Isolation of Breast Cancer Accumulation in Mammograms for Improving Radiologists Analysis

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***Abstract*—Breast cancer is one of the major causes of death among women around the world. An improvement in early diagnostic technique can help for better diagnosis of abnormalities. Mammography is the main investigation screening technique used for an early diagnosis of it. It display a small percentage of the information detected which is due to the minor difference in x-ray Attenuation between normal glandular tissues and malignant disease. This makes the detection of small malignancies difficult. This paper proposes group of pre and post processing technique with segmentation approach showing better results for medical image processing applications.**

***Index Terms*—mammography, segmentation, morphological operators, lesion**

I. Introduction

Breast cancer stays in the first place among women malignant structures list (about 30%). It is a one of the leading causes of cancer death for women all over the world According to Worldwide Health Corporation it is the fundamental reasons of the women's average age mortality. The National Cancer Institute estimates that one out of eight women develops breast cancer at some point during her lifetime [1].

The goal of mammography is to provide early detection of breast cancer. It is considered to be the most efficient technique for identifying lesions when they are not palpable and when there are structural breast modifications [2]. It shows to the physician differences in breast tissue densities and these differences are fundamental to a correct diagnosis. At present, there are no effective ways to prevent breast cancer, because its cause remains unknown [3].

Therefore urgency and importance of mammography image processing is obvious.

Manuscript received July 3, 2013; revised October 22, 2013.

Computer-Aided Detection (CADe) and Diagnosis (CADi) systems are continuously being developed aiming to help the physicians in early detection of breast cancer. These tools may call the physician's attention to areas in the mammography that may contain radiological findings.

Image segmentation plays a crucial role in many medical imaging applications by automating or facilitating the delineation of anatomical structures and other regions of interest. In digital mammography, segmentation is the process of partitioning mammograms into regions, aiming to produce an image that is more meaningful and easier to analyze [4]. After being segmented, the mammogram or the mass lesion region can be further used by physicians, helping them to take decisions that involve their patient's health.

II. Review of Medical Imaging Technique

Magnetic resonance imaging (MRI), computed tomography (CT), digital mammography, and other imaging modalities provide an effective means for noninvasively mapping the anatomy of a subject. These technologies have greatly increased knowledge of normal and diseased anatomy for medical research and are a critical component in diagnosis and treatment planning. With the increasing size and number of medical images, the use of computers in facilitating their processing and analysis has become necessary. In particular, computer algorithms for the delineation of anatomical structures and other regions of interest are a key component in assisting and automating specific radiological tasks. These algorithms, called image segmentation algorithms, play a vital role in numerous biomedical [5] imaging applications such as the quantification of tissue volumes diagnosis localization of pathology [6], study of anatomical structure [7], treatment planning [8], improvement in the diagnosis accuracy [9], and computer integrated surgery.

doi: 10.12720/ijoee.2.2.94-98

III. Mammography

Mammography is a low dose x-ray procedure for the visualization of internal structure of breast. Mammography has been proven to be the most reliable method and it is the key screening tool for the early detection of breast cancer. Mammography is highly accurate, but like most medical tests, it is not perfect. On average, mammography will detect about 80–90% of the breast cancers in women without symptoms. It works fairly well in the postmenopausal women and is inexpensive. In a screening mammogram, each breast is X-rayed in two different positions: from top to bottom and from side to side. When a mammogram image is viewed, breast tissue appears white and opaque and fatty tissue appears darker and translucent. The goal of diagnosis is to distinguish between malignant and benign breast lumps. The three methods currently used for breast cancer diagnosis are mammography, fine needle aspirate and surgical biopsy. Mammography has a reported sensitivity (probability of correctly identifying a malignant lump) which varies between 68% and 79% [Mangasarian]. Taking a fine needle aspirate (i.e. extracting fluid from a breast lump using a small-gauge needle) and visually inspecting the fluid under a microscope has a reported sensitivity varying from 65% to 98% [Mangasarian]. The more evasive and costly surgical biopsy has close to 100% sensitivity and remains the only test that can confirm malignancy. The goal of machine learning techniques is to have the sensitivity of surgical biopsy without its evasiveness and cost.

