International Journal of Future Generation Communication and Networking
Vol. 12, No. 5, 2019 pp.125-133

Breast Cancer Detection Using Neutrosophic Logic

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Abstract

The breast cancer is a very common finding disease among women now-a-days. Approximately, over 10 lakhs women in the world are affected by breast cancer. There are various methods to diagnosis and detect the breast cancer. The existing method is to detect the breast cancer using Fuzzy c means algorithm and AdaBoost algorithm. These features had some disadvantages that inability to provide indeterminate values and provide noise in images. In order to overcome these problems, we proposed a new method. In this proposed system, theneutrosophic logic and SVM classifier is used. By using these features, the indeterminate values are identified easily and extraction of hottest region is easily carried out in thermal breast images. This thermal breast images are captured by using high resolution infrared (IR) cameras.

Index Terms: *High-resolution diagnostic images,Breast thermal images, Neutrosophiclogic,SVM classifier*

I. INTRODUCTION

Benign breast disease is one of the cancer types that formed from cell where malignant tumor occurs within a breast and results in a diagnosis of approximately 1 million women annually in the world. The different types of breast cancer may occur for different women, but the disease yields few common symptoms. Breast thermography can be used for early detection of cancer and non invasive. It is low cost, risk free and painless. The rule of digital infrared imaging depends on that metabolic activities and vascular course in both pre dangerous tissues and the zone, encompassing the, creating breast malignant growth is quite often higher than in ordinary breast tissue.In a consistently expanding requirement for nutrients, harmful tumors increment flow to their cells by holding open leaving vein, opening lethargic vessels and making new ones(neoangiogenesis). The research is to identify the exact causes of breast cancer to diagnose the disease. This procedure much of the time brings about an expanding territorial surface temperature of the breast.Thebreast thermograms are used in image processing to enhancehotspot, segment and align relevant portions. The higher order spectral invariant features are used. In breast thermograms, the resultant images that exhibit vary in size, shape, location and number.

This paper gives a clear explanation about higher order spectra and its applications and use of various features in image processing.

II. EXISTING SYSTEM

There are many approaches available for detection and diagnosis of breast cancer. In existing systems we use fuzzy logic and AdaBoost classifier. The use of fuzzy logic is to segment the clusters and select the hottest region in thermal images. The use of AdaBoostclassifier is to classify unseen test images into normal, benign and malignant.

ISSN: 2233-7857 IJFGCN

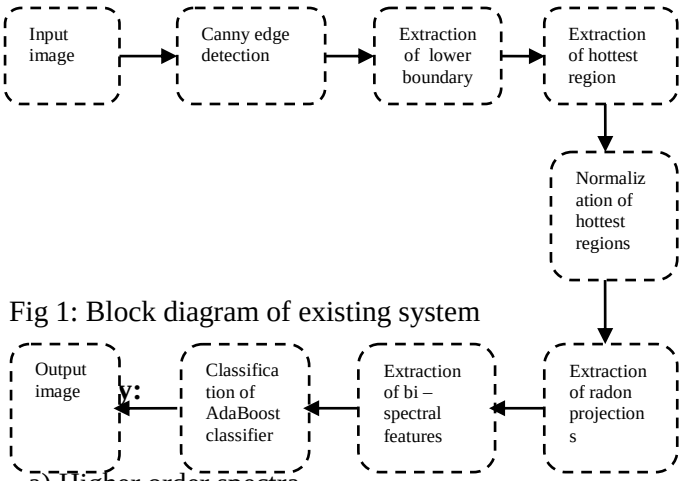

Fig 1: Block diagram of existing system

y:

a) Higher order spectra

A higher order spectrum (HOS) givesa representationof moments belonging to the higher order of random process. It is helpful in issues where no guassianity, Noise and non linearities are significant. These properties are demonstrated to be available in regular Images. This yield higher spectra and particularly the third order, to be specific the bispectrum, to be an intriguing device with image processing. The information and data about the second order time is given by the power spectrumanalysis. All Fourier information are eliminated by this power spectrum and are retained by higher order spectra and in a deterministic signal, it is more sensible to shape which changes.

