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Preprocessing Techniques for Enhancement of MRI Brain Images

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Abstract – Medical image processing plays an essential role in providing information in wide area for such advanced images. Magnetic resonance imaging (MRI) is an advanced medical imaging technique providing rich information about the human soft tissue anatomy. MRI of the brain is an invaluable tool to help physicians to diagnose and treat various brain diseases including stroke, cancer, and epilepsy. The specific information to evaluate the diseases. Histogram equalization is one of the important steps in image enhancement technique for MRI. There are several methods of image enhancement and each of them is needed for a different type of analysis. In this paper study and compare different Techniques like Histogram Equalization (HE), Local histogram equalization(LHE) and Adaptive Histogram Equalization (AHE) using different objective quality measures for MRI brain image Enhancement.

Keywords- Medical Image Processing, MRI Brain Image, Contrast Enhancement, Histogram Equalization.

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INTRODUCTION

Image processing is a vast and demanding area and applications used in various fields like medical images, satellite images and also in industrial applications. In our human senses eye is the most powerful sense. Obtaining and exploring images are forms a huge part of the habitual cerebral activity of human beings in their whole life time. The human brain is engaged in processing images from the image cortex. MRI of brain is an easy and effortless test that used to create in depth images of the brain. MRI machines that have bigger opening are useful for patients.MRI machines are situated in many hospitals and radiology centers. MRI of brain is able to evaluating problems easily such as persistent pain and weak points, and helps us to notice positive result for the patient.

The main function of image enhancement is to carry out the hidden part in an image or to enhance the low contrast image. The quality of the image gets better by contrast manipulation. A very well-liked performance for contrast enhancement is Histogram Equalization (HE). The most part of techniques is used, due to simplicity and moderately better performance on images .

The main objective of this work is to study and compare the Histogram Equalization basic methods like Histogram Equalization (HE), Local histogram equalization (LHE), using different objective quality measures for MRI brain image Enhancement.

This paper is organized as follows. Section II Introduces about the brain image Enhancement. Section III discuss about the Histogram Equalization Techniques. In this Technique some basic Techniques and the equations are explained. Sections IV discuss the Analysis of experiments and results for HE, the diagrams displays the Histogram Equalization for all the methods. Finally, Section V presents the conclusion.

II. BRAIN IMAGE ENHANCEMENT

Digital Image Processing (DIP) engages the modification of digital data for improving the image qualities with the aid of computer. The processing helps in maximizing clearness, sharpness and details of features of attention towards Information extraction and further analysis.

MRI is an experiment that applies a magnetic field with pulse of radio wave force to obtain pictures in the head. The diagnostic method that applies a mixture of a large magnet, radiofrequencies, and then the processor to create complete images of organs also structures in the body, which used to find flow of blood and also find the bleeding in the brain, and find

the injury in the head. In below diagram “Fig.1”shows the MRI brain image.

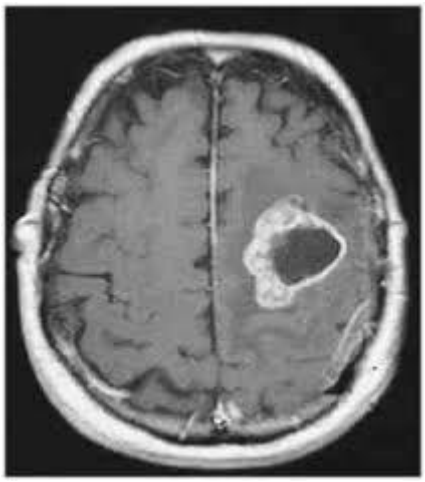

Figure 1. MRI brain image

Enhancement is the alteration of an image to adjust impact on the viewer. Generally enhancement alters the original digital values to bring out specific features of an image, and Highlight the certain characteristics of an image. The processed image is more suitable than the original image for a particular application.

The classical contrast enhancement is Histogram Equalization (HE), which has good performance for ordinary images, such as human portraits or natural images. Transformation of mapping of each pixel of input image into corresponding pixel of processed output image is called as Histogram Equalization.

III. HISTOGRAM EQUALIATION TECHNIQUES

Histogram Equalization (HE) and their complex methods are measured for contrast enhancement of the images. In this paper discuss about some techniques in HE.

A. Histogram Equalization

For a given image X, the probability density function p (X_k) is defined as

$$p(X_k) = \frac{n^k}{n}$$

For k = 0, 1… L – 1, where n^k represents the number of times that the level (X_k appears in the input image X and n is the total number of samples in the input image. Note that p (X_k) is associated with the histogram of the input image which represents the number of pixels that have a specific intensity. In fact, a plot of n^k vs. X_k is known histogram of X. Based on the probability density function, the cumulative density function is defined as

$$c(x) = \sum_{j=0}^{K} p(x_j)$$

Where X_k = x, for k = 0, 1… L – 1. Note that c(X_{L-1}) = 1 by definition. HE is a scheme that maps the input image into the entire dynamic range, (X_0, X_{L-1}), by using the cumulative density function as a transform function. Let’s define a transform function f(x) based on the cumulative density function as

$$f(x) = X_0 + (X_{L-1} - X_0)c(x)$$

Then the output image of the HE, Y = {Y (i, j}, can be expressed as

Y=f(x)

= {f(X (i, j) | $^{\forall}$ X (i, j) $^{\in}$ X}

The high performance of the HE in enhancing the contrast of an image as a consequence of the dynamic range expansion, Besides, HE also flattens a histogram. Base on information theory, entropy of message source will get the maximum value when the message has uniform distribution property. As addressed previously, HE can introduce a significant change in brightness of an image.

