A Survey: Medical Image Segmentation Algorithms and Comparisons

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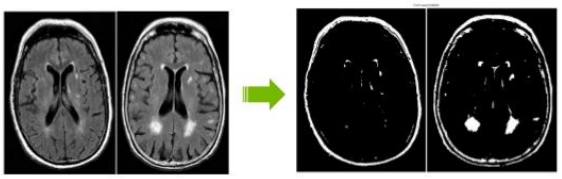
Abstract- *Medical Image Segmentation process is crucial in medical images. It helps in dividing of an image into multiple objects. It is the crucial and essential process for facilitating the characterization, declination, and virtualization of sector of interest in any medical image. Medical image analysis is existing due to the image segmentation algorithms as every application must be segmentation of a medical image. Hence, it remains unsolved, challenging but is a complex task too. Some of the image segmentation techniques have been proposed for the medical images. The image segmentation algorithms included edge detection segmentation, k-means clustering algorithm, watershed algorithm and so on. This work concludes on analyzing these techniques of image segmentation. Finally, we make a forecast of the development trends of image segmentation with the combination of these algorithms.*

Keywords- Image segmentation, edge detection, k-means clustering, watershed, fuzzy c-means, neural networks

I. INTRODUCTION

Image segmentation is the vital and difficult process for the task analyzing medical image. It is the partitioning technique where a single image is divided into many segments. The important goal of segmentation process is to alter the illustration of a picture as easy and sensible to investigate. There is a large number of applications such as CBVIR system for searching of digital images in huge databases. A major problem of medical segmentation is the variability observed in medical image. It is the basis for analysis of image and understanding extraction of the image feature and recognition. The relations and the global patterns which hide in huge databases are discovered by using data mining technology. For this segmentation some of the algorithms are used.

SEGMENTATION RESULTS



DIFFERENT TECHNIQUES OF IMAGE SEGMENTATION:

1. EDGE DETECTION METHOD
2. K-MEANS CLUSTERING
3. WATERSHED ALGORITHM
4. FUZZY C-MEANS
5. ARTIFICIAL NEURAL NETWORKS

II. EDGE DETECTION METHOD

Edge detection, one of the important tool for the segmentation of image. These methods convert actual images into edge images. The outline exists between the object and background is the edge which indicates the boundary between overlapping objects. These are the symbols of the lack of continuity and its end. As a result, the physical characteristics doesn't vary for the obtained edge image. The key role of the image analysis and the recognition of the pattern problems are edges which specifies the objects physical extents which in turns provide an accurate detection. The local derivative of image computations is the main principle of edge-detection techniques. Edge detection method is the discovery of lines which limits and divide the image appearance from the different regions the digital image. The intensity variations occur in the image points has been declared as the edge. This technique is used by edge detection. These steps are useful for extracting images having related information. E.g: image enhancing, sharpening and location of object in image. Edges of an image denotes the essential features and production of line of a scene from an image are the main aims. These features used by higher level computer vision algorithm (recognition).

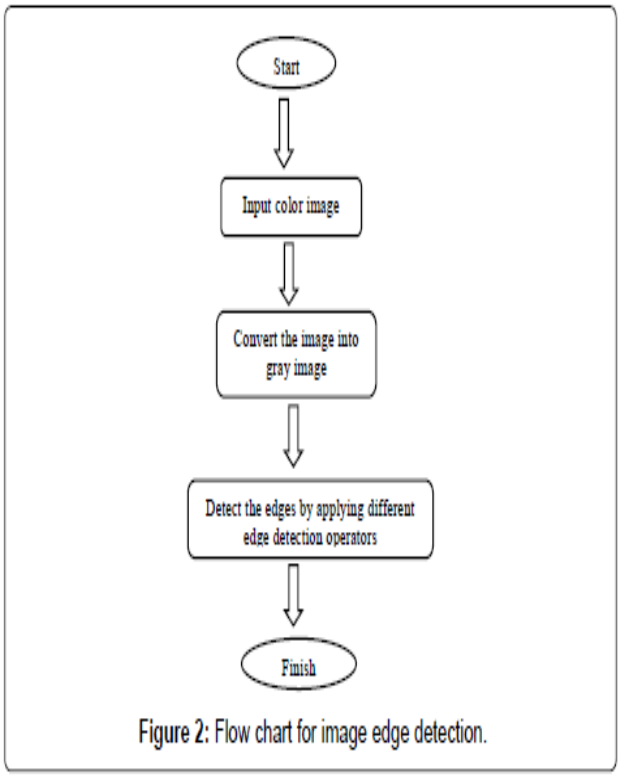


Figure 2: Flow chart for image edge detection.

