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A Study on Various Image Segmentation Algorithms

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ABSTRACT

Medical images have made a great effect on medicine, diagnosis, and treatment. The most important part of image processing is image segmentation. Medical Image Segmentation is the development of programmed or semi-automatic detection of limitations within a 2D or 3D image. In medical field, image segmentation is one of the vital steps in Image identification and Object recognition. Image segmentation is a method in which large data is partitioned into small amount of data. If the input MRI image is segmented then identifying the lump attacked region will be easier for physicians. In recent days, many algorithms are proposed for the image segmentation. In this paper, an analysis is made on various segmentation algorithms for medical images. Furthermore, a comparison of existing segmentation algorithms is also discussed along with the performance measure of each.

Keywords : Image segmentation, Thresholding, Clustering, Graph, Markov Random Field

I. INTRODUCTION

Medical images are at the fundamental of medical science and a huge source of information that need to be utilized. Image processing techniques with regards to biomedical images are commonly either used for the retrieval of images or for analysis and variation of images. The field of medical imaging developments so fast that all of those working in it, scientists, engineers, physicians, educators and others, need to frequently update their knowledge in order to stay abreast of developments[10]. While journals and periodicals play a key role in this, more extensive, integrative publications that connect fundamental principles and new advances in algorithms and techniques to practical applications are essential. Medical Image Processing techniques and applications meet this task and provide an enduring bridge in the ever growing field of medical imaging [1]. It serves as an authoritative resource and self-study guide explaining cultured techniques of quantitative image analysis, with a focus on medical applications.

A numerical image is a representation of a 2D image as a finite set of digital values, called picture elements or pixels. Pixel values characteristically represent gray levels, colours, heights, opacities etc. Digital image handling focuses on the Enhancement of pictorial data for human interpretation and Processing of image data for storage, transmission and representation for autonomous machine perception .Some dispute about where image processing ends and fields such as image analysis and computer visualization start[5].

The goal of Image segmentation is the process of partioning the Present image is divided into small regions are easily analyze and meaningful from the digital Image. The segment regions should strongly relate to depicted objects or features of interest[3]. Essential image segmentation is the preliminary step from low-level image processing transforming a greyscale or colour image into one or more other images to high-level image description in terms of features, objects, and scenes. Segmentation can also be considered as a process of grouping organized pixels that have similar attributes[18]. The basic applications of image segmentation are Medical imaging, Content-based image recovery, Object detection and Recognition Tasks, Automatic traffic control systems and Video surveillance, etc. A major effort of medical image segmentation is the high variability in medical images. CT scan, MRI, X-ray, Ultra sound wave Images, PET, Mammograms image extensions are .DCM files. DCM files were generated by the National Electrical Manufacturers Association as a regular file format for the design and storage of various body scans done for medical purposes[19]. The files are now a worldwide format for viewing patient scans.

II. REVIEW OF LITERATURE

Medical Image segmentation techniques are vast and different techniques are used for different applications. In this section, we discuss about the different segmentation techniques available.

i) **Thresholding**: Image thresholding is an easy, effective and way of separating an image into a fore and backdrop[2]. This image analysis method is a type of image segmentation that segregates objects by converting greyscale images into binary images[9][14].

ii) **Classification Methods**: Searching for patterns in data, called pattern recognition, is a basic problem with a long history. Classification is a pattern recognition technique which uses training data to find the patterns[12]. Training data includes a sample of image features with their target labels. This technique is known as the supervised learning technique, because it involves training data which are segmented manually and then presented to the automatic process. A number of classifier methods have been used for image processing.

Classification accuracy computed using the RCGA based RBFNN approach is noted to be higher in comparison with that of the classifiers proposed earlier in the literatures [13].

iii) **Clustering:** It is the process of splitting a set of data into a specific number of groups[4]. It's one of the popular method is k-means clustering. In k-means clustering, it partitions a collection of data into a k number group of data. It classifies a given set of data into k number of disjoint cluster. K - means algorithm consists of two separate phases. In the first phase it calculates the k centroid and in the second phase it takes each point to the cluster which has nearest centroid from the respective data point [16]. There are different methods to define the distance of the nearest centroid and one of the most used methods is Euclidean distance.

iv) **Graph:** Graph cuts can be hired to efficiently solve a wide range of low-level computer revelation problems such as image smoothing, the stereo correspondence problem, image segmentation, and many other computer vision problems that can be formulated in terms of energy minimization[11]. Many of these energy minimization problems can be approximated by solving a maximum flow problem in a graph. Under best designs of such problems in computer vision, the lowest energy solution corresponds to the maximum a posteriori estimate of a solution [17]. The table below lists the various algorithms used in various papers for varying dataset.

v) **Hybrid Method:** Some segmentation methods work based on regions like region growing, region

merging, etc., while some other methods are based on boundaries like active con-tour, deformable model, etc[8]. Hybrid methods are based on the ROI and boundary [14]. These methods use both boundary and regional information to segment the images. The results of these methods are rather better than other segmentation approaches applied in medical images [15]. Here we explain graph-cut segmentation methods which present good accuracy in different medical images.

vi) **Markov Random Field**: Markov Random field approaches are widely studied for medical image segmentation, especially in MR images[7]. It is because this method can model intensity in homogeneities occurring in these images. But this method has two critical weaknesses: Computational complexity and sensitivity of the results to the models parameters.

vii) **Neural Networks**: Neural networks are well known for their good performance in classification and function approximation, and have been used with success in medical image processing over the past years, particularly in the case of preprocessing, segmentation, registration and recognition[6].

