ISSN 2321-807X
Volume 13 Number6
Journal of Advances in chemistry

Thyroid Nodule Image Analysis using Morphological Segmentation

M.Malathi
Department of ECE
Bharathiyar College of Engineering & Technology
Karaikal, Puducherry, India
m_malathi123@rediffmail.com
Dr.S.Srinivasan
Department of EIE
Annamalai University
Tamilnadu, India
vasanau2004@yahoo.co.in

Abstract

Computer-aided investigative processing has become an important part of medical practice. New growth of high expertise and use of a choice of imaging modalities, more confront arise so that high rate information can be produced for disease finding and behavior. Ultrasonography of Thyroid gland is the most common, portable, widely accessible, cheap, painless and secure. It is used to distinct the thyroid nodule images that are classified into two categories: (i) benign thyroid ample, (ii) malignant lump of thyroid gland. In this paper, Mathematical Morphology is used to segment the thyroid region and measure the area, perimeter, width and height of the thyroid area. Thyroid nodule images are taken from twenty peoples as samples.

Keywords— Thyroid, Morphological operation, Ultrasound, Segmentation, Tumor

I. INTRODUCTION

Bio-Medical images of a specific organ are get from medical examination for the opinion of a disease in scientific environment. Though, bio-medical imaging tests are also achieved to obtain images to study the anatomical and functional structures for research principle with normal as well as pathological subjects [1]. The implication of medical imaging model is its direct contact on the healthcare during identification, dealing evaluation and forecast of a specific disease [2]. Ultrasound is the ideal imaging modality for identifying thyroid cancer and wound.

An ultrasound is a painless procedure that uses sound waves to generate images of the inside of your body. A thyroid ultrasound is used to examine the abnormalities in thyroid nodule. The thyroid glands are found and the shapes are marked from ultrasound (US) images. This move towards the experience of the doctor and is awfully time unbearable. US thyroid images contain reverberation conflict and speckle noise, which can make analysis difficult.

A number of methods for eradicate noise and segmenting anatomical matter from US images have been survive such as lump, breast malignancy [3]. Preprocessing is the process of adjusting digital images in terms of eliminating noise so that the results are more suitable for further image analysis [4]. Gaussian filter is used in preprocessing stage to smoothen the edge regions in thyroid image.

More, image segmentation refers to the process of partitioning an image into groups of pixels which are homogenous with respect to some principle [7]. The main objective of image segmentation is to extract various features of the image which can be build objects of interest on which analysis and interpretation can be performed. Thus, Image segmentation is concerned with dividing an image into meaningful regions like objects, boundaries, lines, curves, etc. in images.

Mathematical morphology is one of the method in the image segmentation and used in the field of image processing to remove details smaller than a certain reference shape in order to produce the desired segmentation [9]. The basic morphological operators are opening, closing, erosion and dilation. In this paper, erosion and dilation is preferred because the method paying attention on the detection of region based of thyroid image. Morphological operations are applied over the preprocessed thyroid tumor image in order to divide the malignant region.

The rest of this paper is arranged as follows. Section II initiates a explanation of the main components of the proposed methods. Then in section III, the result and discussion of the proposed image segmentation technique is described. We conclude the results in section IV.

II. PROPOSED METHODOLY

Thyroid nodules are irregular lump growing within the thyroid gland which may signify different conditions including malignancy [5]. Various works are done for the analysis of thyroid diseases using different image processing algorithms. Several information is collected in order to get the unprocessed thyroid ultrasound nodule images. The information had been processed using some images processing techniques which are preprocessing and segmentation [6]. The image undergoes the preprocessing as image enhancement to hold back speckle. The improved image is used for additional processing of segmentation of thyroid region by mathematical morphology [12]. From segmented thyroid locale, the value of area, border, thickness and altitude of thyroid nodule are measured. The essential steps of the planned methodology are shown in Fig. 1.

