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# Detection of Malignant Tumour in Mammography Images Using Artificial Neural Networks with Fuzzy Rules

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## ABSTRACT

Breast cancer is a collection of cancer cells that starts in the breast cells and it expands from tissue of breast. Now a day Mammogram is one technique to detect the breast cancer earlyusing x-ray image of breast and it is used to reduce the deaths of breast cancer. This breast cancer disease is curable if discovered starting stage. This paper studies different methods utilized for the detection of breast cancer using mammogram classification. In this paper, the feature extraction and classification of mammogram image can be done by the artificial neural networks. Different kinds of feature extraction from mammogram image to detecting the bread cancer contains shape, position and surface features etc., this image feature extraction is significant in classification of image. By utilizing the image processing these image features are extracted. Image segmentation is performed for feature extraction of mammogram image, in this process image is partitioned into multiple segments, therefore when change the image representation into something that is more significant and simple to examine. Here the fuzzy rules are introduced to process the related data from cases of breast cancer in mammogram image in order to give the risk diagnosis of breast cancer. The preprocessing method is used to sustain an effectiveness of image by correct and adjusting the mammogram image and also it is used to improve the image quality and create it ready for additional working by reducing the unrelated noise to provide new brightness value in output image it is called as filtration and unwanted parts of background of mammogram image is eliminated. Some techniques are discussed for mammogram image classification to earlier detection of breast cancer.

## Indexing terms/Keywords

Digital mammogram, Artificial Neural Networks, Fuzzy rules, Preprocessing, Image segmentation.

## I.INTRODUCTION

Breast cancer is one kind of malignant tumor that is begins in the breast cells. This malignant tumor is a collection of cancer cells that can develops from tissues. This Breast cancer is the most common cancer in women, this disease is curable if found beginning stages [11]. The breast cancer can be identified by the mammogram. Mammography is a low energy x-ray procedure for the visual image of the internal breast structure. The mammogram is the one screening method that is carried out for finding the breast cancer; these x-ray images are utilized to disclose lumps in the breast. Currently breast cancer is a most important cause of death among women [4] [10]. Mammogram helps to reduce the breast cancer deaths by detecting the breast cancer in early stages. The diagnostic method has been verified to be the leading reliable method and it is the necessary screening method for finding of breast cancer [3] [19].During a mammogram breasts are squeezed between two dense surfaces to extend out the tissue of breast. After that an X-ray takes black-and-white images of breasts that are exposed on a computer screen and tested by a doctor who looks for cancer signs. These medical x-ray images are used to diagnosis the diseases early stages. However, ordinary characteristics of the medical images such as unidentified noise, poor contrast of image, weak boundaries, in homogeneity and irrelevant parts can affect the content of the medical images [14]][15][16]. This difficulty is corrected by image processing methods. There are a number of stages to breast image processing. The first phase is breast image attainment through mammography. The next phases are pre-processing methods, image segmentation, feature extraction, selection of feature and classification. Characteristics calcification, restricted, speculated and other unwell described masses is diagnosed with technique digital mammography.

An artificial neural network (ANNs) is an ever more interests in medical image processing. ANN is one of the most excellent artificial intelligence methods for common data mining works, such regression and classification problems. Many research showed that ANN give good accurateness in diagnosis of breast cancer. Conversely, this technique has a number of limitations that limitations are ANN contains a few parameters to be regulated in the starting of training process such as number of hidden nodes and hidden layer, activation function and learning rates [18][20]. Due to complex architecture and parameters update process in all iteration it takes long time for training process that require luxurious computational cost. It is fascinated to local minima so that the best performance is not to be guaranteed. Many efforts is attempted to obtain the solutions of neural networks limitations. An extraction of breast region is a basic step in pre-processing of mammogram that is significant to locate the skin-air interface, or the breast boundary. The aim of this preprocessing is to divide the breast from the rest of objects that might show in a digital mammography; labels, the black background and tape artifacts. Improvement also contains the pre-processing step that has the image segmentation process [2][3][11][15]. The aim of image enhancement and image segmentation in this process is to improve the interpretability or information perception in images for human viewers, or to give an improved input for other automated image processing methods [11]. The aim of this paper is to propose a method of ANN with fuzzy rules, pre-processing and image segmentation on mammograms that is composed of four stages: the first step is image segmentation and enhancing images, second stage image feature extraction, third is image classification and final stage is noise removal from mammogram image. This step is referred as segmenting breast profile. The purpose of this paper is to cover those approaches introduced and to create a plan for ANN methods utilized for medical image processing. In this paper, we revealed the implementation of artificial neural networks with excessive learning methods in breast cancer diagnosis such

