

DETECTION OF THYROID NODULE IN ULTRASOUND IMAGES USING ARTIFICIAL NEURAL NETWORK

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Abstract— Thyroid Gland is a major player in regulating your metabolism. It is one of the largest endocrine glands in the body and it consists of two connected lobes. This gland is found in the neck, below the Adam's apple. The thyroid's main role in the endocrine system is to regulate your metabolism, which is your body's ability to break down food and convert it to energy. Food essentially fuels our bodies, and our bodies each "burn" that fuel at different rates. It controls how quickly the body uses energy, makes proteins and controls the body's sensitivity to other hormones. The thyroid keeps your metabolism under control through the action of thyroid hormone. It produces hormones that performs regulation of growth and rate of function of many other systems. These hormones are named as triiodothyronine and thyroxine. There are various thyroid disorders like Hypothyroidism, Hyperthyroidism, goiter and thyroid nodules (benign/malignant). Different modalities that are used to identify and classify abnormalities of the thyroid gland are Ultrasound imaging, Computer Tomography(CT), Magnetic Resonance Imaging(MRI) and Computer Aided Diagnosis (CAD). CAD help radiologists and doctors to improve the diagnosis accuracy, reduce biopsy ratio and save their time and effort. Medical image analysis has played an important role in many clinical procedures for detecting different types of human diseases. Thyroid medical images are utilized for the diagnosis process.

Keywords— CAD, Ultrasound, ANN, feature Extraction, Segmentation.

I. INTRODUCTION

Image processing is one of the type of signal processing which uses input as an image such as photograph or video frame and gives output as an image or parameters related to the image. In digital image processing the use of algorithms in computer is to perform the image processing on digital images. Medical imaging is the method used to obtain images of the human body for clinical purpose. Different Imaging technologies are:- Photo acoustic imaging, Radiology, Magnetic resonance imaging, Nuclear medicine, Tomography and ultrasound imaging.

Medical imaging includes the study of normal anatomy and physiology. For diagnosing thyroid diseases, Ultrasound (US) and Computerized Tomography are some of the most popular imaging modalities. US imaging is inexpensive, non-invasive and easy to understand and use. US images are often preferred due to their cost-effectiveness and portability in smaller hospitals. Because of its superficial location, size and echogenicity, the thyroid is well suited to ultrasound study. Computer-Aided Diagnosis of Thyroid Ultrasound is required in order to delineating nodules, classifying benign/malignant and reduce invasive operations such as Fine Needle Aspiration (FNA) and biopsy. Computerized system is a valuable for feature extraction as well as classification of thyroid nodule for elimination of operator dependency and to improve the diagnostic accuracy. [16]

II. PROPOSED METHOD

Fig.1 shows the schematic of proposed method. The management of thyroid nodules involves head and neck surgeons, pathologists and radiologists. US is easy to perform and widely available. It does not involve ionizing radiation and is readily combined with fine needle aspiration cytology (FNAC). Therefore it is an ideal investigation of choice for evaluating thyroid nodules. It gives evaluation of specific features that help in identifying the nature of the nodule and FNAC helps in diagnostic accuracy. Ultrasound provides a safe tool for disease surveillance [1].

Different Image processing step includes removal of noise using filters and enhancing the image. Nonlinear filters are becoming increasingly important in image processing applications. They are often better than linear filters at removing noise without distorting image features [2]. It includes Median filtering as the most common method of clearing image noise while retaining edges of an image [3]. The histogram equalization spreads out intensity values along the total range of values in order to achieve higher contrast.

Histogram equalization is a straightforward image-processing technique often used to achieve better quality images in black and white colour in medical applications. Normalization is a process that changes the range of pixel intensity values. The purpose of normalization is to bring the image in a range which is more familiar or normal to the senses.

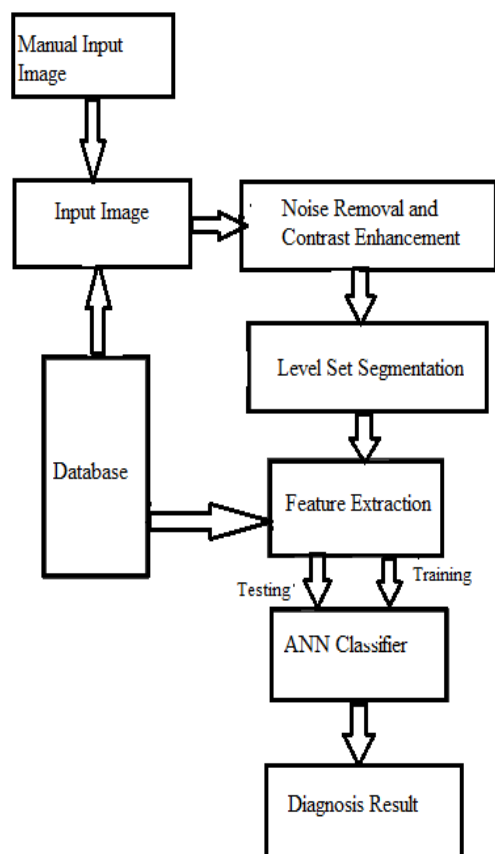


Fig 1.Schematic Of Proposed Methodology

A digital image can be divided into multiple segments, it is nothing but image segmentation. To simplify and or change the representation of an image which is more meaningful and easier to analyze is the goal of segmentation [6].

