ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

IJIREEICE

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

nCORETech

LBS College of Engineering, Kasaragod

Vol. 3, Special Issue 1, February 2016

A Review on MRI Brain Image Segmentation Techniques

Reema Mathew A[1], Dr.Babu Anto P [2]

Associate Professor, Electronics & Instrumentation, Vimal Jyothi Engineering College, Chemperi, India[1]

Associate Professor, Information Technology, Kannur University, Kannur, India[2]

Abstract: Brain tumor is a life threatening disease and its early detection is very important to save life. The tumor region can be detected by segmentation of brain Magnetic Resonance Image (MRI). Once a brain tumor is clinically suspected, radiologic evaluation is required to determine the location, the extent of the tumor, and its relationship to the surrounding structures. This information is very important and critical in deciding between the different forms of therapy such as surgery, radiation, and chemotherapy. The segmentation must be fast and accurate for the diagnosis purpose. Manual segmentation of brain tumors from magnetic resonance images is a tedious and time-consuming task. Also the accuracy depends upon the experience of expert. Hence, the computer aided automatic segmentation has become important. MRI scanned images offer valuable information regarding brain tissues. MRI scans provide very detailed diagnostic pictures of most of the important organs and tissues in our body. It is generally painless and noninvasive. It does not produce ionizing radiation. So MRI is one of the best clinical imaging modalities. Several automated segmentation algorithms have been proposed. But still segmentation of MRI brain image remains as a challenging problem due to its complexity and there is no standard algorithm that can produce satisfactory results. The aim of this research work is to propose and implement an efficient system for tumor detection and classification. The different steps involved in this work are image pre-processing for noise removal, feature extraction, segmentation and classification. Proposed work plans to make a study on different techniques exists for each step and to propose a method well suitable to get an accurate solution.

Keywords: Tumor, Image segmentation, MRI image, image processing.

I. INTRODUCTION

The cell can be considered as the fundamental structural unit of all living organisms. Human body contains about 100 trillion cells and each of them has its own functions. For the correct functioning of the body, these cells have to divide to form new cells in a controllable manner. But sometimes, they divide and grow uncontrollably to form new cells. This results in a mass of unwanted tissue which is defined as a tumor [4**].** Tumors can occur in any parts of the body. Brain tumor can be considered as one of the serious and life- threatening tumors. It is actually created either by the abnormal and uncontrolled cell division within the brain or from cancers primarily present in other parts of the body. Tumor can affect healthy cells directly and indirectly. It may cause brain swelling and also increases the pressure inside the skull. Generally, tumors are classified based on the location of their origin and its malignancy.

Types of tumors

Based on the location of the origin of tumors, they are classified as primary and metastatic brain tumors.

a) Primary brain tumors:

Tumors which originates in the brain cells are called as primary brain tumors. In the case of primary brain tumors, sometimes they spread to other parts of the brain or to the spine. But spreading to other organs occurs only rarely.

b) Metastatic brain tumors:

Metastatic or secondary brain tumors are those which originate in other parts of the body and then spread to the brain. These tumors are named according to the location which they originate. Based on the malignancy of tumors originated, they are benign and malignant brain tumors.

a)Benign brain tumors:

From the name itself, it can be understood that the benign tumors are the least aggressive ones. They originate from cells within the brain or from associated parts of the brain and they will not contain cancer cells.

They only grow slowly and also they have clear borders i.e. their growth are self-limited and they will not spread into other tissues.

IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
nCORETech
LBS College of Engineering, Kasaragod
Vol. 3, Special Issue 1, February 2016

b) Malignant brain tumors:
These tumors contain cancerous cells and their growth is not self-limited. Often their borders are not clear. Also they grow rapidly and cover surrounding brain tissue. Hence they will become life threatening if proper treatment is not taken at the correct time.

