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METHOD FOR DETECTION OF BREAST CANCER AMONG WOMEN USING WAVELET TRANSFORMS AND SUPPORT VECTOR MACHINE- A REVIEW

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Abstract: Breast cancer is one of the most dangerous types of cancer among women all over world. In particularly the breast and ovarian cancer are most dangerous to women. The age between 40 - 60 have more risk of the breast cancer. Mammography is the method for early detection of the breast cancer some time it is difficult to the radiologists to detect the correct diagnostic sign like microcalcification and masses on the mammograms and the dense region in mammography images are noisy and low contrast. Here we propose a method to breast cancer detection and classification using wavelet transforms, Neural Network(ANN) and support vector machine(SVM). To evaluate this proposed method by transforming the data of the images in wavelet and curvelet basis, this transformation is done by using matlab software and MIAS (Mammographic Image Analysis society).

Keywords: **Breast cancer, Mammographic images, Wavelet transform, Curvelet transform, support vector machine.**

I. INTRODUCTION

1.1 Breast Cancer Detection

Breast cancer is the second most common and leading cause of cancer death among women in all over world [Jinshan Tang et al].In the united state in 2007 there were 178,480 new case of breast cancer diagnosed and 40,460 deaths from this disease among women. The world health organization's International Agency For Research On Cancer(IARC) estimates more than one million case of breast cancer will occur worldwide annually and more than 400,000 women die each year due to this disease [Mohamed moeth et al]. Satish G.Kandlikes et al. Describe as the breast cancer can originate in any part of the breast, it will more than 20 types of cancer have been identified, from this the common type of breast cancers are ductal carcinoma, which originate in ductal epithelium and lobular carcinoma, which develops in the glands. Breast carcinoma is the most common malignancy observed in women in developing countries and it is curable if it detected an early stage. The most efficient possibility of reducing the cancer related deaths is by an early diagnosis when the tumor is at low risk of metastasis and stage of high curability [S.Issac Niwas et al].

Mammography is the common screening technique for detecting the presence of tumor using low energy X-Ray to image of the internal anatomy of the breast. It detects the masses in the breast and calcification, which may indicate the presence of a tumor. A randomised study with 134,867 women aged between 40 and 74 showed that regular Screening resulted in a 31% of reduction in mortality from the breast cancer [S. G.Kandlikes et al]. A mammographic image is characterized by a high spatial resolution which adequate enough to detect microcalcifications on other hand the analysis of mammographic image is a complex task which required highly specialized radiologists. Adequate computational tools are needed to be helpful to the radiologist. This is documented by many groups whose aim is to develop computer-aided diagnosis (CAD) systems that focus the physician's attention on suspicious image region and provide quantitative image descriptions. L.Bocchi et al. Proposed as a fundamental step in automatic mammographic analysis is the enhancement and detection of possible target signals, quantitative description of this possible lesions is the another crucial step. There are several tumor detection techniques have been analyzed.

Deepthi Sehrawat et al proposed a wavelet transform based method of a neural framework for providing multi- scale image representation from multi-scale decomposition most of the gross intensity distribution can be isolated in a large scale image, while details about the singularities like edges and textures can isolated in mid to the small scale. Deepthi et al perform I-D wavelet based analysis to find the PDF and adaptively selected proper thresholds for segmentation of image. Pelin GORGEL et al used a spherical wavelet (SWT) to obtain features of mass and support vector machine for diagnosis. Amir hossein et al proposed another method for diagnosis of breast cancer, that is based on combining wavelet transform and LBP(Local Binary Pattern) algorithm. Muhammad Talha et al. Introduced a method for enhance the low-contrast mammogram image for clarity and better interpretation by using Discrete Cosine Transform(DCT), Discrete Wavelet Transform(DCT) and support vector machine(SVM).

Mohamed meselhy et al proposed a supervised classifier for mammograms using a multi-scale curvelet transform. Curvelet transform is a effective method for detecting image activities along curves. It capture the structural activity along radial wedge in the frequency domain. In his paper first extract a set of co-efficient from each level of decomposition, which are used to classify the mammogram image into normal or cancer classes. The cancer classes are microcalcification clusters, speculated lesions, circumscribed masses, III-defined mass, Architectural distortion and asymmetry lesions, and also the co-efficient are used to distinguish between normal, benign and malignant tumors.

In this paper we proposed a method for breast cancer detection using different types of wavelet transforms (Discrete Wavelet Transform-DWT, Fast Wavelet Transform-FWT) and curvelet transform. Here we extract mammogram images from popular database (MIAS) and classify which are normal and abnormal by using different adaptive transform technique.

