DETECTION AND CLASSIFICATION OF MICROCALCIFICATION USING SHEARLET WAVE TRANSFORM

Ms.Saranya.S[1], Priyanga. R[2], Banurekha. B[3], Gayathri.G[4]

[1] *Asst. Professor,Electronics and communication,Panimalar Institute of technology, Tamil Nadu,India*
[2]*Student, Electronics and communication,Panimalar Institute of technology, Tamil Nadu,India*
[3]*Student, Electronics and communication,Panimalar Institute of technology, Tamil Nadu,India*
[4]*Student, Electronics and communication,Panimalar Institute of technology, Tamil Nadu,India*

ABSTRACT

In recent scenario number of people affected by breast cancer is increasing exponentially. The disease occurs almost entirely in women. A tumor could be benign (not dangerous to health) or malignant (has the potential to be dangerous). When the affected cells appear close to normal they are considered as Benign tumors and the nearby tissues are not disturbed or spread to other parts of the body. Malignant tumors are cancerous. Mammography is a fast procedure and discomfort is minimal for most women.. In this study, a Computer Aided Diagnosis (CAD) system, using shearlet wave transform algorithm and Support Vector Machine (SVM), is being proposed to evaluate mammography images ,denoising and to improve accuracy. During the process, the region of interest is defined before applying the method. The system includes a feature extraction approach based on shearlet wave algorithm. In terms of classification, the process has two main stages such as feature extraction and classification of normal-abnormal regions and malignant-benign ones.

Keywords: *Shearlet wave transform, SVM classifier, region of interest.*

1.INTRODUCTION

Cancer is a class of diseases characterized by abnormal cells that grow and affect healthy cells in the body. Mammograms don't prevent breast cancer, but they can save lives by finding breast cancer as early as possible. Breast cancer is a disease in which cancer cells form in the tissues of the breast. One in eight women will be diagnosed with breast cancer in her lifetime.Breast cancer is the most commonly diagnosed cancer in women.Breast cancer is the one of the leading cause of cancer death among women.Each year it is estimated that over one-fourth of the women in the country will be affected by breast cancer. Malignant represents mammogram result having a tumor with diagnosed with breast cancer and more 40% will die. Among the various radiographic indications related to the breast cancer microcalcification clusters play a vital role.The diagnosis result of tissue is widely classified as: Normal, benign and malignant. Normal mammogram represents no cancerous cell is present, benign represents mammogram that indicates a tumor, but not produced by cancerous cells and malignant represents mammogram result having a tumor with cancerous cells.The existing system uses Discrete Wavelet Transform (DWT) in which features extracted from preprocessed images are passed through different classifiers. and employs the combination of non sub sampled Contourlet transform (NSCT) and artificial neural networks (ANN) for building the classifiers. The classification of masses are done using the Artificial Neural network(ANN). This will detect whether the tumor is benign or malignant on the region of interest that contains mass. It requires two stages, detecting the abnormalities and then classifies the abnormalities into benign and malignant tumors.

1.1 Methodology

The proposed system for the classification of mass in digital mammogram is developed based on Shearlet wave transform and SVM classifier. The theoretical background of all the approaches are introduced.

2.1 SHEARLET WAVE TRANSFORM

Shearlets perform a multi-scale and multi-directional analysis. Each basis element has a frequency support that is contained in a rectangle of size proportional to 2j×4j (or 4j×2j) in both transforms. This property is called parabolic scaling. Fequency supports become increasingly thin as j decreases. This is the optimal approximation rate for this type of functions and this property is often referred to as optimal sparsity. Shearlets are generated by applying a family of operators to a single function. Shearlet is almost similar to curvelets. Shearlets are normally associated to a fixed translation lattice.

Shearlets applications: when combining information from multiple scales and orientations.
In the construction of the shearlet: tight frame above
the number of orientations doubles at every scale. Shear lets are associated to a multi-resolution analysis.
The primary **advantage** of Shearlets is that it allow for a much less redundant sparse tight frame representation, while offering shift invariance.

2.2 SVM CLASSIFIER

SVMs are a new classification technique of non-linear, non-parametric, which showed good performance in the medical diagnostics.
SVM pattern classifier, uses a threshold value to separate two classes of patterns.

3. EXPERIMENTAL SETUP

The proposed method consists of two stages : The feature extraction stage and classification stage. The two stages are described below:

3.1. Feature extraction stage

In our proposed system, the energy of each shearlet sub-band is used as features. The feature extraction stage is shown in figure1.

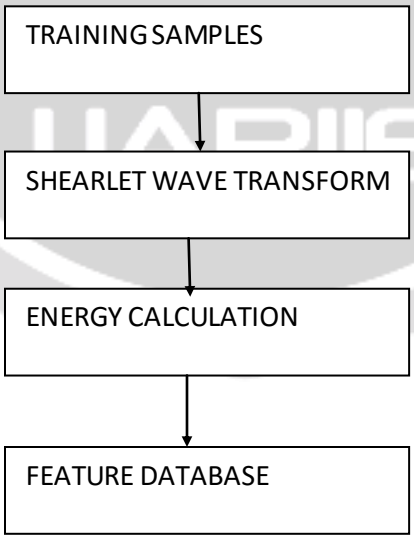

Fig -1: Feature extraction stage

The property of the energy features satisfy the following conditions:

- The features carry enough information about the abnormal and normal regions.
- The feature are differentiated from normal to abnormal and vice versa.
- They are easy to compute.

The **main objective** of this study is to distinguish between the images as benign or malignant. MIAS database, a benchmark database used by many researchers is taken to evaluate this study. The original mammograms in MIAS are very big size (1024×1024 pixels). The whole image consists of 50% of noise.

