

Mammographic Image Analysis of Breast Using Neural Network

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Abstract: This paper discusses the various stages of detecting tumours of the breast mammogram images. A Neural Network algorithm is applied for obtaining the complete classification of the tumour into normal or abnormal. The most important procedure or technique for obtaining the classification is the feature extraction, by extracting a few of discriminative features, first-order statistical intensities and gradients. The Image Pre-processing technique is essential prior to Image Segmentation in order to obtain accurate segmentation. Thus mass detection can be carried out. The processes involved in achieving the three techniques mentioned above include global equalization transformation, denoising, binarization, breast orientation determination and the pectoral muscle suppression. The presented feature difference matrices could be created by five features extracted from a suspicious region of interest (ROI). Grey Level Co-occurrence Matrix (GLCM) aids the obtaining of statistical features such as correlation, energy, entropy and homogeneity. The other statistical to features to obtain are area, moment, variance, entropy, standard deviation and moment. The Neural network technique yields results of abnormal mammograms. *Copyright © 2015 IFSA Publishing, S. L.*

Keywords: Digital mammography, Pre-processing, Pectoral muscle suppression, Segmentation, Feature extraction, Gray-level co-occurrence matrix, Linear classifier.

1. Introduction

Breast cancer is the most common cancer in women worldwide. Over the past few years, the cancer has been one of the most responsible for the high number of deaths, and could become one of the main responsible for most deaths in next decades. Mammography is seen to be the most effective and reliable method for reducing morbidity and mortality. Computer Aided Detector (CAD) is required to help the radiologist in the detection of cancer.

The images should be free from noise, artefacts and pectoral muscles to prevent distraction while detecting masses; therefore, we obtain a more accurate result. In order to enhance the image quality

of mammograms, filter and segmentation technology is usually the first stage in image processing before application of the detection algorithm to detect suspicious lesions.

The segmented image will contain nipple breast and pectoral muscle, thus the pectoral muscle should be removed before the detection of the mass. Efficient mass detection can be achieved by using adaptive histogram equalization for pre-processing and Otsu's thresholding method [1] for segmentation and suppression of the pectoral muscles. Depending on the experience of the physician, breast cancer detection can be facilitated using computerized feature extraction algorithms. Mammogram images are divided into different regions of mass candidates;

the discrete texture features were then calculated for the area of each mass candidate [2].

The features were computed based on gray-level co-occurrence matrices (GLCM) that requires high computational loads and the effectiveness of the textural information possessed by mass regions in comparison with the mass margins was evaluated [3]. Characterized regions of interest (ROIs) by means of textural features computed from the GLCM. In this paper the feature extracted values are computed for feature weights. Finally the Neural Network technique is proposed for identifying the abnormal mammograms [4]. The data for the use of this experiment was obtained from the mini-MIAS database of mammograms by popular request; the original MIAS Database (digitized at 50 micron pixel edge) has been reduced to 200 micron pixel edge and clipped/padded so that every image is 1024×1024 pixels.

2. Principle of Operation

The detection of abnormal mammograms mainly consists of image pre-processing, mass detection and the classifier. This image pre-processing of the system consist of the global equalization technique transformation, image denoising, binarization, breast object extraction, breast orientation determination, and pectoral muscle suppression. Fig. 1 shows the proposed block diagram.

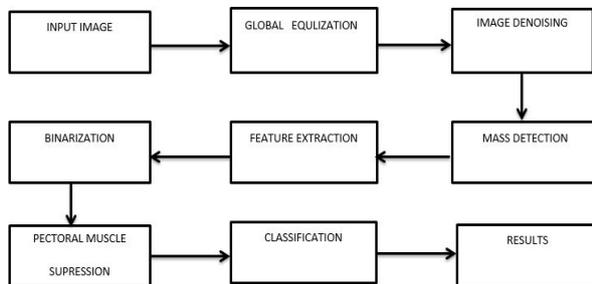


Fig. 1. Proposed block diagram.

2.1. Global Equalization Transformation

The Enhancement Contrast Limited Adaptive Histogram Equalization (CLAHE) technique has been used for global equalization transformation on the image. This technique is used to adjust image intensities to enhance contrast. This technique corresponds to redistribution of gray-levels in order to obtain uniform histogram. In this case every pixel is replaced by integral of the histogram of the image in that pixel. Histogram equalization is a method in image processing of contrast adjustment using the image's histogram. Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to get

better contrast. Histogram equalization accomplishes this by efficiently spreading out the most frequent intensity values. The number of possible intensity values, is often 256.

