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MAMMOGRAM IMAGE SEGMENTATION-A SHORT SURVEY

S.Chidambaranathan

HoD, Department of MCA, St. Xavier's College (Autonomous), Tirunelveli

Abstract—Breast cancer is one of the dreadful diseases that seriously affect women. It is proven that this dreadful disease ends the life of one among ten women. Mammogram is an efficient technique to detect breast cancer at earlier stages. This paper aims to survey image enhancement and segmentation on mammograms. Mammogram image segmentation aims at partitioning the image into meaningful Regions of Interest (RoI).

Index Terms— Breast cancer, Mammogram image segmentation, RoI

I. INTRODUCTION

Breast cancer is one of the dreadful diseases that seriously affect women. It is proven that this dreadful disease ends the life of one among ten women. This disease occurs when the cells in the breast tissue turns to be abnormal. These abnormal cells tend to form dense tissue and thereby causing cancer. Breast cancer can be detected and diagnosed through several ways. Mammogram is an efficient technique to detect breast cancer at earlier stages.

The abnormalities cited in a mammogram are masses and calcifications. Calcifications are the deposits of calcium. The cancer can be categorized as benign or malignant and this is determined by the shape of the mass. Usually, benign tumours are round or oval in shape and a malignant tumour can be observed with a partially rounded mass with a spike or an irregular outline [1]. Benign tumours are non-cancerous whereas malignant tumours are cancerous in which, the cells grow abnormally [2].

Retrospective studies show that, in current breast cancer screenings, 10%–25% of the tumours are missed by the radiologists [3]. The clinical significance of the early diagnosis and the difficulty of the diagnostic task have generated a tremendous interest in developing Computer Aided Detection (CAD) schemes for mammographic interpretations.

This paper aims to survey image segmentation on mammograms. Mammogram image enhancement makes sense of processing mammogram images in such a way to enhance the contrast and reduce the noise, which makes it easier for radiologists to detect abnormalities. Mammogram image segmentation aims at partitioning the image into meaningful Regions of Interest (RoI).

II. MAMMOGRAM IMAGE SEGMENTATION

Mammogram image segmentation aims at partitioning the image into meaningful Regions of Interest (RoI). The segmentation algorithms can be decomposed into breast region segmentation and RoI segmentation, on the basis of regions needed to be segmented. Breast region segmentation splits the mammogram image into a breast region and a background in order to focus more to detect abnormalities in the breast region and to minimize the effect of background. RoI segmentation segments the suspicious regions to check for abnormalities.

Segmentation with multiple views can be divided into left and right mammograms, two mammographic views and Medio Lateral Oblique (MLO) of the same breast and same view mammograms taken at different times. Unsupervised segmentation with single view can be decomposed into region-based, contour-based, clustering, pseudo-colour, graph segmentation and variant feature transformation and depicted in Fig 2.

2.1 Breast Region Segmentation

Breast region segmentation splits the mammogram image into a breast region and a background in order to focus more to detect abnormalities in the breast region and to minimize the effect of background. A breast region segmentation based on local threshold is presented in [19]. An algorithm based on histogram thresholding, morphological filtering and contour modelling is presented in [20]. In [21], an automatic technique for digital mammogram segmentation based on a two-phase approach is presented. An algorithm that segments breast region and extracts breast contour automatically by snake or active contours is presented in [22]. In [23], a scheme is proposed to extract the contour of a RoI in mammogram images.

2.2 Regions of Interest Segmentation

RoI segmentation is divided into segmentation with a single view and multiple views. These techniques are reviewed below.

2.2.1 Segmentation with a Single View

RoI segmentation with a single view can be classified into supervised and unsupervised segmentation. We focus more on unsupervised segmentation here.

2.2.1.1 Region based Segmentation

These techniques are usually employed to segment both masses and calcifications. A new region growing algorithm for a CAD system is proposed for mass segmentation in [24]. In [25], a technique to segment suspicious masses in dense mammograms based on watershed transformation is proposed. In [26], watershed algorithm is utilized to segment micro-calcification.

