A Review on Thyroid Segmentation and Volume Estimation Using Image Processing

Kiran Kore[1], Kurva Thirupathanna[2], Banoth Ramu Nayak[3], Mandla Haripriya[4]
[1]*Assistant Professor, Department of Biomedical Eng, University College of engineering, OU, Hyderabad,*
[2] *Senior lecturer Govt. Institute of Electronics, Marredpally, Secunderabad*
[3,4] *M.E. Student, Department of Biomedical Eng, University College of engineering, OU, Hyderabad*

***Abstract*- Thyroid is one of the endocrine organs which are little butterfly fit as a fiddle. It situated in the front of the neck just beneath the Thyroid cartilage and produces hormones that assistance the body to control the digestion. There are diverse sorts of thyroid issue which incorporate Hypothyroidism, Hyperthyroidism, goiter, and thyroid knobs (kindhearted/threatening). To distinguish and group variations from the norm of the thyroid organ, ultrasound imaging is most regularly utilized. The target of this outline is to give finish data about the estimation of the volume of the thyroid organ specifically from US pictures. This diagram concentrated on the assessment of the thyroid volume. The utilization nourish forward back engendering impartial system is utilized to group squares of the thyroid organ. The vital district which is additionally procured by applying a particular area developing technique to potential focuses. The parameters for assessing the thyroid volume is estimation utilizing a mix of KNN classifier with change based match point figuring.**

***Index Terms*- Feed Forward Back Propagation Neural Network; Thyroid Segmentation; Region Growing; KNN Classifier.**

I. INTRODUCTION

The capacity of thyroid organ is to make and store hormones which help to direct the circulatory strain, body temperature, heart rate, and the rate at which sustenance is changed over into vitality. Thyroid hormones are extremely basic for the capacity of all cells in the body. The hormones discharged from thyroid organ help in directing development and the rate of substance responses (digestion) in the body. The thyroid organ is situated in the Throat cartilage in the lower some portion of the neck, wrapped around the trachea (windpipe). It would seem that a butterfly shape which has two wings (flaps) connected to each other by a center part called the isthmus. There are diverse sorts of thyroid issue which incorporate Hyperthyroidism, Hypothyroidism, goiter, and thyroid knobs (amiable/threatening). In the neck the thyroid malignancy is effortless mass. It is extremely uncommon for the thyroid tumors to give side effects. Subsequently, by its volume doctors frequently analyze irregular side effects of the thyroid organ. Figure 1. demonstrates the position of the thyroid organ and additionally right and left projection for a person. It includes three estimations of the thyroid, which are the width, profundity and length. The typical thyroid organ is of 2cm or less in width and profundity and 4.5 – 5.5 cm long. Longitudinal and transverse sweeps are performed permitting the estimations of the profundity (d), the width (w) and the length (l) of every projection. The flap volume is figured by the recipe: V (ml) = 0.479 x d x w x 1 (cm) The thyroid volume is the total of the two projection volumes.

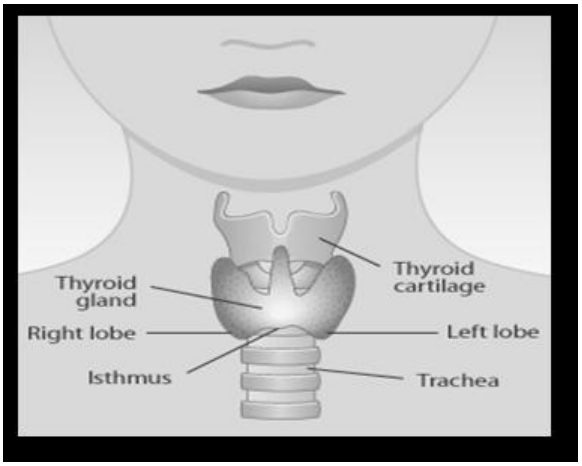

Fig -1: Position of thyroid gland

In different medicinal pictures, for example, Computer tomography (CT), Magnetic reverberation pictures (MRI), X-beams, ultrasound, and so on., assumes an imperative part in distinguishing diverse sorts of illnesses. Among these few symptomatic modalities, ultrasound picture is a standout amongst the most prominent. There are a few positive properties for ultrasound picture. It is economical and simple to utilize. It isn't second rate compared to CT or MRI pictures as far as symptomatic esteem. It can take after anatomical distortions continuously amid treatment and biopsy and it is non-intrusive and does not require ionizing radiation. Notwithstanding, US pictures contains resound irritations and dot commotions which can make analysis difficult.US pictures have not clear representation than CT and MRI pictures, Ultrasound pictures are frequently received because of their cost compactness and adequacy. US pictures give an auspicious way to deal with get thyroid organ picture, it is valuable for dispensary in versatile therapeutic administrations or in remote regions. In a years ago the handling strategies of US pictures are ceaselessly created. A few division strategies are use for anatomical articles from US pictures have been creating in the thyroid knob and tumors in the bosom.

