Detection of Micro Calcification in Breast using Morphological operators

V.Parameshwari
Assistant Professor, Department of ECE,
Nandha Engineering College, Erode-52, Tamilnadu, India.

Abstract – Nowadays, Micro calcification in digital mammogram is an important early sign of breast cancer and their early detection is very important to improve its diagnosis. Early detection of cancer is the best method to increase the chances of survival. In early stage, cancer can be detected using mammography, fine needle aspirate, and surgical biopsy. Computer- based detection system can assist the radiologist to improve the diagnostic accuracy. Digital Mammogram is the low cost and effective for early detection of masses or abnormalities which related to the high risk factor of breast cancer. In this paper, various techniques for detection of micro calcification have been studied. Further, brief discussion has been done on breast cancer detection which is included with feature extraction methods based on texture. At the end of this paper, comparative study between various morphological operations for detecting micro calcification has been done.

Index Terms – Micro calcification, Morphology, Feature extraction, Classifiers.

1. INTRODUCTION

Breast cancer is one of the frequent and leading cause of mortality among woman, especial in developed countries. Age is one of the risk factor of breast cancer. Women within the age of 40-69 have more risk of breast cancer. In western countries about 53%-92% of the population has this disease. In a Philippine study a mammogram screening was done to 151,198 women. Out of that 3479 women had this disease and were referred for diagnosis. Though breast cancer leads to death, early detection of breast cancer can increase the survival rate. The current diagnostic method for early detection of breast cancer is mammography. Mammography's are low dose X-ray projections of the breast, and it is the best method for detecting cancer at the early stage. Micro calcifications (MC) are quiet tiny bits of calcium, and may show up in clusters or in patterns and are associated with extra cell activity in breast tissue. Usually the extra cell growth is not cancerous, but sometimes tight clusters of micro calcification can indicate early breast cancer. Scattered micro calcifications are usually a sign of benign breast cancer. 80% of the MC is benign. MC in the breast shows up as white speckles on breast X-rays. The calcifications are small; usually varying from 100 micrometer to 300 micrometer, but in reality may be as large as 2mm. Though it is very difficult to detect the calcifications as such, when more than 10 calcifications are clustered together, it becomes possible to diagnose malignant disease. But the survival depends on how early the cancer is detected. So, any MC formation should be detected at the benign stage. Hence, a Computer Aided Diagnosis (CAD) system is used to detect MC clusters. Many different algorithms have been proposed for automatic detection of breast cancer in mammograms. Features extracted from mammograms can be used for detection of cancers.

Studies reports that features are extracted from the individual MCs or from the ROI which contain MC clusters .There are problems with the subjective analysis of mammographic images by radiologist. Subjective analysis depends mainly of the experience of the human operator, but it is also affected by fatigue and other human-related factors. Since, the interpretation is a repetitive task that requires lot of attention to minute details; it requires lot of staff time and effort, which results in increasing diagnosis time. On the other hand, the objective analysis of mammograms, which is carried out by automated systems, provides consistent performance but its accuracy is usually lower. Due to the sensitivity of this problem, I believe that radiologists should be involved and computers should not replace them completely. However, computer systems can help them perform better by enhancing the quality of images, highlighting the suspicious regions and providing better analysis tools. Proper precautions and treatment can only be achieved by Awareness and understanding of this disease and will help the doctor in making correct decision. It is the second most fatal cancer after cervical cancer found among women. Studies suggest that age, family, Gene changes, radiation therapy, breast density, drinking alcohol etc are the common reasons of the breast cancer. The life time probability of the cancer is 1 out of 22 women in India and its current incidence rate is 24.6. The various indications of Breast Cancer are as follows:

- A change in the shape or size of the mature breast.
- Thickening found in the breast area or a lump in armpit area.
- A change in shape of nipple.
- Leakage of some sorts of fluid from nipple.
- A change in the skin of the breast.

