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# Malignant Breast Cancer Detection Method - A Review

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## Abstract

***Mammography is a specific type of imaging that uses a low-dose x-ray system to examine breasts. A mammography exam, called a mammogram, is used to aid in the early detection and diagnosis of breast diseases in women. Breast cancer is a type of cancer originating from breast tissue. Most commonly from the inner lining of milk ducts or lobules that supply the ducts with milk. Breast cancer is the most common cause of cancer death and is the most common cancer among women. In this paper, we study various methods to detect malignant breast cancer.***



## 1. Introduction

Mammography is the process of using low-energy X-rays to examine the human breast and is used as a diagnostic and a screening tool. The goal of mammography is the early detection of breast cancer typically through detection of characteristic masses and microcalcifications[11] A mammography exam, called a mammogram, is used to aid in the early detection and diagnosis of breast diseases[12] a woman born today has about a 1 in 8 chance of being diagnosed with breast cancer at some time during her life. On the other hand, the chance that she will never have breast cancer is 87.6 percent, or about 7 in 8 [13].

Recent advances in mammography include digital mammography, computer-aided detection, X-Ray mammography, MRI mammography and breast tomosynthesis [12].

## 1. Digital Mammography

Digital mammography, also called full-field digital mammography (FFDM), is a mammography system in which the x-ray film is replaced by solid-state detectors that convert x-rays into electrical signals. These detectors are similar to those found in digital cameras. The electrical signals are used to produce images of the breast that can be seen on a computer screen or printed on special film similar to conventional mammograms. From the patient's point of view, having a digital mammogram is essentially the same as having a conventional film mammogram [12].

## 2. Computer-aided detection (CAD) systems

Computer-aided detection (CAD) systems use a digitized mammographic image that can be obtained from either a conventional film mammogram or a digitally acquired mammogram. The computer software then searches for abnormal areas of density, mass, or calcification that may indicate the presence of cancer. The CAD system highlights these areas on the images, alerting the radiologist to the need for further analysis [12]

## 3. Breast tomosynthesis

Breast tomosynthesis, also called three-dimensional (3-D) breast imaging, is a mammography system where the x-ray tube and imaging plate move during the exposure. It creates a series of thin slices through the breast that allow for improved detection of cancer and fewer patients recalled for additional imaging[12]

## 4. X-ray mammography

X-Ray Mammography is commonly used in clinical practice for diagnostic and screening purposes. Screening mammography has been recommended as the most effective method for early detection of breast cancer. Mammography provides high sensitivity on fatty breast and excellent demonstration of micro calcifications, it is highly indicative of an early malignancy. Due to its low cost, it is suitable for mass screening program. Mammography has its limitations. It is less reliable on dense breast of young women or women underwent a surgical intervention in the breast because glandular and scar tissues are as radiopaque as abnormalities. Furthermore, there is low dose X-Ray radiation [5]

## 5. MRI of the breast

Magnetic Resonance Imaging is the most attractive alternative to Mammography. MRI is sensitive for detecting some cancers which could be missed by mammography. In addition, MRI can help radiologists and other specialists determine how to treat breast cancer patients by identifying the stage of the disease. It is highly effective to image breast after breast surgery or radiation therapy. To be effective, contrast-enhanced breast MRI is carried out by injecting in the patient's body of a paramagnetic contrast agent. It can perform with all women including who are not suitable for mammography, such as young women with dense breast and women with silicone-filled breast implants. Since it uses magnetic fields, MRI has no harmful effects on human bodies. However, MRI takes rather long time to perform and has high cost which is more than ten times greater than mammography. Its low resolution limits its application to very small lesions or micro calcifications [5].

## 2. Method and Materials for the detection of malignant breast cancer

### 2.1. Breast cancer Detection through Mammographic Feature Analysis

A new features-set was formed and used for the classification of tumors involving six existing and one devised feature [1].

#### 2.1.1. Features Used

Author used a new one deviced feature and six existing features Feature devised is the ratio of major to minor axis of the tumor [1].

**2.1.2. Preexisting Features**

1. Area of the tumor [7]
2. Circularity of tumor [8]
3. Mean contrast of the tumor [7]
4. Average central region contrast [9]
5. Second moment of the tumor boundary [7]
6. Ratio of average inner to outer contrast [10]

**2.1.3. Devised feature**

The feature devised is the ratio of major to minor axis. As cancerous tumors tend to grow equally in all directions, an oval shaped or elongated tumor is less likely to be malignant as compared to the benign ones. Major and minor axes of the tumor were observed and their ratio was taken. [1]

### 2.2 Bilateral asymmetry identification

In this work, author present a procedure for bilateral asymmetry detection composed of the following steps [2].