Different types of imaging techniques like Magnetic Resonance Imaging (MRI), Computed Tomography (CT) etc exist for the diagnosis of brain tumor. MRI is the most advisable one due to the following reasons. It does not uses ionizing radiation while CT scans do. This radiation is harmful if there is repeated exposure. MRI is a non-invasive medical test which helps physicians to diagnose and treat medical conditions. Also MRI gives detailed pictures of brain and nerve tissues in multiple planes without obstructed by overlying bones.

II. REVIEW OF LITERATURE

The automated techniques should be self-explanatory and easy to operate for the radiologists. However, segmentation of the tissues of the brain, especially tumor and edema is a quite difficult task because of the non homogeneous intensity distribution, background noise, complex shape, unclear boundaries, and low intensity contrast between adjacent brain tissues [5]. Finding automated brain tumor detection techniques is a widely growing research area and several ideas have been proposed for the detection of brain tumors. There are studies that segment brain tissues into three components as white matter (WM), gray matter (GM), and cerebrospinal fluid (CSF) [21]. Studies that segment only tumor and tumor and edema together [21] use patient data with different type of tumors. Paper [1] analyses the Cellular Automata (CA) algorithm to segment the brain tumor. In [2] explains formal stochastic models to estimate multifractal dimension for brain tumor texture extraction in pediatric brain MRI that is initially proposed in [10].

In [4] there is an automated and efficient brain tumor detection technique implementing on Magnetic Resonance Imaging (MRI) images, which integrates two image segmentation methods such as modified texture based region growing and cellular automata edge detection. Simulation of the proposed work is done in MATLAB. Even though the modified texture based region growing and cellular automata edge detection are efficient techniques, incorporation of both enhances the efficiency of brain tumor detection. In [8] SOM clustering is proposed for MRI brain image segmentation. Before the segmentation the histogram Equalization is utilized for feature extraction which will improve the segmentation accuracy. After the segmentation process, the feature extraction using Gray Level Co-occurrence Matrix is utilized. The Principle Component Analysis (PCA) method is used for the feature selection to improve the classifier accuracy. In [17] the proposed method is implemented using Optimization Technique, Machine Learning and Curve Fitting Techniques to detect tumor. MRI Brain image classification of cancer, based on Rough Set Theory and Feed Forward Neural Network classifier was explained in [18]. For this purpose, first the features are extracted from the input MRI images using Rough set theory, and then the selected features are given as input to Feed Forward Neural Network classifier. Finally, Feed Forward Neural Network classifier is utilized to perform two functions. The first is to differentiate between normal and abnormal. The second function is to classify the type of abnormality in benign or malignant tumor.

A brain tumor detection technique based on artificial neural network is proposed by Monica Subashini. M and Sarat Kumar Sahoo[13]. Here the enhanced image is segmented using thresholding and finally classified using back propagation network. Brain tumor detection technique based on artificial neural network is also proposed by V. Amsaveni and N. Albert Singh. Here the feature extraction is done by using Gabor filter and then they are used to train and classify MRI images as tumorous or not. The type of classification used here is back propagation network [19]. Ewelina Piekar, Paweł Szwarc, Aleksander Sobotnicki and Michał Momot proposed a region growing method for the tumor segmentation. Here segmentation is done based on the intensity criterion [6]. Brain tumor detection technique based on region growing which uses extracted feature points as seed points is also proposed. Wavelet methods and image edge maps are incorporated to obtain the feature points [11**].** Efficiency of brain tumor detection by region growing depends on the homogeneity criteria selected for region growing. K. S. Angel Viji and Dr J. Jayakumari proposed a more efficient region growing technique for brain tumor detection which is based on both texture and intensity criterion . Manoj Diwakar, Pawan Kumar Patel and Kunal Gupta[12] suggested cellular automata edge detection method for detecting brain tumors. Comparison of classical edge detection methods with cellular automata is also made.

An integrated method which incorporates modified texture based region growing segmentation and sobel based edge detection method is proposed for brain tumor detection [5]. This work proposes an automated brain tumor detection technique texture based region growing and cellular automata based edge detection which will provide the exact detection of the tumor by utilizing the benefits of both the individual techniques. Also the classification of detected tumor as benign, malignant or normal is proposed using artificial neural networkn easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it.

IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
nCORETech
LBS College of Engineering, Kasaragod
Vol. 3, Special Issue 1, February 2016

III. METHODOLOGY

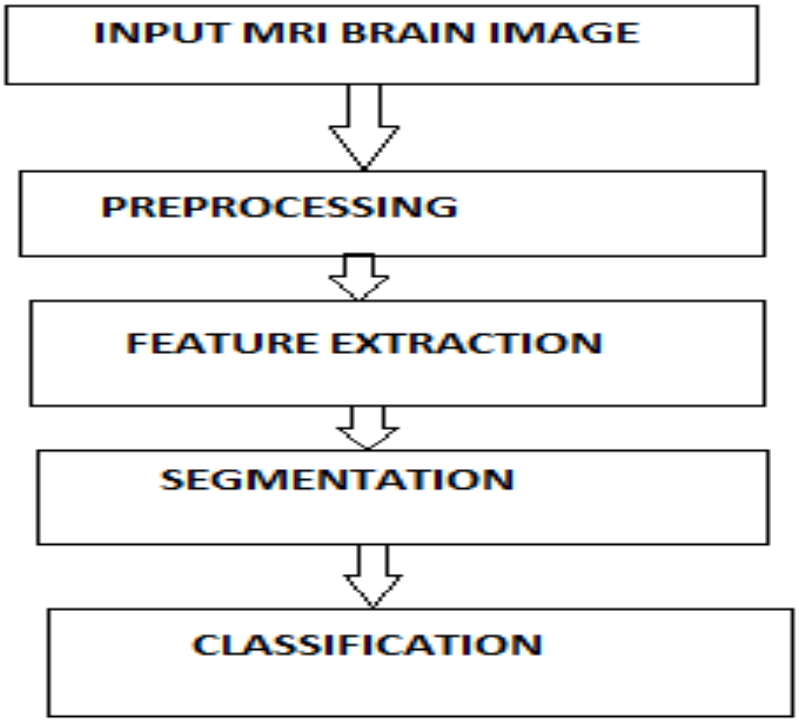

Fig 1.Block diagram

A.Input MRI Brain Image

DICOM MRI brain images with and without tumor are the inputs required for the proposed work. Original DICOM images can be collected from different hospitals. It is also possible to collect the publically available data set of web MRI images like BRATS-2012.

B.Preprocessing

Image pre-processing techniques are used to improve the quality of an image before processing into an application. In all image modalities noises will be added during image acquisition. Noise will degrade image and reduce quality. So it should remove from MRI images. The aim of image pre-processing is to remove noise and film artefact's from the original image. The various methods are available for pre-processing like median filtering, high pass filtering, fourth order partial differential equation, morphological operators, Brain surface extractor(BSE), Brain extraction tool(BET),tracking algorithm etc. Based on the application one can select the suitable technique for noise removal.

Filtering techniques have the advantage of not affecting the acquisition process. When developing a filtering method for medical image data, image degradation by blurring or by artifacts resulting from a filtering scheme is not acceptable. Recent developments based on anisotropic diffusion filtering overcome the major drawbacks of conventional spatial filtering, and significantly improve image quality .This work plans to apply the different filtering techniques available to the input MRI image. Then the method which produces high quality output image can be selected as pre-processing filter. The proposed work also plans to remove the skull before segmentation. Skin, skull, fat, muscle, and connective tissues etc can be removed which are not regions of interest in this study. Skull part is bright and it will affect segmentation process. Also skull and tumor has almost same intensity. So skull has to be removed before segmentation. Morphological operations on MRI images can perform this operation.