2.2. Image Denoising

The noise within a mammographic image could result in imprecise object extraction. Thus, the Mass Detector uses the median filter [5] to eliminate short-tailed noise such as uniform and Gaussian-type noise from the global equalized image, and a neighbourhood window size of 11×11 is given. The denoised image obtained by removing the noise from the global equalized image [1]. In this procedure we have used the median filter, a nonlinear digital filtering technique used to remove noise. This filter attempts to remove impulse noise by replacing the center pixel of the filtering window with the median of the pixels in the window [6]. This approach provides a reasonable noise removal performance, and it removes thin lines.

2.3. Binarization

This algorithm should automatically determine an intensity level to threshold an image to segment out the foreground from the background. The output of your function should be a binary image that is 0 for all background pixels and 1 for all foreground pixels. To determine the breast object, the Mass Detector utilizes Otsu's thresholding method to find the optimal adaptive threshold to correspond to the intensity of I , and the value of t_0 is approximated. The Mass Detector excludes the dark background and calculates the area of each disjointed object from the study. All probable breast objects in Fig. 2 shows the histogram equalized images for the corresponding breast images are processed by the basic morphological operations, erosion and dilation.

The muscle on the top corner of the images is removed by morphological operations which is called Pectoral muscle suppression. From the above Fig. 3 we have our region of interest ROI and from this region we are able to obtain the discriminative features of the mammogram which is called as Mass detection.

2.4. Segmentation and Feature Extraction

After applying all the morphological operations we obtain the desired ROI which is further used for feature extraction. From the region of interest we will extract five features which are: entropy, standard deviation, mean, area and homogeneity. Fig. 4 shows the segmented images which can be feature extracted further. The feature extracted results are given in Table 1.

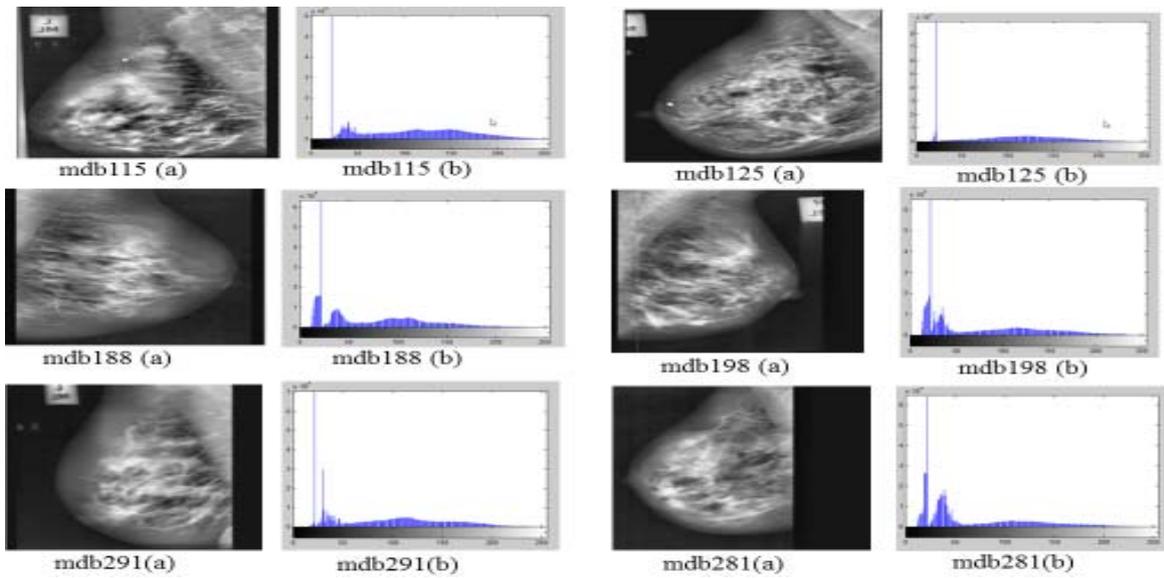


Fig. 2. Histogram equalized images for the corresponding breast images.

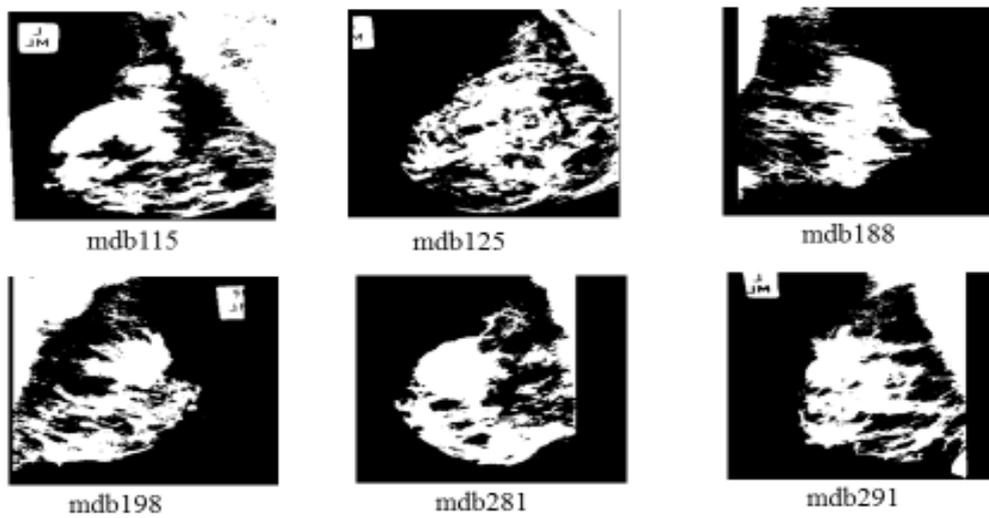


Fig. 3. Shows the images after Binarization.

