

# Wavelet Based Automatic Lesion Detection using Improved Active Contour Method

Ashmitha Khaleel Khan  
Dept. Electronics & Communication,  
MES College of Engineering,  
Kuttippuram, Malappuram, Kerala,

Noufal P  
Dept. Electronics & Communication,  
MES College of Engineering  
Kuttippuram, Malappuram, Kerala

**Abstract**— Mammography is one of the available techniques for the early detection of masses or abnormalities which is related to breast cancer. Breast Cancer is the uncontrolled growth of cells in the breast region, which may affect the other parts of the body. Digital Mammography is one of the best available technologies currently being used for the early detection of breast cancer. In this paper, we have proposed a method- Improved Active contour method that helps in the segmentation process for lesion detection. In this method before segmentation preprocessing and DWT of image is done. Preprocessing is one of the most important stages in medical images to remove the unwanted noise and for the enhancement of image. Discrete Wavelet Transform is considered for segmentation as it contains most significant information of the input image.

**Keywords**—Digital Mammography, Preprocessing, Discrete wavelet transform, Segmentation, Active contour method.

## I. INTRODUCTION

The Lesion refers to the uncontrolled multiplication of a group of cell particularly in human breasts[1]. Breast tumors are uncontrolled and abnormal proliferations of cells, some originate in the breast itself. In that case they are termed primary. Some others spread to this location from somewhere else in the body through metastasis, they are termed as secondary. Primary breast tumors can be malignant or benign but they do not spread to other body sites. Secondary breast tumors are always malignant. The most common type of breast cancer begins in the milk-production ducts. Cancer may also occur in the lobules or in other breast tissue [2]. Breasts consist mainly of fatty tissue interspersed with connective tissue. Radical mastectomy (surgical removal) is rarely needed today with better treatment options.

Mammography is one of the effective tools in early detection of breast cancer. It is a low dose x-ray procedure for the visualization of internal structure of breast. Digital mammography replaces x-ray film by solid-state detectors that convert x-rays into electrical signals. These signals are used to produce images that can be displayed on a computer screen (similar to digital cameras). Mammography is the most reliable method and it is the key screening tool for the early detection of breast cancer. Mammography is highly accurate. Screening mammography examinations are performed on

asymptomatic women to detect early, clinically unsuspected breast cancer [3]. Digital mammography uses the DICOM data which is an image where all details of the patient such as Name, Age, Gender, Address, Patient-ID, Date, Size(WL,WW) and frame are present on the image and are included in the object classes. The DICOM formatted images which contains the details of the patient are more important for the radiologists in performing their diagnosis.

At present breast cancer is a leading cause of death among women and second main cause of death after lung cancer [1-7] so the need of early detection of breast cancer is a must. Breast cancer is the one of the important factors of mortality in women over the world. According to the international agency for research on cancer, in India around 79,000 women per year are affected by breast cancer [4]. The National Cancer Institute estimates, in United States one among the eight women will develop breast cancer at some point during her lifetime. According to the American Cancer Society which quotes a morbidity of 230 000 and a mortality of 40 000 according to the latest figures gathered for the American population [7]. Early detection and diagnosis of breast cancer increase the treatment options and a cure is more likely.

The most important step in the mammogram analysis is the pre-processing, as it can rectify the poor captured mammogram image quality. Pre-processing is very important to correct and adjust the mammogram image for further study and processing. There are different types of filtering and enhancement techniques available in pre-processing. These filters are used to improve image quality, remove the noise, preserves the edges within an image, enhance and smoothen the image.

This paper describes about active contour method for segmentation of lesion in mammogram images .For this method the preprocessing is done for removal of noise and image enhancement which will help in segmentation of lesion by resulting a clear boundary and DWT is done to get more accurate information about the input image.

## II. RELATED WORKS

Segmentation process in mammograms are used to detect the lesion present in it ,and its possible only if the image is not gone through any lossy compression .If the image is noisy or

not clear we use the preprocessing technique. The preprocessing steps deal with noise removal, special mark removal and Image enhancement. This is a fundamental step in the medical image processing to produce a better image quality for segmentation. Denoising and image enhancement methods have been applied to the mammography, for reducing the possible Additive random noise in the image, such as Gaussian white noise.

**Mean filter or average filter:** The mean filters are used to improve the image quality for human viewers. In this, filter each pixel has been replaced by the average of pixel values of the intensities in the neighborhood. It reduces noise in the image, but it blurs the edges. It locally reduce the variance, and easy to carry out [8]. When mean filter applied to an image corrupted by impulse noise, the noise is not removed but its only attenuated and diffused.

