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Review on Breast Cancer detection methods from Digital Mammograms

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Abstract: Methods for detection of breast cancer from digital mammogram using artificial neural network (ANN), Support Vector Machine (SVM), and Discrete Wavelet Transform (DWT) are used. Before processing, the enhancement image has been taken from histogram equalization technique. Then, segmentation technique is used to extract the region of interest (ROI). ROI is extracted using peak analysis from the histogram of the breast tissue. Therefore, also get the exact boundaries of suspicious regions, and it is now convenient to obtain good shape feature for classification. Experimental result shows that the accuracy of ANN method is good i.e. 97.975%, because it have low false positive and false negative rate. Furthermore, the True Positive detection rate of this methodology is good for a data set 54 mammograms. Moreover, proposed this method is simple and it takes less time for iterations.

Keywords: Artificial neural network (ANN), Support Vector Machine (SVM), and Discrete Wavelet Transform (DWT).

I.INTRODUCTION:

The incidence of breast cancer is low in India, but rising. Breast cancer is the commonest cancer of urban Indian women and the second commonest in the rural women. Owing to the lack of awareness of this disease and in absence of a breast cancer screening program. A recent study of breast cancer risk in India revealed that 1 in 28 women develop breast cancer during her lifetime. This is higher in urban areas being 1 in 22 in a lifetime compared to rural areas where this risk is relatively much lower being 1 in 60 women developing breast cancer in their lifetime. In India the average age of the high risk group in India is 43-46 years unlike in the west where women aged 53-57 years are more prone to breast cancer.

A report estimated that one in eight women in the U.S. and one in thirteen in Australia develops breast cancer during their life time. Breast cancer continues to be significant public health problem among women around the world. It has become the number one cause of cancer deaths amongst Malaysian women. In the European Community, breast cancer represents 19% of cancer deaths and the 24% of all cancer cases. Nearly 25% of all breast cancer deaths occur in women diagnosed between ages 40 and 49 years.

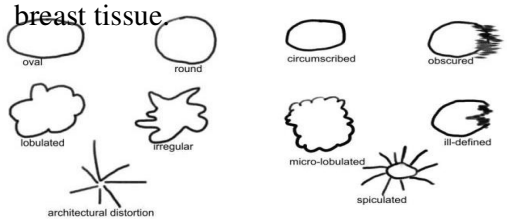
In order to reduce morbidity and mortality, early detection of breast cancer is essential. However, the appearances of breast cancer are very subtle and unstable in their early stages. Therefore, doctors and radiologists can miss the abnormality easily if they only diagnose by experience. The computer aided detection technology can help doctors and radiologists in getting a more reliable and effective diagnosis. Since it checks mammograms as the "second reader", thus giving to doctors and radiologist a favorable advice.

Mammographic Abnormalities

There are large number of types of abnormalities that can be present in breast. Among those, signs of breast cancer are normally associated with:

- Asymmetry between images of left and right breasts.
- Distortion of the normal architecture of the breast tissue.
- Presence of micro-calcifications in the breast.
- Presence of masses in the breast.

It is generally accepted that the essential characteristic of a high-quality mammogram is the ability to visualize these four features breast. Both breasts are usually considered as almost symmetric structures. While exact mirror images are not to be expected when comparing them, the tissue patterns within each breast should be similarly distributed. An asymmetric area may be indicative of a developing mass or a variation of normal breast tissue.



Mass Shapes Mass Margins

Figure 1: The shape and margin of a mass are strong signs of their malignancy/benignancy Degree [9].

II. LITERATURE REVIEW.

Mammography screening associated with clinical breast examination is the only viable and effective method to detect early breast cancer. Breast cancer can be categorized as benign or malignant. Digital mammography is the application of digital techniques on mammograms. Mass detection from digitized mammograms is still very challenging. The main reason is that the abnormal masses usually mix with the homogeneous tissues in the breast. The images provided by different patients have different dynamics of intensity and present a weak contrast.

Indra Kanta Maitra *et.al* in [1] proposed detection of abnormal masses using Divide and Conquer algorithm in digital mammogram. Mammograms were analyzed

using image orientation, noise suppression and Gaussian smoothening. This method is based on image segmentation method, the inputs are images and final yields are the features extracted from the input image. The segmentation process is to obtain the regions of interest (ROI) depending on the image and its characters. Author proposed a homogeneity enhancement process namely divide and conquer homogeneity enhancement algorithm, Edge detection algorithm , Breast boundary detection algorithm, pectoral muscle detection algorithm, Anatomical segmentation of breast ROI, Seeded region growing algorithm in digital mammogram.

Jawed Nagi *et.al* in [2] developed an automated technique for mammogram segmentation. Author proposed algorithm useing morphological preprocessing and seeded region growing (SRG) to remove digitization noises, suppress radiopaque artifacts and remove the pectoral muscle to accentuate the breast profile region for use in CAD algorithms.

