An Identification of Breast Cancer Disease by Using ANN Using Contourlet Transform

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Abstract— The most frequent cause of death of women in a recent times is breast cancer around the globe. Mammography found to be effective in an early diagnosis of breast cancer. Earlier, it was difficult for radiologists to identify the cancerous tumor present in a mammographic X-Ray pictures. In this presented work, a technique for classification of mammogram image on the basis of Artificial Neural Network (ANN) by employing feature extraction techniques in an image processing domain is stated. The feature vectors are extracted by applying Contourlet transformation (CT) procedures on a mammographic image. Finally, the classification process is conducted utilizing ANN technique.

Key words: Mammography, Artificial Neural Network, Contourlet Transform

I. Introduction

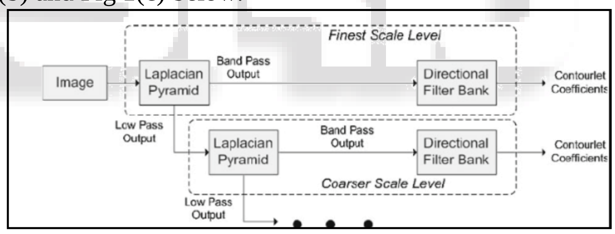
Breast cancer is found to be one of the most significant cause of death among females around the globe. It is found that one person out of seven loses life due to this disease. Mammography is a technique used for imaging the interior formulation of the breast and it has the potential for diagnosing cancer prior to physical emergence. It is necessary to use Computer-Aided Diagnosis (CAD) system, as it is able to identify an area of cancerous tumor present in the breast region. The Contourlet Transform (CT) is a method utilized for transforming the mammogram gray scale image. Contourlet is used in medical images because it detects the curves appropriately. Artificial neural Network (ANN) is a machine learning method generally utilized for the purpose of classification, recognization of patterns and regression.

II. Related Work

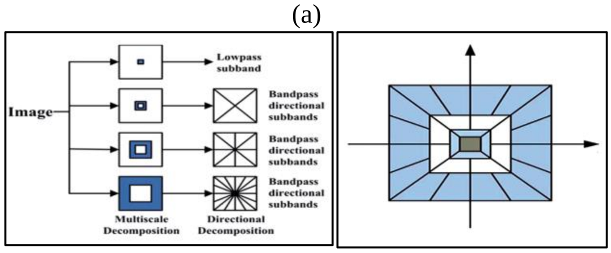
Research is going on in various domains related to CT on medical images. Few of these are discussed here: Wei-shi Tsai et al., [1] stated a design for pattern recognization based on machine learning. CT is used for edge detection and also comparison is made with other algorithms. Swapna et al., [2] stated extraction of images utilizing CT, as it contains multiple-scaling and multiple-directional decomposition values of an image. The CT further decompose the medical image into numerous directions at various scaling levels. Girish H et al., [3] presented a technique for feature extraction with the help of mammogram images, the feature variables are extracted from the unusualness of mammograms using textual feature extraction process. Saritha C et al., discussed a Contourlet-based watermarking method to scale the previously derived properties of Contourlet for watermarking on an medical pictures [4]. A Arafi et al. [5] stated a classification method for digital mammographic images utilizing ANN classification. Basically, the characteristic feature values of digitalized mammographic images are retrieved and then classification is conducted using ANN classifier method. Hashem B et al., [6] presented a work based on nearest neighbour method. Initially, Region of Interest is found using segmentation technique further feature values are extracted from these segmented images and finally K-Nearest Neighbour (KNN) method is applied to classify the image as benign or malignant. All the previous work show that limited work is done using ANN and CT on mammograms.

III. Contourlet

In an architecture of Contourlet [1] shown in Fig 1(a) below, mammogram image is passed as an input to Lapalacian Pyramid (LP) which results in both low and band pass outputs. The band pass are further fed to directional filter bank resulting in the contourlet are shown coefficient values. The low pass values of LP is passed to another LP, which again results in both low and band pass outputs and further, the process continues, which lead to second level second level Contourlet coefficients. The LP splits the input mammogram gray-scale image into various scales and the directional filter banks at every scaling position results in the complete directional details. The partitioning of frequencies and the decomposition of LP and directional filters are shown in Fig 1(b) and Fig 1(c) below.



