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A Review of Image Segmentation Methods in Brain Tumor

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ABSTRACT

Accurate segmentation of the medical image of the brain is significant stage in the identification of a brain tumor during the preparation of radiotherapy. In general, medical images are utilized as radiographic techniques in diagnosis, clinical studies, and therapy planning, Segmentation is one of the most widely used methods to correctly classify the pixels in an image , This review sheet discusses a comprehensive literature review of modern methods of brain tumor segmentation, and outlines the extent and robustness of each currently existing method for brain tumor clinical image segmentation.

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1. Introduction

We can define a tumor as an abnormal growth of cancer cells and which In any part of the body. Cancerous tumors are classified into , several types and which have different characteristics and each has a different treatment. At present, brain tumors are classified into two types of tumors: primary brain tumors and metastatic brain tumors, the first type begins stay, and the second type begins elsewhere in the body and spreads to the brain., (Liu, J., Li, M., Wang, J., Wu, F., Liu, T., & Pan, Y. ,2014). Examples of low-grade tumors include gliomas and meningiomas, which are considered benign tumors (Wadhwa, A., Bhardwaj, A., & Verma, V. S. ,2019). Image segmentation which is an fundamental, subject in image processing and has many applications such as scene understanding, medical image analysis, machine perception, video surveillance, augmented reality, and image compression (Minaee, S., Boykov, Y. Y., Porikli, F., Plaza, A. J., Kehtarnavaz, N., & Terzopoulos, D. ,2021) , Medical image processing and segmentation is an active and interesting area of interest in tumor diagnostics following the discovery of CT and MRI (Kaur, G., & Rani, J. ,2016) , The main purpose of image segmentation is to find regions and objects that describe significant

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parts of objects in order to facilitate their analysis. In this review paper, our goal is to collect and analyze the methods used in image segmentation. Therefore, in general, this paper is a summary of methods Segmentation of medical images.

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2. Methods

Several widely used techniques in medical image segmentation are clearly described. The pixel classification method is a division in which regions of similarity are allowed to be created in an image. Image segmentation methods can be broadly categorized into three different categories, threshold-based, region-based, and clustering-based. In addition, there are other ways to split photos. Figure 1.1 shows the types of segmentation used in this paper

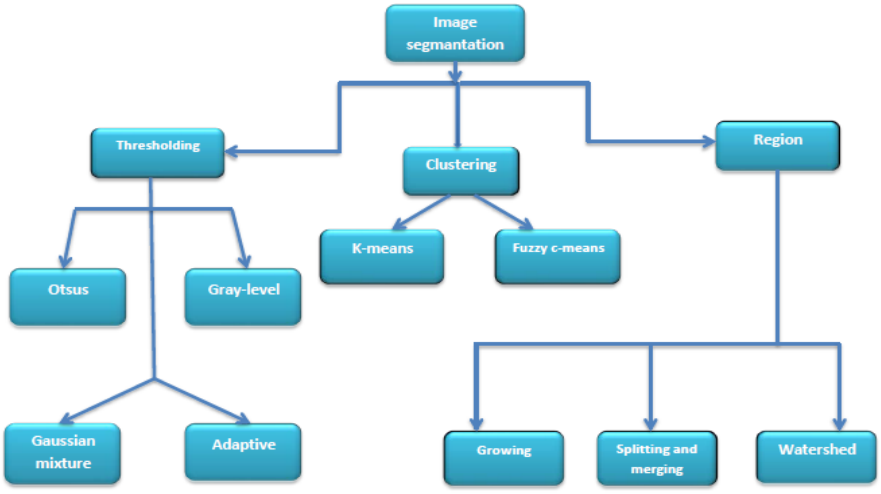

Fig. 1 - Methods of image segmentation

2.1 Thresholding-Based

WANG (Wang, D., Li, H., Wei, X., & Wang, X. P. ,2017) and others proposed an effective iterative threshold method for multi-stage image segmentation, the algorithm is easy to implement and also showed that the iterative algorithm has the property of total power decomposition. Zhang (Feng, Y., Zhao, H., Li, X., Zhang, X., & Li, H. ,2017), et al. proposed a threshold algorithm for segmentation of medical images, to reduce noise and weak edges. Arifin (Arifin, A. Z., & Asano, A. , 2006), proposed a threshold method for image segmentation. Experiments with practical images show the effectiveness of this method. Al-amri (Al-Amri, S. S., & Kalyankar, N. V. ,2010)studied the segmented

