A Survey on Various Segmentation Methods in Medical Imaging

J.Ruby Elizabeth
AP, Department of Computer Science and Engineering, VV College of Engineering, Tisaiyanviali, Tuticorin District, Tamil Nadu, India.

S.Ebenezer Juliet
ASP, Department of Computer Science and Engineering, VV College of Engineering, Tisaiyanviali, Tuticorin District, Tamil Nadu, India.

Abstract –Medical imaging is a process to view the internal parts of the body for analyzing the clinical conditions. Medical imaging is used to diagnose, monitor, or treat medical conditions. In order to retrieve the accurate information from medical images segmentation is needed. Image segmentation is a process in which a single digital image is divided into multiple images as a segment. Medical images should be segmented accurately for detecting various diseases. In segmentation, images are simplified or the image's representation are changed, so that it is easier to analyze the possible diseases. Segmentation can also easily detect the affected or injured area and it also act as a key step for the effectiveness of the treatment given to the particular patient. The various segmentation methods are given in this paper.

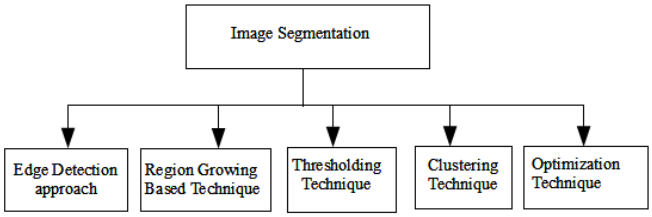
Index Terms – Segmentation, Medical images, Optimization

1. INTRODUCTION

Medical imaging is a non invasive method to detect various diseases in the body. Medical imaging refers to many technologies such as X-Ray imaging, Ultrasound imaging, Magnetic Resonance Imaging (MRI). The most important and challenging problem in medical imaging is segmentation. The general concept of segmentation is partitioning an image into many segments. Instead of pixel oriented the image segmentation are area oriented. The first and main step in segmentation is denoising the image. For removing the noise from the image, filters are used. The filters such as high pass filter, low pass filter, Gaussian filter, mean filter, median filter can be used depending on the image type. The second step is to convert the denoised image into a binary image based on the threshold values. For converting into a binary image thresholding approaches such as Otsu thresholding, Histogram thresholding are used. After converting the region of interest can be segmented from the rest of the image based on the threshold value.

2. SEGMENTATION METHODS

Since there are many problems in performing segmentation in medical images, many research works are going on various segmentation techniques. Some of the basic segmentation techniques are discussed as follows.



2.1 EDGE DETECTION APPROACH:

An image composes of many edges, so edge detection plays a vital role in segmentation. An image can be segmented accurately only when the edges are detected correctly. There are many basic edge dection techniques such as Roberts edge detection, Sobel Edge Detection, Prewitt edge detection, Kirsh edge detection, Robinson edge detection, Marr-Hildreth edge detection, LoG edge detection and Canny Edge Detection.

Wei Yang et.al. proposed a Structured Edge Detector in order to segment the Lung in Chest Radiographs from Boundary Maps. [1]

Aslam Asra et.al. used Sobel edge detection to segment the tumor in the brain.In this paper the author combines the Sobel method and thresholding method. Closed contour algorithm is used to find the different regions[2].

Ashi Agarwal et al. proposed an automatic detection technique for detecting the optic disc from the fundus images. He used edge based and active contour fitting method and it uses image processing techniques such as smoothing filters to remove the blood vessels, morphological operations for segmenting the optic disc correctly as well as to reject the false positives, active contour snake based model for smoothing the boundaries of the optic disc[3].

Julio Carballido-Gamio et al. characterized the MRI Cartilage of the Knee by using a Combined Image Processing Techniques which is based on Bezier splines and edge detection[4]

B. Devkota et al. used Mathematical Morphological Reconstruction method to Segment an image to detect the Brain Tumor at Early Stage[5].

Dey, Sidhartha, et al.automatically localized the optic disc by using normalized cross-correlation and used Affine Snakes in Gradient Vector Field for segmenting the Optic Disc [6].

Ünver, Halil Murat, et al. modified the robust rank order for detecting the edges and optic disc was located by using the circular Hough transform (CHT)[7].

2.2 REGION GROWING BASED TECHNIQUE:

Region growing based technique uses the pixel based image segmentation method. This method first selects the initial seed points based on the user's criterion and then starts growing by adding the adjacent pixels depending on the criterion. This process is iterated until the image is segmented. Region growing method can use both 4 – connected neighborhood and 8 – connected neighborhood. The main goal of the region growing method is to classify the images by finding the similar regions, so that the image can be segmented.

Imran Siddiquel et al. used Region Growing and Seed Pixel method to segment the Brain MR image[8].

Öztürk, C.N. and Albayrak, S. automatically segmented the high-field magnetic resonance (MR) images of the knee joint which has the whole femoral, tibial, and patellar cartilage tissues by using a voxel-classification-driven region growing algorithm [9].

Parveen.S and Kavitha C. used an automatic region growing method to detect the lung cancer nodules. The threat Points are identified by using the region growing method to segment the region which is suspicious [10].

Abhishek M. Taori et al. used the Automated Seeding Region Growing Technique to segment the Macula in the Retinal Images[11].

Harikrishna Rai G.N et al. discussed about popular seeded region growing methodology for segmenting anatomical structures which is present in CT Angiography images and proposed a homogeneity criteria based on gradient to control the region growing process[12].

B. Senthilkumar et al. developed a novel Region Growing Segmentation Algorithm for the Detecting the Cancer in the Breast. They used Harris corner detect theory for automatically finding the growing seeds and the seeded region growing rule for the region development[13].