Figure 2: Ultrasound Image of Thyroid gland

The thyroid volume is estimated according to the area of segmented thyroid region, the thickness, and the depth of thyroid. Proposed a method for volume estimation which uses Back Propagation neural network and cooperates with KNN classifier with variance based match point calculation algorithm to estimate the thyroid volume from US images.

2. RELATED WORK

There had been different endeavors towards the subjective methods for analysis of thyroid organ knob. A portion of the prior research for thyroid knob analysis is depicted. In [1], the spiral premise work (RBF) neural system is utilized to characterize squares of the thyroid organ. The fundamental locale is additionally obtained by applying a particular area developing strategy and with the assistance of that picture the thyroid volume was assessed. Nikita Singh et al. [5] proposed characterization utilizing KNN,SVM and Bayesian and furthermore give a great deal of data about division and order strategies that are imperative for restorative picture handling. They gave highlights of harmful knobs in thyroid organ and a relative report was finished. The outcomes demonstrated that SVM gives much preferable precision over KNN and Bayesian classifiers.

Nasrul Humaimi Mahmood and Akmal [8] had introduced a basic guide of decide the thyroid projections in the thyroid ultrasound picture utilizing a MATLAB. The picture was done complexity improvement to stifle spot clamor. The improvement picture was utilized for additionally handling of division the thyroid area by nearby locale based dynamic form. The thyroid district is portioned into two sections, which are correct and left with the dynamic shape strategy independently. Thyroid ultrasound picture of transverse view was utilized as a part of this investigation. Along these lines, the estimations just include the width, profundity and territory of the thyroid locale. The consequence of thyroid estimation was effectively computed in pixel unit. The proposed technique is profited to upgrade the picture and division the thyroid flap.

3. THYROID SEGMENTATION AND VOLUME ESTIMATION APPROACH

Ultrasound pictures of thyroid organ are chosen for trial work. These ultrasound pictures contain some of strange pictures having considerate thyroid knob (non dangerous) and threatening thyroid knob (destructive). The aggregate 80 thyroids ultrasound

pictures were utilized which contains add up to 42 harmful and 38 non-dangerous knobs was chosen in database. These thyroid pictures are accessible in picture display of Wilmington Endocrinology PA on site. The picture size of 546 × 410, with 24 bit profundity estimate, organization of pictures are JPEG and real nature picture. The Matlab R2013a programming using picture preparing tool kit is utilized for test work. Subtle elements of these procedures are depicted as takes after:

3.1 Image Enhancement and Locating a Suspicious Thyroid Region:

In thyroid US pictures, low visual quality influences the division and the volume estimation comes about. A preprocessing step is required to upgrade the US picture and to find suspicious thyroid area. The preprocessing step incorporates 1) finding suspicious thyroid area, 2) playing out a versatile weighted middle channel to diminish spots, 3) applying a morphological operation to improve the sifting result, 4) remunerating diverse US pictures as per power layout of thyroid locale.

1) Locating Probable Thyroid Region: In a thyroid US picture, the thyroid organ is dependably in the center, underneath the brilliant part or more the dim piece of the picture. Two reference esteems (R1 and R2) are characterized to find the likely thyroid area. R1 is the line list with the biggest normal power in the even projection of the US picture. R2 is the principal push list with a normal power of zero from the through and through in the flat projection of the US picture. The plausible thyroid locale is situated between the R1th push and the R2th column of the US thyroid picture. A case of finding a likely thyroid area in a US thyroid picture is appeared in Fig. 3.

2)

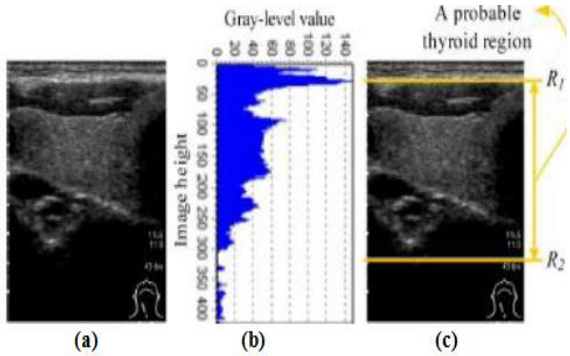

Fig 3: a) Original US image b) Horizontal projection of the US image c) Result of locating a probable thyroid region.

