Segmentation Technique To Detection Microcalcification In Mammograms

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Abstract : Breast cancer is the most common cancer among women. Early detection of breast cancer increases the chances of survival. Early detection of microcalcification forecast about cancer and reduction in mortality. Mammography is the best diagnostic technique for screening breast cancer. However, the interpretation of mammograms is not easy because of small differences in densities of different tissues within the image. This is especially true for dense breasts. For early detection of mammograms segmentation is very useful. This paper is contains early detection of microcalcification by analyzing mammographic images using Foveal segmentation. This analysis could provide radiologists a better understanding , if it is detected at an early stage than it is decrease in mortality.

Keywords: **- Breast Cancer; Microcalcification; Early detection; Breast density; Foveal segmentation.**

I. INTRODUCTION

Microcalcifications are an early sign of breast cancer, which is the most frequent cancer in women and a high mortality rate. However, no study has been able to identify with certainty why every year, one million breast cancer cases are discovered and 400000 women die. Besides, according to the SFSPM (French Society of sinology and breast pathology), 7% of women with breast cancer are under 40 years in 2010, while the rate was 5.6% in 2002.

According to WHO, for the year 2012, an estimated 232,714 women in USA, 187,213 women in CHINA and 144,937 women in INDIA were newly detected with breast cancer and 70218 women in INDIA, 47984 women in CHINA and 43909 women in USA died due to breast cancer. The American Cancer Society estimates that in 2015 approximately 2, 34,190 women in the US will be diagnosed with tumor breast cancer, and about 40,730 women will die from breast cancer. Tumors that are not cancer are called benign. Benign tumors can cause problems, as they can grow very large and press on healthy organs and tissues. But they cannot grow into other tissues. Distribution of calcification in four manners as classifies as diffuse, Regional, Clustered, Segmental. It starts from benign and turns into malignant stage.

Breast cancer is a malignant tumor that starts in the cells of the breast. A malignant tumor is a group of cancer cells that can grow into surrounding tissues or spread to distant areas of the body. The disease occurs almost entirely in women, but men also affected it. Early detection of breast cancer is easier to treatment, with fewer risks and reduces mortality by 25%. This early detection can be achieved by subjecting women at risk to a mammography every two years, since it takes about five years for a breast tumor to reach 1 mm, two years longer to reach 5mm and one or two years to measure 2 cm, large enough to detect by palpation.

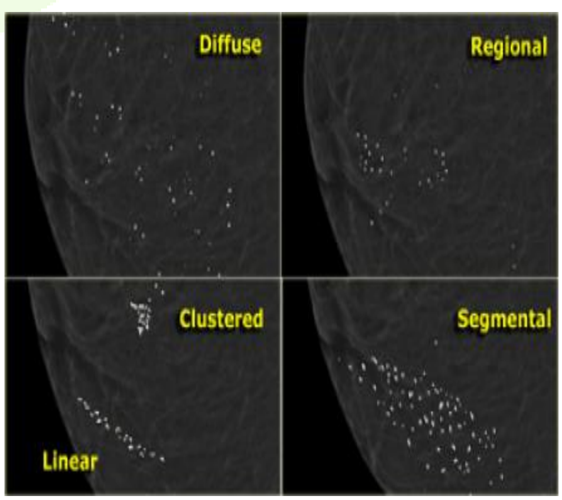

Fig. 1: Microcalcificatin Distribution

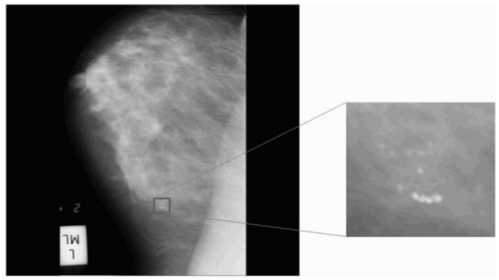

Fig. 2: Microcalcification in Mammogram Image.