2.3 THRESHOLDING TECHNIQUE:

Thresholding is one of the simple method for segmenting the medical images.Thresholding is used to create binary images from a gray scale image. In thresholding technique, the pixels in the images are divided into two major groups, according to their gray-level. Thresholding is mainly used to distinguish between the background and the foreground in the image.Otsu’s Thresholding method is one of the most popular thresholding method which performs clustering based thresholding.

Singh, J. Fenshia, and V. Magudeeswaran enhanced brain images and segmented with best quality using Otsu’s thresholding method [14].

Swetha, T.L.V.N. and Bindu, C.H. detected the Cancer in the Breast by using Hybrid image segmentation and Otsu's thresholding. In the Hybrid image segmentation fast sweeping algorithm and dual front evolution with laplacian or gradient is used. In Otsu’s thresholding method 10 levels of threshold are used in order to segment the tumor. It also provides the tumor’s size and the cancer’s stage[15].

Deng et al. used via two-dimensional OTSU thresholding to segment drosophila's compound eyes. It is based on the Adaptive Genetic Algorithm (AGA)[16].

Tseng et.al. used an adaptive thresholding method for automatically segmenting the lung s in the CT images. In each CT slice in a stack of a patient the threshold is determined and the lung was segmented automatically[17].

Carrillo, Juan, et al. segmented the optic cup and disc by finding the good threshold. Based on the segmented optic disc and cup Glaucoma is detected [18].

2.4 CLUSTERING TECHNIQUE:

One of the most common and popular unsupervised segmentation method is clustering. In clustering instead of using the trained images, the images are divided into multiple cluster of pixels with similar intensities.

Bilenia, Aniket, et al denoised the acquired image and the irrelevant tissues are stripped of on the outer boundaries and the fuzzy c-means algorithm is used for further processing[19].

Veena, M., and M. C. Padma preprocessed the input image by reducing the noise’s impluse by using the adaptive median filtering technique.Then the Gaussian mixture model (GMM) is used to segment the image. GMM is one of the clustering algorithm and the feature classification is done using probabilistic neural network (PNN) classifier. [20].

Alam, Md Shahariar, et al. detected the tumors in the brain which is visible in a magnetic resonance imaging (MRI)

image by using the template-based K means and improved fuzzy C means (TKFCM) algorithm[21].

Mohamed, Nur Ayuni, et al. screened the glaucoma automatically by using a system which uses cup-to-disc ratio through the Simple Linear Iterative Clustering superpixel approach[22].

2.5 OPTIMIZATION TECHNIQUE:

Optimization technique is a process of providing an optimized method for segmenting the particular part from the image. It is an efficient method and improves the quality of the image segmentation.

Khorram B, Yazdi M used ant colony optimization to segment of MR brain images[23].

HROSIK, Romana CAPOR, et al. segmentated the brain tumors using firefly algorithm and it's solution is enhanced by the k-means clustering algorithm and the Otsu's criterion. The Otsu's criterion was used as the fitness function[24].

Punitha, S., A. Amuthan, and K. Suresh Joseph used Intelligent Artificial Bee Colony and Enhanced Monarchy Butterfly Optimization Technique (IABC-EMBOT)for diagnosing the Cancer in the Breast effectively[25].

Ahmad S. Abdullah et.al used bat meta-heuristic algorithm for detecting the retinal optic disc. This method segments the optic disk of the retinal images in less than 2.1 s per image[26].

Rafael Arnay et al. segmented the optic cup which is present in the retinal image based on the Ant Colony Optimization. This method is used in screening the Glaucoma[27].

2.6 COMPARISON OF VARIOUS SEGMENTATION TECHNIQUES:

Segmentation Methods	Concept	Outcomes	Limitations
Edge Detection Approach	It depends on the detection of discontinuity, normally tries to locate points with more or less abrupt changes in gray level.	Edge detecting technique works well for images having good contrast between regions.	1) When edges are ill-defined or there are too many edges it does not work well. 2) It is not an easy job to find the accurate boundary. 3)It is less immune to noise
Region Growing Based Technique	This approach to segmentation examines neighboring pixels of initial seed points and determines whether the pixel neighbors should be added to the region.	Work best when the region homogeneity criterion is easy to define. They are also more noise immune than edge detection approach.	1) Are by nature sequential & quite expensive both in computational time and memory. 2) Region growing method depends on the seed region which is selected and the order in which pixels and regions are evaluated.
Thresholding Technique	Requires that the histogram of an image has a no. of peaks, each corresponds to a region.	1)It does not need prior information of the image. 2)This method is fast and computationally efficient method	1) It is sensitive to noise. 2) Since spatial details are not considered, the segmented regions cannot guarantee that they are contiguous.
Clustering Technique	Assumes that each region in the image forms a separate cluster in the feature space.	Straight forward for classification and easy for implementation.	1) Difficult to determine the no. of clusters 2) Features depends on the

			image and feature selection is not clear. 3) It does not uses the spatial information.
Optimization Technique	Optimization techniques is used to generate an optimum outcome in comparison with simple segmentation methods.	It works well in discontinuous, noisy, high dimensional, and multimodal image.	

3. CONCLUSION

In this paper various segmenting algorithms for segmenting the medical images was discussed. In the diseases like cancer, tumor, Glaucoma ,etc the infected area are segmented by using the various methods such as edge detection, region growing, thresholding, clustering and optimization. By surveying the various papers with different diseases and methods, the optimization technique shows results with high accuracy and less processing time. So Optimization technique is best for segmenting the medical images.

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