In order to remove this unwanted noise, a cropping operation is done manually before the feature extraction by choosing the given center of abnormality as the center of the ROI. The size of ROI image is 128×128. In the proposed system, the shearlet wave transform coefficients are used as features to classify the images. The original image is decomposed by using the shearlet wave transform. All coefficients are taken features for the classification process. This method is applied to all the training images and the feature vectors are stored in the database called as **Feature Data Base**. The energy of each sub-band of the image I is calculated by using the formula in (2):

$$Energy_e = \frac{1}{RC} \sum_{i=1}^{R} \sum_{j=1}^{C} |I_e(i,j)|$$

where, $I_e(i,j)$ the pixel value of the eth sub-band and R, C is width and height of the sub band respectively.

3.2 Classification of stage

In the proposed method, the classification of microcalcification is done using SVM as a classifier. While comparing SVM with ANN, Classification phase executes two phases. In the first one, the classifier is applied to classify mammograms into normal and abnormal cases. Then the mammogram is considered as abnormal if it contains tumor (mass). Finally, the abnormal mammogram is classified into malignant or benign in the final stage. In this classification stage,

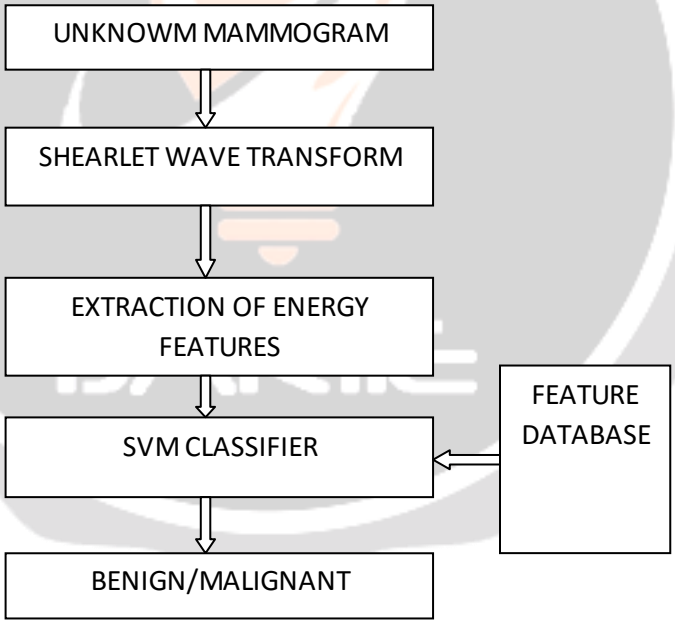

Fig -2: Classification stage

SVM gives the better performance in most of the cases and they are furnished below;

- SVM is very simple to analyze and derivation can be done theoretically than ANN.
- In the learning stage, SVM maps the training data to high dimensional space using various kernels like linear, radial basis functions. Finally a hyperplane is selected that separates the training data which has maximum margin and minimum error "Error optimization" is the main difference between SVM and ANN.
- The main objective of learning stage in ANN is to minimize the error for a particular set of weight values whereas in SVM is to adjust the capacity of the machine.
- The number of hidden layers in ANN is same as support vectors in SVM.

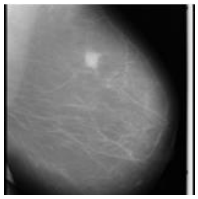

Fig -3: Original image

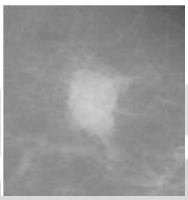

Fig -4: Extracted ROI

4.EXPERIMENTAL RESULTS

The experiments is carried out to calculate the accuracy, sensitivity and specificity for the mammographic images. The assessment is carried out in relation with two stages of mass classification system namely (i) normal/abnormal classification (ii) benign/malignant classification. The performance of the proposed system is carried on 80 normal images and 65 mass images. Among the 65 abnormal images, there are 25 benign and 13 malignant images available. All the images are considered for the classification test. Table 2 shows the success rates of SVM method for the classification of images as normal and abnormal. Table 3 shows the success rates of SVM method for the classification of images as normal and abnormal.

TABLE 1 : number of images used to train SVM Classifier Images

IMAGES	NORMAL	ABNORMAL	BENIGN	MALIGNANT
TRAINING	55	65	25	13
TESTING	80	84	37	19

TABLE 2: Success rates of SVM method for the classification of images as normal and abnormal.

SCALE	ACCURACY	SENSITIVITY	SPECIFICITY
1	100	1	1
2	100	1	1
3	96	0.92	1
4	92	0.88	1

TABLE 3: Success rates of SVM method for the classification of images as benign and malignant

SCALE	ACCURACY	SENSITIVITY	SPECIFICITY
1	100	1	1
2	98	0.90	0.90
3	78	0.76	0.70
4	66	0.63	0.63

Initially, the data is classified as normal and abnormal. Then the accuracy is calculated for both normal and abnormal images. After that the same process is done for both benign and malignant images.

5.CONCLUSION

This paper describes a system for detection and classification of mammographic images using Shearlet wave transform and SVM classifier. **Advantages of this paper is**: Finding breast cancer early reduces your risk of dying from the disease by 25-30% or more, The procedure is safe, **Get the best quality you can.**The SVM classifier showed a great performance in classifying the images. The overall accuracy for this classification is **95%** . These results demonstrate that shearlet wave transform and SVM are useful methods to distinguish the mammographic images. The images are classified as either normal or abnormal and further the abnormal images are classified as either it is a benign or malignant.

6.REFERENCES:

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