Mammogram Images enhancement Using Fuzzy Histogram Equalization Technique

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Abstract

The most common cause of death in women produced from breast cancer. Now days, the main challenge in the breast cancer detection image is low contrast and poor quality therefore, enhancement the breast cancer is required. Digital mammography breast masses images can be improved using the technique of fuzzy histogram equalization. Comport to the well-known histogram equalization enhancement technique (Classical Histogram Equalization (CHE) and Adaptive Histogram Equalization (AHE).

Fuzzy histogram equalization is based techniques which pay more attention because of its performance and the contrast of the image is adjusted contrast approaches enhancement. The proposed Analyses will help the doctors to improve the diagnosis of the disease to detected cancer cells and the comparative output images using quality assessment include (MSR, PSNR, RMSE, and UQI). The software tool that has been used is MATLAB 7.0 to evaluate the performance of the algorithm, many images containing masses of mammogram image were taken from Baghdad Madina Al-tab and Kirkuk hospital but display only three. From the results we that found fuzzy histogram equalization algorithm better perform than the others histogram equalization and are important with extract features from biologic images.

Keywords: Enhancement, Histogram Equalization**,** mammography image, Fuzzy image enhancement**,** Breast cancer image quality.

تحسين صور جهاز التصوير الشعاعي لسرطان الثدي باستخدام تقنية تسوية المخطط التكراري الضبابي

الخلاصة

السبب الأكثر شيوعا للوفاة في النساء تنتج من سرطان الثدي في الوقت الحالي والتحدي الرئيسي في صورة الكشف عن سرطان الثدي هو تباين منخفض وضعف الجودة لذالك مطلوب تحسين صور سرطان الثدي.الصور الناتجة عن جهاز التصوير الشعاعي للثدي يمكن تحسينها باستخدام تسوية المخطط التكراري الضبابي ومقارنته مع طرق تسوية المخطط التكراري(الاعتادية والمعدلة). تقنية التحسين باستخدام تسوية المخطط التكراري الضبابية تولي مزيدا من الاهتمام بسبب أدائها وتباين الصورة يتم تحسينه . التحليلات المقترحة تساعد الأطباء لتشخيص المرض والكشف عن الخلايا السرطانية والصور الناتج تم مقارنتها باستخدام7.0 MATLAB) .الاداة البرمجية المستخدمة (MSR, PSNR, RMSE, and UQIتقييمات الجودة التي ولتقييم أداء الخوارزمية استخدام العديد من الصور التي تحتوي على كتل خبيثة الماخوذة من جهاز التصوير الشعاعي للثدي من بغداد (مستشفى مدينة الطب)ومستشفى كركوك من التصوير الشعاعي للثدي المأخوذة من وعرضت ثلاثة فقط من النتائج وجدنا أن تقنية التحسين باستخدام تسوية المخطط التكراري الضبابية يحقق أداء أفضل من غيرها من تقنية التحسين باستخدام تسوية المخطط التكراري لاستخراج ميزات من الصور البيولوجية

Introduction

Diagnosis and treatment is highly dependent on medical images and explaining these models is very useful and helps health care students in their studies. In recent years the great advances in digital imaging techniques create great growth in a number of digital visualization methods [1]. The interpretation and analysis of medical images represent an important and exciting part of computer vision. Medical imaging (which is the technique and the art of creating a visual approach to the internal representation of the body and analysis of clinical and medical intervention) seeks to diagnose and treat the disease and to detect the hidden structures of the skin and bones [2]. Medical image analysis techniques have played an important role in several medical applications [3].

Mammography is the primary screening method for early detection of breast cancer, which is a major health problem for women. Mammography which given images of tumors that are not correctly visible .There are two kinds of tumor benign or malignant species. The cells in benign tumors have natural form and the cells will increase slowly but it does not propagation to other parts of the body and it is not cancerous [4], [5]. But malignant tumors could spread to other parts of the body can spread malignant tumors. Mammography is the more challenging space in medical imaging. Early detection of breast cancer using radiography using low-energy x-rays for imaging and human breast testing for soft detection of small calico deposits. In this sense, a digital image enhancement plays an important role to reduce the noise level of the digital image which maintains mission details and enhancing the contract to improve the detection of mammographic characteristics [6].

