

# Detection of Tumor in Mammograms Using Canny Edge Detection Technique

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**Abstract** -Mammography helps to provide some criteria in order to help the physicians to decide whether a certain tumor is malignant or benign. A mammogram is an x-ray of the breast tissue which is designed such that it can approximately identify the abnormalities. In mammograms selection of suspected area is easy as it looks brighter than its surrounding pixels. The method used for detecting tumor in breast is based on edge based segmentation for which we are using Canny Edge Detection Technique. The work proposed is based on the following procedure: (a)Removing the background information (b)Applying the edge detection technique and retrieving the largest ROI (c)After getting the close loops, filling is performed in order to highlight the tumor (d) Performing the morphological operations which are erosion and dilation. This method was tested over multiple images and implemented using matlab code.

**Keywords**- Mammogram, Canny Edge Detection, Morphological, ROI

## I. INTRODUCTION

Mortality rate among women is increasing day by day due to cancer. Generally women around 45 years old are most likely suffering from this disease [1]. At present there are various techniques available for the diagnosis of such type of diseases. Early detection increases the survival rate whereas delayed diagnosis can reach the patient to an unrecoverable stage and hence results in death. However, current methods of treatment are very effective but only for the early stage of breast cancer. At current large number of diagnostic methods are available, among which mammography is the most reliable method for detecting early breast cancer [2]. The analysis of mammograms include following these steps: (a) Enhancement of preselected features (b) Localization of area which is suspected to be a tumor (c) Classification of the extracted areas into Benign or Malignant tumor [3].

The analysis is difficult due to several reasons. It involves the analysis of small features with low contrast which is superimposed onto non-uniform backgrounds. The

mammogram images are scanned first then are digitized for further processing that reduces the difference between background and tumor. In addition the presence of noise, ducts and glands increase the background variations of tumor area. The boundaries of the suspected area are almost fuzzy and in some cases are partially available. Also the early stage tumors are very small in size. Various image processing techniques are available for enhancement of images, localization of objects and pattern classification. Here, our aim is to just extract the tumor and no classification between benign and malignant tumor is performed. Section II involves the details about the recent work in the field of tumor extraction.

Section III involves the techniques being used in this paper to extract the tumor in the breast. Section IV contains the experimental results of the techniques that are described in this paper. Section V shows the comparative results by previous method and proposed method. And the final section VI consists of conclusion and the future work information.

## II. RECENT WORK

We have studied about the various techniques which were employed in order to extract the tumor, subtraction based segmentation is one of them. Image subtraction or pixel subtraction is a process whereby the digital numeric value of one pixel or whole image is subtracted from another image which makes the background disappear leaving only the target. It simply compares the previous frame image with the current one. Image subtraction [5]. In previous work implemented subtraction on two images, the segmented image and the converted RGB image and finally obtained the tumor that is present in the screened mammogram. Although this method provides automatic segmentation but works accurately only with the images having low density. Since this method works on the basis of brightness difference between the original and enhanced image, in addition I tumor extraction, it sometimes also extract the irrelevant brighter part of mammogram that leads to false detection. So in order to improve the accuracy of detection we are using canny edge detector for tumor extraction that considers two characteristics for tumor detection. These are

brightness and close loop that means it will detect the tumor only when the close loop is obtained at the same brighter region.