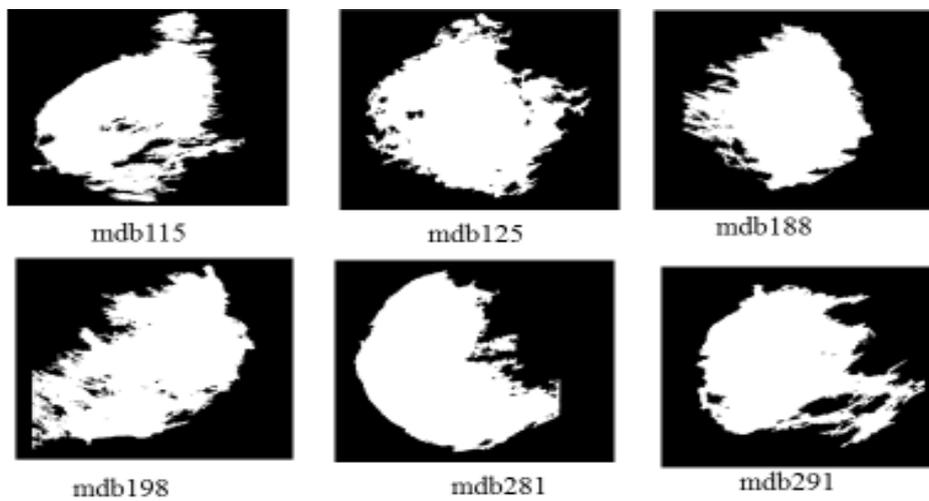


Fig. 4. Segmented images.

Table 1. Extracted results.

Images	Entropy	Standard Deviation	Mean	Moment	Area	Variance
mdb115	0.5610	0.5002	0.5908	0.0962	4.6060	0.2502
mdb95	0.4455	0.4872	0.3867	0.0962	4.6060	0.2374
mdb90	0.5632	0.5002	0.5332	0.0962	4.6060	0.2520
mdb125	0.5573	0.5002	0.5059	0.0962	4.6060	0.2502
mdb155	0.4743	0.5002	0.5459	0.0962	4.6060	0.2502
mdb198	0.5059	0.4982	0.4551	0.0962	4.6060	0.2482
mdb193	0.5841	0.5002	0.5176	0.0962	6.3650	0.2502
mdb188	0.5255	0.5002	0.5127	0.0962	0.6350	0.2502
mdb315	0.5920	0.5002	0.5420	0.0962	4.6060	0.2502
mdb81	0.4635	0.4892	0.3955	0.0962	4.6060	0.2393
mdb281	0.5157	0.5002	0.5029	0.0962	4.1460	0.2502
mdb291	0.5402	0.5001	0.5402	0.0962	4.1460	0.2501
mdb284	0.5971	0.5002	0.5801	0.0962	4.1460	0.2502
mdb197	0.4955	0.5002	0.5430	0.0962	4.1460	0.2502
mdb116	0.4411	0.4999	0.4805	0.0962	4.1460	0.2499

3. Classification

A neural network tool has been used for the classification of breast into abnormal and normal. The neural network classifier used is linear classifier. The goal of statistical classification is to use the images characteristics, which is in this case area, to identify which class it belongs to. A linear classifier achieves this by making a classification decision based on the value of area. The images characteristics are also known as feature values and are typically presented to the machine in a vector and are called feature vector.

4. Results and Discussion

The classifier has produced the results correctly in the graphical form as shown in Fig. 5. Fig. 5(a) shows a plot of input and target data, Fig. 5(b) shows the performance plot. Fig. 5(c) is given as response of training set and Fig. 5(d) shows the Regression plot. Our input data is the statistical area value and the target is our desired output. If target is 1 then our

results is normal and if 0 our result is abnormal. In the command window we get results according to the input and target values. Any values less than target value 1 or greater than statistical value 4.606 gives abnormal image and any values greater than target value 1 and less than statistical value 4.606 give normal image.

We have implemented all this work in Neural Network using the MATLAB tool. Our results have yielded 81.25 % accuracy. Other studies have yielded such a percentage or less. Our work is easy to implement less time consuming and produces effective results. This is what makes it better than others work. The classifier has yielded efficient results which are shown in Table 2.