There are many different techniques for enhancing the quality of an image [7–11], which allow the observer to better perceive the desirable information in the image. These techniques often have parameters to control the enhancement process and its outcome.

Mammogram Image Enhancement

An optical image has rich in information and a lot of Real world photos have a low contrast and less quality, sometimes eyes of human unable reading X-ray or medical images. Enhancement of Image is one of a classic problem in computer vision and image processing. Enhancement of image using

broadly as step of preprocessing for texture synthesis, recognition of speech, and a lot of applications. to show out image details that are hidden or making a plus contrast in image with a low contrast using image enhancements [12]. In order to provide the best input to other image processing techniques and improve the interpretation of information by the viewers we can be using the enhancements images [13].Enhancement technologies of Medical image have attracted a lot of interest since advanced medical equipment use in the medical field. Enhanced medical images is required to help the surgeons for diagnosis and interpretation because the qualities of medical image are often had been deteriorated by noise and data have get by devices, conditions of illumination, etc.. Also goal of enhancement of medical image are basically to solve problems for medical image which has low contrast. Image enhancement is improvement of image quality without know the source of image degradation [14]. Making the resulting images more suitable for the

specific application of the original image is the main objective of image enhancement [13].

Techniques of Enhancement

The goal objective of an image enhancement is getting the hidden image details or contrast in image more with a new dynamic range. Histogram equalization (HE) is one the popular techniques used in image contrast enhancement, since HE is quick and simple in computationally execution [15, 16]. Enhancement of Histogram Based Contrast had used in this work are:

Classical Histogram Equalization (CHE)

CHE is the fundamental technique used in digital image processing when image level are prepare. The goal of this technique is distributing number of image levels over a range uniformly, this lead to enhancing contrast. The cumulative density function (CDF) is given by the below mentioned formula [15]:

$$C_i^{0(I_s,I_f)} = \sum_{i-I_s}^{I_f} P_i^{I[I_s,I_f]} = \frac{i-I_s+1}{I_s-I_f+1} \quad \ldots\ldots\ldots (1)$$

The CHE technique attempt to obtain an output image with a flat histogram that means a uniform deviation. Consists the image by the dynamic scale of number of gray levels. Fundamentally for entire gray levels denoted by 0 to L −1 [15].

Adaptive Histogram Equalization (AHE).

The second technique which improves contrast of an input image is Adaptive Histogram Equalization (AHE). By computes number of ordinary histograms, each histogram is related to a specific portion of input image. Then, results of every histogram is redistributing of gray level values. It is suitable to fetch clear details and adjust the local contrast. The other side, AHE is accountant for a lot of magnification for noise in some areas of an Image which homogeneous. Bypass this impediment by using an advanced version of AHE, which is named Contrast Limited Adaptive Histogram Equalization (CLAHE) had introduced [17].

Fuzzy image enhancement

image enhancement using Fuzzy technique is done by map drawing gray level intensities for image into a fuzzy plane done this by membership functions, for contrast enhancement the membership functions are modified ,to get gray level intensities of image the fuzzy plane is mapped back. The target is produce image has contrast larger than the original image by

giving higher weight for gray levels of image which near to the mean gray level than those far from the mean. The theory of Fuzzy set offers mathematical frame for a fresh perception of image. An image of L gray levels and size $M \times N$ pixels can be prepare as matrix of fuzzy single tons, all value have a membership indicate its level of brightness relative to some brightness levels with $g = (0 , 1 , 2 \dots L - 1)$ [18]. Fuzzy array which corresponding to this image was writes as [14].

