Pre-treatment and Segmentation of Digital Mammogram

Kishor Kumar Meshram[1], Lakhvinder Singh Solanki[2]

[1]PG Student, ECE Department, Sant Longowal Institute of Engineering and Technology, India
[2]Associate Professor, ECE Department, Sant Longowal Institute of Engineering and Technology, India

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Abstract - *Breast cancer is the one of the biggest reason behind the death among females. This paper discuss an approach for pre-processing of mammograms to detect an abnormalities in mammogram images in an early stage. Mammogram is one of the most effective way to diagnosis breast cancer in an early stages but early detection of breast cancer depends on radiologist and quality of mammogram image. For reading of mammogram images radiologist required enough experience to read accurately. So there is a strong need of algorithm which pre-processed the mammograms and accurately detects abnormality in images. Our algorithm is successfully extracted the abnormal region from images. The algorithm is divided into five part: pretreatment of mammogram, extract breast region from whole mammogram, image smoothing, pectoral muscle removal, and extraction of abnormal region.*

Key Words: Mammogram, pre-treatment, Pectoral muscle, Segmentation of abnormal region.

1. INTRODUCTION

Breast cancer is second leading cause of deaths in women after lung cancer. According to American cancer society in year 2015 approximately 40,290 US women are expected to die from breast cancer and they estimated 231,840 new cases of breast cancer in year 2015[1]. In India, breast cancer incidences are increasing in younger age group between 30-40 years [2]. The report says that more than 1.8 million women were diagnosed with breast cancer and among them 571,000 deaths are only due to breast cancer in the year 2015 in world [3]. Cancer are due to abnormal growth of tissues but no one know exact cause of cancer it can only cured if it is detected in an early stages [4]. CT-scan, Mammography, and X-Ray are used to detect tumor in early stages. Commonly mammography is used to detect breast tumor in early stage. Mammogram screening is one of the most effective, low cost and highly sensitive screening technique to detect breast cancer in an early stages [5]. Mammogram is low dose X-ray of breast which is used to view breast tissue to detect an abnormality in early stage [6]. But reading of mammogram is not easy task many times radiologist read it more than two times, so there is a strong need of automatic algorithm which detect abnormalities in early stage, so that early detection of cancer will increase the life span of the patients [4].
In this paper our approach for segmentation of abnormal region after pre-treatment of mammogram image. Which help the radiologist to detect cancer in an early stage. Our paper is organized as follows: Section 2 represent the review of several preprocessing and segmentation method, Section 3 deals with the image acquisition and data base used, Section 4 presents the methodology of our algorithm, in section 5 deals with result and the performance analysis and finally section 6 concludes the paper.

2. RELATED WORK

The method presented by Shaymaa A. Hassan [7] uses region growing technique for segmentation of digital mammogram in Cranial-Caudal (CC) and mediolateral oblique (MLO) views. In this algorithm they does not crop breast region from whole mammogram which contain lots of noise. The method presented by Nadia Smaoui [6] developed computer-assisted diagnosis system (CAD) to segmentation of abnormal region by using Marching Square method. Author extracted the outline of breast by using principle of Marching square. Marching square is a computer graphics algorithm that generate 2-D scalar field. After breast outline detection they extracted suspicious region from breast region but accurately detection of breast outline by using this method is not possible.

Naglaa S. Ali Ibrahim [3] developed an algorithm for pre-processing of mammogram images by using morphological operations, and uses Band Limited Histrogram Equalization (BLHE) method for contrast enhancement of mammogram images. After preprocessing of image, otsu's threshold method are used to segment mammogram images but this algorithm does not extract the abnormal region from mammogram. When contrast enhancement is done than contrast of background noises is also enhanced, these are losses of this algorithm.

Method presented by Kanchan Lata Kashyap [8] uses median filter for noise removal and uses fuzzy-C-means with thresholding for extraction of suspicious region from mammogram. But they not remove pectoral muscles from mammogram so in segmentation this muscles may be treated as abnormal tissues. Before segmentation of mammogram, breast region should be extracted from whole mammogram or cropping of breast region. Image cropping reduced the false alarm rate.

In this paper, we will develop an algorithm for pre-processing of mammogram and extract abnormal region from mammogram image.

3. MAMMOGRAPHY IMAGES

Mammogram is a low dose X-ray of breast region. In this section we discuss about mammogram acquisition and mammogram database which is used to test our developed algorithm.