2) Adaptive Weighted Median Filter: An adaptive weighted median filter (AWMF) is applied to remove inevitable speckle noise and enhance a suspicious thyroid region in the US images. AWMF performs on a fixed running mask with the weights adjusted according to the local statistics. In practical, the performance of the AWMF method depends on the filtering mask size and its parameter selections.

3) The Morphological Operation: A 3×3 closing and opening operator is used to further removal of the redundancy enhanced by AWMF.

4) Gray-Level Compensation: If the variance of the gray level of thyroid region in the US image is too large, the segmentation result will be affected finally. A gray-level compensation technique is applied to adjust the intensity of the suspicious thyroid region.

3.2 Feature Extraction: Textural features contain important information which is used for analysis and the explanation of US images. The physician manually extracted 2n ROIs with size of M×M (n thyroid ROIs and n non-thyroid ROIs) from the suspicious thyroid region.

$$\text{Energy} = \sum_{i,j} p(i,j)^2$$

$$\text{Contrast} = \sum_{i}\sum_{j} (i-j)^2 P(i,j)$$

$$\text{Entropy} = -\sum_{i}\sum_{j} P(i,j) \log (p(i,j))$$

$$\text{Homogeneity} = \sum_{i,j} \frac{p(i,j)}{1+|i-j|}$$

NMSID feature =

$$NMSID = \sum_{k=1}^{n} \left[\begin{array}{l} \sum_{x=0}^{M-1}\sum_{y=0}^{M-k-1} |I(x,y)-I(x,y+k)| / M(M-k) + \\ \sum_{x=0}^{M-k-1}\sum_{y=0}^{M-1} |I(x,y)-I(x+k,y)| / M(M-k) + \\ \sum_{x=0}^{M-k-1}\sum_{y=0}^{M-k-1} |I(x,y)-I(x+k,y+k)| / (M-k)^2 + \\ \sum_{x=0}^{M-k-1}\sum_{y=0}^{M-k-1} |I(x,M-y)-I(x,M-(y+k))| / (M-k)^2 \end{array} \right] / 4$$

3.3 Feed Forward Back Propagation Neural Network and Recovering: Here, feed forward back propagation neural network classifies the block into thyroid gland and non-thyroid gland by using the scaled conjugate gradient stochastic based learning algorithm. The trained feed forward back propagation neural network classifies the block into the thyroid gland and the non-thyroid gland.. Finally, the largest connected component is extracted from the classified US image. The region of the largest connected is considered as part of the thyroid gland region. Using the aforementioned procedures, a pure region of the thyroid gland can be extracted. However, the shape of the segmented thyroid region is serrated, and thus, a refinement procedure is required to recover the complete shape of the thyroid gland.

3.4 Volume Estimation: The thyroid volume estimation is done by using a combination of KNN classifier with variance based match point calculation. The k-nearest neighbor's algorithm (k-NN) is a method for classifying objects based on closest training examples in the feature space. KNN is a type of instance-based learning, or lazy learning where the function is only approximated locally and all computation is deferred until classification. The k-nearest neighbor algorithm is amongst the simplest of all machine learning algorithms, an object is classified by a majority vote of its neighbors, with the object being assigned to the class most common amongst its k nearest neighbors (k is a positive integer, typically small). If k = 1, then the object is simply assigned to the class of its nearest neighbor.

4. CONCLUSION

These days, the US pictures are the most capable and economical instrument for clinical finding. In any case, it is tedious to fragment thyroid organ area by methods for the doctor visual perception and the estimation volume of thyroid organ district in CT picture is extremely costly, so a helpful framework for thyroid division and volume estimation in US pictures is important to help doctors. The impact of the spot commotion causes the division aftereffect of the thyroid organ area in US picture wastefulness and incorrectness. Consequently, our technique incorporates picture upgrade preparing advancements to expel clamor in the first. All the while, find the suspicious thyroid organ district from the US picture. Besides we use the nourish forward back spread neural system to characterize the piece into thyroid organ and non-thyroid organ in the US picture. Thirdly, district developing is connected to recuperation the precise state of the thyroid organ area by and by. The thyroid organ locale from US picture and evaluated the thyroid organ volume from US pictures straightforwardly.

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