$$F = \bigcup_{m=1}^{M} \bigcup_{n=1}^{N} \frac{\mu_{mn}}{g_{mn}} \; with \; \mu_{mn} \; C[0,1] \dots\dots (2) \; [14]$$

gmn is the intensity of $(m,n)^{th}$ the image pixel and μmn is its membership value. Fuzzy image processing includes three stages: fuzzification (coding of image), operations done in the membership plane, and defuzzification (decryption the results). Fuzzification stages when the image conversion into the membership plane (fuzzification), fuzzy approach is appropriate for modifies the membership values [19]. Modified gray levels are achieved, must be code extraction for plane (defuzzification) for the output of membership. It refer that the membership values are retransformed for plane of gray-level. For example, to manage ambiguity the grayness, should be fuzzified the gray levels in relation to location histogram of image it refer to assigned a degree of membership depending on its location in the histogram for each gray level. Generally, had creation dark gray level as values of low membership, and high membership values of bright gray level had assigned. Qualities of Image if the preprocessing is done for human perception are brightness and contrast.[20].Techniques Histogram Equalization was using to enhancement of contrast by treat the crisp histograms of images. Statistic crisp suffers was normal limitation for images because it does not considered into account the approximation of gray-values in image. Additionally, to achieve equalization and useful partitioning for crisp histograms need smoothing. Statistics Fuzzy of images (fuzzy histogram). Besides statistics fuzzy inexactitude in gray levels is handled well, fuzzy membership function when was computed with appropriate did not have random volatility or missing intensity levels and is basically smooth produce fuzzy histogram. This helps us obtain significative partitioning had wanted maintain equalization brightness [21].

Images quality measure

Choose subjective evaluation for measuring the image quality. Various parameters are used to measure the image quality in objective evaluation of image include. Mean square error (MSE), Peak signal to noise ratio (PSNR), Root mean square error (RMSE) and Universal Quality Index (UQI).

Mean square error (MSE)

The quality measuring parameter which is used over a great extent is mean square error (MSE) and is the simplest one among all other metrics. It is found by taking the average of the squared differences of the intensities of the original and estimated image [22], [23]. Image of size M x N the mean square error (MSE) is introduced by this equation

$$\mathrm{MSE} = \frac{1}{\mathrm{MN}} \sum_{\mathrm{x}=0}^{\mathrm{M}-1} \sum_{\mathrm{y}=0}^{\mathrm{N}-1} (\mathrm{f}(\mathrm{x},\mathrm{y}) - \mathrm{f}_{\mathrm{enh}}(\mathrm{x},\mathrm{y}))^2 \quad \ldots (3)$$

$\mathbf{f}(\mathbf{x},\mathbf{y}), \mathbf{f}_{\mathbf{enh}}(\mathbf{x},\mathbf{y})$ **the intensities of original and estimated image** [**22**]

Root Mean Square Error (RMSE)

The other quality examining metric of image is Root mean square error (RMSE). It is calculated by taking the square root over mean square error (MSE).

$$RMSR = \sqrt{\frac{1}{MN} \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} (f(x,y) - f_{enh}\,(x,y))^2} \ldots (4)\ [22]$$

$\mathbf{f}(\mathbf{x},\mathbf{y}), \mathbf{f}_{\mathbf{enh}}(\mathbf{x},\mathbf{y})$ **the intensities of original and enhanced image** [**22**]

Peak Signal to Noise Ratio (PSNR)

The widely used quality metric is Peak signal to noise ratio (PSNR). It is measured in logarithmic scale in decibels. By calculating the ratio of maximum signal power to the maximum noise power we can find the value of PSNR from the corresponding image. If the PSNR value of image is increase, the quality of the image also increases gradually [22]. Here the maximum possible pixel value of the image by L .If K channel is encoded with a depth of 8-bit, then $L = 2^8 - 1 = 255$. Terms of decibels scale is usually use to express PSNR. The mean square error will be minimum when a signal to noise ratio is high [24]. (PSNR)Peak signal to noise ratio is defined as [24].

$$\mathbf{PSNR} = \mathbf{10log_{10}}\left(\frac{\mathbf{255^2}}{\mathbf{MSE}}\right) \text{...(5) [24]}$$

Universal Quality Index (UQI)

Universal Quality Index (UQI) is introduced to successfully measure image similarity across distortion types and is expressed as [25].

