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USING ADAPTIVE MEDIAN FILTER FOR NOISE REMOVAL FROM IMAGE TO DIAGNOSE BREAST CANCER

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ABSTRACT

Breast cancer is one of the main causes of fatality among women around the world. Mammography is a basic screening technique in fast diagnosis of tumor in the breast. The main goal of mammography is to recognize small masses/tumors in the shortest time, since these masses can be the sign of cancer. But due to existence of noise, low and opaque contrast and fuzziness of mammograms' images, diagnosis of small masses is difficult. Hence, the images of mammograms shall be improved. Recovering the images is carried out for better display of mammographic special features including mass and micro classification, and exaggeration of certain properties is done for simple and fast diagnosis. "Makendor" and "Helali" reviewed different techniques of removing noise and image enhancement in order to determine the enhancement technique appropriate to mammogram's images. Mammograms remove the noise by linear and non-linear filtering techniques. The operation of these techniques are measured by using Root Mean Square Error (RMSE) and Peak Signal Noise Rate (PSNR). Finally, the contrast of images is improved by histogram techniques.

Keywords: breast cancer, mammography, noise removal, root mean square error (RMSE), Peak signal noise rate (PSNR), Contrast Limited Adaptive Histogram Equivalent (CLAHE).

1. BACKGROUND

Mammogram is an X ray of breast that can show its abnormality such as benign and malignant masses. The process of this apparatus is as such that the breast is located between two plates. Then, a low dosage of radioactive is applied to produce the image of X ray. Mammogram is used in screening and diagnosis. The screening of mammogram is an effort to diagnose breast cancer before outbreak of disease's symptoms. The aim of screening mammography is to reduce the death caused by breast cancer. Diagnosis of mammogram to help to diagnose the breast cancer is after outbreak of symptoms. Among these signs, we can refer to feeling the mass in breast. Breast cancer is one of the most common cancers which leads to women's death especially in developed countries. Now, mammography is the most effective way for images' modulation in order for screening the breast cancer. Mammography is a radiographic imaging technique that is used to take images of breast. The aim of these images is for early detection of cancer and screening. These images are called mammograms which are gained by low dosage of radioactive in certain intervals. Mammography plays an important role in diagnosing the disorder in the breast. Mammography as screening and detecting the breast cancer provides limited information of anatomy, morphology and pathology of breast. Sometimes, it is difficult to diagnose due to similarity of masses to tissues of breast. Moreover, it is hard to distinguish between benign and malignant masses. Malignancy is more probable in irregular shapes/forms and benignity is more probable in regular shapes. Differences in the areas of right and left breast are known as bilateral asymmetry.

Lots of efforts have been made regarding the enhancement of mammogram images. Improving the contrast of mammograms is done for fast diagnosis. Rapid diagnosis means rapid classification of images, division of the chest area and removing noise by using filter. Moreover, improving the contrast is carried out by using contrast limited adaptive histogram equivalent and wavelet transform. Some articles contained the image enhancement techniques in order to improve digital mammograms were investigated. Different spaces and the techniques in field of frequency had been reviewed. In a comparative study regarding the algorithms of digital mammography images enhancement like enhancement based on wavelet transform, CLAHE, morphology operations and non-sharp masks were presented. An optimum adaptive neighbor processing algorithm or a collection of contrast enhancement functions were discussed in order to enhance the mammography features. This method is able to enhance the image but it has some defects in field of noise removal. The algorithms are used both for contrast enhancement and

background enhancement in mammogram images. Dual tree wavelet transform will remove the limitations of linear filtering techniques. This transform has rather constant displacement and two-dimensional space.

"Keronika" presented the intensity histogram method in CT images of down sampling. According to this method, low contrast and opacity of some areas were enhanced in CT images. In order to increase the accuracy of the results of down sampling, Markov random field model was used that pays attention to geometrical restrictions of processed images. Median filtering opens a new door of morphology operations and enhanced the images' contrast. This filter was used to reduce noise and enhance the image. "Lie" used the four selective median plans and change of median filtering was named the selective median filtering. In order to reduce the special signs and unwanted noises, pre-processing technique was used in medical images. Regarding to the background of each area, "Morro" computed the condition of areas. Removing the noise of background together with preserving the information of edges can reinforce the digital mammogram. Noise, lack of contrast, asymmetry, weakness of image's margins and special signs existing in the separation process of medical images will make the noise removal and exiting signs in the image difficult. Pre-processing method contains excision of background and normalization of CT brain images. In the suggested approach, an oval structure based on skull and modified tilt angle was presented.

