An Efficient Image Processing Technique To Automatically Detect Microcalcifications in Mammograms of Breast Cancer

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Abstract — Breast Cancer is one of the Major Causes of Death of Women in the World. Early Detection of Breast Cancer is a Key Point for Successful Breast Cancer Treatment Process. Cancer Detection Using Computer Aided Diagnosis (CAD) is an Active Field of Research. CAD System Provides tool to radiologist for making decision about discover of Breast Cancer. In Order to Provide Primary Identification of Breast abnormalities, Several CAD Systems has been developed. This Paper Presents Early Detection of Breast Abnormality like Microcalcification Using Image Processing Techniques. Algorithm Implemented for Microcalcifications Detection in Mammogram Image. The Image from Database is Preprocessed Using Filtering and Image Enhancement Technique which makes Image more effective for Analysis. Paper Presents Median Filtering Method to remove noise and Adaptive Histogram Equalization for Image Enhancement. Image Analysis is done by Image Segmentation. Paper Presents Improved Otsu's Automatic Thresolding Technique for Image Segmentation. Impurities of Segmentation is Removed by Post Processing. Paper Presents Morphological Operation for Post processing. Fifteen Patient's Mammograms have been processed. Mammogram dataset has been taken from Scientific Diagnostic Center. We Found Our Approach can be very useful to Radiologist to detect Microcalcifications and gives good Result.

Keywords- Mammograms, Microcalcification, CAD, Morphology, AHE

I. INTRODUCTION

All Cancer is one of the causes of death of humans without any accident. One of Six deaths in world is due to cancer. Cancer is second leading Cause of deaths among women. In India, about 8% to 10% of Women confronted with breast cancer in their lives. Women can have more chances to survive if breast cancer detect earlier because early detection of cancer is key point of breast cancer treatment. CAD system is one of the best tools to detect cancer earlier. Many Techniques are used to detect breast abnormalities like Microcalcifications, Architectural Distortion, Asymmetrical Density of Tissues and Mass. Mass is common sign of having Breast Cancer and Appear bright than surrounding Tissues. Benign mass has well defined border and malignant mass has ill-defined and speculated border. Bilateral Asymmetry is an asymmetrical difference between breast parenchyma of left and right breast. Architectural Distortion is a distortion of normal pattern of curvilinear and fine linear structure.

This Paper presents a method for detection of microcalcifications. Median Filtering is used to remove noise from Image, Adaptive Histogram Equalization for Image Enhancement, Automatic Thresolding Technique for Image Segmentation and Morphological Operation for Post processing. Flow diagram of proposed work is shown in figure 1.
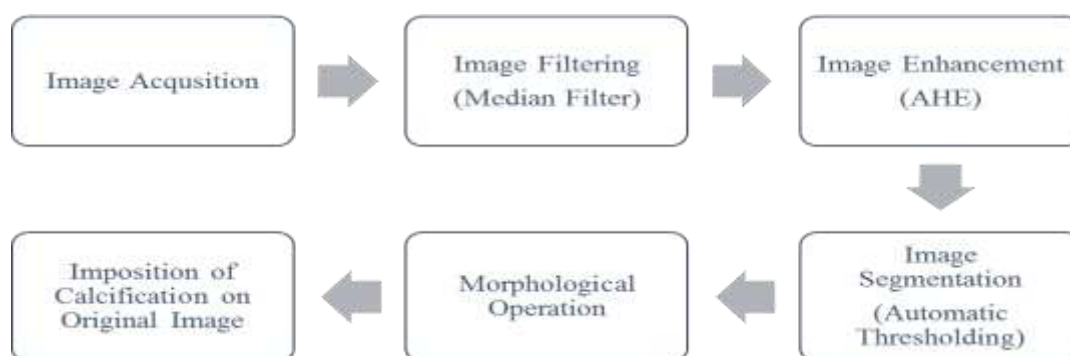

Figure 1. Flow of Proposed System

II. RELATED WORK

Elmoufidi et al. [1] Paper presents Detection of ROI in Mammograms by Using Local Binary Pattern, Dynamic K-Means Algorithm and Gray Level Co-occurrence Matrix. Proposed System of This paper works in three stages like image enhancement after that generation of initial number of cluster and at last detection of ROI. Paper presents the dynamically determination of k parameter that was depends upon a processed image. The testing result of ROI with the mean of 86%.

P.Spandana et al. [2]Paper presents early detection of breast cancer using image enhancement, image segmentation and feature extraction. image enhancement using wavelets and histogram equalization, segmentation using region growing method and feature extraction using canny edge detection and morphological operation. Paper presents a case studies of four patients.

