ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

SEGMENTATION AND AREA MEASUREMENT FOR THYROID ULTRASOUND IMAGE

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DOI: 10.5281/zenodo.47553

ABSTRACT

The thyroid measurement and recognition system is very useful in the medical field because the measurement of thyroid is important for the doctor diagnostic and medical analysis. In this paper, we present a simple guide of determine the thyroid lobes in the thyroid ultrasound image using a MATLAB. The image undergoes the contrast enhancement to suppress speckle. The enhancement image is used for further processing of segmentation the thyroid region by local region-based active contour. The thyroid region is segmented into two parts, which are right and left with the active contour method separately. This is accordingly to the thyroid have two lobes; right lobe and left lobe. Thyroid ultrasound image of transverse view is used in this study. Therefore, the measurements only involve the width, depth and area of the thyroid region. The result of thyroid measurement is successfully calculated in pixel unit. The measurement is converted in centimetre (cm) unit. The proposed method is benefited to enhance the image and segmentation the thyroid lobe. It shows that from five samples, different people have different size of thyroid, especially in measurement of the width, depth and area.

KEYWORDS: (Thyroid, Contrast Enhancement, Active Contours, Ultrasound, Local-region based.).

INTRODUCTION

Introduction ultrasound is one of the non-invasive low cost imaging techniques for thyroid scanning. It can follow anatomical deformations in real time during biopsy and treatment, and it is non invasive and does not require ionizing radiation. However, ultrasound images produced by this technique contain to echo perturbations and speckle noise that can affect the diagnosis result for a patient. Therefore, the appropriate thyroid-id region detection in the ultrasound image may involve segmentation method and image enhancement to suppress the speckle noise. Nowadays, many techniques have made use of digital pre-processing of coherent echo signals to enhance the quality and information content of ultrasonic images of the body. Example of these methods consists of resolution enhancement, contrast enhancement to suppress speckles and imaging of spectral parameters. Therefore the appropriate thyroid region detection in ultrasound image may involve segmentation method and image enhancement to suppress the speckle noise. Contrast enhancement is a technique that able to suppress speckle in thyroid ultrasound image. One of the popular methods in contrast enhancement is histogram equalization. Histogram Equalization is a technique for recovering some of apparently lost contrast in an image by remap-ping the brightness values in such a way as to equalize and distribute its brightness values. Functional in order to produce the desired segmentation. Example of active contour method is snakes, Balloons and local region-based. In this project, local region based active contour is chosen because this method focused on the detection of region based of thyroid image. The advantage of region based compare to edge based is the robustness against initial curve Placement and insensitivity to image noise. Segmentation is a collection of methods allowing interpret-ing spatially close parts of the image as objects. An active con-tour is one of the methods in the image segmentation and used in the domain of image processing to locate the contour of an image and allow a contour to deform so as to minimize a given energy functional in order to produce the desired segmentation. Example of active contour method is snakes, bal-loons and local region-based. In this study, local region based active contour is chosen because the method focused on the detection of region based of thyroid image. The

advantage of region based compare to edge based is the robustness against initial curve placement and insensitivity to image noise. The rest of this paper is organized as follows. In section 2, the thyroid terminology is discussed as well as related work on proposed method. Details on method and material are de-scribed in section 3. Section 4 includes several experiments on the proposed image processing techniques that are used to segment the thyroid ultrasound image. Nowadays many techniques has make use of digital pre-processing of coherent echo signals to enhance the quality and information content of ultrasonic images of the body. Example of these methods consists of resolution enhancement, contrast enhancement to suppress speckles and imaging of spectral parameters. Contrast enhancement is a technique that able to suppress speckle in thyroid ultrasound image. One of the popular methods in contrast enhancement is histogram equalization. Histogram Equalization is a technique for recovering some of apparently lost contrast in an image by remapping the brightness values in such a way as to equalize and distribute its brightness values.

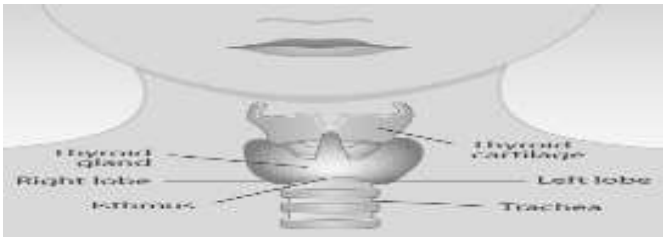
Figure:- Thyroid ultrasound image of a normal person.

LITRATURE RIVIEW

Several data collection has been done in order to get the raw human thyroid ultrasound images. The data have process using several images processing method which are image enhancement, segmentation and measurement to get the value of depth and width of thyroid. Even though the entire image enhancement is automatically; the initialization mask still manually done which is region of interest in order to choose the thyroid region must be done by medical expert.