Jelena Bozek *et.al* in [3] described a computer-aided detection and diagnosis of breast abnormalities in digital Mammography. Author describes lesions that are possible to be detected and diagnose using developed computer aided detection and diagnosis methods. Masses calcifications, architectural distortion and bilateral asymmetry are defined with wide range of features and can indicate malignant changes but can also be a part of benign changes. Most of the features such as shape, margin distribution size etc. can be detected by using developed algorithms.

Nawazish Naveed *et.al* in [4] has proposed a malignancy and abnormality detection of mammograms using DWT features and ensembling of classifiers. The main complexity about digital mammogram diagnosis is the detection of malignant images and its classification on the basis of abnormalities present. Author investigated the accuracy of detection methodology that uses DWT features as an input to different classifiers like K-nearest neighbor (KNN), Artificial neural networks (ANN) and Support Vector Machine (SVM) and ensemble the results generated by these classifiers.

A mass lesion detection using wavelet decomposition transform and support vector machine has been proposed by Ayman Abu Baker *et.al* in [5] . Author's proposed method is designed using three main stages, detection region of interest, extraction wavelet features and support vector machine (SVM). In detection region of interest the

morphological processing, object labeling , and size filtering are implemented. Mass detection is a more difficult problem compared to micro-calcification cluster detection because masses are highly connected to the surrounding parenchymal tissue density, particularly for speculated lesions and they are usually surrounded by non-uniform tissue background with similar characteristics. There are three different sizes for the mass lesion: small size (3-15 mm), middle size (15-30 mm) and large size (30-50 mm) which increases the mass detection complexity.

Dr. H.B.Kekre *et.al* in [6] proposed an image segmentation of mammographic images using Kekre's proportionate error technique on probability images. Mammography is well known method of detection of breast tumors. Early detection and removal of the primary tumor is an essential and an effective method to enhance survival rate and reduce mortality. Author proposed a algorithm uses probability of mammographic image as input for vector quantization. Vector Quantization (VQ) is an efficient technique for data compression and has been successfully used in various applications such as index compression. VQ has been very popular in a variety of research fields such as speech recognition and face detection.

According to Prof. Samir Kumar Bandyopadhyay in [7], high quality mammogram images have high resolution and are of large size. Processing these images require high capabilities. Breast segmentation consists of breast order contour extraction, pectoral muscle extraction, nipple identification etc. Mammograms are medical images that are difficult to interpret, thus a pre-processing phase is needed in order to improve the image quality and make segmentation results more accurate.

III. RESULTS

In design methodology, input images are taken from Mammography Image Analysis Society (MIAS) database. These images have some noises. Before processing of these images, noises are removed. So image enhancement technique, used histogram equalization method for enhancing the images. After then, segmentation technique is required for extracting the region of interest (ROI) from the mammogram images. Next, extraction of the features such as area, average gray level (mean), standard deviation, skewness, perimeter, homogeneity, energy, contrast and entropy from the selected ROI of the mammogram image is required.

Histogram Equalization result:

The histogram of a digital image with gray levels in the range [0, L–1] is a discrete function $g(r_k) = n_k$, where r_k is the kth gray level and n_k is the number of pixels in the image having gray level r_k.

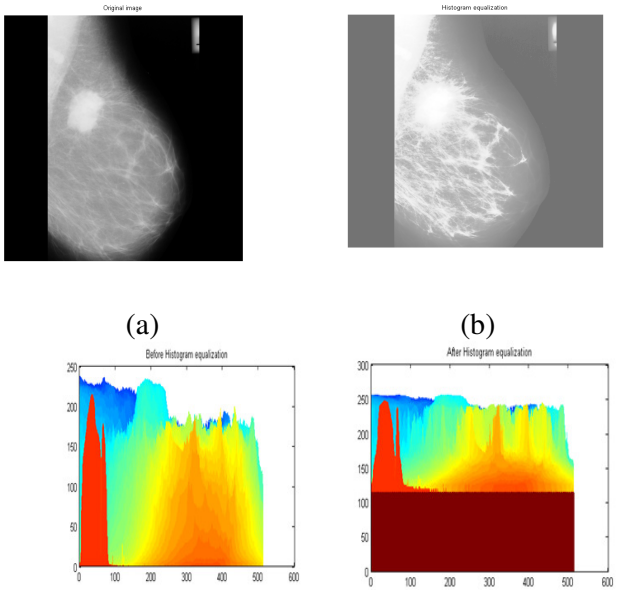
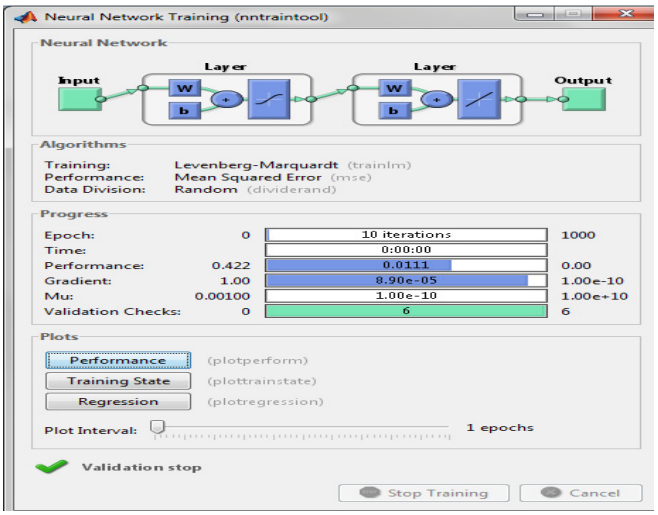