Mammography plays a central role in the process of detecting abnormalities in breast cancer screening. A mammogram is a x-ray projection of the 3D structures of the breast obtained by compressing the breast between two plates. Mammograms have an intrinsic scattered appearance due to the superimposition of densities from differing breast tissues, and the differential x-ray absorption characteristics associated with these various tissues. A high contrast is always required to differentiate very fine structures with slight differences in density, such as micro calcifications.

In the United States, breast cancer is the second leading cause of death in women. One out of eight women develops breast cancer in their lifetime. Studies have indicated that early detection and treatment improve the chances of survival for breast cancer patients. At present, mammography is the only proven method that can detect minimal breast cancers. However, 10-30% of the breast cancers that are visible on mammograms in retrospective studies are not detected due to various technical or human factors. Computer-aided diagnosis (CAD), alerts radiologists to locate suspicious locations on the images during mammographic reading. It also develops a computerized image analysis system to assist radiologists in mammographic interpretation. At present, it focuses on the detection and classification of two of the most important mammographic indicators of breast cancers: masses and clustered micro calcifications. The mammograms for a patient are digitized by a high-resolution film scanner. The digitized mammograms are then processed by automated detection programs to identify the regions containing suspicious micro calcifications or masses. In each region of interest (ROI), the identified lesion is analyzed by the appropriate classifier to estimate its likelihood of malignancy.

The digitized mammograms will be displayed on the CAD workstation. The locations of the detected lesions and their likelihood of malignancy is superimposed on the displayed mammograms. A digitized mammogram is processed with a different-imaging technique that enhances the micro calcifications and suppresses the structured background and random noise. A locally adaptive gray level thresholding technique is used to segment the potential signals.

IV. Need of Medical Imaging

The internal structure and functions of the human body are not generally visible to the human eyes.

However by various imaging technology, images can be created through which the medical professional can look into the body to diagnose abnormal condition and guide therapeutic procedures. Different medical imaging method reveals different characteristics of human body. With each method image quality and structure visibility can be considerable, depending on characteristics of the imaging equipment, skill of operator, and compromises with factors such as patient radiation exposure and imaging time.

A. Medical Image Processing System

Medical image processing system comprises of patient, the imaging system, the system operator, the image itself and the human observer. Generally, the visibility of specific anatomical feature depends on the characteristics of the imaging system and the way in which it is operated. Medical imaging systems have a considerable number of variables that must be intellectually selected by the operator. For example intensifying screens in radiography, transducers in sonography or coils in magnetic resonance imaging (MRI). Some variables are adjustable physical quantities associated with imaging process such as kilo voltage in radiography, gain in sonography, and echo time in MRI.

The quality of the medical image depends on number of factors like contrast, blur, noise, artifacts, and distortion etc.

B. Image Contrast

An imaging system translates a specific tissue characteristic in to image shades of gray or color which can be referenced as contrast. Contrast is the fundamental feature of an image. An object within the body will be visible in an image only if it has sufficient physical contrast relative to surrounding tissue, that is, it must represent a difference in one or more tissue characteristics. For example, in radiography an object can be imaged if there is adequate difference in either density or thickness of tissue.

The fundamental characteristics of an imaging system that establishes relationship between image contrast and object contrast is its contrast sensitivity. When the imaging system has relatively low contrast sensitivity, only object with a high object contrast is visible in the image. If the imaging system has high contrast sensitivity, the lower contrast object will also be visible [10].

C. Blurring

Structures and objects in the body vary not only in physical contrast but also in size. Objects range from large organs and bones to small structural features such as trabecula patterns and small calcifications. It is the small anatomical features that add detail to a medical image [10]. Each imaging method has a limit as to the smallest object that can be imaged and thus on visibility of detail. Visibility of detail is limited because all imaging methods introduce blurring into the process. The primary effect of image blur is to reduce the contrast and visibility of small objects or detail.

The original image and its blurred version, obtained through a low pass filter, are combined so that the high frequency components of the image are amplified and as a result the perception of the image around edge areas improves. All high frequency components of the image are amplified and the noise in the image will also be inadvertently amplified.

D. Artifacts and Distortion

Most of the imaging methods can create image features that do not represent a body structure or object.

These are image artifacts. In many situations an artifact does not significantly affect object visibility and diagnostic accuracy. But artifacts can obscure a part of an image or may be interpreted as an anatomical feature. A medical image should give an accurate impression of body objects in term of their size, shape, and relative positions; however, it may introduce distortion of these factors.