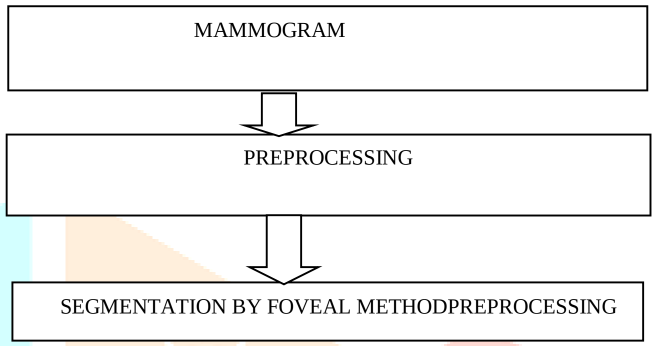

Fig. 3 : Method to Detect Microcalcificaion

II. MAMMOGRAMS

The original MIAS Database digitized at 50 micron pixel edge has been reduced to 200 micron pixel edge and clipped/padded so that every image is 1024x1024 pixels. The Mini Mammographic database was established by the UK"s National Breast Screening Program: each mammogram film has been digitized with a Joyce-Loebl device and has dimensions of 1024x1024 pixels. Each pixel in the image is presented by a byte (8-bit) in order to record one of 256 gray scale values. Images in the MIAS database were created from 161 test subjects, each of whom had an image taken of each of their breasts in the medio lateral oblique view, producing a total of 322 images.

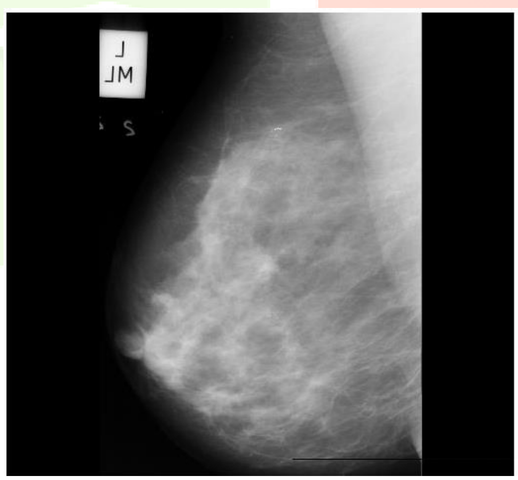

Fig. 4: Mammogram

III. PREPROCESSING

The pre-processing phase of digital mammograms refers to the enhancement of mammograms intensity and contrast manipulation, background removal, black border and black area removal, histogram etc.

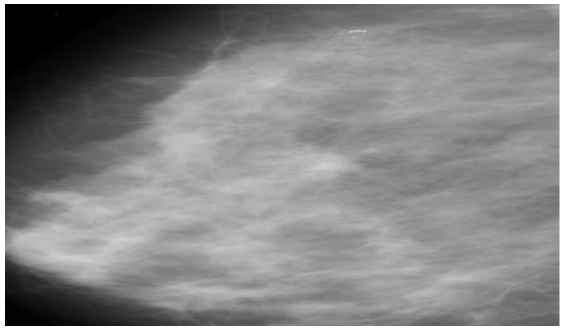

Fig. 5: Black Border and Area Removal by Cropping of Mammogram

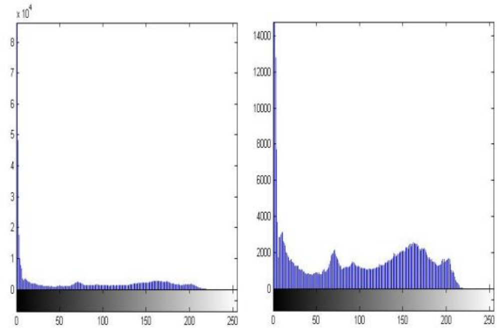

Fig. 6: Histogram of Authentic Mammogram and Crop Mammogram

IV. SEGMENTATION

Microcalcification detection means it is scheme to separate the suspicious region that may contain masses and microcalcification from the mammogram, i.e. to partition the mammogram into several non-overlapping regions, then extract region of interest (ROIs), and locate the suspicious microcalcification portion from ROIs. The suspicious area is an area that is brighter than its surroundings, has almost uniform density, has regular shape with varying size, and has fuzzy boundaries. In generic computer vision terminology, segmentation techniques can be divided into unsupervised and supervised approaches. Supervised segmentation or Model-based methods rely on the prior knowledge about the object and the background region to be segmented. The prior information is used to determine if specific regions are present within an image or not. Alternatively, unsupervised segmentation partitions an image into a set of regions which are distinct and uniform with respect to specific properties, such as gray level, texture or colour. Segmentation is performed separately for microcalcification.

