

**REPUBLIC OF TURKEY**  
**FIRAT UNIVERSITY**  
**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**



**IMAGE ENHANCEMENT BASED BREAST  
CANCER DETECTION USING ARTIFICIAL  
NEURAL NETWORK  
MASTER THESIS**

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## ABBREVIATIONS

|             |                                     |
|-------------|-------------------------------------|
| <b>ACO</b>  | : Ant Colony Optimization           |
| <b>ANN</b>  | : Artificial Neural Network         |
| <b>ARNN</b> | : Adaptive Resonance Neural Network |
| <b>BPNN</b> | : Back Propagation Neural Network   |
| <b>CAD</b>  | : Computer Aided Diagnosis          |
| <b>GA</b>   | : Genetic Algorithm                 |
| <b>GUI</b>  | : Graphical User Interface          |
| <b>LR</b>   | : Logistic Regression               |
| <b>LTI</b>  | : Linear Time Invariant             |
| <b>MLP</b>  | : Multi-Layer Preceptor             |
| <b>MRI</b>  | : Magnetic Resonance Imaging        |
| <b>SAXS</b> | : Small Angle X-ray Scattering      |
| <b>SVM</b>  | : Support Vector Machine            |
| <b>WBCD</b> | : Wisconsin Breast Cancer Diagnosis |

## OZET

### **Meme Kanseri Algılamada Yapay Sinir Ağını Kullanarak Görüntü Geliştirme**

Göğüs kanseri kadının ölümünün ana nedenlerinden biridir. Bu hastalığın erken safhalarda saptanması, ölüm sayısının artmasını önlemeye yardımcı olabilir. Göğüs kanserini saptamak için en çok kullanılan algoritmalarından biri, istenilen görüntüyü özel uygulama için uygun hale getirmek için kullanılan mamografi görüntülerinin zenginleştirilmesidir. Ayrıca görüntülerin görsel kalitesi, dijital görüntü geliştirme metodu kullanılarak iyileştirilebilir. Bu yazıda mamografi görüntülerini geliştirmek için sinir ağı tekniği kullanılmıştır. Bu yöntem, sağlıklı kişinin mamogramını tanımaya yönlendiren görüntü yoğunluğundaki beklenmedik değişiklikleri anlamak için tasarlanmış iyileştirme ve netleştirme prosedürünün bazı büyük avantajlarından faydalanmayı hedeflemektedir. Kullanılan algoritma, görüntü işleme alanındaki uygulamalarının neden olduğu bileme ve pürüzsüzleştirme tekniklerinin görüntüsünü de ortadan kaldırır. Bu çalışmada, önerilen yöntem MATLAB simülasyon yazılımı kullanılarak gerçekleştirilmiştir. Sistemler, birkaç meme X-ışını mamogramı kullanılarak eğitilmiş ve test edilmiştir. Simülasyon sonuçlarına bağlı olarak, önerilen yöntem, seçilen mamografi görüntüsünü avantajlı bir şekilde artırabilir ve meme kanseri enfekte mamografilerini tespit etmek ve tanımlamak için ilave radyologlar olan yardım sağlayabilen meme kanserini başarıyla tespit edebilir.

**Anahtar kelimeler:** Görüntü işleme, sinir ağı, Görüntü geliştirme Mamografi, sınıflandırma, segmentasyon.

## ABSTRACT

Cancer of breast is one of the major reasons for women death. Detection of this disease in early stages can help to avoid the raising number of deaths. One of the most used algorithm for detecting cancer of breast is by enhancement of mammogram images which is used to make desired image suitable for specific application. Also the visual quality of images can be improved using digital image enhancement method. In this paper neural network technique has been used to enhance the mammogram images. This method aims to earn some great benefits of improve and sharpening procedure that is designed to understand unexpected changes in the image intensity, which leads to recognize healthy person's mammogram. The used algorithm can also remove the noise of both sharpening and smoothing techniques caused by their application in image processing field. In this work, the proposed method has been implemented using MATLAB simulation software. The systems have been trained and tested using several breast X-ray mammograms. Depending on the simulation results, the proposed method can advantageously enhance the selected mammogram image and successfully detect the breast cancer which can provide help that is additional radiologists to detect and identify infected mammograms of breast cancer.

**Keywords:** Image processing, neural network, Image enhancement Mammogram, classification, Segmentation.

## 1. INTRODUCTION

Cancer was a substantial health issues that will be general public recently. In accordance with IARC (International Agency for Research on Cancer tumors) from the exactly WHO (World Health Organization), 8.2 million fatalities happened to be brought on by cancers in 2012 and 27 millions of brand new instances of this disorder are anticipated before 2030. In particular, cancer of the breast is among common style of disease among female. Mortality of breast cancer is extremely higher when comparing to other kinds of disease. Discovery and prognosis of breast cancer is possible by imaging processes such as symptomatic mammograms x-rays, magnetized resonance imaging, ultrasound (sonography), and thermography. Imaging for the cancer assessment that has been examined for more than 10 many years. Nonetheless, biopsy will be the method in which is just diagnose with certainty if disease is really current. The most prevalent tend to be okay needle aspiration, key needle biopsy, vacuum-assisted and surgical (open) biopsy (SOB) among biopsy tips. The task consists in obtaining samples of tissue or muscle, which are fixed across a glass microscope fall for consequent assessment and staining this might be certainly tiny. Histopathological evaluation is an incredibly, frustrating job this is certainly specialized determined by the ability associated with influenced and pathologists by factors such as for example exhaustion and loss of focus. There can be a requirement that is pressing computer assisted diagnosis (CAD) to alleviate the workload on pathologists by filtering markets that are demonstrably harmless, so your gurus can focus on the more difficult-to-diagnose matters. An amount that is considerable of provides hence has been specialized in the world of cancer of breast histopathology image analysis, and also in specific with the automatic category of harmless or malignant files, for computer aided medical diagnosis. Pathology labs have started to go towards a workflow that will be completely digital by utilizing glide that is electronic the primary section of this technique. It was authorized because associated with introduction of scanners for whole scan imaging (WSI) that enable cost creation that is effective of representations of cup glide. In addition to value which are most conditions and terms of storage and scanning capacities with the picture data, one of many features of digital

slides is that they let the usage of graphics evaluation methods that make an effort to give off properties that are quantitative assist pathologists inside their efforts. An automatic mitosis detection strategy with great show could relieve subjectivity both together with tediousness of manual mitosis counting, As an example, by independently creating an activity that is mitotic or leading the pathologist in the right part within the structure with activity that is greatest that is mitotic. Auto element collection was attained utilizing a novel feature scheme this is certainly weighting. Function weights derive from the necessity of a characteristic and then we reject services with lower loads. A generation that is new of (brand-new populace of Woods) is established which functions on a reduced ability put. Each forest associated with the trained woodland votes using their corresponding loads to execute the classification during the examination step.

Improved image quality to computing in the medical field is the use of computers to clarify the image [1]. The types of image enhancement surrounding noise reduction, an increase in the point, and contrast enhancement. Improved quality can be used to restore the image of poor or improving certain features in the image [2].

Mammography is the examination of the breast glands DNG using X-rays are used to detect early breast cancer. Digital mammography is aimed at applications in digital systems engineering on a digital mammogram. Digital systems have the capacity to detect breast cancer. 12 bit resolution detection is usually required to produce a digital mammogram with high resolution without loss of information from the original mammogram.

Analysis of mammography is a challenge due to low illumination and high noise in an image that can reach 10-15% of the maximum intensity of the pixels. A mammogram is the most difficult

### **1.1. Techniques For Measurement Of Breast Cancer**

Analysis of Breast images must be performed using X-rays, , ultrasound or medicine of nuclear, magnetic resonance

### **1.1.1. X-Ray Mammography**

X-Ray Mammography is often used in medical practice for screening purposes and diagnostic [26].

### **1.1.2. Magnetic Resonance Imaging of the Breast**

The most attractive alternative to Mammography for detecting some cancers that may be loosed by specialists to ascertain how exactly to treat cancer of the breast patients by identifying the stage associated with the illness [26].

## **1.2. Diagnosis of Breast Cancer**

Breast cancer Detection utilizes the screening method. In this method, examination by doctor or nurses to find tumors is used. In addition, screening methods include mammography and other imaging techniques. Screening can detect cancer in its early stages.

Due to its simple, inexpensive and speed, mammography can be classified as the good method for early detection of cancer of breast. Cancer of breast detection in mammography starts with the detection of abnormalities, such as populace and calcination. In addition, many hidden signs may also be detected. It has been reported that the detection accuracy of mammography of breast cancer is 76% 94% which is higher by more than 50% as compared with other clinical examination [4].

## **1.3. Problem Statement**

Breast cancer will be the second influence this is certainly top of affecting females in the population, surpassed lung cancer. Earlier in the days discovery and prognosis of cancer of the breast advances the opportunities for profitable cures and data recovery that is total of client. There are various ways chest malignant tumors try identified, like, Breast Self-Examination (BSE), chemical breast evaluation (CBE), mammography or imaging, and surgical treatment. Mammography is considered the most method this is certainly effective

breast cancer earlier identification and assessing of public or irregularities; it would possibly discover 85-90% of most breast cancers. To identify cancer of the breast we have to get a hold of problems like people and calcifications that indicate breast cancer Mammogram graphics enhancement is the method of influencing mammogram pictures to improve their unique comparison and present facilitate radiologists by reducing the noise to from inside the discovery of irregularities. The strategy accustomed to manipulate mammogram imagery are separated into four major groups; the predictable enhancement methods, the improvement strategy that is region-based.

#### **1.4. Objective of this Work**

This thesis suggests a technique for detecting breast cancer in mammography images. The technique includes of two main parts. In first part, image processing techniques are used to prepare images for feature and pattern extraction processes. The extracted features are utilized as an input to a neural network machine learning algorithm. This algorithm is a supervised machine learning algorithm that is trained with input images.

The primary objectives of this work can be summarized as bellow:

- 1- Implementation of new Computer aided diagnosis system for breast cancer diagnosis.
- 2- Utilizing image processing techniques and supervised machine learning in the new proposed model.
- 3- Increasing the accuracy of breast cancer detection.
- 4- Reducing the false positive probability in the breast cancer diagnosis process.

#### **1.5. Organization Of This Thesis**

It is divided into five chapters. This chapter provides an introduction to the conception of breast cancer, breast cancer diagnosis, techniques used for breast Cancer measurement. It is also introduces the objectives of the research and problem statement.

The rest of this thesis is organized as follows:

**Chapter 2** presents a literature review. Also, it summarizes the related work and most recent.

**Chapter 3** provides a detailed description of the (ANN) Artificial Neural Network.

**Chapter 4** presents experiments that are performed to evaluate the neural network and logistic regression algorithm for the detection of breast cancer over a number of images.

