International Journal of Software Science and Computational Intelligence
Volume 12 • Issue 1 • January-March 2020

Detection of Microcalcifications on Mammograms

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ABSTRACT

Breast cancer is a common disease of women. The number of new cases diagnosed in Algeria is increasingly high and it is the first cause of cancer related deaths for women. The microcalcifications are considered the primary sign of breast cancer. The early detection of these allows doctors to take the necessary measures for the treatment of this pathology. Medical imaging has made possible enormous progress in the field of diagnosis and provides an important contribution to the care of patients. This article proposes an approach for the segmentation and detection of microcalcifications in mammographic images based on wavelets, K- means, and the windows of Parzen, in order to detect the presence of breast cancer as early as possible and to avoid radical treatment such as the removal of the breast.

KEYWORDS

Breast Cancer, Detection, K-Means, Microcalcification, Parzen Windows, Wavelets

1. INTRODUCTION

The world of medicine has changed at the beginning of the twentieth century to the discovery of a new tool that is the medical imaging.

Medical imaging is a growing field; it is the result of the development of digital technologies. A better knowledge of the internal anatomy of the patient, carried out using the various tools of the medical imaging rely on the practitioners, doctors today are able to establish a better diagnosis and plan the appropriate therapy for a given case (Perez-Ponce, 2009).

Breast cancer is one of the diseases which threaten the lives of many women all over the world. The number of new cases diagnosed in Algeria is increasingly high and it represents the first cause of cancer death for the women. The interest of the breast cancer routine screening in asymptomatic women over age 50 has been shown. It can detect the lesions at an earlier stage, increasing the chances of recovery.

Small clusters of microcalcifications appearing as collection of white spots on mammograms are early warnings of breast cancer. Primary prevention presently seems impossible since the causes of this disease remains to be discovered. Thus, an improvement in the early diagnostic techniques of breast cancer is an extreme necessity.

DOI: 10.4018/IJSSCI.2020010105

Diagnosed and treated early, breast cancer has a very good prognosis in terms of survival; however, if the disease is at an advanced stage, it is more difficult to eradicate it (risk of metastasis). This is why a cervical cancer screening by mammography is necessary.

Mammography is the main tool used for screening and early diagnosis. The detection is performed on X-ray mammography which provides better results for breast cancer prognosis. Divers computer-aided diagnosis systems have been developed to improve the detection of primary signs of breast cancer: masses and microcalcifications. Microcalcifications are easily detectable in mammogram because of their high degrees of density and they appear as white dots on gray tissue. In reality, there are tiny deposits of calcium.

This primary sign of breast cancer represents the majority of problems encountered on screening mammograms. They reveal, according to published series, 30 to 50% of subclinical cancers, mostly strict intraductal cancers (CICS), which is considered as non-invasive (Dilhuydy, 2001).

Several studies bas been proposed for detection of microcalcifications in mammogram images.

Ayman A. Abu Baker (2015) proposed a method based on two main stages. The probable MCs region (PMR) is detected based on visual characteristics of the MCs on mammograms. Classification of the PMR to true and false positive is done used wavelet decomposition transform.

Sayedeh Somayeh Hosaini and Mehran Emadi (2015) proposed a method for suspicious areas detection of breast cancer tumors based on wavelet and hidden Markov model. Firstly, they use median filter that in order to smooth and remove noises of mammogram images. Segmentation step is done using the wavelet transform. Markov model is used with a tree structure in order to extract statistical properties of wavelet transform components which enhance cancerous tumors detection of mammogram images.

Shruti Dalmiya et al. (2012) present an approach of mammogram images using wavelet transformation and K – means clustering for cancer tumor mass segmentation.

Digambar A Kulkarni and Kochari (2016) proposed a method for detection of breast cancer using k-means algorithm. The preprocessing image is enhanced using Adaptive Histogram equalization. K means clustering algorithm is used to segment the processed image. Then mean and standard deviation features of the mammogram are extracted. These extracted features are fed as input to the Support Vector Machine classifier to classify the mammogram as benign or malignant.

Belgrana and Benamrane (2013) proposed a hybrid system using Neural Networks (NN) and Evolutionary Algorithm (EA) for detection of anomalies present on mammograms. They used growing region algorithm to extract regions and the RBF neural network to detect the suspect regions.

Saravanan et al. (2017) proposed an approach for segmentation of mammograms using k-means clustering based on thresholding algorithm. The digital mammographic images are given to image preprocessing and filtering steps before they are segmented. The preprocessed mammogram is filtered by Gaussian Low pass filter. Then the mammogram images are given as input and are segmented by both thresholding technique and k-means clustering.

Wang and Shitong (2008) proposed a novel image thresholding method based on weighted Parzen-window estimation. Parzen window algorithm is used for estimating the corresponding probabilities.

Other methods have been proposed for the detection of microcalcifications of mammogram images. These methods are based on fractal models (Shirazinodeh et al., 2015), the support vector machines (SVM) (Gaikwad, 2015), mathematical morphology (Zhang et al, 2014), the Bayesian models (Domingues and Cardoso, 2014), the fuzzy logic (Langariza et al., 2016), the local Chan-vese Model, hierarchical fuzzy partitioning and fuzzy decision tree induction (Boutaouche and Benamrane, 2017), search harmony algorithm (Rahli and Benamrane, 2012) and bioinspired algorithm (Bourara, 2019)

In this paper, we have proposed an approach to detect microcalcifications in mammograms images based on wavelet transform, K-means and Parzen windows; Wavelet transform allows making a multi-scale presentation and also allows the use of image characteristics at different scales. These characteristics will be used as inputs for the k-means classifier for a first segmentation. The Parzen