

Breast Mass Segmentation using Seed based Region Growing Technique

Lothe Savita A.
Research Student
Dr.B.A.M.U., Aurangabad

Telgad Rupali L.
Research Student
Dr.B.A.M.U., Aurangabad

Siddiqui Almas
Research Student
Dr.B.A.M.U., Aurangabad

Deshmukh P.D.
MGM's, Dr. G.Y.
Pathrikar, College of CS
& IT, Aurangabad

ABSTRACT

Accurately detecting the breast cancer disease in the early stage is extremely essential for fast recovery or to avoid the death probability. Breast cancer can be detected by various imaging modalities out of mammography is more used. Breast lesions are mass and microcalcification. Segmentation is mainly divided into 2 types according to the similarity and discontinuity. In this paper we proposed system for segmentation of breast mass using seed region growing technique, which is most important step in CAD system, depending upon the result of segmentation breast mass can be characterized as benign or malignant.

Keywords

CAD, Mammogram, Enhancement, DFT, Segmentation, Seed region growing.

1. INTRODUCTION

Breast cancer that forms in tissues of the breast, usually the ducts (tubes that carry milk to the nipple) and lobules (glands that make milk) [1]. Breast cancer is a leading cause of death among women in developed countries. The morbidity of breast cancer is increasing with a fast speed in developing countries due to the increase of life expectancy, urbanization and change in life styles. In china compared to other countries where the incidence growth of breast cancer is fast increasing. Unfortunately, only 20% of the breast cancer patients are diagnosed at the early stage. As the cause of breast cancer is not clearly known, early stage. As the cause of breast cancer is not clearly known, early detection remains the corner stone in breast cancer treatment [2]. Breast cancer can be detected through various examination magnetic resonance imaging (MRI), mammography, ultrasound, CSE and BSE. Mammography is the most effective in reducing mortality rates by 30% - 70% [3]. Mammogram interpretation is a repetitive task which requires maximum care for avoidance of misinterpretation. Therefore, computer aided detection and diagnosis (CAD) system is currently a very popular and efficient method which analyses the digital mammogram with the use of image processing. CAD system helps radiologists in accurate interpretation of mammograms for detection of suspicious lesions and classification. It has been observed that 60%-90% of the biopsies of cancers predicted by radiologists found benign-malignant mammogram. Computer aided detection system is a combination of image-processing techniques and intelligent methods that can be used to enhance the medical interpretation process can make better results in the development of more efficient diagnosis. The computer outcome assists radiologists in image analysis and diagnostic decision making. In addition, a CAD system could direct a radiologist's attention to regions where the probability of indications of disease is greatest. A CAD system provides reproducible and quite realistic outcomes [4].

This work is organized as follows. In section II provides literature review about segmentation in CAD system. Section III gives about CAD system, followed by database used for experimental purpose in IV section. Section V gives the details of proposed system.

2. BACKGROUND

This section gives the literature review about the segmentation method.

Lochanambal et al [5] developed template-matching used for segmenting cancerous part is pixel-based mass detection.

Bandyopadhyay et al [6] proposed segmentation techniques into two parts i.e., formation of Homogeneous Blocks and Color quantization after preprocessing.

Han et al [7] in order to get the regions of interest (ROIs) in the mammogram, a segmentation method called isocontour map is firstly used. One useful property of this method is its invariance with respect to an affine transformation of intensity. This is a particularly useful property in analyzing mammograms, since they are taken under imaging conditions that vary across patients and x-ray machines. As a result, the intensity values for each mammogram may vary significantly even for the same patient. In practice, this method could be robust against such changes. In this method, a topographic representation called the isocontour map is developed in which a salient region forms a dense quasi-concentric pattern of contours. The isocontour representation of the 3-D image surface is equivalent to slicing the image surface with a series of horizontal planes.

Faye et al [8], proposes method use for classification of images is based on preselecting features based on their capabilities of differentiating classes using a T test. Random subsets achieving a predefined accuracy rate are then used to generate a final set of features. The method was used in this work with wavelet transform with LDA and k-NN classifiers. Although the final accuracy rate obtained in the experiments are relatively low, the improvement when combining classifiers is highly encouraging. Pereira D.C. et al [9] presents a set of computational tools to aid segmentation and detection of mammograms that contained mass or masses in CC and MLO views. An artifact removal algorithm is first implemented followed by an image denoising and gray-level enhancement method based on wavelet transform and wiener filter. Finally, a method for detection and segmentation of masses using multiple thresholding, wavelet transform and genetic algorithm is employed in mammograms which were randomly selected from the Digital Database for Screening Mammography (DDSM).

Jen C. et al [10], proposed a high-performance CAD system for detecting abnormal mammograms by using the two-stage classifier ADC, which applied the PCA-based technique accompanied by robust feature weight adjustments.

