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Thyroid Segmenetation and Area Measurement using Active Contour

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Abstract— In this paper, we are presenting a simple guide to determine the thyroid Segmentation and Area lobes in the thyroid ultrasound image using a MATLAB. The thyroid measurement, recognition and segmentation system is very useful in the medical field because it measurement is important for the doctor diagnostic and medical analysis. Ultrasound image using undergoes the contrast enhancement and enhancement image .The enhancement image is used segmentation the thyroid region by local region active contour. The thyroid region is segmented into the 2 parts that is right and left with the active contour method separately. the thyroid have two lobes; right lobe and left lobe. We take five samples, different people have different size and area of thyroid, especially for measurement of the width, depth and area Therefore, measurements only involve the width, depth and area of the thyroid of particular region. The result of thyroid measurement is successfully calculated in pixel unit that can be converted in centimetre (cm) unit. The proposed method is benefited to enhance the image and segmentation the thyroid lobe.

Index Terms— Thyroid medical imaging, ultrasound image, Contrast Enhancement, local area Active Contours

I. INTRODUCTION

This Image segmentation is the procedure of partitioning an image into the multiple segment or set of pixels that is used to locate object and boundaries. Each of the pixels in local or global region are similar with respect to some characteristics such as colour, intensity ,brightness or texture. Different applications of images, ultrasound images segmentation are used for Locate objects in various images for recognition of Fingerprint recognition, Traffic control systems, Face recognition, particular area and volume measurement. There are many techniques that is based on digital pre- processing of coherent echo signals to enhance the quality and information content of ultrasonic images of human body. Example of these methods consists of contrast enhancement to suppress speckles, resolution enhancement and ultrasound imaging of spectral parameter. Contrast enhancement is a technique that able to suppress speckle in thyroid ultrasound image of a normal person. In this method One of the popular method in contrast enhancement is histogram equalization. Histogram Equalization is based on technique for recovering some of apparently lost contrast in any image by remapping the brightness values in such a way as to equalize and distribute its brightness values of images.

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The Segmentation is a collection of methods that allowing interpreting spatially close parts of the image as objects. An active contour is the one of the methods in the image segmentation are used in the domain of image processing to locate the contour of an image and allow a contours for deform sothat as to minimize a given energy functional in order to produce the desired segmentation of ultrasound images.

Fig. 1 Thyroid Ultrasound Image

Symptoms of specific thyroid problems

1. *Hyperthyroidism*

The symptoms for thyroid hyperthyroidism include weight loss even when you have an increased appetite, increased heart rate, excessive perspiration, high blood pressure, nervousness, heart palpitations, shorter or lighter menstrual periods, frequent bowel movements and at times with diarrhea, muscle weakness, trembling hands, goiter development.

2. Hypothyroidism

The symptoms for hypothyroidism include reduced heart rate, depression, slow mental processing, lethargy, oversensitivity to cold, numbness or tingling in the hand, goiter development, heavy menstrual cycle, constipation, dry hair and skin etc.

3. Subacutethyroiditis

The symptoms include severe before mild pain in the thyroid gland, discomfort with pain when turning your head or swallowing, tender thyroid gland, appearance of the aforementioned symptoms soon after a viral infection like measles, mumps or flu.

4. Nodules/Goiter

Symptoms include difficulty feeling full, swallowing, pressure or pain in the below neck, hoarse voice and neck tenderness.

5. Thyroid Cancer

Symptoms include lump in neck, voice changes, difficulty swallowing or breathing and swelling of lymph node.

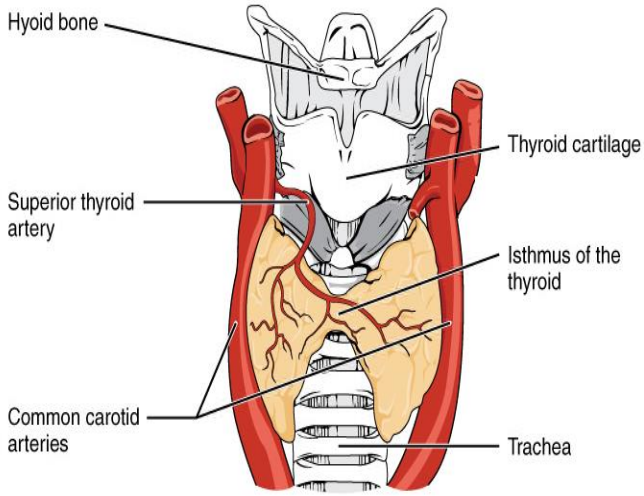

Fig. 2 Thyroid front View

II. PREPROCESSING & METHODOLOGY

The pre-processing is an improvement of the image data that suppresses undesired distortions and noise or enhances some image features relevant for further processing and analysis next task. That compare Neighbouring pixels corresponding to one real object have the same or similar brightness and colour value. Image pre-processing includes Noise Reduction, EDGE Detection, QUAD Tree, Geometric correction adjusts locations of pixels, and pixel values and radiometric correction adjusts pixel values.