3.1 Acquisition of mammography images

Acquisition of an image is very important step in the field of image processing specially in medical imaging. The selection of sensor and acquisition conditions affects the quality of mammogram images. Mammogram is screening method which is used to detect abnormality in breasts. For get better result mammogram is taken from different angles.

3.2 Mammogram database

Database include number of mammogram images sampled perform in any number of years. Mammogram database are available to the scientific research and contribute to development of algorithm for detection of cancer in medical field [6]. Most of database are not available for public. The most easily accessible and most commonly used database is Mammographic Image Analysis Society (MIAS) which is available for researchers [9].

4. METHODOLOGY

Our method contains five steps. First step consists selection of mammogram and pre-treatment of mammogram. Then we crop breast region from whole mammogram after that use median filter for smoothing of cropped image. In next step remove pectoral muscles from cropped image and finally extract abnormal region from mammogram. Flow chart of our model is given in Fig. 1 which includes all steps.
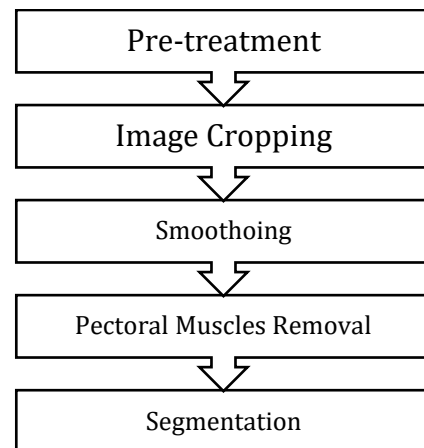

Fig. 1: Flow chart of methodology

4.1 Pre-treatment of mammogram

After selection of mammogram image pre-treatment is compulsory step to remove noise which occurs during acquisition of image. Pre-treatment is done to improve quality of the mammogram image and minimizes the noise. This sage is done in following steps:

Step 1: First of all convert original image into binary image by applying threshold technique. Threshold is the technique which separate the background of mammogram to breast region. It is given by mathematical formula [10]:

$$C_i = \sum_{i=1}^{m} Ci \leq T1$$

$$R_i = \sum_{j=1}^{n} Ri \leq T2$$

Where i, j are the number of columns C and rows R, and T_1 T_2 are threshold value for column and rows respectively.

Step 2: After change image into binary image remove background noise such as label and other noises. For remove label first of all fill holes on binary image and then select maximum area from binary mammogram which is our breast region. Fig. 2 shows the pre-treatment step.


(a)

(b)

(c)

(d)
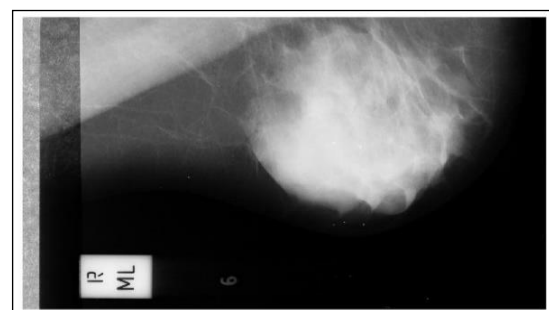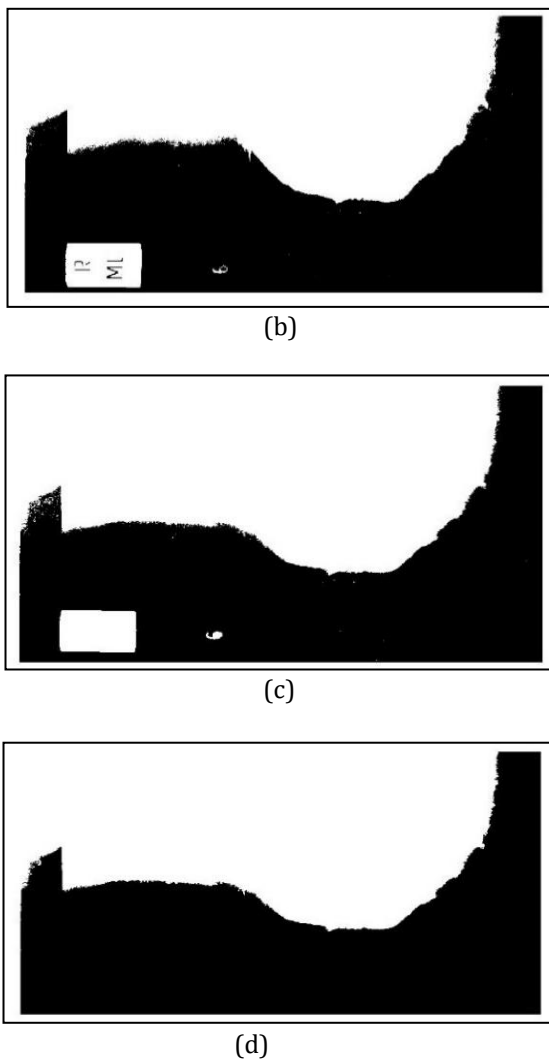
Fig. 2. Pre-treatment of mammogram: (a) Original image, (b) binary image, (c) Hole filled image, (d) Noise remove image