The level set method is introduced to produce good results on medical images for which the boundary of the regions of interest usually have low curvature values [4][5]. With the help of level set method we can do segmentation in the presence of intensity inhomogeneity. It is a numerical technique for tracking interfaces and shapes. The main advantages of level set method is that we can perform numerical computations including curves and surfaces [6]. It is the process of acquiring information of an image, such as color, shape and texture.

Features contain the relevant information of an image. Features are divided into different classes depending on properties they describe. Texture is an important characteristics used in identifying region of interest in an image. GLCM (Grey Level Co-occurrence Matrices) is one of the earliest methods for texture feature Extraction [7]. GLCM characterize the texture of an image by calculating how often pairs of pixel with specific values and within a specified spatial relationship occur in an image. It creates a matrices and then extracts statistical measures from this matrix.

The texture features in ANN helps to resolve misclassification. ANN is a parallel distributed processor that has a natural tendency of storing experiential knowledge. It can provide suitable solutions for problems, which are generally characterized by non-linear ties as well as high dimensionality noise, complex, imprecise and imperfect or error prone sensor data and lack of a exactly stated mathematical solution or algorithm. A key benefit of neural networks is that we can build a model of the system from the available data. Image classification using neural networks is done by texture feature extraction and then applying the back propagation algorithm [8].

The remaining paper is organized as follows. Section 3 covers the discussion of thyroid gland overview and different thyroid disorders, Section 4 gives experimental Results, Section 5 presents conclusion and in Section 6 references are given.

III. THYROID GLAND OVERVIEW AND DIFFERENT THYROID DISEASES

3.1 Thyroid Gland Overview

The butterfly-shaped thyroid gland is located in the base of neck. This gland releases hormones that control metabolism—the way our body uses energy. The thyroid hormones regulate vital body functions like breathing, heart rate, central and peripheral nervous system, weight of body, muscle strength, menstrual cycles, body temperature, Cholesterol levels. This gland is about 2-inches long and it lies in front of throat below the prominence of thyroid cartilage sometimes called the Adam's apple. Thyroid has two lobes that lie on either side of your windpipe, and is usually connected by a strip of thyroid tissue known as an isthmus.

3.2 How Thyroid Gland Works?

Thyroid is part of the endocrine system, which is made up of glands that produce, store and further release hormones into the bloodstream so the hormones can reach the body's cells. The thyroid gland uses iodine from the foods we eat to make two main hormones like Triiodothyronine (T3) and Thyroxine (T4). The levels of T3 and T4 should be neither too high nor too low. The hypothalamus and the pituitary communicate to maintain T3 and T4 balance. Hypothalamus produces TSH Releasing Hormone (TRH) that signals the pituitary to inform the thyroid gland to generate more or less of T3 and T4 by either increasing or decreasing the release of a hormone called thyroid stimulating hormone (TSH). Whenever these T3 and T4 levels are low in the blood, the pituitary gland releases more TSH to inform the thyroid gland to produce more thyroid hormones. If the level of T3 and T4 are high, the pituitary gland releases less quantity of TSH to the thyroid gland to slow production of these hormones.

A thyroid that is functioning normally produces (approximately) 80% T4 and about 20% T3.

3.3 Thyroid Diseases

Thyroid diseases can be found at any age and can result from a variety of causes—injury, disease or dietary deficiency, for instance.

Following are some of the most common thyroid disorders.

Goiters: A goiter is a bulge in the neck. A toxic goiter is related with hyperthyroidism and a non-toxic goiter, also known as a simple or endemic goiter, is caused by deficiency of iodine.

Hyperthyroidism: Hyperthyroidism is caused by too much thyroid hormone. People with hyperthyroidism are sensitive in case of heat, hyperactive, and eat excessively. Goiter is sometimes a side effect of hyperthyroidism. This is because of an over-stimulated thyroid and inflamed tissues, respectively.