A. *Noise Reduction*

Noise is an important factor that effect image quality. Noise reduction is very necessary to do image processing and image interpretation so that acquire useful information can be obtain easily. the median filter is used to reduce noise in an ultrasound image.

B. EDGE Detection

Edges characterize object boundaries and are therefore useful for registration, segmentation and identification of objects in the image. That is used in image processing, particularly within the edge detection algorithms. The Canny edge detector is an edge detection operator that is uses a multi-stage algorithm to detect a wide range of edges in same images.

C. Contrast Enhancement

Contrast enhancement technique is used to suppress speckle in thyroid ultrasound image. A popular method in contrast enhancement is histogram equalization. Contrast enhancement is complete by suppressing speckles and modulation of image brightness by random dark and bright region of images.

D. Histogram Equalization

Histogram equalization is appropriate to improve a given ultrasound image. The move toward is to design a transformation such that the gray values in the output are uniformly distributed in value of binary [0, 1].

III. ACTIVE CONTOUR

Active contour model is a framework for delineating an object outline from a possibly noisy 2D image.This framework attempts to diminish an energy associated to the current contour as a sum of the internal and external energy. The external energy is supposed to be least when the snake is at the object boundary positions. The most straight forward approach consists in giving small values when the regularized incline around the contour position reaches its peak value.The internal energy is supposed to be least when the snake has a shape which is supposed to be relevant considering the shape of the sought object. The most straightforward approach grants high energy to lengthened contours (elastic force) and to bended/high curvature contours (rigid force), considering the shape should be as regular and smooth as possible. Active contour model is popular in computer vision, and led to several developments in 2D and 3D. In two dimensions, the active shape model represents discrete version of this approachs, taking advantages of the point distribution model to restrict the shape range to an explicit domain learned from a training set of images.

IV. SEGMENTATION

Segmentation is a tool that used widely in many applications including image processing as well as digital processing. The common applications of segmentation are in medical ultrasound image analysis for clinical diagnosis that has an important role in terms of quality and quantity of any images. Medical image segmentation methods generally have restrictions because of the medical images have very similar gray level and texture among the other interested objects.

Applications of Segmentation

- Medical imaging
- Locate tumors and other pathologies
- Measure tissue volumes
- Diagnosis, study of anatomical structure
- Surgery planning
- Virtual surgery simulation
- Intra-surgery navigation

A. Fuzzy c-means Algorithm

Fuzzy c-means (FCM) is data clustering technique in which a data set is grouped into the clusters with every data point in the dataset belonging to each and every cluster to a certain degree. For example certain data point that lies close to the center of a cluster that will be a high degree of belonging or membership to that cluster and another data point that lies far away from the center of a cluster will have a low or less degree of belonging or membership to that cluster.

B. Histogram Clustering

This is based on the intensity or colour value of images. Other forms of thresholding exist where the threshold is allowed to vary across image, but thresholding is primitive technique, and will only work for a very simple segmentation tasks.

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Thresholding is a non- linear operation that converts a greyscale images into the binary image where the two levels are assigned to pixels that are below or above the specified threshold value of images. the selection of initial threshold value is depends on the histogram of an image and the gray scale of an ultrasound image.

C. QUAD Tree

Quad tree data structure is widely used in digital image processing for modelling spatial segmentation of images and surfaces. A quad tree is one tree in which each node has four descendants. Since most algorithms based on quad trees require complex navigation between the nodes, efficient traversal methods as well as efficient storage techniques are of great interest. Quad tree data structure is a tree in which each node has at most four children. In digital image processing, quad tree is used to efficiently store image segmentations of any types of images.

D. Region Growing

Region growing is a procedure that groups pixels or sub regions into the larger regions based on predefined criteria for growth of images. The basic approach is start with a set of seed points and from these grow regions by appending to each seed those neighbouring pixels have predefined the properties similar to the seed.

E. Random Walker

The random walker algorithm is algorithm for image segmentation. In the first description of the algorithm, user interactively labels small number of pixels with its known labels unlabeled pixels is each imagined to release a random walker, and probability is computed that each pixel's random walker the first arrives at a seed bearing each label, i.e., if user places K seed, each with different labels, then it is necessary to compute, for each and every pixel, the probability that a random walker leaving pixel will first arrive at each seed. This computation may be determined by solving a system of linear equations. After the computing these probabilities for each and every pixel, the pixel is assigned to the label for which it is most likely send a random walker. The ultrasound image is modelled as a graph, in which the each pixel corresponds to a node which is connected to neighbouring pixels by edges, and the edge is weighted to reflect the similarity between the pixels. for an introduction to random walks on graphs.