as fuzzy rules, image classification, preprocessing methods and image segmentation. We mainly focus our discussion on three major topics: ANN with fuzzy rules, preprocessing methods and image segmentation.

## II. LITERATURE SURVEY

Aziz Makandar, et.al, author evaluate and discuss various methods and approaches presented in order to improve the images of breast cancer and a competent preprocessing method for mammography. The existing preprocessing methods for mammography images are discovered and the methods used and their advantages are discussed. Other than for pectoral muscle there should be captivating breast part cares as along with muscle some time breast details also are eliminated.

Luqman Mahmood Mina, et.al., presented a pre-processing algorithm on medio-lateral oblique-view (MLO) mammograms that contains two phases: initially, the enhancement of image of which the aspire is to progress the perception of information or interpretability in images or to give a enhanced input for other automated image processing methods. Here, eight methods for the improvement of overall mammograms within the mini-MIAS database were executed. These results were implemented utilizing Peak Signal to Noise Ratio (PSNR). The next phase is to take out the breast region from the image rest. For this reason, a method based on automatic thresholding was utilized.

Zhenghao Shi, et.al., reviewed the artificial neural networks application in medical image preprocessing, in detection of medical image object and appreciation. Major advantages and disadvantages of artificial neural networks were described. This paper is attempted to answer what the main strengths and failing in neural networks for medical image processing would be.

Yasmeen M. George, et.al., a computer-aided diagnosis scheme is developed for FNAC classification of breast. Two textural features and ten shape-based features are utilized for the feature extraction of image. For these feature the values obtained reschedule a good separation between malignant cells and benign. Four various classification models are performed namely learning vector quantization, multilayer awareness, probabilistic neural networks, support vector machine for the categorization stage. These results of classification were obtained utilizing validation of 10-fold cross.

Bekaddour Fatima, er.al., outlines an approach for analyzing breast cancer detection utilizing neuro-fuzzy inference system namely Adaptive Neuro-Fuzzy Inference System. At University of California WBCD (Wisconsin breast cancer diagnosis) database developed, Irvine (UCI) is utilized to calculate approximately this technique. This results show that the best performances are obtained by using WBCD model compared to others cited in literature.

Victor Balanica, et.al., proposed a fuzzy logic method for the forecast of the risk of breast cancer based on a set of sensibly selected fuzzy rules using patient age and mechanically extracted features of tumor. The example links the patient age to the disclosed tumor surface in order to evaluate the risk of breast cancer. The described fuzzy logic rules result in rational agreement with the clinician's evaluation. Although it requires more calibration and validation on bigger number of patients, this process is simply and productively integrated in screening programs to routinely assign risk of breast cancer risk to patients in order to emphasize the cases that require priority awareness and care.

L.S.S.Reddy, et.al., presented an advance for finding in digital mammograms not only the finding and early on stage of tumors is also obvious. At correct recognition of boundary in image segmentation difficulty detected misclassified pixels directs to ambiguity. By NN Classifier an efficient classification is probable. By an N-ary morphological operator it provides efficient Boundary error removing. The overall consequence of proposed operator resembles N-ary morphological corrosion followed by N-ary morphological expansion i.e. correct spreading of Cancer Tumor is detected and eliminate the boundary errors about it.

## III.METHODOLOGY

### A. Artificial Neural Networks

B. ANN is a kind of artificial intelligence that emulates a few functions of the person mind. ANN contains usual propensity for storing experimental knowledge. An ANN has a sequence of layers; every layer contains a set of neurons. By weighted connections to every neuron all neurons of each layer are linked on the previous and succeeding layers. It utilizes approach of nonparametric. Performance and accuracy of image based upon the structure of network and number of inputs.

