ISSN:0975-9646

Detection of Abnormal Masses in Mammogram Images

Samir Kumar Bandyopadhyay
Dept. of Computer Sc. & Engg, University of Calcutta
92 A.P.C. Road, Kolkata – 700009, India

Abstract- *Masses in the breast can be located in digital mammogram images by computationally analysing various feature statistics from the image. Any algorithm used to analyse digital mammogram images can be both time-consuming and error-prone because many areas of these images appear to have features that are mass-like but not masses. Thus false positives are produced which detract from the effectiveness of the algorithm. In this paper an efficient-straightforward algorithm to locate and record suspicious areas in a mammogram image is presented. Mammography is at present one of the available method for early detection of masses or abnormalities which is related to breast cancer. The most common said abnormalities that may indicate breast cancer are masses and calcifications. The challenge is to early and accurately detect to overcome the development of breast cancer, which affects more and more women throughout the world. Masses appear in a mammogram as fine, granular clusters, which are often difficult to identify in a raw mammogram. Digital mammogram is one of the best technologies currently being used for diagnosing breast cancer. Breast cancer is diagnosed at advanced stages with the help of the digital mammogram image. In the paper a method is proposed to make a supporting tool to easy and less time consuming of identification of abnormal masses in digital mammography images. The technique uses a form of template matching at multiple scales to locate pixels in the image, which may be part of a mass. The resulting image is adaptively thresholded to a predetermined level of accuracy and then the remaining pixels are grouped together and extracted. The type of masses, orientation of masses, shape and distribution of masses, size of masses, position of masses, density of masses, and symmetry between two pair are clearly sited after proposed method is executed on raw mammogram for easy and early detection abnormality.*

Keywords: *Breast Cancer, Mammogram, Masses, Template*

1. Introduction

Methods have already been published for the computer assisted detection of mass lesions in digital mammograms. These methods can be classified as either pixel or region based. Pixel based methods extract statistical features from each individual pixel in the mammogram image. These methods use a classification scheme to identify and record pixels of interest. In some cases, a further examination could indicate if a mass represented by these pixels is benign or malignant. The other method is region based and it searches whole areas of the mammogram image for masses. Researcher presents a hybrid method for computer assisted screening of mammograms for masses. The hybrid method is a combination of pixel and region based analysis. We employ a step, which narrows the focus of analysis from every pixel in the image to groups of pixels, which are areas in the image. These image areas are screened to determine if they have possible masses. Those with possible masses are then extracted and processed. This processing employs multi-scale tests to refine the suspicious areas. This approach offers the potential for increased efficiency and reduced error for computer assisted screening of mammogram images.

The technique uses a form of template matching at multiple scales to locate pixels in the image, which may be part of a mass. The resulting image is adaptively to a predetermined level of accuracy and then the remaining pixels are grouped together and extracted.

Imaging techniques play an important role in helping perform mammogram, especially of abnormal areas that cannot be felt but can be seen on a conventional mammogram or with ultrasound [7]. In the paper a proposed technique, we have developed a supporting tool to easy identification of abnormal masses in mammography images, which will reduce false positive (FP), false negative (FN) detection.

2. Review Methods

Cancer is a group of diseases that cause cells in the body to change and grow out of control. Most types of cancer cells eventually form a lump or masses called a tumor, and are named after the part of the body where the tumor originates. Breast cancer begins in breast tissue, which is made up of glands for milk production, called lobules, and the ducts that connect lobules to the nipple. The remainder of the breast is made up of fatty, connective, and lymphatic tissue [1].

Breast cancer is a leading cause of cancer deaths among women. For women in US and other developed countries, it is the most frequently diagnosed cancer. About 2100 new cases of breast cancer and 800 deaths are registered each year in Norway. In India, a death rate of one in eight women has been reported due to breast cancer [2].

Efficient detection is the most effective way to reduce mortality, and currently a screening programme based on mammography is considered one the best and popular method for detection of breast cancer. Mammography is a low-dose x-ray procedure that allows visualization of the internal structure of the breast.

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. Testing is somewhat more accurate in postmenopausal than in premenopausal women [3]. The small percentage of breast cancers that are not identified by mammography may be missed for just as mammography uses x-ray machines designed especially to image the breasts. An increasing number of countries have started mass screening programmes that have resulted in a large increase in the number of mammograms requiring interpretation [4].

In the interpretation process radiologists carefully search each image for any visual sign of abnormality. However, abnormalities are often embedded in and camouflaged by varying densities of breast tissue structures. Estimates indicate that between 10 and 30 per cent of breast radiologists miss cancers during routine screening [4, 5]. In order to improve the accuracy of interpretation, a variety of screening techniques have been developed.

Breast image analysis can be performed using mammography, magnetic resonance, nuclear medicine or ultrasound. So far the most effective and economical breast imaging modality has been mammography due to its simplicity, portability and cost effectiveness. Segmentation is the fundamental process which partitions a data space into meaningful salient regions. Image segmentation essentially affects the overall performance of any automated image analysis system thus its quality is of the utmost importance.