Senthilkumar et al. [3] Paper presents A Novel Region Growing Segmentation Algorithm for the Detection of Breast Cancer. Selective median Filter is used for preprocessing, CLAHE method used for enhancement, Harris corner detect theory is used to auto find growing seed. It combines selective median filtering and CLACH with region growing technique for cancer detection gives very good accuracy.

M.M.Fathima et al. [4]Paper presents morphological filtering and threshold based segmentation techniques to find ROI. Various features like texture features, GLCM features, DWT features, higher order gradient features and length features are extracted to find ROI. Classified result is obtained from SVM.

SpandanaParamkusham et al. [5] Paper presents novel algorithms for early detection of breast cancer. Algorithms like mass extraction is used to get shape of mass. That is imposed on mammogram to view boundary of mass region. features like entropy, mean, standard deviation, geometric features like area, perimeter, wavelet based features, ENC (Elliptical normalized circumference) are extracted for classification of benign and malignant masses.

Basha, S. S. et al. [6] Paper presents Automatic Detection of Breast Cancer Mass in Mammograms Using Morphological Operators and Fuzzy C –Means Clustering. Paper presents two steps is to distinguish masses from background tissue using morphological operation and FCM implemented for intensity based segmentation to shows accurate result.

JelenaBozek et al. [7] Bilateral Asymmetry is one of the abnormality of Breast Cancer. Paper Presents CAD algorithm for bilateral asymmetry which uses B-spline interpolation for breast alignment. Alignment of right and left breast is important for comparison. Differential Analysis is subtraction of two image. Author presents colored features to highlight asymmetry features which is useful to radiologist.

SuraRamziShareef et al. [8] Paper presents breast cancer detection based on morphological operation and watershed transformation to extract watershed lines. Author Uses Two types of medical Images. Proposed algorithm is applied to both Ultrasound image and Mammogram Image. Author uses a Database of Mosul Hospital and gives good result.

SayedehSomayeh Hosaini et al. [9] Paper presents a new method is proposed for detection of suspicious areas of breast cancer tumor based on wavelet and hidden Markov model. cancer masses are detected as well as percentage of cancer masses becomes clear; this makes to estimate mass growth rate. Markov model with tree structure is used in order to extract statistical properties of wavelet transform components. Markov model has special ability in extracting information related to edges and protruding parts of image context due to its features which can accurately detect cancer areas. The results indicate that proposed method is more accurate compared to methods that use only wavelet transforms method. Combination of MIAS database and Paden including 150 images is used in order to test the proposed method.

MarijaDakovic and SlavoljubMijovic et al. [10] Paper Presents digitizing mammograms were analyzed using basic point operators to highlight particular features and to extract quantitative information. Main focus was to the contrast enhancement between "suspicious" breast structures and adjacent tissues. Basic algorithms such as normalization, equalization and thresholding were applied and their actions have been shown in both: the image and its histogram. Matlab as an image processing tool was used. It was shown that basic point operators could be successfully used to help radiologists by increasing probability in early detection of breast cancer, even if the original image was not optimally taken.

III. IMPLEMENTATION IN MATLAB

Proposed Algorithm to Detect Microcalcification:

Step 1: Read Grey Level Image Mammogram.
Step 2: Median Filter to Remove Noise and to make Image Smooth
Step 3: Contrast Adjustment with Adaptive Histogram Equalization is used to enhance Image Using Histogram of Original Image
Step 4: Automatic Thresholding Method to find Threshold Image Using Histogram of Enhanced Image
Step 5: Perform Mathematical Morphological Operation to detect Micro calcification in Mammogram Image
Step 6: Impose Calcification on Original Mammogram to get Location and Spreading of Micro calcification

3.1. Pre-Processing

Pre-processing is an important part of Image processing used to remove noise, to make image smooth, to make border sharpen, to make image bright and to enhance contrast.