Hypothyroidism: Hypothyroidism is characterized by too little thyroid hormone. This condition is known as cretinism in infants. Cretinism has very dangerous side effects, including abnormal bone formation as well as mental retardation. If you have hypothyroidism as an adult, sensitivity to cold, little appetite, and an overall sluggishness can be experienced. Hypothyroidism often goes unnoticed, sometimes for years, before being diagnosed.

Solitary thyroid nodules(benign): Solitary nodules, or lumps, in the thyroid are actually quite common—in fact, it is estimated that more than half the population will have a nodule in their thyroid. The great majority of nodules are benign. Generally a fine needle aspiration biopsy (FNA) will determine if the nodule is cancerous.

Thyroid cancer(malignant): Thyroid cancer is mostly common, though the long-term survival rates are excellent. Occasionally, symptoms such as hoarseness, neck pain as well as enlarged lymph nodes occur in people with thyroid cancer. Thyroid cancer can affect anyone at any age even though women and people over thirty are most likely to develop the condition[3]

IV. EXPERIMENTAL RESULTS:

In this paper thyroid Ultrasound images are used. The database contains cancerous as well as non cancerous images. The format of images is JPEG. ANN classifies the disease either as Benign (Non cancerous) Or Malignant(Cancerous). Following figures show actual execution of methodology which shows the results obtained.



Fig.2 a)Thyroid US image



Fig.2 b)Histogram Equilisation



Fig.2 c)Median Filtering



Fig.2 d)Normalisation

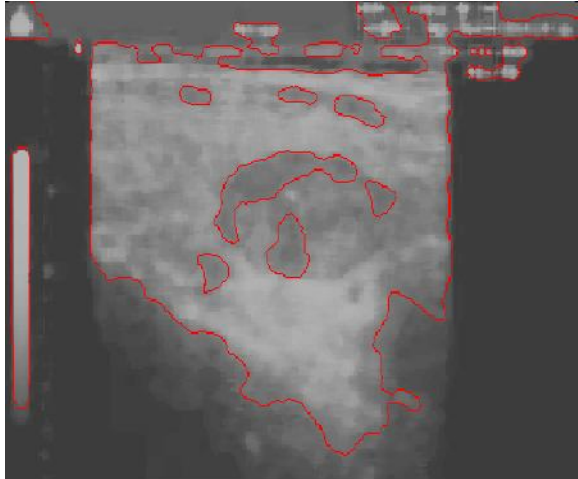


Fig.2 e) Segmentation After 2 Iterations

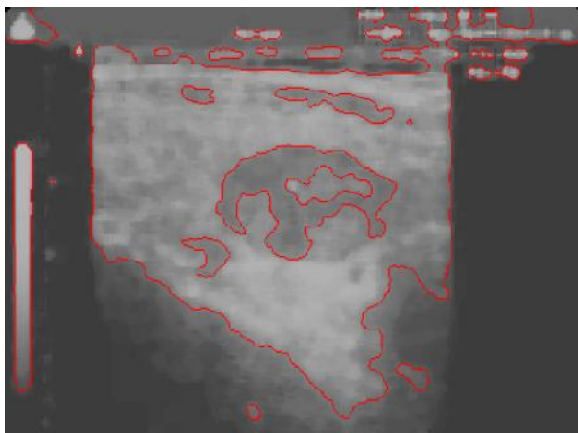


Fig.2 f) Segmentation After 4 Iterations

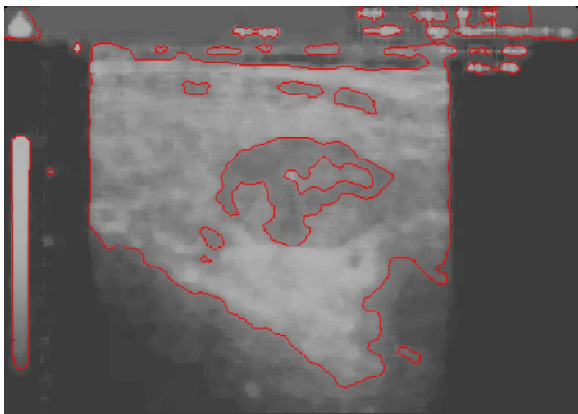


Fig.2 g) Segmentation After 8 Iterations



Fig.2 h) Final segmentation

Table 1. Feature Extraction

Parameter	Value
Area	1.05E+03
Perimeter	330.75
AP	3.178
compactness	104.0747
solidity	0.6084
eccentricity	0.5439
orientation	-75.8007

The extracted features are given to the neural network to determine which type of nodule is present (malignant or benign).

CONCLUSION

Medical images are useful for clinical diagnosis. It is a time consuming for physicians to manually segment the thyroid nodule. From the experimental results, it is concluded that ANN gives 70% classification accuracy. However the generation of more features may enhance the evaluation procedure accuracy. This work gives efficient platform for researchers and scientist.

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