III. K-MEANS CLUSTERING

Clustering methods are used for segmenting large scale images. Clustering is one of the important unsupervised learning methods where the essential set being divided as similar groups. There are different types of clustering: fuzzy c-means clustering, hierarchical clustering, k-means clustering. The most familiar clustering technique used for different applications is k-means. K-means which is the vital and simple unsupervised learning algorithms is most preferred to solve clustering problem. This technique is partion-based cluster analysis. It is used in the primary segmentation for smoothening the course areas as it helps in reducing the complexity level of the computations being performed and is more efficient and easy. The k-means algorithm consists of four steps.

1. Initialization:

K-means clustering result depends upon the first step that is initialization. In this step we choose many cluster centers i.e, k. the value of K affect the output of algorithm. This is the practical method of finding optimal number of clusters with k and computes the sum of squares of result.

2. Classification:

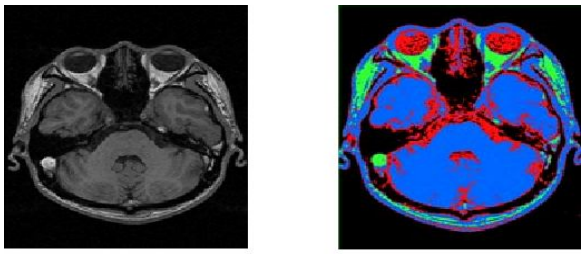
By using Euclidian distance square is to assign each pixel to cluster which is close to centroid.

3. Computational:

After assigning the pixel to a cluster, using mean of pixels assigned to that particular cluster, cluster centers are again computed.

4. Convergence condition:

During the iteration, the objective function has to be achieved. When the objective goal cannot be minimized further then the condition is called convergence. This is the final step of the algorithm. Suppose if the convergence condition is not achieved then the iteration from second step. The above algorithm repeats itself until the stable convergence is not achieved. The k-means clustering algorithm is computationally very fast.



(a) (b)

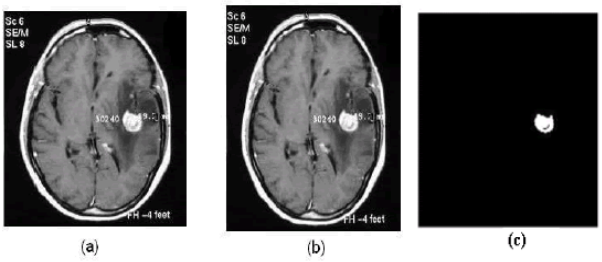
Fig:(a)original image (b) after applying k-means clustering

IV. WATERSHED ALGORITHM

The watershed algorithm is most generally used in medical image segmentation. The image is easily divided using a watershed algorithm for a medical image analysis. On the other side it results in over segmentation and responsiveness to false edges. The objective of the watershed algorithm is to reduce the problem of over segmentation. Watershed segmentation is a morphological based method within an image segmentation. The magnitude gradient of image is examined as a topographic surface for the watershed transformation. In different ways the lines of watershed is found.

The watershed transformation depends on best image gradient estimation throughout the image division. Background noise leads to the reduction of watershed transform and generates segmentation. The different researchers proposed many preprocessing techniques for the purpose of reducing deficiencies of watershed. For example Scharcanski and jung proposed a watershed segmentation

which is robust using wavelets. In order to denoise wavelets technique is used.



(a) (b) (c)

Fig 7 a, b, c, d. (a) Input Image (b) Segmented Image(c) Output Image

V. FUZZY C-MEANS ALGORITHM

Fuzzy C-means clustering or ISODATA, where each data points belongs to specific clusters where the membership value specifies its degree. Different applications like pattern recognition, image segmentation, classification we use FCM. FCM divides a group of n vectors into c fuzzy groups and finds a cluster center in each group such that a cost function of dissimilarity measure is minimized. FCM uses fuzzy dividing such that a given data point can belong to several groups with the degree of belongingness specified by membership values between 0 and 1. This algorithm is simply an iterated procedure.