images using the thresholding technique and its types and compared them with each other to choose the best image technique for the threshold segmentation techniques. These techniques were applied to three satellite images to choose the baseline guesses for the threshold segmentation image , Thresholding is the simplest technique for segmenting medical images, it is quick to implement and easy to understand. It converts the scalar image into a binary image, the threshold value is determined based on the image intensity values, the pixel density values are compared with the threshold value, and the pixels having an intensity value equal to or higher than the threshold value are set to 1b(white), while the Set pixels with lower density values to 0 b (black) (Wadhwa, A., Bhardwaj, A., & Verma, V. S. ,2019).

2.1.1 Gray-Level Thresholding

CHEN (Chen, J., Guan, B., Wang, H., Zhang, X., Tang, Y., & Hu, W. , 2017), proposed a new strategy to improve the segmentation performance of the thresholding methods, in which the spatial information between pixels was combined and used the gray level of the pixel and the local entropy within the neighborhood to create a new 2D histogram, where the experimental results showed that this proposed method is superior to many existing threshold methods. S. Chabrier (Chabrier, S., Rosenberger, C., Laurent, H., Emile, B., & Marché, P. ,2004)proposed an unsupervised criterion that allows the quality of the gray-level image segmentation result to be determined. This method is based on a new standard that takes into account differences within and between regions. Given the type of region, the experimental results show the efficiency of this technique for images. W. Yang (Yang, W., Cai, L., & Wu, F. ,2020) He proposed a method to select,a two-dimensional diagram using pixel splendor and relative local entropy of adjoining pixels, and the optimal threshold vector is acquired, by decrease cross-entropy parameters, and the experimental results showed that this method can achieve more accurate segmentation results compared to other methods, The other threshold.

2.1.2 Otsu's Method

Liu, D (Liu, D., & Yu, J. ,2009) adopt the Otsu method and prove that the objective function of the Otsu method is equivalent to the function of the K-mean method at the multilevel threshold. But the Otsu method needs to calculate the gray level graph first. The Otsu method is the most successful method for determining the image threshold, The Otsu method has made significant progress by automatically converting a gray scale image into a binary image.(Lee, L. K., Liew, S. C., & Thong, W. J. ,2015), Xiangyang Xu, (Xu, X., Xu, S., Jin, L., & Song, E. ,2011)proposed the Otsu method, which limits the search scope to gray levels. Experimental results show the advantage of this method distinctly , Xiangyang Xu, (Husham, S., Mustapha, A., Mostafa, S. A., Al-Obaidi, M. K., Mohammed, M. A., Abdulmaged, A. I., & George, S. T. ,2020,)suggested Otsu's method where many experiments were performed using standard BRATS dataset and this method was evaluated by similarity coefficient as standard measure using dice, Jacquard, and BF scores. The results proved that this method has higher segmentation accuracy.

2.1.3 Gaussian Mixture Method

Pravitasari, A. A.,(Pravitasari, A. A., Qonita, S. F., Irhamah, N. I., Fithriasari, K., Purnami, S. W., & Ferriastuti, W. ,2020) used a Gaussian Mixture Model (GMM), a method based on a data probability model, which it is supposed,that if there are There are only a limited number of groups in the sample, then they can be assumed to be constant, then each group will represent which are as the best certain, probability distributions fit For which are the characteristics of the information, the results prove that this method has a higher segmentation accuracy , Nguyen, D. M., (Nguyen, D. M., Vu, H. T., Ung, H. Q., & Nguyen, B. T. ,2017) used the Gaussian Mixture Method (GMM) on the basis of which several studies were developed to describe the information density of brain tissue and achieve positive performance. Chaddad, A., (Chaddad, A. ,2015)used the advantages of the Gaussian mixture method (GMM) using magnetic resonance imaging that was able to extract the feature of glioblastoma (GBM) and the features of GMM showed better performance and more accuracy.

