ISSN : 2231-0711

Ruchi D. Deshmukh et al | International Journal of Computer Science Engineering and Technology(IJCSET) | April 2014 | Vol 4, Issue 4,133-136

Study of Different Brain Tumor MRI Image Segmentation Techniques

Ruchi D. Deshmukh
Research Student
DYPIET Pimpri, Pune, India

Prof. Chaya Jadhav
Assistant Professor
DYPIET Pimpri, Pune, India

***Abstract*-The method of brain tumor segmentation is nothing but the differentiation of different tumor area from Magnetic Resonance (MR) images. There are number of methods already presented for segmentation of brain tumor efficiently. However it's still critical to identify the brain tumor from MR images. The segmentation process is extraction of different tumor tissues such as active, tumor, necrosis, and edema from the normal brain tissues such as white matter (WM), gray matter (GM), as well cerebrospinal fluid (CSF). As per the survey study, the brain tumors most of time detected easily from brain MR image, but required level of accuracy, reproducible segmentation, abnormalities classification is not predictable and straightforward. The segmentation of brain tumor is composed of many stages. The manual process of doing the segmentation of brain MR images is very time consumption and tedious task, and hence it is associated with many challenges. Therefore, we need automated segmentation method for brain images. There are many techniques presented to investigate the performance of automated computerized brain tumor detection for the medical analysis purpose. In this review paper, our main goal is to present the review of different brain tumor segmentation methods using the MR images. The different methods for segmentation are studied with their advantages and disadvantages in this paper.**

Index Terms- Brain Tumor, Classification, Disease Identification, Magnetic Resonance Imaging (MRI), Segmentation, Tumor Detection.

I. INTRODUCTION

In medical practices, the early detection and recognition of brain tumors accurately is very vital. In literature, there are many techniques has been proposed by different researchers for the accurate segmentation of brain tumor. Some discoveries such as X-rays, ultrasound, radioactivity, magnetic resonance imaging (MRI) or computed tomography and the development of tools that can generate medical images have facilitated the development of some of the most efficient exploration tools in medicine. Such tools are capable of exploring the structure, function and the diseases that affect the human brain, and deals with the cancer-affected region of the brain.The main goal for the medical researchers since from last few decades is the curing brain tumors, however the building of new methods for treatments requires more time as well as money. Medical science yet needs to find all the main causes of different types of cancers and then develop the methods to cure them before brain tumors development starts.

Magnetic resonance imaging (MRI) is high-quality medical imaging, particularly for brain imaging. MRI inside the human body is helpful to see the level of detail. Doctors have major technical and economic importance of reliable and fast detection and classification of brain cancer, based on common practices. Most of the technicians are slow, less responsible, and that's hard to quantify possess a degree of subjectivity.

For the early detection of brain tumors there are many imaging methods for diagnostics purpose are presented. These imaging techniques are Positron Emission Tomography (PET), Magnetic Resonance Imaging (MRI), and Computed Tomography (CT). Among this all imaging techniques, MRI is most efficient for the research of brain tumor detection and classification as compared to other imaging techniques. This is because of high contrast of soft tissues, high spatial resolution as well as it does not produce any harmful radiation Reliable and fast detection and classification of brain cancer. Although MRI and the tumor about the size of being able to provide information, it is unable to classify tumor types, invasive techniques such as biopsy and spinal applications, which are painful and time consuming methods.

In this paper we are aiming to take review of different methods of brain tumor image segmentation. We are aiming to present the different MRI images segmentation methods.

II. REVIEW OF MRI BRAIN IMAGE SEGMENTATION METHODS

Objective of this review section is to present literature survey of image segmentation methods. The main goal is to highlight advantages and limitations of these methods. Key image processing techniques for brain MRI image segmentation is classified as thresholding, region-growing, clustering, soft computing, atlas-based, image/symmetry analysis, other methods etc.

*A. **Thresholding***

Thresholding is one of the most generally used and oldest methods for image segmentation. In the process of thresholding, image is supposed to be composed of regions and these regions belong to different ranges of gray scale. Histogram of image is consists of peaks and valleys, where each peak represents one region. The valley between the peaks represents a threshold value. Histogram thresholding method is based on a concept that divides the image into two equal halves and histograms are compared to detect the tumor and cropping method is used to find a proper physical dimension of brain tumor. The threshold technique makes decision based on the local raw pixel information. It helps in extracting the basic shape of an image, overlooking the little unnecessary details.