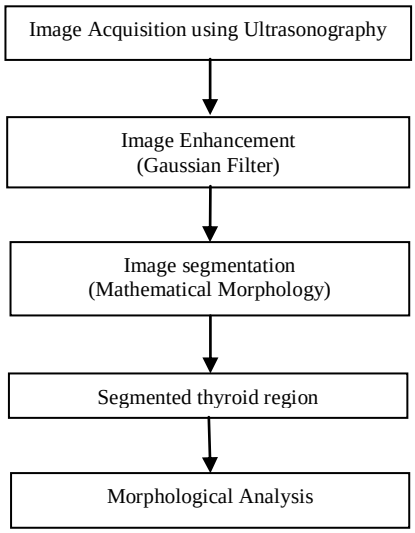
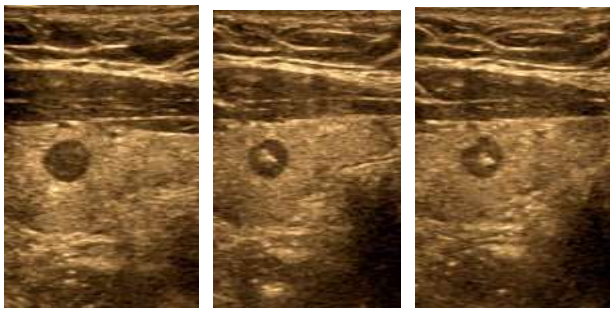


Fig. 1. Proposed methodology using Mathematical Morphology

A. Input Image

Total 20 Number of ultrasound thyroid nodule images were used where 12 benign and 8 malignant images was selected in database. The format of images was used in JPEG. Sample US thyroid nodule images are exposed in Fig. 2 (a-c).



(a) (b) (c)

Fig. 2. Ultrasound Thyroid nodule Images

B. Image Enhancement

Low visual quality of ultrasound thyroid nodule images, deeply change the segmentation and the measurement outcome. The aim of pre-processing is an enhancement of the image data that restrain undesired distortion which is occurring from image acquisition stage or enhances some image features relevant for further processing and analysis task. Such procedure is also called filtration [11]. Various types of filters like median filter, wavelet filter and anisotropic diffusion filter are used to remove or suppress the noise. In this planned methodology, Gaussian filter is used in preprocessing stage to smooth the edge regions in thyroid nodule image [8].

Gaussian filter is used to blur images and remove speckle noise and feature. In one dimension, the Gaussian function is

$$G(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{x^2}{2\sigma^2}} \quad (1)$$

where σ is the standard deviation of the distribution. The distribution is assumed to have a mean of 0. Fig. 3 shows its preprocessed thyroid nodule image.

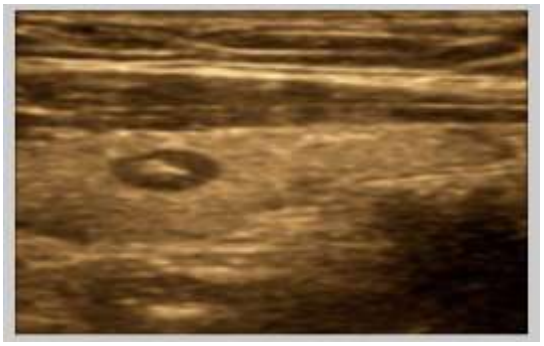


Fig. 3. Preprocessed ultrasound thyroid nodule image

C. Segmentation

Image segmentation represents the first step in image analysis and pattern recognition. Usually image segmentation is an initial and vital step in a series of processes aimed at image understanding. The purpose of image segmentation is to partition an image into multiple regions with respect to particular applications. The segmentation is based on the measurements taken from the image and might be grey level, color, texture, depth or motion. One of the main applications of image segmentation is identifying objects in a scene for object based measurement such as size and shape. Segmentation based on texture, enables various surfaces with varying patterns of grey to be segmented [10] [15].

Aim of medical image segmentation is to study anatomical structure and identify the region of interest i.e. locate tumor, lesion and other abnormalities. After locating the tumor position, measure the tissue volume to identify the growth of tumor and to help in further planning to treatment. Mathematical Morphology as a segmentation method is proposed in this paper.

The field of mathematical morphology contributes a wide range of operators to image processing, all based around a few simple mathematical concepts from set theory. The operators are particularly useful for the analysis of binary, grey scale and color images and common usages include edge detection, noise removal, image enhancement and image segmentation. Morphological techniques typically probe an image with a small shape or template known as a structuring element. The structuring element is positioned at all possible locations in the image and it is compared with the corresponding neighborhood of pixels. Morphological operations differ in how they carry out this comparison [13] [14].

