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Mammogram Based Automatic Computer Aided Detection Of Masses In Medical Images

K.Jagadeesh., M.E.,(Ph.D)
Research Scholar, Department of ECE,
Adithya Institute of Technology,Coimbatore

K.P.Jamunalaksmi.,M.E.,
AP/ECE, Department of ECE,
Adithya Institute of Technology,Coimbatore

P.Muthuvidhya.,M.E.,
AP/ECE, Department of ECE,
Adithya Institute of Technology,Coimbatore

S.Mohammed Harris.,M.E.,(Ph.D)
Research Scholar, Department of ECE,
Adithya Institute of Technology,Coimbatore

V.Ganga.,M.E.,
AP/ECE, Department of ECE,
Adithya Institute of Technology,Coimbatore

Abstract
Breast cancer was a treacherous disease, which leads to large scale of death for women. Substantial numbers of patients are reaching to a progressive breast cancer stage due to increase in the false negatives coming out of cumbersome and tedious job of continuously observing the mammograms in fatigue. Mammogram is a scanning image of breast, used to aid in the early detection as well as diagnosis of breast diseases. Because of high sensitivity, mammogram will lose precision of an image. To overcome this issue, the Automatic Mass Detection of Mammogram was developed based on the Computer Aided Detection (CAD) techniques for the correct identification of cancer in the breast and it gives 80-90% of high detection rate. This technique will guide radiologist to determine the presence of cancer accurately. The proposed Independent Component Analysis will involve local and texture feature for mass detection. The two complex features are extracted, based upon the co-occurrence matrix and optical density transformation to describe local texture characteristic. The proposed method uses Independent Component Analysis for selecting normal and abnormal area of individual region, which will give more accuracy. Finally, compared to LDA the obtained successive rate of accuracy in ICA method is 93.82%

Index Terms*- Computer Aided Detection (CADe) system, feature extraction, mammographic mass detection.*

INTRODUCTION

Breast cancer is one of the most frequent leading cause for deaths for women. Mammographic tool helps in reducing women's death due to cancer through early detection of mammogram. The mammography and the screening methods were used in early years for the diagnosis process but these two methods were become very difficult due to affect of the image quality due to high sensitivity. To overcome these issues Computer Aided Detection was developed and acknowledge assisting radiologist by improving the accuracy of diagnosis. The goal of using this technique is to reduce the human error and to improve the accuracy of diagnosis.

The CAD system have to classify the suspicious masses in mammogram as benign or malignant. The abnormalities in mammogram will be classified into two calcifications and masses. And is tiny mineral deposits within the breast tissue. Which look like small white spots on a mammogram. The calcification may be of

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different size and may differ in distribution. A mass was usually something a little more substantial and clearer than lesion. Specifically a mass has volume and occupies the vast space. On a mammogram, it tends to be denser in the middle than towards the edge. Masses may also have different shapes and margins, that may differ in size, location and orientation, and may have different backgrounds. If the mass appears more like a lobule than a purely round or oval shape, then it is somewhat more suspicious for breast cancer. Breast cancer are difficult to identify because of abundant appearance and ambiguous margin compared to calcification. Thus the mass detection continues to challenges both radiologist and CADe systems.

Recently, there are many studies about the breast lesion detection based on the machine learning system and manually extract ROIs on mammograms. This proposed paper demonstrate on the automatic system with the satisfactory performance is feasible. Moreover the optical density image and the complex texture feature extraction are also the improvement of this arrangement.

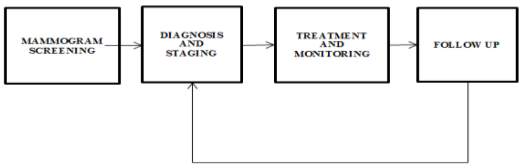

Fig.1. *Imaging of cancer management*

The proposed scheme will provide the preprocessing step to realm the breast area and eliminates the structural noise in mammogram. Then, the sech template method is used to select the suspicious region from the breast area and the ROIs region corresponding to the suspected region are segmented from the original mammogram. Next, the characteristic of each square ROI are extracted based on gray level and optical density image to comparing the capabilities. Atlast the Linear Discriminant Analysis are used to choosing the significant features from the characteristic of training set, then used to distinguish the normal and mass region.