### C. Mammogram segmentation

D. Image segmentation is dividing the image into related ingredient parts, containing discovering and dividing regions of interests. In image processing, segmentation is a significant function and also the primary fundamental step, which must be effectively taken before succeeding tasks such as extraction of feature and classification step. This method is imperative in applications of breast such as localizing doubtful regions, giving purpose quantitative evaluation and onset monitoring and sequence of breast diseases, as well as anatomical structures analysis. Mammogram segmentation can be done by threshold technique. Thresholding frequently contains choosing a single gray level value from an examination of the grey-level histogram for mammograms, to segment the histogram into background and tissues of breast. Every pixel with value of grey level less than the threshold are noticeable as background and the rest as breast. Thresholding utilizes only grey level value and no space information is considered. Hence, in the breast and the background the main threshold shortcoming is that there is frequently an overlap between grey levels of the objects.

In this process, image by segmenting the mammogram image into two regions the thresholding method is employed to form a binary that is a by a white region foreground represented and by a black region a background represented. Some pixel (x, y) is regarded as an object part if its strength is greater than or equal to the value of threshold that is f(x, y) ≥T. or else the pixel fit in to background. As per the thresholding value selection, two kinds of thresholding techniques are obtainable, thresholding of global and local. While T is stable, the approach is known as global thresholding or else, it is known as local thresholding. Methods of Global thresholding are failing while the clarification of background is uneven. Multiple thresholds are utilized to recompense for uneven illumination in local thresholding. Selection of Threshold is characteristically prepared interactively though; it is probable to obtain automatic threshold selection algorithms.

## Feature Extraction of mammogram image

The texture feature extraction algorithm is used to extract the feature of mammogram image. Figure 3.1 shows the block diagram of texture feature extraction of mammogram, here, by the spatial distribution of gray levels the texture is characterized in an area. In texture extraction, from the mammogram database to allocate an unknown sample mammogram X-ray image to one of set of recognized classes of texture. The unknown sample image is decomposed with Discrete Wavelet Transform (DWT). A DWT decomposes an image into a set of necessary functions is known as wavelet. The wavelet estimation use is in compression of data. From a single prototype wavelet y(t)Wavelet are obtained is known as mother wavelet by distention and shifting. DWT transform a discrete time signal to a representation of discrete wavelet. It translate an input series x0 , x1,……xm, into one low and high-pass wavelet coefficient series. At low frequency components, first-class for signal containing high frequency resolution and poor time resolution for long duration. Features of textural are discrete histograms or empirical distributions and scalar numbers.

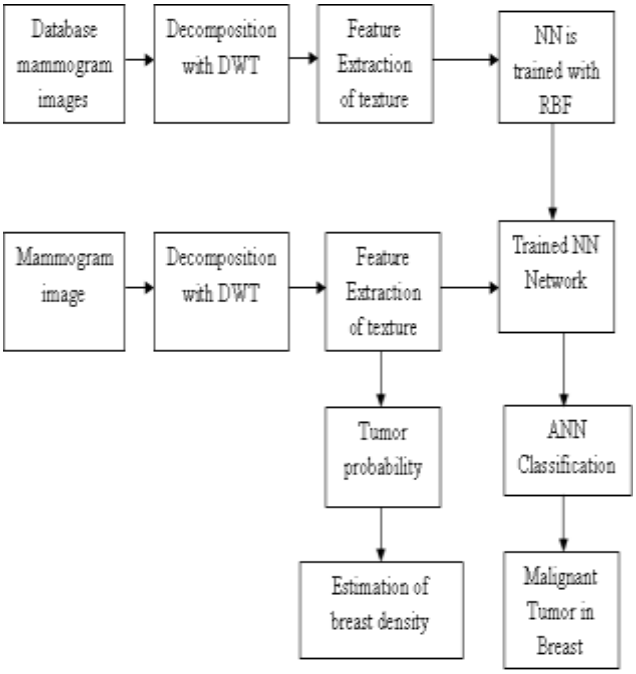



**Figure 3.1: Block diagram of texture feature extraction of mammogram**

We assign the four textural features to mammogram image extraction namely the image contrast, angular second moment, association and variance are measured. Texture and character contains indescribable association to one another. Though on time one asset can neglect the other they are always there in an image. In order to keep the spatial assurance of values of gray-level, here provide to the awareness of texture, a two dimensional dependence, and matrix of texture examination is considered. Since, by both pixel and values of pixel, texture shows its characteristics, there are numerous approaches utilized for classification of texture.

