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IMAGE PROCESSING TECHNIQUE FOR THYROID USING IMPROVED HILL CLIMBING ALGORITHM

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ABSTRACT - Image segmentation is a fundamental and challenging task in image processing and computer vision. The color image segmentation is attracting more attention due to the color image provides more information than the gray image. In this paper, we propose a variation model based on a convex K-means approach to segment color images. The proposed variation method uses a combination of l1 and l2 regularizes to maintain edge information of objects in images while overcoming the staircase effect. Meanwhile, our onstage strategy is an improved version based on the smoothing and thresholding strategy, which contributes to improving the accuracy of segmentation. Transforming colorful image in to gray image), Image segmentation (thresholding) and feature extraction (hill climbing algorithm) to determine cold thyroid nodules automatically with high accuracy.

Keywords: [image segmentation, Magnetic resonance imaging, Hill Climbing, Image processing.]

1. INTRODUCTION

The thyroid gland is located in front of larynx, under Adam's apple in the neck. This gland has 2 lobes and looks like a butterfly. Thyroid gland is one of the endocrine glands that produce thyroid hormones. It controls heart rate regulation, weight, body temperature, and blood pressure by thyroid hormones. It also can affect childhood intelligence, growth and adult metabolism. Image processing is a technique that can be used in detecting objects in images. This technique is widely being used in medical science for detecting diseases. It can implement various algorithms to process medical images. For diagnosing thyroid nodules, various imaging technologies such as Magnetic resonance imaging (MRI), Radiology, Radioactive iodine scan, Computed tomography and ultra-sonography (US) are performed. Among them we studied radioactive iodine scan of thyroid due to high accuracy.

With the development of molecular imaging technologies, diagnosis and treatment of thyroid nodules are being improved. Molecular imaging technology performed by radioactive iodine uptake can be used widely for thyroid nodules treatment. Thyroid uptakes radioactive iodine in the form of hot, warm and cold nodules. Due to risk of malignancy diagnosis of cold nodules is important. The aim of this article is to implement algorithms of image processing to detect the cold nodules in thyroid radioactive images.

In the above segmentation methods based on the SaT strategy, thresholding is recognized as an effective method of image segmentation. A great number of thresholding techniques have been widely used for grayscale and color image segmentation. Moreover, some clustering algorithms have been utilized by many picture segmentation models to decide limits for segmentation, for example, fluffy clustering and the K-implies clustering a thresholding technique in light of fluffy set was proposed to manage medical images, and the strategy got great performance outwardly and numerically. Jia presented a robust self-sparse fuzzy clustering algorithm for solving over-segmentation.

2. EXISTING METHODOLOGIES

1. Junying Chen (2016) et.al proposed Malignant Thyroid Tumors Based on Characteristics of Medical Ultrasonic Images. As the health issue is being concerned by more and more people, the workload of a clinical doctor becomes larger. As there are many images to analyze consistently for a medical ultrasonic specialist, picture pattern acknowledgment and classification technologies for medical ultrasonic images are necessary to reduce the workload of the clinical doctor. The significant picture pattern acknowledgement strategies incorporate a Bayesian pattern classifier, support vector machine strategy, and brain network model. These image pattern classification methods present good image classification performance but require large training dataset and long training time. Accordingly, productive attributes based picture pattern classification strategies were examined in this paper, standard deviation classification technique and angle proportion classification method. They were applied to the recognition and classification of benign and malignant thyroid tumors on medical ultrasonic images. The strategies examined in this paper showed great classification performance, which confirmed that the effective attributes based picture pattern classification methods can be utilized in effective image classifier construction.