Fundamental Morphological Operations are Erosion and dilation work by translating the structuring element to various points in the input image, and examining the intersection between the translated kernel coordinates and the input image coordinates. For instance, in the case of erosion, the output coordinate set consists of just those points to which the origin of the structuring element can be translated, while the element still remains entirely `within' the input image. Virtually all other mathematical morphology operators can be defined in terms of combinations of erosion and dilation along with set operators such as intersection and union.

The basic effect of the erosion operator on a binary image is to erode away the boundaries of regions of foreground pixels (*i.e.* white pixels, typically). Thus areas of foreground pixels shrink in size, and holes within those areas become larger. The basic effect of the dilation operator on a binary image is to gradually enlarge the boundaries of regions of foreground pixels (*i.e.* white pixels, typically). Thus areas of foreground pixels grow in size while holes within those regions become smaller.

Morphological operations are applied over the preprocessed thyroid image in order to segment the malignant region. The eroded image is subtracted from dilated image to detect and segment the malignant region. Fig. 4 & 5 shows the segmented thyroid malignant region as binary image and gray scale image.

Fig. 4. Binary image of segmented thyroid malignant region.

ISSN 2321-807X
Volume 13 Number6
Journal of Advances in chemistry

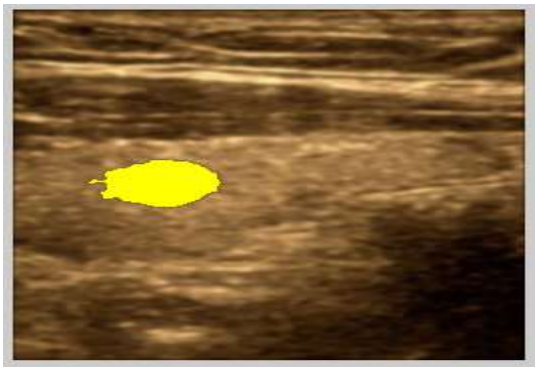


Fig. 5. Gray scale image of segmented thyroid malignant region.

III. RESULTS AND DISCUSSION

Morphological analysis of the thyroid malignant region is very important in screening and diagnosing the thyroid cancer. The morphological parameters used in this paper are perimeter (μm), area (μm^2), width (μm) of the malignant in horizontal position and height (μm) of the malignant region in vertical position [11].

The abnormal regions in thyroid image are classified into either benign or malignant. The benign is the biopsy region in thyroid and it may cured by medication and it is not lead to any cancerous cells in thyroid. The cancerous cells region is called as malignant and it can be cured only by surgery in severe case.

The morphological measurements are carried over the segmented malignant region in thyroid images. The perimeter of the segmented malignant region is computed using the following Equation as,

$$\text{Perimeter} = 2\pi r\ \mu m \quad (2)$$

where, r is the radius of the segmented cancer region of thyroid image. The area of the segmented cancer region is computed using the following Equation as,

$$\text{Area} = \pi r^2\ \mu m^2 \quad (3)$$

Fig. 6 indicates the morphological analysis result from the segmented thyroid malignant region.

```
Tumor's Morphometric Features


ans =

Area:        1514.000000
Perimeter:   168.877000
Width:       59.298484
Height:      32.953572
```

Fig. 6. Morphological Analysis

The morphological analysis of both benign and malignant is shown in Table I.

TABLE I

MORPHOLOGICAL ANALYSIS

Morphological analysis parameters	Benign	Malignant
Perimeter(μm)	12.61±12.76	168.3± 12.76
Area(μm^2)	209.1±10.63	1701±152.67
L(μm)	18.28±3.28	34.93±4.26
W(μm)	27.19±2.87	62.3±3.69

The proposed morphological segmentation methodology is used to locate the malignant region and also used to analyze the severity of the affected thyroid region with reference to the ground truth method. The measurements for the area, perimeter, width (W) and height (L) of the thyroid region involve 20 samples.

IV. CONCLUSION

Ultrasonography can identify exterior growths and foreign bodies eg, in the thyroid gland, breasts, testes, limbs, and some lymph nodes. This work proposes a mathematical morphology to identify the thyroid malignancy on ultrasound image. It comprises preprocessing stage using Gaussian filter to reduce speckle noise that may affect the segmentation results and segmentation stage to locate the thyroid malignancy region and analyze the severity of the affected thyroid portion. As a conclusion, the dimension of area, perimeter, width and height of the thyroid lobe is successfully analyzed using MATLAB.