In this process, the co-occurrence matrix is utilized to extract textural features. It has two combined likelihood' dimensional matrix Ld, r (a, b) between pixels pairs, by a distance it is divided, take d in a given direction r. In the image every pixel for discovering textural features for each pixel is considered as a center and followed by particular n x n window. The matrix for that particular window is evaluated and standardized. The co-occurrence matrix namely, Lh, Lv, Lrd and Lld for every pixel is after that obtained. Here, Lh, Lv, Lrd and Lld are correspondingly the $0^o$, $50^o$, 90o, and $136^o$ adjacent neighbors to a exacting declaration cell. Standard deviation and mean are at the present obtained for every matrix and the textural features are estimated. The particular entry in a normalized spatial dependence matrix is estimated for more reference, i.e., L(a,b), $L_i(a)$, $L_j(b)$, $L_{i+j}(k)$ and $L_{i-j}(k)$. After that textural feature, contrast, the angular second moment, correlation and variance are calculated. After extracting the textural features the network is trained with radial basis function (RBF).

A neural network makes on this base and generalizes it to regard each of the other points. From the point the distance is computed being evaluated to all of the other points, and RBF is also known as a kernel function is applied to

the distance to calculate the weight for every point. The RBF is so named because the distance of radius is the argument to the function. Image classification is performed using ANN with fuzzy rules after trained network for Malignant Tumor in breast.

## B. Fuzzy rules

In Fuzzy image classification, a variety of stochastic associations are defined to explain image characteristics. The different types of problematic are combined in which the members of this properties set are fuzzy in environment. It gives the chance to explain various categories of problematic characteristics in the similar form. The theory of fuzzy sets is a motivating and helpful tool, as it gives a good theoretical foundation to symbolize in distinctness of the information and it establishes a combined framework for representing and processing both mathematical and representative information, and also structural information.

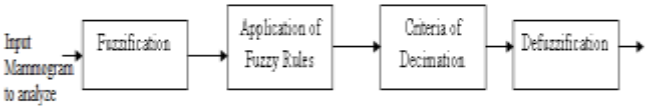



**Figure 3.2: Fuzzy system**

Figure 3.2 shows the fuzzy system, in this method, our new image classification procedure is one of supervised-type, because it needs sample Image of the decomposed structure. Furthermore, the adding of area knowledge about the characteristics of images enhances the accuracy of classification. The produced fuzzy system for this application utilizes a rule-based linguistic explanation of the images belonging to the Region of Interest that serves to direct the scheme for the edge detection-based classification. Forevery input image a symbolic representation is determined at the e system entry. After that, fuzzy rules are applied. By applying a few decimation criteria among all points of interest only those fulfilling the rule sets are reserved for additional analysis. These criteria contain the spatial agreement with rules and the density between boundary points. The scheme gives the position of outline points at the exit.

The manually tracked reference object border is obtained utilizing evaluating the average gray level correspondingly within two moving (outer and inner) windows positioned on the two sides of the outline point. This method gives a good reduction of noise and is made for each direction αj. Therefore, one establishes the obtainable relations between the average gray levels within the two windows and the angle value θ. BRIGHTNESS and POSITION the relations between these two variables are straight obtained through the fuzzification of the fuzzy variables. Afterward, derived a IF...THEN fuzzy rules, that show the N (N=25) relations between the two fuzzy variables. For every case while the value of membership to a class αj is maximum (1)for POSITION that is {1/αj}, a novel fuzzy rule may be definite. For example, some of these fuzzy rules may be:

(1) IF the POSITION is {1/α1} THEN the BRIGHTNESS transition every side of the outline differs from {1/DARK} to {1/GRAY}
(2) IF the POSITION is {1/α25} THEN the BRIGHTNESS transition every side of the outline differs from {0.9/DARK ; 0.1/GRAY} to {1/GRAY} .