B. Region-growing

In this technique the images are partitioned by organizing the nearest pixel of similar kind.It starts with a pixel (initial seed) that having similar properties. Accordingly the neighbouring pixels based on homogeneity criteria are appended progressively to the seed.In splitting process,region get devided into subreions that do nt satify a given homogeneity crieteria.Spliting and merging can be used together and its performance mostly depends on the selected homogeneity criterion. Without tuning homogeneity parameters, the seeded region growing technique is controlled by a number of initial seeds. If the number of regions was approximately known & used it to estimate the corresponding parameters of edge detection.

C. Clustering

The method of clustering organizes the objects into groups based on some feature, attribute and characteristic. Hence a cluster consists of groups of similar objects. There are two types of clustering, supervised and unsupervised. In supervised type clustering, cluster criteria are specified by the user. In unsupervised type, the cluster criteria are decided by the clustering system itself.

1) K-Means Clustering:

K-Means Clustering partition the n observations into k clusters in which each pixel belongs to the clusters by minimizing an objective function in a way that the within cluster sum of squares is get minimized. It starts with initial K cluster centers and it reassigns the observations to clusters based on the similarity between the observations and cluster center.

Automation of detection and segmentation of brain tumors in MRI images is a very challenging task due to occurrence of high degree of gray-level similarity in the image. T. U. Paul and S. K. Bandhyopadhyay [10] have presented a fully automated two-step segmentation process of brain MRI images. In the first step, skull stripping is performed by generating a skull mask from the MRI image and in the second step, an advanced K-means algorithm improvised by two-level granularity oriented grid based localization process based on standard local deviation is used to segment the image into gray matter, white matter and tumor region and then length and breadth of the tumor is assessed.

2) Fuzzy C-Means clustering:

Fuzzy C-means (FCM) clustering is a data clustering method in which each data point belongs to a cluster to a degree specified by a membership value. Fuzzy C-means divides a collection of n vectors into c fuzzy groups and finds a cluster centre in each group such that a cost function of dissimilarity measure is minimized.

*D. **Soft-Computing***

A self-organizing map (SOM) or self-organizing feature map is a type of artificial neural network for unsupervised learning. SOMs organize in training and mapping mode. Training process builds map using vector quantization process and mapping automatically classifies a new input vector. SOM map consists of neurons or nodes. Self organizing maps each of which are neurons associated with a weight vector map data input vectors and position in the map space. The self-organizing maps a higher dimensional input space to a lower dimensional map space. Energy, entropy, contrast, mean, median, variance, correlation, maximum and minimum intensity values used to provide clear description of tumor.

E. ***Image/Symmetry Analysis***

Image/Symmetry Analysis is an interactive segmentation method that in addition to area of the region and edge information uses prior information, also its symmetry analysis which is more consistent in pathological cases.A conceptually easy supervised block-based, shape, texture; content based technique has been used to analyze MRI brain images with relatively lower computational requirements. Classifying regions by means of their multi-parameter values does the study of the regions of physiological and pathological interest easier and more definable.

F ***Other Segmentation Methods***

There are also others segmentation methods such as wavelet transform, edge detection method, watershed algorithm, deformable models with their own pros and cons. It is possible to combine different segmentation methods depends on application.

III. COMPARATIVE STUDY OF DIFFERENT SEGMENTATION TECHNIQUES

Comparative study of different segmentation techniques is summarized in compare table (TableI) with advantages and disadvantages. Most of the key features of methods are mentioned in TableI with respective limitations and benefits that make our work unique.

