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High Contrast Limited Adaptive Histogram Equalization in Digital Mammogram

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Abstract

Medical Image processing is a best possible solution for different issues particularly in the medical field. At present, mankind all through the world is influenced with one or different sorts of cancer. It is ubiquitously throughout that the breast cancer is a major cause of death among ladies. Early discoveries and screening of cancer is enormously builds the odds for fruitful treatment. Mammography is generally used test by radiologists for screening and diagnosis of breast cancer. This paper proposed modified ie. High Contrast Limited Adaptive Histogram Equalization method (HCLAHE). The presented study outcomes were compared with existing techniques CLAHE and generate an image with similarly disseminated brightness intensities above the complete brightness range. New Histogram equalization augments contrast for brightness standards near to histogram maxima, and reduced contrast near minima. Absolute Mean Brightness Error and entropy in evaluation in this study is carried out on the platform of HCLAHE image processing. It has great impact on the feature of decreasing the divergence among input plus output images absolute mean brightness error and it shows higher entropy to extract more possible information lies in variables to reducing visualization problems.

Keywords*: Mammography, CLAHE, HCLAHE, Breast cancer, Intensity*

1. Introduction

Breast Cancer is common leading disease among ladies. It drives the need of effective tools to find out the breast cancer from mammographic image processing technique. Other than skilled diagnosis, present world basically needs suitable conveyance of the reports of the cancer detection detail to the professionals for timely treatment consequently to spare the life of the suffering individual. Mammographic detection may not save the patient's life without making delay, but turn down to five to seven years from the start of screening [1]. Indian women are less liable to develop the breast cancer when compared with western people. Early breast cancer comprises only 30% of the cases accounted from various parts of India, In contrast to 60-70% of cases in developed world [2]. Over 70% of the women with advance stage of disease [2] which is the major factor following the elevated rate of death rate among women [3-4].

Preprocessing mammogram is measured as a considerable step in image analysis. The meticulousness of this step decide the possibility of accomplishment of the remaining processes such as segmentation, classification etc. Unidentified noise in image, reduced image contrast, in homogeneity, feeble boundaries and independent elements are general traits of clinical images. It influences the stuff of the medicinal films. These matters can be rectified by pre-processing. It involves grayscale contrast, enhancement, image re-sampling, manual correction, noise removal and mathematical operation [7].

Contrast is a key attribute of an image that differentiates the existence of different objects in it. Histogram equalization is a extensively used technique in contrast augmentation, but at times it upshot by reducing the quality of image. To, overcome this problem an adaptive histogram equalization method is employed [8]. It enhances the contrast of every RGB channel independently by doing histogram equalization depend on the light intensity principles of discrete frames of the

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mammogram. In this study, Absolute Mean Brightness Error and Entropy were used to weigh up maximum accuracy attained by the HCLAHE, and the outcome of study analyzed with previous reports.

2. Literature Review

A variety of image processing and classifier technique were developed for clinical diagnosis of cancer. Projected entropy–preserving and mapping of contrast improvement, it focuses on making fine texture in an image to point out the enhancement of image contrast [9]. The assortment contrast limited adaptive histogram equalization (CLAHE-mix) to augment image visibility and decrease the noise plus artifacts in image. Processing improved by incorporating the CLAHE-RGB and CLAHE-hue-saturation value (HSV)-employing images by means of Euclidean norm. Though, the image turn out to be progressively greener and produces elevated noise intensity by showing less peak signal to noise ratio [12].

The 3D addition of CLAHE was lately initiated [11] for processing and the algorithm apply volumetric source to work out the confined histograms with tri-linear interpolation to originate the voxel wise intensity mappings from very close neighbor essential part. The outcomes were explained on Magnetic Resonance Imaging data, it shows enhanced contrast than employing 2D CLAHE separately.

Contrast limited adaptive histogram equalization (CLAHE): Contrast differences of every pixel, comparative to its restricted neighborhood are adaptively improved in this process [12]. An effort to brightness conservation with contrast augmentation was anticipated, [13] augmentation of image is attained by separating the histogram of input image with mean as dividend [11]. Fuzzy methods in calculating the clip boundary of Contrast Limited Adaptive Histogram Equalization is introduced [14]. These systems take priority over the labor-intensive surroundings of brittle snip boundary [11].

