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A Review on Image Enhancement Methods

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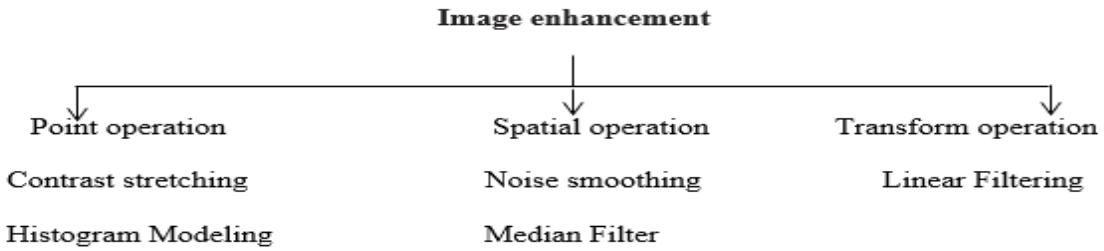
Abstract:
Image enhancement plays a key role in mammography for improved analysis of breast cancer detection. Inadequat equality of mammogram images may produce obscure expectation about the results in breast cancer predictions. Traditional image enhancement approaches, such as median filter, morphological method, wavelet transformation, contrast stretching is produced an improved quality of images, in mammography, it is needed to emphasize the boundary and edge features with good quality. Demonstration of efficiency and provisional results are exhibited in the empirical study using mammogram image datasets.

I. INTRODUCTION

Image enhancement [30] is one of the most important methods in mammography research. Design of image enhancement is to enrich the presence of an image in terms of quality, which provides a better enhance transformation for further automated mammogram image processing. Mammogram images endure from miserable and bad contrast. Thus, it is needed to improve the contrast of the mammogram images for better diagnosis of the detection of masses. Image enhancement methods, enhance the accuracy of images for human viewing, removing noise, increasing contrast, and revealing mammogram details.

A Key intention of image enhancement is to modify a given image in order that the resulting mammogram is more applicable than the original image for mammography applications. It accentuates the image features such as boundaries, edges, or contrast to make a mammogram display as good would be more useful for mammography analysis. An Enhancement would increase the dynamic quality for the exclusive features so that they can be distinguish handly on mammography.



The complication of image enhancement in mammography for the existing methods are compute the criterion for enhancement and, therefore, most of image enhancement methods are factual, so that they require interactive procedures for obtaining decent results. The frequently used image enhancement methods are described in the following sub-sections.

II. IMAGE ENHANCEMENT METHODS

a. Contrast stretching and Histogram Equalization:

Low-contrast images having destitute illumination, lack of image sensing, uncertainty of suspected objects in mammogram images. In such cases, contrast stretching is further convenient enhancement method for expanding the effective

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range of the gray levels in the image being processed.

Histogram of a mammogram image with different gray levels in the range [0,L-1] is defines as a function $p(r_k)=n_k/n$, here 'r_k' is the kth gray level, 'n_k' is the total pixels in the image with gray level, 'n' is the total number of pixels in the image, and k=0,1..L-1.

$p(r_k)$ denotes an estimation of contingency for an instance to the gray level r_k. The histogram of an image may produce indicative information based on the shape about the contrast enhancement [59] and narrow shape denotes a little range for specific indication of an image having small contrast.

b. Morphological Operations:

Morphology operations in medical images processes images based on different textures or shapes. Morphological operations may use structured things to a medical image that creates another image of the same size. Based on size and shape of the neighborhood patterns, it is possible to perform a morphological action that is very delicate to shapes in the input image.