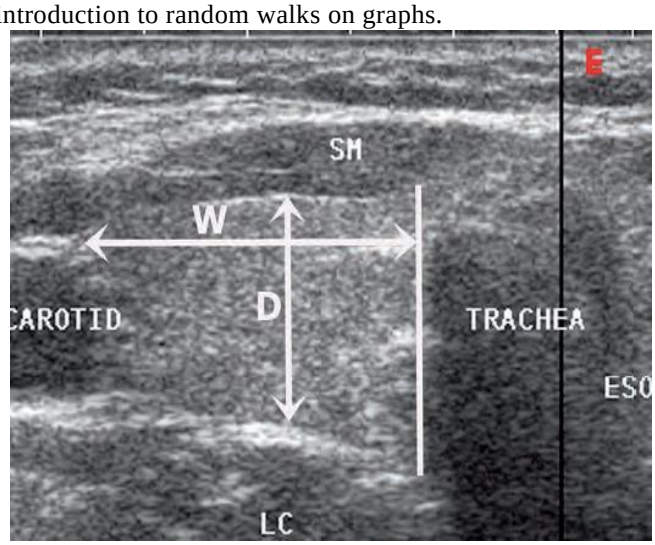

Fig. 3 Measurement of Width (W) and Depth (D) of

V. RESULT & ANALYSIS

Measurements for width (W), depth (D) and area of human thyroid are presented in SI unit (centimeter). The experiments involve five samples of human thyroid ultrasound image from different of thyroid area between different people in different regoin. Table 1 indicates the result from the image processing.

Thyroid region	Right Lobe (cm)			Left Lobe (cm)		
	W	D	Area	W	D	Area
A	1.8	1.2	15	1.4	1.0	13.6
B	1.7	1.1	16.7	1.7	1.3	26.5
C	1.6	1.2	19	1.6	1.1	22.5
D	1.5	1.3	20	1.5	1.0	18.3
E	1.7	1.5	23.5	1.8	1.1	20

Table 1 Thyroid Measurement Result Obtained

Width 1.8cm. For depth size of thyroid, the higher is person E width 1.5 cm for right lobe while for left lobe person B is higher that is 1.3 cm . The higher area of thyroid is person E for right lobe & person B for left lobe. Research found that the right lobe is usually slightly larger than the left lobe of people. When the thyroid gland enlarges, so its extends superiorly and inferiorly to elongate the length of lobes and laterally to broaden the width of the whole gland.

VI. COMPARISON

With snake active contour method Local region –based active contour method is suitable for this project to segment the thyroid region as well as area. Other method of active contour such as snakes is focused on the edge based ultrasound image. An Edgebased active contour models utilize image gradients in order to identify boundaries not region. Snakes method very sensitive to image noise and highly dependent on initial curve placement of any image.

VII. ADVANTAGE AND WEAKNESS OF METHOD

The advantages of region based approach are robustness against initial curve placement and insensitivity to ultrasound image noise. This region based methods also can detect the region automatically by only specify initialization mask compare to snake method that user need to identify the area want to do segment by give specify point by point on the image. It is hard for user that not knows more about thyroid region. It found that edge detection techniques is inappropriate for images compare to region based approach .Although user know the area of thyroid region automatically, users need to measure the width and depth manually using MATLAB operators. This can cause to time delay before user can know the final result of thyroid measurement of any type of images.

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VIII. RECOMMENDATION TO MINIMIZE THE WEAKNESS

In this method to minimize the weaknesses of this method, the automatic system that can give the width and length measurement of thyroid .By this system the error that occurs can be minimized. For further new development of the system, the user friendly user interface need to been develop. This is because not all know how to use MATLAB especially for doctor and radiologist. Therefore the user interface can also help them to use the system.

IX. CONCLUSION

The measurement of width, depth, segmentation and area of thyroid is successful applied in MATLAB. it does not prone to small region segmentation, but it is suitable for segmentation of medical image feature.. It is easy to generate the over segmentation or less segmentation, which leads to accuracy in the segmentationUltrasound image are widely used tool for clinical diagnosis and recognition. So that the convenient system for thyroid segmentations, measurement & ultrasound image enhancement is of interest. By better resolution and accuracy of the image segmentation, width, depth and area measurement it can also be applied for real time application. This method is includes contrast enhancement using histogram equalization is important to reduce speckle that may help to provide the better accuracy and segmentation of ultrasound image.

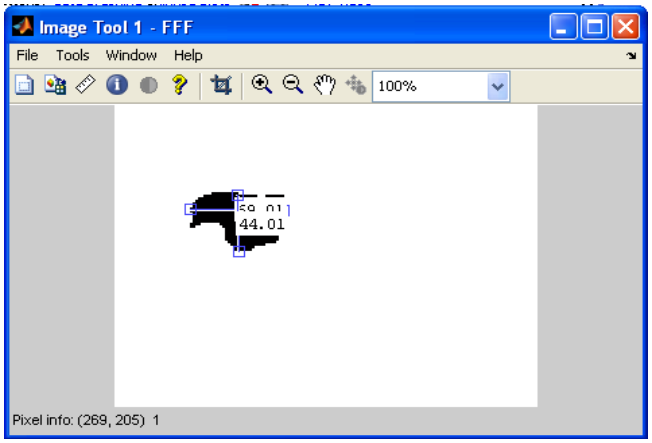

Fig4 Area Measurement Using Active Contour

X. ACKNOWLEDGMENT

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