Digital mammography is a technique for recording x-ray images in computer code instead of on x-ray film, as with conventional mammography. The first digital mammography [6] system received U.S. Food and Drug Administration (FDA) approval in 2000. An example of a digital mammography system is the Senographe 2000D. The images are displayed on a computer monitor and can be enhanced (lightened or darkened) before they are printed on film. Images can also be manipulated; the radiologist can magnify or zoom in on an area. From the patient’s perspective, the procedure for a mammogram with a digital system is the same as for conventional mammography [7].

Digital mammography may have some advantages over conventional mammography. The images can be stored and retrieved electronically. Despite these benefits, studies have not yet shown that digital mammography is more effective in finding cancer than conventional mammography [8].

Initial mammographic or MRI images themselves are not usually enough to determine the existence of a benign or malignant disease with certainty. If a finding or spot seems suspicious, your radiologist may recommend further diagnostic studies. Interpretations of mammograms can be difficult because a normal breast can appear differently for each woman. Also, the appearance of an image may be compromised if there is powder or salve on the breasts or if you have undergone breast surgery.

Recent studies showed that the interpretation of the mammogram by the radiologists give high rates of false positive cases indeed the images provided by different patients have different dynamics of intensity and present a weak contrast. Moreover the size of the significant details can be very small. Several research works have tried to develop computer aided diagnosis tools. They could help the radiologists in the interpretation of the mammograms and could be useful for an accurate diagnosis [9, 10, 11].

3. Proposed Method

A mass in a mammogram image is either benign or malignant. To search for malignant masses we have developed a template that closely matches the properties of the masses in our developmental data. Masses tend to have a greater intensity than their neighbouring regions. They are somewhat circular, although they display weak or fading boundaries with neighbouring tissue.

We locate and identify objects in a mammogram image by comparing the image to the chosen template. The template is constructed from a part of another image that exhibits the visual and statistical properties of the objects being sought. Other authors have offered suitable templates. We thoroughly examined possible templates and chose the template that was most effective for the mammograms used in this research.

We used a statistical correlation to compare a template with the actual mass. Since, the size and location of each actual mass is known, a template of the same size can be generated and centred about the same location for comparison. Also, the effects of slight errors in comparisons, when the template is not centred exactly with the centre of the mass or when the template is sized differently from the size of the mass can be viewed.

The mammogram images used in this experiment are taken from the mini mammography database of MIAS [12]. 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 1024 pixels x 1024 pixels. All images are held as 8-bit gray level scale images with 256 different gray levels (0-255) and physically in portable gray map (.pgm) format. The list is arranged in pairs of mammograms, where each pair represents the left and right breast of a single patient.

To analyzing mammogram image, we segmented the mammogram into very small blocks, called Template. To reduce the complexity of the algorithm, we first degenerate the image into 2X2 pixel templates. Checks the intensity or the pixel value of the blocks and calculate the pixel value which present maximum within the template. Propagate the value in the adjacent pixel of the block is showing in figure 1. Now the entire block contains the same pixel value. So, the whole mammogram image now consists of 2X2 homogeneous blocks.

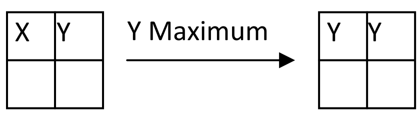

Figure 1 Formation of 2X2 Template

We repeat the same process to produce mammogram image to the 8X8 homogeneous blocks.

Major objective of the algorithms is to remove the non-masses area from the mammogram to identify the presence of abnormality clearly. The stage, intensity, type, future and treatment can only be detected on the basis of type of masses, orientation of masses, shape and distribution, size, position of masses, density of masses, symmetry between two pair etc. The outputs of aforesaid algorithms are depicted in the following figures for masses and non-masses mammograms along with the histogram and Colormap of the images.

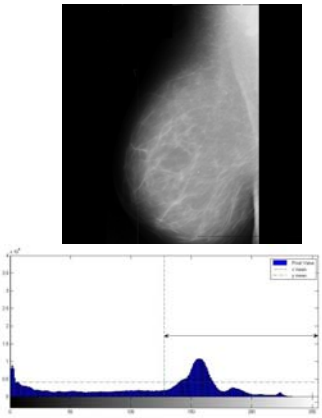

Figure 2 Normal Mammogram with Histogram and Colormap after Preprocessing

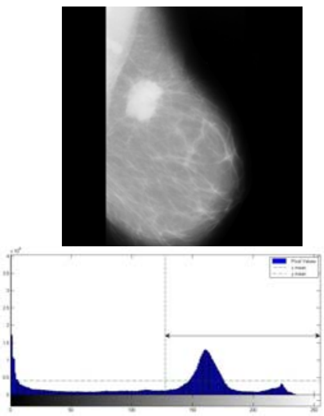

Figure 3 Mammogram containing masses with Histogram and Colormap after reprocessing