2.1.4 Adaptive

An adaptive algorithm is an algorithm that changes its behavior at run time based on available information and on predefined information. This information can be recently received data, information about available computational resources, or other previously known runtime information related to the environment in which it is run (Zaknich, A. ,2005) , Agn, M., (Agn, M., af Rosenschöld, P. M., Puonti, O., Lundemann, M. J., Mancini, L., Papadaki, A., ... & Van Leemput, K. ,2019) used the adaptive thresholding method and this method proved to be a worthy procedure towards automate the identification of brain tumors and organs at hazard in glioma patients undergoing radiotherapy.

2.2 Clustering-Based

Aggregation is the most common and popular unsupervised hashing method. In clustering instead of using trained images, images are split into multiple sets of pixels with similar intensities (Elizabeth, J. R., & Juliet, S. E. ,2019) ,Clustering is a common technique for statistical data analysis. In other words, it is the process of dividing the data set into subsets so that the data in each subset is according to some specified distance measure. Clustering can be used in many areas including machine learning, data mining, as well as pattern recognition and image analysis (Madhulatha, T. S. ,2012).Clustering algorithms should be chosen based on the nature of the problem in order to solve the properties of the objects to be analyzed, the expected clusters, the size of the problem and the available computational power (Naik, D., & Shah, P. ,2014).Use different collection techniques to track tumor bodies on MRI images of the brain, The information in this system is the MR image of the pivotal panorama of the human brain, here the given gray level MR image is applied into a color space image and then the clustering algorithms are applied. The position of tumor regions is isolated from the MR image using clustering algorithms. The clustering algorithms are analyzed and performance evaluated according to the execution time and algorithm accuracy. (Selvy, P. T., Palanisamy, V., & Purusothaman, T. ,2011).

2.2.1. Fuzzy C-Mean Clustering Method

FCM is a clustering algorithm introduced by James in 1981, and this algorithm is based on reducing the object function by frequent updating of the membership function and the centers of cluster, the object function is the weighted sum of the distance of the data from the centers of cluster (Balafar, M. A. ,2014). Use Ms. Priya Patil, (Patil, M., Pawar, M., Patil, M., & Nichal, A. ,2017)fuzzy c-means image segmentation method and was able to detect brain tumor boundaries and calculate the actual area of the tumor. Experiments with practical images show the effectiveness, accuracy and clarity of images this method. Latif, G., (Latif, G., Alghazo, J., Sibai, F. N., Iskandar, D. A., & Khan, A. H. ,2021) proposed fuzzy c-means on images acquired from magnetic resonance imaging (MRI) machines as a technique for brain tumor segmentation consequent to the , elasticity of this algorithm in allowing pixels to belong to more than one group at the same time., Arora, J., (Arora, J., Khatter, K., & Tushir, M. ,2019) proposed the fuzzy c-means method, one of the most widely used aggregation techniques that uses Euclidean distance measures as a measure of similarity and provides a mathematical description of the various distance measures. Alam, M. S., (Alam, M. S., Rahman, M. M., Hossain, M. A., Islam, M. K., Ahmed, K. M., Ahmed, K. T., ... & Miah, M. S. ,2019) proposed a fuzzy c-means method and which that to discover human brain tumors in a magnetic resonance imaging (MRI) image , and the updated membership which is is specified by which are the distances from the group for centroid to the group information points as it relates to its best result, which are The results display that the suggestion algorithm realized best , which that to disclosure of abnormal, and natural , texture in the human brain down a short class of gray level density,and which In addition, this algorithm uncover human brain tumors in a quite, short time contrast to employing other algorithms.