Pre Processing includes Image Filtering and Image Enhancement:

3.1.1. Image Filtering

There are many techniques used for filtering an image like median filter, Gaussian filter, Average filter, Sobel Filter etc. we have practically Compared results of different filtering methods and results are shown in figure 2.
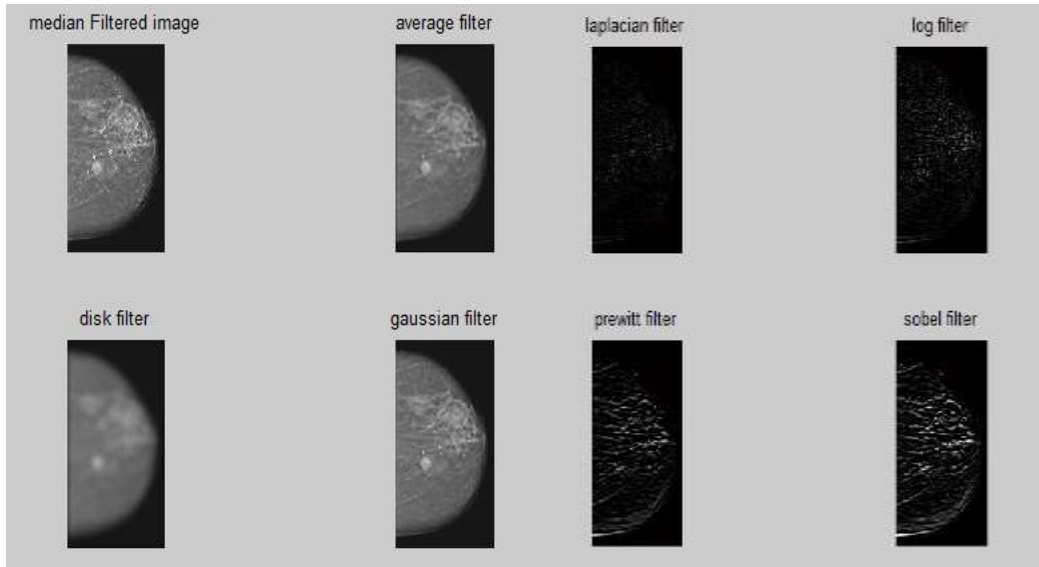

Figure 2. Comparison Between Different Filtering Techniques

From this comparison we observed that median filter gives good result for image filtering. Thus We use median filter technique in proposed work. The median filter is a nonlinear digital filtering technique. In median filtering, the neighboring pixels are ranked according to brightness or intensity and the median value becomes the new value for the central pixel. We used 3x 3 window size for neighborhood.

3.1.2. Image Enhancement

There are many enhancement techniques for image enhancement like histogram equalization, CLAHE, DCT, Adaptive Histogram Equalization etc. we have practically Compared results of different Image Enhancement methods and results are shown in figure 3.
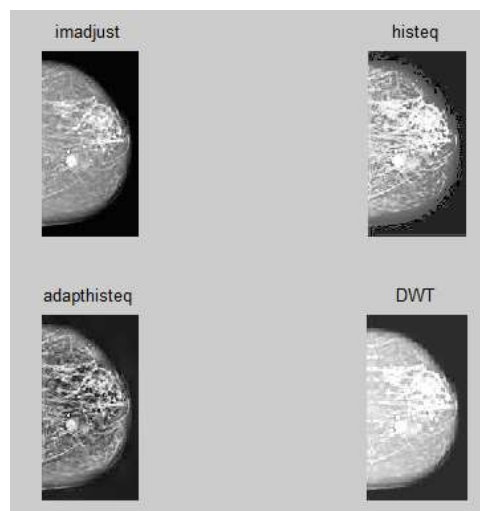

Figure 3. Comparison Between Different Image Enhancement Techniques

From this comparison, we observed that adaptive histogram equalization technique gives good result practically. Thus we use adaptive histogram equalization technique to enhance mammogram image. Adaptive histogram equalization maximizes the contrast of an image by adaptively enhancing the contrast of each pixel relative to its local neighborhood. It operates on small data regions (tiles) rather than the entire image. The contrast enhancement can be limited in order to avoid amplifying the noise which might be present in the image.

3.2. Image Segmentation

Segmentation is very important part of image processing steps. It partitioned mammogram image into several part to detect ROI. We used an automatic Thresholding method. It selects the threshold based on the minimization of the within-group variance or maximizing between group variance from the two groups of pixels separated by the thresholding operator. Initially Threshold t is automatically selected using a histogram of mammogram image. Then partitioned an image into two class h1 and h2 based on intensity values. Range of intensity of image is 0 to L-1. Here, h1= {0,1…t} and h2= {t+1, t+2…. L-1}. Automatic thresholding gives optimal thresholding value by minimizing intra class variance or maximizing between class variance.

Algorithm of Automatic Segmentation:

Step 1: Compute the histogram of the input image.
Step 2: Denote the components of the histogram(Intensity) by pi, i=0, 1, …, L-1.
Step 3: Divides Intensity into two class h1 and h2.
Step 4: Compute the cumulative sums, P(k), for k = 0,1, …, L-1.
Step 5: Compute the cumulative means, m(k), for k = 0,1, …, L-1.
Step 6: Compute the global intensity mean.
Step 7: Compute the between-class variance, for k = 0,1, …, L-1.
Step 8: Obtain the optimal threshold k* by maximizing variance.