2. J. Ding (2019) et.al proposed Automatic Thyroid Ultrasound Image Segmentation (ATUIS) Based on U-shaped Network. Programmed growth segmentation of thyroid ultrasound images is very challenging because of the unfortunate picture quality. As of late the U-molded network, particularly U-Net, has accomplished great outcomes in medical picture segmentation. In this paper, we proposed a changed U-Net model (ReAgU-Net), which implanted the superior remaining units into the skip connection among the encoding and decoding path and introduce the attention gate mechanism to multiply the weight feature maps obtained from shallow layers and deep layers. Also, a hyper parameter is introduced to combine Focal-Tversky Loss, Dice Loss and Cross entropy Loss to jointly guide the model optimization process. The experimental results demonstrate that the proposed approach outperforms the other U-shaped models. When the contrast between nodules and background is low, as shown in the first row, the performance of the three models is not good. The dark areas of blood vessels, muscle folds and low echo in the image are similar to the gray level of the lesion. Therefore, when facing these problems, the probability of misjudgment increases. And when multi-nodule appears, such as the case in DDTI dataset, the algorithm also needs to improve.

3. P. Poudel, A. (2019) et.al proposed Patch Based Texture Classification (PBTC) of Thyroid Ultrasound Images using Convolutional Neural Network. Ultrasound (US) is an affordable and important imaging modality in medical imaging without potential hazards for patients and medical practitioners as compared to computed tomography which uses X-rays, magnetic resonance imaging which uses magnetic field and radio waves that could heat up the patient's body during long examinations, nuclear imaging, etc. Texture classification of anatomical structures in US images is an essential step for disease diagnosis and monitoring. In this work, we utilized a Convolutional brain network to section thyroid organ in US images. This is particularly important for thyroid diseases diagnosis as they involve changes in the shape and size of the thyroid over time. The training of the Convolutional Neural Network (CNN) was not done directly on the acquired US images but on texture database that is created by dividing the thyroid US images of size 760 x 500 pixels into smaller texture patches of size 20 x 20 pixels. However, a quantitative analysis could also be carried out by computing the accuracy of segmentation in the isthmus area. On top of that, CNN is fully automatic, fast and robust as compared to other methods which aid the medical practitioners in diagnosis and monitoring of thyroid over time with less effort. Similarly, there were no any cases that proved to be difficult to segment with this approach. However, all the US images were acquired using a single US machine (GE Logiq E9).

3. PROPOSED METHODOLOGY

Image Enhancement

Image enhancement or image preprocessing is applied on the image to improve the perception of data for automatic image processing detection. Spatial and frequency domain methods are the known image enhancement techniques [6, 10]. The first step of Image enhancement is to apply filter (Circular averaging filter) and morphological opening by diamond structure element to the RGB Thyroid Radioactive Image, in parallel. Both of these processes belong to spatial domain methods.

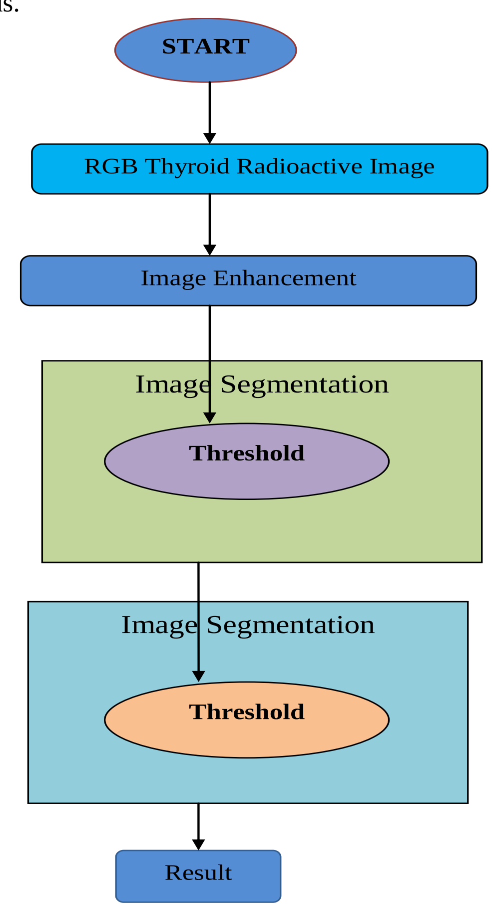

Figure 1. Flowchart of method step by step

Image Segmentation

Image segmentation is an inseparable part of any image description and recognition technique which can divide image into regions [11]. Detection of abnormalities like tumors and tissue classification can be determined by image segmentation. It gives label to every pixel of image so the pixels with same label have same characteristics, which means it can make the medical image easy to analyze [12]. Discontinuity and similarity are properties of Image segmentation which are based on edge and histogram thresholding respectively. After applying thresholding on a gray image, the pixels will change into logical (1 or 0). Thresholding can increase the speed of processing and reduce the space that is needed to store the image is the result after thresholding.

