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Automated Seed-based Region Growing Using the Moving K-Means Clustering for the Detection of Mammographic Microcalcifications

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Abstract
Mammography is by far the proven method of early detection of breast cancer. However, mammography is not without its problems. It is amongst the most difficult of radiological images to interpret as the images are of low contrast and features indicative of abnormalities are very subtle and minute. In this study, a new method of automated edge detection technique is proposed to detect the abnormalities in a region of interest in a mammogram. The proposed technique consists of two algorithms i.e. the moving k-means clustering and the modified seed-based region growing algorithm. Two case studies are presented for analysis purposes.

Keywords
Seed-based Region Growing, Moving K-Means Clustering, Mammographic Microcalcifications

Introduction
Early detection is vital to improve breast cancer prognosis. Mammography has proven to be the method for early detection of breast cancer [1].However, mammography is not without its problems. It is amongst the most difficult of radiological images to interpret as the images are of low contrast and features indicative of abnormalities (e.g. the presence of microcalcifications which are tiny calcium deposits) are very subtle and minute[2]. Computer-aided diagnosis (CAD) systems are expected to provide much-needed help to radiologists who sometimes have to routinely scrutinize mammograms sometimes with their naked eyes.

In this study, a new method of automated edge detection technique is proposed to detect the abnormalities in a region of interest in a mammogram. The proposed technique consists of two algorithms i.e. the moving k-means clustering and the modified seed-based region growing algorithm.

The Proposed Method
In order to accommodate the detection of edges of the object of interest automatically, two algorithms are proposed namely the moving *k*-means clustering and the proposed modified seed based region growing (MSBRG) algorithm. Figure 1 shows a schematic representation of the proposed method.

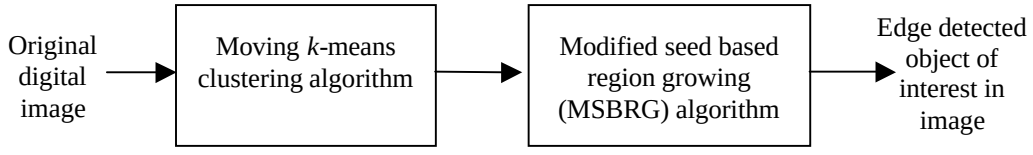

Figure 1: Block diagram of the proposed automated edge detection technique

The moving *k*-means clustering algorithm is used to automatically find the threshold value for classifying 2 regions of clusters, ie. the object of interest (the microcalcifications, if they exist) and the background. Based on the threshold value, the proposed MSBRG algorithm is applied to detect the edges of the regions of interest.

The Moving K-Means Clustering Algorithm

The K-means and Fuzzy C-Means (FCM) clustering algorithm have been used as clustering techniques[3,4]. However, both of these clustering techniques do not always perform well due to dead centre and centre redundancy problems. Moreover, they are not able to avoid the centres from being trapped in the local minimum. In order to reduce these problems, the moving *k*-means clustering algorithm (a modified version of *k*-means clustering) has been introduced[5]. This modified version of *k*-means clustering approach offers several advantages as compared to the conventional *k*-means and FCM clustering to find the cluster values. As a result, centres are not trapped in the local minimum and dead centres and centre redundancy problems are avoided.

The Modified Seed Based Region Growing (MSBRG)

Having found the threshold value from the moving *k*-means clustering algorithm, the MSBRG method is then applied on the resultant image. This is to detect the object of interest in the given image, i.e. in this case, the presence of microcalcifications. As opposed to the seed based region growing method[6], the MSBRG enable the whole image area to be scanned in turn i.e. pixel by pixel, with a pixel value that befits the threshold criterion to be taken as a centre. This is followed by the process of growing the area surrounding the particular pixel center until it cannot grow anymore. The next possible pixel that has a potential as initial seed location is then determined. The whole process is repeated until all the pixels in the given image is used up.

Results

The proposed methodology was applied on two case studies. The results are presented for analysis purposes.

Two original digital mammogram images are given in figures 2a and 3a. The resultant images after applying the algorithms are given in figures 2b and 3b.

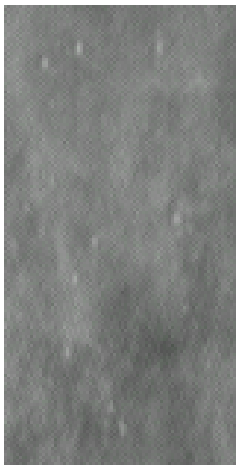

Figure 2a. The original image of mammogram A

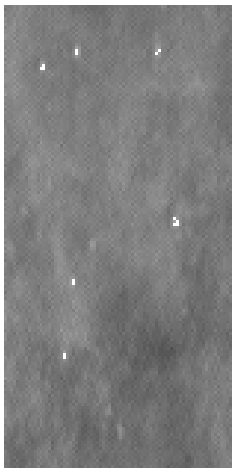

Figure 2b. The processed image of mammogram A

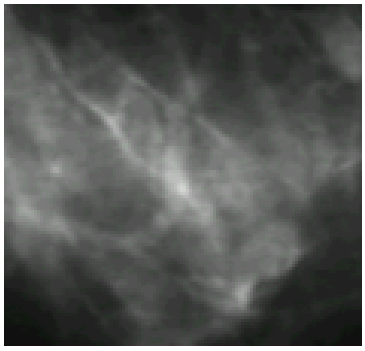

Figure 3a. The original image of mammogram B

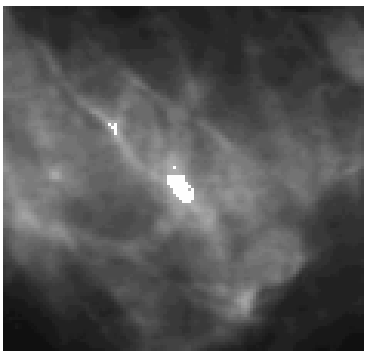

Figure 3b. The processed image of mammogram B

The whole calculation processes are automatically done and this included the calculation of the threshold values. The results show that the microcalcifications are successfully located and their margins are detected.

Conclusion.

An edge detection method using a combination of the moving *k*-means clustering and the modified seed based region growing (MSBRG) algorithm has been proposed for the detection of subtle abnormalities i.e. microcalcifications in mammograms in this

paper. This approach would prove valuable for diagnostic purposes namely in assisting radiologist in interpreting the mammogram that they have to scrutinize.

Reference

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