$$\boldsymbol{UQI}(\boldsymbol{x},\boldsymbol{y}) = \frac{\mathbf{4}\mu_x\mu_y\boldsymbol{\sigma_{xy}}}{(\mu_x^2+\mu_y^2)(\boldsymbol{\sigma_x^2}\ +\boldsymbol{\sigma_y^2}\ )} \text{...(6)}$$

Where

$$\boldsymbol{\sigma_{xy}} = \frac{\mathbf{1}}{\boldsymbol{MN-1}}\sum_{\boldsymbol{i=1}}^{\boldsymbol{M-1}}\sum_{\boldsymbol{j=1}}^{\boldsymbol{N-1}}(\boldsymbol{x}(\boldsymbol{i},\boldsymbol{j}) - \mu_x)\big(\boldsymbol{y}(\boldsymbol{i},\boldsymbol{j}) - \mu_y\ \big) \text{... (7)}$$

Where r and e denote the original and enhanced images respectively, MN is the size of the image and L is dynamic range of pixel values (256 for 8-bit gray scale images)

Proposed Analyses

Aim of this paper is to enhancement the contrast of mammograms image which performs best in extracting the mammogram bract cancer Images. In order to find the effective one, performance of the Histogram equalization this involves number of Steps like on.

1-The first step in this algorithm is to read the mammogram images, were taken from Baghdad teaching hospital and Kirkuk hospital. The format of these images is "jpg" with size 256 by 256.

2- Convert image to gray scale its mean each pixel has one color (grayscale), that is, carries only the intensity information. Region of interest (ROI) determined remove time and date label of mammogram image.

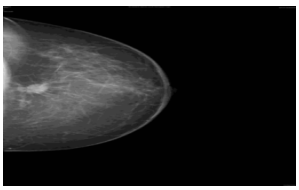
3-Apply various contrast enhancements methods separately include.

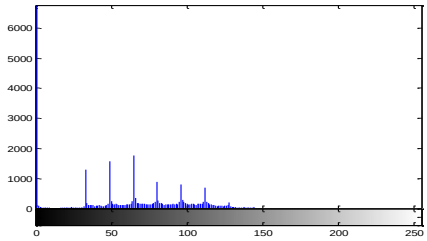
a- Classical Histogram Equalization-(CHE).

b- Adaptive Histogram Equalization (AHE).

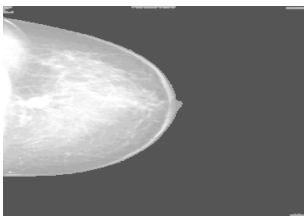
c- Fuzzy image enhancement.

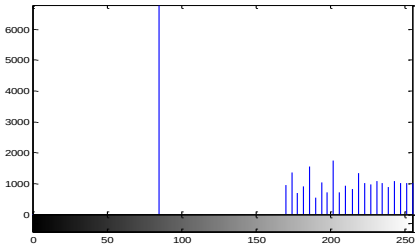
4- Drown histogram for various contrast enhancements methods are apply on mammogram images are shown in Figure (1, 2, 3).



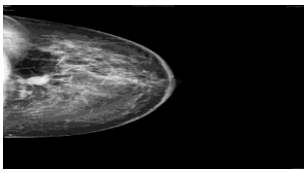


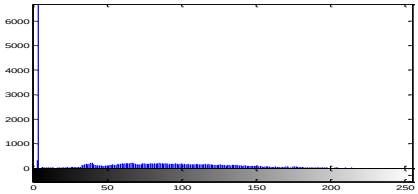
grayscale mammogram image1 and its histogram



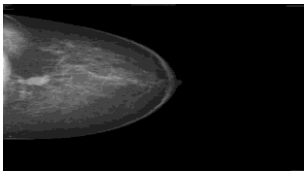


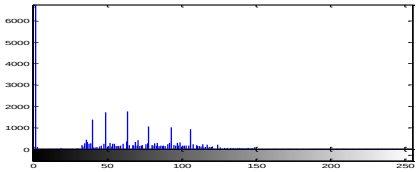
grayscale image1 and its histogram after applying histogram equalization





grayscale mammogram imag1e and its histogram after applying adaptive histogram equalization





grayscale mammogram image1 and its histogram after applying fuzzy histogram equalization