The knowledge base utilizes the fuzzy rules encoding, that is their translation into mathematical values. Certainly, for a assured direction *αj* two mathematical values are described: the inner BRIGHTNESS, $B_{in}(\alpha j)$, and the outer one, $B_{out}(\alpha j)$.

The inner and outer BRIGHTNESS is calculated by following equations.

$$B_{in}(\alpha_j) = \frac{\sum_{i=1}^{n} m_{i,} in(\alpha_j) c_i}{\sum_{i=1}^{n} m_{i,} in(\alpha_j)}$$

$$B_{out}(\alpha_j) = \frac{\sum_{i=1}^{n} m_{i,} out(\alpha_j) c_i}{\sum_{i=1}^{n} m_{i,} out(\alpha_j)}$$

where $C_i$ are the center of the classes BRIGHTNESS that is the center values of the gray levels of every class. The values $m_{i,}in(\alpha_j)$ stand for the membership degrees for the BRIGHTNESS i-class, for the route j and the inner outline. A related description stands for $m_{i,}out(\alpha_j)$.

## C. Preprocessing

The image preprocessing techniques are applied to noise removal from mammogram image after fuzzy rules are applied for classification of mammogram image. The image pre-processing methods are required, in order to discover the mammogram orientation, to remove the noise from the mammogram image and to improve the image quality to detect the

tumor in breast. The main pre-processing goal is to progress the quality of image to create it prepared to more processing by reducing or removing the unwanted and excess parts in the background of the mammogram images. Mammograms are medical images that complex to understand. Therefore pre-processing is necessary to recover the image quality. Here noise is removed by using filtering methods. Preprocessing is utilized in orientation of mammogram, artifact removal, label and enhancement of mammogram and segmentation of mammogram. Preprocessing might also occupy in making mask for pixels with highest concentration, to decrease resolutions and to segment the breast to discover the breast cancer.

### Adaptive Median Filter

We use the adaptive median filter to remove noise and unwanted background parts from the mammogram image to provide quality image. A median filter is nonlinear kind of filter and salt and pepper noise and Gaussian noise is removed by this median filter. At the time of removing the noise it supports to maintain the image sharpness. This filter processes on a region of rectangular Sxy. During the filtering operation it modifies the Sxy size based on definite conditions as scheduled below. In the input images every pixel of output has the median value in the 3-by-3 locality approximately the analogous pixel. The edges of the images though are substituted by zeros. The filter output is a single value which replaces the present value of pixel at (x, y),at the time the point on which S is focused. The following notations is utilized

Zmin = minimum pixel value

Zmax = maximum pixel value

Zmed = median pixel value

Zxy= pixel value at coordinates (x, y)

Smax = maximum permissible Sxy size

This Adaptive Median filtering is establish to smooth then on disgusting noise from two-dimensional signals without dimming edges and protects details of image. This creates it mainly appropriate for increasing mammogram images.