E. Image Noise

It is generally desirable that image brightness is to be uniform except where it changes to form an image. There is a variation in the brightness of a displayed image even when no image detail is present. This variation is usually random and has no particular pattern reducing image quality specifically when the images are small and have relatively low contrast. This random variation in image brightness is nothing but a noise. All medical images contain some visual noise. The presence of noise gives an image a grainy, textured, or snowy appearance. No imaging method is free of noise, but noise is much more prevalent in certain types of imaging procedures than in others. Shot noise is black and/or white spots removal Dropout pixels common in some types of microscopy such as interference microscopes, or from dust on a scanned negative, and also produced by dead or locked transistors in digital cameras) are typically filled in with a median filter. It can also be used to remove scratches, cracks, etc. narrow than the radius of the neighborhood

F. Consequences of an Inaccurate Reading

Consequences of an inaccurate reading of mammography can lead to

- False Positive interpretation: leading to unnecessary follow up, tests like biopsies performed on women with benign condition (good tissue).
- False negative interpretation: causing delay in diagnosis and treatment converting early stage breast cancer to a advanced stage with severe deduction for survival rate and resource utilization.

V. PREPROCESSING

Image pre-processing techniques are necessary, in order to find the orientation of the mammogram, to remove the noise and to enhance the quality of the image. Before any image-processing algorithm can be applied on mammogram, preprocessing steps are very important in order to limit the search for abnormalities without undue influence from background of the mammogram.

Digital mammograms are medical images that are difficult to be interpreted, thus a preparation phase is needed in order to improve the image quality and make the segmentation results more accurate. The main objective of this process is to improve the quality of the image to make it ready to further processing by removing the unrelated and surplus parts in the back ground of the mammogram Preprocessing may also involve in creating mask for pixels with highest intensity, to reduce resolutions and to segment the breast

VI. DENOISEING USING FILTER

One of the most important problems in image processing is denoising. Usually the procedure used for denoising, is dependent on the features of the image, aim of processing and also post-processing algorithms. Denoising by low-pass filtering not only reduces the noise but also blurs the edges. Spatial and frequency domain filters are widely used as tools for image enhancement. Low pass filters smooth the image by blocking detail information.

A. Morphological Operation

Automatic segmentation of mass is considered difficult because of the ill-defined boundaries and overlapping with fibro-glandular tissue of many masses [11]. Morphology is an operation of image processing based on shapes. The value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors [12]. The morphological operations are applied on the grayscale mammography images to segment the abnormal regions. Erosion and dilation are the two elementary operations in Mathematical Morphology [13]. An aggregation of these two represents the rest of the operations. The symbols _, Θ, o, and • respectively denote the four fundamental binary morphological operations: dilation, erosion, opening, and closing which act on the structuring element . detection aims to extract the edge of the tumor from surrounding normal tissues and background, high pass filters (sharpening filters) could be used to enhance the details of images

VII. Segmentation

In Segmentation the inputs are images and, outputs are the attributes extracted from those images. Segmentation divides image into its constituent regions or objects. The level to which segmentation is carried out depends upon the problem being solved. For the segmentation of intensity images like digital mammograms, there are four main approaches, namely, threshold techniques, boundary-based methods, region- based methods, and hybrid techniques which combine boundary and region criteria.

A. Threshold Techniques

These techniques are based on the postulate that all pixels whose value (gray level, color value, or other) lies within a certain range belong to one class. Such methods neglect all of the spatial information of the image and do not cope well with noise or blurring at boundaries .For mammograms, thresholding usually involves selecting a single gray level value from an analysis of the grey-level histogram, to segment the histogram into background and breast tissues. All the pixels with grey level value less than the threshold are marked as background and the rest as breast [14]. Thresholding uses only grey level value and no spatial information is considered .Therefore, the major shortcoming of the threshold is that there is often an overlap between grey levels of the objects in the breast and the background.

B. Boundary Based Methods

The above methods use the postulate that the pixel values change rapidly at the boundary between two regions. The complement of the boundary-based approach is to work with the regions [14].

C. Hybrid Technique

These techniques combine boundary and region criteria. This class includes morphological watershed segmentation and variable-order surface fitting. The watershed method is generally applied to the gradient of the image.

