A Survey on Emerging Schemes in Brain Image Segmentation

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Abstract: Image segmentation plays a vital role in medical research field. It often required as a preliminary and an indispensable stage in the computer aided medical image process. Hundreds of segmentation algorithms have been proposed in the last decades. Image analysis algorithms for segmentation continuously grow as the reliability and robustness of systems. An important field of interest for image analysis is medical applications. However, it is well known that elemental segmentation techniques based on Edge based, region based, threshold based, and cluster based to produce accurate segmentation results. This paper reviews different segmentation proposals which integrate edge and region information. In contrast with other surveys which only describe and compare qualitatively different approaches, this survey deals with a real quantitative comparison. In this sense, key methods have been programmed and their accuracy analysed and compared using Medical images. This survey addresses the basics of segmentation algorithms for betterment of Medical image analysis.

Keywords: *Image processing, Medical image segmentation, Clustering, Edge Detection, Thresholding.*

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1. INTRODUCTION

Magnetic resonance imaging is used as a valuable tool in the clinical and surgical environment because of its characteristics like superior soft tissue differentiation, high spatial resolution and contrast. It does not use harmful ionizing radiation to patients. Image Segmentation is the process of partitioning a digital image into multiple regions or sets of pixels. Image segmentation is the first step in image analysis and pattern recognition, and it is one of the most difficult tasks in image processing, and determines the quality of the final result of analysis [1]. Image analysis has made several advances over the past decade derived from new fields of interest and many proposed algorithms. Image segmentation is an important and growing part of image analysis and is used to extract information from a certain image. E.g. Medical images (brain). The extraction has to be reliable and robust to be able to meet the demands of the application. One of the most important applications of image segmentation is medical applications. Automatic image segmentation systems can simplify the examination process in many situations.i.e clustering, and classification, feature Extraction etc. The amount of data to be analysed can widely exceed the amount a human can handle. This enables more reliable test results and the human factor can be overlooked. Image segmentation in general together with several segmentation approaches.

II. IMAGE SEGMENTATION

Image segmentation can be demonstrated in terms of image analysis and the main idea is to distinguish different objects in the image content. The image is divided into two parts namely: background and foreground. These concepts are intuitively defined. The foreground is defined as the interesting objects and the background as the rest. Image segmentation is simply differentiating and separating the two from one another. For intensity images, i.e., each pixel is represented by an intensity level (usually 0-255) there are mainly five approaches namely,

Threshold-based techniques
Edge-based techniques
Region-based techniques
Clustering-based techniques
Atlas-Guided techniques

All these techniques are explained further in the following sections.

A. Threshold-based techniques

The threshold technique is the most intuitive technique of all approaches. It is based on local pixel intensity levels. The current image is compared to the background image and a threshold value decides if the pixel differs enough to belong to the foreground. Clearly, additional filtering and clustering has to be considered since the background can also vary.[5]

i. Works well even the image having different illumination.
ii. Works well for simpler images

B. Edge-detection techniques

Edge detection is one of the fundamental steps in image processing, image analysis, image pattern recognition, and computer vision techniques. Edge- based is by far the most common method of detecting boundaries and discontinuities in an image. An edge is a set of connected pixels, i.e., same intensity level, between two adjacent pixels and can be distinguished by estimating the intensity gradient [1] variance in contrast. An edge is a local concept and does not necessarily have to form a closed path [2].

C. Region-based techniques

In region growing group the pixels that are similar based on some criteria. The basic process is starts with yielding of seed points and emerge regions by appending to each seed those neighbouring pixels that have similar properties to the seed. The selection of similarity criteria and number of seed points depends upon the type of application [7].

Algorithm

(i)Start with an initial seed pixel.

(ii)Choose neighboring pixels, based on a connectivity and merge pixels that satisfy the homogeneity condition.

(iii)If the region does not grow anymore select another seed and repeat the process. Until all pixels are accounted for.

(iv)A final tidying operation is often performed to remove very small regions.