1.2 Literature review:

In previous years so many research are done in the field. In particularly many works were done based on wavelet and curvelet transform and SVM classifiers. Here we present a chat to indicate year wise growth in breast cancer detection and classification using different adaptive methods, especially wavelet transforms

Figure 1

1.3 Wavelet Transform

Wavelet transforms are a mathematical means for performing signal analysis when signal frequency varies over time. For certain classes of signals and images, wavelet analysis provides more precise information about signal data than other signal analysis techniques.

Common applications of wavelet transforms include:

- Speech and audio processing
- Image and video processing
- Biomedical imaging
- 1D and 2D applications in communications and geophysics

The wavelet transform is a mathematical tool that can be used to describe image in multiple resolution. Wavelet decomposition is a complete representation, since it allows a perfect reconstruction of the original image.The wavelet transform also used to analyses various applications like Feature extraction, compression, watermarking applications etc. The wavelet transforms work with the adoption of prototype function, and it is called as mother wavelets some of them are Haar, Daubechies, Mexican Hat and Morlet etc. The wavelet families are generated by the mother wavelet ( ) and it is given by the following equation

$$\Psi_{j,k}=1/a_j \ \Psi \ x-b_k/a_j \quad \text{.......................(1)}$$

1.3 Discrete Wavelet Transform (DWT)

In DWT the data elements are separated by multiple frequency components. The DWT of image signals produces a non-redundant image representation, which provides better spatial and spectral localization of image formation; it can be interpreted as signal decomposition in a set of independent spatially oriented frequency channels. The signal is passed through two complementary filters and emerges as two signals, approximation and details, this is called decomposition.

1.4 Fast Wavelet Transform (FWT)

The Fast wavelet transform (FWT) is a computationally efficient form of the discrete wavelet transform (DWT). It is a multi- resolution analysis method that provides frequency decomposition of the image or signal using scaling ($\phi_{j,k(x)}$) and wavelet ($\psi_{j,k(x)}$) function

$(\phi_{j,k(x)})=2^{j/2}$ --------------------------------→ 1

$(\psi_{j,k(x)}) =2^{j/2}$ --------------------------------→ 2

In above equation j&k determine scaling and wavelet function width and position respectively while the valve $2^{j/2}$ controls the amplitude.

1.4 Curvelet Transform

The curvelet transform is a multi-scale directional transform and higher dimensional of the wavelet transform. This allows an optimal non-adaptive representation of edge designed to represent image at different scales and angles. Also curvelet transform is more accurate to deal with the curve than wavelet transform. In wavelet approach many wavelet co-efficient are needed to account edges but in curvelet transform less co-efficient are needed to account edges.

II. PROPOSED METHODOLOGY

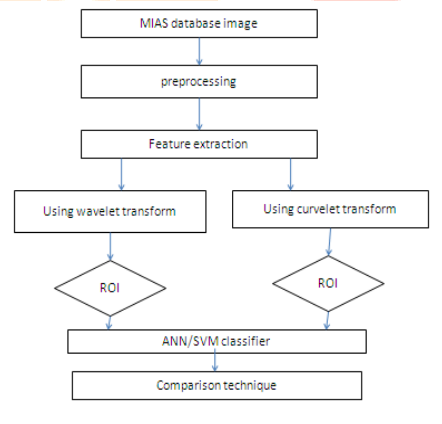


Figure 2

2.1 Database Source

The source of data images from mammographic image analysis society (MIAS) of the mammogram images used in this scientific study, including 322 samples labelled with categories (normal, benign, and malignant), 1024 × 1024 is in pixels of images database. Additional the abnormality cases in database were dividing to six categories as follow: first one is micro-calcification, followed by circumscribed-masses, then speculated-masses, and ill-defined-masses, after that architectural-distortion, finally asymmetry. 110 samples are used in this study with 8 × 8 pixels region of interest (ROI) for each image.

2.2 Preprocessing

The process of preprocessing is to reduce any noise in the image to detect tumor. Database image is input to this unit. In this section noise of image reduced and enhance image using various filtering method.

2.3 Feature extraction

The feature extraction is the process used to transform the visually extractable and non-extractable features into mathematical descriptors. Any pathological or traumatic discontinuity of tissue or loss of function of a part is called a lesion; this module contains texture statistical features that are classified as Transform Domain

2.4 Neural Network Classifier

The ANN architecture consists of one hidden layer with fifteen sigmoid nodes and an output layer with one sigmoid node, whose value indicates a malignant or a benign microcalcification cluster. Principal component analysis (PCA) has been implemented in order to reduce the size of the input feature vector. The output of the PCA is a reduced feature vector composed of seven features, providing the best classification performance. PCA eliminates features contributing to more than 3% of the total variation of the original feature set. Those features are normalized to zero mean and unit variance. Gradient decent, resilient back propagation, conjugate gradient and quasi-Newton methodologies were employed for ANN training in order to select the one with the best classification ability. Best results were obtained using the quasi- Newton one-step-secant (OSS) algorithm. The two-fold cross validation method was used for the performance assessment. When the enhanced feature set is used the classification performance, using the same ANN architecture and PCA, is improved.