2. METHODOLOGY

Image pre-processing techniques are needed in order to remove noise and enhance the quality of mammogram images. Before applying any pre-processing algorithm, it is essential that pre-processing stages are known in order to do researches about diagnosis of disorders. Digital mammograms are medical images which are difficult to interpret; thus, the quality of images shall be improved and the result of separation shall be specified more accurately. The main purpose of this trend is to reinforce the quality of image and this will prepare the image for next processes by removing the irrelevant and extra parts in the mammogram backgrounds. Extraction of breast border and ruining the muscle skull are other stages of pre-processing. Types of noises observed in mammogram are rectangular sticker with high intensity, sticker with low intensity, and artificial bars and etc. Majorly, filters are used to filter the unwanted things or filter the objects in the space and surface of image. In processing the digital image, usually images are affected by different types of noises. The main goal of filters is to reinforce the image quality. Enhancing an image means presenting the information of image to human's eyes. Image filtering is used in many fields including smoothening, sharpening, removing noise and recognizing the edges. Any filter is defined by one kernel. This kernel is a small array applied on each pixel and neighbors of that pixel.

Median Filter: median filter is a non-linear filter used in removing pepper and salty noise. Median filter not only tends to remove noise, but also preserves the sharpness of image's edges. Types of median filters are center-weighting median filter, weighting median filter and maximum median filter. Increasing the size of window in median filter will lead to better efficiency of filter in noise removal.

Mean filter: Mean filter places the mean value of adjacent pixel instead of each pixel. This filter is easily performable and leads to local decline of variance. This filter affects smoothness and opacity of images and it is the most optimum filter for the Gucci noise added into the mean square error. Speckle images are multi-condition model with non-Gucci noise. Therefore, median filter is not appropriate for such images.

Adaptive mean filter: this was presented to reduce the effect of opacity of image. This filter makes balance between the mean and all-pass filtering. These kinds of filters adapts themselves with the image properties and remove speckles from different parts of image. For effective diagnosis and protection from edge and image properties, these filters use the statistical part of image like mean, variance, and spatial correlation. Speckle noise is replaced by a local mean value and is removed. Adaptive mean filters reduce speckles besides maintaining the edges.

Histogram equivalent: this technique distributes the gray areas in order to make a unified histogram. In this case, each pixel is replaced by the integral of image histogram. Histogram equivalent is a method in image processing which sets the image contrast by using image histogram. Regarding to this adjustment, the intensity of histogram distribution can be better. This fact will cause that areas with less contrast are affected by better contrast. Histogram equivalent does this act frequently by effective development of most of intense values. This method is used in images which have light or dark background and foreground. Histogram equivalent is used in mammogram images to adjust the contrast. Therefore, image disorders are observable more clearly.

3. PROPOSED METHODOLOGY

In the present system, processing the system of mammogram image classification is more complex. Each model has its own specific way for process. Many of noise removal models have not been used in pre-processing stage.

Adaptive Median Filter: adaptive median filter works on the rectangular area of Sxy. In the specific conditions like following list, this filter changes the size of Sxy during filtering operations. Any output pixel is obtained by the mean value of its neighbor pixels selected as input. The edges of image are replaced by zero values. The filter output is a value replaced by current pixel. The current pixel, i.e. place of (x, y) in which S is located at any moment. The following considerations have been used.

Zmin = minimum value of pixel in Sxy

Zmax = maximum value of pixel in Sxy

Zmed = median value of pixel in Sxy

Zxy = value of pixel in coordinations of (x, y)

Smax =maximum possible value for Sxy

Adaptive median filter is used for smoothening the nondestructive noises. This filter has two-dimensional signals and it is able to enhance the mammogram image without making the edges dark. Therefore, pre-processing is used in removing the orientation, sticker and artificial points in mammogram, mammogram enhancement and mammogram separation. Moreover, pre-processing can make a mask for pixels with high intensity in order to decrease the resolution and separate/cut the part of chest image. After pre-processing stage, it is processing stage which uses adaptive median filter.