b) Applications

The application of Higher Order Spectrum length a wide scope of territories, for example, oceanography for the portrayal of wave wonders, earth sciences to gauge barometrical weight and disturbance, crystallography, plasma material science for wave cooperation, mechanical frameworks to examinations vibration and thump recognition, monetary time arrangement, bio medicinal sign investigation for ultrasonic imaging and location of wave coupling, picture preparing for surface demonstrating and portrayal, reproduction, converse separating, discourse handling for pitch identification and voiced/unvoiced choice, correspondences, exhibit preparing to distinguish the heading of appearance estimation, estimation of number of sources, bar shaping, source signal estimation, and source characterization, consonant recovery.It has three properties. They are, it hasability in characterization of non GaussianProcesses and to regain Fourier information and also has an ability to withstand additive Gaussian noise.

2) Method:

a)Canny edge detector

Canny edge detector isto identify edges in images.It is an operator usedfor edge detection which usesparticular algorithm namely multistage algorithm to identify edges in an image.This process contains fivemethods are Smoothing, Gradient finding, Nonmaximumsuppression, doublethresholding, and Edge tracking byhysteresis.This edge tracking method is used to find and detect edges in images.By using Gaussian filters, the input image is smoothened to reduce noise in smoothing process. The function of gradient finding process is able to determine the edges based on the more changes present in the intensity of gray scale of the image.

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The other name of gradient magnitudes isthe edge strengths.The conversionof non clearededges present in the inputimage into the sharpenedges are carried out in non-maximum suppression step.The remaining pixels present in the edgeare represented by pixel-by-pixelstrength, after the non-maximum suppression process.

Due to rough surfaces, many edges in an image may be caused by noise and colour variations. Although many edges remains to be true. By using the threshold techniques, the edges can be separated and it could be stronger. This task can be achieved by the double thresholdingtechnique. In the edge tracking process, by using binary large object analysis edge tracking can beimplemented. By using an 8-connected neighbourhood, these edge pixels aredivided into connected binary large objects.

b) Fuzzy c means

Theclustering methodcomes under the algorithmof Fuzzy c-means (FCM), that has the content of one data belongs to more clusters.In hard clustering, data are separated into distinct clusters bycontrast techniques.The partition matrix, which has a value between 0 and 1, is given by thisparticular algorithm. It contains clustersthat are determined by reducing the objective function for each and every point. It is expressed as,

$$J_{m(U,C)} = \sum_{i=1}^{c} \sum_{k=1}^{n} U_{ik}^{s} \|X_k - C_i\|^2$$

Where,S is any real number greater than one,
X1, X2,…..,Xn are n data sample vectors.

c) Radon projections

The Radon transform minimizes a 2-D image into a pair of 1-D parallel beam projections, at different angles and it forms the basis of tomography which to be computed.

It was used to extend 1-Dbispectralinvariants and then applied to thermal pictures. For projections, the Bispectral invariants features arecalculated. For each angle of projection, itcan yield some features.

d) Bispectrum

In frequency domain, the bispectrum of a signal is expressed as
P(f1,f2)=E[X(f1)X(f2)X*(f1+f2)]

Where, x[k] is theinverse Fourier transform of X(f),
f is normalized frequency, that is between 0 and 1,
* denotes the complex conjugate,
E[ ] denotes the statistical expectation operation over
an ensemble of possible realizations of the signal

For a deterministic signal there is no needfor expectation.
B(f1,f2)=X(f1)X(f2)X*(f1+f2)

Due to symmetry properties, the bispectrum has a function of two frequencies. Inbifrequency space, it has an ability to compute onlya triangular region. It can be normalized by the sampling frequency.

ISSN: 2233-7857 IJFGCN

e) Bispectral invariants

The bispectrum are morecomplex and it hasFourier information.In bi-frequency space, the phase of the integrated bispectrum along a straight line of given slope, is the bispectral invariant feature.