## D.Overall Process

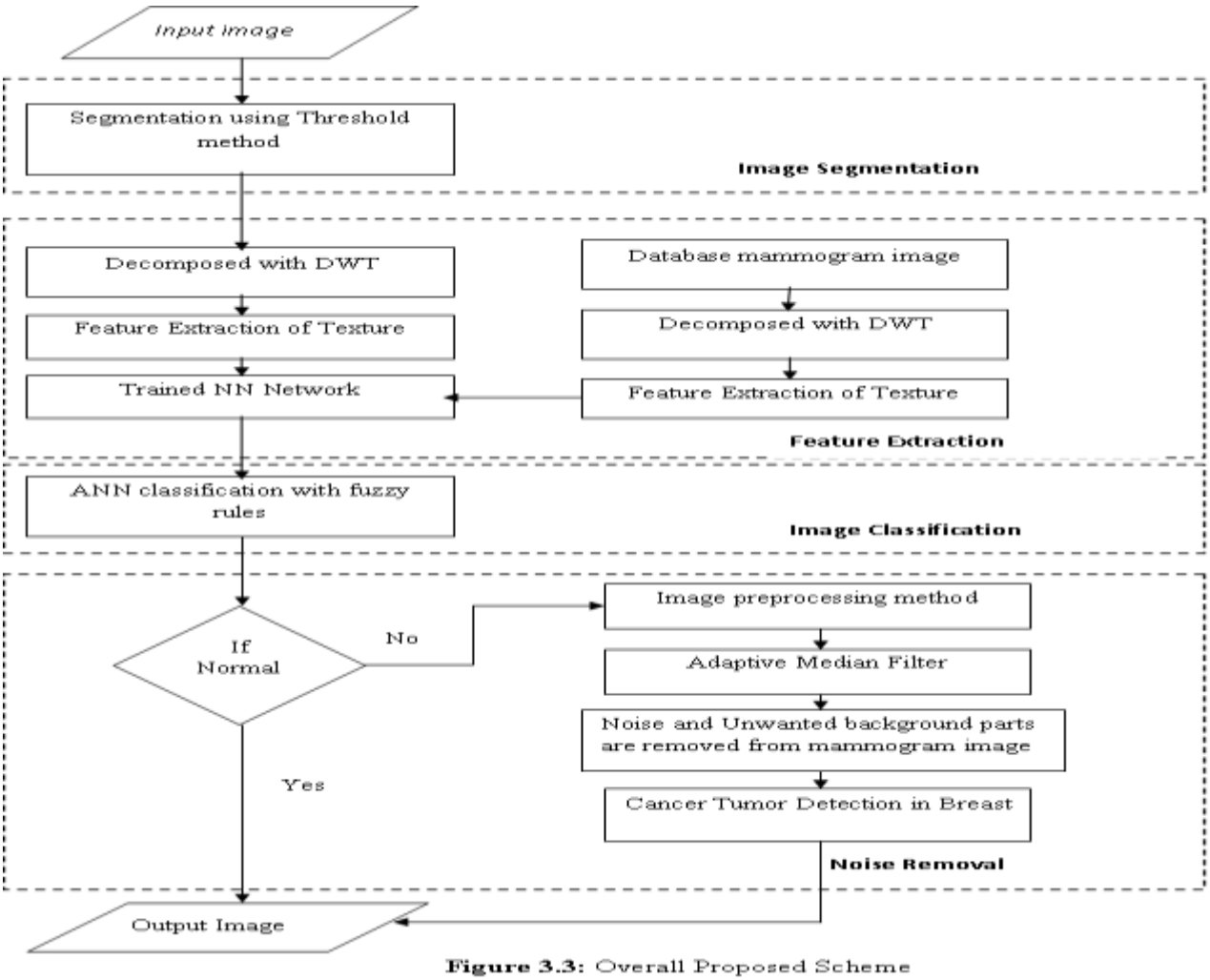
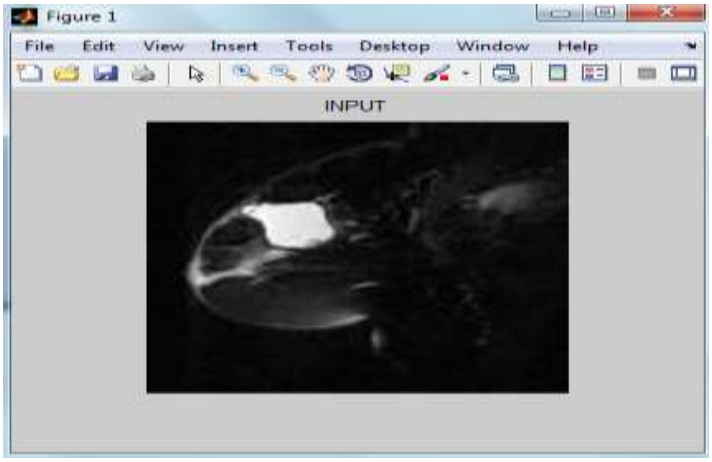