A change in texture and/or color of the areola or the nipple. Identification on the basis of signs and symptoms are the basis of diagnosis of the disease. Naked eyes can never detect breast Cancer. Fading and flow of hormones may be the reason of lumps and bumps. There may be many other sources such as sunburns, radiation treatment and infections which result to changes required to get a clear diagnosis for such cases. Women, who are between 20 and 30 years of age, should have regular breast checkups annually and in case if abnormalities are found, one should go for ultrasound and mammogram to know the exact cause. Most mammogram image classification done by detecting abnormal structure of micro calcification. Micro calcification is a small collection of calcium which relate to additional cell activity in breast tissue. Micro calcification can be seen in clusters or patterns. The dense cluster of micro calcification indicates early symptoms of breast cancer and separate micro calcification usually indicates benign breast cancer.In mammogram classification, tissue diagnosis are classified in three categories: normal (representing a mammogram without cancer cells), benign (representing a mammogram that showed a tumor, but not cancer cells), and malignant (tumor represents a cancer cell). The study about mammogram image classification has been done by many researchers.

2. RELATED WORK

The digitized mammogram is preprocessed by Gaussian Low pass filter. At this stage the noise is removed, and it is introduced due to image acquire and image transmission. Segmentation subdivides an image into its constituent regions or objects that have similar features [1]. To detect the boundary of cancer tumors in digital mammograms the edge based segmentation techniques of first and second order provides an effective segmentation to detect the boundary profiles. Detecting edge of image significantly reduces the amount of data and filters out insignificant information, while preserving the important structural properties in an image. Edge detectors are a collection of very important local image pre-processing methods [2]. Tomar et al. (2009) in their paper describes that a mammograms can be used to diagnose the abnormality in breast tissues. Initially the various ways to diagnose cancer in an x-ray are calcification contents and spicular lesions. Various detection systems can be used to extract these features. Neural network, wavelet and fuzzy logic are the common approaches employed for this purpose.[3] Alolfe et. al. (2008) in their paper illustrates that the deposits seen in x-rays of patient in their paper where one shows signs of generally of calcium. A new method has been described in which we can find out lesions in an early stage and this is with the help of CAD system[4]. The paper presented fcm method for determining the stage of breast cancer malignant or benign based on the size of the cancer on the mammogram image basis. The resulting eight graph feature sets were aggregated and constituted the multiscale topological feature vector,which has been used to classify the microcalcification clusters into malignant or benign[5].

3. PROPOSED MODELLING

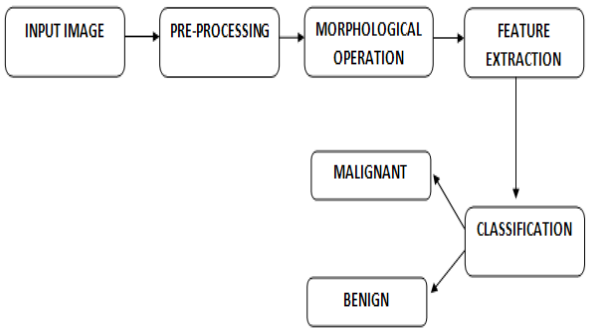

Figure 1.Block diagram of proposed method

A. Morphological operators

Detection of micro calcification in breast using Morphological operations is of great importance as it is a powerful tool in extracting important information in an image. Dilation, one of the basic morphological operation results in growth or object or thickening while erosion shrinks objects based on the size of structuring element.

Erosion is defined as

$$I \ominus S = \{ z / (S)_z \subseteq I \} \quad (1)$$

where I is the image and S is the structuring element and z is the outcome when S is subset or equal to I.

Dilation is represented by

$$I \oplus S = \{ z / [(S)_z \quad I] \subseteq I \} \quad (2)$$

By combining erosion and dilation, the important morphological filter operations opening and closing are formed. Opening and closing are defined as follows.

$$I \ S = (I \ominus S) \oplus S \quad (3)$$

$$I \bullet S = (I \oplus S) \ominus S \quad (4)$$

B. Feature Extraction

Feature Extraction is a special form of dimensionality reduction. Feature refers to a piece of information that has relevance in solving the computational tasks related to a certain application. Feature extraction can be defined as a quantitative measurement or analysis of the medical images. To deal with

the abnormalities of the ultrasound images, many types of features can be extracted. The different types of features calculated from the extracted ROI broadly come under the category statistical, geometrical or structural. The statistical features are the simplest ones and they include mean, standard deviation, variance etc. Texture analysis of micro calcification helps to identify texture feature information about the spatial distribution of tonal variations and describes the pattern of variation in gray level values in a neighborhood. Gray Level Co-occurrence Matrix (GLCM) is used to extract texture information from images. The GLCM characterizes the spatial distribution of gray levels in an image. The features that are used for classification are:

Energy: Energy returns the sum of squared elements in the Grey Level Co-Occurrence Matrix (GLCM). Energy is also known as uniformity. The range of energy is [0 1]. Energy is 1 for a constant image. Energy is also known as uniformity of ASM (angular second moment) which is the sum of squared elements from the GLCM.

