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Denoising and Extraction of Intima Media Thickness in B-Mode Ultrasound Common Carotid Artery Images

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ABSTRACT: Automatic segmentation of the blood vessel lumen from ultrasound images is a vital task in clinical identification. Correct measurement and understanding of the pure mathematics of the arterial blood vessel (CA) is crucial within the assessment and management. The Proposed work was the thresholding technique as a result of it will notice the arterial blood vessel while not blurring the image. This could stay the ultrasound image resolution. This can be vital particularly in medical image attributable to patient details are going to be lost if low ultrasound image quality occur. Before thresholding, the original B-Mode ultrasound RGB image had to be modified to gray scale and do some image process. After that, the image required to rework into binary image be-fore thresholding. When thresholding, the ultrasound image must be removing some elements that aren't arterial blood vessel and replenish some elements within the middle of the arterial blood vessel. After all these steps, the arterial blood vessel will successfully be detected. Within the planned work, we are going to compare our planned one with the existing technique used for segmentation. additionally, we will use some filters for de-speckling method (i.e., to get rid of the noises present within the image) and finally can notice that filter outperforms best in de-speckling method by measurement the image quality performance and additionally texture analysis.

KEYWORDS: Carotid, ARTERY, External CA, Internal CA

I. INTRODUCTION

Ultrasound machine is a noninvasive diagnosis machine. It uses the high frequency wave to capture the human inner body image. In contrast to different imaging modalities, the wave that transmits from the ultrasound machine probe is safe to shape. The wave produce by ultrasound machine don't bring any facet effects to human. Ultrasound machine can produce high frequency wave and transmit the wave through the probe. The wave can undergo shape and mirror back to the probe once more. However, differing types of tissue in shape can cause the wave to mirror in numerous ways that. When the probe receives the mirror signals, it'll send to post process system to form a picture of human inner body. The grey scale image created is predicated on the distinction of the mirrored wave.

A special frequency wave is made once the users use differing types of probes. Higher frequency has higher resolution however has low penetration whereas lower frequency has lower resolution however higher penetration. As Associate in Nursing example, once scan the abdomen of the patients, 3.5 megahertz probe is appropriate as a result of the abdomen is huge and deep. once scanning the arterial carotid, ten megahertz probe is required as a result of the arterial carotid is simply beneath the muscle layer of shape. However, for those that don't seem to be aware of the ultrasound image can misdiagnosis the ultrasound image as a result of several human elements appear as if alike in ultrasound pictures. Solely the skilled doctors or radiologists will differentiate the distinction between the body elements arterial carotid is one in all the elements that hard to spot by ignorance doctor or specialist as a result of the form is sort of same just like the muscle layer. A common, non-invasive check accustomed check for arterial carotid sickness could be a physicist ultrasound. This variation of the traditional ultrasound assesses blood flow and pressure and potential narrowing of the vas by bouncing high-frequency sound waves (ultrasound) off red blood cells. Ultrasound pictures of arterial carotid are one in all the elements that arduous to spot by ignorance doctor or specialist as a result of the form is sort of same just like the muscle layer.

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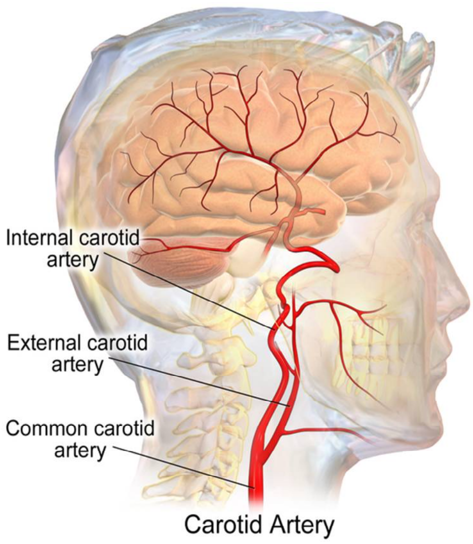
SCOPE OF THE PROJECT:

Ultrasound pictures of arterial carotid are one in all the elements that arduous to spot by ignorance doctor or specialist as a result of the form is sort of same just like the muscle layer. Hence, a arterial carotid automatic detection methodology and automatic formula for the segmentation and activity of the membrane Media Thickness (IMT) is projected during this study. The results can facilitate the doctors and specialist for additional diagnosing. Besides that, the patient will get the right earlier treatment and also the likelihood of recovery is multiplied.

II. ULTRASOUND MODES

A-Mode, or AM, is that the show of amplitude spikes of various heights. it's used for opthamalolgy studies to observe finding within the second cranial nerve. A-Mode consists of an x and y axis, wherever x represents the depth and y represents the Amplitude. The higher than image shows an example of A-Mode show.