METHODS

The proposed CADe system for mammographic mass detection comprises the four major phases: preprocessing, detection of suspicious region, feature extraction and classification.

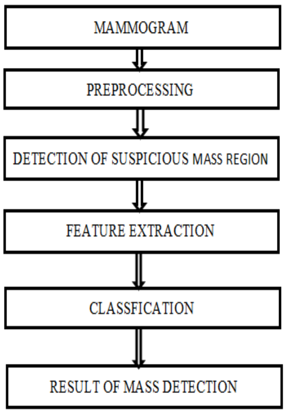

Fig.2. *Block diagram of mammographic mass detection*

Mammogram

Mammogram is the scanning of breast image, which is get from the mammography tool. This method used for the early detection and diagnosis of breast cancer, shown in Fig.3. Mammography is a specific type of imaging system that uses a low-dose system to examine breasts. A mammography exam, called a mammogram, was used to aid in the early detection and diagnosis of breast diseases in women. An x-ray (radiograph) is a non-invasive medical test which helps the physicians diagnose and treat medical conditions. Imaging with x-rays involves exposing a part of the body to a small dose to produce pictures of the inside of the body. X-rays were the oldest and most frequently used form of medical imaging.

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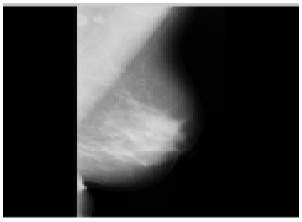

***Fig.3.** Original Image*

B. Image Preprocessing

The mammogram image was taken for preprocessing, shown in Fig.4 to preserve the breast area by reducing the noise by using morphological filter(opening and closing). Morphological filtering has been simplified segmented images by smoothing out object outlines using filling small holes, eliminating small projections. Primary operations are dilation and erosion. These operations will use a structuring element which determines exactly how object will be dilated or eroded. A structuring element is a special mask filter that will enhance the input images, which can be of different sizes and of different shapes (square, diamond, and circle), This paper will focus on two types of structuring element. First step, flat structuring elements, in this case, structuring element could be [1, 1, 1]. Second, step concave structuring elements, in this case, structuring element could be [0, 1, 0]. These two filters were used to suppress the useless information of breast region for mass detection. The opening filter will smooth's bright object contour and removes the small dark spots and the closing filter were used to smooth dark object contour and remove small bright spots. The both filters will break the narrow connection and eliminate the minor protrusions.

Thresholding an important technique for image segmentation that tries to identify and extract a target from its background on the basis of the distribution of gray levels or texture in image objects. In the proposed technique, the Otsu thresholding method has been first applied to the mammogram to find the foreground of concern, which contains a breast region and a pectoral muscle region in mediolateraloblique view of mammogram. The pectoral muscle represents the brighter region which will affect the detection result. The whole foreground was transformed by the gamma correction with a decoding gamma to preserve the brighter luminance and suppress the darker luminance. Otsu's method was an automatic method to perform clustering-based image thresholding or the reduction of a graylevel image to a binary image. This algorithm will assume that the image contains two classes of pixels following bi-modal histogram, it then calculates the optimum threshold separating the two classes so that their combined spread is get minimal.

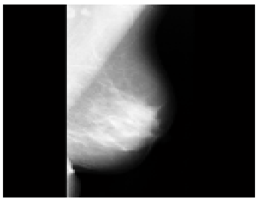

Fig.4.Preprocessing image

Detection of Suspicious Mass Region

Detection is done by using pectoral muscle region suppression technique. The hierarchical matching method is used here to detect the suspicious breast masses on mammograms. In proposed technique, three types of templates are taken and the performance of each template were compared then the sech template is selected to match the suspicious area,shown in Fig.5.