**Wiener filter:** The wiener filter is used for noise suppression. it tries to build an optimal estimate of the original image and desired or target image, by minimizing the mean square error between the estimated random process and the desired process. The wiener filter is an optimum filter. A wiener filter has the capability of handling both the degradation function as well as noise [9].

**Adaptive median filter:** Adaptive median filter works on a rectangular region. The Adaptive Median Filter performs spatial processing to determine which pixels in an image have been affected by impulse noise. The Adaptive Median Filter classifies pixels as noise by comparing each pixel in the image to its surrounding neighbor pixels. The size of the neighborhood is adjustable. A pixel that is different from a majority of its neighbors, as well as being not structurally aligned with those pixels to which it is similar, is labeled as impulse noise. These noise pixels are then replaced by the median pixel value of the pixels in the neighborhood [10]. Purpose-1). Remove impulse noise 2). Smoothing of other noise 3). Reduce distortion, like excessive thinning or thickening of object boundaries. The preprocessing techniques used in mammogram, orientation, label, artifact removal, enhancement and segmentations. The preprocessing involved in creating masks for pixels with highest intensity, to reduce resolutions and to segment the breast [11]. In this paper Adaptive median filter is used for noise removal.

**Adaptive Histogram equalization:** Adaptive Histogram equalization method is a simple global enhancement technique. By using the image's histogram the adjustment of the image contrast is done. In this method, the intensities are distributed in a good way over histogram, which allows the areas of lower local contrast to get better contrast. This method results with images at which the intensity of background and foreground are simple, both are bright or dark.

In segmentation step, the suspected objects are separated from background, Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. This is an important step which helps for classification algorithm. [12].

In [13] histogram based thresholding technique, where pixels with gray level values greater than a particular threshold are retained by setting all other value zero, from such region statistical features are extracted which reveal the important texture features of breast tissue. With the help of the support vector machine (SVM) classifier the tissue can be classified. The main drawback in this method is that during this processes some important information may be lost and other normal region will be added to the ROI such as nipple and lactation ducts.

A supervised method for the segmentation of masses in mammographic images using texture features was proposed in [14, 15], which presented a homogeneous behavior inside the selected region. It gives a good result but it requires a large amount of data for representing different types of cancers with all its possible shapes and margins.

Edge-detection, traditional method for image segmentation [16]. This method depend on the size of objects and sensitivity to noise. Conventional boundary finding depends on changes in the grey level, rather than their actual values. it is less sensitive to changes in the grey scale distributions over images.

Discrete wavelet transform is used to extract the features. In this method, the images were sent through a series of down-sampling filters which consist of high-pass and low-pass filters. These filters help to increase the intensity and make helpful to extract accurate information [17].

There are some objects whose boundaries are not well defined through the gradient i.e., smeared boundaries and boundaries of large objects defined by grouping smaller ones 'Chan and Vese' [18] introduce a new active contour model, called "without edges". In such case for detecting path or tracking shapes the edges are not required the internal information is enough the track the correct path or boundary. Active contours, also called snakes, are used extensively in computer vision and image processing applications, particularly to locate object boundaries.

### III. LESION DETECTION

Lesion detection in mammograms is carried out after some principle stages. Each stage is important to get a perfect result. In this section the principle stages of the process is explained. Fig .1.

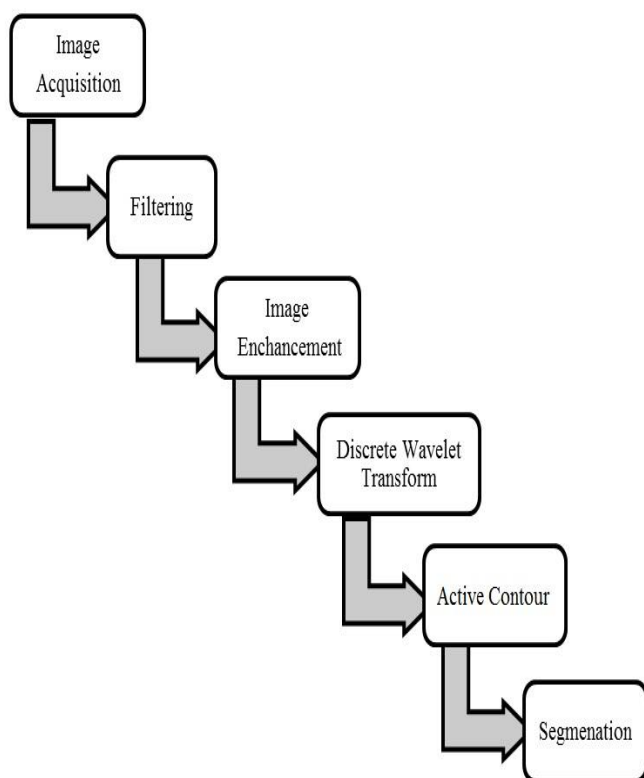


Figure. 1. Principal Stages

Stages:

- A. Image Acquisition
- B. Preprocessing
- C. Discrete wavelet transform
- D. Improved Active contour method

#### A. Image acquisition:

Image acquisition in image processing is defined as the action of retrieving an image from some source, usually a hardware-based source, so it can be passed through whatever processes need to occur afterward.

#### B. Preprocessing:

It's a fundamental step in the medical image processing producing a better image quality for segmentation. Denoising and image enhancement methods have been applied to the mammography, for reducing the possible Additive random noise in the image. The pre-processing steps deal with Image enhancement, Noise removal and special mark removal. Pre-processing is very important to correct and adjust the mammogram image. Different types of techniques are used to

improve image quality, remove the noise, preserves the edges within an image, enhance and smoothen the image.

a) *Filtering*: Adaptive Median filtering is used to smooth the non-repulsive noise signals without blurring edges and preserved images. It creates a mask of highest intensity pixels to reduce resolutions and to segment the breast.

b) *Image-enhancement*: Adaptive histogram equalization is a method in image processing of contrast adjustment using the image's histogram. Intensities are better distributed on the histogram in such way low contrast area get a better contrast. Adaptive Histogram Equalization is done by efficiently spreading out the most frequent intensity values. This method can lead to better views detail in mammogram that is over or under-exposed. In mammogram images by using Adaptive Histogram Equalization contrast are adjusted for the improvisation of the appearance of the image abnormalities.

#### C. Discrete Wavelet Transform:

Discrete wavelet transform (DWT) is a suitable tool any type of segmentation or classification. Theoretically 2-D wavelet decomposition of an image is performed after applying one dimensional in the same image. This results in four decomposed sub-band images referred to as low-low (LL), low-high (LH), high-low (HL), and high-high (HH). The LL-subband image contains only low frequency information of the original image. The HL and LH parts contain the horizontal and a vertical high-frequency component of the original image the HH-subband image contains the high frequency components in diagonal directions. Thus, disturbances caused due to high frequency will less found in the LL-subband images and it will be containing more accurate information which helps for further process.

#### D. Segmentation:

Image segmentation is the process of partitioning a digital image into multiple segments. The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. In mammogram images it is important to distinguish the suspicious region from its surroundings.

Images where the objects object boundaries are noisy and blurry we consider active contours as these issues can be rectified. Chan and Vese introduce a new active contour model, called "without edges" [18]. The main idea is to consider the information are present inside the regions not only at their boundaries, considering this even when the boundaries are not well identified with the help of the inside information we can calculate the boundary. This method can

be used for image segmentation [19] for acquiring the correct boundary for lesion detection.

#### IV. METHODOLOGY

Active contour for segmentation: we use active contour without edges method for segmentation as in medical images boundaries are very difficult to get it accurate Chan and Vese [18] stated that some objects whose boundaries are not well defined through the gradient ie smeared boundaries and boundaries of large objects defined by grouping smaller ones. In this method considering the information inside a region its boundary is calculated. In active contour energy minimization also occur [20].

#### STEPS INVOLVED:

1. Image acquisition
2. Preprocessing
3. Discrete wavelet transforms (Single level decomposition of the image).
4. Specify the initial contour
5. Mask created
6. Segmented

#### Description of the steps:

Image acquisition: Dicom image acquired from the dataset as the Dicom images will have maximum information it will help to segment the image more easily. In MATLAB using the `dicomread(filename)` we can read the image. Preprocessing is done to remove the noise and to enhance the image. For this process adaptive median filter and adaptive histogram equalization is done. After this stage DWT technique is used to get more accurate information from the input mammogram image after image decomposition .LL subband will be showing the maximum information. Extract the level 1 coefficients- $a_1$   $d_1$   $h_1$   $v_1$ . From these reconstruct each coefficients using 'wrccoef'. By Adding each reconstructed coefficients- a reconstructed image formed. For specifying the initial contour we use a roipoly to specify a polygon region at the desired region in the image. A mask is created which is used for masked filtering. In the mask image roipoly sets values for the pixels 1 for the region inside the mask and 0 for region outside the mask. Maximum number of iterations is given in evolution of segmentation. Depending upon mask created the number of iteration is given if the region of interest is away from the mask region the iteration is maximized. Active contour stops evolution if the current iteration is same when compared to the previous five positions. The active contour used are of without edges - 'Chan-Vese' method.