B-Mode, or Brightness Modulation, is that the show of 2nd map of B-Mode information, and is that the most common variety of ultrasound imaging. Not like A-Mode, B-Mode relies on brightness with the not present of vertical spikes. Therefore, the brightness depends upon the amplitude or intensity of the echo. There's no y axis on B-Mode, instead, there's a z axis, which represents the echo intensity or amplitude, and a x axis, which represents depth. B-Mode can show a picture of large and tiny dots that represent robust and weak echoes, severally. Below is Associate in nursing example of B-Mode imaging of an echogenic mass during an explicit organ. M-Mode or Motion Mode (also referred to as Time Motion or TM-Mode), is that the show of a one-dimensional image that's used for analyzing moving body components commonly in viscous and foetalviscous imaging. This will be accomplished by recording the amplitude and rate of motion in real time by repeatedly measuring the space of the object from the one electrical device at a given moment



III. EXISTING METHODOLOGY

1) Image space Selection: as a result of the CA structure typically seems within the center of the image. The lateral 100% of the image breadth was ignored. Whereas conserving the complete image height.

2) VIP Signal Selection: within the reduced image, the thought of lateral interspacing custom-made by Rossi et al. was followed. Specifically, a finite range (N) of vip signals was thought-about each step millimeter so reducing its second info content to a series of 1D signals. The lateral interspacing of step = 0.5 millimeter was chosen, as a result of it provides a rather adequate sample size for sturdy and correct CA recognition, and features a comparatively low process

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value. once testing, any price of step within the interval (0 0.5] millimeter yielded an equivalent success rate, whereas smaller values were solely at the expense of increased process value.
3) Single Lumen Center purpose Detection: for every chosen VIP signal, a statistics-based, multistep procedure was used for the estimation of one lumen center point. This procedure is predicated on the ultrasonicgraphically portrayed CA anatomical characteristics. especially, ranging from all-time low of the ultrasound image and moving upwards, 1st one unremarkably encounters the (usually brightest) so much wall region, then the (usually darkest) lumen, and so the (usually second brightest) close to wall.
4) Backbone Processing: At the tip of the applying of the lumen center purpose detection rule to all or any VIP signals, variety of cluster U and/or cluster D points that equals or is lesser than N is created. However, due either to artifacts in some VIP signals, or to the impossibility to search out segments/ points meeting the obligatory constraints, the ensuing set of points must be more processed to well increase the success rate.

IV. PROPOSED METHODOLOGY

Carotid artery is one amongst the parts that onerous to spot by ignorance doctor or specialist as a result of the form is nearly same just like the muscle layer. A common, non-invasive take a look at wont to check for arterial blood vessel sickness may be a physicist ultrasound. This variation of the traditional ultrasound assesses blood flow and pressure and doable narrowing of the vas by bouncing high-frequency sound waves (ultrasound) off red blood cells. Ultrasound pictures of arterial blood vessel ar one amongst the components that onerous to spot by ignorance doctor or specialist as a result of the form is nearly same just like the muscle layer.

Accurate activity and understanding of the pure mathematics of the arterial blood vessel (CA) is crucial within the assessment and management of arterial hardening of the arteries. Non-invasive ultrasound imaging of the CA is wide employed in the identification of fat as a result of it permits the characterization of the severity of pathology and plaque morphology within the clinical routine. However, precise activity and analysis of the vascular pure mathematics, morphology and snap need reliable definition of the arterial wall borders that at this time isn't standardized within the identification of the sickness. Moreover, though knowledgeable observers perform the outlining of the carotid wall-lumen interface, the procedure is tedious and at risk of variability. Therefore, automatic segmentation of the blood vessel lumen is important within the assessment of the sickness.

MODULE NAMES
1) Image Acquisition
2) ROI Extraction
3) Despeckling/Filtering
4) Thresholding/Binarization& Morphological Operations
5) Measurement of Intima Media Thickness

MODULE 1:
IMAGE ACQUISITION

The image acquisition method generates massive ultrasound image sequences that ar understood exploitation either manual annotation procedures or microscopic anatomy valid semi-automatic image-processing environments. The Ultrasound image sequences of longitudinal sections of the common carotid Artery (CCA) of some patients are captured. The captured pictures are converted into gray scale image if it's in RGB format.

MODULE 2:
ROI EXTRACTION

Automatic region of interest (ROI) detection is one amongst the steps employed in segmenting the IMC within the 1st frame of the sequence that is totally unattended. the most principle behind the projected approach is to spot the

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placement of the so much wall interface employing a suite of image process steps that mix the information contained within the intensity domain with knowledge about the body structure of the arterial blood vessel.