To determine the location of a cancer defined by a micro calcification cluster in a mammogram, one must generate regions of interest (ROIs) in those areas where the number of micro calcifications is greater than 3 in an one-square-centimetre neighbourhood. Therefore, once the micro calcification detection phase is optimized, each mammogram is processed to obtain

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an image with the location of micro calcification candidates. This image was filtered to discard spurious micro calcifications (isolated pixels or artifacts). The resulting image will be processed by an ROI builder system which groups neighbouring micro calcifications into disjoint zones of interest.

The suspicious regions were selected from the breast area using the Sech template matching method and adaptive square ROIs are segmented from the original mammogram corresponding to suspected regions. This method of system also applies the Sech template to the filtered. This template is defined as

$s(x, y) = 2/exp (\beta * \sqrt{x^2 + y^2}) + exp(-\beta * \sqrt{x2 + y2})$

where x, y represents the coordinate of the template and various templates that can be obtained by different values of β.

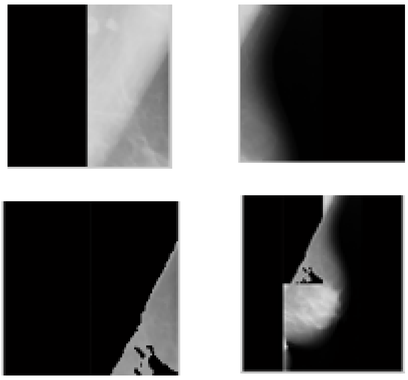

Fig.5. *Pectoral Muscle Region Suppression method of detecting mass region*

The similarity between template and the breast region were calculate by using the template size. The similarity is describe by using the correlation measurement

$cor(T, I) = E[(I - \mu_I) - (T - \mu_T)]/\sigma_I\sigma_T$

where T denotes the template, I represents the area in the breast region, μ_I is the average of I, μ_T is the average of T, σ_I is the standard deviation of I, and σ_T is the standard deviation of T.

Template matching was a technique used in classifying an object by comparing portions of images with another image. Template matching has been widely used for processing images and pictures. Template matching will provide a new dimension into the image processing capabilities, although there have been many attempts to resolve different issues in this field there have always been newer concepts emerging in this ever challenging field.

D.Image Segmentation

Image segmentation is the process of partitioning a digital image into set of region that covers, shown in Fig.6. The goal of segmentation is to decompose the image into parts for further analysis, it is used to extract only the part that need to be analyzed further. Image segmentation is typically used to locate objects and boundaries(lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics.

Fig.6 *Segmented Image*

E. Feature Extraction

The features were extracted to express the characteristics of the suspicious object region, this was done after segmentation. Generally speaking, the intensity distribution of masses was an important characteristic for mass detection. Therefore, some pattern recognition methods will use a grey-level co-occurrence matrix (GLCM) to extract characteristics. This is a type of complex texture feature extraction method which extracts the information of local intensity

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relation and discrete photometric distribution.

This study will propose two complex feature extraction methods to achieve a complex description of quantitative characteristics. The first feature extraction module will approve GLCM features and optical density features. This is the type of complex feature extraction method that extracts the information of local intensity relation as well as discrete photometric distribution.

Fig.7 *Feature Extracted Image*

Grey Level Co-occurrence Matrices (GLCM) were one of the earliest techniques used for image texture analysis. Texture is an important characteristics used to identify regions of interest in an image. This method is widely used for many texture analysis applications and remained to be an important feature extraction method in the domain of texture analysis. The special multidimensional co-occurrence matrices used for object recognition and matching. Multi dimensional texture analysis was introduced in which is used in clustering techniques.