#### Implementation of Project:

- 1) Dicom images are acquired.
- 2) Preprocessing
- 3) Discrete wavelet transform is done to the input image.
- 4) Single level decomposition of the image. Extract the level 1 coefficients- $a_1$   $d_1$   $h_1$   $v_1$ ,  $a_1$  will be having maximum information.
- 5) Reconstruct each coefficients using 'wrccoef'
- 6) By Adding each reconstructed coefficients we reconstruct a new image.
- 7) To this reconstructed image we add the original image which gives a modified image which has more information. This image is considered for further processes.
- 8) Specify the initial contour in this modified image.
- 9) Mask is created.
- 10) Will the help of the mask we define the number of iterations
- 11) Segmented Image

#### V. RESULTS & ANALYSIS

Output of Wavelet Based Improved Active Contour Method using MATLAB TOOL is implemented and the results obtained are as follows. The output of each stage.

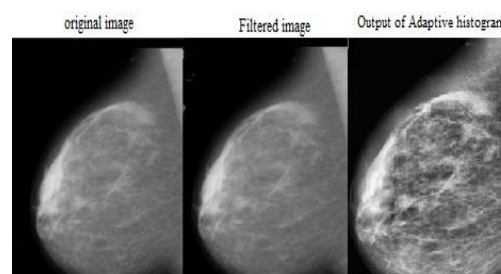


Figure. 2. Original image, Output after filtering & Output of Adaptive histogram

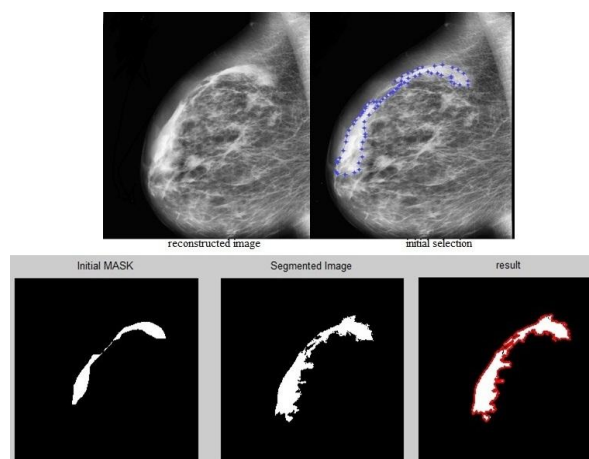


Figure. 3. Final Result after Complete Segmentation



## VI. CONCLUSION



Breast cancer is the most common form of cancer among women and is the second leading of death after lung cancer. Early detection and diagnosis of Breast Cancer increases the treatment options and a cure is more likely. One of the most effective tools for early detection of breast cancer is the mammography.

Using Improved Active Contour Method with wavelet transform a segmented image is obtained from a mammogram dicom image for the further diagnosis. The noise has to be removed in preprocessing which yield the accurate results. It has been observed that after the segmentation process, the white shaded portions i.e. the abnormalities present in the breast region will appear. Using this method the lesion from the mammogram can be segmented accurately.