CROPPING

From the input image, the specified portion is cropped which cropped image is employed for more process.

ADAPTIVE THRESHOLDING

An accommodative thresholding formula that's applied to notice the borders between the 2 main image classes: the blood and therefore the blood vessel tissues.

MODULE 3:

DESPECKLING/FILTERING

The divided arterial blood vessel region consists of multiple noises. Among them speckle noise content are high. Thus so as to get rid of the noise we are able to use filters like lee, kuan, ripple denoising and SRAD. The method of removing the noise content within the image by victimization filters is named De-speckling .Speckle noise may be a granular noise that inherently exists in and degrades the standard of ultrasound pictures. Speckle noise in standard measuring deviceresults from random fluctuations within the come signal from an object that's no larger than one image-processing component. It will increase the mean gray level of space area.

Speckle noise is mostly additional serious, inflicting difficulties for image interpretation. It's caused by coherent process of backscattered signals from multiple distributed targets. As an example, speckle noise is caused by signals from elementary scatters, the gravity-capillary ripples, and manifests as a pedestal image, below the image of the ocean waves.Several completely different ways are wont to eliminate speckle noise, primarily based upon completely different mathematical models of the development.

MODULE 4:

THRESHOLDING

Thresholding is that the simplest methodology of image segmentation. From a gray scale image, thresholding is wont to produce binary pictures. to see the thresholding level, Otsu's thresholding methodology is employed. Otsu's thresholding methodology involves iterating through all the doable threshold values and calculative a live of unfold for the pixel levels all sides of the edge, i.e. the pixels that either falls in foreground or background. The aim is to seek out the edge worth wherever the sum of foreground and background spreads is at its minimum.

BINARIZATION

Binarization may be a method wherever every pixel in a picture is converted into one bit and you assign the worth as '1' or '0' relying upon the norm of all the picture element. If greater then norm then its '1' otherwise its '0'.

MORPHOLOGICAL OPERATIONS

After changing the image into binarized image, remove all the pixels smaller than 600 by using morphological operations. within the morphological processed image, take away the holes occurred between 2 lines.

MODULE 5:

MEASUREMENT OF INTIMA MEDIA THICKNESS (IMT)

Intima-media thickness (IMT), also called intimal medial thickness, is a measurement of the thickness of tunica intima and tunica media the innermost two layers of the arterial wall. The measurement isusually made by external ultrasound, occasionally by internal, invasive ultrasound catheters, see IVUS, andmeasurements of the thickness of the wall of blood vessels can also be using other imaging modalities.

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V. RESULTS

The first step is Image Acquisition (Getting the Image as an input). The below image shows the original Ultrasound B-Mode image. This is a colored Image.

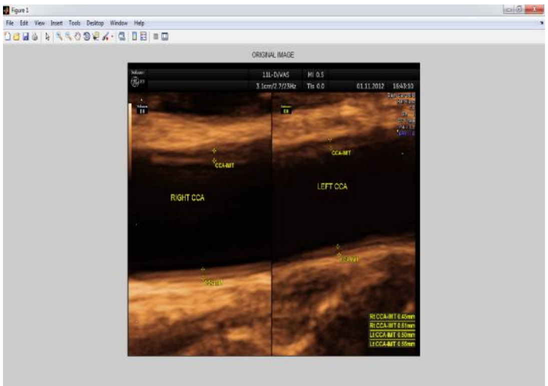

Fig 1 ORIGINAL IMAGE

GRAYSCALE CONVERTED IMAGE
The Second step is preprocessing. Convert the RGB of original Ultrasound B mode image into Gray Scale Image.

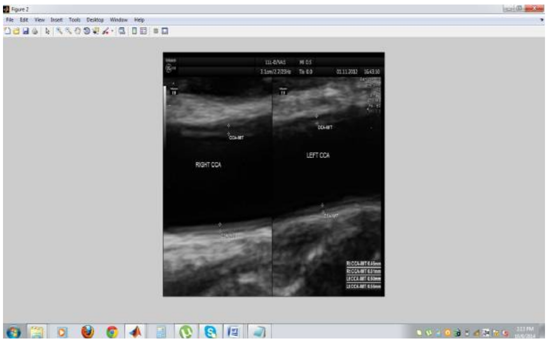

Fig 2 GRAYSCALECONVERTED IMAGE

CROPPED UPPER IMAGE
The third step is Image cropping. By using ROI (Region of Interest) Cropping of image can be done.

SRAD FILTERED IMAGE
The next step is Image Filtering. By using SRAD, Lee, Kaun and Wavelet Denoising the Image Filtering Can be done.

