Breast Cancer Detection in Mammogram Images using Region-Growing and Contour-Based Segmentation Techniques

D. Sujitha Priya[#1], Dr. B. Sarojini[*2]
[#]*Research Scholar,* [*]*Assistant Professor*
Department of Computer Science, Avinashilingam Institute of Home Science and Higher Education for Women, Coimbatore, Tamil Nadu, India.

Abstract
An increase in the use of computers to improve human-to-human and human-to-computer interaction has necessitated automated methods that extract information on human behavior in an efficient manner. Technology has highly involved in medical science and the serious problem in the medical field is that the death rate is highly increased due to cancer. The main focus is to detect breast cancer related information from the x-ray images. The system can be used to study about the detection process and segmentation process. Mammogram images are used for detecting cancer, since the images occupy very low levels of radiation. Test images are subjected to a Region-growing segmentation and contour based segmentation algorithms and results are compared. The tumor cells are further enhanced with watershed segmentation and the morphological operations are applied to enhance the images.

Keywords: *Breast Cancer, Mammogram Images, Region-growing Segmentation, Contour- Based Segmentation, Watershed Segmentation.*

I INTRODUCTION

Technology has been undoubtedly changed every aspect of our lives, especially the current scenario tends to occupy the past few years, and it takes an effective and evident work in the field of medicinal science.Connecting in the modern medical field, the technology has developed much, that to eradicate and cure disease, but it faces some risks and leads to failure diagnosing.

After diabetics and cardiovascular diseases, Cancer attains the third major diseases according to the report. Almost 1400 new cancer cases and around 950 deaths takes place each year.

One of the ten leading causes of death in India is due to Cancer. 25 years back, 2% were in 20 to 30 years age group out of every 100 breast cancer patients, 7% were in 20 to 30 years and 69% of the patients were above 50 years of age. Presently, 4% are between 20 to 30 years age group, 16% are between 30 to 40, 28% are between 40 to 50 age group. Almost 48% patients are below 50 age group. After going through all the statistical report, breast cancer accounts for nearly 25% to 32% of all females in all the cities of India. According to Population based Cancer Registries (PBCR) the report provides as 25% to 31% of breast cancers in women in cities such as Mumbai, Delhi, Chennai, Ahmedabad, Bengaluru, Bhopal etc.. And this translates into big numbers in the year 2006-2008. The total cancer cases in India likely to go up from 979,786 cases in the year 2010 and 1,148,757 cases are expected in the year 2020. The female cancer case report as 75,289 in the year 2010 and 93,563 cases are expected in the year 2020. The breast cancers alone are expected to cross 100,000 by the year 2020.

II EXISTING TECHNIQUES

The reliability of optical inspection significantly increases in image preprocessing. The preprocessing operation takes place with the lowest level of abstraction. The preprocessing method inhibits the undesirable distortions from the raw data. Enhancement of raw data also takes place in preprocessing techniques [1] for further processing. The distortion of data obtains by calculating the neighboring pixels that help when distorted data needs often. The distortion of data or removal of noise is also called filtering. Preprocessing method occupies the first phase of the noise removal or enhancement of the digital image [1].

Preprocessing technique contains Linear and Non-Linear Filtering. Linear and Non-Linear filtering contains a number of filtering methods to smooth and sharpens the edges of the images and also the method removes the noise from the image. This filtering technique includes convolution and correlation methods which help in filtering process. A convolution and correlation method marks the mask value of the image and proceeds with the further process. The filtering methods used to study the suitable images by using these techniques such as mean filtering, median filtering, and adaptive median filtering.

The adaptive median filtering shows the best results by comparing with other filtering techniques. Whenever the MSE value minimum, the PSNR value provides maximum results. With the low resolution of the grayscale image, the MSE value is reduced only for the Gaussian method under Adaptive Median Filtering. The comparison of filtering methods shows that the Gaussian method is suitable for mammogram image and it predict the MSE and PSNR value that is shown in the figure 1and demonstrate it. Thus the image is suitable for further segmentation technique.