Skewness: Skewness is a measure of the asymmetry of a histogram. A distribution is said to be symmetric if it looks the same to the left and right of the centre point. If longer tails occurs to right the distribution is said to be skewed to right, while if the tails occurs to the left it is said to be skewed to the left.

C. Classification

Once the features are extracted, they are input to a classifier to classify the detected suspicious regions into benign or malignant micro calcifications. Classifier such as Artificial Neural Network (ANN) is used. ANN is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working to solve specific problems. The advantage of ANNs is their capability of self-learning and often suitable to solve the problems that are too complex to use the conventional techniques or hard to find algorithmic solutions compare with Support vector machine and all.

4. RESULTS AND DISCUSSIONS

(i)Region of Interest (ROI) Identification

The first stage of micro calcification detection is ROI identification. The enhanced mammogram image is decomposed by undecimated wavelet transform (filter bank implementation without downsampling). The resulting horizontal detailed image or vertical detailed image is used to identify the region encircling the micro calcification clusters. Third and fourth order statistical parameters, skewness and kurtosis, are used to find the regions of micro calcification clusters.

(ii)Sensitivity and Specificity

The evaluation of the proposed method is calculated by two parameters (specificity and sensitivity) with below equation

$$Specificity = TN/TN+FP \quad (5)$$

$$Sensitivity = TP/TP+FN \quad (6)$$

TP is the number of true positive, TN is the number of true negative, FP is the number of false positives, and FN is the number of false negative. High specificity means that some cases will get unnecessary biopsy. High sensitivity show how many cancers missed. Sensitivity is the most important parameter because the errors are life-threatening.

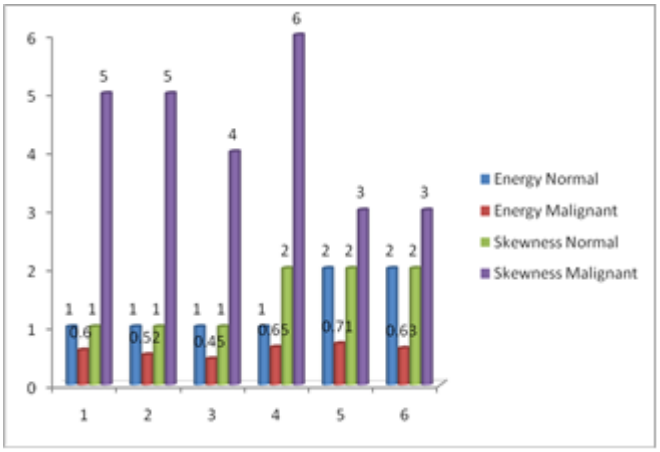

Figure2.Comparison of energy and skewness

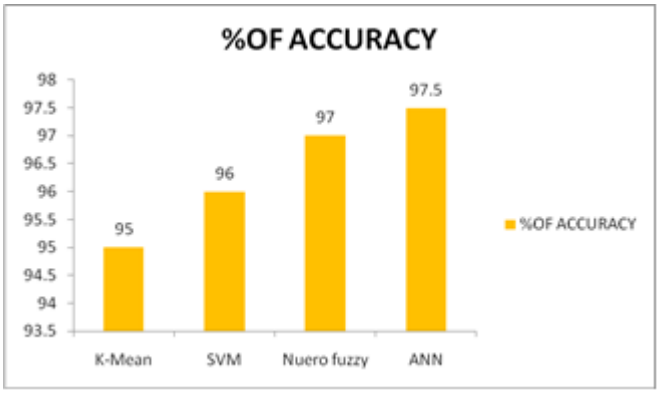

Figure3.Comparison of accuracy with various classifiers

5. CONCLUSION

I have presented a method for classifying micro calcification clusters in mammograms based on morphological operators. After comparing various classifiers, it is concluded that the detection of micro calcifications in breast is easy to identify using ANN classifier and it has been achieved the highest

accuracy compare with other classifiers. This proposed method has used the morphological operators for detecting the malignant and benign stage of micro calcification which has been measured based on the energy and skewness feature extraction methods.

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