**Chapter 5** contains the research conclusions and a number of recommendations for future work.

## **2. LITERATURE REVIEW AND PREVIOUS WORK**

### **2.1. Literature Review**

A lot of work has been made by researchers to efficiently use fuzzy logic, neural networks to improve the diagnosis efficiency in cancer of breast detection.

The mammography is an x-ray image of breast. Hospitals have been started to replace x-ray films with digital mammography images that can be analyzed and studied in computer systems. Many techniques and methods have been proposed to enhance the efficiency and quality of breast cancer detection [25] have proposed a method that employs thresholding of the area of interest and filters for a clear identification of micro-calcification. There is a method for the detections of micro-calcification from a segmentation of mammogram image and analysis was tested over several images taken from mini-MAIS (Mammogram Image Analysis Society, UK) database. That algorithm was implemented by using Matlab. Also they explained a decision system of computer aided for the detecting micro-calcification in images of mammogram. Also The system uses an ordinary PC with a software package developed using Matlab.

### **2.2. Previous Work**

Use of segmentation with classification and fuzzy models by the crisp K-nearest neighbor (K-nn) algorithm for assisting cancer of breast detection in digital mammograms. The main approach of their research consists in utilizing images from the Digital Database.

In machine learning neural network used a database and signal processing [14]. Statistical neural networks(ANN) are used to increase the accuracy and objectivity of diagnosis of the breast cancer.

Proposed detecting of micro-calcifications based on a meta-historical method, like ant Colony Optimization (ACO) and Genetic Algorithms [27]. However, this method was a complex to implement.

The goal of another project [12] was to improve cancer of breast checking, firstly by collecting an angle x-ray scattering images of applying pattern recognition techniques, and second breast biopsy tissue by as a semi-automatic screen based features were generated from the Small Angle X-ray Scattering image data. This features were supplied to the classifier, in order for images to be sorted in distinct groups, such as normal and mammogram images.

Berry was used modeling techniques to assess the relative and treatment of adjuvant to the reduction in breast cancer mortality and absolute contribution of screening mammography.

Was proposed a method for detecting [1]. Micro-calcifications of clusters mammography images. The authors utilized Daubechies Wavelets (db2, db4, db8 and db16). They claimed an precision of 80%;however they did not justify either the selection of features or how neural networks were used in the decision making.

Another study [3] showed an result of applying image processing threshold, edge-based and watershed segmentation on mammogram breast cancer image and a presents a case in between themIn terms of times and simplicity.

Utilized Wavelet transforms for feature extraction [11].

However, an interactive step is required from the radiologist.

Used and implemented [18] the genetic algorithm and artificial immune system and the hybrid algorithm and tested in the Wisconsin breast cancer diagnosis (WBCD) problem in order to generate a fuzzy rule system for breast cancer diagnosis. The hybrid algorithm generated a fuzzy system which reached the maximum classification ratio earlier than the two other ones [8] briefly portrays typical steps in computer-assisted detection and computer diagnosis algorithms. They proposed methods to detect and diagnose each lesion. They outline some of the developed CAD algorithms and showed which moreover developments are required to improving the detection and diagnosis of breast abnormalities by using computer.

Proposed a method to identify abnormal growths of cells in breast tissues and suggest over more pathological test, if it's necessary [10]. They contrast that normal breast tissues with malignant invasive breast tissues by a series steps of image processing. Indeed, A features of cancerous breast tissue are extracted and analyzed with normal breast tissues.

They suggest that cancer of breast recognition be carried out during image processing, and preventions be achieved by controlling gene mutation to some greatest extent.

Present a research tumors detection algorithm from mammograms [24]. It was suggested the system focuses depending on the solution of two problem:

Firstly is how to detect tumors as suspicious region with a weak contrast to Their background and anther is to how to extract features that classify tumour.

The tumour detection method follows the scheme of mammogram enhancement, the segmentation of the tumor area, the extraction of features from the segmented tumor area, and the use of SVM (Support Vector Machine ) classifier.

Multi-wavelet was compared with wavelet technique in the de-noising process. However, decision making was a user (not a machine) decision [15].

Proposed a techniques to discover the abnormal growth of populace in the breast and using very simple algorithms [16]. A Digital mammogram diagnosis is the one of the best technologies currently was used for diagnosis detection of cancer of breast. In their papers, method was developed to make a supporting tools, this can make the abnormal identification populace in digital mammography images easier and less time consuming. The technique of identification was divided into two specific parts. a formations of homogeneous color quantization and blocks after preprocessing. The shapes and distribution of populace, size of populace, type of populace, orientation of populace, symmetry between into two pairs are very clearly sited after the proposition of method and executed on raw mammogram, to ease the detection of abnormalities at an earlier stage.

Using MLO (media-lateral oblique) view mammograms in that physiological features show clearly [17]. Their objective was to differentiate some area of breast by physiological

segmentation of the breast. And a proposes of method are tested on some different types and categories of mammograms within mammogram image analysis society (MIAS) database.

Reviewed existent techniques of preprocessing in images of mammographic [20]. And The objectives of preprocessing are to enhance the quality of images and making it to further processing by removing the irrelevant noises and unrequired parts in the mammogram background.

There are different of methods for preprocessing the image of mammogram.

The breast cancer lesions and their features, and shortly presents some of the developed computer- assistant detection and diagnosis methods developed for very lesions [5]. Here, he uses mammogram database selection as a required tools in the early detection of cancer of the breast.

Novel technique to improve the malignant classification and using mammograms are multi - classification of the malignant mammograms into six abnormality classes discrete wavelet transformation features are extracted from the preprocessed image and passed across different classifier.

Used morphological operations ordered to enhance the contrast of the mammogram image [21]. Morphology has various operations, when they are applied to mammogram they produce a high contrast image. Image enhancement is done as a preprocessing step. The preprocessing step is necessary for every mammogram image. This pre-processed image serves as an input for further segmentation steps, which leads to an easy identification of cancerous portion.

Used image processing techniques to detect breast cancer by utilizing gray color histogram [9]. The authors processed mammogram images depending on gray colors' histogram value. They divided the gray image into four different classes depending on the white color. The author did not use a threshold value. Moreover, the white color in an image may present an illumination noise in the background.

Singh was presented a research on images of mammography by using (K-means) algorithm and fuzzy (C-means clustering) to detect cancer tumors mass and calcification that is micro [26]. the propose of technique has good result, in few time (in second) and as friendly user, it is based on GUI.

So the real time implementation of the propose method may be done using data conquest software interface and hardware with the systems of mammography.

Artificial neural networks using (CGPANN) Cartesian Genetic Programming to detect cancer of breast [2]. Features from breast mass are extracted using fine needle aspiration and applied to the (CGPANN) for diagnosis cancer of breast and used a method that is contain of many steps:

Segmentation, Preprocessing, Classification, Feature extraction. Noise removal is performed in the preprocessing step. Alarm area process of generation with area growing Method is used to segment the suspicious area. Spatial (gray-level) dependence method is used for feature extraction process and Extracted features are classified using support VM (machine vector).

Their research algorithms of genetic and (ANN) artificial neural networks to improve the diagnosis of breast cancer, and they present an attempt to identify cancer by processing the qualitative information and the quantitative obtained from medical infrared imaging. To analyzing this information. The best parameters of diagnosis among artificial neural network (ANN) and the available parameters are selected and its precision in cancer diagnosis by utilizing genetic algorithm.

Another one presents an overview in classification of the cancer of breast [19]. Using (ARNN) adaptive resonance neural network and supply forward artificial neural network(ANN) and network performance is evaluated using Wisconsin of cancer of breast data set of various training algorithms.

The target of their work is to suggest an approach for cancer of breast distinguishing between different classes in cancer of breast [22].

Used processing techniques of image and algorithms of techniques for detection of breast tumor and for interpreting. Its stage in some cases so that proper treatment must be given to the cancer patient for enhancing his quality of life [28]. The technique of Digital mammography is widely used for early stage of diagnosis of breast cancer but due to its negative effects on human body other techniques of safe like MRI, infrared imaging, , Biopsy are also proposed.

Used various algorithms of machine learning to, Unsupervised Learning, Supervised Learning, Semi-supervised Learning, Transduction, and Learning and methods to enhance the precision of predicting of cancer of breast [13].

It evidenced from previous studies that more research is necessary to develop the precision of early detection for cancer of breast, using a realistic dataset of mammogram.

### **3. MACHINE LEARNING AND IMAGE PROCESSING TECHNIQUES**

In this chapter, we discuss techniques of Image processing and machine learning artificial neural network used in our work.

#### **3.1. Image Processing**

Image running graphics controls to try a solution to transform an image into electronic kind and perform some processes on it, in order to get an image that will be enhanced to extract some useful details from it. It is really a type of indication in which insight is imaged, like movie frame or production and image is likely to be image or characteristics connected with that image. Often, image processing systems contain images which are managing two dimensional signals while using currently set sign operating methods to them. Picture processing paperwork core study location within computers and engineering research professions too. Image processing running fundamentally consists of the subsequent three strategies include:

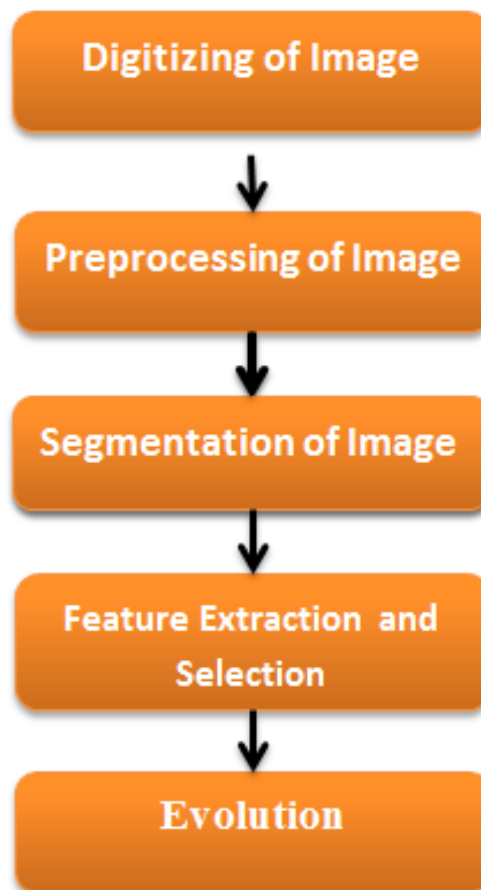
- a) Importing the image with optical scanner or by photography.
- b) Evaluating and influencing the picture including information compression and image enlargement and patterns which happen to be recognizing commonly to man sight like satellite photographs.
- c) Production will be the period that is final which outcome is generally altered picture or report that will be according to picture evaluation.

