Analysis of Detection of Atherosclerosis Using Marker Controlled Watershed Modified Segmentation Altorithm

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Abstract: Heart attack is caused due to atherosclerosisand strokes in humans. Carotid atherosclerosis, i.e. plaque build-up in the arterial wall due to the formation of proteins, cholesterol and lipids in excess is the major cause of stroke. To resolve the mechanism behind plaque formation many research institutes are investigating plaque formation, plaque growth and the factors affecting plaque in the Coronary artery. Intravascular Ultrasound Imaging (IVUS) is a new medical promising technique for coronary heart disease. This technique is expected to play a crucial role in plaque detection in coronary artery because images of better quality can be produced at video-rate and therefore it will help in analyzing moving structures. This proposed approach presented in this paper will consists of recording of ultrasound images from tissue under different degree of deformation and then various steps of pre-processing using digital image processing software (MATLAB) will be used for feature extraction, analysis and early diagnosis by removing speckle noise from the image which is the reason for corrupting images fine details.

Keywords: Atherosclerosis, Intravascular ultrasound (IVUS), watershed algorithm and image denoising

I. INTRODUCTION

Heart attack is the disease which is also called atherosclerosis or atherosclerotic disease. The arherosclerotic disease is caused by plaque due to the result of formation of substances rich in protein, cholesterol and lipid in the interior arterial wall which decreases the region or the area for the flow of blood and oxygen due to the blockage caused by plaque inside the arterial wall.There are four methods which are capable of producing desired output or result for plaque detection with accuracy but among four available methods ultrasonography is proposed to be the best methodology for detection of atherosclerotic disease i.e. plaque analysis and detection economically and easily availability in all the labs, many people looses their life due to lack of method, easily available to analyze and detect plaque. So, this proposed methods will bemethodto serve the the requirements of mass of people especially for Americans where huge number of people encounters this problem of heart attack.

II. RELATED WORK

This section is the existing work done by various researchers and authors:

Anju Bala [1], has contributed a noble method called Improved Watershed Image Segmentation Technique using MATLAB which is applicable to find the 'catchment basins' to imagine the landscape being immersed in a lake in current work prewitt's operator was used for detecting inputted image edges rather than sobel operator to avoid over segmentation.

Thodeti et al [10], has presented a method for color image segmentation using watershed algorithm in which they have shown that the color and texture are the two important features of information retrieval in images and videos, Color image segmentation is informative although it has various limitations. The gray scale image segmentation methods are not applicable to the color images which will be carried out in the proposed approach.

Faouzi Benzarti and Hamid Amiri [2], has presented an image denoising approach using diffusion tensor and homographic transformation to adapt the flow of diffusion by applying anisotropic diffusion along the coherent structure direction of the echo graphic images which is interesting features in 3D Ultrasound images. This approach allows diffusion with the condition of additive noise in 3D image denoising.

R. Sukanesh et. al [8] has developed a technique for image noise reduction by Wavelet Thresholding based on Weighted Variance using standard speckle filters". The new version used here was an adaptive filter wiener 2 in the MATLAB image processing toolbox and signal to noise ratio (SNR) of each denoised image was also calculated.

Firas Wada and Mohamed Ali Hamdi[6] has developed a method called 3D Segmentation of Intravascular ultrasound Images by using Fast Marching method and the goal of this method is to demonstrate the IVUS segmentation using the method of curvelet to improve the IVUS image quality.

S. Satheesh and Prasad[9] has proposed a method for Gaussian noise removal from MR IMAGES of biomedical using algorithm which is efficient and is based on the contourlet transform for Gaussian noise for both the qualitative and quantitative analysis.

Kalpana saini et al [7] has proposed the idea of image segmentation in ultrasound images for diagnosis and therapeutic purposes which shows that in order to enhance the feature of an image which requires further pre-processing there are various techniques out of which the image segmentation is expected to give better results in comparison to other techniques and it is expected even for detection of plaque in an IVUS image it will be beneficial.

Anthony N. De Mari [5] has proposed comparative technique for vulnerable plaque. In this comparative work it was suggested that IVUS has the ability to characterize plaque either as calcified or fibro-fatty but could not detect lipid-rich plaque, necrotic core and thrombus. But in recent advances in medical application of IVUS it is possible to detect lipid-rich plaque by back scattered wavelet analysis.

Alka Vishwa and Shilpa Sharma[4] have developed a wavelet-based thresholding scheme for noise removal from IVUS images. In their work they have used adaptive and anisotropic diffusion technique to remove noise from different types of images like ultrasonography images and they have obtained better results. The same results may be possible by analyzing carotinoid artery scan images.

