Image Segmentation methods : A Review

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ABSTRACT: *Image segmentation has been used in image processing for extraction of region of interest from images. In the process of image segmentation various images have been undergoes the process of segmentation so that valuable information from images can be extracted. Image segmentation is the fundamental step to analyze images and extract data from them. Digital image processing supports strong research program in areas of image enhancement and image based pattern recognition. It is mostly useful for applications like image compression or object recognition, because for these types of applications, it is inefficient to process the whole image. So, image segmentation is used to segment the parts from image for further processing. In this paper different image segmentation has been discussed that has been used for feature extraction.*

Key Words: *Image segmentation;Thresholding; edge detection; clustering based ; region based;ANN;*

INTRODUCTION

1.1 Image segmentation

Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The main aim of segmentation is simplification i.e. representing an image into meaningful and easily analysable way. Image segmentation is necessary first step in image analysis. The goal of image segmentation is to divide an image into several parts/segments having similar features or attributes. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.

The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image (see edge detection). Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity or texture. Adjacent regions are significantly different with respect to the same characteristic(s). When applied to a stack of images, typical in medical imaging, the resulting contours after image segmentation can be used to create 3D reconstructions with the help of interpolation algorithms like marching cubes.

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1.2 METHODES OF SEGMENTATION

1.2.1 Thresholding

The simplest method of image segmentation is called the thresholding method. . These methods divide the image pixels with respect to their intensity level. These methods are used over images having lighter objects than background. The selection of these methods can be manual or automatic i.e. can be based on prior knowledge or information of image features. Thresholding can be implemented either globally or locally. Global thresholding distinguishes object and background pixels by comparing with threshold value chosen and use binary partition to segment the image. Local thresholding is also called as adaptive thresholding. In this technique the threshold value varies over the image depending on the local characteristic of the subdivided regions in the image. Several popular methods are used in industry including the maximum entropy method, Otsu's method (maximum variance), and k-means clustering. Recently, methods have been developed for thresholding computed tomography (CT) images. The key idea is that, unlike Otsu's method, the thresholds are derived from the radiographs instead of the (reconstructed) image.

1.2..2 Clustering methods

The clustering based techniques are the techniques, which segment the image into clusters having pixels with similar characteristics. Data clustering is the method that divides the data elements into clusters such that elements in same cluster are more similar to each other than others. There are two basic categories of clustering methods: Hierarchical method and Partition based method. The hierarchical methods are based on the concept of trees. In this the root of the tree represents the whole database and the internal nodes represent the clusters. On the other side the partition based methods use optimization

methods iteratively to minimize an objective function. In between these two methods there are various algorithms to find clusters. There are basic two types of clustering

1. *Hard Clustering:* Hard clustering is a simple clustering technique that divides the image into set of clusters such that onepixel can only belong to only one cluster. In other words it can be said that each pixel can belong to exactly one cluster. These methods use membership functions having values either 1 or 0 i.e. one either certain pixel can belong to particular cluster or not. An example of a hard clustering based technique is one k-means clustering based technique known as HCM. In this technique, first of all the centers are computed then each pixel is assigned to nearest center. It emphasizes on maximizing the intra cluster similarity and also minimizing the inter cluster equality.

2. Soft clustering: The soft clustering is more natural type of clustering because in real life exact division is not possible dueto the presence of noise. Thus soft clustering techniques are most useful for image segmentation in which division is not strict. The example of such type of technique is fuzzy c-means clustering. In this technique pixels are partitioned into clusters based on partial membership i.e. one pixel can belong to more than one clusters and this degree of belonging is described by membership values. This technique is more flexible than other techniques

1.2.3Watershed Based methods

The watershed based methods uses the concept of topological interpretation. In this the intensity represents the basins having hole in its minima from where the water spills. When water reaches the border of basin the adjacent basins are merged together. To maintain separation between basins dams are required and are the borders of region of segmentation. These dams are

1.4.4 Region-growing methods

In this technique pixels that are related to same object are grouped for segmentation. The thresholding technique is bound with region based segmentation. The area that is detected for segmentation should be closed. Region based segmentation is also termed as Similarity Based Segmentation. There won't be any gap due to missing edge pixels in this region based segmentation the boundaries are identified for segmentation. After identifying the change in the color and texture, the edge flow is converted into a vector.

There are two basic techniques based on this method

Region growing methods:The region growing based segmentation methods are the methods that segments the image intovarious regions based on the growing of seeds (initial pixels). These seeds can be selected manually (based on prior knowledge) or automatically (based on particular application). Then the growing of seeds is controlled by connectivity between pixels and with the help of the prior knowledge of problem, this can be stopped.

Region splitting and merging methods:The region splitting and merging based segmentation methods uses two basictechniques i.e. splitting and merging for segmenting an image into various regions. Splitting stands for iteratively dividing an image into regions having similar characteristics and merging contributes to combining the adjacent similar regions. Following diagram shows the division based on quad tree.