#### **3.2. Role Of Image Processing In CAD Systems**

Computer aided diagnosis system are procedures in medicine will help doctors to explain the health condition of the patient. Techniques of Imaging by x-ray and nuclear magnetic resonance and ultrasound diagnostic sound produce a great deal of information,

which is imperative for radiology specialist analyzed and thoroughly evaluated in a short time. CAD helps scan digital images, for example, gives a drawing of a computer tomography better picture of certain parts of the body help to diagnosis, as the likelihood of disease or tumor.

CAD is a modern technology relative multidisciplinary combines components of artificial intelligence and processing of digital image with processing of radiological image as in a figure3.1. A typical application is to detect the presence of tumors. For example, some hospitals use diagnosis of breast cancer in support of some preventive medical examinations in mammography (CAD).



**Figure 3.1.** CAD system operation, detailing the importance of the processing of image through the first stages.

### 3.2.1. Image Enhancement

There are many algorithms to improve the image depending on the purpose intended. It is important purposes purify the image noise (noise), which produces a number of reasons Khans camera or during storage and image transfer as show in figure 3.2. As well as the improvement of the image to reduce or eliminate motion blur (blur) of the image. Of the important things before processing the image correction and re-distribution of the colors and the lighting is done in several ways as needed as a distribution of shades evenly or increase or decrease the contrast and brightness.

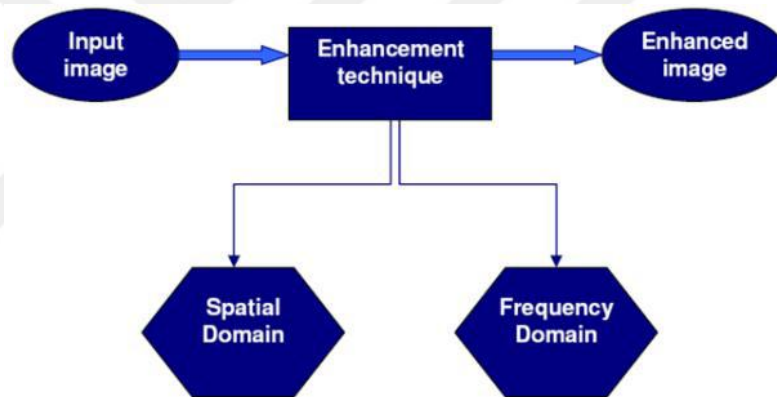
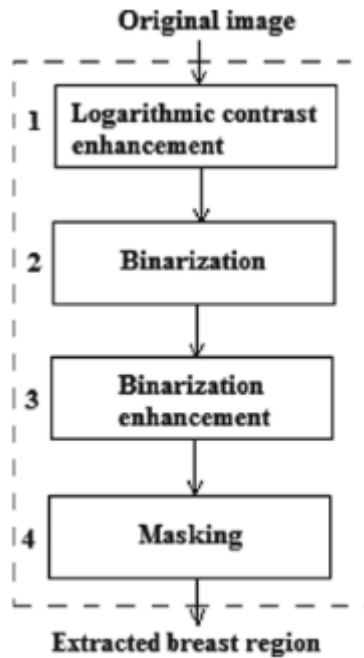


Figure 3.2. Image Enhancement Technique

### 3.2.2. Image Segmentation

It is a division of automated image of important areas in image processing. What is meant by dividing the image: the separation of distinct elements in the picture for other items as in figure 3.3. This can be done in several ways as distinctive edges or the discovery of heterogeneous parts colors or inscription, or as advance information about the item you want. After the separation of these distinctive elements can perform many operations as recognition or measurement of its size.



**Figure 3.3.** Segmentation for enhancement of microcalcifications in digital mammogram

### 3.2.3. Quantification of Image

Some full cases, quantification of image are applied to the role of image obtained through segmentation. The goal of quantification of image is basically to characterize that is classify of further potentially the elements of interest in the role of image [6]. For instance, numerous computer aided diagnosis systems that investigate possible cases of cancer of the breast will trying to classify observed calcifications considering features and masses such as shape, size and sort of tissue as mirrored in the colors obtained within the mammogram or MRI. One important aspect of image quantification is that its results be determined by the quality of the processing of image performed throughout the previous actions, but additionally on the fit between the option of features, aim and method of quantification that is final (Bankmen, ).

### 3.2.4. Data Acquisition

In this thesis and the image number 60 images are used as mammography used, 50 of which contained the intact blocks 110 and Contained blocks "malicious, from three countries: the United States, Lebanon and Syria. The number of each of these Alsourotabiatha and source. Contained each image screenings on at least one block, and accompanied each of these blocks with the report of a surgical biopsy which shows 100% and reliably the presence of slag or whether or not.

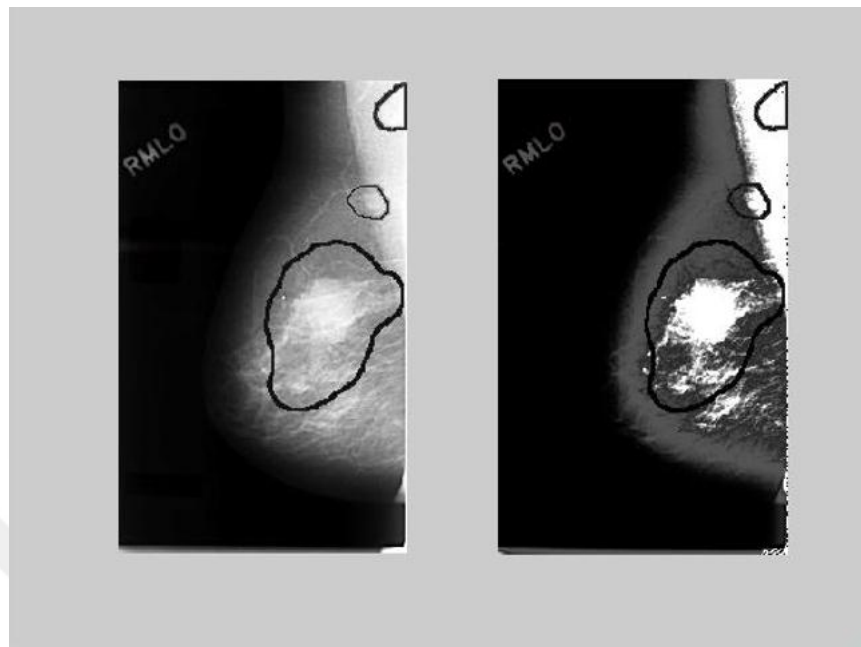
### 3.2.5. Preprocessing (Improved Image Quality)

Possibility Distribution Algorithm Possibility distribution algorithms for image enhancement using fuzzy logic approach using five parameters, namely  $\alpha$ ,  $\beta_1$ ,  $\gamma$ ,  $\beta_2$  and max.

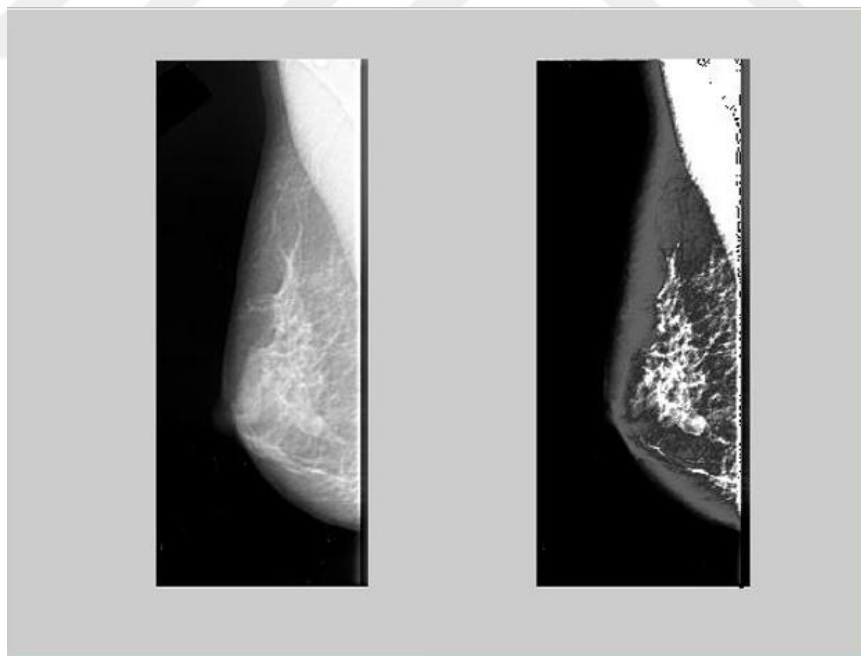
Necessary parameters,  $\alpha$  represents the minimum,  $\gamma$  represents the average value of the distribution and max represents the maximum value of the distribution. Fuzzy transformation function to get an overall value is defined as follows:

$\alpha = \min$  ,  $\beta_1 = (\alpha + \gamma)/2$   $\gamma = \text{mean}$  The purpose of the use of algorithms possibility distribution in image enhancement is to lower the gray level of pixels that have a value of gray in between  $\beta_1$  and  $\beta_2$ . How that is done is to give new pixel intensity values between  $\beta_1$  and  $\gamma$ ,  $\gamma$  and  $\beta_2$  with director's value opposite to the mean value of  $\gamma$ .

Fuzzy rules below are used to perform image enhancement contrast based on Figure 3.5. Rule-1: If  $\alpha \leq u_i \leq \beta_1$  then  $P = 2((u_i - \alpha)/(\gamma - \alpha))^2$  2. Rule-2: If  $\beta_1 \leq u_i \leq \gamma$  then  $P = 1 - 2((u_i - \gamma)/(\gamma - \alpha))^2$  3. Rule-3: If  $\gamma \leq u_i \leq \beta_2$  then  $P = 1 - 2((u_i - \gamma)/(\max - \gamma))^2$  4 4. Rule-4: If  $\beta_2 \leq u_i \leq \max$  then  $P = 2((u_i - \gamma)/(\max - \gamma))^2$  Where  $u_i = f(x, y)$  is the i-th pixel intensities. A regulation which lowers the level of gray pixels that have a value of gray in between  $\beta_1$  and  $\beta_2$  represented by rules 2 and 3. Steps possibility distribution algorithm.



**Figure 3.4.** Results of experiments using mammography normal data



**Figure 3.5.** Results of experiments using of cancer mammography data

### **3.2.6. Compression Of Image, Communication And Storage.**

The image compression, communication of digital image and storage is increasingly very important given the vast amounts of data medical that is currently has been stored and further acquired through such as images. In addition, compression and efficient that is reliable interaction are usually definitive for the functioning of complex, distributed systems that involve several computers in different access information and locations from databases that are effectively stored in various locations across a network or even multi networks. Specific challenges consist of the need for efficient compression that keeps the info that is important in medical images, and efficient storage solutions that make it simple for users discover, share and retrieve subsequently the images they need [6].