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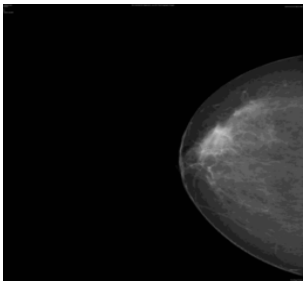

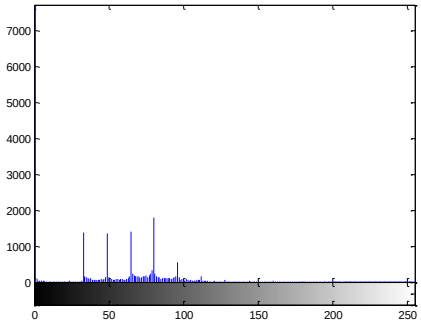

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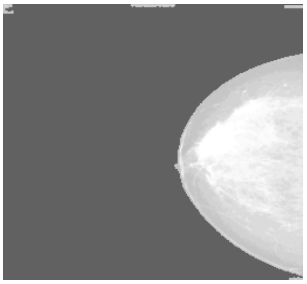
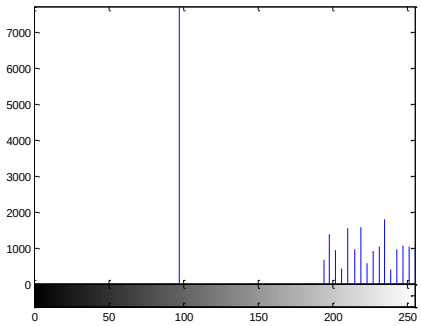
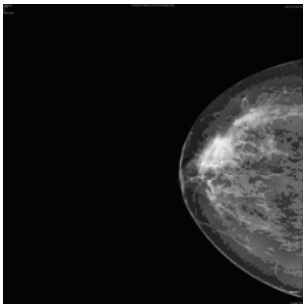
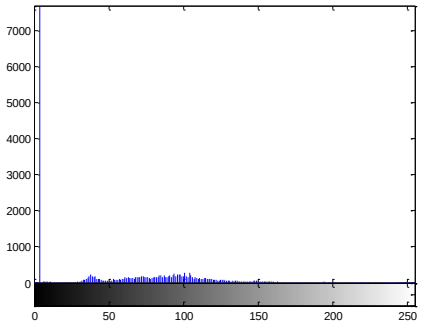




grayscale mammogram image2 and its histogram after applying histogram equalization





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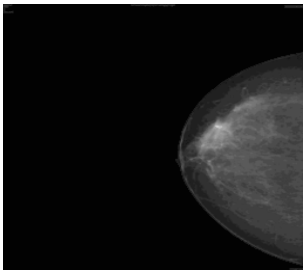
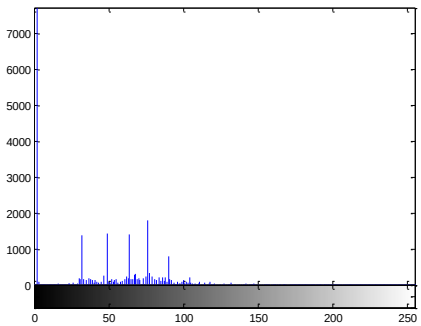
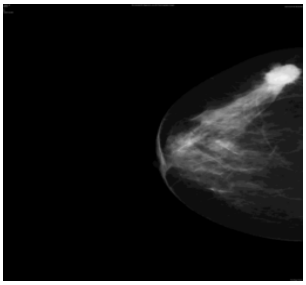
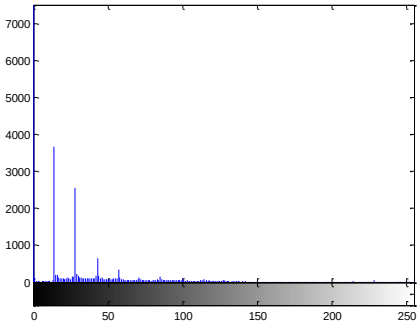