1.2.5. Edge-based methods

In image segmentation process, the basic step is edge detection. It divides an image into object and its background. Edge detection divides the image by observing the change in intensity or pixels of an image. Gray histogram and Gradient are two main methods for detecting edge detections in image segmentation. In edge based segmentation methods, first of all the edges are detected and then are connected together to form the object boundaries to segment the required regions. The basic two edge based segmentation methods are: Gray histograms and Gradient based methods. To detect the edges one of the basic edge detection techniques like sobel operator, canny operator and Robert‟s operator etc can be used. Result of these methods is basically a binary image. These are the structural techniques based on discontinuity detection

1.4.6*PDE Based* methods

The partial differential equation based methods are the fast methods of segmentation. These are appropriate for time critical applications. There are basic two PDE methods: non-linear isotropic diffusion filter (used to enhance the edges) and convex non-quadratic variation restoration (used to remove noise). The results of the PDE method is blurred edges and boundaries that can be shifted by using close operators. The fourth order PDE method is used to reduce the noise from image and the second order PDE method is used to better detect the edges and boundaries

1.4.7*ANN Based* methods

The artificial neural network based segmentation methods simulate the learning strategies of human brain for the purpose of decision making. Now days this method is mostly used for the segmentation of medical images. It is used to separate the required image from background. A neural network is made of large number of

connected nodes and each connection has a particular weight. This method is independent of PDE. In this the problem is converted to issues which are solved using neural network. This method has basic two steps: extracting features and segmentation by neural network.

TABLE I
COMPARISON OF VARIOUS SEGMENTATION TECHNIQUES

Segmentation technique	Description	Advantages	Disadvantages
Thresholding Method	based on the histogram peaks of the image to find particular threshold values	no need of previous information, simplest method	highly dependent on peaks, spatial details are not considered
Edge Based Method	based on discontinuity detection	good for images having better contrast between objects	not suitable for wrong detected or too many edges
Region Based Method	based on partitioning image into homogeneous regions	more immune to noise, useful when it is easy to define similarity criteria	expensive method in terms of time and memory
Clustering Method	based on division into homogeneous clusters	fuzzy uses partial membership therefore more useful for real problems	determining membership function is not easy
Watershed Method	based on topological interpretation	results are more stable, detected boundaries are continuous	complex calculation of gradients
PDE Based Method	based on the working of differential equations	fastest method, best for time critical applications	more computational complexity
ANN Based Method	based on the simulation of learning process for decision making	no need to write complex programs	more wastage of time in training

CONCLUSION

Image segmentation has a promising future as the universal segmentation algorithm and has become the focus of contemporary research. As the result, image segmentation is affected by lots of factors, such as homogeneity of images, spatial characteristics of the image continuity, texture and image content. In this work, various techniques of image segmentation has been discussed, an overview of some related image segmentation techniques has been presented. The main image segmentation algorithms and classification of image segmentation are discussed. In this study, the overview of various segmentation methodologies applied for digital image processing is explain briefly.

REFRENCES

1. Taherdangkoo, M "Segmentation of MR brain images using FCM improved by artificial bee colony (ABC) algorithm" IEEE Conf. on Information Technology and Applications in Biomedicine (ITAB), 2010, pp 1 – 5.
2. Yu Li "Image Segmentation Using FCM Optimized by Quantum Immune Clone Algorithm", IEEE Conf. on Intelligent Systems Design and Engineering Applications (ISDEA), 2014, pp 537 – 540.
3. Beevi, S.Z "A robust fuzzy clustering technique with spatial neighborhood information for effective medical image segmentation: An efficient variant of fuzzy clustering technique with spatial information for effective noisy medical image segmentation", IEEE Conf on Computing Communication and Networking Technologies (ICCCNT),, 2010, pp 1 – 8.
4. Chuan Long Li "Novel Fuzzy C-Means Segmentation Algorithm for Image with the Spatial Neighborhoods" IEEE Conf. on Remote Sensing, Environment and Transportation Engineering (RSETE), 2012, pp 1 – 4.
5. Gaganpreet Kaur1, Dr. Dheerendra Singh "Pollination Based Optimization For Color Image Segmentation" International Journal of Computer Engineering and Technology (IJCET), ISSN 0976 – 6367(Print), ISSN 0976 – 6375(Online) Volume 3, Issue 2, July-September (2012).
6. Zeng-Wei Ju "Image segmentation based on edge detection using K-means and an improved ant colony optimization" IEEE Conf. on Machine Learning and Cybernetics (ICMLC),, 2013, pp 297 – 303.
7. Apoorva "Optimal multilevel thresholding based on Tsallis entropy using Fibonacci Particle Swarm Optimization for improved Image Segmentation", IEEE Conf. on

Communication, Information & Computing Technology (ICCICT), 2012, pp 1 – 6.
8. Gaganpreet Kaur1, Dr. Dheerendra Singh" POLLINATION BASED OPTIMIZATION FOR COLOR IMAGE SEGMENTATION" International Journal of Computer Engineering and Technology (IJCET), ISSN 0976 – 6367(Print), ISSN 0976 – 6375(Online) Volume 3, Issue 2, July- September
9. Vanitha, M. and 2K. Thanushkodi, "An Effective Biogeography Based Optimization Algorithm to Solve Economic Load Dispatch Problem " Journal of Computer Science 8 (9): 1482-1486, 2012
10. Shan Zhu, Kai-Khuang Ma, A New Diamond Search Algorithm for Fast Matching Motion Estimation, IEEE Trans. Image Processing, 9(2000), pp.287-290.
11. Chun-Ho Cheung, Lai-Man Po, A Novel Cross Diamond Search Algorithm for Fast Block Estimation, IEEE Trans. Circuits and Systems, 11(2002) pp. 1442-1448.
12. Praveen G.B. "Hybrid Approach for Brain Tumor Detection and Classification in Magnetic Resonance Images", 2015 International Conference on Communication, Control and Intelligent Systems (CCIS), 2015, pp 115-125.