2.2.2. K-Means Clustering

Wu, M. N., (Wu, M. N., Lin, C. C., & Chang, C. C. ,2007) proposed the K-mean segmentation method for tracking tumor bodies in brain magnetic resonance (MR) images and demonstrated that the method can successfully achieve segmentation of brain MRI images to help radiologists accurately distinguish between lesion size and area. Vijay, J., (Vijay, J., & Subhashini, J. ,2013) proposed the K-mean segmentation method and demonstrated that this method is effective and rapid for automatic brain tumor segmentation to extract tumor tissue from MRI images. Khan, A. R., (Khan, A. R., Khan, S., Harouni, M., Abbasi, R., Iqbal, S., & Mehmood, Z. ,2021) suggested a K-mean segmentation method for classifying brain tumors using MRI data analysis, and the results proved the effectiveness of the proposed strategy and achieved better accuracy compared to other techniques. Arunkumar, N., (Arunkumar, N., Mohammed, M. A., Abd Ghani, M. K., Ibrahim, D. A., Abdulhay, E., Ramirez-Gonzalez, G., & de Albuquerque, V. H. C. ,2019) proposed a K-mean segmentation method to obtain the precise brain tumor region region from MRI images, using K-mean clustering as part of the MR image enhancement process to be characterized in light of its gray scale.

2.3 Region-Based

By zone technology the image is divided into different zones. Regions are distinguished based on various criteria including element, density, or color. The algorithm starts with a specific initial point or seed region and evaluates incrementally and either ignores or adds neighbors to an area depending on their similarity value(Muhammad, M., Zeebaree, D., Brifcani, A. M. A., Saeed, J., & Zebari, D. A. ,2020). Zhou, Y. M.,(Zhou, Y. M., Jiang, S. Y., & Yin, M. L. ,2008) proposed a region-based segmentation method that extracts the color, texture and location features from each pixel to form the feature vector by selecting the appropriate color space and the experimental results show that this method can segment images quickly and has good segmentation results. Karthick, S., (Karthick, S., Sathiyasekar, K., & Puraneeswari, A. ,2014) proposed a region-based segmentation method in which adjacent pixels are scanned and added to the region session if no edges are detected. This process is repeated for each border pixel in the region. Area augmentation procedures can provide unique images that have sharp edges and good segmentation results.

2.3.1 Region Growing

Biratu, E. S., (Biratu, E. S., Schwenker, F., Debelee, T. G., Kebede, S. R., Negera, W. G., & Molla, H. T. ,2021) proposed a region-growth-based segmentation method that grows the region in order to automatically initialize the starting point of any brain images and test them on a data set. It was concluded that the proposed algorithm can detect brain tumor sites and extract the best different regions of interest. Latif, G., (Latif, G., Iskandar, D. A., & Alghazo, J. ,2018) suggested a segmentation method based on region growth to extract the tumor region from the tumor images., Area- established image segmentation produces better results compared to various methodologies and pixels in a given area based on employer standard are applied as premier points in area- founded image segmentation, The region grows through neighboring pixels iteratively based on various compositional and density qualifications , Determining the accurate explicit points that precisely describe the trouble is an significant operator in the segmentation of the image on the , fundamental, of area. Reddy, C. K. K., (Reddy, C. K. K., Anisha, P. R., & Raju, G. V. S. ,2015) proposed A segmentation method based on the growth region algorithm where segmentation is performed to analyze the tumor fraction and on which the tumor size and stage depends experimentally.Węgliński, T., (Węgliński, T., & Fabijańska, A. ,2011) proposed a new brain segmentation algorithm. This method is a labeled area growth approach which was developed to segment the brain tumor affected area and present and discuss the test results of the developed method on real MRI dataset.

2.3.2 Region Splitting and Merging

The splitting method starts which with the whole image, then frequently divides which that all part which that into quarters if the analogy gauge is not met, And also these divisions can occasionally, split parts of which one topic, and the merging style connects the neighboring parts of the same object, if the area is not completely divided, it can be made Correction by adding borders or dividing certain areas containing parts of different objects, and if the area is

fragmented too much, which that is rectification, can be done by removing counterfeit borders and merging akin spaces if which they are belong to the same target(Al-Tamimi, M. S. H., & Sulong, G. ,2014). ,Selvaraj, D., (Selvaraj, D., & Dhanasekaran, R. ,2013) studied the split and merge algorithm for brain segmentation, the image is divided into different regions depending on some criteria and then merged, and the whole image is initially taken as one region , then comes the merging phase ,where two regions are combined if they are adjacent and similar, and prove that the split and merge algorithm is a fast computation method.