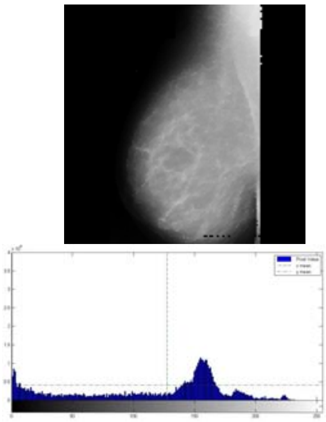

Figure 4 Normal Mammogram with Histogram and Colormap after Formation of Template

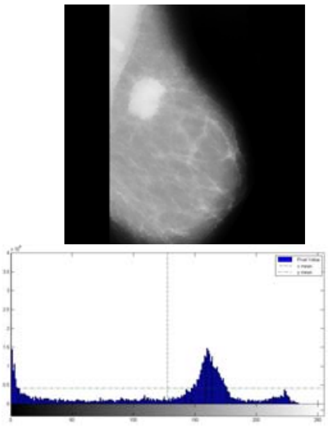

Figure 5 Mammogram Containing Masses with Histogram and Colormap after Formation of Template

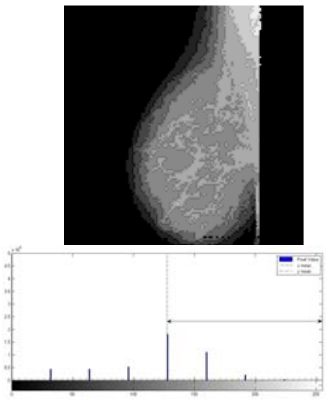

Figure 6 Normal Mammogram with Histogram and Colormap after Color Quantization

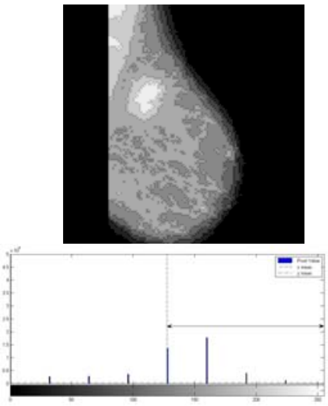

Figure 7 Mammogram Containing Masses with Histogram and Colormap after Color Quantization

The primary measure for selection for the various templates is the template sensitivity to scale errors. When a template is compared to portions of the mammogram image, a specific sizing of the template will have to occur. This sizing of a template will probably be different from the size of the actual mass in the image; this sizing introduces scale errors.

Conclusions

The primary measure for selection for the various templates is the template sensitivity to scale errors. When a template is compared to portions of the mammogram image, a specific sizing of the template will have to occur. This sizing of a template will probably be different from the size of the actual mass in the image; this sizing introduces scale errors. In other research, templates of multiple scales were used as part of the template matching process ; it produced little benefit over a single scale. Therefore, when a template is selected and subsequently used to search the image, a single template, which will match masses of varying size, is desirable.

References

[1]. Breast Cancer Facts & Figures, 2009-2010, American Cancer Society, Inc.

[2]. Norum J. Breast cancer screening by mammography in Norway. Is it cost-effective? Ann Oncol 1999, 10: 197-203.

[3]. Michaelson J, Satija S, Moore R, et al. The pattern of breast cancer screening utilization and its consequences. Cancer. Jan 1 2002; 94(1): 37-43.

[4]. Baines CJ, McFarlane DV, Miller AB. The role of the reference radiologist: Estimates of interobserver agreement and potential delay in cancer detection in the national screening study. Invest Radiol 1990, 25: 971-6.

[5]. Wallis MG, Walsh MT, Lee JR. A review of false negative mammography in a symptomatic population. Clin Radiol 1991, 44: 13-5.

[6]. FDA Web site, http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfMQSA/mqsa.cfm

[7]. National Cancer Institute (NCI) Web site, http://www.cancernet.gov

[8]. RadiologyInfo.org developed jointly by Radiological Society of North America and American College of Radiology.

[9]. E. E. Sterns, "Relation between clinical and mammographic diagnosis of breast problems and the cancer/ biopsy rate," Can. J. Surg., vol. 39, n°. 2, pp. 128-132, 1996.

[10]. R. Highnam and M. Brady, Mammographic Image Analysis , Kluwer Academic Publishers, 1999. ISBN: 0-7923-5620-9.

[11]. Dr.H.B.Kekre, Tanuja K. Sarode and Saylee M. Gharge, "Tumor Detection in Mammography Images using Vector Quantization Technique", International Journal of Intelligent Information Technology Application, 2009, 2(5):237-242

[12]. J Suckling et al (1994): The Mammographic Image Analysis Society Digital Mammogram Database Exerpta Medica. International Congress Series 1069 pp375-378.