Table 1: Review on various image segmentation algorithm

S.No	Author	Data	Algorithm	Performance measure
[1]	Wentao Fan et al	Simulated brain database, IBSR database	Finite Inverted Dirichlet Mixture Model , FIDMM-SC	IDMM-SC (runtime) SBD (9%) : 181.22 SBD (7%) : 178.53 IBSR 05 :199.21 IBSR 11 :195.23
[2]	Qinghua Huang et al	Breast Ultrasound images	Thresholding, Clustering, Watershed, Graph, Active Contour Model, Markov Random Field And Neural Network	TB: 86 % (automatic) CB: 92.4%(automatic) WB: 81.7%(automatic) GB: 87.5%(automatic) ACM: 93.9 %(semi-automatic) MRF: 90.12%(automatic) NN:92.8%(automatic)
[3]	Ronghe Wang et al	Brain Web Database	Frequency domain separation transformation , processing for low frequency and high frequency image spectrum	Extract the density field : 102 s Density field correction : 40s Segmentation : 52 s
[4]	Xiaofeng Zhang et al	Brain Web Database	Cluster centre initialization, FCM with spatial information, Reallocation of misclassified pixels	Noise=0.7 FCM 0.9464 FCMS 0.9999 FGFCM 0.9996 EnFCM 0.9924 Proposed algorithm 1.0000
[5]	David P. Ortiz et al	Centre IGURCO Database	Synthetic frequencies, Toroidal geometry, Otsu's threshold.	Mean : 0.89 SD: 0.102 Max : 0.977 Min: 0.532 Comp time : 9.04

[6]	Kajaree Das et al	SL and USL data	Machine learning algorithms	TT PT ACC Naïve B: 2.708 0.328 0.692 SVM : 6.485 2.054 0.6565 DT : 454.609 0.063 0.69
[7]	Husein Hadi Abbass et al	Original Image	Markov Basis and Laplace filter	This method has less false edges when compared to Sobel, Prewitt, Roberts and Canny's edge detection algorithms.
[8]	Neeraj Dhungel et al	IN breast dataset	Bayesian optimisation, Level Set Method ,	Detects : 90 % - 1 FPI Dice : 0.85 Se :0.98 Sp :0.7
[9]	Dusan Koniar et al	Video file	Differential methods , Thresholding-based methods- global and adaptive , Color matching.	BC : 91 129 CL : 67 119 E : 04 39 Diff1 : 83 56 Diff2 :82 53
[10]	Pat Banerjee et al	3D models of CT or MRI images.	Volumetric approach, Hough transform method , Manual centring method	Segmentation time : 56.38% Dataset 4 : 1062 min only
[11]	Mohammad A. Alsmirat et al	Brain Images from MRI DICOM files and Breast Images using mammography	Fuzzy C-Means Sequential and Parallel algorithm.	Segmentation accuracy : 8.9 X Overall best: IT2FCM Breast image : 7.6 X Side Brain Image : 6.6 X Top brain : 7.4 X
[12]	Mehul C. Parikh et al	real life images	Pixel Level Feature Extraction, Training, Pixel Classification	FPR TPR Campus 0.0195 0.9852 Fountain 0.0100 0.0089 Browse 0.0089 0.8978 RF on Floor 0.0242 0.9518 Hall 0.0249 0.7747
[13]	Jasmine Selvakumari Jeya et al	Lung Image Database , Real time lung cancer datasets	Real Coded Genetic Algorithm, Radial Basis Function Neural Network Classifier	LID RTLCD Sensitivity : 99.10 98.42 Specificity : 100.00 99.73 Classification accuracy: 98.36 97.31 AUROC: 1.00 0.9865
[14]	Chandni Panchasara et al	2D Visible Human dataset	Otsu's algorithm , Canny's Edge detection algorithm , Region Growing Algorithm	Faster detection in disease affected region.

[15]	Saba Amiri et al	Simulated brain database, IBSR database	Pre-processing , feature extraction, Classification -multilayer perceptron.	JI CI GM WM CSF GM WM MCBS: 76 69.1 28 68.4 55.3 SCBS : 74.3 69.5 23.6 65.4 56.1
[16]	Lahouaoui Lalaoui et al	IBSR image segmentation data set	Modified Expectation of Maximization (MEM)	SSIM: 0.6254 VIP: 0.2430 Martin: 0.2356 Inter Intra: 0.5014
[17]	Anamika Ahirwar	Keith's database	Self Organizing Map(SOM) , Neuro Fuzzy scheme	Accuracy :96.67% Sensitivity : 72.50% Specificity : 88.89% Prevalence of Disease : 81.63%
[18]	Anders Eklund et al	FMRI and DTI dataset	Image registration , Image segmentation, Image denoising	GPU is used to solve many problems in Medical image.
[19]	Alamgir Nyma et al	MR Images.	Vector Median Filter , Otsu Thresholding , EnSFCM	Segmentation accuracy WM : 6.42 -17.03% GM : 6.79 -14.73%

III. CONCLUSION

In this review paper, we made an analysis of medical image processing and its vital role in medical sectors. Medical images are used for the object identification, image segmentation, pattern recognition and classifications. In the previous era, medical fields found it difficult to identify the chunk in the human organs. Now clearly image segmentation methods are used to find the blocks of the affected region. In the tabular column discussed above, various methods for image segmentation algorithms and its results are discussed. But it is clear more that image segmentation structures are not enough for classifying the image. Furthermore, Deep learning techniques are required to classify the image more clearly in the field of Image Processing.

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