more deeply and work on image processing techniques.

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- [9]https://www.google.com.pk/?gws_rd=ssl#safe=strict&q=mse stand for in image processing.