3.3. Image Post-processing

Mathematical morphology operations are applied to remove impurities of segmentation. Basic Morphological operations are Erosion, Dilation, Opening and Closing. We used Erosion and Dilation as post processing. Dilation is defined as maximum value in window. Dilation can repair breaks in white objects and can split apart black object. Erosion is an opposite of Dilation. It defined as the minimum value in window. Erosion can repair breaks in black objects and can split apart white object.

IV.   RESULT

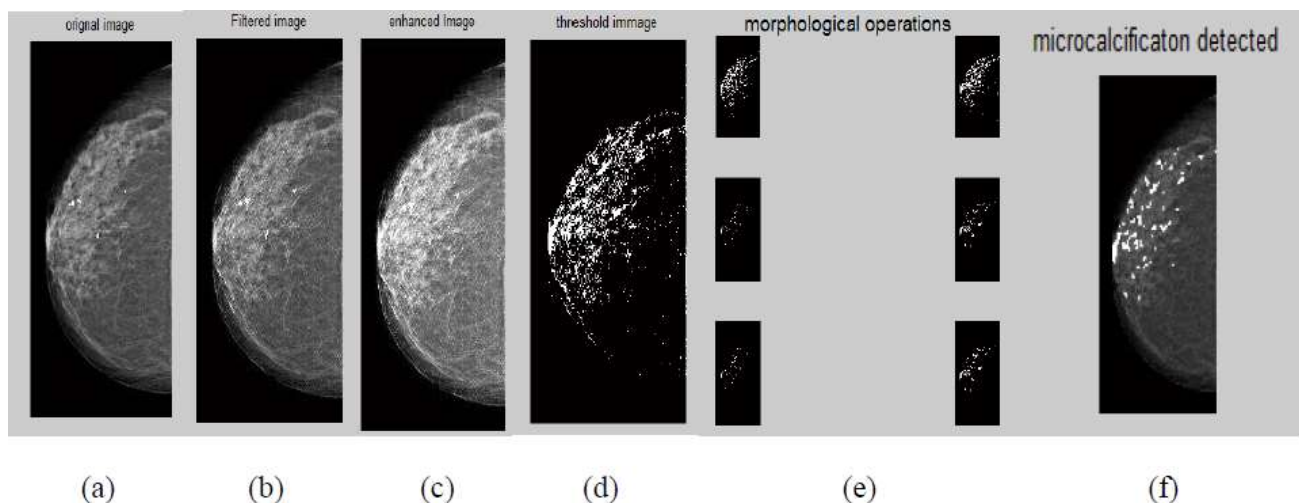Result of proposed approach is shown in figure 4, 5 and 6.

Figure 4. Result: (a) Original Image (b)Filtered Image (c) Enhanced Image (d) Image After Automatic Thresholding (e) Image After Post-processing (f) Image with Microcalcification Detection
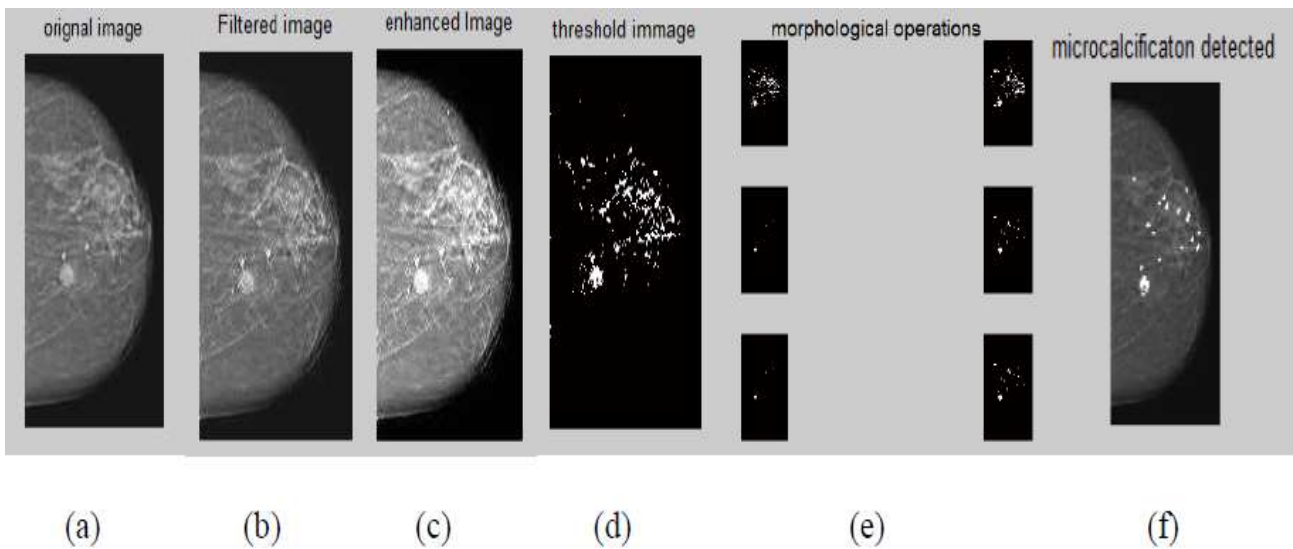
Figure 5. Result: (a) Original Image (b)Filtered Image (c) Enhanced Image (d) Image After Automatic Thresholding (e) Image After Post-processing (f) Image with Microcalcification Detection