### **3.3. Image Processing Techniques Used In This Thesis**

We used many image processing techniques starting with filtering to reduce noises, and neural network algorithm used.

### **3.4. Machine Learning Algorithm**

It is a system based on a deep knowledge of, and works on the "machine learning algorithm" system, which enable a computer learning and translation of words and images and complex patterns that appear, by configuring the multilayer neural networks, industrial, and after a certain algorithm operations and after it was computer training distinguish between cancer cells and healthy cells, through his training to hundreds of training slides.

After that is extracted millions of training samples and the use of deep learning, to build models for the classification of those samples, and every time the smart system make mistakes, be trained more difficult sample, until the system was able to accurately diagnose cancer increase of 92%.

### 3.5. Artificial Neural Networks (ANN)

In several years of artificial neural models (ANN) network has developed to predict breast cancer risk. According to all performance studies discrimination, but not one and the values of the calibration, which is equivalent important measure to predict the precise risks. In this study, and to assess whether the book neural network synthetic (ANN) trained to collect in the future a large database of consecutive radiography mammography results can distinguish between benign and malignant disease and accurately predict breast cancer risk for individual patients.

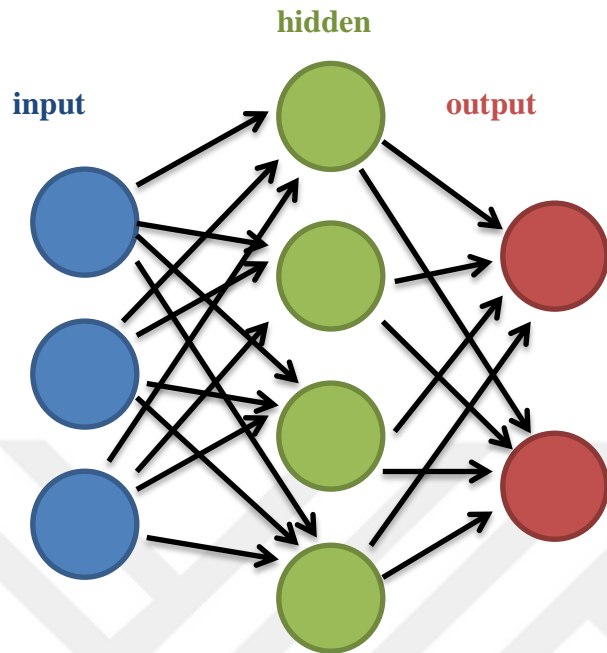
Artificial Neural Networks (ANN) are used in three basics methods:

- As biological nervous system models and intelligence.
- As real time adaptive signal processing controllers implemented in hardware for applications such as robots.
- As methods of data analytic.

The basic principle of neural network computing is the decomposition of the input-output relationship into a series of linearly separable steps using hidden layer.

There are three featured steps in developing an ANN based solution:

- Scaling or Data transformation.
- Definition of Network architecture as in figure 3.6, when the number of hidden layers, the number of nodes in each layer and connectivity between the nodes and set, learning algorithm construction in order to train the network.



**Figure 3.6.** Typical network architecture

That contain of an input layer, a series of hidden layer, an output layer and connections between them. Nodes in the input layer represent possible influential factors that affect the network output and have no computational activities, while the layer of output contains one or more nodes that produce the output of network.

Hidden layer may consist a large number of hidden processing nodes. A feed –forward back–propagation network propagates the information from the input layer to the output layers, compares the network output with known target, and propagates the error term from the layer of output back to the layer of input, by using a learning mechanism to adjust the biases and weights [23].

### **3.6. Thresholding Algorithm**

The purpose of Otsu thresholding algorithm is to segment the image in a way can be divided into two classes, namely the background (the value is set to 0) and the object (the value is set to 1) use a certain level as a barrier.

The steps undertaken to perform thresholding Otsu is:

1. From the images that have improved its image, taken the number of pixels at level  $i$ , which is represented by  $n_i$ , the total of the number of pixels defined by  $N = n_1 + n_2 + \dots + N_n$ . Then the  $p$  values obtained from the number of pixels divided by the total of the number of pixels.

$$p = \text{counts} / \text{sum}(\text{counts});$$

2. After that the distribution of pixels into two classes,  $C_0$  as a background, and  $C_1$  as objects.  $C_0 \rightarrow \omega = \text{cumsum}(p)$ ;  $C_1 \rightarrow 1 - \omega$ ;

3. After that, the division of the pixels into two classes,  $C_0$  as a background, and  $C_1$  as objects.  $\mu = \text{cumsum}(p .* (1:\text{num\_bins}))$ ;

4. Then to get the mean is represented by the following formula:  $\mu_t = \mu(\text{end})$ ;

5. To get the class variance is defined by the following formula:

$$[\text{sigma\_b\_squared}] = (\mu_t * \omega - \mu).^2 ./ (\omega .* (1 - \omega)) ;$$

6. Once it is done searching the maximum value of all the variance in sight, and the threshold value is determined using the average of the discovery of the variance. If not found, the threshold value means 0.0.

### 3.7. Classification

We used several distinct recipes for the classification of breast lumps. First, we will mention the "characteristics used by radiologists to distinguish between healthy and malignant breast lumps, and then we will talk briefly about the characteristics that have been selected for this research and, finally, "we will discuss How do we use the same reverse propagation neural network sound (Back propagation neural network) to draw a distinction between breast lumps and malignant using these characteristics.

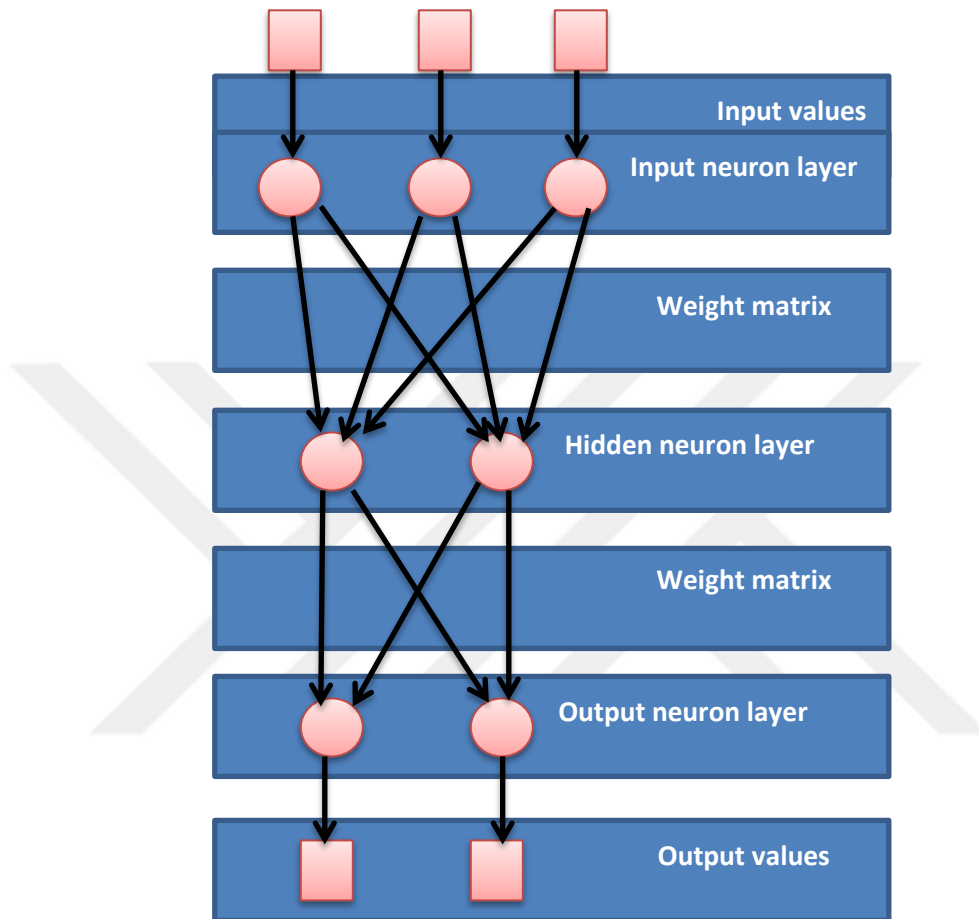
### 3.8. Algorithm Neural Network(ANN)

ANN is a model developed to imitative the function of studying the brain of human. In Neural Network, neurons grouped into layers, called neurons layer. Usually each neuron of a layer is connected to all the neurons in the back or front layer (except for input and output). Information posted on a Neural Network, propagated layer - by - layer ranging from input to output without or through one or more hidden layers. Depending on the algorithm used, information can also be propagated toward the rear (back propagation). The following figure shows the Neural Network with three layers of neurons.

One type of neural network is a Multilayer Perceptron (MLP). MLP has an input layer, some hidden layer and output layer. Point  $i$  in Figure 7 is a neuron in a network, and  $g$  is a function.

Input  $x_k$ ,  $k = 1, K$  to neuron multiplied by the weight and summed with a constant bias  $\Theta_i$ . The result is input to activate the function  $g$ . This activation function taken for the purpose mathematical hyperbolic tanh (tangent) or sigmoid function is commonly used. hyperbolic tangent As defined:

So that the output point to be like this: By linking several points in series and parallel, the MLP network will be formed, as in Figure 3.7.



**Figure 3.7.** is a neuron in a network, and  $g$  is a function

One type of neural network is a Multilayer Perceptron (MLP). MLP has an input layers, some hidden layers and output layers. Point  $i$  in Figure 3.7 is a neuron in a network, and  $g$  is a function

### 3.9. Rating Radiologists Blocks

It depends radiologists in diagnosing breast lumps on their eyes and the light. Radiologists used mainly distinctive recipes drawn from the shape of the block, and sometimes "use a distinctive structural characteristics. Characteristics used by radiologists to classify breast lumps of mammography images.

The four qualities are the qualities mentioned by radiologists when we asked about the qualities used to classify breast lumps of mammography images.

### **3.10. Characteristics Used To Classify The Blocks**

In this research, we chose the ten distinctive qualities of structural and morphological neuronal network to be entered. BNN of reverse spread calculated the formal qualities of the edges of the blocks, while the calculated recipes cladding.

Gray Scale elements of images within the blocks. Details used in this research:

Mass Area & space and the area around the block, fusion Perimeter Compactness, , Radial Length average length of the radius Mean & Standard Deviation of the standard deviation to the length of half a standard diameter Normalized Radial Length Average, , Fourier Transcriptions Fourier signs, Minimum & Maximum Axis axes Minimum and maximum mass average roughness insisted, Average Boundary Roughness lesions Laws windows Textural structural Laws Masks, ten Speculation Measurement and measurement Ahariqhat these characteristics are the knowledge base that will be used in the subsequent stage as income expert system that will process classified blocks to the sound or malignant.