**Figure 3.3:** Overall Proposed Scheme

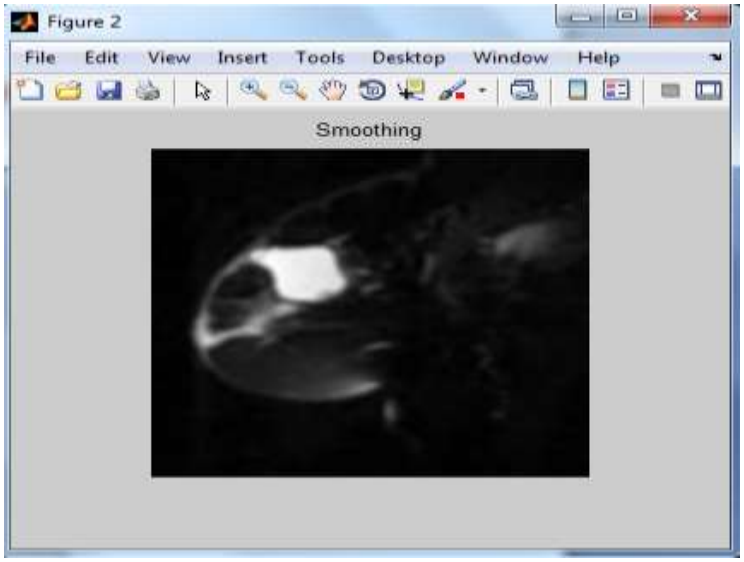
Figure 3.3 shows the overall proposed scheme. Initially, the input mammogram image is segmented using threshold method. The texture feature is extracted after image segmentation, here image is decomposed with DWT and then NN trained network is utilized to feature extraction. After that, the mammogram image can be classified using ANN with fuzzy rules. The preprocessing method is employed after image classification in which Adaptive Median filter is used to remove the noise and unwanted background parts from mammogram image to detect cancer tumor in Breast. Finally we will get output mammogram image to detection of breast cancer.

## IV. RESULTS AND DISCUSSIONS

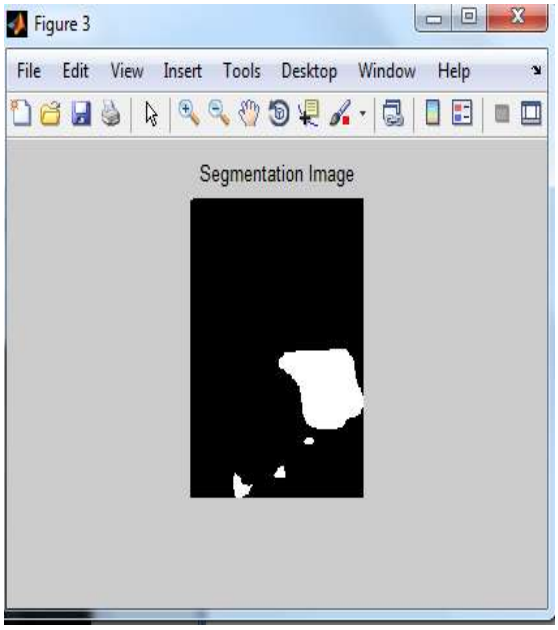
In our result, take one input mammogram image to detect the tumor in breast to analyze the breast cancer




The above figure 1 shows the input mammogram image to breast cancer detection




In figure 2, the smoothing process is done. In smoothing the image, to smooth a data set is to make a similar to function that attempt to keep significant patterns in the image. After smoothing the input image is segmented by using the threshold values that are shown in the figure 3