Thyroid is one of the largest endocrine glands in the body. A normal healthy thyroid lobe is pear-shaped in the transverse view. Thyroid gland is located in front of the trachea just inferior to the thyroid cartilage. The anatomy and pathology of thyroid are explained in the following sections.

Anatomy



Thyroid gland is located in the neck in front of the larynx and trachea at the level 5th, 6th 7th cervical and 1st thoracic verte-brae. It is a highly vascular gland that weighs about 25 g and is surrounded by a fibrous capsule. It resembles a butterfly in shape, consisting of two lobes, one on either side of the thyroid cartilage and upper cartilaginous rings of the trachea. The lobes are joined by a narrow *isthmus*, lying in front of the tra-chea. The lobes are roughly cone-shaped, about 5 cm long and 3 cm wide.

PROPOSED METHODOLOGY

Database- *The famous medical imaging is thyroid Ultrasound images. These images are mixed types like some images has nodules, some images has not nodules, some type of images are benign (non-cancerous) and some type of images are malignant (cancerous) nodule. Total 13 Number of thyroid images were used where total 8 cancerous and 5 non-*

cancerous images was selected in database. These thyroid images provided by internet (Thyroid Images Wilmington Endocrinology PA, Gallery- category-thyroid Ultrasound Images). The format of images was used in JPEG.

B. Software and computer used for analysis- We used MATLAB version 7.7.0 (R2008b) and used image processing Toolbox) For our analysis and used a computer with Intel® Core™i3-350M Processor 2.26 GHz CPU and 3 Gigabyte of memory.

C. Data pre-processing Ultrasound images contain speckle noise and to remove the noise various filters are used and also used histogram equalization produce visual differences and enhanced the contrast between images .The various modules of proposed work are classification of thyroid images and segmentation of thyroid nodular images. The basic steps of the proposed methodology are shown in Fig below.

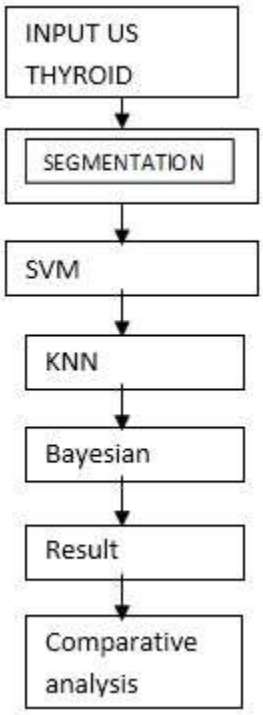


Fig 1 Flow Chart of the Proposed Methodology

Segmentation- *We process the image from the region using the segmentation based algorithm localized based active contour (region based) [5] method that is basically to select the small region of the thyroid nodule or to segment the local area of the images and to segment the nodule which is give the information of which type nodule exist benign and malignant.*

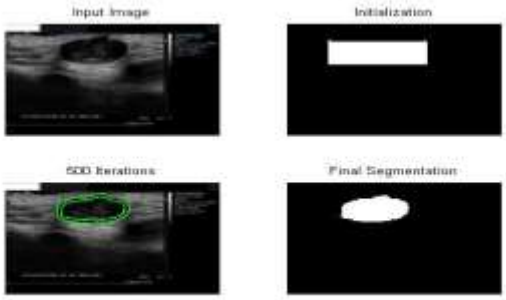


Fig:-2 Final Segmentation

F: Classifiers- Following types of classification methods are discussed:

1. Support vector machine- Support vector machine (SVM) are basically linear classifiers. SVM is widely accepted classifier, considered very effective for pattern recognition, machine learning and bioinformatics (protein classification and cancer classification) [10]. In SVM, a separator hyper plane between two classes is chosen to minimize the functional gap between two classes, the training data on the marginal sides of this optimal hyper plane called support vector. The kernel function is an important step is successful design of a SVM in specific classification task.

2. K-nearest neighbour- A K-nearest neighbour (KNN) classifier is also in the system proposed, offering a good alternative when simplicity and ease of the training phase are the predominant issues. The KNN method is nonparametric and generally effective classification approach.

3. Bayesian classifier- Bayesian classifiers have been used in many areas of medicine. For example, to built a Bayesian classifier to predict breast cancer. And also given that sonographic features predictive of malignancy have been extensively studied and the sensitivity and specificity of these features for malignancy are readily available. In simple terms, a naïve bayes classifier assumes that the presence (or absence) of a particular feature of a class is unrelated to the presence (or absence) of any other feature given the class variable. Also bayes classifier is that it only requires a small amount of training data to estimate the parameters are necessary for classification.

METHODS AND PROCEDURES

Image Processing is an area that uses several techniques and algorithms in order to interpret and understand the information contained in a digital image. Most image processing algorithms consist of a few typical steps viz. image pre-processing, segmentation, feature extraction, feature selection and classification. The methodology used for the thyroid disorder detection is as shown in the following flowchart.