D. Clustering-based techniques

The general problem in clustering is to partition a set of vectors into groups having similar values. In image analysis, the vectors represent pixels or sometimes small neighborhoods around pixels. Commonly used techniques are:

Log Based Clustering: Images can be clustered based on the retrieval system log maintained by an information retrieval process. This technique is difficult to perform in case of 2D images [11].

Fuzzy Clustering*:* In this technique pixel values are divided into clusters on the basis of some similarity criteria and classify pixels values with great extent of accuracy and suitable for decision oriented applications i.e. tumour detection. It also involves FCM (fuzzy C means) algorithm, FCM is the most accepted method since it can preserve much more information than other approaches [11] Features can include: Intensity values, RGB values, Shape, size properties, Texture based.

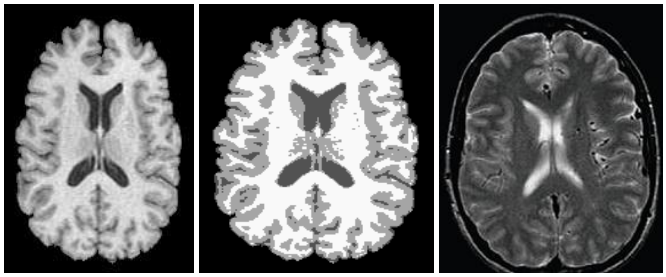

Figure 1: Segmentation of a MR brain image: (a) original image, (b) segmentation using
The K-means algorithm, (c) segmentation using FCM

E. Atlas-guided approaches

Atlas-guided approaches are a powerful tool for medical image segmentation when a standard atlas or template is available. The atlas is generated by compiling information on the anatomy that requires segmenting. This atlas is then used as a reference frame for segmenting new images. Conceptually, atlas-guided approaches are similar to classifiers except they are implemented in the spatial domain of the image rather than in a feature space. The standard atlas-guided approach treats segmentation as a registration problem for a detailed survey on registration techniques. It first finds a one-to-one transformation that maps a pre-segmented atlas image to the target image that requires segmenting. This process is often referred to as atlas warping. The warping can be performed using linear transformations but because of anatomical variability, a sequential application of linear and non-linear transformations is often used [7].

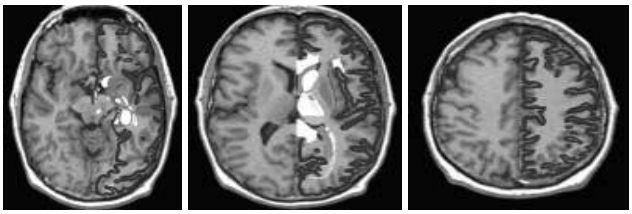

Figure 2: Three slices from a MR brain volume overlaid with a warped atlas

An example of atlas warping for a MR Head scan is shown in figure 2. Because the atlas is already segmented, all structural information is transferred to the target image. This has been mapped to an MR image. Atlas-guided approaches have been applied mainly in MR brain imaging. An advantage of atlas-guided approaches is that labels are transferred as well as the segmentation. They also provide a standard system for studying morphometric properties. Even with non-linear registration methods however, accurate segmentations of complex structures is difficult due to anatomical variability. [8]

III VARIOUS IMAGE SEGMENTATION APPROACHES

A. Pixel-Based Segmentation

Point-based or pixel-based segmentation is conceptually the simplest approach used for segmentation.

B. Model-Based Segmentation

All segmentation techniques discussed so far utilize only local information. The vision System has the ability to recognize objects even if they are not completely represented. The information gathered from local neighbourhood pixels is not sufficient to perform this task [3]. Instead specific knowledge about the geometrical shape of the objects is required, which can be compared with the local information. This assumption leads to model-based segmentation. It can be applied if know the exact shape of the objects contained in the image.

C. Gray-scale Image Segmentation

The segmentation of image data into connected regions of common gray-scale has long been seen as a basic operation in image analysis. In texture analysis, just this type of segmentation is possible after individual pixels in an image have been labelled with a numeric classifier. In preparing images for used in medical image. This segmentation is usually followed by the vector representation for each region [6]. A new parallel region segmenting and labelling algorithm is available, that is applicable to gray-scale images, and is appropriate to coarse scale parallel programming. The key feature of this algorithm is the geometric splitting of the image into rectangular blocks.