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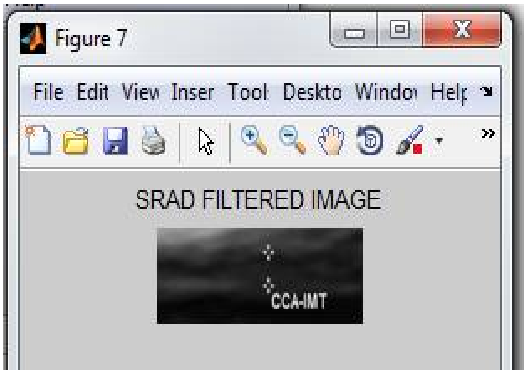

Fig 3 SRAD FILTERED IMAGE

COMPARISION TABLE FOR ALL FILTERS

After Filter the Image Quality Measure (PSNR, MSE, NCC, NAE) Can be calculated between the original image and filtered image.

Peak Signal to Noise Ratio (PSNR):

$$PSNR(I,\hat{I}) = 10\log\left(\frac{\max(I^2)}{MSE(I,\hat{I})}\right)$$

Mean Squared Error (MSE):

$$MSE\ (I,\hat{I}) = \frac{1}{NM}\sum_{i=1}^{N}\sum_{j=1}^{M}\left(I_{i,j} - \hat{I}_{i,j}\right)^2$$

Normalized Absolute Error (NAE):

$$NAE\ (I,\hat{I}) = \frac{\sum_{i=1}^{N}\sum_{j=1}^{M}|I_{i,j} - I_{i,j}|}{\sum_{i=1}^{N}\sum_{j=1}^{M}|I_{i,j}|}$$

Normalized Cross-Correlation (NCC):

$$NCC(I,\hat{I}) = \frac{\sum_{i=1}^{N}\sum_{j=1}^{M}(I_{i,j}.I_{i,j})}{\sum_{i=1}^{N}\sum_{j=1}^{M}(I_{i,j})^2}$$

	LEE	KUAN	WAVELET	SRAD
PSNR	35.1690	37.1125	13.2523	47.8795
MSE	19.7780	12.6425	3.0751e+03	1.0596
NCC	0.9721	0.9749	0.0011	0.1529
NAE	0.0408	0.0414	0.9994	0.8629

Fig 4 COMPARISION TABLE FOR ALL FILTERS

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BINARISED IMAGE

The seventh step is Binarized Image.

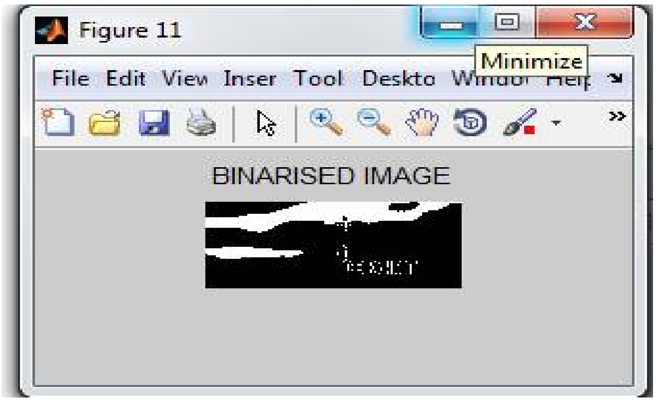

Fig 5 BINARISED IMAGES

SMALLER PIXELS REMOVED IMAGE

Next step is smaller filer image using Image Morphological operators. Final Step is Carotid artery detection.

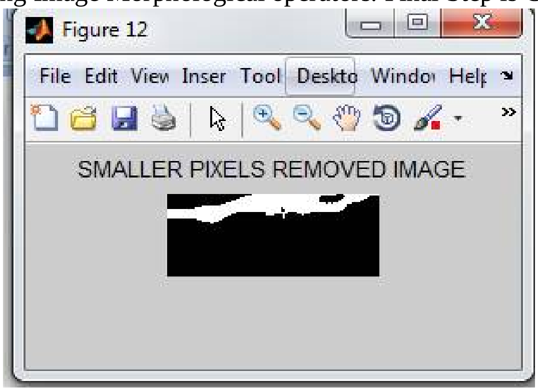

Fig 6 SMALLER PIXELS REMOVED IMAGE

Fig 7 DETECTED CAROTID ARTERY

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INTIMA MEDIA THICKNESS is 1.375832 mm

The above value shows the diameter of intima media thickness value of artery.

VI. CONCLUSION

The overall method of segmenting the carotid artery has been successful developed in this phase using MATLAB to automatically detect the carotid artery from ultrasound images. The proposed algorithm entails a multi-stage ultrasound data analysis. This system can help in experience doctor to identify the carotid part in the ultrasound images. This proves that the carotid artery automatic detection software system is successfully developed and ready to use.

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