Processing and analyzing methods of image improvement are separated into spatial domain enhancement plus transform domain enhancement distribution. Adaptive histogram equalization (AHE) [15] coming under the spatially non consistent augmentation method. These techniques employ an input output modification that differs adaptively with the nearer characteristics in the image. AHE employs in the vicinity undependable gray-scale transformation on every petite section of image and it do not entirely get rid of noise improvement in smooth regions in image. The noise in the background is eliminated employing median filter and wiener filter, contrast improvement is made using CLAHE techniques, the region of interest detected using segmentation by otsu's thresholding algorithm [16]. Combinations of methods for filtering and contrast enrichment in mammographic images were evaluated by the machine made processes of the signal-to-noise ratio (SNR), peak signal-to-noise ratio (PSNR). De-noising carried out by wavelet transform with an automatic threshold, while, the contrast enhancement is by CLAHE algorithm [17].

Histogram equalization (HE) is a extensively used as contrast enrichment technique for images and to attain a distinctive input to the output contrast transfer function. HE extends over an increasing area and flattens the histogram of the number of image pixels at every gray level rate [18]. The foremost design in adaptive histogram equalization (AHE) is to take into account histogram sharing over the local window and amalgamate it with global histogram distribution. The modified CLAHE algorithm differs from standard HE. CLAHE works on small regions of the image said to be tiles, and computes quite a few histograms, each equivalent to a distinct slice of the image and employ them to reallocate the lightness values of the image [19-21].

3. Methodology

The proposed and modified algorithm is to improve the image contrast and intensity level of the images.

The study divides the image into several non over lapping regions of approximately equal sizes, and adds 3x3 masks to each and every region. Then calculate the histogram of each region.

The proposed algorithm read and analyze the outcomes of the images, were compared with the Contrast

Limited Adaptive Histogram Equalization (CLAHE).

Step1: Image reading.

Step2: Identify variable that is used to display the histogram image.

Step3: Split the image into specified number of region.

Step4: Include 3X3 mask with every region.

Step5: Compute the intensity.

Step 6: Restore the enhanced image.

Step7: Use MATLAB to calculate the evaluation method.

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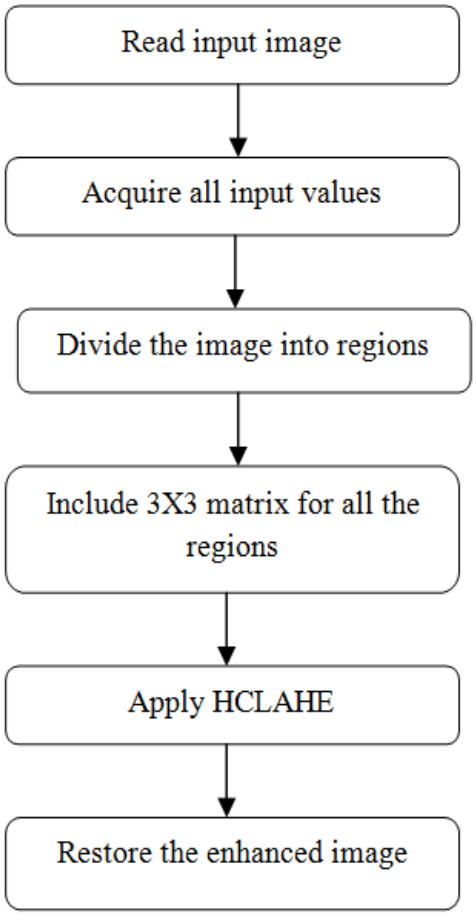

Figure 1: Work Flow of the proposed system

4. Performance Criteria

In Mammography image preprocessing techniques, the following two evaluation experimental systems are used to compare existing and proposed method.

Parameters: Following parameters are employed to assess the superiority of the processed image.

A. Absolute mean brightness error (AMBE): It is used to compute brightness intensity conservation in the processed image. AMBE described as: AMBE (I, J) = | IM - JM |.Where IM is the average intensity brightness of input image I= {I(x, y)} and JM is the average intensity brightness of output image J = {J(x, y)}. Minimum brightness error means better brightness preservation.