III IMAGE SEGMENTATION

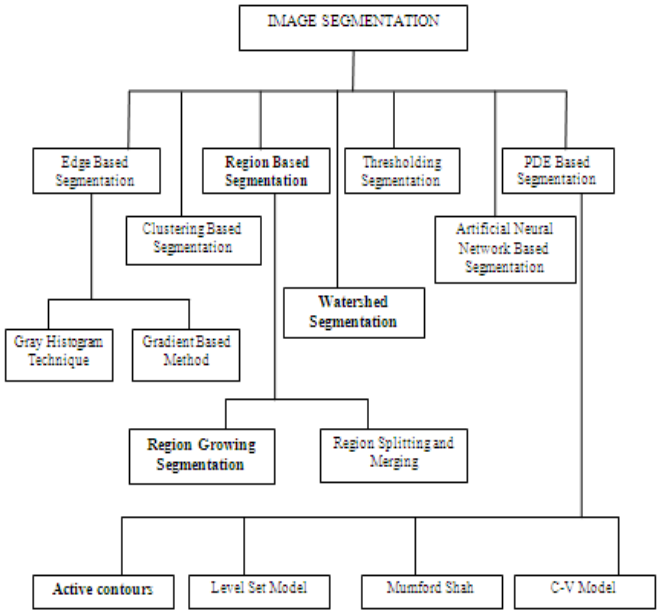

Fig 1. Classification of Image Segmentation

Splitting the desirable information into some smaller groups of the raw data is known as Segmentation [2]. An image is separated into component regions or an object refers to segmentation [2]. These regions can be further processed or analyzed for the extraction of quantitative information. Here, the data are used for processing biological data where the data have been usually messy or noisy and the resultants are difficult to segment [3]. By combining segmentation with morphological processing and filtering techniques are used to attain accurate and robust segmentation of an image. The symbolic representation of the image is constructed by segmentation techniques [4].

Region-Growing Segmentation

Segmentation tends to partition an image into regions. Region-based segmentation directly determines the regions after preprocessing [5] as compared with thresholding method. Since thresholding method collects the boundaries between regions based on discontinuities. The formulation of Region-Based Segmentation is:

(1) $\bigcup_{i=1}^{n} R_i = R$

(2) R_i is a connected region, $i = 1,2,3.....n$

(3) $R_i \bigcap R_j = \phi$ for all $i = 1,2,3.....n$

(4) $P(R_i) = TRUE$ for all $i = 1,2,3.....n$

(5) $P(R_i \bigcup R_j) = FALSE$ for all adjacent region R_i and R_j

$P(R_i)$ is a logical predicate that defined the points in set R_i and ϕ is the null set.

(1) Every pixel must be in a region, it represents that the segmentation is completed.
(2) i represent the points in a region and must be connected in some predefined sense.
(3) intersection indicates that the regions must be disjoint.
(4) carriers the properties that must be satisfied by the pixels in a segmented region.
(5) The sense of predicate P indicates that the regions R_i and R_j are different.

Region-growing segmentation [6] profit rewards that it separates the region correctly and defines the when it has the same properties. Region-growing segmentation provides the clear edges of the images. Region growing segmentation needs the minimum seed points to represent the property to grow the region [6] [7]. The seed points can determine the multiple criteria at the same time respect to the noise.

Contour-Based Segmentation

The active contour based segmentation method is implemented after preprocessing techniques takes place. The resultant from Gaussian of adaptive median filtering is enforced for algorithm implementation. The active contour segmentation model is introduced by Chane and Vese [8]. The segmentation model [8] [9] contains Classic approach to active contour model, Active contour without edges, Piecewise Smooth Segmentation, Global Minima via Convexification. The approach used here to segment and detect the cancer using, Classic approach, since it works better with the gradient of the images to locate the edges of the object. Edge function is used to determine the edges with zeros and the positive values in homogeneous regions.

$$\inf E(C) = \int_C |C'(s)|^2 ds + \lambda \int_C g\left(\left|\nabla u_0(C(s))\right|\right)^2 ds$$

g is the edge-detection function. This model depends on the parameterization of the curve and cannot work with automatic topology changes of the contours.

An example for edge-function used is,

$$g(|\nabla u_0|) = \frac{1}{1+|\nabla(G_\sigma * u_0)|^2}$$

g is a positive and decreasing function. These steps are implemented in Matlab code to generate the detection of tumors on mammogram images that is a conversion of gradient image.