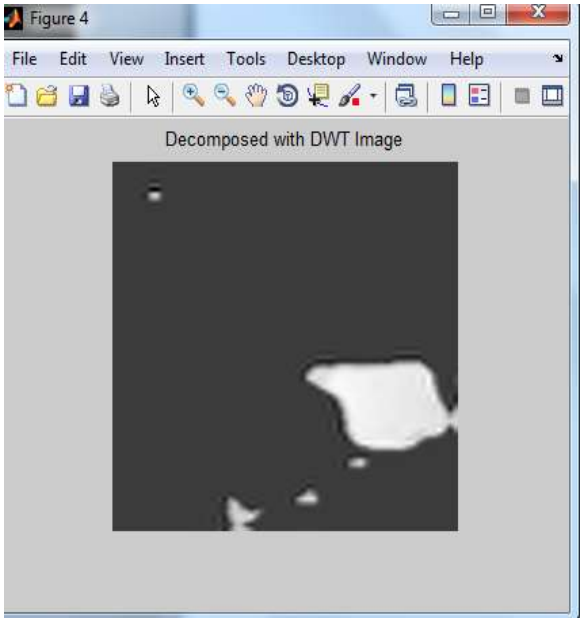
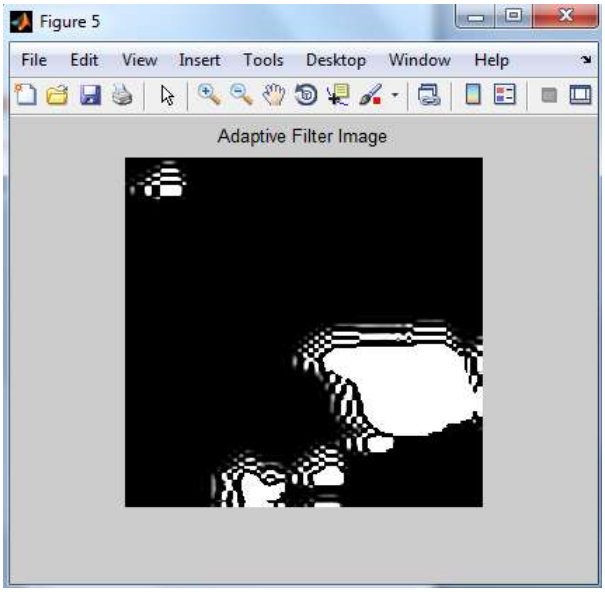
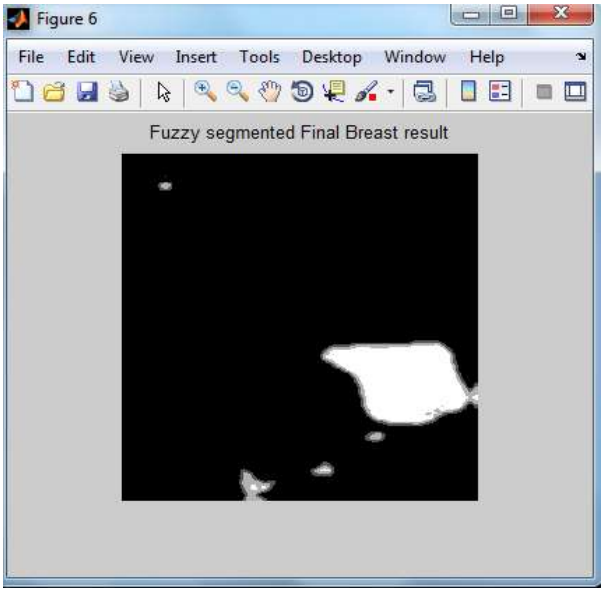




Figure 4 shows the decomposed image, in this figure the image is decomposed with discrete wavelet transform to extract the feature from the mammogram image and image is classified and then by using the adaptive Median filter to remove the noise and unwanted background parts from the image as shown in the figure 5.



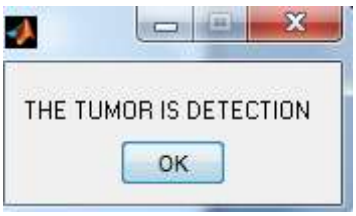




Figure 6 shows the fuzzy segmented final breast result. Finally the tumor is detected in breast in which fuzzy rules are applied with artificial neural networks in mammogram image. In our results, tumor is separated using segmentation, classification and noise removal.

## V. CONCLUSION

At present, the mammography as normal procedure for diagnosis of breast cancer, different methods are utilized for classification problem in the medical diagnosis area. In this paper, one mammogram image taken as input image, then three methods are done to identify the cancer tumor in breast, such methods are image segmentation, feature extraction,

image classification and noise removal. Threshold method is employed to image segmentation. For the feature extraction of image, DWT is used. The fuzzy rules are applied to classify the image efficiently. Noise and Unwanted background parts are removed from mammogram using Adaptive Median filter. Therefore, using this proposed scheme we can effectively find the tumor in breast for early detection of breast cancer tumor using mammogram image to decrease the deaths of breast cancer that are particularly in women.

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