- **Extraction of Region of Interest**

An automatic cropping algorithm is developed using Gaussian blurring and Entropy based Thresholding method which extracts the significant region of interest from the pectoral muscle removed pre-processed image .

- **Foveal Segmentation**

It is easier to identify an object against dark background than to identify an object against a light background. Figure shows part of mammograms and it is difficult to identify the suspicious cells in Fig. compare to another Fig. due to denser background. The observation of tiny objects by naked eye over lighter background is even more difficult because surrounding dense makes objects almost invisible.

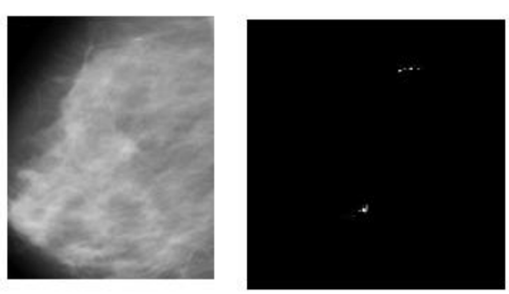

Fig.7: Microcalcification in Mammogram

After the breast region was identified, individual microcalcifications were detected using foveal algorithm. The classical contrast (***$C_{classic}$***) is calculated at every pixel as the difference between that pixel value (P_0) and a weighted sum of the pixel values in an immediate neighborhood (N), as in Eq (1).

$$C_{classic} = p_0 - \frac{1}{8}\sum_{i\epsilon N} P_i \qquad (1)$$

In a simpler scenario, $C_{classic}$ is compared with a fixed threshold, over the whole image and microcalcification is marked. The variation in height in a image or intensity in a typical mammogram makes it far easier to detect microcalcification (or contrast changes) against a fatty (dark) background but more difficult to detect correctly against a denser (bright) background). We compute a set of mean intensity values of the inner area of the object to visualize (i.e. within the boundary of calcification), its neighborhood (the local area around the object) and background (the rest of the breast tissue).The histogram of the inner foveal surface provides the mean of the object (μ_o), as the histogram of the whole image will give us the mean of the background (μ_B) and a measure of the density of breast. The mean of the neighborhood (μ_N) is found from the intensities of pixels within the neighborhood and excluding the object pixels according to Fig. 8.

μ_N determines whether the visualized object is on a dense (bright) or a fat (dark) area of breast. The size of the kernel of the inner object (O) used to compute μ_O is established according to the average size of micro-calcification). It is desirable to have a slightly smaller kernel than the micro-calcification diameter to assure the detection of small calcium salts, which are overlooked by larger kernels. Still, the size of O must not be too small to avoid overlapping O and N for slightly bigger micro-calcification. In our application N is set twice the size of O. O is 10x10 dimensions. Then the perceivable contrast C is calculated in agreement with the following equation:

$$C = \begin{cases} \frac{\mu_o - \mu_N}{\mu_N}, \text{if } \mu_o > \mu_N \\ 0, \quad \text{otherwise} \end{cases} \tag{2}$$

We then computed Cmin from Eq.4, a measure of contrast sensitivity, where

$$\mu_A = \omega\mu_N + (1-\omega)\mu_B \tag{3}$$

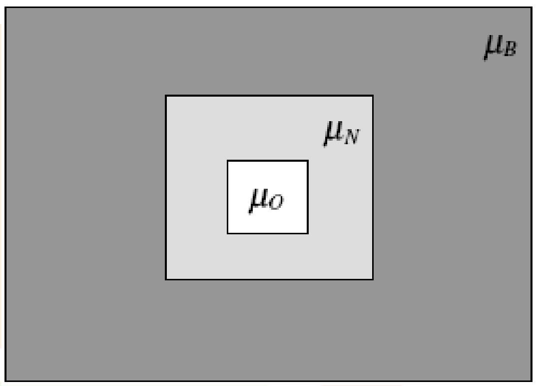

Fig.8: foveal masks used for the computation of μo, μn and μb the o is the size of the kernel object, n its neighborhood and b the background

and ω is a suitable weight between 0 and 1 affecting the amount of background implied in the computation of contrast. Cmin sets the threshold from which objects in the image are visible for the observer, a measure of the eye's ability to perceive luminance gradients. The literature proposes 7.7% of the adaptive luminance to be due to the background luminance, which gives a value of 0.923 to our weight w. In practice, we studied the effect of varying w with 10% more or less than the proposed value. For parameter b in Eq. 4, we have found that the literature proposed value b = 0.0808 gives good results. Areas in the image having C > Cmin are marked as micro-calcification).

$$C_{min} = \begin{cases} \frac{C_w}{\mu_N}(b + \sqrt{\mu_A})^2, & \mu_A \geq \mu_N \\ \frac{C_w}{\mu_N}\left(b + \sqrt{\frac{\mu_N^2}{\mu_A}}\right), & \mu_N > \mu_A \end{cases} \tag{4}$$

The segmented image is a binary image with white spots that depict the microcalcifications.