IV RESULTS AND DISCUSSIONS

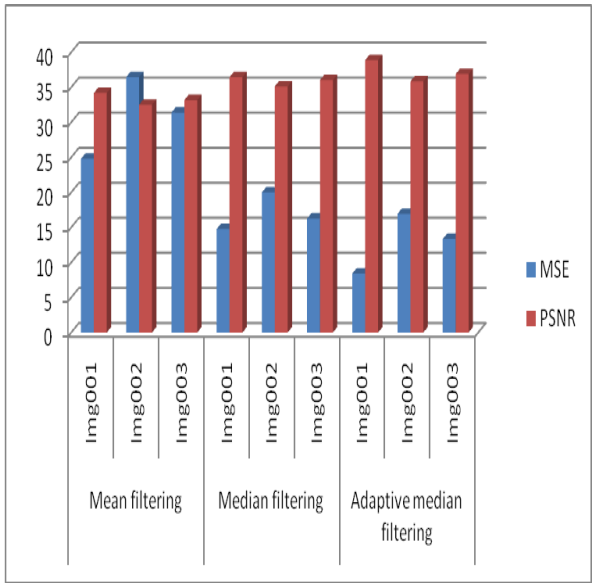

Fig 2 Filtering Technique Comparison

Figure1 shows the results of filtering technique comparison with MSR and PSNR values. Whenever the MSE value minimum, the PSNR value provides maximum results. With the low resolution of the grayscale image, the MSE value is reduced only for the Gaussian method under Adaptive Median Filtering. Thus the image of adaptive median filtering technique is suitable for the further segmentation process.

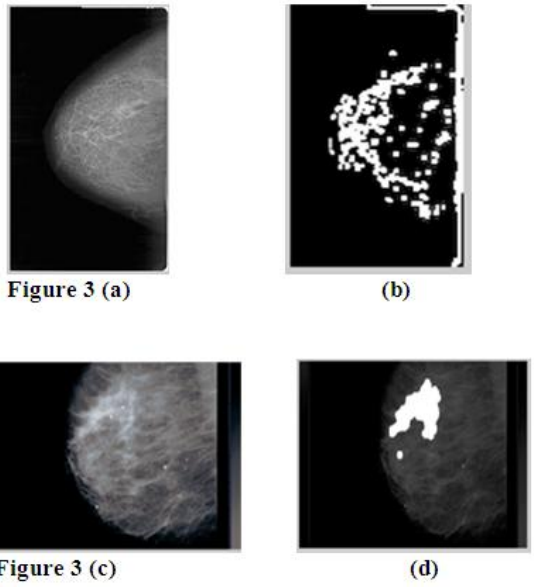

Figure 3 (a) (c) is an original image taken for preprocessing and segmentation process. Likewise 55 mammogram images are taken for tumor detection by using region-growing and contour segmentation algorithms. Figure 2 (b) shows the region-growing segmentation result. And figure 2 (d) shows the contour segmentation algorithm result.

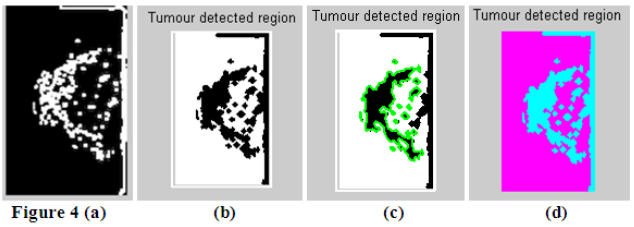

Figure 4 indicates the results for different images with detection matrices. With these image results, the tumors are grouped and enhanced using watershed segmentation technique. Figure 4 (a) shows the region detected image; figure 4 (b) shows the grouped image with black and white radiation; figure 4 (c) (d) shows the enhanced tumor detected results for better conformation of tumor cells. Figure 4 (c) (d) shows the enhanced tumor cell detection using a watershed segmentation algorithm.

V CONCLUSION

Rapid growth of cancer caused higher death rates in women during the current years. Mammogram machines are used to capture mammogram images that are grayscale images. The preprocessing method provided the best idea related to tumor detection, that provides efficient and suitable results for tumor detection. The implementation of preprocessing methods such as, mean filtering, median filtering and adaptive median filtering produced the results as an Adaptive Median Filtering technique that is

implemented with a Gaussian filter produced the best result among three. From the preprocessing implementation, Gaussian produces the best result by measuring MSE and PSNR value. The rate of PSNR value is high for Gaussian method and with the resultants; segmentation algorithm is implemented for Region-growing segmentation and contour-based segmentation. For the region-growing segmentation, the threshold value is set at 0.5 masks. The result given by the segmentation algorithm proved that, contour segmentation produced the best result in the pictorial representation of tumor detection. The detected tumor cells are enhanced with watershed Segmentation and produced best identification of tumor cells. The tumor cells are grouped and enhanced using watershed segmentation techniques.

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