B. Local Histogram Equalization

Local Histogram Equalization (LHE) carries out block-overlapped histogram equalization. LHE classify a sub-block and recovers the information. Then, the histogram equalization is use full for the center pixel used in the CDF of the sub-block. Now, the sub-block is stimulated by one pixel and the sub-block histogram is repeated until the image achieve. LHE can not get used to well partial brightness in sequence, still more enhances some section depends on size of the mask.

$$s_k = c(r_k) = \sum_{i=0}^{k} p(r_i) = \sum_{i=0}^{k} \frac{n_i}{n}$$

C. Adaptive Histogram Equalization:

Histogram is the graph between gray levels and the number of pixels corresponding to that gray level. (i.e. frequency). It can be drawn by using MATLAB program or other software programs. The main purpose of drawing histogram is to know about the dynamic range of the image so that we may

device some techniques for the proper modification of its contrast. There are many image enhancement techniques which have been proposed and developed. One of the most popular image enhancement methods is Histogram Equalization (HE). HE becomes a popular technique for contrast enhancement because this method is simple and effective. HE technique can be applied in many fields like medical image processing, radar image processing, and sonar image processing. The basic idea of HE method is to re-map the gray levels of an image based on the image's gray levels cumulative density function.(CDF). HE flattens and stretches the dynamic range of the resultant image In HE; we obtain approximately a uniform probability density function (PDF). However, HE is rarely employee din consumer electronic applications such as video surveillance, digital camera, and television, since HE tends to introduce some annoying artifacts and unnatural enhancement, including intensity saturation effect. One of the reasons for this problem is that HE normally changes the brightness of the image significantly, and thus makes the output image to become saturated with very bright or dark intensity values. In order to overcome the aforementioned problems, mean brightness preserving, histogram equalization based techniques have been proposed in the literature. Generally, these methods separate the histogram of the input image into several sub-histograms, and the equalization is carried out independently in each of the sub-histograms.

Adaptive histogram equalization is a computer image processing technique used to improve contrast in images. It differs from ordinary histogram equalization in the respect that the adaptive method computes several histograms, each corresponding to a distinct section of the image, and uses them to redistribute the lightness values of the image. Ordinary histogram equalization simply uses a single histogram for an entire image.

Consequently, adaptive histogram equalization is considered an image enhancement technique capable of improving an image's local contrast, bringing out more detail in the image. However, it also can produce significant noise. A generalization of adaptive histogram equalization called contrast limited adaptive histogram equalization, also known as CLAHE, was developed to address the problem of noise amplification. CLAHE operates on small regions in the image, called tiles, rather than the entire image. Each tile's contrast is enhanced, so that the histogram of the output region approximately matches the histogram specified by the 'Distribution' parameter.

IV. RESULTS OF HISTOGRAM EQUALIZATION TECHNIQUES

In this paper, study and compare histogram based approach for contrast enhancement. These techniques are implemented in MATLAB V 7.12. The good contrast image is useful for detail analysis.. All the above methods are applied on different brain MRI images. In below diagram "Fig.2" shows the HE images with Histograms. and "Fig.3" shows that local HE images with Histogram, "Fig.4" refers that Adaptive HE images with Histogram. The proposed images without making any loss in image information.

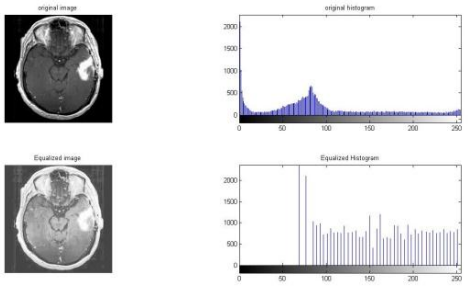

Figure 2. Histogram Equalization images with Histograms.

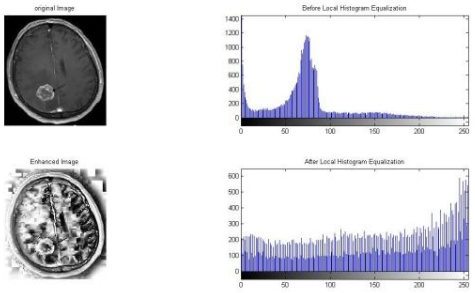

Figure 3. Local Histogram Equalization images with Histograms.

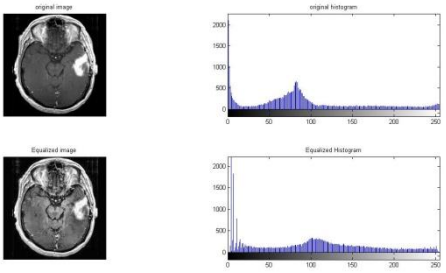

Figure 4.Adaptive Histogram Equalization images with Histograms.

V. CONCLUSION

In this work, image histogram based enhancement Equalization methods are compared for particular Enhancement like contrast of MRI brain image. More Popular HE methods like LHE and AHE are compared and some of MRI image data sets and

obtained results from the HE methods are processed under the Quality metrics and results are analyzed.

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