Feature Extraction

After applying image enhancement and image segmentation, we could only make the image clear but it's not enough since the ROI is not found automatically so we need to implement an algorithm to determine the ROI (Cold nodule). For this reason we implemented a hill climbing algorithm with 100 runs to determine the ROI. Other articles have applied artificial neural networks, genetic algorithm, Fuzzy support Vector Machines and Support Vector Machines while they have focused on US images. Hill climbing algorithm is an optimization technique which works with random numbers and finds local optimums.

We can divide the image with the traditional regional growth method, but if the area we select is too small, the target area cannot be fully separated; on the contrary, if the region we pick is too large, although we can fully separate the target area, we will also separate the areas that are not necessary, which can lead to the over segmentation. If the dark contrast between the pixel to be recognized and the seed pixel point is more modest than the development limit T, then, at that point, we can think the pixels are like the seed pixels, and add them to the parceled target region. In actuality, if the dim distinction between the pixel to be recognized and the seed pixel point are greater than the development limit T, then, at that point, we can imagine that the pixels are not the target area.

Improved Hill-Climbing Algorithm (IHCA)

To achieve satisfactory segmentation results, the segmentation method should be nonparametric and should take the local and global feature distribution into consideration. Nonparametric methods are based on clustering the points of an image. There are two types of nonparametric clustering methods: distance-based clustering and density estimation clustering. The distance-based clustering joins pixels of an image based on the distance (i.e. Euclidean distance) between their feature vectors without considering the global distribution of a feature. As an outcome of disposing of this fundamental data on the worldwide dispersion of a component, relics are probably going to happen in the segmentation. Then again, thickness assessment clustering considers the element space as a likelihood thickness capability, where thick districts relate to nearby maxima (peaks of clusters). Once a peak is determined, the cluster associated with it is determined based on the local structure of the feature space.

Our algorithm, called the improved hill-climbing based segmentation, is a simple and fast nonparametric algorithm that detects the peaks of clusters in the global three-dimensional color histogram of an image. We utilize the histogram bins rather than the pixels themselves to find the peaks of clusters; thus, our algorithm can find the peaks efficiently. Then, the algorithm associates the pixels of a detected cluster based on the local structure of the cluster. The hill-climbing based segmentation algorithm is outlined below. We will first explain the algorithm for a one-dimensional color histogram

Input : an image
Output : a set of visually coherent segments
[1]. Compute the color histogram (one-dimensional) of the image, say the hue values (existing colors) versus the number of pixels in each existing color,
[2]. Start at a non-zero bin of the color histogram and make uphill moves until reaching a peak as follows:
[a]. Look at the quantity of pixels of the ongoing histogram canister with the quantity of pixels of the adjoining (left and right) receptacles. Note that since the tint part is addressed as a variety wheel the extreme left and extreme right canisters in the tone hub
[b]. On the off chance that the adjoining canisters have various quantities of pixels, the algorithm takes a difficult action towards the adjoining container with a bigger number of pixels.
[c]. Assuming the prompt adjoining receptacles have similar quantities of pixels, the algorithm really takes a look at the following adjoining containers, etc, until two adjoining canisters with various quantities of pixels are found. Then, at that point, a difficult move is made towards the receptacle with a bigger number of pixels.
[d]. The difficult climbing is proceeded (rehash steps 2.1-2.3) until reaching a container from where there is no conceivable uphill development. That is the situation while the adjoining canisters have more modest quantities of pixels than the ongoing receptacle. Consequently, the ongoing receptacle is identified as a peak (local maximum).
[3]. Select another unclimbed bin as a starting bin and perform step 2 to find another peak. This step is continued until all non-zero bins of the color histogram are climbed (associated with a peak).
[4]. The identified peaks represent the initial number of clusters of the input image; thus these peaks are saved.
[5]. Finally, neighboring pixels that lead to the same peak are grouped together, that is associating every pixel with one of the identified peaks. Thus, forming the clusters of the input image.

