CLASSIFICATION OF MICRO CALSIFICATION AND CATEGORIZATION OF BREAST ABNORMALITIES - BENIGN AND MALIGNANT IN DIGITAL MAMMOGRAMS USING SNE AND DWT

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ABSTRACT

Mammography is used as a diagnostic and a screening tool that uses X-rays[1]. The objective of mammography is the premature revealing of breast cancer, usually through detection of characteristic masses and/or microcalcifications. Mammography is believed to decrease mortality from breast cancer[2]. This research work deals with classification of micro calcifications and mass in digital mammograms based on Discrete Wavelet Transform (DWT), Stochastic Neighbor Embedding (SNE) and the classifiers, K-Nearest Neighbor (KNN) and Support Vector Machine (SVM). Experimental results show that the proposed methods are successful in classifying the microcalcification in the digital mammogram.

Key words : *Digital mammograms, stochastic neighbor embedding, K-nearest Neighbor, support vector machine, Micro- calcification.*

I. INTRODUCTION

Mammography is the only effective and viable technique to detect breast cancer in particular in the case of minimal tumors. About 30% to 50% of breast cancers reveal deposits of calcium called micro calcifications[3]. The classification of microcalcification is achieved by applying SNE on sub-bands of wavelet transformed image individually. SNE is used for reducing high dimensionality data into relatively low dimensional data. The classifier system based on K Nearest Neighbor (KNN) and Support Vector Machine (SVM) is constructed. The same technique is applied on mammograms containing masses.

The proposed system for the classification of microcalcification and mass, classifies the given mammogram images into normal or abnormal, and also the abnormal severity as benign or malignant. The proposed methods are implemented in MATLAB and the performance of these methods is also analyzed.

II. INSIGHT OF RESEARCH

To produce more accurate diagnosis of breast disease, radiographic breast imaging and screening has developed during the past few decades. However, 10-30% of malignant cases still undetected due to the following reasons.

- Technical issues in capturing the images,
- Un-observable abnormalities in digital mammograms.
- and misinterpretation of abnormalities

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This work is mainly focus to reduce the diagnosis error through computer aided diagnosis system. While considering the computer applications, the classification of abnormalities in digital mammograms may be implemented by mammography procedure or computerization method.

After the classification of abnormalities, human assessment, pathology, automated methods, or combination of some of the three methods are used to classify the abnormalities. This research works may lay the foundation for overall automated classification system. The proposed system has the capability to distinguish between normal and abnormal cases. The abnormal cases are further subdivided into benign or malignant in the second stage.

III. Related Research works

The review of literature given in this section is centered upon various techniques for mammogram classification [4 & 5]. Intensive research work has been undertaken in the development of automated image analysis methods to assist radiologists in the identification or classification of abnormalities. Early detection of breast cancer by mammography depends on the production of excellent images and expert analysis[6]. Mammography alone cannot prove that a suspicious area is malignant or benign. To decide that, the tissue has to be removed for examination using breast biopsy techniques. Diagnosis using mammograms is intended at classifying the detected cancerous regions as benign or malignant.

Studies at various levels have been carried out to investigate on the problem of breast cancer diagnosis based on digital mammograms[7]. Different methods have been used to classify and/or detect abnormalities in medical images, wavelets (Rafayah Mousa, 2005, Y.Ireaneus Anna Rejani, 2009 , Pelin Gorgel,2009), fuzzy logic (Brijesh Verma 2001), fractal theory (Deepa Sankar,2007), Active contour segmentation (B. Sahiner 2001), and Texture and statistical based methods (Fatemeh Saki 2010),computer Aided diagnosis(Songyang Yu, 2000 , Ryohei Nakayama, 2006 ,B. Sahiner,2001 and H.D. Cheng,2006), Neural network(Mohammed J. Islam,2010) and Recursive Feature Elimination (Matteo Masotti,2006).

The fractal modeling of the mammographic images and their background morphology is presented by (Alireza Shirazi Noodeh, 2010) [11]. For fractal modeling, the original image is first segmented into appropriate fractal boxes followed by identifying the fractal dimension of each windowed section. Then used two dimensional box counting algorithm after which based on the order of the computations; they are placed in an appropriate matrix to facilitate the required computations. Finally using eight features identified as characteristic features of tumors extracted from mammogram images.

A combination of global texture features extracted from the second histogram is combined with local texture features obtained from a wavelet decomposition of the regions containing the calcifications as described by (Atam P. Dhawan, 1995). The performance of the radial-basis-function neural network [12] is compared to the standard multilayered perceptron. The neural networks

yielded good results for the classification of hard-to-diagnose cases of Mammographic microcalcification into benign and malignant categories using the selected set of features also investigated. ROC curve is used to compare the performance of the neural network classifiers. The radial-basis-function neural network classifier is found to be satisfactory especially since the cases being considered are hard-to diagnose[8].

Four feature selection methods all based on different approaches on ranking and selection and perform classification of data is compared by (Andreadis I, 2010) [13].Experiments are performed on cases containing clusters of microcalcifications, extracted from a large public mammography database[9] and the classification stage takes place through the SVM approach.

Automatic mammogram analysis is important in early breast cancer detection. (Aijuan Dong and Baoying Wang, 2009) [14] have presented a multi-resolution approach to automated classification of mammograms using Gabor filters. Specifically, Gabor filters of different frequencies and orientations have been used to extract textual patterns of mammograms[15 & 16]. To increase classification efficiency and reduce feature space, statistic t-test and its p-values for feature selection and weighting are proposed[17].