2.3.3 Watershed

Dhage, P., (Dhage, P., Phegade, M. R., & Shah, S. K. ,2015) studied the ability of the watershed segmentation algorithm to separate abnormal tissue from surrounding normal brain tumor tissue to obtain a true identification of the involved and uninvolved area that helps the surgeon to accurately distinguish the affected area. At the end of the operation, the tumor is extracted from the magnetic resonance image, its exact position and shape are determined, and many parameters such as circumference, entropy, and centroid are calculated. Shanthakumar, P., (Shanthakumar, P., & Ganesh Kumar, P. ,2015) applied a watershed segmentation algorithm on an abnormal brain image to detect and segment the tumor region in the brain image. This method is suitable for medical images with higher intensity value and achieved good accuracy when applied. Singhai, P. P., (Singhai, P. P., & Ladhake, S. A. ,2013) introduced a method for brain tumor detection which is the watershed segmentation algorithm. The watershed segmentation depends on the marker, which in turn depends on the value set for the lower limit, so it is necessary to determine the optimal value for the lower limit, and the tumor area that represents The region of interest is also defined in pixels using continuum component analysis . Sharma, A. K., (Sharma, A. K., Nandal, A., Dhaka, A., Koundal, D., Bogatinoska, D. C., & Alyami, H. ,2022) introduced a method for brain tumor detection which is the watershed segmentation algorithm which is a more effective, accurate and trustworthy approach to detect and classify brain tumor tissues.

3. Discussion

From Figure 1-1, this classification illustrates the research and development that has been done in the field of medical image segmentation, where more efficient methods of brain tumor segmentation have been used.

Table (1-1) discusses these different methods, and the advantages and disadvantages of each method are presented and this helps us to choose the best method for a particular case.

Table 1 below summarizes the advantages and Disadvantages of each methodology

Methodologies		Advantages	Disadvantages
	Gray level	-Ease of implementation and efficiency. -You don't need previous information.	-Edges are blurred and noisy. -lack of sharpness. -multidimensional and complex

Thresholding-based	Otsu's method	-the method works well and is a willingly. -widely used and is able to expand to mule-level threshold.	-segmentation is less and slow. -this method expands the classes to get a good separation.
	Gaussian mixture	-The probability of mis classification is small when the model is failed. -this method is applicable to small scale classification.	-most graphs are not Gaussian. -the intensity is limited . -it is very difficult to distinguish flat and close areas.
	Adaptive	-simple and easy to apply. -give a clear and orderly solution.	-the image entered must be segmentation.
Clustering	k-means	- Easy to understand, powerful and fast. -Relatively well organized. -This algorithm gives the best result when the data set is discrete.	-It randomly picks the center points (X) which leads to inconsistency and non-returnable results, as we will get different results (group centers) every time we run the algorithm on the same data.
	Fuzzy c-means	-It gives good results and is very effective from k-mean. -The membership data point is awarded to each cluster center	-When the system is complex, it is difficult to ensure that the rules and degree of membership are sufficient, efficient and low in consumption in the traditional non-obvious calculations.
Region-based	growing	-it is a good and useful method. -easy to calculate. -less sensitivity to light.	-Expensive method. -it is necessary to determine the starting point. -the images are not fragmented.
	splitting and merging	-speed of execution. -the image can be divided according to the required a curacy.	-it produces full segments
	Watershed	-better execution in the image of noise. -exact results. -high speed.	-the starting point must be specified. -calculating the gradient is complicated. -easily excess segmented.

2. Conclusion

This existing review is based on the recent studies made on brain tumor segmentation and detection of the tumor. The identification of brain tumor present in a person through the MRI and CT scan methods in an accurate, quick, and productive manner is a difficult task. Even though the field of medical image processing is quite an advance and

developed field, it has still got a long way to go. These brain tumor segmentation methods have already proven a great deal at detecting and studying the tumors in medical images, which will be very beneficial to mankind in the future , For accurate detection and diagnosis of brain tumor patients, a proper segmentation method is required to be used for MRI and CT scan images which that to take out , an afflicted diagnosis and remediation,. actually, data which is supply , by much images from different, slabes and which is desired for exact diagnosis, design and Also, the target of the treatment, The above-mentioned review proves that it is not valid to rely on one method of brain tumor segmentation because each method has its own advantages and disadvantages. To overcome these disadvantages, more than one method can be integrated and this procedure has been relied upon in many types of research, which are called the hybrid methods.

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