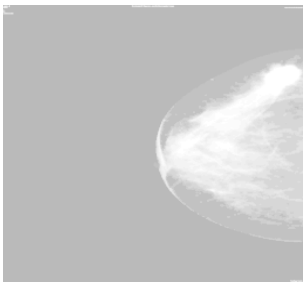
grayscale mammogram image2 and its histogram after applying fuzzy histogram equalization

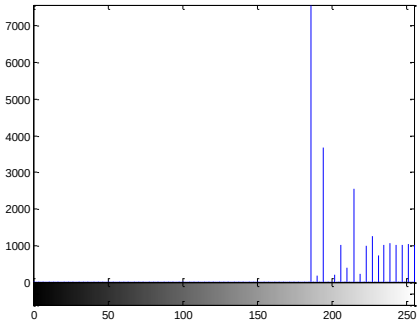
Grayscale mammogram image2 and its histogram after applying fuzzy histogram equalization



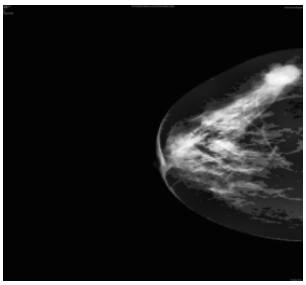


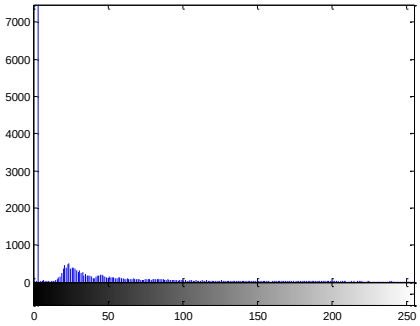
grayscale mammogram image3 and its histogram



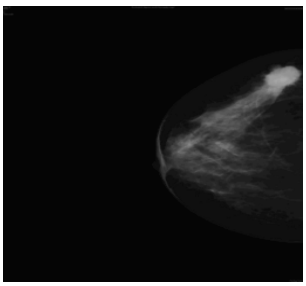


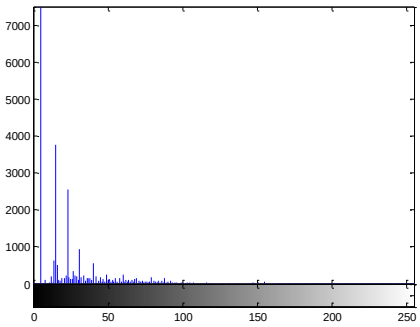
mammogram grayscale image3 and its histogram after applying histogram equalization





mammogram grayscale image 3 and its histogram after applying adaptive histogram equalization





mammogram grayscale image3 and its histogram after applying fuzzy histogram equalization

Grayscale mammogram image3 and its histogram after applying fuzzy histogram equalization

The comparison between mammogram image before and after applying different contrast enhancement methods can be determined by calculate various parameters to measure the image quality include(MSE) ,(RMSE),(PSNR) ,(PSNR) and(UQI) the result be shown in the Figures(4,5&6).