ACKNOWLEDGMENT

I would like to thank Dr. S.Srinivasan, Research Guide and Dr.J.Samuel Manoharan, Co-guide for providing their uninterrupted support and guidance for this effort. I would also like to thank Dr.S.Mohan, M.D., for clearing up the details of medical terms in this paper.

REFERENCES

[1] Gurinder Kaur, Vikas Wasson, “Thyroid Gland Segmentation Of Ultrasound Images Based On Neural Networks: A review”, International journal of advanced research computer science and software engineering, Volume 5, Issue 4, 2015.

[2] M.Malathi, Srinivasan, “Segmentation and classification methods of ultrasound thyroid nodule image: issues and challenges”, International journal of applied engineering research, volume 10, 2015.

[3] Gireesha H M, Nanda S, “Thyroid Nodule Segmentation and Classification in US images”, International Journal of Engineering Research & Technology, Volume 3, Issue 5, 2014, pp. 2252–2256.

[4] S. Binny, “Mean-shift filtering and segmentation in ultra sound thyroid images”, International Journal of Research in Commerce, IT & Management, Volume 3, Issue 3, 2013, pp. 126-130.

[5] Nikita Singh, Alka Jindal, “A Segmentation Method and Comparison of Classification Methods for Thyroid Ultrasound Images”, International Journal of Computer Applications, Volume 50 - No.11, 2012.

[6] Ms. Nikita Singh, Mrs Alka Jindal, “A segmentation method and classification of diagnosis for thyroid nodules”, IOSR Journal of Computer Engineering, Volume 1, Issue 6, 2012, PP 22-27.

[7] Sheeja Agustin A, S. Suresh Babu, “Thyroid Segmentation on US Medical Images: An Overview”, International Journal of Emerging Technology and Advanced Engineering, Volume 2, Issue 12, 2012.

[8] Nikita Singh, Alka Jindal, “Ultra sonogram Images for Thyroid Segmentation and Texture Classification in Diagnosis of Malignant (Cancerous) or Benign (Non- Cancerous) Nodules”, International Journal of Engineering and Innovative Technology Volume 1, Issue 5, 2012.

[9] Deepika Koundal, Savita Gupta and Sukhwinder Singh, “Computer-Aided Diagnosis of Thyroid Nodule: A Review”, International Journal of Computer Science & Engineering Survey, Volume 3, No.4, 2012.

[10] Ioannis Legakis, Michalis A. Savelonas, Dimitris Maroulis and Dimitris K. Iakovidis, “Computer-based nodule malignancy risk-assessment in thyroid ultrasound images”, International Journal of Computers and Applications, Volume 33, No. 1, 2011.

[11] Nasrul Humaimi Mahmood and Akmal Hayati Rusli, “Segmentation and Area Measurement for Thyroid Ultrasound Image”, International Journal of Scientific & Engineering Research Volume 2, Issue 12, December-2011.

[12] Ali Kermani, Ahmad Ayatollahi, Ahmad Mirzaei, Mohammad Barekatain, “Medical ultrasound image segmentation using genetic active contour”, J. Biomedical Science and Engineering, Volume 4, 2011, pp. 105-109.

[13] D. Selvathi and V. S. Sharnitha, “Thyroid Segmentation in ultrasound images using Support Vector Machine”, International Journal of Neural Networks and Applications, 4(1), 2011, pp. 7-12.

[14] Stamos Katsigiannis, Eystratios G. Keramidas, Dimitris Maroulis, “A Contourlet Transform Feature Extraction Scheme for Ultrasound Thyroid Texture Classification”, Published in Engineering Intelligent Systems, Special issue: Artificial Intelligence Applications and Innovations, Volume 18, No. 3/4, 2010.

[15] Dimitris K. Iakovidis, Eystratios G. Keramidas, Dimitris Maroulis, “Fusion of fuzzy statistical distributions for classification of thyroid ultrasound patterns”, Artificial Intelligence in Medicine, Volume 50, 2010, pp. 33–41.

[16] Chuan-Yu Chang, Yue-Fong Lei, Chin-Hsiao Tseng and Shyang-Rong Shih, “Thyroid Segmentation and Volume Estimation in Ultrasound Images” IEEE Trans. on Biomedical Engineering, Vol. 57, No. 6, 2010.