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Topic: Automated detection and classification of tumor from medical imaging

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ABSTRACT

Computer aided diagnosis (CAD) system has advantage over traditional methods because computer algorithms can enhance the appearance of the images and highlight suspicious areas. In this thesis, a new framework for the detection and classification of masses in mammograms has been developed. The proposed approach helps to locate suspicious mass regions with high accuracy. In present work, the most promising segmentation methods, namely fuzzy c-means (FCM), K-means (KM), marker controlled watershed (MCWS), and region growing (RG) are compared for an accurate segmentation of breast masses in digital mammograms. The results demonstrate the effectiveness of the RG method.

Thresholding method is a powerful tool for image segmentation. Otsu method is one of the most preferred thresholding methods for segmentation of various types of images. However, Otsu method has some limitation for segmentation of masses in mammographic images. To resolve this problem, a CAD algorithm is developed for the segmentation and characterization of breast tumor using Otsu thresholding method aided by morphological reconstruction filtering technique. The performance of the proposed method is evaluated in terms of relative error measure. The results show that the proposed CAD algorithm gives the satisfactory performance with respect to manual segmentation.

Region growing method is considered to be one of the most efficient region based segmentation technique. However, selection of appropriate seed pixel value plays a crucial role in region growing method for accurate segmentation of mass regions. Therefore, a statistical mean based region growing segmentation (MRGS) method is developed to automatically find the seed pixel value that makes the segmentation process very fast and accurate. The proposed approach reduces computational complexity of conventional region growing method. It helps the radiologist to analyze the in-depth diagnosis of breast tumor at considerably reduced time. The experimental results are compared with

the findings of expert radiologist and marker controlled watershed segmentation approach. The numerical and visual results demonstrate the efficacy of the proposed method and shows that proposed MRGS method outperforms over the MCWS method. In the present study, the proposed algorithm achieved the high segmentation performance at the reduced computational cost.

The watershed transformation is a powerful tool for image segmentation based on mathematical morphology. However, the main drawback of this method is the over-segmentation due to the presence of many local minima. Therefore, we propose a robust marker-controlled watershed method which reduces the effect of severe over-segmentation. In addition, this method gives higher segmentation performance and yields more accurate lesion contours in mammograms. The proposed method comprises three main steps: pre-processing, marker extraction and the final segmentation. Pre-processing algorithm is developed using top-hat morphological filter, wavelet transform followed by a noise smoothing anisotropic diffusion filter. For the extraction of robust markers to locate the accurate position of the suspicious lesions, a new approach is proposed. Finally, the extracted markers are used within the watershed algorithm to allow the reliable segmentation and quantification of masses in mammograms. The developed computer method was quantitatively evaluated using the area overlap metric (AOM), average minimum Euclidean distance (AMED) and Hausdorff distance (HD). We compared the present method with a marker-controlled watershed algorithm. A comparison of the results of proposed method with marker controlled watershed algorithm shows that our method has a strong potential to be used as an aid to radiologists in the interpretation of screening mammograms.

A threshold selection system is developed using a combination of Fuzzy C-means (FCM) and Otsu algorithms. Pre-processed image is then segmented with the computed threshold to yield the suspicious regions from it. The proposed system is simulated for a large number of mammographic images. The performance of the computer system is analyzed and compared with the existing mass segmentation techniques. The results obtained are very promising and satisfactory.

To classify the mass abnormality into benign and malignant categories, an artificial neural network (ANN) is developed using a set of nine gray level and morphological features. The set of four optimal features are further selected using principal component analysis (PCA) to improve the classification performance. A sensitivity analysis is used to examine the robustness of the proposed CAD system. The classifier results are very promising and satisfactory.