### **3.11. Usage Of Matlab Implementation**

Matlab is the most widely used software packages in digital image processing.

It has powerful and easy to use features for dealing with complex structures, arrays and images, for example an image reading process is one command "imread". These functionalities are already available in Matlab.

Very important steps in image processing are Filtering, then Artificial Neural Network applications and Logistic Regression for prediction. All these functionality becomes main reason to use Mat lab implementation.

We use a Matlab software to implement the algorithms, because Matlab is a high – performance language for education and research as it computation, visualization and

programming in an easy to use environment where problems and solutions are expressed in familiar mathematical notation and also it has toolboxes for signal processing, neural networks, processing of image, and databases [7].

processing of Matlab image toolbox is a set of functions that extend the capability of the Matlab numeric computing environment. The toolbox supports a wide range of image processing operations such as image analysis and enhancement.region of interest operation, a filter design and linear filtering.



## **4. EXPERIMENTAL RESULTS AND DISCUSSION**

This chapter discusses the developed model. It starts by explaining the two main layers of the model; image preprocessing and machine learning. Subsequently, this chapter will present the experiments and the analytical results that were obtained. Detecting breast cancer by utilizing mammography images is a two steps procedure. In the first step, images are filtered, cropped and mapped into values that can be used as an input to a second step.

In the second step, the input data can be used to train the system to predict future cancer in future images. Our model consists of these two steps or layers.

In the following sections, the result, and processing of the images will be discussed.

### **4.1. Methodology**

#### **4.1.1. Image Preprocessing**

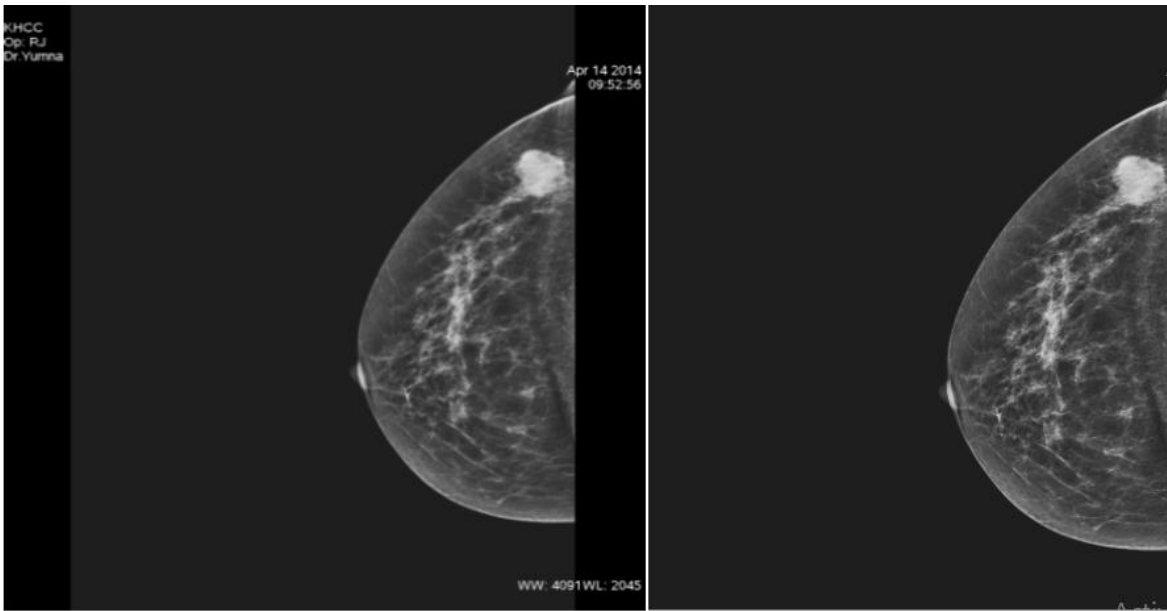
Our preprocessing procedure consists of four main steps, cropping, filtering, converting and transformation. These steps are explained in the following sections.

#### **4.1.2. Image cropping**

Image cropping is the process of cutting or deleting a part of an image and extracting another part of the image. This process is very important in our work since it can delete the margin of images in our dataset. Figure 4.1(A) shows an image of our dataset. As we can observe, there is a black margin with words written in this margin.

Fortunately, this margin has the same size in all of the images in our dataset.

This allowed us to use a static cropping process. A static means that the cropping size does not change. Figure 4.1(B) shows the output of the cropping process.



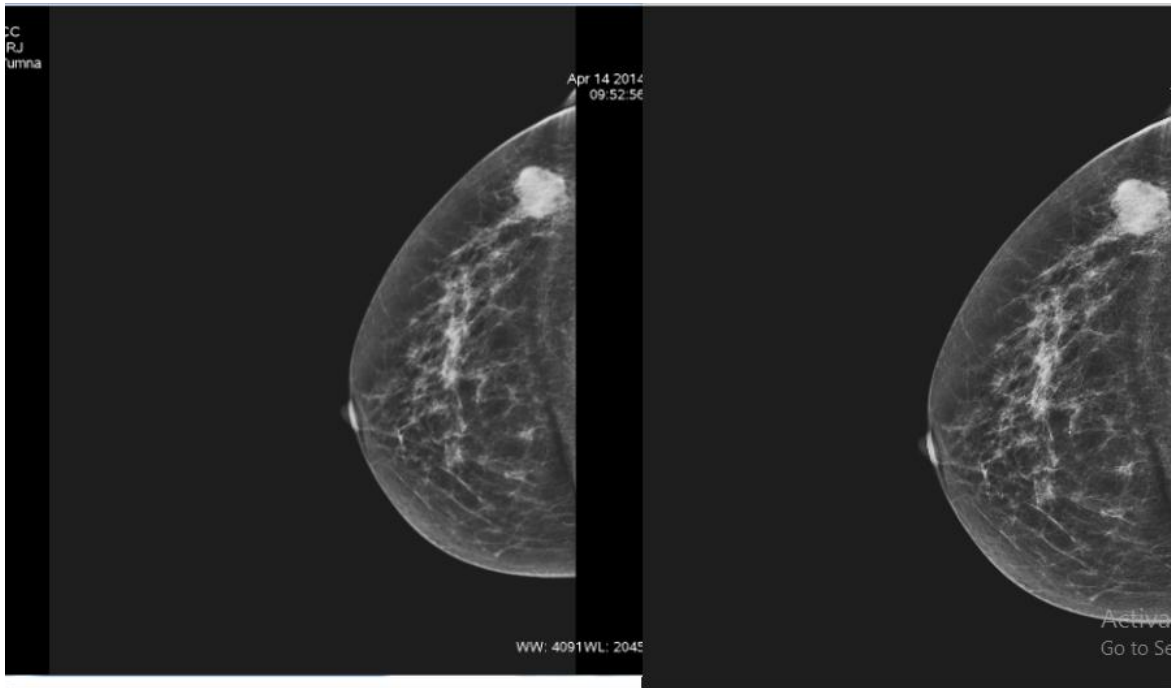
**Figure 4.1.** (A) Image before cropping.

(B)Image after cropping

### 4.1.3. Filtering

Our dataset images have fuzzy or blur effects. This effect is considered as noise in our data. To remove and eliminate it, Wiener filter will be used.

In signal processing, Wiener filter is a technique that estimates the target signal by Linear Time Invariant (LTI) processing on a noisy signal. In Matlab, Wiener filter is categorized as a de-blurring filter. Figure 4.3 shows the image before and after applying Wiener filter. We can observe that the white lines are less blurred in the figure 4.2 (B) than the white lines in the figure 4.2(A).



**Figure 4.2.** (A) Image before applying Wiener filter (B) Image after Wiener filter

#### **4.1.4. Converting Into A Binary Image**

The conversion process of a gray scale image into a binary (black/white) image is not an easy task. Which scale values should be white and which values should be black? This question requires a way to generate a threshold value that can be used as separation line between gray values that will be converted into black and white.

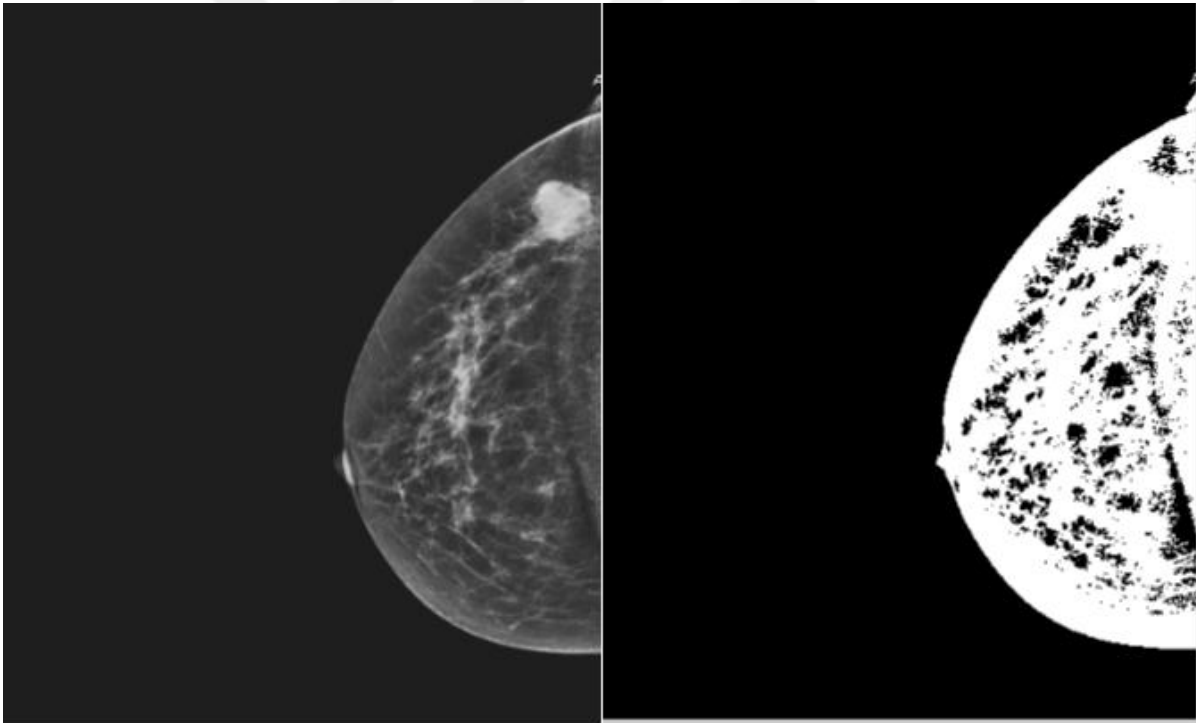
Many algorithms have been written to generate a threshold value. It has been reported that threshold process can be categorized into one of six classes according to the manipulated information.

