

# Brightness Preserving Contrast Enhancement of Medical Image Using Homomorphic Filtering and CLAHE

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**Abstract** - In this article, we recommend an effective way to get around improve the contrast of medical images. Improving image contrast is a pretreating step that improves the efficiency of other images Commercial applications such as pattern recognition and computers Sight. The proposed method improves the contrast and preserves the brightness of the given image using CLAHE and homomorphic filtration. It uses couple of steps treatment in the global image contrast in the first step is enhanced with the help of CLAHE and weighted probability distribution of luminance Pixels and then in the second step homomorphic filtering is used for Sharpen the image to maintain the brightness of the image Filter when an image normalization follows. Test result show that the proposed method can improve the contrast of medical images without significantly compromising brightness. It does the proposed algorithm is intended to be a flexible tool for the medical image Extension.

**Index Terms** - Image enhancement, HE, AHE, CLAHE and Homomorphic Filter etc.

## I. INTRODUCTION

Insufficient contrast in medical images reduces the ability by the observer when analyzing the image and in many cases it can Cause difficulties during subsequent processing. In the available We present different methods in the literature is used to enhance the medical image contrast. The histogram adjustment (HE) is one of the simplest and effective contrast enhancement techniques. The main reason he is so popular is (in) its simplicity Implementation and calculated cheaper than other methods. In HE, we reduce the number of gray levels by combining two or more common adjacent shades of gray Levels (with small probabilities) in gray level; We too Stretch high frequency intensities over a wide range of gray levels to achieve a comparatively flatter histogram. This flattening causes general improvement in the contrast

of the input image. To overcome the above limitations of the traditional HE method and make it more flexible, a number of HE-based methods proposed by different research groups [1]. To reduce the noise in the processed image, K. Zuiderveld introduces a new and effective method called Contrast Limited Adaptive Histogram Equalization (CLAHE). Various researchers later proposed variants of CLAHE, some of which are described in, here we propose a method called Brightness Preserving Contrast enhancement of medical images with Contrast limited adaptive histogram equalization (CLAHE) and homomorphic filtering (CLAHE-FIL) for medical images [2]. In the proposed method, we will first improve global contrast of the given medical image using our latest proposed framework for "Contrast Limited Adaptive histogram equalization" (in this Work for which we apply " Contrast Limited Adaptive histogram equalization " medical images with grayscale). Then we use homomorphic Filters to sharpen images and then to minimize Difference between input and processed image, average brightness, we normalize it.

## II. CONTRAST LIMITED ADAPTIVE HISTOGRAM EQUALIZATION (CLAHE) AND HOMOMORPHIC FILTERING

In this section we will completely describe proposed method Brightness Preserving Contrast Enhancement of Medical Images Contrast Limited Adaptive histogram equalization and Homomorphic Filtering (CLAHE-FIL). It has pair of steps. in first step whole contrast of image is modified using the Contrast Limited Adaptive histogram equalization and weighted probability distribution of brightness pixels and then in other one step homomorphic filtering is used for sharpening the image to retain image brightness this filtering if go along by image

normalization. Now we describe both of them in detail [3].

#### A. Contrast Limited Adaptive Histogram Equalization

Contrast-limited adaptive histogram smoothing (CLAHE) for compensating images. CLAHE is a variant of adaptive histogram compensation (AHE), which ensures an over-improvement of the contrast. CLAHE works on small areas of the image, called tiles, rather than the entire image. The adjacent plates are then combined with bilinear interpolation to remove the artificial boundaries [4].

#### B. Homomorphic Filtering

Although "CLAHE" is effective Method for improving the contrast of all types of images. To Images with very low contrast and complex structure Background as medical images, sometimes this contrast an improvement leads to the sound being improved in some cases important areas; therefore, to reduce the content of noise in improved image We apply homomorphic filtering. Homomorphic filtration is a well-known method Improve or restore the degraded, unevenly displayed images Information. This technology uses the reflectance of lighting Model in their business. This model takes into account that the image it was characterized by two main components [5]. The first Component is the amount of source lighting that falls on it the scene is seen in  $(x, y)$ . The second component is Reflection component of the object in scene  $r(x, y)$ . The Image  $f(x, y)$  is then defined as:

$$F(x,y) = r(x,y) I(x,y), \quad (1)$$

#### C. Image Normalization

For some image applications, it is necessary to keep this the average brightness of the processed image. In order to the average difference in brightness (between input and processing Image) as low as possible, homomorphic after application When filtering, we apply image normalization [6].