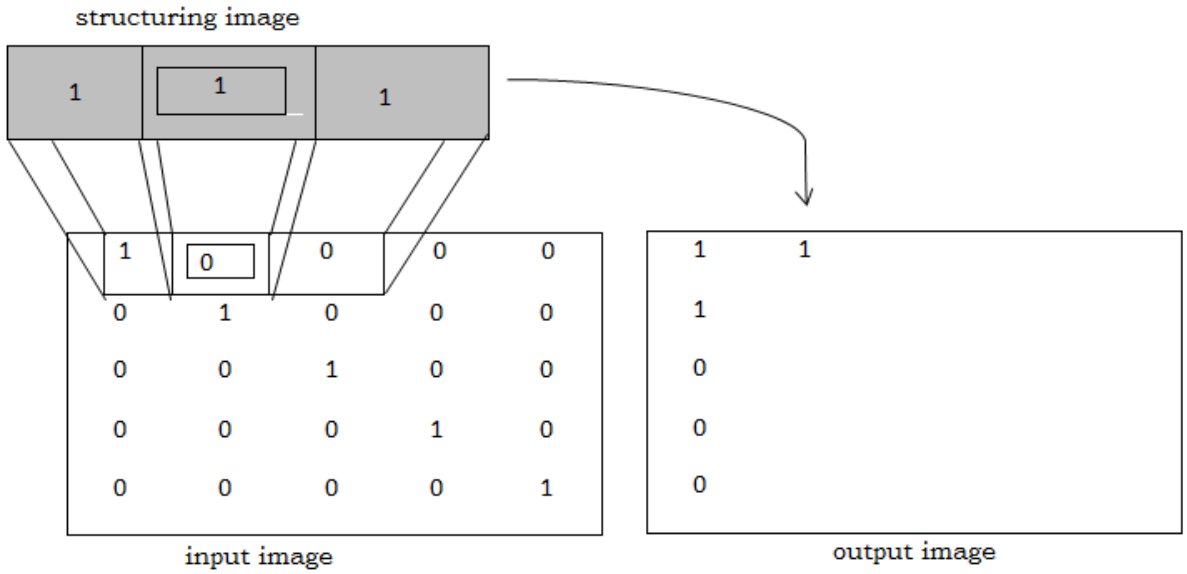

Fig. 1 Process of morphological to binary image

Underlying morphological operations are expansion and destruction. Dilation constructively adds pixels to the boundaries of objects to an image, while erosion discard pixels on object boundaries and number of pixels may considered or ignored from the objects in an image, which depends on the size and shape of the *structuring element* used to alter the image. In the morphological dilation and erosion operations, the state of any given pixel in the output image is decisive by applying a rule to the corresponding pixel and its neighbors in the input image.

c. Noise Smoothing and Median Filters

Pre-processing in medical image processing is the basic term which refers to set of exercise on images at the minimum level of image abstractions.

The intent of pre-processing is to image by suppressing undesired distortions and also enlarge image features that useful for further processing of analysis task. Image preprocessing use the repetition in images Distorted pixel is picked from the image and this pixel value can be restored as an average value of neighboring pixels for reducing the noise

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level to large extent for performing of smoothing operations for an image.

Median filtering is singular of non-linear smoothing method and it diminish the obscure of edges in mammogram images and automatically eliminates the noise levels for attain of better clarity of image. It lessens the noise levels in images without reducing the sharpness of images.

The intensity value of the current pixel in the mammogram image is regained by the median intensity value of either 3-by-3 or 4-by-4 neighborhood.

d. Wavelet Denoising Method

The Wavelet transformation for denoising use the discrete wavelet transform (DWT) in current research of medical image enhancement and image data is processed at different resolutions that enables general surface morphology. The noise in images is formed by high distortions. Thresholding high frequency of DWT reduces noise levels in order to preserve low prevalence components that present general trend, so that DWT is treated as most favorable tool for denoising of mammogram images and it's experimental results are presented in following sub-sections.

Fig. 2displays a generic procedure of DWT denoising with ternary key steps, which are as follows: decomposition, verge detail coefficients, and reconstruction. In decomposition step, the exterior is disintegrating as distinct levels (N) of likeness of familiar trends and detailed coefficients. Denoising mechanism is called also wavelet shrinkage that ignores the noise by keeping some threshold value in wavelet domain and it is performed in second step. The preferred ultimately associates a dealamid keeping a bit of noise in the data and removing a bit of certainouter details. Certainly, the denoised outer is reassemble using alikness coefficients of the last level (N) and threshold detail coefficients of all levels (1 - N).

