

# Ultra Sonographic Examination of Carotid Artery for Cancer Identification

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**Abstract**— This paper discusses how we can use the carotid ultrasound scanning method more beneficially to detect oral cancer and carotid plaque which are the main causes of paralysis or death. This is done with the help of Audio video and Image processing of ultra sound images of carotid artery which is a blood vessel that supplies pure blood to the different parts of our head. Here the MATLAB processing tools are used for ultrasound image analysis. Ultra sonography is a simple and cost effective scanning method which uses harmless sound waves of more than 30MHz frequency. Although it is not a confirmation method, the low cost, accuracy and simple and harmless nature of scanning makes it more dependable for early identification of oral cancer and better treatment.

**Index Terms**— Cancer, Carotid Artery, MATLAB, Plaque, Ultra-Sonography

## I. INTRODUCTION

Ultra sonography is a simple and cost effective scanning method which uses harmless sound waves of more than 30MHz frequency. The transmitted ultrasound signal after reflection from the body part is given for imaging. More accurate methods like X-rays, MRI scanning etc is available now. The harmful radiations and high cost prevents them from using frequently.

Carotid arteries are the blood vessels located on both sides of the neck that supply pure blood to the different parts of the head. Normally blood flow rate in these two arteries will be equal. But Carotid plaque or cancerous growth in the corresponding artery destination can make large difference in the rates of blood flow. Plaque in arteries lowers the blood vessel volume and increase the blood flow speed. Cancerous cells are highly active and take more pure blood. So the blood flow rate to the cancerous tissue will be high.

Here is a method to identify cancer and chances of stroke in a scientific way. With MATLAB Audio-Video Processing of Doppler ultrasound images we can compare flow rate in the left and right carotid arteries. If there is any difference in the blood flow rate then there is a chance for the cancer in the side to which the carotid supplies blood in a higher rate and further confirmation tests are to be done.

The B-Mode artery images are segmented using MATLAB Image processing tools for checking the presence of Plaque and chances of brain stroke. Intima -Media Thickness (IMT) is also checked. The normal value of IMT is 0.05cm to

0.12cm. If IMT is not in this value then there is high chance for developing Carotid Plaque. [1], [2]

This is not a cancer confirmation method. But it can be used for regular check up since it is harmless, cost effective, simple and apparently accurate. This makes possible the early identification of oral cancer and to save one from death. In future we can widely use ultrasound waves for cancer treatment.

## II. ULTRASONOGRAPHY

Ultrasound is a mechanical disturbance that moves as a pressure wave through a medium with a very high frequency. One of the applications of ultrasound is Ultrasonography. It is the method of scanning and imaging the inner body parts using ultrasound of more than 30 MHz frequency for diagnosis. This is based on the 'pulse-echo' principle in which a short burst of ultrasound is emitted from a transducer and directed into tissue. [1] Echoes are produced from tissues are collected with a receiver transducer and processed. A piezoelectric crystal serves as a transducer because of its piezoelectric effect and indirect or reciprocal piezoelectric effect [3]. It converts electrical energy into mechanical (ultra sound) energy and vice versa. The echo or reflection of the sound at the boundary of two layers of tissues is due to the acoustic impedance difference between the tissue layers. If  $\rho$ - density of the medium and  $c$ - Sound velocity in the medium then the acoustic impedance

$$Z = \rho.c \quad (1)$$

For legible images to be produced the echo signals need a minimum intensity. The signal loss in the tissues depends on depth of the target from the transmitter which is called penetration depth which is a function of wave frequency. As frequency increases the penetration depth decreases or attenuation loss of the wave increases. So for scanning different body parts we need ultrasound with corresponding frequency. Different ultrasound frequencies that can be used for scanning different body parts are shown below. [1], [4]

3–5 MHz	for abdominal areas
5–10 MHz	for small and superficial parts and
10–30 MHz	for the skin or the eyes

A simple ultrasound scanning system has a transmitter, processor and receiver which is shown in fig. 1