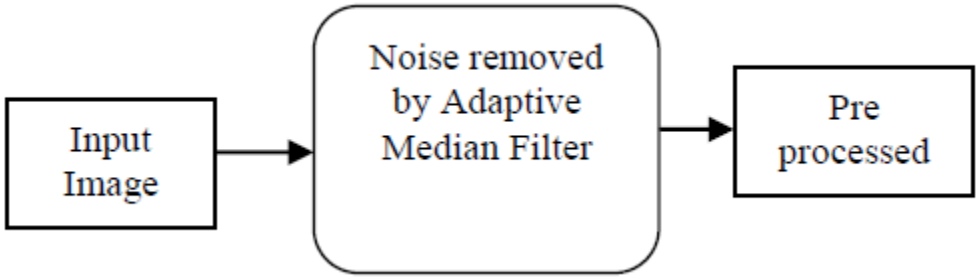

Figure 1- Process Current

a. Proposed Algorithm

Input: mammogram image
Output: pre-processed image
First stage: selecting one image as the input from the collection of images
Second stage: adding noise into the input image
Third stage: using mean filter, median filter, adaptive mean filter and adaptive median filter on input image
Fourth stage: computing the values of PSNR and MSE
Fifth stage: repeating stages 3 and 4 for all images of data set

b. Performance Evaluation

The following math calculations have been used for assessing the quality of image.

- Peak Signal Noise Rate (PSNR)
- Mean of Square Errors (MSE)

PSNR: PSNR / Peak Signal Noise Rate is an engineering expression which states the ratio between maximum of possible power of signal and power of destructive noise. Since signals have vast dynamic range, they usually mention PSNR in logarithm decibel scale.

$$PSNR = 10.\log_{10}\left(\frac{MAX_1^2}{MSE}\right) = 20.\log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right)$$

In this relation, MAX_I indicates the maximum value of image pixel. When the pixels use 8 bits in each sample, value of MAX_I will equal 255. When the samples use linear PCM with B bit for each sample, value of MAX_I will equal $2^B - 1$. MSE / Mean of Square Error: PSNR are usually used to measure the restoration quality in compressed image. For two single-color images of m × n namely I and K and one of the mis more noisy than the other, MSE is defined as following:

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}\|I(i,j) - K(i,j)\|^2$$

Generally, a great image restoration is identified with low values of MSE and high values of PSNR. This means that the image has low error and high adaptation.

4. TEST RESULTS

The proposed method was tested on the image collection of mammography image analysis and its results were presented separately. The set of images had different sizes and divided into classes. A retrieved picture is comparable if and only if it is placed in the specific group. Pre-processing was done by adaptive median filter. This is the output image of pre-processing for an enhanced and without-noise image that is used for image classification. Mammogram image as pre-processing input and output is as following:

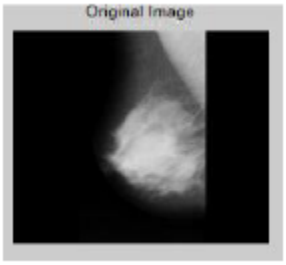

Figure 2- Input image

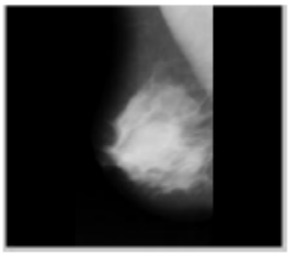

Figure 3- Output Image

Table 1 shows the output values of PSNR and MSE for pre-processed images. The results of the test indicate that adaptive median filter is the best type of filter to remove noise of image and its function gets better by estimation of PSNR.

