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A Novel Approach for Breast Cancer Detection and Segmentation in a Mammogram

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Abstract

Mammography is a well-known method used for the detection of breast cancer. Many researchers worked in the area of breast cancer detection and proposed segmentation methods. However, no solution given by researchers is best promising and has limitations and it is still a challenging problem to solve. We introduce a simple and easy approach for detection of cancerous tissues in mammogram. Detection phase is followed by segmentation of the tumor region in a mammogram image. Our approach uses simple image processing techniques such as averaging and thresholding. We introduce a Max-Mean and Least-Variance technique for tumor detection. Experimental results demonstrate the effectiveness of our approach.

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Keywords: Breast cancer detection; Image Segmentation; Mammograms; Smoothing; Window mapping.

1. Motivation

Breast cancer is the main leading cause of death for the woman in world. It is observed that early detection of malignancy can help in the diagnosis of the disease for woman and it can help strongly to enhance the expectancy of survival. For the detection of breast cancer, various techniques are used in which mammography is the most promising technique and used by radiologist frequently. Mammogram images are usually of low contrast and noisy. In breast mammography, bright regions represent cancer. In some mammogram images, malignant tissues and normal dense tissues both may be present. To contrast between malignant and normal dense tissues is not possible only through applying thresholding. Understanding the information of mass regions of cancerous lesions in a mammogram is necessary and helps to identify the tumor and its segmentation. Therefore, detection of cancerous lesions in mammogram images becomes an active research area. Many techniques including computer-aided detection systems and intensity-based methods were introduced for breast cancer segmentation in mammogram images. However, no solution is best promising or able to satisfy detection criteria of only including cancerous regions successfully.

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2. Contribution of Our Work

Initial detection of the cancerous region in mammogram helps in early diagnosis of a diseased person which can reduce death possibilities. Methods developed for detection of the malignant region in mammograms may not be able to provide results successfully. To overcome this limitation, it is necessary to develop an approach which can segment malignant regions properly. This inspired us to work on the problem of breast cancer detection in mammogram images which are able to segment cancerous region along with detection. Consumption of time in execution is also important to provide good results in real time. Having this factor in mind, we develop an important and significant method which first detects the cancerous region and then segment the area covered by malignant tissues. In this paper, we are focusing onto detecting the malignant tissues which represent higher intensity values compared to background information and other regions of the breast. However, in case of some normal dense tissues having similar intensities to tumor region, it is necessary to detect tumor region excluding those regions successfully. We propose a method including detection followed by segmentation of mammogram images based on simple image processing techniques which provide good results in real time. Our method consists of two main steps (1) detection and (2) segmentation. In the detection phase, an averaging filter and thresholding operation is applied on original input image which outputs malignant region area. To find the malignant tissues, we create a rectangular window around the outputted region area and apply Max-Mean and Least-Variance technique. In segmentation phase, a tumor patch is found using morphological closing operation and image gradient technique to find the region boundary. We highlight the resultant region boundary and detected malignant tissues on the original input image.

3. Organization of the Paper

Organization of the paper is as follows: In section 4, we discuss some state-of-the-art methods. In section 5, we explained our method and give a detailed diagram of a whole method. In section 6, we perform our method on two mammogram images and show the comparison with one existing method. Performance analysis of our method is explained in section 7. Finally in section 8, we conclude our work.

4. Related Work

Abo *et al.* proposed an algorithm to detect suspicious region on digital mammograms[1]. Proposed algorithm is based on the Fisher information measure. Bethapudi *et al.* proposed a detection and identification method of mass structure in digital mammogram images[3] which detect malignant tissues in following steps: (1) Thresholding to remove the background information, (2) Apply median filter for random noise removal, (3) Extract the binary image contours. Thereafter, morphological open and close operations to fill the gaps in holes inside the image region. Authors proposed methodology to identify the shape of mass. Basheer *et al.* proposed a breast mass segmentation method based on adaptive median filtering and texture analysis[2]. Authors used adaptive median filtering for contouring the image. Thereafter, best contour is chosen based on the texture properties of the resulting Region-of-Interest (ROI). Dalmiya *et al.* introduced a segmentation method for mammograms using wavelet and k-means clustering[5]. Authors defined their method in following steps: (1) Discrete wavelet transform is used to extract high level details from MRI images, (2) the outputted image is then added to original input image to get sharpened image, (3) k-means clustering is performed on sharpened image to locate the tumor region. final tumor region is extracted by performing thresholding on clustered image.

Sampaio *et al.* presented a computational methodology for detection of masses in mammogram images[10] which can be described in following steps: (1) removing noise and objects outside the boundary and highlighting the internal structures of the breast, (2) regions containing mass are segmented using cellular neural network, (3) Thereafter the shape of these regions are analyzed through shape descriptors, (4) classification of candidate region is classified as masses or non-masses through Support Vector Machine.

Kekre *et al.* proposed a segmentation method for tumor detection in mammography images based on vector quantization technique using Linde Buso and Gray (LBG)[7]. Cascio *et al.* proposed a mammogram segmentation method using Contour Searching and Mass Lesions Classification With Neural Network[4]. Authors achieved to segment