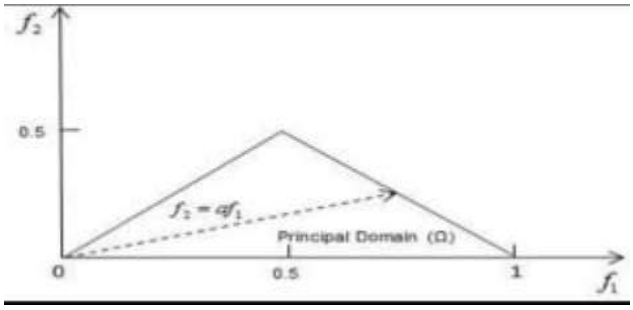

Fig 2: Spectrum computation of non-redundant region

f) AdaBoost algorithm:

The AdaBoost algorithm uses simple threshold classifier.Depends on the classification of performance over a training set rather than testing set of data of known classes, for each and everyclassifier, the threshold is set to an exact value.Every thermograph image(data sample)is weighted equally in initial position. The retaining process of classification threshold of best performing features is done. The weighted classifier and weighted error on the training data are inversely proportional to each other.

The data samples which are misclassified are weighted byAdaBoostclassifier are nowbecomerelatively high and a second feature and its corresponding classifier are selected, by using weighted error which has least performanceson the training data rather than testing data.

These functions are illustrated untileither certain desired number of features or the optimal performance is achieved. The weightedlinear combination and a weightedthresholdof the selected features are used by this resultant classifier.By using Matlab, the algorithms were implemented.

To ensure theunseen data performance, thedata are splitedinto different train and test sets. By using several random splits, the accuracy of train set over the test set iscalculated.

Thus, by using this above mentioned process, the detection of breast cancer was implemented.

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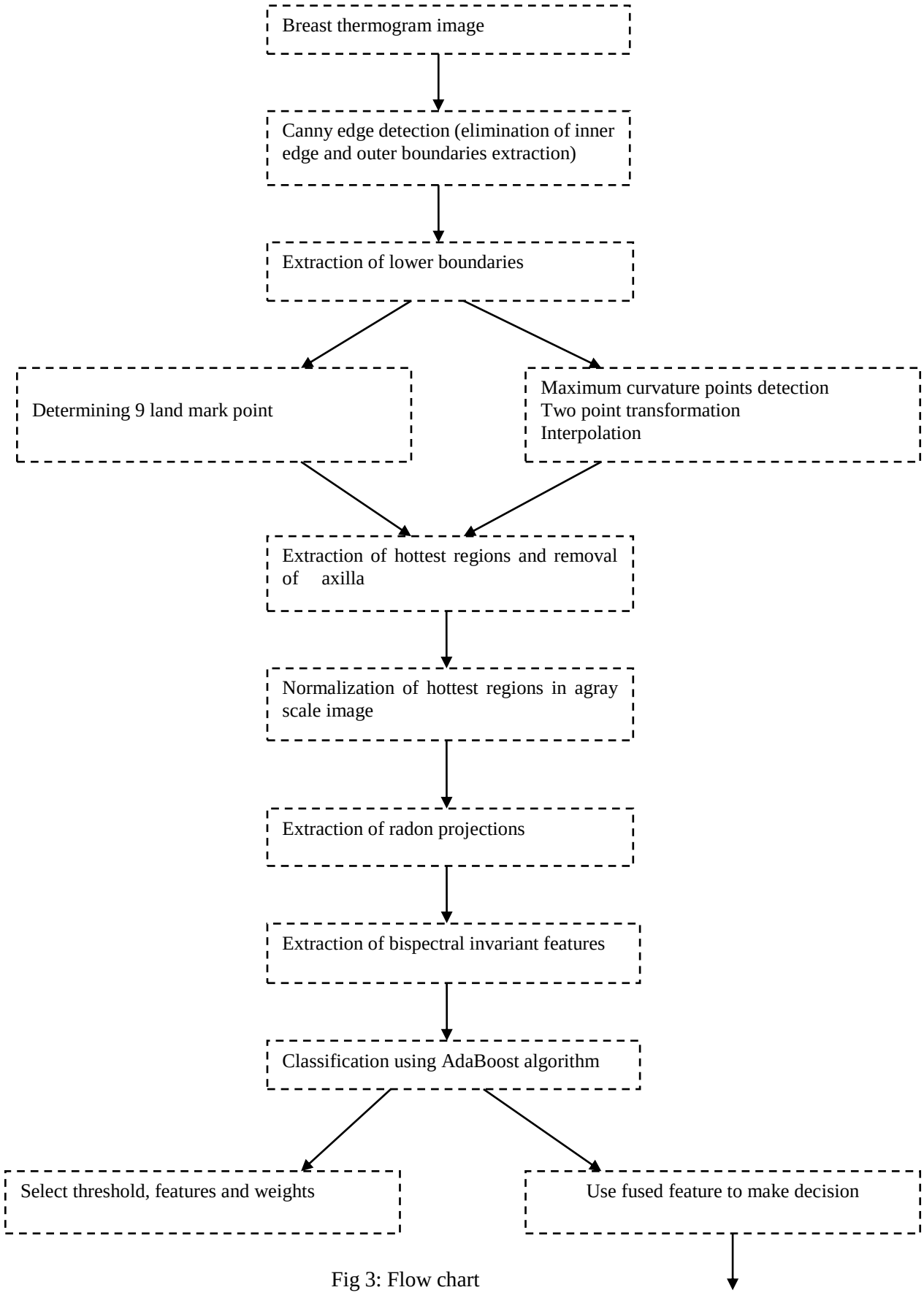