3. CAD SYSTEM

CAD is invented to follow the subsequent steps:

1. Initially mammogram images read by radiologists for marking suspicious areas.
2. A CAD system scanning to detect suspicious features.
3. Radiologists analysis of the prompts given by the CAD system and verification if the suspicious areas were left unchecked in the first reading [11].

3.1 Steps in Computer Aided Detection

For the time being, mammographic screening remains the most effective method for early detection of breast cancer. However, reading mammography is a time-consume error prone work. Therefore, many computer-aided detection and diagnosis systems (CAD) have been developed to assist radiologists in detecting and classifying mammographic lesions [12]. Figure 1 gives the steps in CAD system.

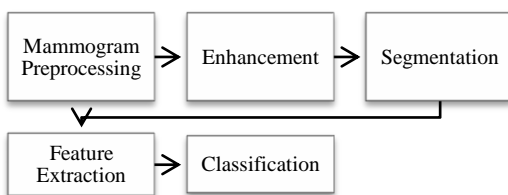


Fig 1: Basic steps in Computer Aided Detection (CAD) System

4. DATABASE

All mammograms used in this work (segmentation of mass) are from a mini Mammographic database provided by Mammographic Image Analysis Society (MIAS), includes radiologist's "truth" markings on the locations of any abnormalities that may be present [13-14].

5. PROPOSED SYSTEM

Mass is one of the main signs of breast cancer. A mass is a space occupying lesion which usually exhibits higher intensity compared with fat tissues in a mammogram. The diction between normal mass has been largely difficult task for the radiologists, as masses can be subtle at a nearly stage, shapes and sizes [2].

A mass is defined as a space-occupying lesion seen in more than one projection with a regular shape has a higher probability of existence benign, whereas a mass with an irregular shape has a higher probability of presence malignant [15-16]. Figure 2 shows the flow of proposed segmentation of mass using seeded region growing method.

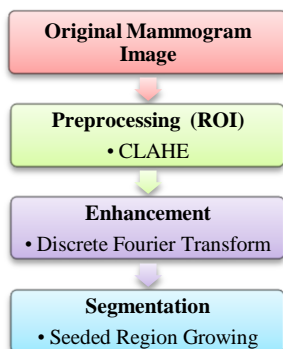


Fig 2: Proposed system for Mass Segmentation

Here we developed CAD system for segmentation of mass consisting image processing techniques as preprocessing, enhancement, segmentation.

Mammogram image is composed of different noises, artifacts in their background. The object area also contains the pectoral muscles. All these areas are unwanted portions for the texture analysis due to which the full mammographic image is unsuitable for feature extraction and subsequent classification. Therefore, a cropping operation has been applied on mammogram images to extract the regions of interests (ROIs) which contain the abnormalities, excluding the unwanted portions of the image. This process is performed by referring the center of the abnormal area as the center of ROI and taking a square enclosing the abnormal area [17] shown in figure 3.3. ROI is a fundamental step used as input for the developed CAD system, representing the selected region of the mammographic image.

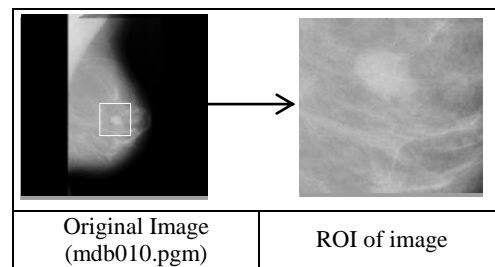


Fig 3: ROI from Original Image

5.1 Preprocessing

Mammograms are difficult images to interpret and a preprocessing phase is necessary to improve the quality of the images [18]. Here the preprocessing stage consists two main stages. In this system the first phase involves the removal of background information and noise from the image with the help of median filters, while the second phase deals with enhancing the contrast of interest areas using CLAHE (Contrast Limited Adaptive Histogram Equalization) technique. CLAHE algorithm operates on small regions of the gray image by partitioning the image into contextual regions called tiles [16].

5.2 Image Enhancement

Image enhancement is the process of adjusting digital images so that the results are more suitable for display or further analysis. We remove noise or brighten an image, making it easier to identify key features [19].

Here we used Discrete Fourier Transform (DFT) technique for enhancement of image shown in figure 4.

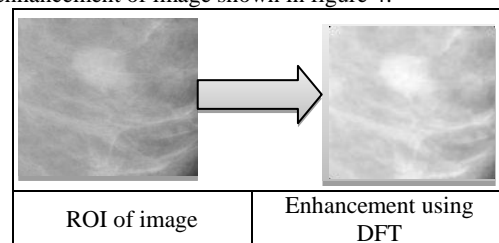


Fig 4: Enhancement using DFT

Fourier transform is a continuous signal can be represented as a (countable) weighted sum of sinusoids. It offers flexibility in the design and implementation of filtering solutions in areas such as image enhancement. The Fourier transform has a number of interesting properties [20].