### III. PROPOSED METHODOLOGY

#### A. Image enhancement

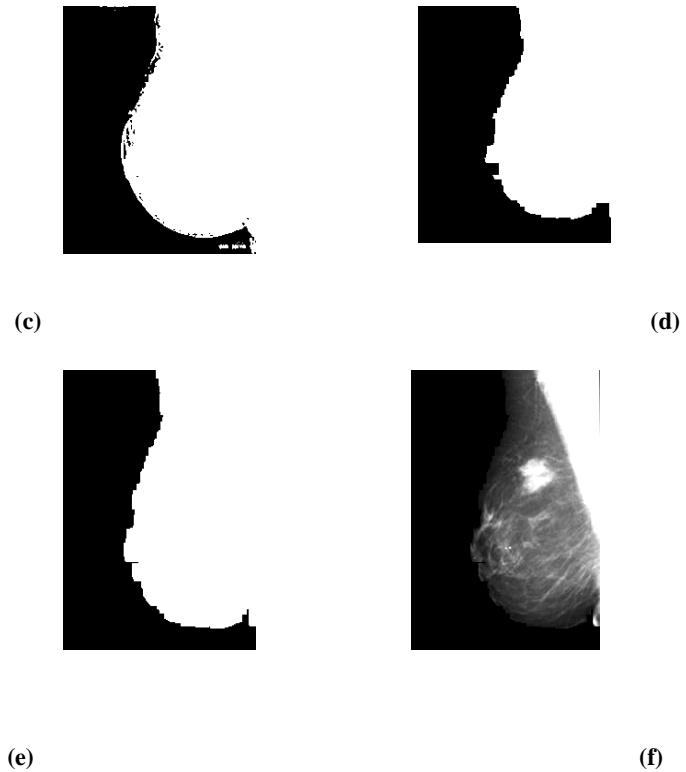
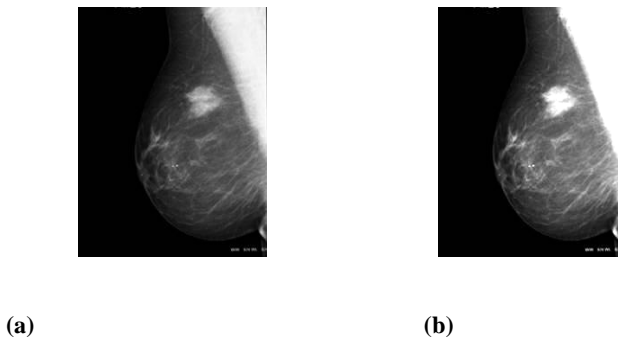
It is a preprocessing step that plays an important role in image processing at low level. The underlying principle of preprocessing is to enlarge the intensity or brightness difference between objects and background and to produce more proper and reliable representations of breast tissue structures. Here enhancement is performed because of low contrast of mammographic images and variations of intensity of objects with background [4]. Fig 1(b) shows the image after performing enhancement.

#### B. Remove artifacts

It includes the removal of background information such as labels and text. In it we perform the following steps:

- a) Set a threshold in order to convert gray scale image to binary image. Here the threshold value we are taking is 20 which is obtained by trial and hit method.
- b) After getting the binary image, our next step is based on morphological operations which are erosion and dilation. In order to erode and dilate the image, the structuring element we are taking is disk having radius of 8 pixels with 8 approximations. At this stage all the binary objects are cleaned except the breast region.

The resulting binary image is then multiplied with the original mammogram image to get the final image without artifacts. Fig 1(f) shows the image after removal of artifacts.



**Fig .1.(a)shows original image (b)Shows enhanced image (c) Shows thresholded image (d) Shows eroded image (e) Shows dilated image (f) Shows image after removal of artifacts.**

#### C. Apply canny edge detection technique

An edge is a high frequency component at which abrupt changes take place corresponding to the features of image such as illumination, texture, contrast etc. When we talk about edge based detection, edges play an important role in extraction of ROI. In our work, edges are used to extract the close loops in our test image and these close loops are highlighted and are hence our suspected area is extracted. Here, in order to separate suspected area, we are assuming two characteristics of tumor defined by the radiologists. These are Brightness and at that brighter area, presence of a Close Loop is already an abnormality in itself. There are various edge detection techniques which are currently available such as Roberts, Sobel, LOG, Prewitt edge detection techniques. Here, we are using canny operator for edge detection as it provides stronger edges as compared to other edge detectors. It includes the following steps which are given in flowchart shown below.