Ahmad EL ALLAOUI and M'barek NASRI [3], has developed an approach for medical image segmentation in order to avoid the problem of over-segmentation which is a major problem of watershed transform. The key points in this approach are morphological reconstruction, extraction of markers and application of watershed transform which is a line of separation in an image of greatest intensity.

III. PROPOSED APPROACH
(Detection of plaque using image segmentation)

Initial step is image acquisition i.e. IVUS image which is converted to RGB and then image attributes will be set and then pre processing will be applied as discussed below in Fig. 2.

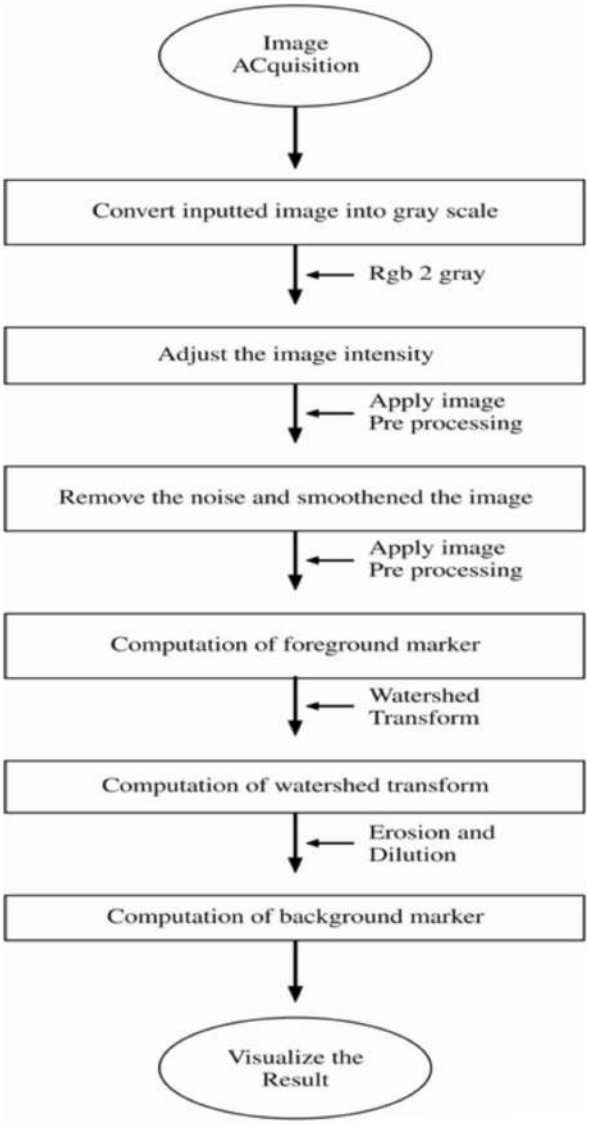

Fig. 2: Overview of Proposed Approach

a. In this step, Foreground markers can be detected by variety of procedures that must be connected blobs of pixels inside each of the foreground objects. In this proposed approach the method called image reconstruction will be used which is called open lobe and similarly closing lobe will also be applied to the image to reconstruction.

b. **Computation of background marker:** In this step, marking of background will be done in the cleaned-up image where the dark pixels Iobrcbr belong to the background, by applying thresholding operation.

c. **Modification of segmentation function:** In this step, usually the pixels will be black in the background and we are not interested in the background markers which will be too close at the edges of the object for segmentation. So, we will "thin" the background by computing the watershed transform to find watershed ridge lines.

d. **Computation of watershed transforms:** In this step, the watershed transform will be used to modify an image so that the regional maxima will be at certain desired locations only and then apply the gradient magnitude inorder to find regional minima and maxima.

Initially, image acquisition is the first step which has to be converted from rgb2gray scale and then adjust the image intensity to preserve the image information and apply pre-processing steps of image processing in order to reduce the noise in an image which corrupts the image and results in over segmentation and even the accuracy level may reduce.

Secondly, Computation of foreground objects in order to reconstruct the image after applying the various morphological operations of pre segmentation process that includes finding of regional maxima.

Thirdly, Computation of background markers where image segmentation is the main task, reconstruct the image that is superimpose with the original image and then cleaning of the edges of the segmented images will be done.

Finally, Computation of watershed transformation by applying erosion and dilution and then visualization of expected result will be performed.