Following are the steps in DFT filtering

1. Convert the image to floating point.
2. Obtain the padding parameters.
3. Obtain the Fourier transform.
4. Generate the highpass filter function.
5. Multiply the transform by the filter.
6. Obtain the inverse FFT.
7. Crop the top, left rectangle to the original size.
8. Convert the filtered image to the class of input image [21-22].

Figure 5 shows the result of applying histogram equalization on enhanced image.

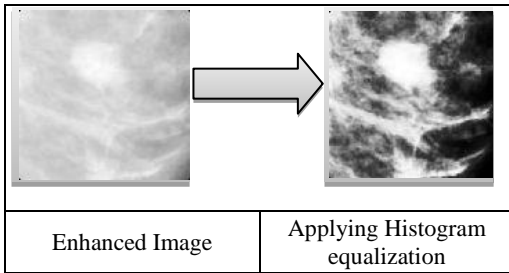


Fig 5: Applying histogram equalisation on image

5.3 Segmentation

Segmentation methods broadly divided into two main categories: edge-based methods and region-based. In edge-based methods, the local discontinuities are detected first and then connected to form longer, hopefully complete, boundaries. In region-based methods, areas of an image with homogeneous properties are found, which in turn give the boundaries [23]. In this work we have used region growing method for the segmentation of mass. Region-growing techniques exploit the important fact that pixels which are close together have similar gray values. The algorithm starts from one or more pixels, called *Seeds*, chosen as the reference values for the growth. Then, region growing expands the selected areas around the seeds to include nearby pixels falling within a threshold range. The main steps are summarized as follows.

1. Choose the seed pixels.
2. Check the neighboring pixels and add them to the region if they are similar to the seed.
3. Repeat step 2 for each of the newly added pixels; stop if no more pixels can be added [24].

The result of segmentation is shown in figure 6.

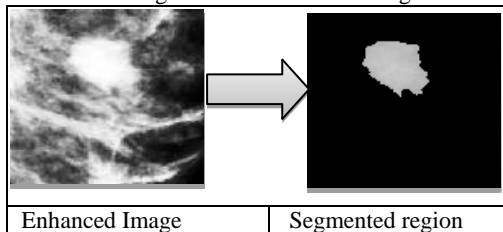


Fig 4: Segmented Region

The table 1 shows more result for segmentation of mass.

Table 1: Experimental result for Segmentation of Mass

Image (.pgm)	Image	ROI of image	Segmented region
mdb001			
mdb002			
mdb005			
mdb010			
mdb012			

6. CONCLUSION

Mammography screening remains the most effective method for early detection of breast cancer. However, reading mammography is a time-consume error work. Therefore, many computer-aided detection and diagnosis systems (CAD) have been developed to assist radiologists in detecting and classifying mammographic lesions. A mass screened on a mammogram can be either benign or malignant depending on its shape. Benign tumors usually have round or oval shapes, although malignant tumors have a partially rounded shape with a spiked or irregular outline. Non-cancerous or benign tumors include cysts, fibro adenomas, and breast hematomas. A cancerous or malignant tumor in the breast is a mass of breast tissue that grows in an abnormal and uncontrolled way. Normally, malignant masses appear brighter than any tissue surrounding it. In this work we proposed system for segmentation of breast mass, important step in CAD system. Further extracting the statistical values of segmented region such as texture and shape, classification is performed to find breast tumor is benign or malignant.

7. REFERENCES

- [1] American Cancer Society, "What is Cancer", [Online], Available: <http://www.cancer.org/Cancer/CancerBasics/what-is-cancer>, American Cancer Society, ACS.
- [2] Yanfeng Li, Hougin Chen, Yongyi Yang, Lin Cheng, Lin Cao, "A bilateral analysis scheme for false positive reduction in mammogram mass detection", *Computers in Biology and Medicine*, vol.57, pp. 84-95, Elsevier, 2015.
- [3] VibhaBafna Bora, A.G. Kothari, and A.G. Keskar, "Mammogram Segmentation Using Rough k-Means and Mass Lesion Classification with Artificial NeuralNetwork", *AMLT*, pp. 60-69, Springer, 2012.