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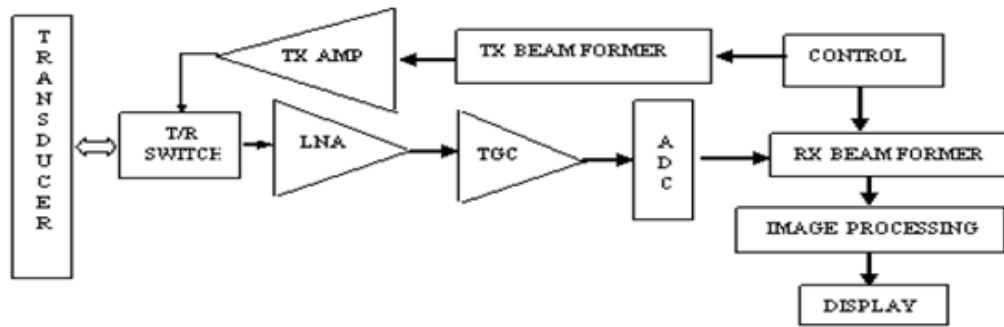


Fig. 1: Block diagram of an ultrasound scanning system

B-Mode Ultrasound imaging is used for scanning. In this mode the strength of the received echoes is usually displayed as increased brightness on the screen. [5] When selecting a frequency, we have to keep in mind that axial resolution is proportional to the ultrasound wavelength; while the intensity of the signal depends on the attenuation of the signal transmitted through the body, with the higher the frequency the higher the attenuation. Therefore, there is a tradeoff between higher resolution ultrasound images at smaller depth and lower resolution images at higher depths. [7]

The process of interpolating the echo signal data to form a TV raster image is scan conversion. With Doppler signal processing, mean Doppler shifts at each position in the image can be determined from as few as 4 to 12 repeated transmissions. The magnitudes of these mean frequencies can be displayed in colour superimposed on the B-mode image and can be used to show areas with significant blood flow. [5], [7] The Doppler frequency ( $\Delta f$ ) increases with the speed of the moving object ( $V$ ) as in the equation (2)

$$\Delta f = \frac{f}{c} V \cos \alpha \quad (2)$$

Where  $f$  is the frequency of ultrasound;  $\alpha$  is the angle between the beam and the moving object. [8]

The main drawback of ultrasound scanning is the poor quality of the images. The MATLAB processing tools can offer a solution for this problem. More specific hardwares can make good images, but it is economically poor. The sound waves have higher conduction and absorption in the solids. So during the scanning process bones will make shadows and noises. Air bubbles also cause noises.

### III. CAROTID ARTERY

Carotid artery directly comes from heart to head. The common carotid artery is a paired structure; the left and right common carotid arteries; for each half of the head and they bifurcate at the neck to form External and Internal carotid arteries. They supply oxygenated blood to the left and right side of the head and neck. [1]

The external carotid arteries supply oxygenated blood to the thyroid, larynx, salivary glands, tongue, mouth, cheeks, nose, chin, neck, face, ears, and lower portion of the skull.

The internal carotid arteries supply blood inside the skull, including the brain and the nearest brain hemisphere with the help of the basilar artery.

The external carotid artery is straight, but the internal carotid artery twists and turns, increasing the likelihood of blockages which could cause a stroke or death. [1], [8]

### IV. CANCER

Cancer, also known as a malignant tumor is a group of diseases involving abnormal cell growth with the potential to invade or spread to other parts of the body. Not all tumors are cancerous; benign tumors do not spread to other parts of the body. There are over 100 different known cancers that affect humans. Oral cancer due to the tobacco use is the cause of about 22% of cancer deaths. It is easier to treat and cure the cancer if we detect them as soon as possible. As time passes the cancer becomes more and more dangerous. [1], [9]

It is found that cancerous tissues need more nutrients than the ordinary cells since they are more active and fast dividing. So the cancerous cells demands more blood flow to feed them than the other tissues. Simply the flow rate of blood in the artery leading to the cancerous part will be high.

### V. CAROTID DIAGNOSIS METHOD

Carotid arteries are located nearer to the skin. So for their scanning 7.5 MHz Ultrasound waves are used. Comparatively they give better image because of good penetration depth and absence of bones. [1], [4]

The Doppler analysis of ultrasound scan is done which gives a moving image of the blood vessel. The Doppler frequency and phase shift are available in the ultrasound machine. From the equation (2) we can analyze the velocity of the blood flow. Using MATLAB audio video processing tools the blood flow rate in the left and right carotid arteries are compared. If the right cheek got a cancerous growth then the flow rate in the right carotid artery will be high. For accuracy External carotid arteries are to be analyzed. Here shows some experimental results. From the fig 2.a it is clear that the right carotid blood flow is greater. So there is a chance for a cancerous growth in right cheek and a confirmation test is done. The test confirmed a cancerous growth. B Mode image of the cancerous growth is shown in fig 2.b.