## REFERENCES

- [1] W. Schulz, Molecular Biology of Human Cancers. New York, USA: Springer, 2007
- [2] M. P. Sampat, M. K. Markey, and A. C. Bovik, "Computer-Aided Detection and Diagnosis in Mammography," Handbook of Image and Video Processing. London, U.K.: Elsevier, 2003K. Elissa,
- [3] M. F. Akay, "Support vector machines combined with feature selection for breast cancer diagnosis," Expert Syst. With Applicat., vol. 36, no. 2, pt. 2, pp. 3240–3247, Mar. 2009, 10.1016/j.eswa.2008.01.009, 0957-4174.
- [4] J. Eric, L. M. Wun, C. C. Boring, W. Flanders, J. Timmel T. Tong, "The lifetime risk of developing breast cancer," JNCI J. Nat. Cancer Inst., vol. 85, no. 11, pp. 892–897, 1993, 10.1093/jnci/85.11.892.
- [5] B. E. Sirovich and H. C. Sox, Jr., "Breast cancer screening," Surgical Clinics N. Amer., vol. 79, no. 5, pp. 961–990, Oct. 1, 1999, 10.1016/S0039-6109(05)70056-6, 0039-6109.
- [6] Cancer Facts and Figures 2012 American Cancer Society, Inc.
- [7] L..M. Wun, R. M. Merrill, and E. J. Feuer, —Estimating lifetime and age-conditional probabilities of developing cancer, Lifetime Data Anal., vol. 4, pp. 169–186, 1998.
- [8] Jwad Nagi "Automated Breast Profile Segmentation for ROI Detection Using Digital Mammograms", IEEE EMBS Biomedical Engineering Sciences (IECBES 2010), Kuala Lumpur.
- [9] M.P. Sampat, M.K. Markey, and A.C. Bovik "Computer-Aided Detection and Diagnosis in Mammography", A.C. Bovik, Ed. Amsterdam: Elsevier Academic Press, 2005.
- [10] Maciej A. Mazurowski , Joseph Y. Lo, Brian P. Harrawood, Georgia D. Tourassi, "Mutual information-based template matching scheme for detection of breast masses: From mammography to digital breast tomosynthesis", Journal of Biomedical Informatics (2011).
- [11] E. D. Pisano, E. B. Cole, B. M. Hemminger, M. J. Yaffe, S. R. Aylward, A. D.A. Maidment, R. E. Johnston, M. B. Williams, L. T. Niklason, E. F. Conant, L. L. Fajardo, D. B. Kopans, M. E. Brown, and S. M. Pizer, "Image processing algorithms for digital mammography: A pictorial essay", Radiographics, vol.20, pp. 14791491, Sep. 2000.19.
- [12] T. S. Subashini, V. Ramalingam, and S. Palanivel, "Automated assessment of breast tissue density in digital mammograms," Elsevier, pp. 33-43, 2010.
- [13] J. Marti, J. Freixenet, X. Mu noz, and A. Oliver, "Active region segmentation of mammographic masses based on texture, contour and shape features.," in Springer-Verlag, Berlin Heidelberg, 2003, pp. 478-485.
- [14] Bin Zheng et al., "Interactive Computer-Aided Diagnosis of Breast Masses: Computerized Selection of Visually Similar Image Sets" From a Reference Library Acad Radio, vol. 14, pp. 917927, 2007.
- [15] JL Viton, M. Rasigni, G. Rasigni, and A. Liebaria, "Method for characterizing masses in digital mammograms," Opt. Eng., vol. 35, no. 12, pp. 34533459, 1996.
- [16] L. H. Li, W. Qian, and L. P. Clarke, "Digital mammography: computer-assisted diagnosis method for mass detection with multiorientation and multiresolution wavelet transforms," Acad. Radiol, no. 4, pp. 724731, 1997.
- [17] R. N. Strickland, H. Hahn, "Wavelet Transforms for Detecting Microcalcifications in Mammograms", IEEE Transactions on Medical Imaging, 15, pp. 218–229, 1996.
- [18] T. Chan and L. Vese, "Active contours without edges," IEEE Trans. Image Processing, vol. 10(2), pp. 266–277, 2001.
- [19] L.A. Vese and T.F. Chan, "A Multiphase Level Set Framework for Image Segmentation Using the Mumford and Shah Model," International Journal of Computer Vision, vol. 50(3), pp. 271–293, 2002.
- [20] M. Kass, A. Witkin, D. Terzopoulos, "Snakes: Active contour models," International Journal of Computer Visio, vol. 1, pp. 321-331, 1988.

## BIOGRAPHIES

	<p><b>Ashmitha Khaleel Khan</b> pursuing master's degree in Communication &amp; Signal-processing from MES College of Engineering, Kuttippuram. Received bachelor's degree in Electronics &amp; Communication from AWH College of Engineering, Calicut. Main research interests in Image Processing, Signal Processing, Embedded System Design etc. Worked as a project co-ordinator on embedded system in Keltron, Calicut.</p>		<p><b>P.Noufal</b> received his master's degree in remote sensing from CEG, Anna university-Chennai in 2010. He is currently working with MES College of Engineering, Kuttippuram as Assistant Professor in ECE department. He has been worked as a part of a live project team on Artificial Intelligence in CARTOSAT-2A IRS Satellite mission at NRSC/ISRO, Hyderabad during 2009-2010. His main research interests are medical/satellite image analysis, Automatic Feature Extraction, Computer vision, Artificial Intelligence, etc.</p>
---	--	---	--