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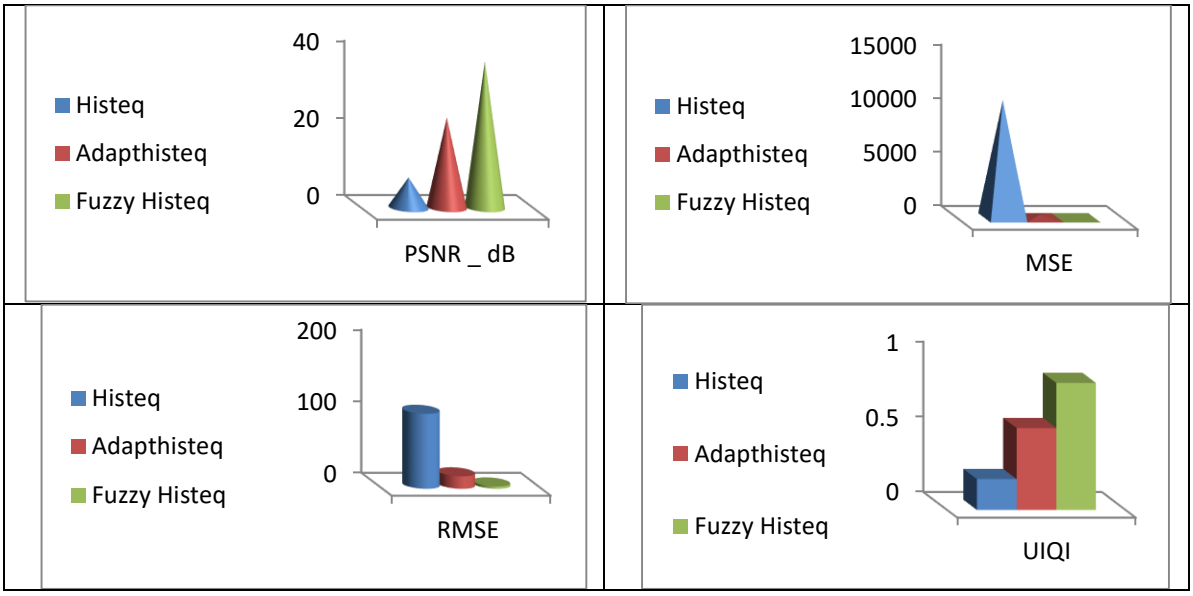