2.2.1.2 Contour based Segmentation

Contour based segmentation segments masses rather than calcification. A contour based segmentation method to segment masses is proposed in [27, 28]. The work presented in [29] compares region growing and gradient based segmentation techniques.

2.2.1.3 Clustering Segmentation

These methods can segment both masses and calcifications. A local adaptive thresholding technique for mass segmentation is proposed in [30]. The work presented in [31] comes up with an initial unsupervised clustering. In [32], an algorithm namely CShells based on Deterministic Annealing (CSDA) is proposed to segment masses.

2.2.1.4 Pseudo-colour Segmentation

Pseudo-colour segmentation methods can segment both masses and calcifications. An algorithm of this type is presented in [33].

2.2.1.5 Graph Segmentation

These methods are used to detect masses. The work presented in [34] proposes a graph segmentation technique to segment masses automatically by utilizing minimum spanning tree. In [35], a comparison between minimum spanning tree based segmentation and adaptive pyramid based segmentation is carried out.

2.2.1.6 Variant Feature Transformation

Variant feature transformation is used for mass segmentation in mammograms. In [36], an algorithm to segment micro-calcification automatically is proposed, on the basis of Scale Invariant Feature Transform. In [37], the segmentation of micro-calcification is improved by the modified multi-fractal segmentation. A methodology to segment mammograms for detecting micro-calcification clusters is proposed in [38].

2.2.2 Segmentation with Multiple Views

Most common views of mammograms are Medio Lateral Oblique (MLO) and Cranio-Caudal (CC) view. Image segmentation techniques with multiple views can be divided into three categories: left and right mammograms, two mammographic views (CC and MLO) of the same breast, and same view mammograms taken at different times. Left and right mammograms evaluates by checking the symmetry of the fibroglandular tissue of two breasts. In the two mammographic views (CC and MLO) of the same breast, the evaluation is done by checking the fibroglandular tissue in CC and MLO images of the same breast.

2.2.2.1 Left and Right Mammograms

Region splitting technique is proposed in [39] and is applied over two images, which are the results of bilateral subtraction technique. An automatic registration framework is proposed in [40], to identify the differences between corresponding mammograms. In [41], a method for mammogram image registration is presented.

2.2.2.2 Two Mammographic Views (CC and MLO)

The work proposed in [42] applies the Bayesian network multi-view system to detect the abnormalities. An ipsilateral multi-view CAD scheme is presented in [43] to detect masses in digital mammograms. A procedure is proposed in [44] for joint analysis of breast's two views, by combining the results of algorithms detecting mass and micro-calcifications detection.

2.2.2.3 Same View of Mammograms Taken at Different Times

A methodology is developed in [45] to provide automatic regional registration for mass detection in mammograms. A landmark-based registration framework of mammograms is presented in [46]. A non-rigid mammogram registration approach is introduced to match mammograms in [47]..

III. CONCLUSION

This paper presented the survey on image segmentation methods. Mammogram image segmentation aims at partitioning the image into meaningful Regions of Interest (RoI). There are four major categories of image enhancement techniques and they are conventional, region based, feature based and fuzzy enhancement techniques. The segmentation algorithms can be decomposed into breast region segmentation and RoI segmentation, on the basis of regions needed to be segmented.

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S.Chidambaranathan, received his post graduate degree in Mathematics from Madurai Kamaraj University, Madurai. He also earned post graduate degree in Computer Application and M.Phil in computer Science from Manonmaniam Sundaranar University, Tirunelveli. Presently he is working as HoD in the Department of MCA, St. Xavier's College (Autonomous), Palayamkottai, Tamil Nadu. He is an author for many books including "PHP for beginners", "XML - An Practical approach" and "Everything HTML". He has published many research papers in National, International journals and conference proceedings. He can be contacted at E-mail: scharan2009@rediffmail.com

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