(a)



(b) (c)

Fig 1(a): Contourlet architecture; Fig 1(b): Directional filter and LP decomposition; Fig 1(c): Partitioning of frequencies

The above diagrams represents in detail the multi-scale decomposition at each scaling level and revels there directionality details. The LP exhibits four sub-bands of low pass levels and directional filter results in coefficients of band pass.

IV. Artificial Neural Network

ANN is basically an interconnected set of nodes, it's functioning and structure is similar to that of human brain where vast set of neurons connected to each other [5]. The artificial neurons are represented by a circular nodes also called perceptrons (number of hidden layers) and the connection is established from the output of one neuron to input of another neuron as shown in Fig 2 below.

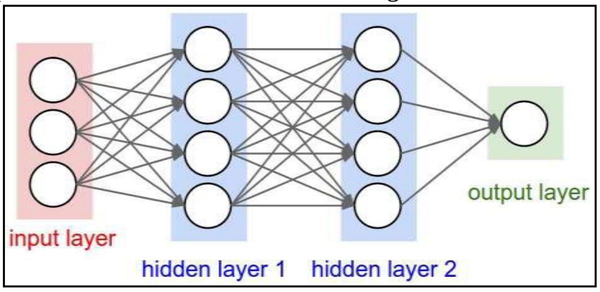


Fig. 2: ANN Architecture

Initially, during training weights are fixed to a small number along with biases randomly. An input vector is forwarded to each neuron of input layer, hidden layer and output layer. The errors are propagated using back propagation method for each neuron of output layer, hidden layer and for weights connected to each edge and biases. During testing, mammogram images are loaded and feature values are stored, utilizing training function feature values and on conversion of values from vector to indices after testing results in obtaining the category of a mammogram image.

V. IMPLEMENTATION

A. *Dataset*

The mini dataset used here are acquired from the MIAS (an open source) database. The treatment initially starts with an identification of cancerous tumor present in the breast area of mammogram image and discover the type of cancer such as normal, benign or malignant. There are total 187 mammogram images including both left and right breast images, from which 80% are used for training and 20% for testing.

B. *Modules used*

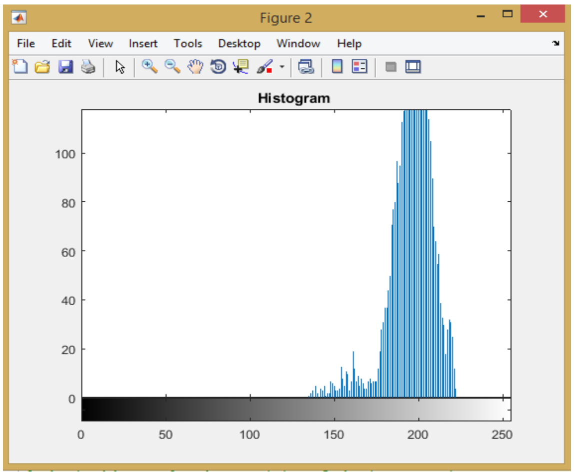
The histogram equalization, Contourlet transform, feature extraction and classification using ANN are the modules used in this work.

C. *Proposed Methodology*

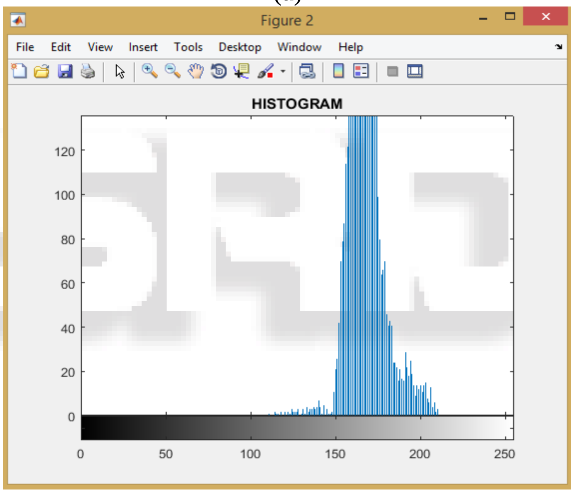
The mammographic Region of Interest (ROI) is a section of an image used for conducting adjoining operations. During pre-processing, the histogram equalization process is used to increase the contrast of an image. The filtration on images are performed using cross-entropy method, which helps to remove artefact such as noise present in a mammogram image. After performing morphological close operation, the gray-scale mammogram images are forwarded to transformation technique. The transform used in this work is Contourlet. The decomposition is performed up to level two and after that most of the valid data was lost. Contourlet is a new method which results in high retrieval rates and holds lower computational complexities. During feature extraction, Contourlet coefficients are accepted as an input along with spatial and textual domain pixel values. The ANN is one of the machine learning method used for classification of mammogram ROI image as benign or malignant.