The second part of the aim is to analyze the chance and presence of carotid plaque which causes Brain stroke. The ultrasound B mode scanning produces the image of carotid artery. Using MATLAB Image Processing Tools this image can be segmented for IMT (Intima -Media Thickness) and Carotid Plaque [1], [6], [9].

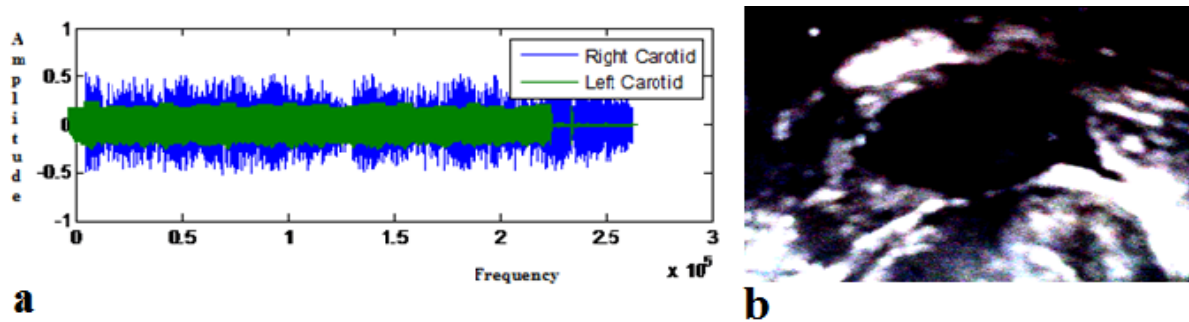


Fig 2: a) Comparison between the flow rates of right and left carotids; b) US image of cheek cancer

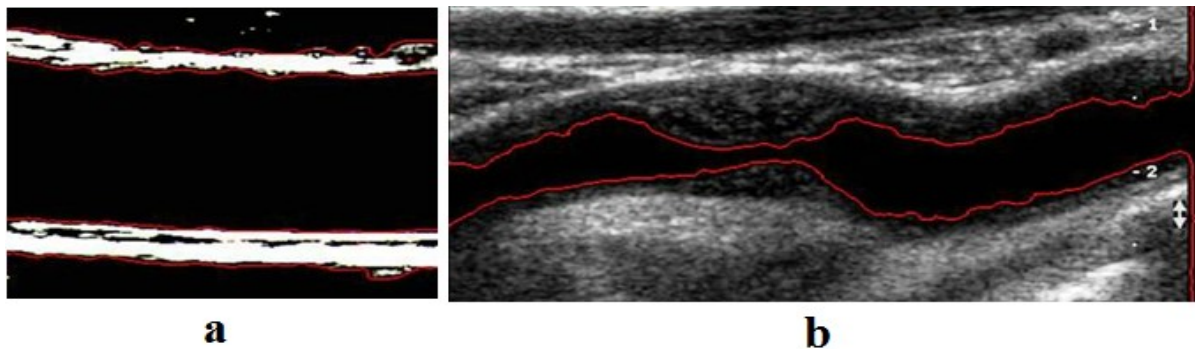


Fig 3: a) Segmented for IMT; b) Plaque Segmentation

The IMT is segmented to find the thickness of the inner wall of the carotid artery which is shown in fig 3.a. If the thickness is 0.05cm to 0.12cm then the chance to form a carotid plaque is less. The ultrasound B Mode Image of carotid plaque can be segmented to find the thickness of the plaque to find the chances of brain stroke (fig.3.b). Now-a-days Manual segmentations are done which is less accurate. Here MATLAB Image processing tools are used for the segmentation which is scientific and more accurate.

#### VI. CONCLUSION

Ultrasound waves can be used for imaging deep seated arteries. This project gives a harmless and cost effective method for scientific detection of cancer and plaque. Here the ultrasound image processing for Despeckle Filtering, which is the main reason for the reduction of resolution of ultrasound image; is done. The chance for oral cancer is analyzed using of the ultrasound audio wave processing. The presence of Plaque and IMT are scientifically detected and segmented using MATLAB Image processing tools. The main challenge of Ultra sound scan is the legibility of the images. It is solved by using MATLAB filters. The proper and targeted design of the ultrasound machine is a better solution for this limitation if the initial cost challenge of setting the machine can be solved. The developments in the field of ultrasound scanning are just in the initial stage. This is a method is going to be a part of regular check up once Ultrasound scanning system is made common because it is the safest and cost effective method of diagnosis. In coming days Ultrasound will help to perform complex surgeries without cutting open the patient and to visualize the inner structure of bodies and also in cancer treatment.

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