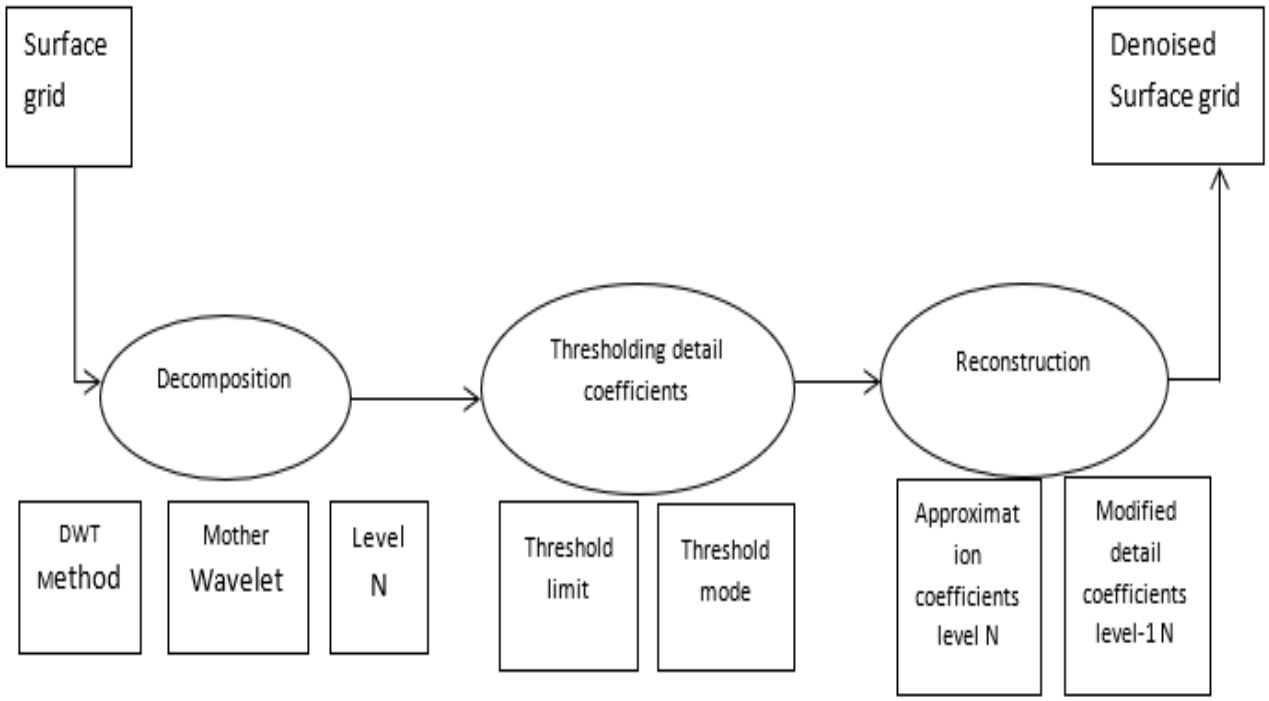

Fig 2 Illustration of Wavelet Denoising Method

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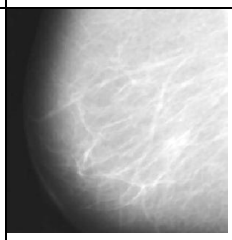
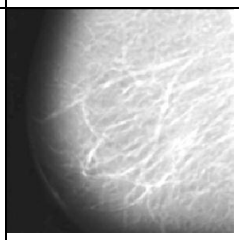
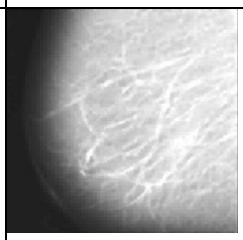
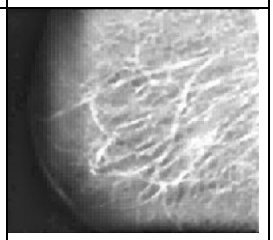
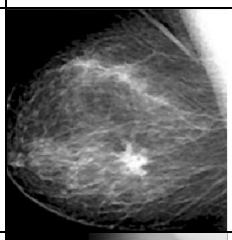
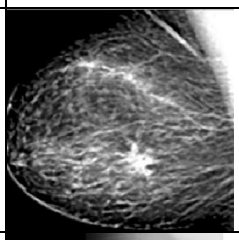
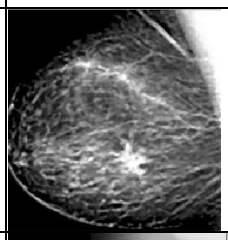
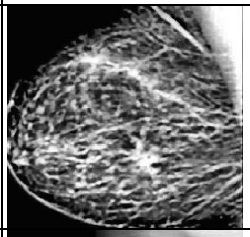
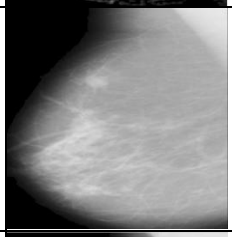
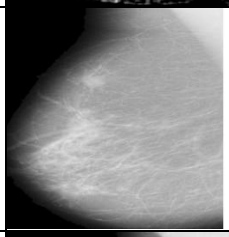
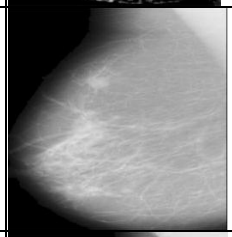
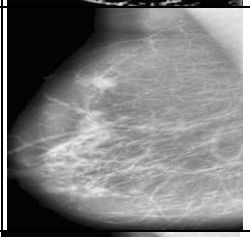
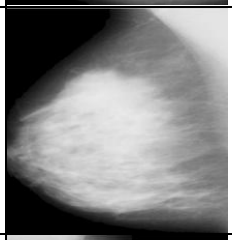
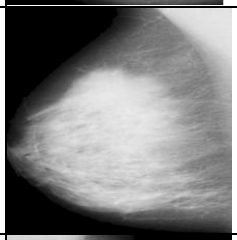
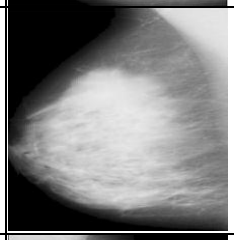
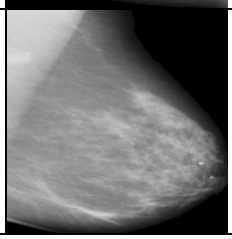
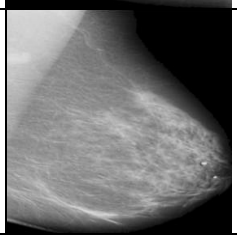
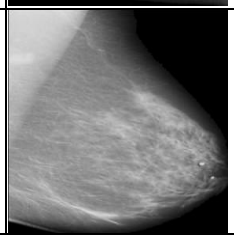
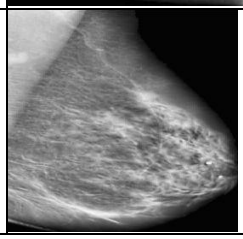
III. Experimental Study

Image	Median filter	Morphological	Wavelet Transformation	Contrast Stretching
1				
2				
3				
4				
5				

The existing image enhancement methods cannot perform smoothing of mammogram image up to a required extent boundary level. These accuracy levels are measured by accepting mean squared error (MSE), peak signal-to-noise ratio (PSNR), The MSE & PSNR are described in following Eqn. (1) and (2) respectively.

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

Here noise-free monochrome image 'I' is with size of m x n, and noisy approximation is 'K'.

$$\mathrm{PSNR} = 20.\log_{10}(\mathrm{MAX}_I) - 10.\log_{10}(\mathrm{MSE}) \quad (2)$$

In Eqn. (2), MAX_I refers to the ultimate possible pixel value of the image. The comparative results in the experimental study are presented as four different cases, these to be overall suspected cases (abnormal mammogram images), fatty, dense, and glandular mammogram images.