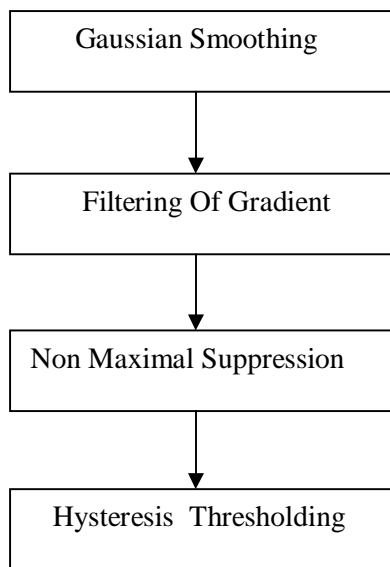


Fig. 2 Flow chart showing different steps of Canny edge detection technique.

### 1) Gaussian smoothing

It is the first step of canny edge detector at which denoising is performed with the help of 2D Gaussian filter. Presence of noise may lead to the unintended edges, hence denoising is performed. Quality of Smoothing depends upon the value of sigma which is also known as standard deviation. Sigma defines the width of Gaussian filter such that it should neither be too small nor too large and most importantly, the value of sigma must be positive because negative value of sigma indicates the observation through infinitesimally small area which is impossible. The smallest value for sigma can be 0.5.

### 2) Gradient filtering

In image processing, gradient refers to the distribution of the brightness throughout the image. High value of gradient means high brightness or intensity level at that pixel. Gradient value is not only the measure for brightness but also for the direction of edges. Edges are normal to the gradient. The series of pixels at which there are abrupt changes in gradient value from pixel to pixel indicates the presence of edge.

Its magnitude value can be obtained using the following formula:

$$|G| = |G_x| + |G_y|$$

Where  $G_x$  and  $G_y$  are the gradient values computed by using Sobel mask in x and y direction respectively and edge direction can be computed by using the following formula.

$$\Theta = \text{invtan} (G_y / G_x)$$

### 3) Non maximal suppression

After having gradient image, obtained edges are thick, due to which it becomes difficult to properly localize the edges. So in order to have thin edges, we perform the next step i.e. non maximal suppression. At this stage, the pixels having maximum value of gradient are preserved and the pixels at which the gradient value is not maximum are suppressed that means they are set to zero.

### 4) Hysteresis thresholding

Suppression leads to the partial filtering of relevant pixels so in order to suppress the remaining irrelevant pixels, we perform the next step i.e. Thresholding. The type of thresholding that canny edge detector uses is hysteresis type of thresholding, in which two thresholds are used. These are high threshold and low threshold. The pixel having the value greater than high threshold is set as an edge pixel and the pixel having the value greater than the low threshold and is having a path to the edge pixel is preserved whereas pixel having gradient value greater than low threshold and is not connected to edgel is suppressed. In our work we are using the following expression with the help of which the threshold value will be calculated dynamically at run time for each image:

$$\text{High Threshold} = \min (\text{find} (\text{cumsum} (\text{counts}) > \text{PPNE} * \text{m} * \text{n})) / 64$$

Where PPNE is the percentage of pixels which are not taking part in the formation of edges. Here the value we are taking is 0.7. The value for low threshold is obtained by multiplying the threshold ratio with high threshold value. The threshold ratio we are using is 0.4 for each mammogram image. Hysteresis thresholding is performed in order to have unstreaked edges and helps to trace the true edges.

### 5) Filling of close loops

At this stage after having edges, we look for the close loops and which are then highlighted with the help of Imfill in built command of matlab that fills all the close loops present in that image. This operation also comes under the category of Morphological operations. It fills holes in the binary image BW. A hole is a set of background pixels that cannot be reached by filling in the background from the edge of the image.