### III. LITERATURE SURVEY

Kitti Koonasanit et al. [7] This article presents enhanced image enhancement in digital chest radio using the so-called N-CLAHE method, which is based on global and local enhancement. The proposed technique consists of two main steps. First, one

encounters the intensity correction of the raw image by the logarithmic normalization function, which dynamically adjusts the intensity contrast of the image. Second, the CLAHE (Contrast Limited Adaptive Histogram Equalization) method is used to improve small details, textures, and local contrast of images. The proposed approach was tested using a radiographic examination phantom and a chest radiographic phantom and compared with traditional improvement methods such as histogram smoothing, blur masking and CLAHE. The results show that the proposed N-CLAHE method significantly improves pretreatment correction for digital breast radiography. He Wen et al. [8] this paper presents a for the medical X-ray image with low brightness, low contrast and noise, we have proposed an image enhancement algorithm based on homomorphic filtering in the wavelet range and contrast-limited adaptive histogram equalization (CLAHE). First, the image is broken down by the wavelet transform, the image is broken down to low-frequency and high-frequency coefficients for the first layer in the wavelet domain. Thereafter, the low frequency coefficients are processed through an improved homomorphic filter and then amplified linearly. The high frequency coefficients are processed by shrinking the wave plate threshold and then performing the wave plastic reconstruction. Finally, CLAHE (Contrast Limited Adaptive Histogram Adjustment) is used to change the histogram of the image and the processing of the image is complete. The quality of image enhancement is taken into account in the subjective and objective evaluation and compared with certain other enhancement algorithms. Experimental results show that the algorithm can effectively improve the structural details of medical X-rays, increase brightness and contrast, suppress noise, better than the general conventional enhancement algorithms. Rahul kumar et al. [9] The main purpose of this essay is to improve the perceptual quality of images generated by CT scanning. Various techniques have been used to achieve the goal, but the main technique used in the proposed approach is to apply a laplacian filter for positive slope edges as well as negative slope edges along with CLAHE and Gaussian filtration. The Laplace approach has been used by various experts, but in this proposed work, a Laplace approach was also applied to the negative slope edges. Thus, both edges are marked with a positive slope and the edges with a

negative slope are equal. As a result, this approach helps a medical expert obtain more detailed information from the computed tomography image.

Tarun Kumar Agarwal et al. [10] In this paper, Here we propose a new one Method called Modified Histogram Based Contrast Improvement by homomorphic filtration "(MH-FIL) for medical images. This method uses two-step treatment The first step also improves global image contrast Histogram modification followed by histogram adjustment and then, in the second step, homomorphic filtration is used for Image sharpening, this filtering when followed by the image Normalization. To evaluate the effectiveness of our method We choose two commonly used measured values for absolute mean values Light error (AMBE) and entropy. Based on results Of these two measurement values, this algorithm has proven to be flexible and effective way for medical image enhancement and can can be used as a pre-treatment step for the medical image Understanding and analysis.

Shailesh kumar et al. [11] this paper proposes a Fundus retinal images regularly experience the negative effects of uneven light, poor contrast and noise. This requires the implementation of appropriate pre-processing techniques to improve image quality. The pretreatment technique includes methods for noise removal as well as for contrast enhancement. Fundus images are often altered by impulse sounds. Meanwhile, the quality of the retinal fundus image suffers due to uneven lighting and poor contrast due to the anatomy of the eyes. This article introduces the performance evaluation of common noise filtering and histogram smoothing techniques to improve the overall quality of the retinal fundus image. In the first phase of the work, two new noise filtering methods will be implemented, namely NAFSM filters and block matching and 3D filter techniques (BM3D) for noise reduction. The second step examines histogram smoothing (HE), adaptive histogram smoothing (ADHE), contrast-limited adaptive histogram smoothing (CLAHE), and exposure-based sub-picture histogram smoothing technique (ESIHE) to obtain the most appropriate combination of filter and HE imaging methods to enhance retinal imaging. The performance evaluation of these techniques was performed by determining the performance parameters such as histogram, SNR, entropy, absolute average

brightness error and peak signal-to-noise ratio (PSNR) from processed retinal fundus images.

