International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue II, Feb 2019- Available at www.ijraset.com

A Review on Thyroid Nodule Detection Using Image Processing

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Abstract: ***Ultrasonography is the most accepted or preferred imaging technique for diagnosis of cancer in thyroid gland. The method for detection of thyroid cancer consists of stages like Image enhancement, segmentation, feature extraction and classification. Image enhancement improves the quality of image followed by segmentation and then features extraction which involves extraction of features. The extracted features are then given to classifier for classification purpose. In last few years, numbers of algorithms have been developed for efficient effective diagnosis of thyroid cancer. This paper covers different techniques related to enhancing of image, segmentation and classification of thyroid nodule.***
Keywords: Ultrasonography (USG), segmentation, Artificial neural network (ANN), Feature extraction, Image enhancement, Image processing.

I. INTRODUCTION

Image processing is a method having an input and an output which plays an important role in further processing of images. Input to image processing involves a photograph or video and output is the set of parameters or image or factors which are related to that image. Medical Image processing is one of the area related to image processing which helps in diagnosing human diseases as manual diagnosing consumes lot of time and also involves lot of efforts as compared with automatic diagnosis. Imaging techniques like Ultrasonography, MRI, CT, OCT are available but most commonly preferred or used among them is Ultrasonography. It has various advantages like free from harmful radiations, painless, immediate response etc. The thyroid gland produces thyroid hormone which helps in regulating the body's metabolism. Ultrasound imaging uses high frequency sound waves to visualise inside part of the body. Thyroid ultrasound image is widely used by the radiologists to examine the malignancy of thyroid nodules. Usually, it is followed by fine needle aspiration biopsy (FNAB) as further diagnosis process [1]. Thyroid nodules are solids lumps forming in thyroid gland, which can be cancerous or non- cancerous. Hyperthyroidism, or an overactive thyroid, may also be caused by inflammation of the thyroid, various kinds of medications, and lack of control of thyroid hormone production. One of the most common causes is Graves' disease. Graves' disease happens when the body makes proteins that constantly tell the thyroid to make more thyroid hormone [2].

II. LITERATURE SURVEY

A. Tsuda T, Tokinobu A, Yamamoto E, Suzukib E.et al.[4]

Tsuda analysed thyroid cancer in the people of Fukushima (Japan) aged from 18 to 25. The authors screened the thyroid cancer using the ultra sound images. The authors achieved 95% confidence level while screening the thyroid cancer in thyroid ultrasound images.

B. Nugroho H A, Nugroho A, Choridah L et al.[4]

Nugroho used active contour bilateral filtering technique to detect the thyroid nodule in ultrasound images. The irregular boundary of the nodule in the thyroid was detected and segmented accurately using this bilateral filtering approach. The authors detected and removed the speckle noises in the thyroid image before the process of segmentation.

C. Gomathy V, Snekhalatha U.et al.[5]

Gomathy used Principle Component Analysis method for detecting the thyroid gland in ultra sound images. Region of Interest (ROI) and Morphological operations were used to segment the thyroid area accurately.

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D. Du W, Sang N. et al.[6]

Du developed a method for detecting the thyroid nodule in ultrasound images. The speckle noises were detected and removed using anisotropic diffusion filter. Local phase symmetry features were extracted from the thyroid images for accurate nodule segmentation.

III. METHODOLOGY

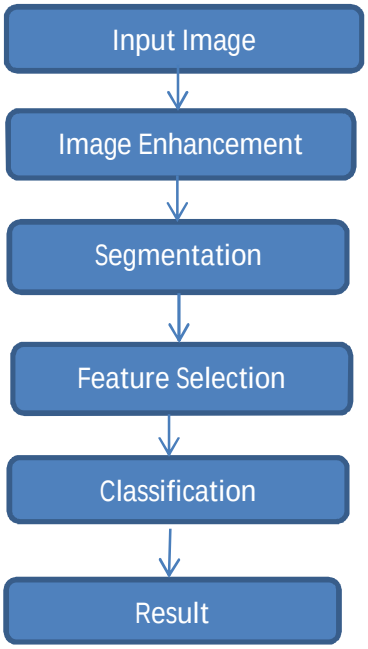
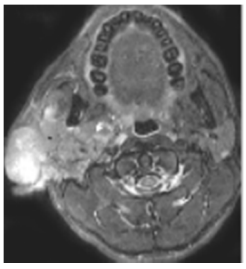


Fig1. Block diagram

1) *Input Image:* The input to the system will be mixed type Ultrasound images like some images having nodules, while some not, some of them with benign or malignant.



a) Input Image

2) *Image Enhancement:* The ultrasound images contain speckle noise in addition to grain noise. This should be removed else it will provide inaccurate results. The different techniques that are proposed for removal of noise are:

a) Brightness Preserving Dynamic Fuzzy Histogram Equalization: It manipulates image histogram in such a way that only redistribution of gray level values in valley portion between two consecutive peaks takes place and no remapping of histogram takes place.

b) Histogram Equalization: It is a technique to obtain a histogram that has uniformly distributed intensity in the image. The approach taken is to get broader levels of gray in the area that has many pixels and narrow levels of gray in area that has few pixels. It can be used to improve overall contrast.

c) Median Filter: It is one of low pass filters that work by changing the values of a pixel in original image with median value of the pixel and its neighbour environment by using zero padding that is by providing auxiliary pad around the image with a value of zero.