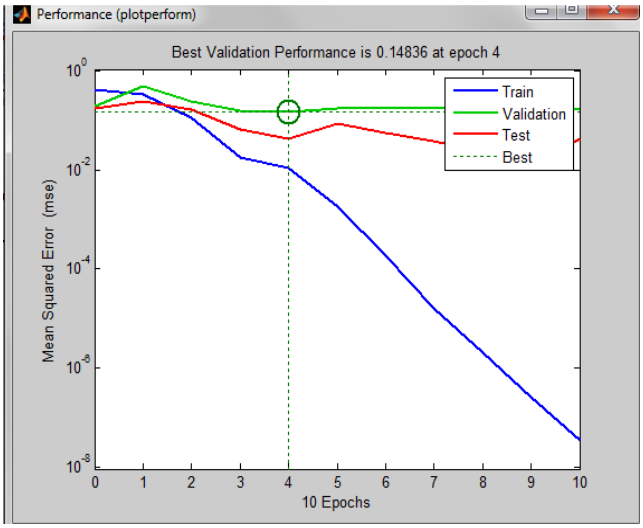
Fig.2: Malignant (mdb 184.pgm) MIAS database (a) Original Mammogram image; (b) Histogram equalization Image (Enhanced Image); (c) before histogram equalization distribution plot. (d) After histogram equalization distribution plot.

Simulation Result:

Neural Network Training: For training of neural network, feed the features to feed-forward neural network.



(a)



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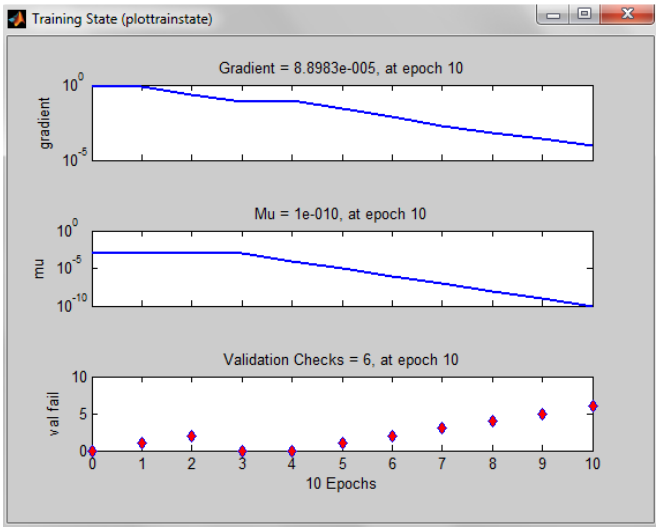
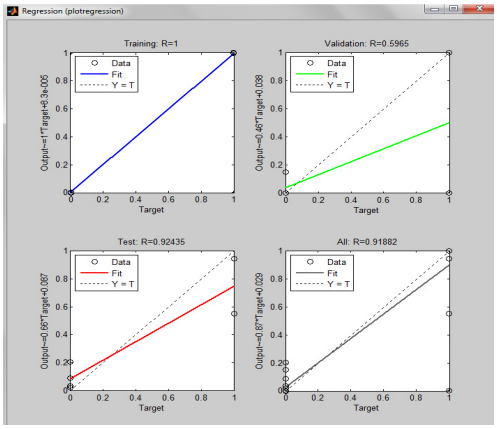


(c)



(d)

Fig.3: Simulation results (a) Neural network training; (b) Performance plot; (c) Training state plot; (d) Regression plot

IV. CONCLUSION

In this paper, Methods for detection of masses from digital mammogram using artificial neural network (ANN) is used. Before processing, the enhancement image has been taken from histogram equalization technique. Then, segmentation technique is used to extract the region of interest (ROI). ROI is extracted using peak analysis from the histogram of the breast tissue. Therefore, also get the exact boundaries of suspicious regions, and it is now convenient to obtain good shape feature for classification. Experimental result shows that the accuracy of ANN method is good i.e. 97.975%, because it have low false positive and false negative rate. Furthermore, the True Positive detection rate of this methodology is good for a data set 54 mammograms.

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