TABLE I. COMPARE TABLE

Author	Title	Proposed Technique	Algorithm Used	Benefits	Identified Problems
Zhang (2001)	Segmentation of Brain MR Images through a Hidden Markov Random Field Model and the Expectation-Maximization Algorithm[1]	Segmentation	Expectation Maximization	Technique possesses ability to encode both spatial and statistical properties of an image.	The method requires estimating threshold and does not produce accurate results most of the time.
Ahmed (2002)	A modified fuzzy c-means algorithm for bias field estimation and segmentation of MRI data[2]	Bias field estimation	Modified fuzzy C-means	Faster to generate results	Technique is limited to a single feature input.
Tolba (2003)	MR-Brain Image Segmentation Using Gaussian Multi resolution Analysis and the EM Algorithm[3]	Gaussian Multi resolution Analysis	Expectation Maximization	Less sensitive to noise	Rarely preserve edges.
Sing (2005)	Segmentation of MR Images of the Human brain using Fuzzy Adaptive Radial Basis function Neural Network[4]	Neural network	Fuzzy adaptive radial basis function	It preserves sharpness of image.	Able to do only one task related to fusion
Yu (2008)	Three-level Image Segmentation Based on Maximum Fuzzy Partition Entropy of 2-D Histogram and Quantum Genetic Algorithm[5]	Fuzzy partition entropy of 2D histogram and genetic algorithm	QGA	QGA is selected for optimal combination of parameters.	Practically impossible
Kumar (2011)	A Texture based Tumor detection and automatic Segmentation using Seeded Region Growing Method[6]	Texture based Tumor detection and automatic segmentation	Seeded Region growing	This is region growing segmentation method for segmentation of brain tumor in MRI, in which it is possible to determine abnormality is present in the image or not.	It takes more time.
Roy (2012)	Detection and Quantification of Brain Tumor from MRI of Brain and it's Symmetric Analysis[7]	Modular approach to solve MRI segmentation	Symmetry analysis	The proposed appoach can be able to find the status of increase in the disease using quantitative analysis	Time consuming.
Meenak-shi (2012)	Brain Tumor Identification in MRI with BPN Classifier and Orthonormal Operators[8]	Brain Tumor Identification in MRI with BPN Classifier and Orthonormal Operators	k-means clustering, BPN classifier	It combines clustering and classification algorithm	Accuracy can be improved in less time

IV. CONCLUSION

In this paper we have studied the different aspects of medical imaging especially for the application of diagnosis of brain tumor using MRI. We have presented the review of different brain image segmentation methods presented so far, as well their advantages and disadvantages are discussed as comparative analysis. In addition to this we are giving the information about different kinds of MRI images datasets which are frequently used for research studies as well as performance evaluation metrics. For the future work we suggest to present more accurate, efficient as well as faster method for early detection and classification of brain tumors.

REFERENCES

[1] Y. Zhang, M. Brady and S. Smith, "Segmentation of Brain MR Images through a Hidden Markov Random Field Model and the Expectation-Maximization Algorithm", Proceedings of the IEEE transaction on Medical Images, January2001

[2] M.N. Ahmed, S.M. Yamany, N. Mohamed and T. Moriarty, "A modified fuzzy c-means algorithm for bias field estimation and segmentation of MRI data", Proceedings of the IEEE transaction on Medical Images, KY, USA, March 2002.

[3] M.F.Tolba, M.G. Mostafa, T.F. Gharib and M.A Salem, "MR-Brain Image Segmentation Using Gaussian Multi resolution Analysis and the EM Algorithm", ICEIS, 2003.

[4] J.K.Sing, D.K. Basu, M. Nasipuri and M. Kundu, "Segmentation of MR Images of the Human brain using Fuzzy Adaptive Radial Basis function Neural Network".Pattern Recognition and Machine Intelligence", LNCS, Berlin, Heidelberg, 2005.

[5] H. Yu and J.L. Fan, "Three-level Image Segmentation Based on Maximum Fuzzy Partition Entropy of 2-D Histogram and Quantum Genetic Algorithm",Advanced Intelligent Computing Theories and Applications.With Aspects of Artificial Intelligence. Lecture Notes in Computer Science, Berlin, Heidelberg 2008.

[6] M.Kumar and K.K. Mehta, "A Texture based Tumor detection and automatic Segmentation using Seeded Region Growing Method", International Journal of Computer Technology and Applications, August 2011.

[7] S. Roy and S.K. Bandyopadhyay, "Detection and Quantification of Brain Tumor from MRI of Brain and its Symmetric Analysis", International Journal of Information and Communication Technology Research, KY, USA, June 2012.

[8] R. Meenakshi and P. Anandhakumar, "Brain Tumor Identification in MRI with BPN Classifier and Orthonormal Operators", European Journal of Scientific Research, September 2012.

[9] T.U Paul and S.K. Bandyopadhyay, "Segmentation of Brain Tumor from Brain MRI Images Reintroducing K – Means with advanced Dual Localization Method", International Journal of Engineering Research and Applications, June 2012.