These classes are: Histogram, Clustering, Entropy-based, Object Attribute-Based methods, Spatial and Local methods.

In our work, we attempted to convert the gray scale images into binary images utilizing histogram based threshold process. In this process, a histogram of all the gray scales is extracted.

The highest value of this histogram is used as a threshold value. However, we found that converting gray images into binary ones eliminate many useful information which led to the loss of categorized features. Demonstrate this problem: In figure 4.3 (A) we can observe a white dot in the middle of the breast, this dot is a possible cancer indicator. However, when we converted this image into a binary image as in figure 4.3(B) this dot disappeared or vanished in the middle of the white area.

In other words, we converted the image from a readable image into a fuzzy unreadable image. According to these image conversions we decided to use grayscale images and technique the conversion process was not included in the implemented system. As last step we count grayscale image to binary image. Then thresholding value can be selected as 128 value.



**Figure 4.3.** (A) Gray scaled image      (B) Binary image

#### 4.1.5. Feature Extraction

The cluster which shows the tumor is certainly predicted the k mean result try removed in feature removal. The removed group is actually put on the method that is thresholding. It uses digital mask throughout the image that will be entire. Within this process the digital mask are used on the image that is entire. In limit programming, each modify coefficient are compared to a threshold. Then it's if it is significantly less than the limit price considered as zero. It will if it is bigger than the threshold be regarded as you. The technique this is certainly thresholding an adaptive approach where solely those coefficients whose magnitudes were above a threshold tend to be retained within each block. Why don't we consider an image 'f' which have the k level that will be gray. An integer value of threshold T, which is based on the scale this is certainly grey selection of k. The procedure this is certainly thresholding a comparison. Each pixel in 'f' is compared to T. Based on that, digital decision is manufactured.

#### 4.1.6. Learning Algorithm

After the steps of preprocessing images, we apply machine learning algorithms. The LR technique requires a hypothesis and a cost function. Equation1 shows the hypothesis of LR and equation2showsthecost function.

$$h_{\theta}(x) = \theta(1) (\theta) = - [y \log h_{\theta}(x) + (1-y) \log (1-h_{\theta}(x))] \quad (4.1)$$

**Table 4.1. LR configuration**

| Parameter         | Value |
|-------------------|-------|
| A                 | 0.45  |
| Iteration         | 1000  |
| Number of feature | 750   |

Where  $\theta$ 's are the weights of the hypothesis, the  $x$ 's are the input features and they  $y$ 's are the output values. Our task is to optimize this cost function. In other words,  $\min \theta(\theta)$ . For optimization purposes, we utilized the gradient descent. The gradient descent optimization method is represented in equation(3). This equation must be repeated until we reach our cost.  $\theta = \theta + \alpha \nabla \theta(\theta)$  (3) As we can observe many variables require optimization, such as the number of features,  $\alpha$  and  $\theta$ . To select an optimal value for  $\alpha$ , we repeated the training process with different values of  $\alpha$ . Subsequently, we plotted the cost function. Figure 4.4 shows the cost function with different values of  $\alpha$ . Table 4.1 shows the configuration that we utilized.

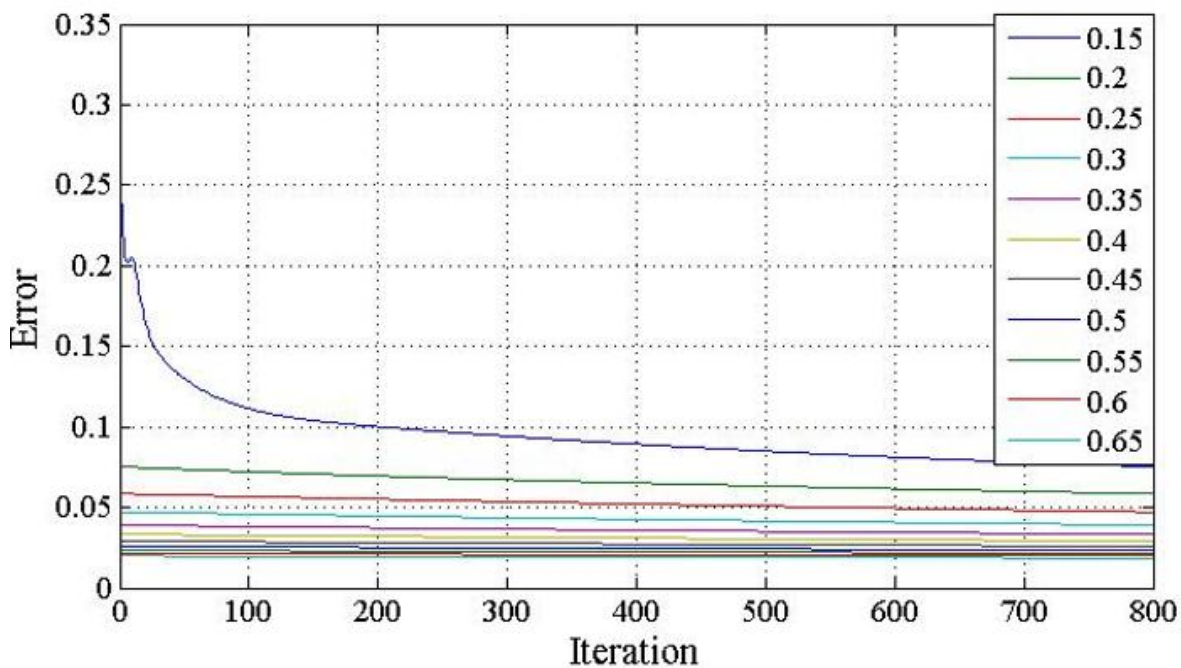


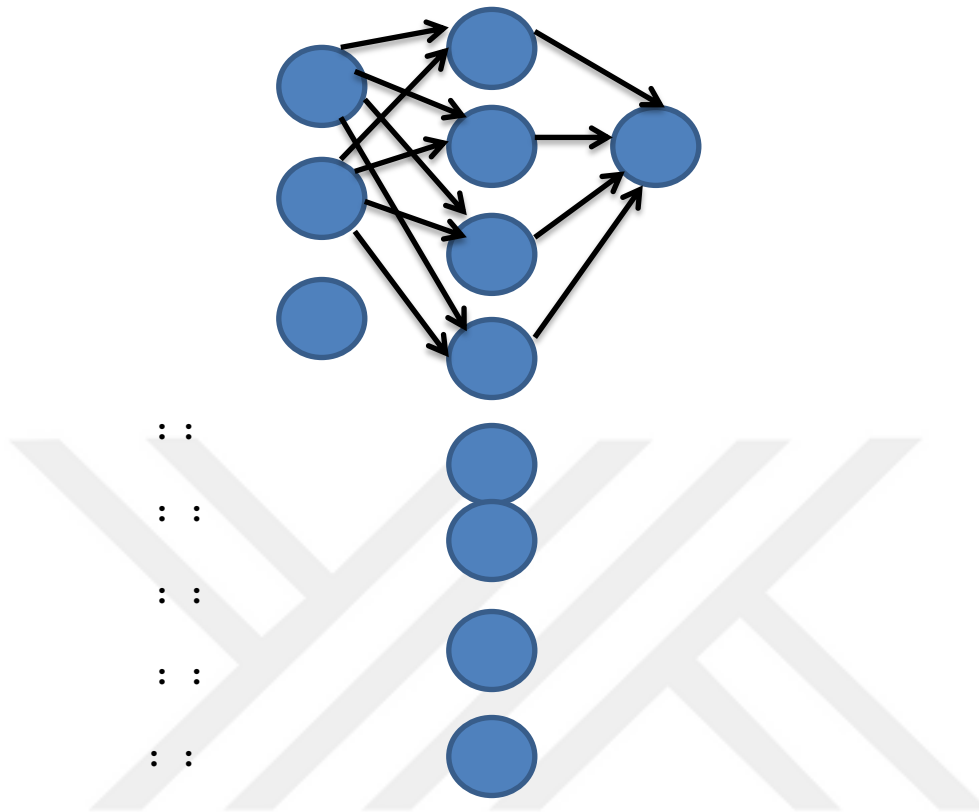
Figure 4.4. Error values of the cost function

#### 4.1.7. Artificial Neural Network (ANN)

In this work, we utilized the back propagation neural network model (BPNN). This model is easy to implement. In addition, it has been used widely in classification problems. Table 4.2 shows the configuration parameters of our neural network. Unfortunately, we could not use the same number of features as in LR. The reason behind this is the memory limitation of Matlab. We could not use more than 264 features before we get a memory error. Nevertheless, this number of features was enough to reach regression values higher than 90% as we will show in the experiments section. Figure 4.5 shows our BPNN model.

**Table 4.2.** Configuration Parameter of Neural Network

| <b>Parameter</b>         | <b>value</b> |
|--------------------------|--------------|
| <b>Numinputs</b>         | 1            |
| <b>Numlayers</b>         | 2            |
| <b>Numoutputs</b>        | 1            |
| <b>Numinputdelays</b>    | 0            |
| <b>Numlayerdelays</b>    | 0            |
| <b>Numfeedbackdelays</b> | 0            |
| <b>Numweightelements</b> | 47           |
| <b>Samptime</b>          | 1            |