1. Mammography density analysis and fibro-glandular disc detection through adaptive clustering techniques.
2. Analysis and implementation of bilateral asymmetries detection algorithms based on Gabor filters Analysis.
3. Use of a linear Bayes classifier with the leave-oneout method to asses the asymmetry degree of the two breasts.
4. Metrological validation of the whole system through the modeling of the uncertainty contributions estimated in the specific context

### 2.3 Detection based on mixture membership function with MFSVM-FKNN ensemble classifier

In this paper, author proposes a mixture membership function based on linear distance membership and tight density membership. Specifically, different fuzzy factors are defined for different training samples based on mixture membership. Furthermore, instead of giving the final classification results as traditional CAD systems, we define the likelihood of a candidate regions, then the final results of breast CAD is decided by the highest fuzzy degree defined in Fuzzy Support Vector Machine based on Mixture Membership (MFSVM) and Fuzzy K-nearest Neighbor (FKNN) ensemble algorithm.[3]

The experimental results in X-ray mammography demonstrate that linear membership function effectively reduces the impact of noise and outliers, while the tight density membership effectively distinguishes noise points from support vector. Furthermore, the mixture membership definition effectively improve the accuracy of the FSVM based CAD system. [3]

## 2.4 Detection of micro-calcification to characterize malignant breast lesion

In this paper, we propose a micro calcification detection algorithm in two parts. One is segmentation of the mass or nodule and the other is detection of micro-calcification within the mass [4]

Author has captured ultrasound images, which are suspected by radiologists. For processing of images we have used median filter to reduce the speckle noise, unsharp masking for contrast enhancement, binary thresholding and edge detection for mass segmentation and identify micro calcification for detection. We also analyze the results for different USG images. Lastly we identify a subgroup of mass as benign or malignant with definitive sonographic characteristics to reduce unnecessary biopsies in clinics [4].

## 2.5 Detection of Suspicious Lesions by Adaptive Thresholding Based on Multiresolution Analysis in Mammograms

In this paper, author develops a novel algorithm to detect suspicious lesions in mammograms. The algorithm utilizes the combination of adaptive global thresholding segmentation and adaptive local thresholding segmentation on a multiresolution representation of the original mammogram. [5] Author present a novel detection algorithm, which combines the gray-level feature and the shape feature to generate more reliable and reasonable detection results, since the graylevel feature and shape feature are two of the most common characteristics of all types of lesions. The proposed algorithm not only improves the detection results effectively based on a previous adaptive thresholding technique but also extends the detection process from a single resolution to multiresolution. The global and local thresholds are chosen adaptively without artificial. We have used the mammograms obtained from the Mammographic Image Analysis Society (MIAS) MiniMammographic database to test the proposed algorithm [5]

## 2.6 Automatic identification of massive lesions in digitalized mammograms

In this paper, an automatic method to identify massive lesions in digitalized mammograms is proposed. The proposed method is a four-step method. In first step, image processing techniques is applied to enhance mammograms. This is followed by detection of the region-of-interest (ROI). Subsequently, Haralick-based features are extracted from the detected ROI. Finally, using artificial neural network, detected ROIs is classified as masses or non-masses based on extracted Haralick features. Our method is evaluated on Mini-MIAS database [6]

The identification process is illustrated in Fig. 1. In preprocessing module, the original digitalized mammogram undergoes a preprocessing to enhance the useful information. Region-of-Interest (ROI) or area which likely contains a mass is detected in ROI Detection module. Features that represent the ROI are calculated in Feature Extraction module. Finally, Classification module identifies each ROI as mass region or non mass region based on the extracted features [6]



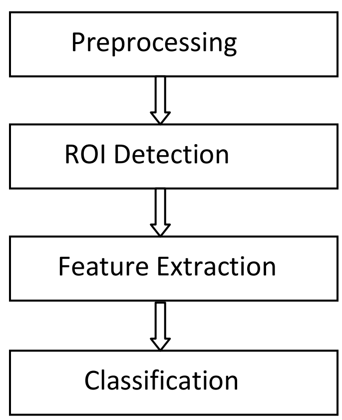


Figure 1. Diagram of proposed method [6]

## 3. CONCLUSION

According to Muhammad Asad, Naeem Zafar Azeemi *et al* (2011) results show a high classification rate. Thus the feature-set formed is well suited for any CAD system. Also these features have an additional advantage of involving less computational complexity. This can prove helpful in increasing efficiency of any CAD system when many features are used [1]

As reported by A. Mencattini, M. Salmeri *et al* (2011). The whole methodology has been described and a sketch of the metrological validation has been provided. An analysis of sensitivity has been also included considering the tolerance in the determination of the alignment angle which corresponds to the difference between the left and right pectoral muscle line orientations. A preliminary pattern classification procedure has been also implemented, providing the results in terms of sensitivity (0.82) and specificity (0.82) along with their confidence intervals for various confidence levels varying the alignment angle [2]

As reported by Yao-lin Li, Jun Feng *et al (2012)* better accuracy has been achieved in lesion detection. The proposed algorithm successfully avoids outliers which affecting accurate classification decisions surface. In the mean time, the algorithm ensembles the advantages of different classifiers for final classification [3]

Subarna Chatterjee, Ajoy Kumar Ray *et al (2011) concluded that* it is a very simple technique. Using this technique we are able to successfully recognize μC on Mass The result represents detection of μC on masses that can be used in further analysis and quantification applications [4]

As reported by Kai Hu, Xieping Gao *et al (2010)* the proposed detection system is capable of detecting suspicious lesions of different types at low false positive rates. Furthermore, the detection results for some types of lesions mainly characterized by texture feature may be improved if other combinations of lesion features are taken into account in the presented algorithm [5]

Viet Dzung Nguyen, Duc Thuan Nguyen *et al (2012)* concluded that the performance of mass identification is evaluated in terms of ROC curve. It is found that our method can be a quite effective tool in diagnosing breast cancer

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