D. Watershed Transform

It can be classified as region based segmentation approach is used. Watersheds are one of the classics in the field of topography and have long been admitted as a useful tool in image segmentation.

VIII. Algorithm

Algorithm consist of group of pre and post processing operators technique with segmentation approach to detect breast cancer mass in Mammograms for improving radiologists examination which is shown in Fig. 1.

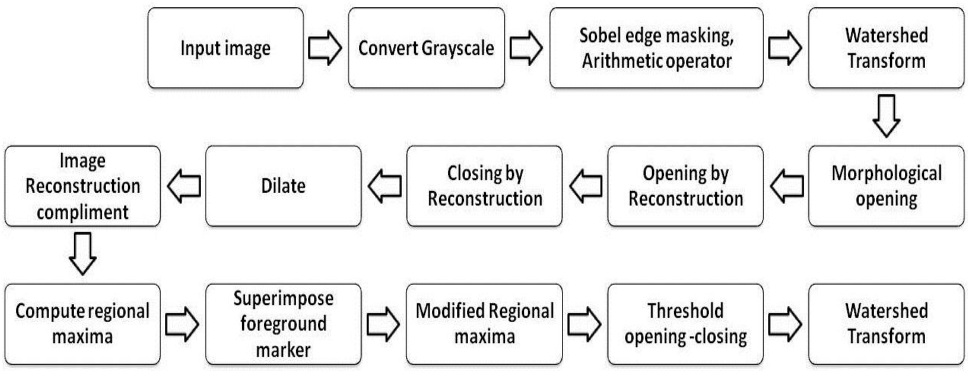

Figure 1. Working flow of proposed algorithm.

IX. Experimental Result

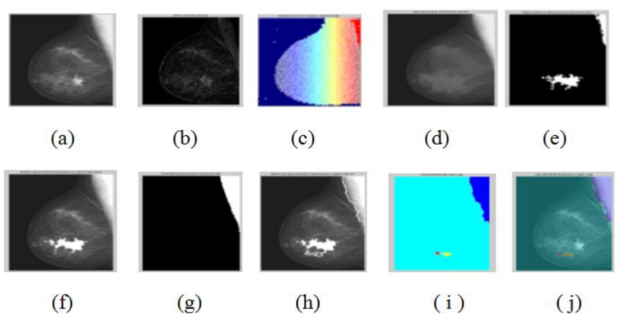

Figure 2. Sample data base.

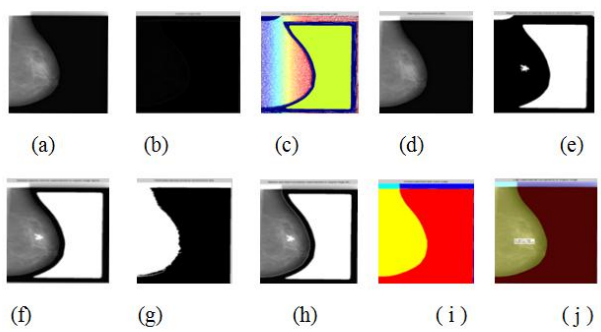

Figure 3. Real time data.

Fig. 2, Fig. 3 shows Watershed transform of gradient magnitude of mamogram image followed by reconstructive morphological processing with modified regional maxima superimposed on original image. The detection and isolation of accumulated masses from segmented region is very important for extracting useful feature measures which can be input to a classifier which classifies each region as either a mass or a false detection

X. CONCLUSION

Breast cancer is one of the leading causes of cancer death for women all over the world. Mammography is the main investigation - screening technique used for an early diagnosis of breast cancer. The resultant mammogram after applying pre and post processing technique with watershade segmentation approach has shown better result which help radiologist for investigation at early stage which will reduce mortality rate. It can be used further for the automated abnormalities detection of human breast like calcification, circumscribed masses, spiculated masses, circumscribed lesions, asymmetry analysis etc. Further works may be conducted to develop integrated system to process other cancer images like lung cancer, liver cancer for better diagnosis reducing mortality rate due to cancer.

ACKNOWLEDGMENT

Author would like to acknowledge and extend heartfelt gratitude to the honorable management for necessary support and Department of Computer Science of Information Technology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (MS) INDIA for technical support.

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