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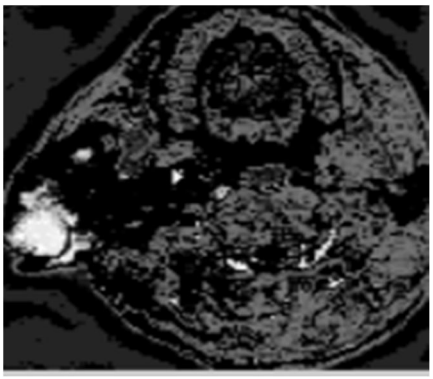
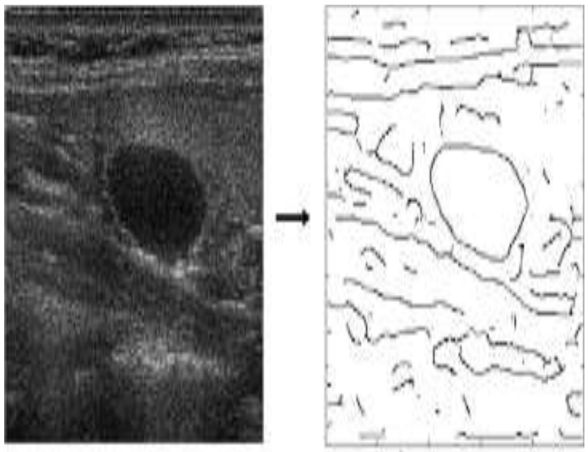


b) Enhanced Image

3) *Segmentation:* Image segmentation is the process of dividing the image into the partitions on the basis of regions with similarities.

a) Active contour without edge: Snake model active contour detects object in an image by setting initial curve then it starts to evolve until it stops on the boundary of the object.

b) Watershed segmentation: Watershed algorithm segments the image into catchment basins. It refers to ridges that divide areas which are drained by different river systems. A catchment basin can be defined as an area draining into a reservoir. The link between the watershed and catchment basins in image processing is performed via computer analysis of objects in digital images. The computer analysis of objects initiates with examining to decide which pixel belong to each object [7]. This is the process of separating objects from the background as well as from each other.



c) Segmented thyroid image

4) *Feature Extraction:* Feature extraction is the process of extracting some related features or desired values from large input data. These extracted features get used further in order to train the classification system. To get the desired and accurate outcome extracted features must be appropriate according to need.

5) *Classification:* The output of classification phase is a class label representing whether the tumour is benign or malignant. For classification phase the schemes like Artificial Neural Network (ANN), Support Vector Machine (SVM) also K-Nearest Neighbour (KNN) can be used.

a) Artificial Neural Network: It is a parallel distributed processor which has a natural tendency for storing experimental knowledge. The use of textural features in ANN helps to resolve misclassification. The main benefit of neural network is that a model of system can be built from available data.

b) Support Vector Machine: It is a discriminative classifier that constructs a hyper plane or set of hyper planes in a high or infinite dimensional space, which used for classification and outliers detection.

c) K-Nearest Neighbour: It is a non-parametric and generally effective classification approach. It allows easy and fast incorporation of new data into an existing trained system.

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IV. REVIEWED RESULTS

The segmentation accuracy using different researches are shown below. The accuracy varies depending on the thyroid diseases.

Author	Title	Segmentation Method	Accuracy %
Chuan-Yu Changet	A Neural Network for Thyroid Segmentation and Volume Estimation in CT Images.	Progressive learning vector quantization neural network (PLVQNN)	98.34
Chuan-Yu Chang	Thyroid Segmentation and Volume Estimation in Ultrasound Images.	Radial basis Function neural networks (RBFNN)	96.54
U Rajendra Acharya	Automated Benign & Malignant Thyroid Lesion Characterization and Classification in 3D Contrast-Enhanced Ultrasound.	Decision tree	96.9
Singh1 and Mrs Alka Jindal	A segmentation method and classification of diagnosis for thyroid nodules.	SVM	84.62

V. CONCLUSION

Ultrasound images are most commonly used for detection of nodules in thyroid gland. Since there is similarity in gray levels of benign and malignant nodules it creates confusions among the physicians and radiologists. Also the noise present in US images degrades the quality of images. This paper presents a computer based method for solving these difficulties by providing various methods for segmentation of nodules and classifying them as malignant or benign.

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