**Figure 4.5.** Back Propagation Neural Network

## 4.1.8. Experiment

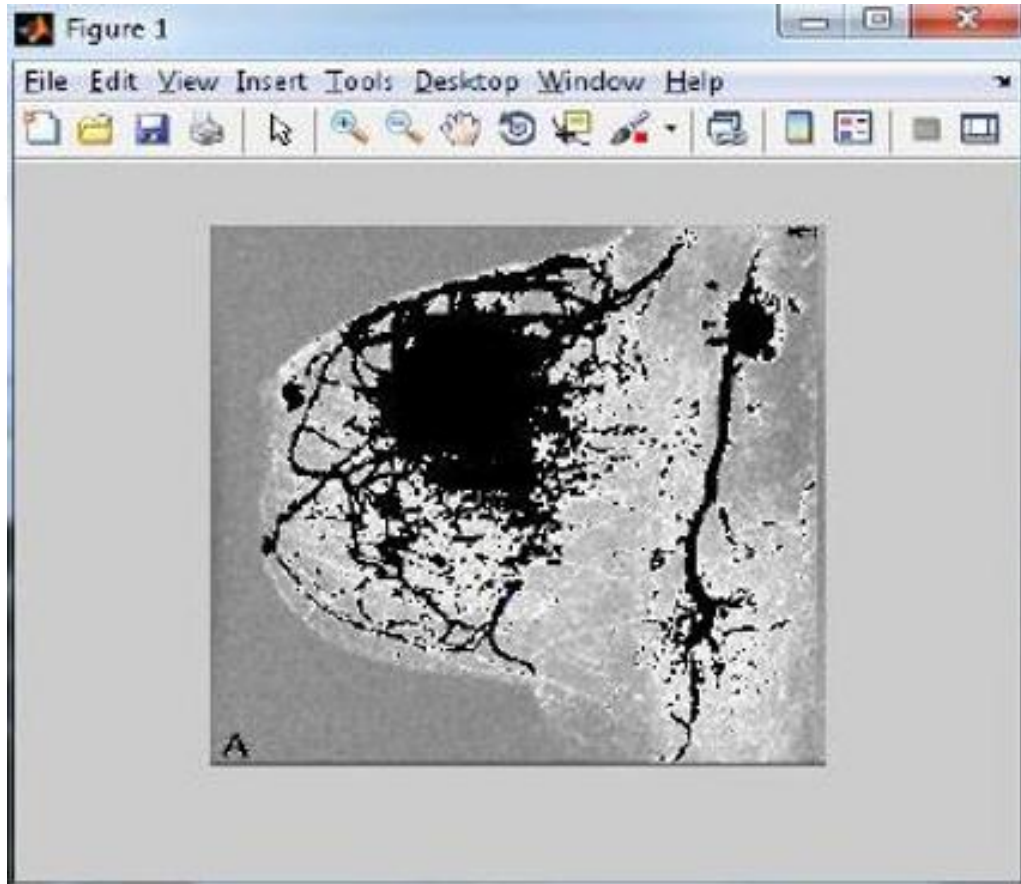
### 4.1.8.1. Pre-Processing

In this pre-processing task there are two works is carried out first sounds can be removed utilizing the filtration that is median. Then mammogram graphics improvement using the Gaussian filters. Sound refers to the place that is undesired of mammogram image. The pre-processing has been broken down two steps.

### 4.1.8.2. Noise Removal

The noise can be removed using four filtering method, the methods become Mean filter, average filter, Wiener filtration and Linear filter figure 4.7. In that filtering this is certainly above Median filtration is the best one review to some other. The Mean filtration is a sliding-window this is certainly easy filtration that replaces the cancer tumors worth into the

window with all the average of the many pixel price within the graphics windows in figure 4.6. The windows are generally rectangular but can any form. The average filter is a nonlinear filtering that is digital; it's utilized to get rid of the sound. The reduction is actually an average action that will be pre-processing enhance the results as in figure 4.8.



**Figure 4.6.** Input image

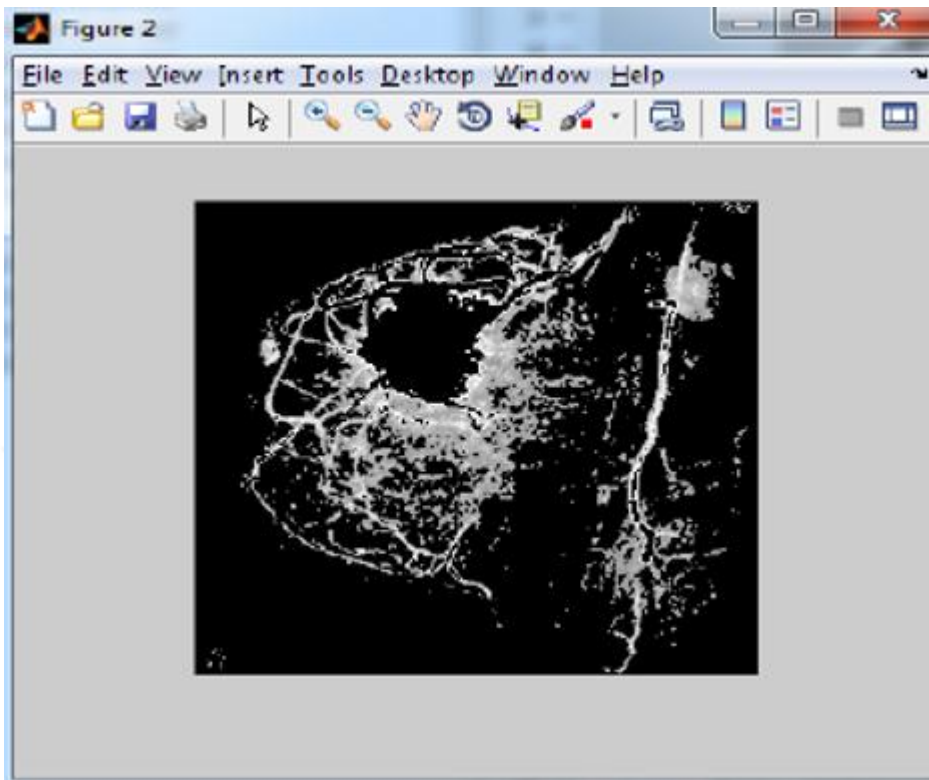


Figure 4.7. Removal noise image

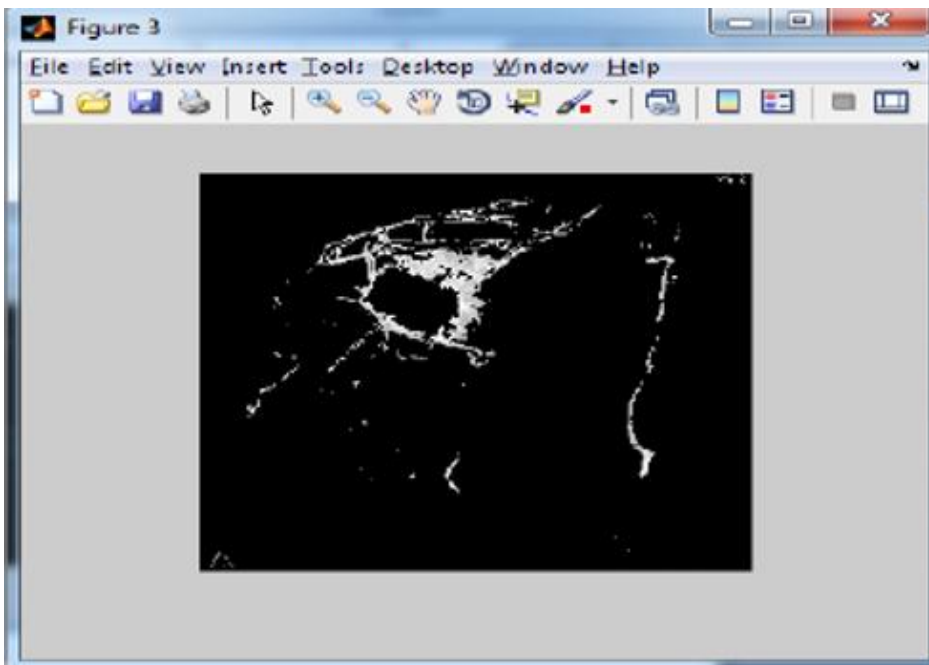
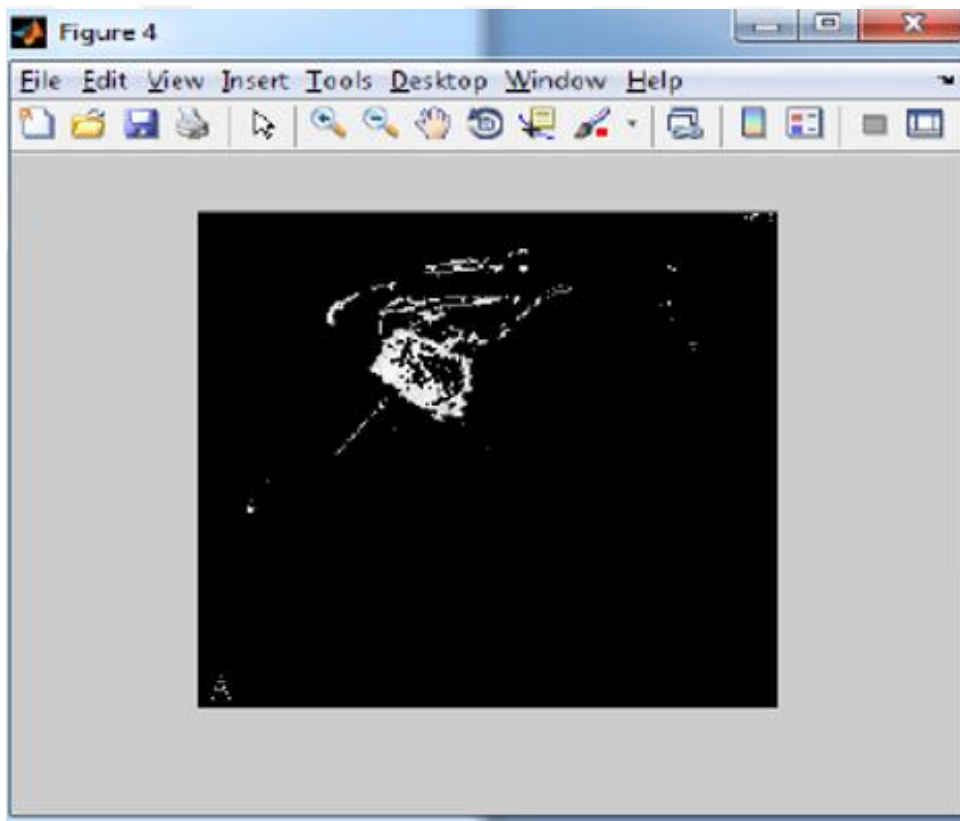


Figure 4.8. Enhancement image

### 4.1.8.3. Segmentation And Edge Detection

Picture segmentation involves partitioning the picture that is digital multiple sections. The purpose of segmentation is always to simplify the representation of an image into extra meaningful and simpler to evaluate. Image segmentation is accomplished utilizing the strategy that is thresholding. The mammogram image could be segmented right after which edge may be identified making use of advantage discovery approach that will be canny. We can get the obvious boundary on the mass edge recognition that is utilizing.



**Figure 4.9.** Edge detected image

The edge discovery strategy is utilized to get the discontinuities out in the photographs. There's two categories of advantage discovery as in figure 4.9, hence they have been Laplacian and gradient. Three fundamental actions of Edge Detections tend to be image smoothing, recognition of side details, edge localization. The side recognition that will be most readily useful is canny side recognition approach.