#### IV. PROPOSED WORK

Here we proposed an systematic method to enhance contrast of medical images and preserving brightness, contrast enhancement of a image is a pre-treating step where efficiency of other image is enhanced such as recognition of pattern and computer vision. Along with contrast our proposed method able to preserve brightness as well contrast an of given image using homomorphic filtering and CLAHE. Figure 1 shows our proposed work and each function is described above with details.

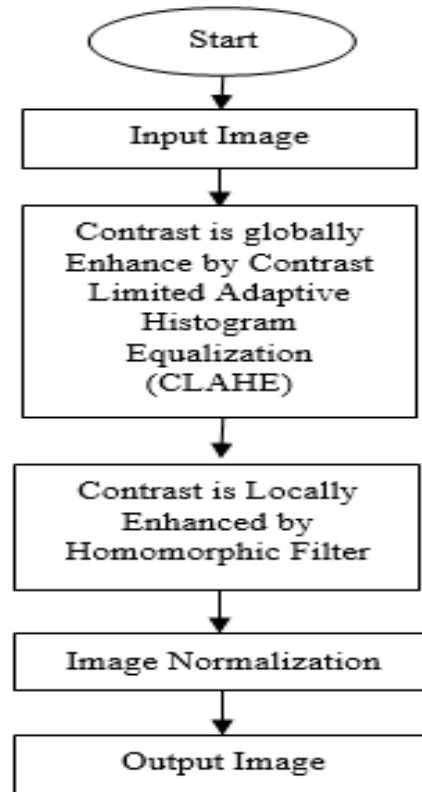


Figure:1 Proposed Method

#### V.RESULT ANALYSIS

In our result analysis we took the MRI Image of The Brain where we are going to enhance the MRI image without damaging original attributes of image. We will increase the contrast of the image and preserve brightness of MRI image using CLAHE and homomorphic filter and obtain parameters like PSNR

and AMBE value where highest value of PSNR and lowest value of AMBE indicated that image is enhanced good.