B. Entropy*:* The entropy is used to measure the richness of the details in the output image. Given Probability Density Function (PDF) p, entropy: Entropy[p] is computed by Entropy [p] = - Σk=0 to L-1 p(Xk) log2 p(Xk) , where p(Xk) is probability mass function of image histogram.

5. Evaluation

Image Acquisition

The CLAHE algorithm is enhanced in the present study to improve the intensity level of the image. The breast cancer mammography patient sample pictures necessary for the proposed present study has been obtained from the Mammographic Image Analysis Society (MIAS). It is UK based science community anxious with the study with the understanding of mammograms, and they established a digital database of mammogram images contains 322 images with the quality of 1024 × 1024 pixels; it contains abnormality information's in mammogram images, i.e., class of cancer, rigorousness of the cancer determination.

Results

In this research study, the proposed technique was implemented for randomized five images in Mini MIAS Database. The performance criteria absolute mean brightness error and entropy are compared to existing method are tabulated in Table1 and Table 2.

Table 1: Absolute mean Brightness error

Image	CLAHE	HCLAHE
Image1	39	26.77
Image2	45	31.98
Image3	49	34.56
Image4	55	38.92
Image5	58	44.56

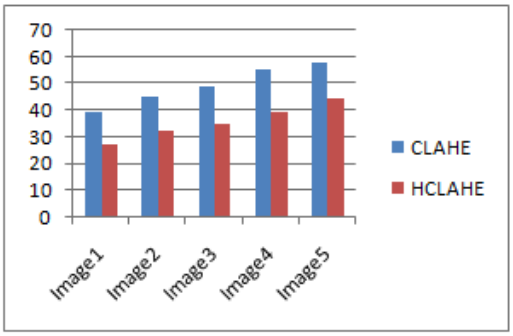

Figure 2: Absolute mean brightness error

Table 2: Entropy

Image	CLAHE	HCLAHE
Image1	0.04	0.13
Image2	0.08	0.2
Image3	0.13	0.28
Image4	0.19	0.39
Image5	0.22	0.45

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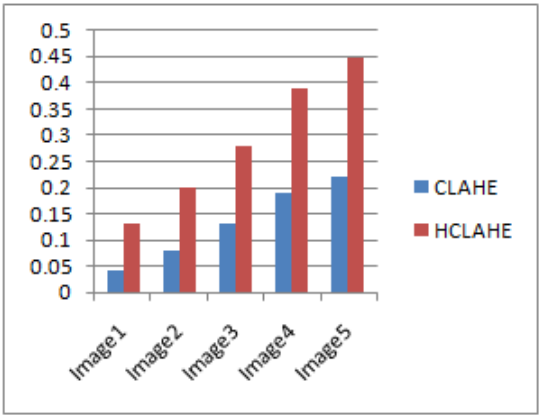

Figure 2: Entropy

In the mammogram image analysis perspective, the numerical data of an image normally refers to a numerical data of the pixel intensity values. Now we compare the intensity level of existing and proposed method.

Table 3: Intensity Level

Image	CLAHE	HCLAHE
Image1	7.83	28.23
Image2	14.44	36.5
Image3	21.87	43.7
Image4	29.9	50.1
Image5	36.43	58.26

Figure 3: Intensity level

6. Experimental Results

To evaluate the proposed HCLAHE algorithm quantitatively experiments on different mammographic images were carried out. The proposed technique implement in MATLAB 2018 software.

These two quantitative metrics not only considered for the account of augmentation impact but also get into consideration of the problem of noise understanding. It is evident that the results of present investigation shown in Table 1 and in table 2 these studies showed that the projected methods provided greater assessment of entropy and lower the value of factor that interfere with the quality analysis of mammogram image by computation, i.e., absolute mean brightness. The out puts shown by the proposed algorithm proves the effectiveness in image processing and improving digital quality of mammogram image processing by computation. The output shows the efficiency of the proposed technique in improving the visual quality of digital mammogram images.

7. Conclusion and Future Work

The results of plant study by this manuscript, improved algorithms of high contrast limited adaptive histogram equalization image augmentation method can be adopted in enhancing the visual superiority of mammogram images. Experimental result proves the processing ability of employed method in this study in augmenting the contrast of mammogram images. In future, the proposed study plane can be extended for the processing of colored and diverse images of suspected cases.

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