#### **4.1.8.4. Morphological Operation**

The process that is morphological completed to obtain the clear view of the size. Erosion, hole dilation and completing is done. Eventually the erode graphics can be overlapped together with the graphics that is earliest. For the reason that dilation that will be grayscale pixels towards the limits of things in a picture, while erosion eliminates pixels on item borders

#### **4.1.8.5. K-Mean Segmentation**

K mean clustering information: K- suggest is amongst the reading this is certainly unsupervised for your clusters. Clustering the graphics was grouping the pixels relating to some traits. It might be color, feel or level that will be gray. Contained in this approach segmentation is done based on grey size. The task pursue an easy method that is simple classify the provided datasets through a specific amount of clusters.

Think K amount of clusters. The idea that will be biggest to define the K amount of centroids. One for each group. The next action is always to make the each importance that will be pixel to an offered Dataset and link they towards the centroid that will be nearby. This procedure continues till most of the pixels of offered graphics become assigned to The centroid that will be nearby.

#### **4.1.8.6. Feature Extraction**

The cluster which shows the tumor this is certainly predicted the k mean result try removed in feature removal. The removed group is actually put on the method that is thresholding. It uses digital mask throughout the image that will be entire. Within this process the digital mask are used on the image that is entire as in figure 4.10. In limit programming, each modify coefficient are compared to a threshold. Then it's if it is significantly less than the limit price considered as zero. It will if it is bigger than the threshold be regarded as you. The technique this is certainly thresholding an adaptive approach where solely those coefficients whose magnitudes were above a threshold tend to be retained within each block. Why don't

we consider an image 'f' which have the k level that will be gray. An integer value of threshold T, which is based on the scale this is certainly grey selection of k. The procedure this is certainly thresholding a comparison. Each pixel in 'f' is compared to T. Based on that, digital decision is manufactured. That describes the value of the pixel that will be specific a Result graphics that is digital'.

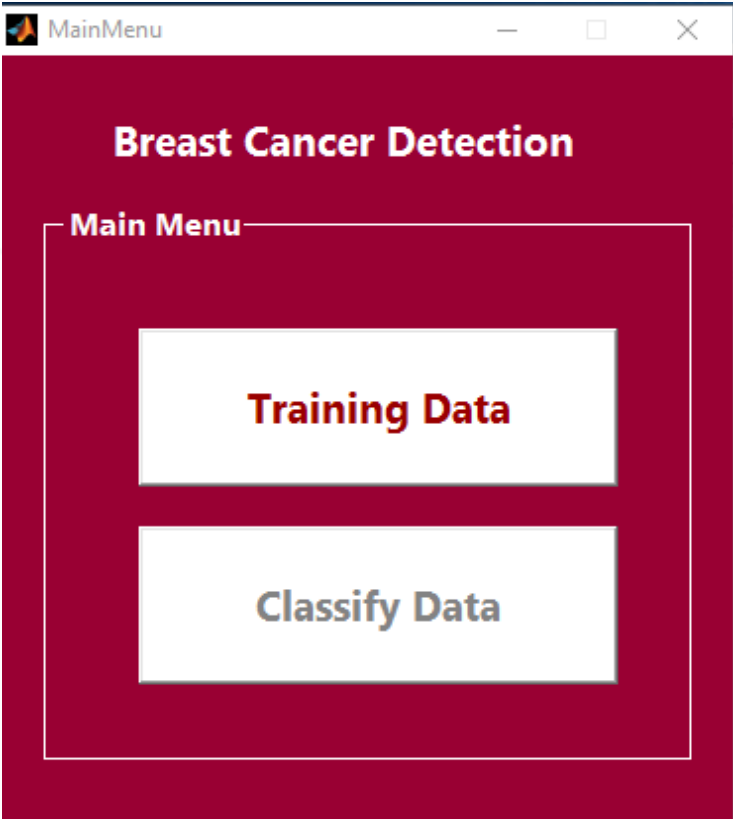


**Figure 4.10.** Output Image of Thresholding

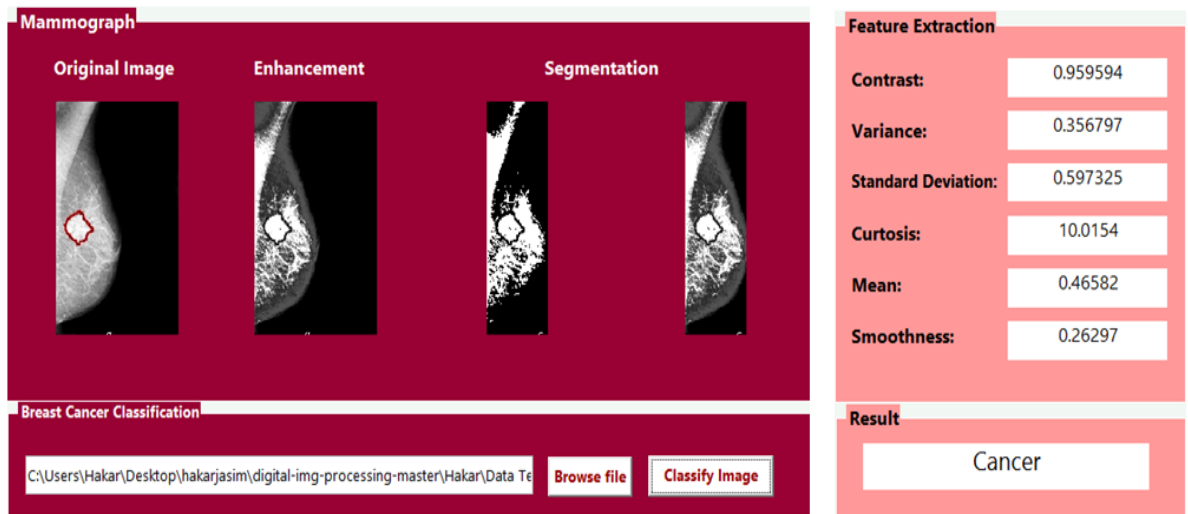
## 4.2. Result

In this thesis that has been produced to show us the area of cancer of breast, firstly you have to run the application to training data that has been saved as show in figure 4.11, after you doing selecting of a mammogram image from data as, the mammography image will process the method of enhancement image, They accentuate or sharpens image attributes for example borders, limits, or distinction to produce a display this is certainly graphic ideal for display and review after that the mammogram image will be process to segmentation image method to evaluate the graphics and certainly will feel described as a processing strategy used to identify or cluster a graphic into several disjoint section by grouping the pixels to make an

area of homogeneity using the pixel traits like grey amount, colors, surface, strength and various other services. Also there is have a extraction feature variable of breast cancer image.so in the result will show for us is there have a cancer or not from the application.

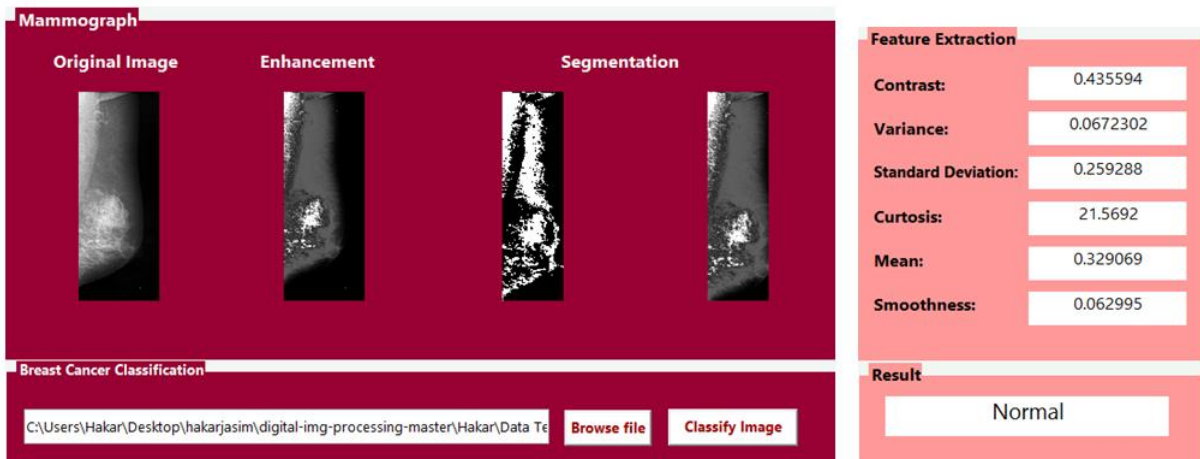


**Figure 4.11.** Training Data in application



**Figure 4.12.** Classified data image and cancer resulted

At this stage we select an image that has cancer and the program gave us contrast, variance. etc. and we have three output images beside the original image the first one is the enhanced image from the original and the other two are the result of the segmentation process.



**Figure 4.13.** Classified data image and no cancer (Normal) resulted.

In figure 4.12 we select a mammogram image that has cancer in it, while in figure 4.13 we selected mammogram image without cancer as we can see in result box we have the final result of the neural network which we train on other prepared mammogram images that has cancer or without cancer.

### 4.3. Discussion

The work in to four stages is divided, first the task that is pre-processing done in this paper, Image practices that are pre-processing necessary, to be able to find the orientation regarding the mammogram, to increase the quality of image and remove the noise. Pre-processing actions are extremely important to restrict the scan for irregularities without excessive influence from back ground of this mammogram, Before that any image processing algorithm can be used on mammogram. In this pre-processing that noise may be reduced by using the filter of median then your mammogram image may be enhancement Gaussian that is using filter. The Second, that segmentation is done making use of threshold values for division the mammogram image into multiple segments to easily recognize the mass. Next of the edge detections are completed using algorithms that is canny mammogram image as the next images

## 5. CONCLUSIONS

1. On this paper “breast cancer detection based enhancement image using neural network” explained about improving the quality of the image data is mammography to detect breast cancer with the use of algorithm fuzzy approach. One of the algorithms used in the completion of this task is the possibility distribution algorithm. Broadly speaking, this algorithm decreases the gray level of pixels that have a value of gray in between  $\beta_1$  and  $\beta_2$ . From the results of the programs can be concluded that this algorithm retains the value that was very dark and very light with a fuzzy approach, while the value of which is around the average (mean) rated Direction opposite to the mean value of  $\gamma$ . So that the results obtained are images that accentuate the image data sets are very bright and very dark, which represents skin tissue and can be further processed to analyze breast cancer.
2. Segmentation using a threshold finding smaller parts to be cut and analyzed to the next stage.
3. In the feature extraction stage, after trying some of the features, we found 6 features that represent a mammogram. We took from GLCM, feature intensity, and intensity histogram feature. GLCM of the features we take the value of contrast, the intensity of the features we take the mean, variance, standard deviation, of the intensity histogram feature we take curtsies and smoothness.
4. Classification using Neural Network algorithm divides the 6 input from the feature extraction into two outputs (normal and cancer) with a hidden layer size.
5. Training data using the data 60 mammograms (30 normal data and the data 30 cancer) and the test data 18 Data mammogram (8 data normal and 10 data cancer) From the test data, 3 data is not precise classification.

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