E. Classification

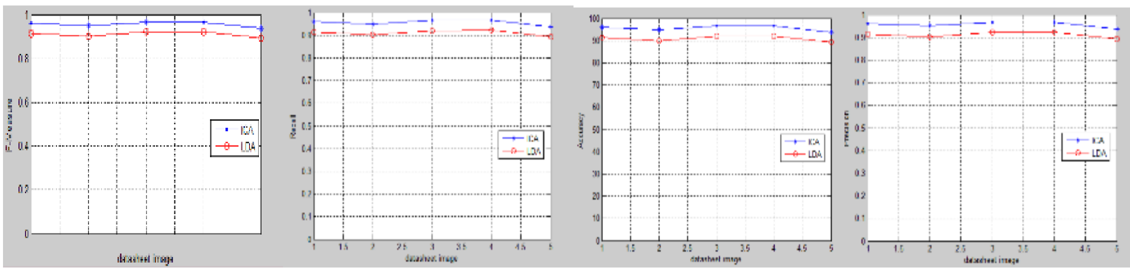
The classification techniques such as linear and nonlinear models with different feature selection methods were examined to optimize and reduce the features. The reduced features were selected by using stepwise method of Linear Discriminant Analysis is done after the performance comparison of classifier. This method will select the first feature based upon their performance.

The Linear Discriminant Analysis (LDA) is a well-known scheme for feature extraction and dimension reduction. It has been widely used in many applications involving high-dimensional data, such as face recognition and image retrieval.

The singularity problem will be overcomed by 2 Dimensional linear discriminant analyses, while achieving the efficiency. The purpose of LDA is to maximize the between-class scatter while simultaneously minimizes the within-class scatter. The ubsequent features are selected based on the combined improvement in classification. This method simply maps a multidimensional space to a scalar decision variable from which a threshold can be applied to determine whether an object region is normal or abnormal. For linear discriminant, the mapping is defined as

$$G(x) = (\mu1 - \mu2)^T S^{-1}_{pooled}\, x$$

where x is the vector of input features, $\mu1$ and $\mu2$ denote the means of the abnormal and normal training datasets.



F-Measure Recall Measure Accuracy Precision

Fig8. *Comparision graph of ICA and LDA*

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The ICA method is used in proposed method for feature extraction and dimension reduction.
The comparison of ICA and LDA with different reduction and sensitivity is shown in the fig.8. In pattern recognitioninformation retrival and binary classification, precision is the fraction of relevant instances among the retrieved instances, while recall is the fraction of relevant instances that have been retrieved over the total amount of relevant instances. Both precision and recall are therefore based on an understanding and measure of relevance.

ICA works better than LDA in higher order statistics. ICA better works on data that have been already preprocessed by LDA. LDA and especially ICA have recently become popular tools
in various fields,e.g. blind source separation, feature extraction, telecommunication, finance, text document analysis, seismic monitoring and many others.The main concept of ICA applied to images insists on the idea that each image (subimage) may be perceived as linear superposition of features.

	LDA	ICA
Accuracy	89.3333	93.8202
Recall	0.8905	0.9391
Precision	0.9376	0.8950
F-Measure	0.9383	0.8928

Table.1. *Comparision table between LDA and ICA*

CONCLUSION

The CAD system has a new approach to the evaluation of screening mammogram by means of complex texture feature. The CAD technique is used here to identify the cancer cell, which is act as the second reader for cancer detection. The aim of this proposed system is to facilitate the identification of suspicious region. The resulting image exactly correlate with the original mammogram to maps the image, then emphasizes the region of identical texture properties by the contour lines and the parallel comparison of the resulted image may help to identify the abnormalities in the mammogram image. In present system the method does not include any growth level information but the resulted image is well applicable to find the growth level of cancer. In mammographic screening method the abnormalities were find with the help of doctor. In proposed system the CAD technique were used for the correct identification of cancer and it gives high detection rate.

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