- [4] FarzanKhatib, Rozi Mahmud, SyamsiahMashohor, M. Iqbal Saripan, Raja SyamsulAzmir Raja Abdullah, "Automated Cystic Mass Extraction from Ultrasound Phantom Images", Sixth Asia Modelling Symposium, pp. 54-58, IEEE, 2012.
- [5] K.P.Lochanambal, M.Karnan, R.Sivakumar, "Identifying Masses in Mammograms Using Template Matching", Second International Conference on Communication Software and Networks, IEEE, 2010.
- [6] Prof. Samir Kumar Bandyopadhyay, IndraKanta Maitra, Prof. Tai – Hoon Kim, "Identification of Abnormal Masses in Digital Mammography Images", International Conference on Ubiquitous Computing and Multimedia Applications, IEEE, 2011
- [7] Wenfeng Han¹, Jianwei Dong¹, Yuting Guo¹, Ming Zhang^{1*} and Jianzhong Wang, "Identification of masses in digital mammogram using an optimal set of features", International Joint Conference of IEEE TrustCom-11/IEEE ICSS-11/FCST-11, 2011.
- [8] Ibrahim Faye, "A random feature selection method for classification of Mammogram images", Third International Conference on Intelligent Systems Modelling and Simulation, ISMS, pp. 330-333, IEEE, 2012.
- [9] Danilo Cesar Pereira, Rodrigo Pereira Ramos, Marcelo Zanchetta do Nascimento, "Segmentation and detection of breast cancer in mammograms combining wavelet analysis and genetic algorithm", Computer Methods and Programs in Biomedicine, vol. 114, pp 88-101, Elsevier, 2014.
- [10] Chun-Chu Jen, Shyr-Shen Yu, "Automatic detection of abnormal mammograms in mammographic images", Expert Systems with Applications, vol. 42, pp. 3048-3055, Elsevier, 2015.
- [11] Rangayyan, R., Ayres, F., &Desautels, J., "A review of computer-aided diagnosis of breast cancer: Toward the detection of subtle signs", Journal of the Franklin Institute, vol. 344, pp. 312-348, 2007.
- [12] Yihua Lan, Haozheng Ren, Jinxin Wan, "A Hybrid Classifier for Mammography CAD", Fourth International Conference on Computational and Information Sciences, pp. 309-312, IEEE, 2012.
- [13] J. Suckling, "The Mammographic Image Analysis Society Digital Mammogram Database", ExcerptaMedica, International Congress Series 1069, pp. 375-378, 1994.
- [14] Mohammed J. Islam, Majid Ahmadi, and Maher A. Sid-Ahmed, "Computer Aided Detection and Classification of Masses in Digitized Mammograms Using Artificial Neural Network", ICSI 2010, Part II, LNCS 6146, Springer, pp. 327-334, 2010.
- [15] Jinshan Tang, Rangaraj M. Rangayyan, Jun Xu, Issam El Naqa, and Yongyi Yang, "Computer aided detection and diagnosis of breast cancer with mammography: Recent advances", IEEE Transactions on Information Technology in Biomedicine, Vol. 13, No. 2, Mar. 2009.
- [16] Nijad Al-Najdawi, Mariam Biltawi, Sara Tedmori, "Mammogram image visual enhancement, mass segmentation and classification", Applied Soft Computing 35, pp. 175-185, Elsevier, 2015.
- [17] ShradhanandaBeura, BanshidharMajhi, Ratnakar Dash, "Mammogram classification using two dimensional discrete wavelet transform and gray-level co-occurrence matrix for detection of breast cancer", Neurocomputing 154, Elsevier, 2015, pp. 1-14.
- [18] Maria Victoria Carreras Cruz, Patricia Rayon Vilella, "Circumscribed Mass Detection in Digital Mammograms", Proceedings of the Electronics, Robotics and Automotive Mechanics Conference (CERMA), 2006
- [19] Prakash Bethapudi, Dr. E. Srinivasa Reddy, Dr.Madhuri. P., "Detection of Malignancy in Digital Mammograms from Segmented Breast Region Using Morphological Techniques", IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE), Volume 5, Issue 4, pp 9-12, June 2013.
- [20] http://www.fpferrarese.com/images0910/MISC/Digital_Image_Processing_Medical_Applications_Frequency_Domain.pdf
- [21] Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson., Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing using Matlab", Second Edition, McGraw Hill.
- [22] Lothe Savita A., Gaikesh Vrushali V., Dr.DeshmukhPrapti D., "Visual Enhancement of mammogram image using DFT", Indian Science Congress – 2015, University of Mumbai, 3 – 7 Jan 2015.
- [23] Subarna Chatterjee, Ajoy Kumar Ray, Rezaul Karim, Arindam Biswas, "Detection of micro-calcification to Characterize Malignant Breast Lesion", Third National Conference on Computer Vision, Pattern Recognition, Image Processing and Graphics, pp. 251-254, IEEE, 2011.
- [24] Arianna Mencattini, Giulia Rabottino, Marcello Salmeri, Roberto Lojaco and Emanuele Colini, "Breast Mass Segmentation in Mammographic Images by an Effective Region Growing Algorithm", ACIVS 2008, LNCS 5259, pp 948-957, Springer, 2008.