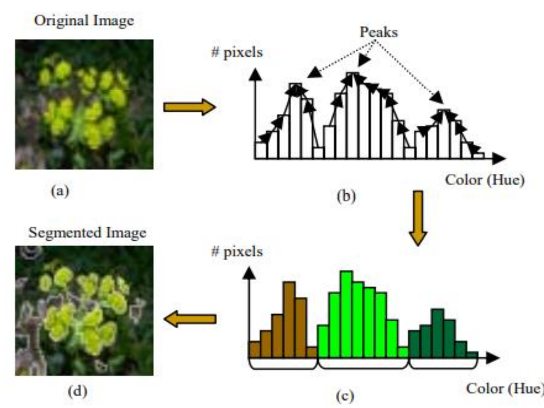

Figure 2. Segmentation process

EXPERIMENT RESULT

We can select multiple or single seed pixels; in the paper, we take a pixel for example to segment the image, the highlights in figure 2 represent the selected seed points, and the figure 3 is the result of the split. We can see that the algorithm has separated the points which are similar to the pixels of the seed pixels, which demonstrates its effectiveness against image segmentation.

Precision

Images	ATUIS	PBTC	Proposed IHCA
50	66.94	74.91	87.01
100	69.66	71.77	90.87
150	74.12	67.93	92.48
200	79.09	68.05	95.23
250	86.38	65.39	97.52

Table 1. Comparison tale of Precision

The Comparison table 1 of Precision Values explains the different values of existing ATUIS, PBTC and proposed IHCA algorithm. While comparing the Existing algorithm and proposed IHCA algorithm, provides the better results. The existing algorithm values start from 66.94 to 86.38, 65.39 to 74.91 and proposed IHCA values starts from 87.01 to 97.52. The proposed method provides the great results.

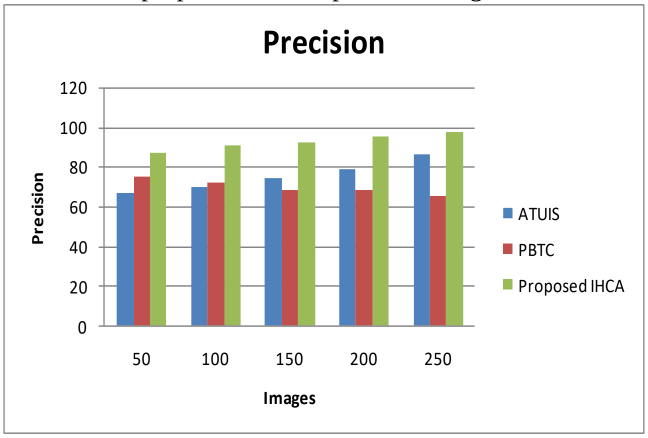

Figure 2 Comparison chart of Precision

The Figure 2 Shows the comparison chart of Precision demonstrates the existing ATUIS, PBTC and proposed IHCA. X axis denote the Images and y axis denotes the Precision ratio. The proposed IHCA values are better than the existing algorithm. The existing algorithm values start from 66.94 to 86.38, 65.39 to 74.91 and proposed IHCA values starts from 87.01 to 97.52. The proposed method provides the great results.

CONCLUSION

After applying image enhancement and image segmentation, we could only make the image clear but it's not enough since the ROI is not found automatically so we need to implement an algorithm to determine the ROI (Cold nodule). For this reason we implemented a hill climbing algorithm with 100 runs to determine the ROI. We have introduced an original slope climbing-based picture segmentation algorithm that produces reasonable sections. The segmentation algorithm is unsupervised and does not require any hand-tuning of parameters during the segmentation process. Furthermore, as we have demonstrated by our experiments, we can conclude that our segmentation method works well on general images, i.e. no deduced information is expected. As of now, in the slope climbing process, there is no restriction on the quantity of contiguous HSV histogram containers that can move uphill to a similar peak.

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