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Two performance measures of Eqn. (1) and Eqn. (2) are evaluated and presented in Table 2 for abnormal mammogram images, Table 3 for fatty images, Table 4 for dense images, Table 5 for glandular images. Low of MSE and higher value of PSNR indicates the best noise free and smooth mammogram images.

TABLE 1

Noise Free Measurement for Abnormal Mammogram Images

Name of the Method	MSE	PSNR
Median Filter	9.56	8.3585
Morphological Method	9.58	8.3499
Wavelet Transformation	9.57	8.3526
Contrast Stretching	9.64	8.3045

TABLE 2

Noise Free Measurement for Fatty Mammogram Images

Name of the Method	MSE	PSNR
Median Filter	9.37	8.5689
Morphological Method	9.39	8.5616
Wavelet Transformation	9.38	8.5642
Contrast Stretching	9.42	8.4954

TABLE 3

Noise Free Measurement for Dense Mammogram Images

Name of the Method	MSE	PSNR
Median Filter	9.04	8.7094
Morphological Method	9.06	8.7014
Wavelet Transformation	9.05	8.704
Contrast Stretching	9.14	8.6146

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TABLE 4

Noise Free Measurement for Glandular Mammogram Images

Name of the Method	MSE	PSNR
Median Filter	9.72	8.2926
Morphological Method	9.74	8.2841
Wavelet Transformation	9.73	8.2867
Contrast Stretching	9.81	8.2363

Fig. 3 and 4 shows the overall comparisons of image enhancement methods for measuring of filtered image quality using MSE and PSNR.

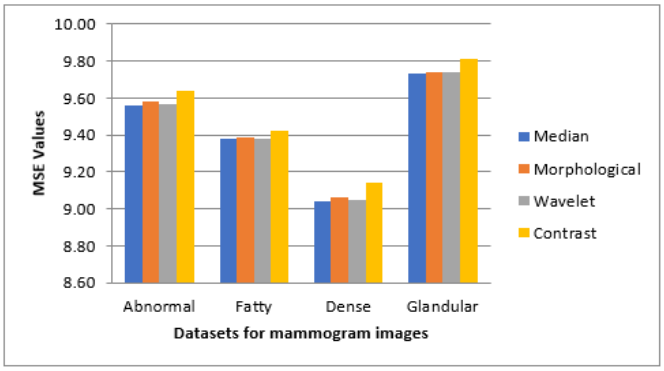

Fig. 3 Comparisons of Image Enhancement Methods Using MSE

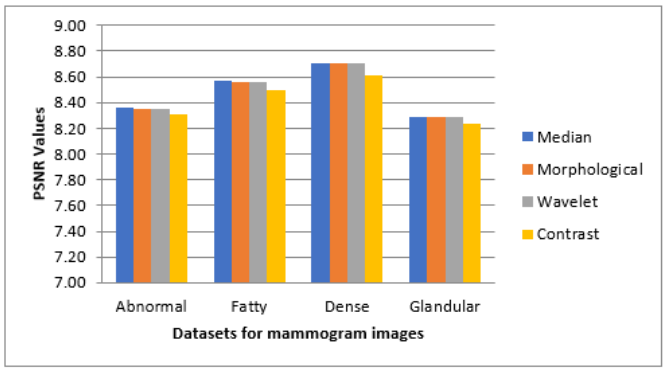

Fig. 4 Comparisons of Image Enhancement Methods Using PSNR

IV. Conclusion

Image enhancement is used in mammography for the efficientdentification of breast cancer. In this paper, analyze the different image enhancement methods, such as median filter, morphological method, wavelet transformation, and contrast stretching. These approaches are producing a quality of an image by changing new concentration values in older places using their mechanisms. It is also essential to integrate edges and boundaries of mammogram images. This paper analyzes the eminence of mammogram images of existing methodologies with the help of two performance measures i.e., MSE and PSNR.