Fig (4) result of rimage1

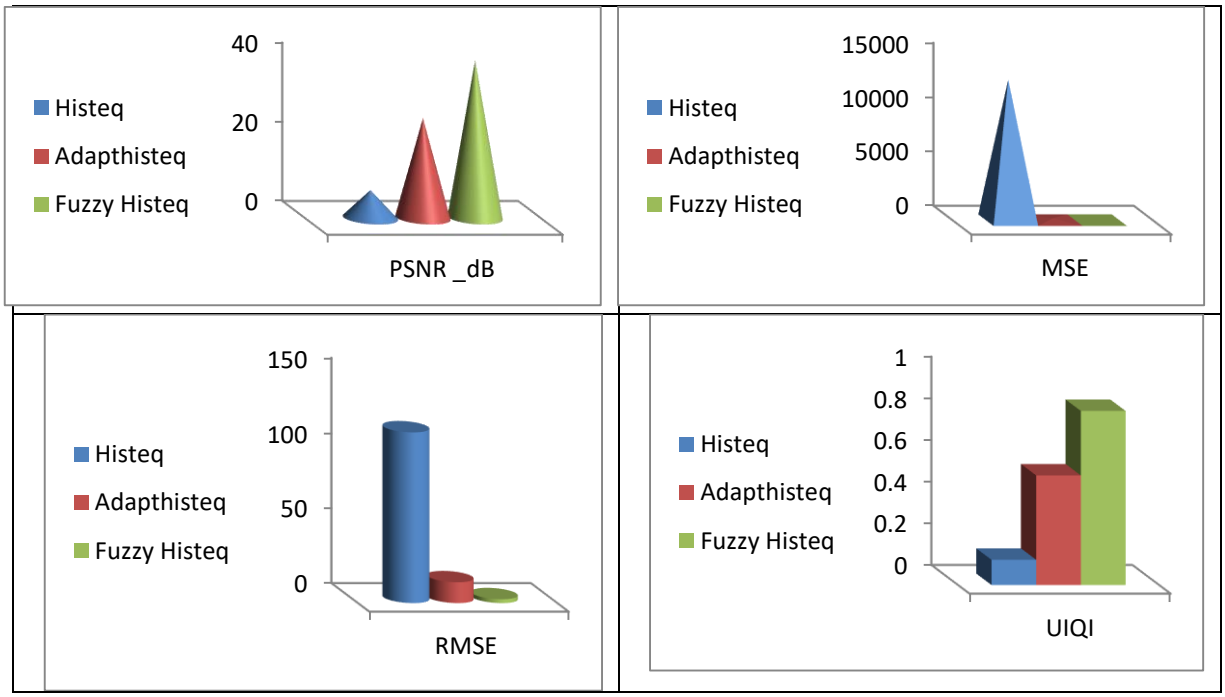

Fig (5) result of image2

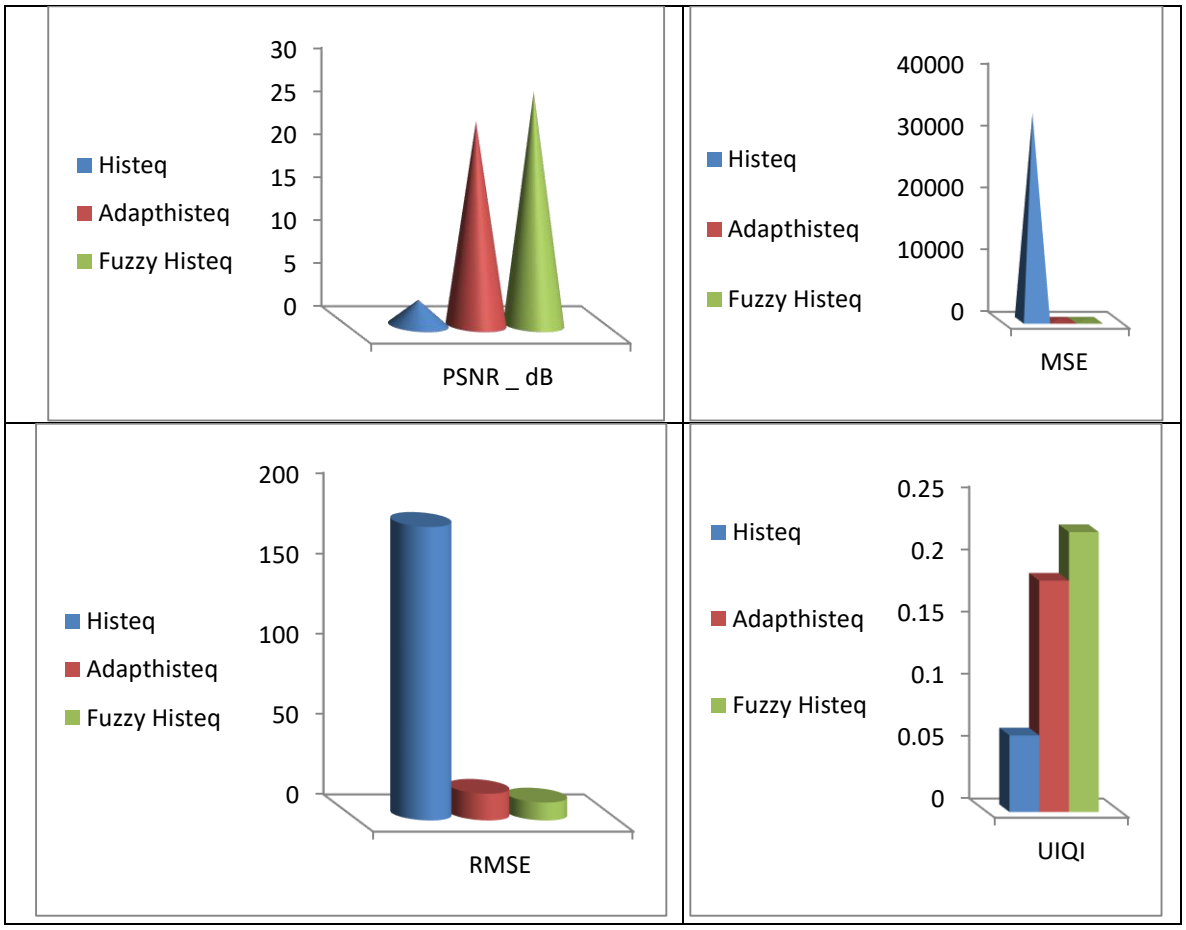

Fig (5) result of image3

Conclusion

The analysis of results showed that

1-the fuzzy histogram equlazation techique was given best performance for Bract cancer Image and had ahigher utility in the process of enhancement.

.2-Adaptive Histogram Equlization is better than Classical Histogram equalization for enhacement cancer images.

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