VI. ARTIFICIAL NEURAL NETWORKS

It is an efficient system of computing, which is also known as 'parallel distributed processing system' or 'connectionist systems'. It is a pattern of interconnection in order to allow communication among the units. Artificial neural networks with supervised learning sometimes not be a best solution for the image segmentation. Here a class is assigned to each input vector. Here the each pixel of the image being categorizes on the basis of the class labels. Here the input vectors are the intensities of pixels or the neighboring ones. This is applicable when you don't have knowledge about segmentation or how to implement it.

VII. OVERVIEW OF THE METHODS

Serial No.	Method Name	Pros And Cons	Applications
1.	Edge Detection Method	**Pros:** It is simple and flexible, Edge detection and their orientation, error is detected by probability, signals to noise ratio is improved. **Cons:** Noise sensitivity, Inaccurate, time consuming, complex.	o Computer vision o Image pattern recognition o Human vision o Image analysis
2.	K-means Clustering	**Pros:** It is fast enough to compute than hierarchical clustering when many variables are in use, tighter clusters are produced. **Cons:** Highly responsive to out layers, Might not settle at global minimum but can at local minima.	o Identifying cancerous data. o Drug activity prediction.
3.	Watershed Algorithm	**Pros:** The connected and closed regions are observed as results, The resulting boundaries of sectioning leads to inefficient results, the combining of the regions from	o Applying Markers o Hierarchical segmentation of images.

		entire image. **Cons:** Excessive over-segmentation is observed, This consumes time 3-times greater than K-means.	
4.	Fuzzy C-Means	**Pros:** Converging, Unsupervised. **Cons:** High computational time, High level of sensitivity to initial guess, Affected by noise and noisy points.	o Image Analysis. o Bioinformatics.
5.	Artificial Neural Networks	**Pros:** Easy use, Any function can be approximated, This is more applicable for problems like image recognition. **Cons:** Less efficient for simple cases, Requires a load of cases and trainings.	o Pattern recognition. o Data classification.

VIII. CONCLUSION

This is the review of some of the image segmentation algorithms are described. All these algorithms are suitable for medical image applications.

In the medical image segmentation future research will strive forwards improving the efficiency and speed of computing in segmentation techniques, accuracy, precision and also reduce manual interaction.

On reducing over segmentation, we obtained a segmentation map. K-means technique is more efficient rather compared to the other algorithms. In future, medical image segmentation can perform more accurate segmentation results by using these algorithms. These algorithms have some features that are reliability, accuracy, repeatability, robustness.

REFERENCES

[1] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2825001/
[2] https://www5.cs.fau.de/research/groups/medical-image-segmentation/
[3] https://pdfs.semanticscholar.org/bdf3/accd867e283b5ca2d3e0371e773837744dc3.pdf
[4] https://www.tandfonline.com/doi/abs/10.1080/02564602.2014.906861?journalCode=titr20
[5] https://link.springer.com/chapter/10.1007/0-306-48606-7_3
[6] https://www.researchgate.net/publication/263608069
[7] http://www.dtic.upf.edu/~afrangi/ibi/CurrentMethodsInImageSegmentation_Phan2000.pdf
[8] http://www.bmva.org/annals/2013/2013-0007.pdf
[9] https://www.igi-global.com/chapter/recent-survey-on-medical-image-segmentation/180956
[10] Deeplai Kelkar and Surendra Gupta," Improved Quad tree Method for Split Merge Image Segmentation", Emerging Trends in Engineering and Technology, 2008 ICETET.
[11] Archana Singh, Avantika Yadav, Ajay Rana, "K-means with Three different Distance Metrics", International Journal of Computer Applications Volume 67– No.10, April 2013.
[12] Shikha Manari,Rajiev Bansal: Watershed:A Comparative Study published in International Journal of Engineering and Technology Vol.3 (3), 2011, 233-238 7
[13] S.Kirindis and V. Chatzis, " A Robust Fuzzy Local Information C-Means Clustering Algorithm," IEEE Trans. Image Process. Vol.19, No.5 , pp. 1328-1337,May 2010

[14] [14] Zhang, Z. C.; Xia, S.R. & Duan, H.L. (2008). Cellular neural network based urinary sediment image segmentation.