Table 1: MSE and PSNR values for samples of image

Image No	Median Filter		Mean Filter		Adaptive Median Filter	
	MSE	PSNR	MSE	PSNR	MSE	PSNR
Mdb001	65.8468	30.5837	30.8829	33.2336	6.7584	39.8323
Mdb002	63.1807	30.125	41.04	31.9987	16.4629	35.9657
Mdb003	52.2811	30.9474	38.339	32.2944	15.9076	36.1147

5. CONCLUSION

Pre-processing technique will increase the quality of image by removing the specific signs and the noise existing in medical images. In this article, 3 filtering techniques were regarded for mammogram images. Filters were compared with each other regarding to the simulated output parameters including image quality, Peak of Signal Noise Rate and Mean of Square error. These 3 filters were tested on mammogram images. The tests and results showed that the best filter for noise removal is the adaptive median filter and the operation of this filter gets better by estimation of PSNR value.

REFERENCES

Yousif Mohamed Y. Abdallah , Ali Hayder, Eltayeb Wagiallah (2014). Automatic Enhancement of Mammography Images using Contrast Algorithm. International Journal of Science and Research (IJSR) , Volume 3 Issue 9,pp.1885-1889, September 2014.

Subodh Srivastava, Neeraj Sharma, S. K. Singh, and R. Srivastava (2014). A combined approach for the enhancement and segmentation of mammograms using modified fuzzy C-means method in wavelet domain. J Med Phys. Vol. 39(3): pp. 169–183, 2014.

Hajar Moradmand , Saeed Setayeshi , Alireza Karimian, Mehri Sirous (2014). Contrast Enhancement of Mammograms for Rapid Detection of Microcalcification Clusters," Iranian Journal of Medical Physics, Vol. 11, No. 2 & 3, pp. 260-269, Spring & Summer 2014.

C. L. Yashwanthi Sivakumari, P. Sudharsan (2013). Comparison of Diverse Enhancement Techniques for Breast Mammograms", International Journal of Advance Research in Computer Science and Management Studies, Volume 1, Issue 7, pp. 400-407, December 2013.

A. Hyvarinen, P. Hoyer, E. Oja (2001). Image denoising by sparse code shrinkage. In Intelligent Signal Processing, S. Hykin, B. Kosko, Eds.IEEE Press, 2001.

A. P. Dhawan, G. Buellon, and R. Gordon (1986). Enhancement of mammographic feature by optimal adaptive neighbourhood image processing. IEEE Trans. Med. Imag., Vol. MI-6, No. 1, pp. 82–83, 1986.

Tomklav StojiC, Irini Reljin, Branimir Reljin (2005). Local contrast enhancement in digital mammography by using mathematical morphology. IEEE Transactions, 2005.

N. G. Kingsbury (2002). Complex wavelets for shift invariant analysis and filtering of signals." Applied and Computational Harmonic Analysis, Vol.10,no.3,pp.International Journal of Scientific & Engineering Research, Volume 6, Issue 4, April-2015 465 -234-253, May 2002.

M.L.Giger (2000). Computer-aided Diagnosis in Medical Imaging – A New Era in Image Interpretation," Medical Imaging Ultrasound, WMA Business Briefing- Global Healthcare, 2000, pp. 75- 79.

Yin, F. F. Giger, M. L., Doi, K., Vyborny, C. J., Schmidt, R.A (1994). Computerized detection of masses in digital mammograms: Automated alignment of breast images and its effect on bilateral subtraction technique," Medical Physics, vol. 21, 1994, pp. 445 – 452.

Méndez, A.J., Tahoces, P.G., Lado, M.J., Souto, M., Vidal, J.J (1998). Computer-aided diagnosis: Automatic detection of malignant masses in digitized mammograms," Medical Physics, vol. 25, pp. 957- 964, 1998.

Veldkamp, W., Karssemeijer, N. (1998). Accurate segmentation and contrast measurement of microcalcifications in mammograms: A phantom study", Medical Physics, vol. 25, 1998, pp. 1102-1110.

Gavrielides, M.A., Lo, J.Y., Vargas-Voracek, R., Floyd, C.E. (2000). Segmentation of suspicious clustered micro calcifications in mammograms," Medical Physics, vol. 27, 2000, pp. 13-22.

R. Ramani (2013). The Pre-Processing Techniques for Breast Cancer Detection in Mammography Images", I.J. Image, Graphics and Signal Processing, 2013, 5, pp. 47-54

Note

This article does not contain any studies with human participants performed by any of the authors.

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