Fig 3: Flow chart

III. Proposed System

There are many approaches available for detection and diagnosis of breast cancer. In proposed systems, we use neutrosophic logic and SVM classifier. The use of neutrosophic logic is to clustering an image and the regions which are hottestin imagesare extracted for feature extraction. The use of SVM classifier is to classify unseen test images into normal, benign and malignant and indeterminate values are identified using this classifier.

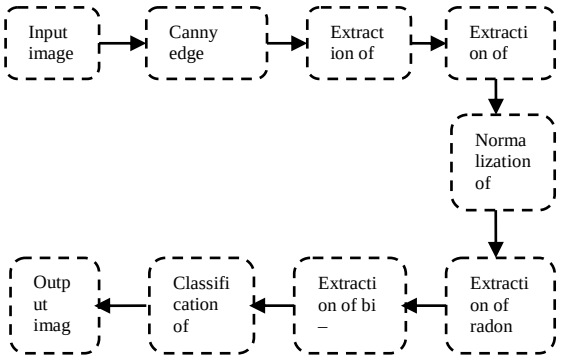

Fig 4: Block diagram of proposed system

In this work,image processing techniques applied to thermal breast images.Canny edge detector is to identify edges in images.It is an operator used for edge detection that usesparticular algorithm namely multi stage algorithm. It has five steps such as Smoothing, Gradient finding, Nonmaximumsuppression, doublethresholding, and Edge tracking by hysteresis. This edge tracking method is used to find and detect edges in images. By using Gaussian filters, the input image is smoothened to reduce noise in smoothing process.

This algorithmis able to determine the edges based on the more changes present in the intensitygray scale of the image. In the second step, they are found to be determining gradients of a thermal image. The other name of gradient magnitudes is, the edge strengths.The conversion of non clearededges present in the inputimage into the sharpen edgesare carried out in non-maximum suppression step.The remainingpixels present in the edgeare represented by pixel-by-pixelstrength, after the non-maximum suppression process.

Due to rough surfaces, many edges in an image may be caused by noise and colour variations. Although many edges remains to be true. By using the threshold techniques, the edges can be separated and it could be stronger. This task can be achieved by the double thresholdingtechnique. In the edge tracking process, by using binary large object analysis edge tracking can be implemented. By using an 8-connected neighbourhood, these edge pixels aredivided into connected binary large objects.

Then after performing canny edge detection, the extraction of lower boundaries and hottest region is performed and normalized. After performing this process extraction of radon projections and bispectral features is carried out. Finally, the image will be classified using SVM classifier and the required output is taken.