Figure 6. Result: (a) Original Image (b)Filtered Image (c) Enhanced Image (d) Image After Automatic Thresholding (e) Image After Post-processing (f) Image with Microcalcification Detection
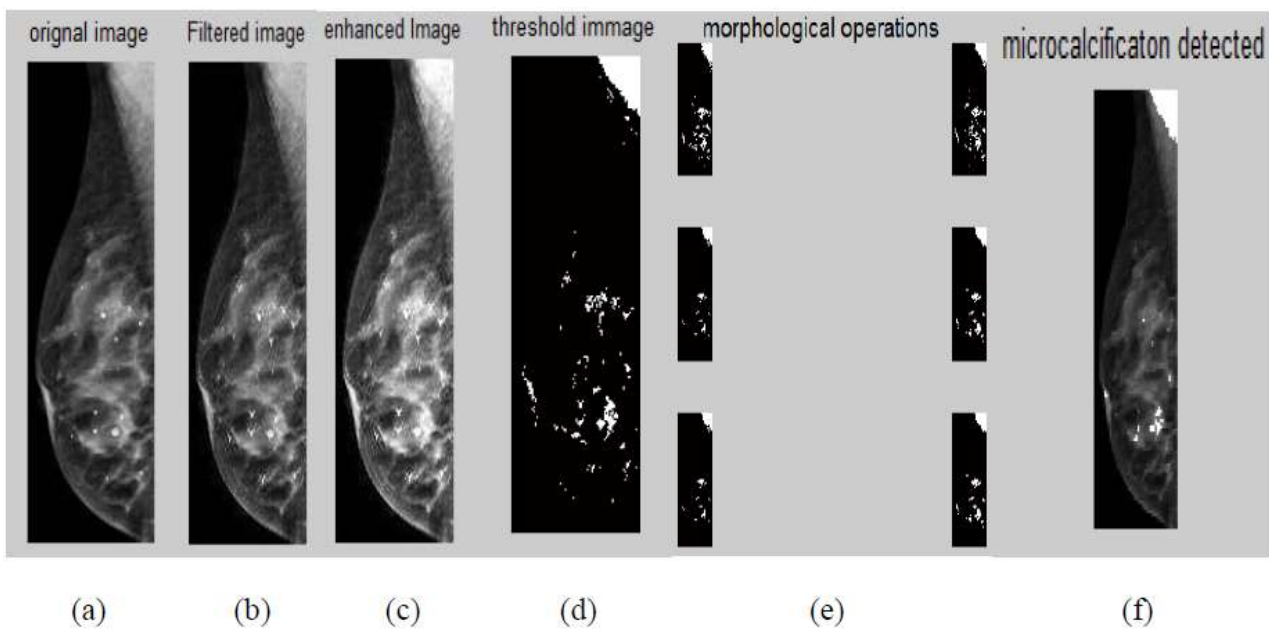
V. CONCLUSION

In Proposed work, we present an algorithm for automatically detection of micro calcification which is one of the breast abnormality. Proposed approach works in three stages: Image pre-processing, segmentation and Image post-processing. We used Median Filtering to make image smooth, AHE to Enhance image, Automatic Thresholding based on otsu's method and Morphological operation as post-processing. By imposing output of morphological operation on original image, we can automatically detect microcalcificatios in breast mammogram image. It gives good result as compared to other existing methods. So, it is very helpful to radiologist to detect microcalcificatios in mammogram and it will play good role in improving quality of CAD system.

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