2.5 Support vector machines

Another category of classification methods that has recently received considerable attention is the use of support vector machines. SVMs have not been used previously for the characterization of microcalcification clusters but only for their detection. SVMs are based on the definition of an optimal hyper plane, which linearly separates the training data so that minimum expected risk is achieved. In contrast with other classification schemes, a SVM aims to minimize the empirical risk Remp and at the same time, maximize the distances (geometric margin) of the data points from the corresponding linear decision boundary as shown graphically.

2.6 MATLAB as Signal Processing Tool

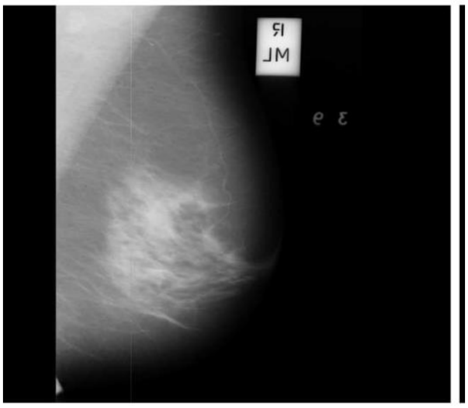
MATLAB is a performance oriented multi-paradigm numerical computing environment that incorporates visualization, computation and programming in a user friendly way where known mathematical representations are used to specify the problems and their solutions17. It has toolboxes for image processing, signal processing, neural network and fitting. Image processing toolbox supports image enhancement and its analysis, Region of Interest (ROI) activity, linear filtering and designing of filter. Engineers and scientists use this software to achieve the required result by selecting proper tools and the features.

III. OVERVIEW OF PREVIOUS RESEARCH

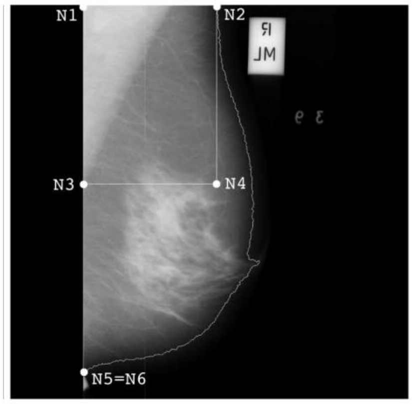
METHODS	REMARKS
Wavelet transform, IR thermagraphy imaging,Data sampling[7]	Noise removal innoised image using WTMM in IR image
Wavelet transform, Neural network, segmentation, variance cantrast(σ) and auto variance contrast(A(Δm,Δn)),[8]	The MLP neural network is used for differential diagnosis of US images by Daubachies wavelet base
CAD, MC cluster, multiscale decomposition,SVM[5]	CAD algorithm for detection of subtle abnormalities in MIAS database image
Complex Daubechies wavelet transform, feature extraction, KNN classifier[4]	Complex Daubechies wavelet transform based decomposition and KNN classifier applied to FNAC image to detect breast cancer
Microcalcification, Gaussian filter, Neural Network[6]	Method to detect µcas from standard mammograms using enhancement filter with ANN classifier
Hough Transform, Gobar wavelet, Edge flow vector[1]	Algorithms for automatic segmentation of pectoral muscle in randomly selected MIAS database images
IR imaging, IR Thermography, prognostic feature, dynamic IR Thermography, 2D rectangular geometry, ANN[3]	Thermal imaging to detect breast cancer in IR images
K-mean clusting to segmentation, watershed segmentation algorithm[2]	Algorithms to reducing the problem of over segmentation when applied to MR images
Fourier Transform, Gobar filter, image enhancement, Feature extraction[9].	Combining algorithms with Fast Fourier transform and overlay mask segmentation is effective method to improve SNR in detection using MIAS images.
CLAHE Algorithm, DFT, Segmentation, classifier-SVM[10].	CAD system based DFT for detection of breast cancer in mammogram images.

4. RESULT AND DISCUSSION

To estimate the performance of review some computer simulation carried out by MATLAB R2014b. Following Fig(a) show Original image mdb042 from the Mini-MIAS database. Fig (b) approximate boundary of the breast along with the control points N1 to N6 used to limit the region of interest (rectangle marked) for the detection of the pectoral muscle.



(a)



(b)

5. CONCLUSION

In this work, we analysis different methods of segmentation, image enhancement and classifier for detection and classification of the breast cancer using MIAS database images. This study give the information about preprocessing is used to enhance the image, extraction to extract ROI of image and classification give the information about normal and abnormal tissue of images.

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