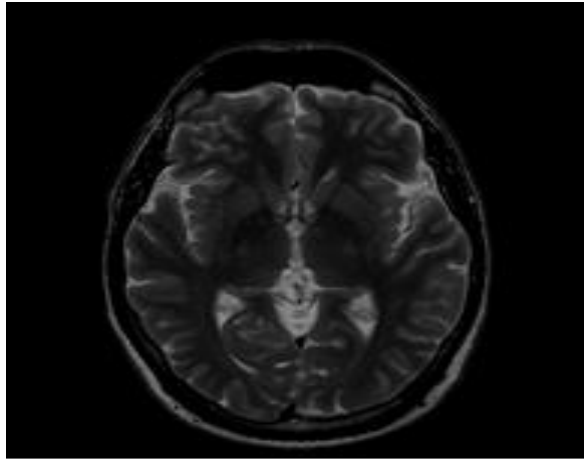


Figure 2 Original Image

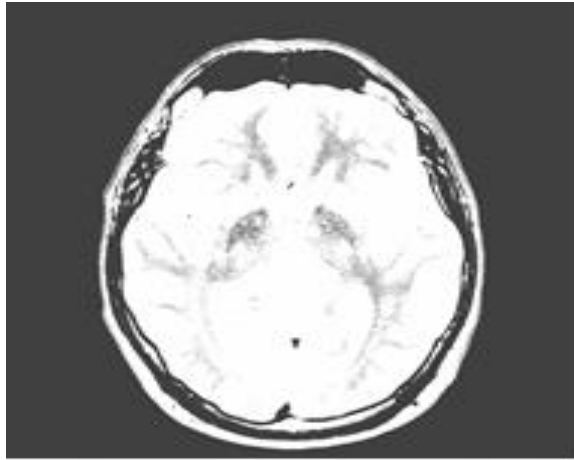


Figure 3 Histogram Equalization

Table-1 Result of HE applied method

MSE	SSIM	AMBE	PSNR
8.5241	0.4826	46.4352	9.9824

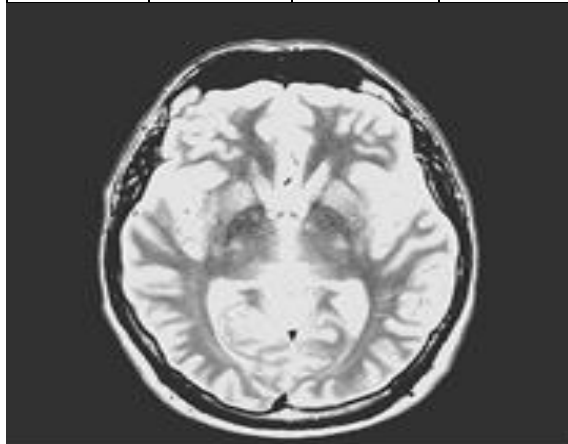


Figure 4 Adaptive Histogram Equalization

Table-2 Result of AHE applied method

MSE	SSIM	AMBE	PSNR
7.5241	0.3785	39.5241	14.2641

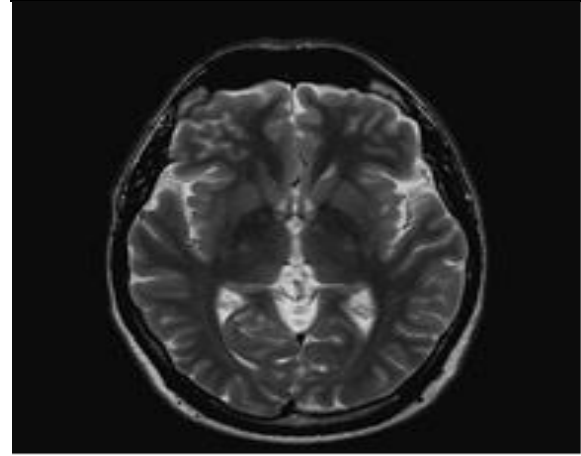


Figure 5 CLAHE

Table-3 Result of CLAHE applied method

MSE	SSIM	AMBE	PSNR
6.4178	0.2548	22.4394	25.6374

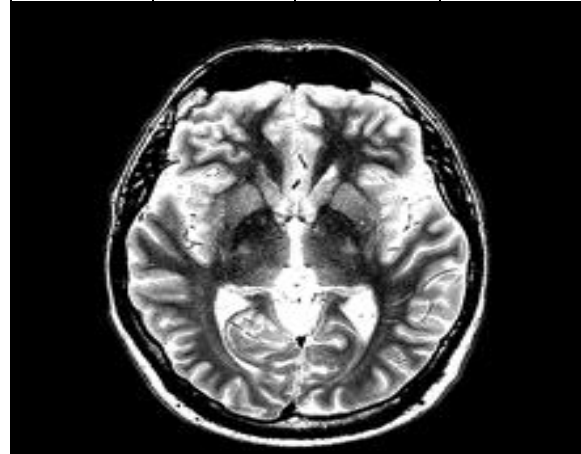


Figure 6 Proposed Method

Table- 4 Result of Proposed applied method

MSE	SSIM	AMBE	PSNR
4.6852	0.2348	19.5674	29.5761

Table- 5 Comparing all result including our proposed Method

Figures	Methods	MSE	AMBE	SSIM	PSNR
3	HE	8.5241	0.4826	46.4352	9.9824
4	AHE	7.5241	0.3785	39.5241	14.2641
5	CLAHE	6.4178	0.2548	22.4394	25.6374
6	Proposed	4.6852	0.2348	19.5674	29.5761

CONCLUSION

We took MRI image of brain where we applied several methods like histogram equalization, AHE, CLAHE along with our proposed method Where we can observe better and enhanced result by our proposed method and clearly see every scale of brain easily and understand. Because too much brightness and contrast can change the real attribute of the structure of brain because structure of brain is quite complex than any other body part so make sure it is very important to enhance the picture Based on the results, it can be concluded that quality of the enhanced image for the proposed method is much better with the lowest MSE AMBE and highest PSNR compared to the other methods which we described above. The proposed method can improve the screening process, where each and every detail must be visible and instead of our proposed method all of them are not justifying the better visibility of our brain image.

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