### 6) Perform erosion and dilation

Erosion is one of two fundamental operations in morphological image processing from which all other morphological operations are based. The erosion [6], of f by a disk structuring element b at

any location  $(x, y)$  is defined as the minimum value of the image in the region coincident with  $b$  when the origin of  $b$  is at  $(x, y)$ . Erosion of a binary image  $f$  by a structuring element  $s$  (denoted  $f \ominus s$ ) produces a new binary image  $g = f \ominus s$  with ones in all locations  $(x, y)$  of a structuring element's origin at which that structuring element  $s$  fits the input image  $f$ , i.e.  $g(x, y) = 1$  if  $s$  fits  $f$  and 0 otherwise, repeating for all pixel coordinates  $(x, y)$ . Erosion removes small-scale details from a binary image but simultaneously reduces the size of regions of interest, too. So in order to restore the original shape of ROI, we perform dilation.

#### IV. EXPERIMENTAL RESULTS

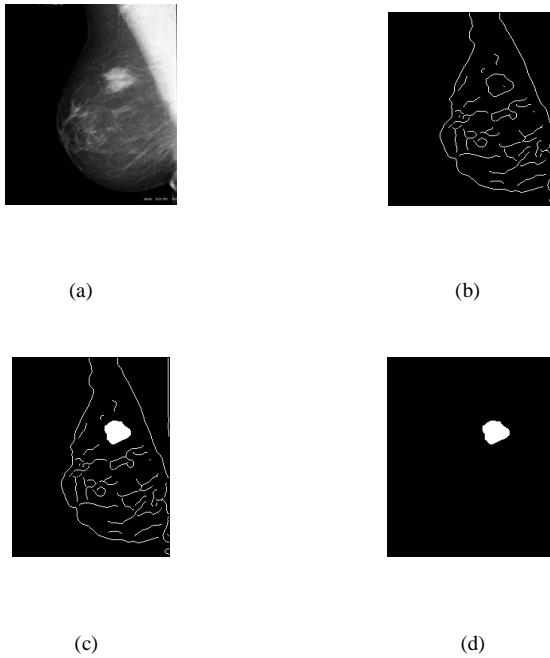


Fig .2. (a) Shows enhanced image (b) Shows image after edge extraction (c) Shows image after filling of close loop (d) Shows extracted tumor.

#### V. COMPARISON WITH PREVIOUS METHOD

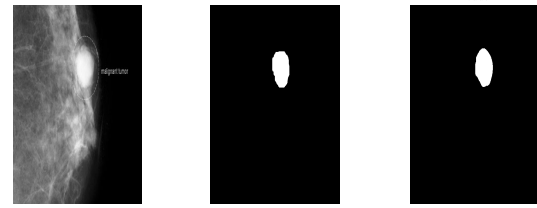
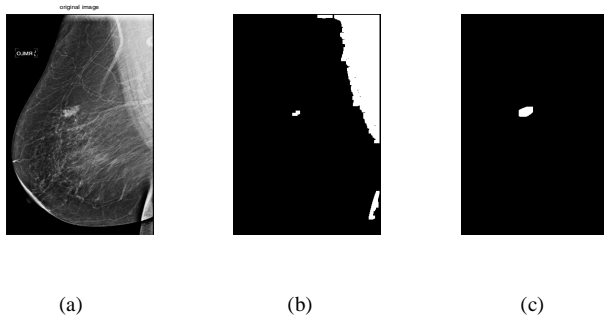


Fig.3 (a) and (d) are the original images containing tumor (b),(e) are the results by previous method whereas (c),(f)are the results by the proposed method.

#### VI. CONCLUSION AND FUTURE WORK

By comparison, we can see that we have got better results by our proposed method as compared to the previous one. Now we can say that the suspected area approximately has been detected with the help of Canny Edge Detection technique. This technique is used as a preprocessing step in order to extract the tumor. It provides the strong edges as compared to other edge detectors and has overcome the problem of threshold adjustment, by which we can extract the tumor by using morphological operations more easily and appropriately. For future work, the proposed algorithm can be used as a preprocessing step for disease classification on the basis of shape and features of the extracted region (which is expected to be a tumor) whether it is an malignant or benign.

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