D. *Experimental Results*

The experimental results show the use of Contourlet transform for ANN classifier. In this work, when mammogram ROI is passed as an input for histogram equalization results are obtained in the form of histogram graph for both benign and malignant ROI images as shown in Fig 3 below.



(a)



(b)

Fig 3: (a) Benign histogram. (b) Malignant histogram

The following are the results obtained on conducting iterations for ANN at Contourlet level 1 and level 2 as shown in Table 1 below. The highest correctness is attained at patternnet value 13 for level 1 and patternnet value 30 at level 2. The maximum value obtained at level 1 is 78.5% and 76.5% at second level.

Pattern net value (level 1)	Efficiency(%)		Pattern net value (level 2)	Efficiency(%)
11	59.1		10	59.7
12	66.7		20	64.7
13	78.5		30	76.5

Table 1: ANN accuracy at Contourlet level 1 and level 2

The feature values of all the benign and malignant images at Contourlet level 1 and level 2 are shown in Table 2 and Table 3 respectively. It can be observed clearly that values less than zero are malignant and values greater than zero are benign at both level and level 2.

Features	Benign value	Malignant values
Energy diagonal	1.4626	0.3280
Homogeneity horizontal	1.1098	0.1058
Y horizontal	1.3892	0.2442
Kurtosis horizontal	1.5142	0.0418
Homogeneity vertical	1.6169	0.1394
Kurtosis diagonal	1.6865	0.0713
Energy vertical	1.6902	0.3577

Table 2: Feature values at Contourlet level 1

Features	Benign value	Malignant values
Energy diagonal	1.6257	0.3229
Homogeneity horizontal	1.4225	0.2004
Y horizontal	1.8118	0.8552
Kurtosis horizontal	2.0183	0.3665
Homogeneity vertical	2.2394	0.5546
Kurtosis diagonal	2.4414	0.1320
Energy vertical	2.4831	0.3120

Table 3: Feature values at Contourlet level 2

VI. CONCLUSION

This work gives a brief study of using ANN classifier with Contourlet. By looking at the above experimental outcomes, following points can be stated. The maximum efficiency is achieved at level 1 is 78.5% bearing patternnet value 13 and at ANN Contourlet level 2, the maximum efficiency achieved is 76.5% bearing patternet value 30. Therefore, ANN at level one performance is better when compared to second level in terms of time and efficiency. Further, work can be done with increased dataset to observe the effect of applying ANN.

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REFERENCES

[1] Wei-shi Tsai, "Contourlet Transforms for Feature Detection", IEEE journal, May 9, 2008
[2] Swapna Borde and Dr. Udhav Bhosle, "Image Retrieval using Contourlet Transform", International Journal of Computer Applications, November 2011.
[3] Girish H, Pradeep N, Sreepathi B, Karibasappa K "Feature extraction of mammograms", Publisher International Journal of Bio information Research, Volume 4, Issue 1, pp-241-244, 2012.
[4] Saritha Chakrasali, Ramachandra Murugesan, "A Contourlet Transform Based Versatile Watermarking Algorithm for Medical Images", Chapter 33, Pg: 263 - 271, Proceeding of International Conference on VLSI, Communication, Advanced Devices, Signals & Systems and Networking (VCASAN-2013)..
[5] AyoubArafi, Youssef Safi and Rkia Fajr, “Classification of Mammographic Images using Artificial Neural Networks”, April 2013.
[6] Hashem B. Jehlol, Zainab khyinoo, “Classification of Mammography Image using Machine Learning Classifiers and Texture Features”. IJIRAE, September 2015.