4.2 Image Cropping

In original mammogram image breast region cover only 30% of the whole mammogram and this is cause of high false alarm [6]. Therefore done cropping or selection of breast region from entire mammogram. This step also help used to reduce noise. Fig. 3 shows the original image with the corresponding cropped mammogram image.

(a)   (b)
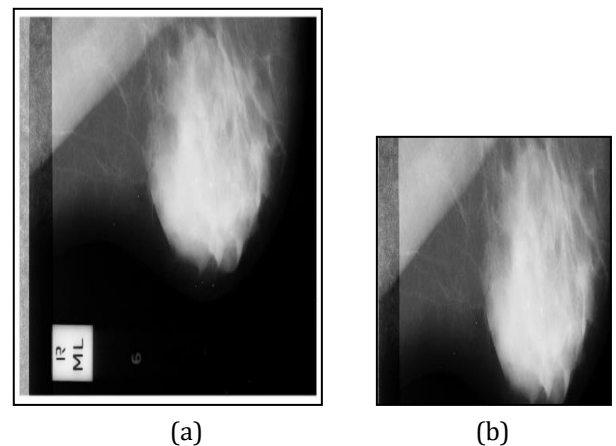
Fig. 3. Image cropping: (a) Origional image, (b)Cropped image

4.3 Image Smoothing

A 2-D median filter in a 3-by-3 connected neighborhood are used to smoothing application of image. In this step denoised vertical and horizonal lines which is present in digital mammogram [3]. Median filter also supressed the fine edges of mammogram image. A 3-by-3 median filter replace the pixel value with mean of neighboring pixel values, it replace it with median of those values. Fig. 4 shows the smoothing application in mammogram image.


(a)   (b)
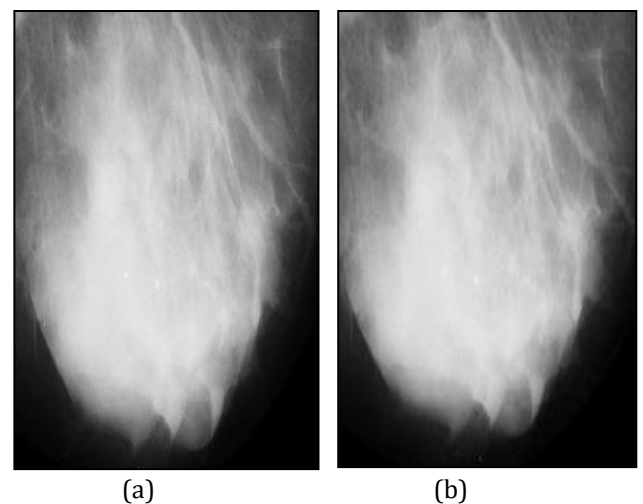
Fig. 4. Smoothing operation: (a) Cropped Image, (b) Smoothed mammogram image

4.4 Pectoral Muscle Removal

In this step remove pectoral muscles which make easier to segmentation of abnoraml region from mammogram [10]. Pactoral muscles may lies right or top corner of mammogram, its depends on the view of mammogram.

This step is done in following manner: Smoothed image is blurred by using gaussian blur filter an then change this blur image to binary image. Now labelled this binary image, for labelling select one pixel and substract to other pixel, the resultent image has no pactoral muscles. Now it is possible that steep may change so we use dilate and erode method to remove this steep [11]. Fig 5 shows step wise result for pectoral muscles removal of mammogram image.