D. Text Segmentation

It is well known that text extraction, including text detection, localization, segmentation and recognition is very important for video auto-understanding. We discuss text segmentation, which is to separate text pixels from complex background in the sub-images from videos. Text segmentation in video images is much more difficult than that in scanning images. Scanning images generally has clean and white background, while video images often have very complex background without prior knowledge about the text colour. Although there have been several successful systems of video text extraction, few researchers specially study text segmentation in video images deeply [5].

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IV. Conclusion

Future research in the segmentation of medical images will strive towards improving the accuracy, precision, and computational speed of segmentation methods, as well as reducing the amount of manual interaction. Accuracy and precision can be improved by incorporating prior information from atlases and by combining discrete and continuous-based segmentation methods. Both qualitative and quantitative MR images in this study used were of high quality and were capable of using k-means and c-means with metrics will make computational complexity less, time period and better accuracy which satisfies the medical oriented needs in terms of medical image segmentation.

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References

[1] Danijela Vukadinovic*, Theo van Walsum, Member, IEEE, Rashindra Manniesing, Sietske Rozie,Reinhard Hameeteman, Thomas T. de Weert, Aad van der Lugt, and Wiro J. Niessen, Senior Member," Segmentation of the Outer Vessel Wall of the Common Carotid Artery in CTA" IEEE transactions on medical inaging, Vol. 29, No. 1, January 2010

[2] Danijela Vukadinovic, Theo van Walsum, Sietske Rozie, Thomas de Weert, Rashindra Manniesing Aad van der Lugt, Wiro Niessen "Carotid Artery segmentation and plaque quantification in CTA", IEEE transactions on medical inaging, 2009

[3] P. Yan and A. A. Kassim, "Segmentation of volumetric MRA images by using capillary active contour,"Med. Image Anal., vol. 10, no. 3, pp. 317–329, Jun. 2006.

[4] R.Manniesing, B.K.Velthuis,M. S. van Leeuwen, I. C. van der Schaaf, P. J. van Laar, andW. J. Niessen, "Level set based cerebral vasculaturesegmentation and diameter quantification in CT angiography," Med.Image Anal., vol. 10, no. 2, pp. 200–214, Apr. 2006.

[5] S. D. Olabarriaga, J. M. Rouet, M. Fradkin, M.Breeuwer, and W. J.Niessen, "Segmentation of thrombus in abdominal aortic aneurysms from CTA with non-parametric statistical grey level appearance modelling,"IEEE Trans.Med. Imag., vol. 24, no. 4, pp. 477–485,Apr. 2005.

[6] T. Boskamp, D. Rinck, F. Link, B. Kuemmerlen, G. Stamm, and P. Mildenberger, "A new vessel analysis tool for morphometric quantification and visualization of vessels in CT and MRI datasets," Radiograph., vol. 24, pp. 287–277, 2004.

[7] M. de Bruijne, B. van Ginneken, M. Viergever, and W. Niessen, "Interactive segmentation of abdominal aortic aneurysms in CTA data,"Med. Image Anal., vol. 8, no. 2, pp. 127–138, 2004.

[8] M. de Bruijne, B. van Ginneken, M. Viergever, and W. Niessen,"Adapting active shape models for 3D segmentation of tubular structures in medical images," in Information Processing in Medical Imaging. New York: Springer, 2003, vol. 2732, pp. 136–147.

[9] M. de Bruijne, B. van Ginneken, W. J. Niessen, M. Loog, and M.A. Viergever, "Active shape model based segmentation of abdominal aortic aneurysms in CTA images," Proc. SPIE, vol. 4684, pp. 463–474,2002.

[10] A. K. Klein, F. Lee, and A. A. Amini, "Quantitative coronary angiography with deformable spline models," IEEE Trans. Med. Imag., vol.16, no. 5, pp. 468–482, Oct. 1997.

[11] Hornal JP "The basics of MRI" http://www.cis.rit.edu/htbooks/mri/index.html 1996.

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