IV. Proposed Method

In this section the first part describes the classification of microcalcification system by applying SNE on wavelet transformed mammogram image and the second part deals with classification of mass system based on the same SNE features.

A. PROPOSED MICRO CALCIFICATION SYSETM

The proposed system for the classification of microcalcifications in digital mammograms mainly consists of two different stages which include the feature extraction stage and classification stage. All the stages are explained in detail in the following sub sections.

i) Feature Extraction Stage

Feature extraction (Figure:1) involves simplifying the amount of resources required to describe a large set of data accurately. In the proposed system, SNE is applied to reduce into a relatively low dimensional data. The well known microcalcification area in the MIAS mammogram images are given to the feature extraction stage. The known microcalcification area which was given by the MIAS database is separated from the whole image. The size of the original. The extracted ROI image is decomposed by using DWT at five different scales from 2 to 6. For an n level DWT, there are $3n+1$ sub bands available. This high dimensional wavelet coefficient is reduced into a relatively low dimensional data by using SNE and this reduced data set is stored in the database as feature. Database-I is constructed by using the training images of normal and abnormal images and used in the initial stage classifier.

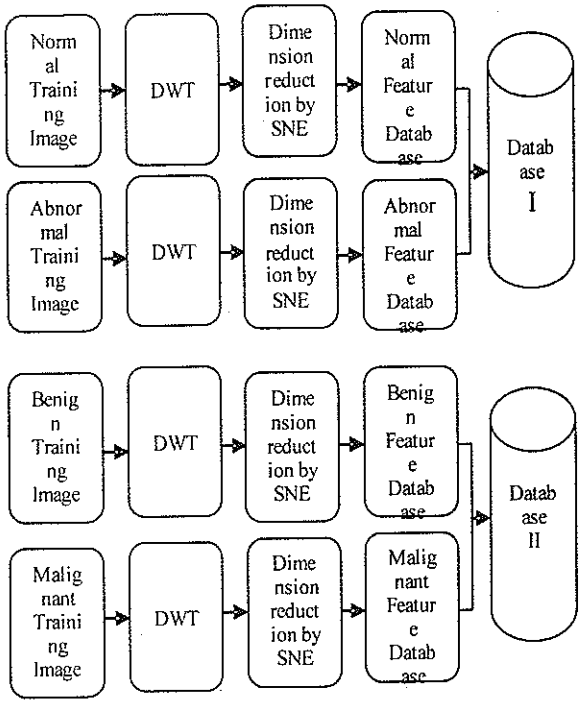

Figure 1: Block diagram of the feature extraction stage of the proposed system

Database-II [10] is constructed by using the training images of benign and malignant images and used in the final stage classifier.

ii) CLASSIFICATION STAGE

Classification stage executes two phases. In the first one, the classifier is applied to classify mammograms into normal and abnormal cases. Then the mammogram is considered abnormal if it contains tumor (microcalciûcation). Finally, the abnormal mammogram is classified into malignant or benign in the final stage. In this classification stage, KNN and SVM classifier in every phase is trained at specific number of training set in each category.

V. PERFORMANCE OF THE MOCROCALCIFICATION SYSTEM

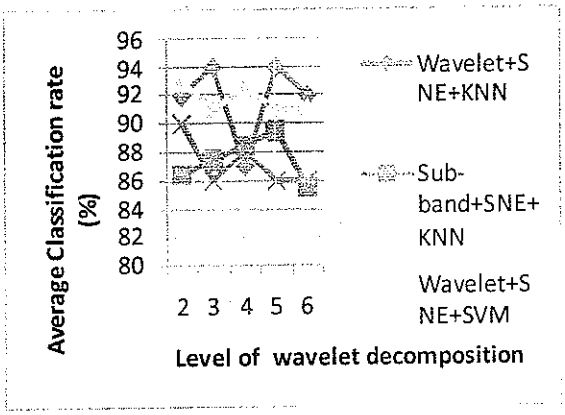

Figure 2 : Average classification accuracy for first stage classifier

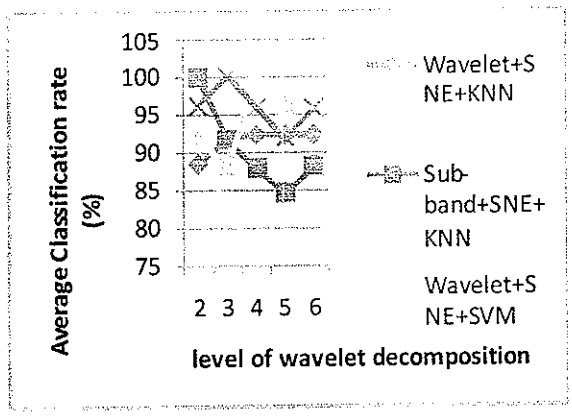

Figure 3 : Average classification accuracy for second stage classifier

The performance of the proposed system is carried on 99 normal images and 25 microcalcification images. Among the 25 abnormal images, there are 12 benign and 13 malignant images available. All the images are considered for the classification test. The wavelet decomposition levels are varied from 2 to 6 and for each level the performance of the proposed techniques are evaluated. Figure 2 and 3 gives the average of the results obtained from the proposed techniques for first and final stage classifier respectively.

VI. Conclusion

The study has attempted to develop new techniques for the classification of microcalcification and mass in digital mammogram images. Mammogram classification systems based on frequency domain features are presented. The proposed method for the classification of microcalcification in digital mammograms based on DWT and SNE which is able to classify the microcalcifications in mammograms independent of their size, orientation, and position. Experimental results show that this method is successful in classifying the microcalcification in the mammogram and the successful classification rate is reasonably high-quality.

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