A 2-D image, are reduced into a pair of 1-D parallel beam projections, at different angles and forms the basis of tomography which has to be computed by using Radon transform.

ISSN: 2233-7857 IJFGCN

The Neutrosophic logic algorithm is one method used for clustering which allows one data belongs to one or more clusters. It is used in clustering and hottest regions extraction from thermal images.

The Support Vector Machine (SVM) classifier is a type of classifier defined by separating hyper plane. In two dimensional spaces,this hyper plane is defined as line which divides a plane into two parts where in each class lay in either side.

It is used to identify and classify the images into normal, benign, malignant, and non- malignant.

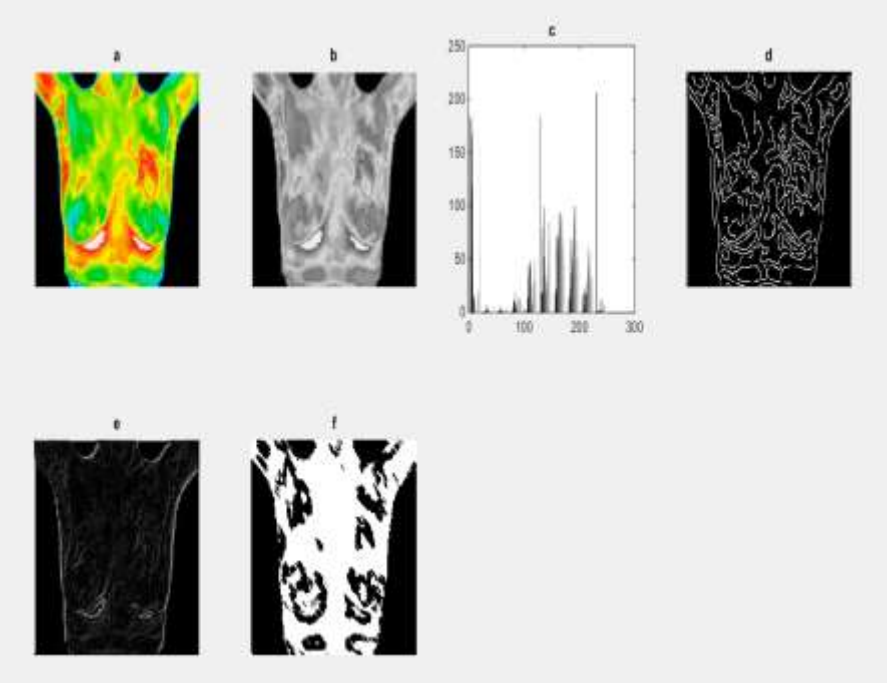

Fig 5: a)Input image b)Gray scale image c)Histogram d)Edge detection e)Extraction of boundaries f)Extraction of upper and lower boundaries

IV. RESULT

Mainly breast cancer occurs only for women. Now-a-days, many women affected by breast cancer which cannot be identified easily. By using this proposed system, the identification of breast cancer is made easier. In this proposed system, we are using neutrosophic logic for segmentation and SVM (Support Vector Machine) classifier for classification. The edge of the captured breast thermal image is detected using canny edge detection. In this, the inner edge of image is removed and the outer boundaries are found.

The identified two lower boundaries undergo two processes. The first one is training, where 9 landmark points are determined and mean locations are selected. The second one is testing, where maximum curvature points are detected using two point transformation and linear interpolation. In the result of these two processes, the hottest regions are identified and the axilla and sternal boundaries are removed. The gray scale image in the hottest region is normalized. A radon projection is extracted. In radon projection, the radon transform reduces two-dimensional image into a pair of 1-D parallel beam projections. There are many features in which bi-spectral invariant features are extracted. Then the image is classified using SVM classifier algorithm. The image which undergoes classification is splited

ISSN: 2233-7857 IJFGCN

into two processes. The first one is training, which is used to select features, thresholds and weights. The second one is testing, which use fused features set to make a class decision. It gives Malignant or Non-malignant, Benign or Normal.

Thus, by using neutrosophic logic and SVM classifier, the detection of breast cancer was implemented.

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