IV. THE VARIOUS RESULTS OF THE PROPOSED APPROACH ARE SHOWN IN THE DIAGRAM.

In Fig.2 (I&II), image is the input to the system which will be converted into grey scale i.e. from rgb2grey and the image intensity will be adjusted for applying

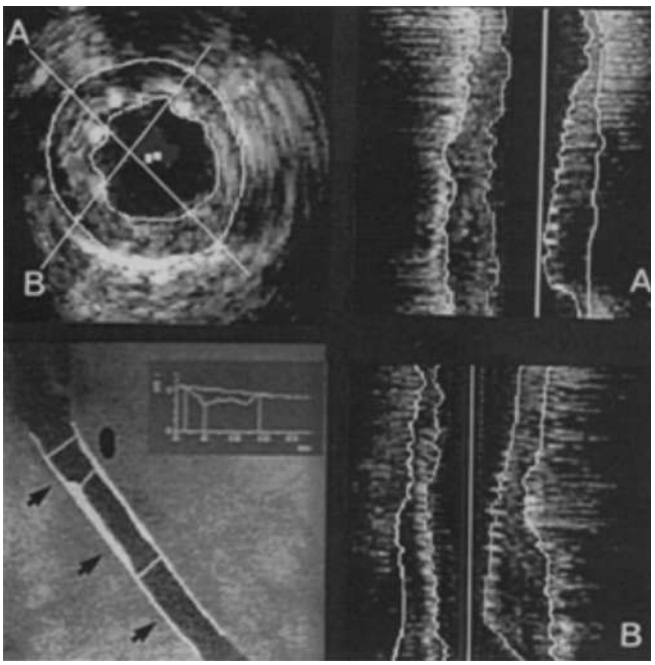

Fig. 2(i): IVUS Input original Images

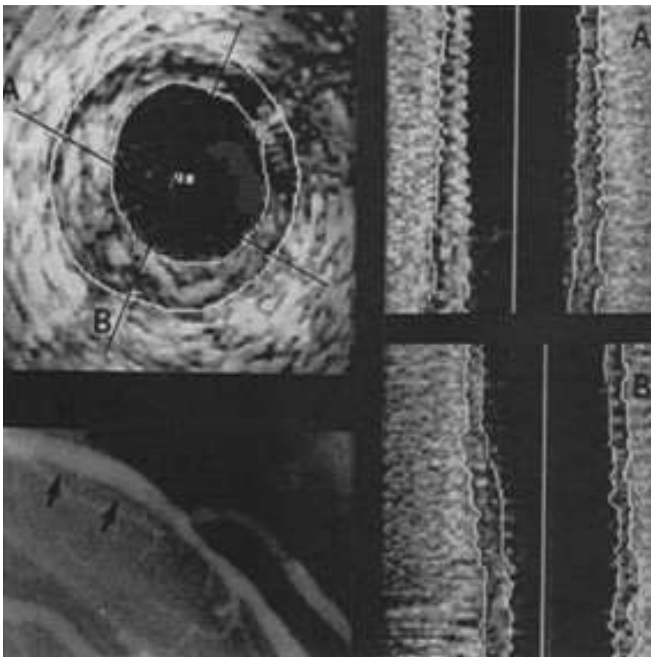

Fig. 2 (ii): IVUS Input Original images

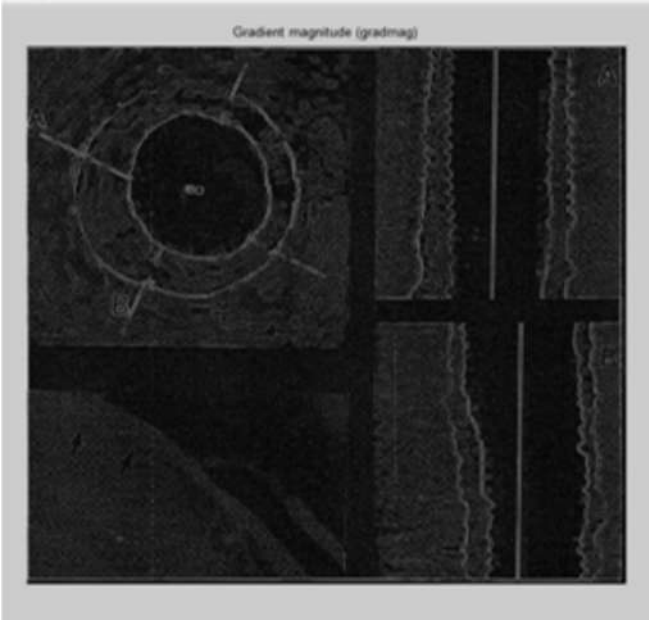

Fig. 2 (III): Application of gradient magnitude on image

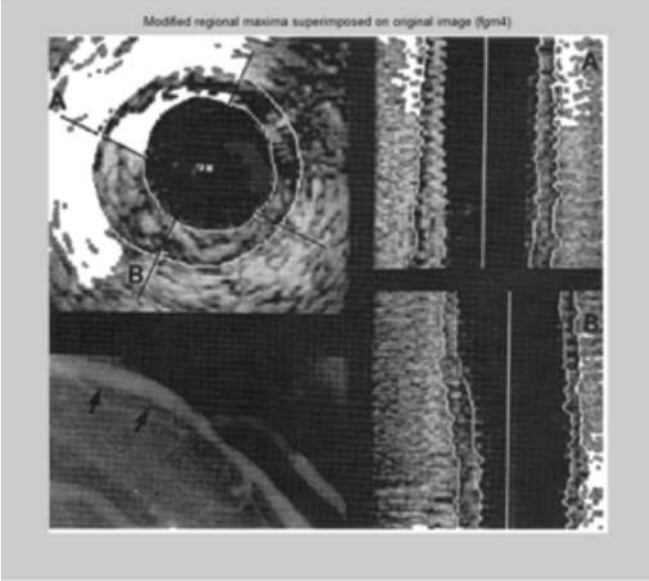

Fig. 2 (iv): Modified Regional maxima superimposed image

image pre-processing steps of image processing like in order to highlight the image information for feature extraction by highlighting the image inner and outer region. By applying gradient magnitude as shown in fig 2 (III) and then image modification of regional maxima is done by superimposing the original image as shown in Fig. 2 (IV).