We have used a statistical feature area to distinguish normal and abnormal image. We have fed this feature in the Neural Network tool and have plotted it and have produced the results accordingly. At 4.606 inputs we have a 0 value which is our target which shows that it is an abnormal outcome and at 4.146 we have obtained value one which indicates that the outcome is normal.

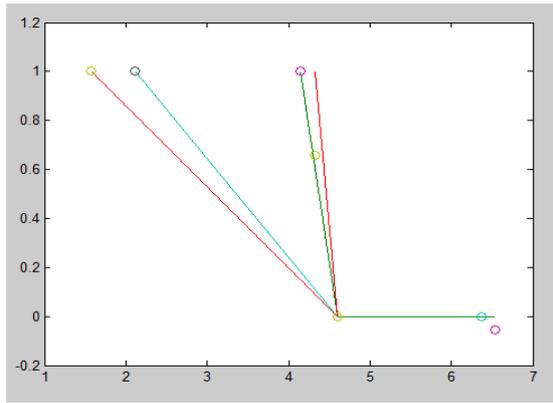
Table 2. Accuracy determination.

No. of images		classifier	Rightly classified	Misclassified	Accuracy
Abnormal	Normal	Linear classifier	39	9	81.25 %
15	33				

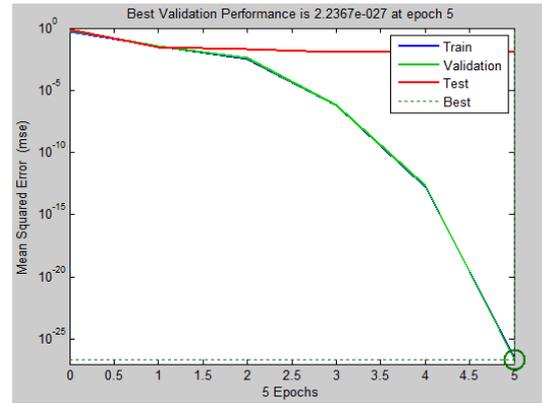
5. Conclusion

The mammographic image analysis using Neural Network has been carried out successfully. We have achieved a classification of 81.25 %. We have obtained the statistical features which are necessary for the classification. We have used MATLAB software to carry out our work. The stages involved are pre-processing, segmentation, feature extraction

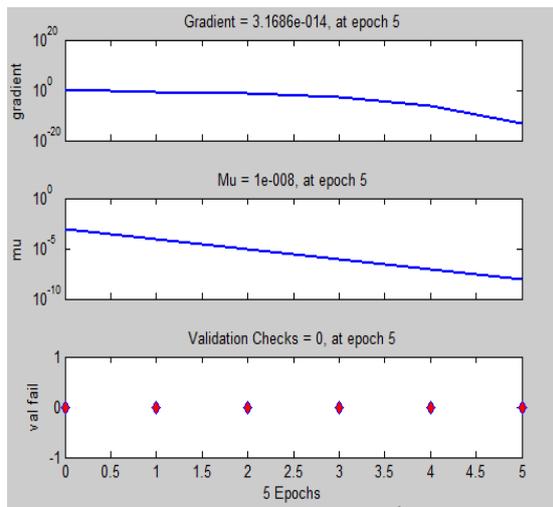
and classification. Through these stages certain results have been obtained to our satisfaction. Our work will be able to carry out its performance and produce efficient results. The use of Neural Network in classification has been explained in details. Also the other stages have been explained i.e. pre-processing, segmentation, and feature extraction. The results have been obtained using the very important parameters called statistical feature.



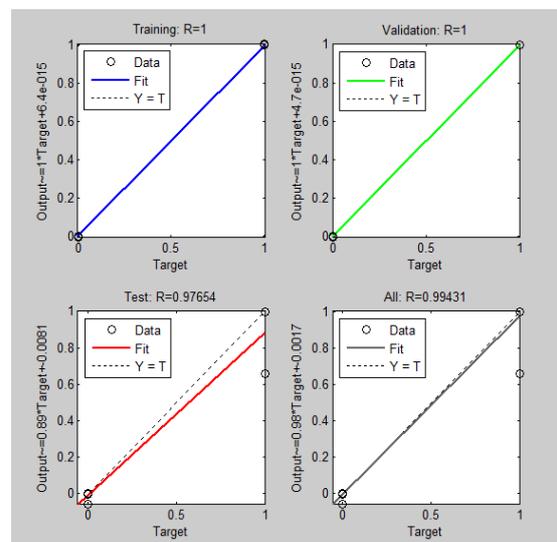
(a) Input vs. target plot



(b) Performance plot



(c) Training state graph



(d) Regression plot

Fig. 5. (a), (b), (c) and (d): Response from classification.

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