(a)   (b)

(c)   (d)
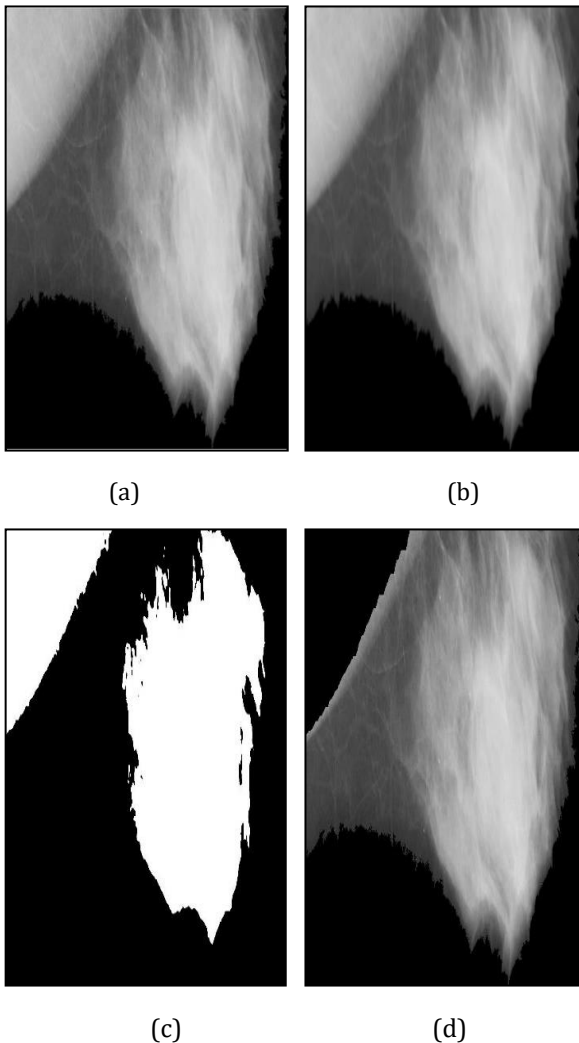
Fig. 5. Pectoral muscles removal process: (a) Cropped image, (b) blurred image, (c) thresholded image, (d) Pectoral muscles removed image

4.2 Segmentation

Segmentation is very important step in tumor detection in mammographic image. The aim of segmentation is to divide processed image into sub region which is further used in analysis [3]. Segmentation of image is done by using thresholding technique. Threshold separate the

background and breast region. The pixel value less than threshold value are classified as background and threshold value greater than pixel value are classified as segmented region. Fig. 6 shows the segmentation region from pectoral muscles removed image.

(a)   (b)
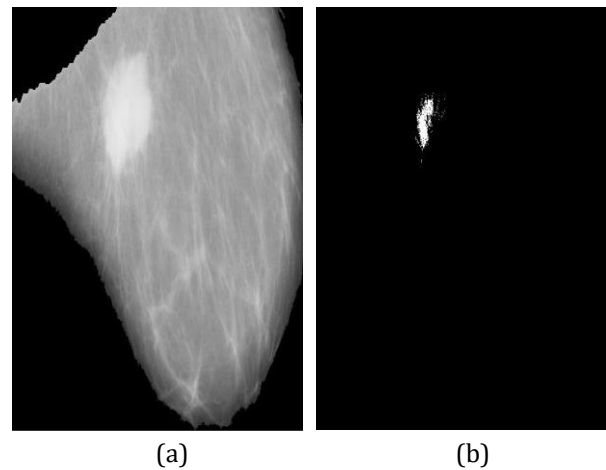
Fig. 6. Segmentation of mammogram: (a) Pectoral muscles removed image, (b) Segmented region.

5. CONCLUSION

Detection of breast cancer in last stages is the major cause of death among females. In this paper we presents an algorithm for early detection of tumor which helps radiologist. Our model is successfully tested on MIAS data base which contain 322 mammogram images. Pretreatment of image is done by using threshold technique and 2-D median filter is used to smoothing of image. We successfully extracted abnormal region from whole mammogram. This result indicate that our system can detect tumor in an early stage. Also our model is low cost and can be used in any general computer.

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BIOGRAPHIES

Kishor Kumar Meshram
PG Student, ECE Department
SLIET, Longowal (Pb)
India

Lakhvinder Singh Solanki
Associate Professor, ECE Department
SLIET, Longowal (Pb)
India