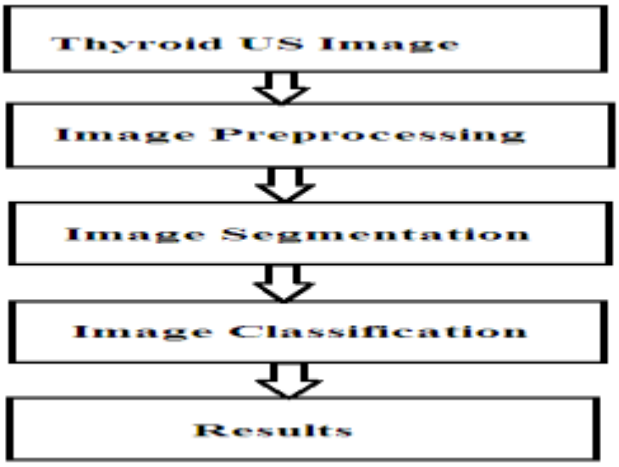


Fig:- Flowchart for the methodology

First, thyroid US image is taken. Image processing step includes removal of noise using filters and to enhance the image. Image segmentation is the process of partitioning an image into multiple segment or set of pixels used to locate object and boundaries. Each of the pixels in a region is similar with respect to some characteristics such as colour, intensity or texture. Image classification of thyroid nodule is done in order to eliminate operator dependency and to improve the diagnostic accuracy[1].In digital image classification the conventional statistical approaches for image classification use only the gray values. Different advanced techniques in image classification are Artificial Neural Networks (ANN), Support Vector Machines (SVM), Fuzzy measures, Genetic Algorithms (GA), Fuzzy support Vector Machines (FSVM). SVM was found to be the best in the available machine learning algorithms in classifying high-dimensional data sets.

Image classification using neural networks is done by texture feature extraction and then applying the back propagation algorithm.

DIFFERENT THYROID DISORDERS AND THEIR SYMPTOMS

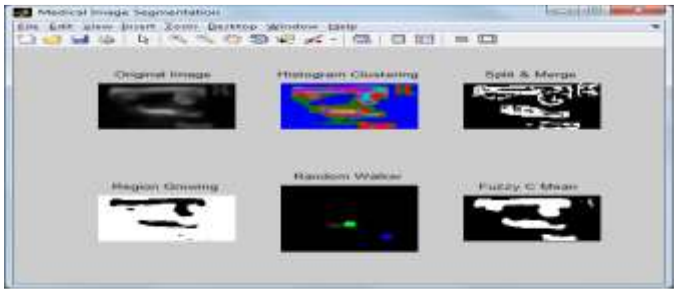
Thyroid gland produces hormones that are helpful for the body to control metabolism. In general, thyroid disease can be divided into two broad groups of disorders: First group is the one which primarily affect the function of the thyroid and the second one is the one which involve neoplasms, or tumors of the thyroid. Both types of disorders are common in the general population. Abnormalities of thyroid function are usually related to production of thyroid harmone.

There are four main types of thyroid diseases-hyperthyroidism (too much thyroid hormone), hypothyroidism (too little thyroid hormone), benign (noncancerous) thyroid disease and thyroid cancer (malignant).

The symptoms of hypothyroidism includes fatigue, mental fogginess and forgetfulness, feeling excessively cold, constipation, dry skin, fluid retention, non specific aches and stiffness in muscles and joints, excessive or prolonged menstrual bleeding (menorrhagia), and depression. Hyperthyroidism can be observed with different signs and symptoms. Common symptoms of hyperthyroidism includes excessive sweating, heat intolerance, increased bowel movements, tremor (usually a fine shake), nervousness, agitation, rapid heart rate, weight loss, fatigue, decreased concentration and irregular and scant menstrual flow.

RESULTS

The experiment involves four thyroid ultrasound images. For the software development, the MATLAB software is used. The results are shown below.



Result shown that the SVM classifier was used these 13 texture features and distinguishing the malignant cancerous nodule and benign noncancerous nodules with up to 84.62%.

Classifiers	Accuracy
SVM	84.62%
KNN	46.15%
Bayesian	38.46%

According to the table 3 SVM shows the best classification accuracy as compare to the others. Fig 3 shows the bar chart. Representing the performance of Bayesian, KNN, and SVM.

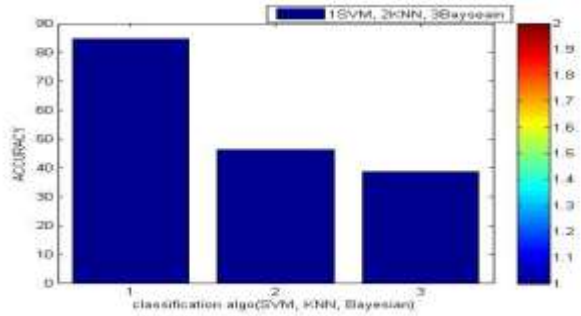


Fig 3 Performance Analysis of Classifiers of Thyroid Using Bayesian, KNN and SVM.

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