Steps involved in Foveal segmentation are

- Firstly an automatic cropping of the ROI is performed to find object.
- Then find the neighbourhood of the object and remaining part of mammogram is background.
- Then a mean matrix is evaluated using Gaussian kernel with the overlapping window of size 5x5 corresponding to object.
- Further, mean of neighbourhood and background is evaluated.
- Then find contrast for each pixel of object comparing with neighbourhood by using equation 2
- Then a constant μ_A is calculated by using equation 3.
- Further find minimum contrast C_{min} by using equation 4.
- Finally area in the image having C >C_{min} marked as microcalcification in the form of small spots.

IV. RESULTS AND DISCUSSIONS

Foveal segmentation is applied on 30 mammograms, in which microcalcification tumour present in 20 mammograms and 10 mammograms are normal, and each mammogram divided into sixteen different different objects. Microcalcification may be present in mammogram and distribution of calcification is different different, That mean presence of microcalcification doesn't sure that a mammograms have cancer tumour.Segmentation of pre-processed mammograms is done by foveal segmentation and result of segmentation is shown in these figures.

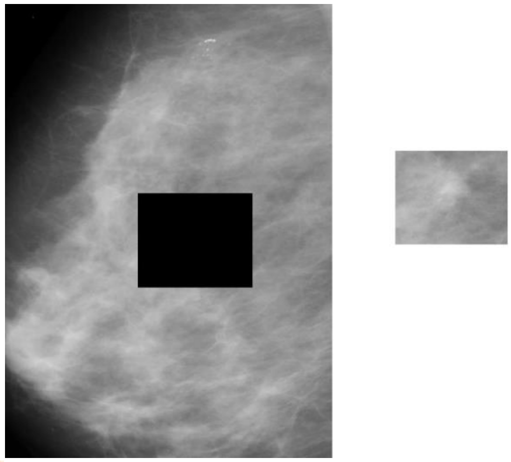

Fig. 9 Single ROI of Image as Object and Mammogram Without Object

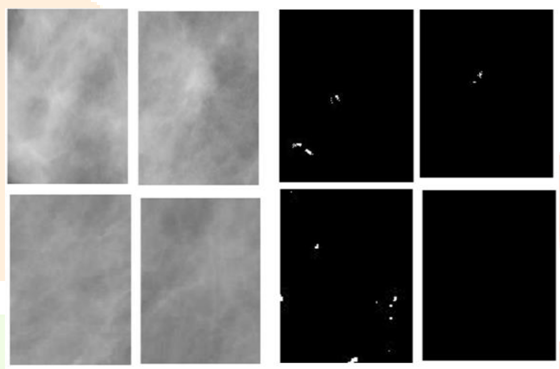

Fig. 10: Different ROIs of Mammogram and Respective Segmentation image

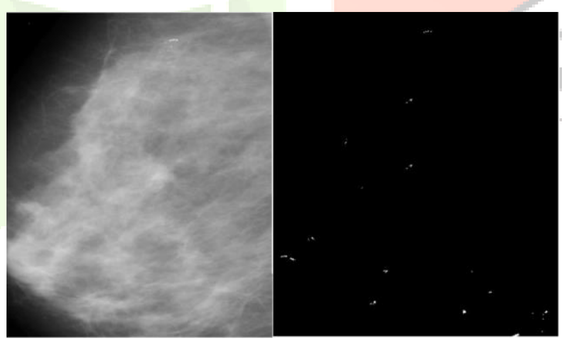

Fig. 11 Segmentation of Mammogram

V. FUTURE SCOPE

The present work dealt with only segmentation of mammograms. Further work can be carried out to find different different feature of mammogram by using GLCM technique and then apply ANN and SVM technique for classification to find normal and abnormal mammograms

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