In Fig. 3(I&II), image is the output of the image which distinctly shows the plaque containing region in which the background and foreground of the image is shown using distinct color after applying the foreground and background markers. Finally the watershed transformation will be applied to get the appropriate result as shown in final output in Fig 3(ii), where red color region is plaque deposition in artery.

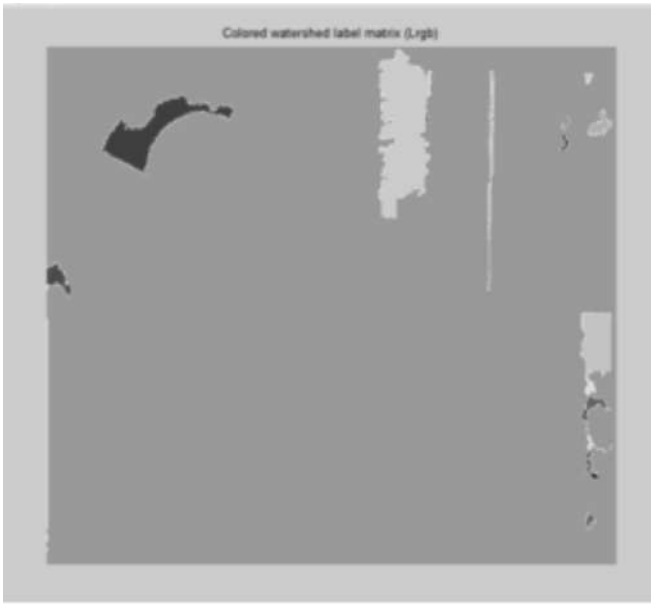

Fig. 3. (i): Expected output image

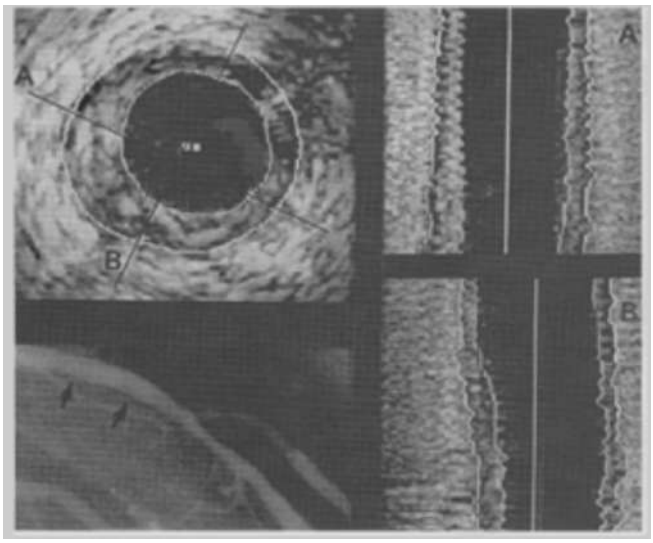

Fig. 3 (II): Expected output image

V. CONCLUSION

This method presented is to the best of my knowledge, a computerized approach for plaque detection from ultrasound images of the carotid artery. This computerized method using ultrasound imaging and marker controlled watershed image segmentation

modified algorithm has great potential to detect and enhance the image containing the plaque with distinctive features. It is expected that this approach will give a promising result with accuracy in comparison to other methodologies and approaches.

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