C.Feature Extraction

Feature Extraction is a methodology of extracting meaningful features from input image. The purpose of feature extraction is to reduce the original data by measuring certain properties, or features, that distinguish one input pattern from another pattern. The extracted feature should provide the characteristics of the input type to the classifier by considering the description of the relevant properties of the image into feature vectors. The feature extraction can be generally classified as shape features, intensity features and texture features. Circularity, irregularity, area, perimeter, shape etc are the commonly used shape features. Intensity features are mean, variance, standard variance, median intensity, skewness, and kurtosis. Commonly used texture features are contrast, correlation, entropy, energy, homogeneity, sum of square variance. Wavelet transform (WT) is utilized recently in feature extraction of MRIs, since

IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
nCORETech
LBS College of Engineering, Kasaragod
Vol. 3, Special Issue 1, February 2016

the WT provides good localization in both spatial and spectral domains [22]. Wavelet transform can be decomposed into different levels. Decomposition coefficients contain information about the middle frequencies. This information is very useful for image segmentation. The features extracted from wavelet coefficients are combined and applied as input to the segmentation stage. This research work plans to extract different texture based features of wavelet transforms.

D.Segmentation

Image segmentation refers to the process of partitioning a digital image into multiple segments i.e. set of pixels, pixels in a region are similar according to some homogeneity criteria such as color, intensity or texture, so as to locate and identify objects and boundaries in an image. Segmentation extracts the tumor region from the original image. Segmentation can also separate pathological tissues like white matter(WM), gray matter(GM) and cerebral spinal fluid(CSF). Segmentation results are used for treatment planning, identification and analysis of growth of tumor. There exists several methods for image segmentation like thresholding, texture based region growing, edge based detection, clustering, genetic algorithm, curve fitting, artificial neural network etc. Even though many algorithms are available for brain tumor detection, the detection rate is still not satisfactory. Also, accurate partitioning of an image into meaningful regions is essential for the success or failure of image classification. Clustering is an unsupervised learning task, where one needs to identify a finite set of categories known as clusters to classify pixels. Clustering use no training stages rather train themselves using available data. Clustering is mainly used when classes are known in advance. A similarity criterion is defined between pixels, and then similar pixels are grouped together to form clusters. A cluster is a collection of objects which are similar between them and are dissimilar to the objects belonging to other clusters. Neural networks (NN) perform classification by learning from data and do not use rule sets. NN can generalize using previous data and learn from past experience. It is proposed to make a detailed study about the different existing segmentation techniques by applying them in the proposed system so that it is possible to suggest a new method or the combination of some methods which produce more accurate results.

IV. CONCLUSION

MRI brain image segmentation is a challenging task. A segmentation method which performs well for one MRI brain image may not work for the other images of same type. Thus it is very hard to achieve a generic segmentation method that can be commonly used for all MRI brain images. This paper produces a review on different image segmentation techniques.

REFERENCES

[1]. A. Demirhan and ˙I. G¨uler, “Combining stationary wavelet transform and self-organizing maps for brain MR image segmentation,” Eng. Appl. Artif. Intell., vol. 24, pp. 358–367, 2011.
[2]. Atiq Islam, Syed M. S. Reza, and Khan M. Iftekharuddin, “ Multifractal Texture Estimation for Detection and Segmentation of Brain Tumors”, IEEE transactions on biomedical engineering, vol. 60, no. 11, November 2013,pp.3204-3215
[3]. Ayse Demirhan, Mustafa Toru, and Inan Guler, “ Segmentation of Tumor and Edema Along with Healthy Tissues of Brain Using Wavelets and Neural Networks”, IEEE journal of biomedical and health informatics, vol. 19, no. 4, july 2015,pp.1451-1458.
[4]. Charutha s and M.J Jayashree, “An Efficient Brain Tumor Detection By Integrating Modified Texture Based Region Growing And Cellular Automata Edge Detection”, 2014 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT),pp.1193-1199.
[5]. Charutha S. and M.J.Jayashree, “An integrated brain tumor detect ion technique”, International Journal of Research in Advent Technology, vol.2, pp. 211-214, May 2014.
[6]. Ewelina Piekar, Paweł Szwarc, Aleksander Sobot nicki, Michał Momot , “Application of region growing method to brain tumor segmentation–preliminary result s”, Journal of Medical Informatics & Technologies,vol.22,pp-153-160,2013.
[7]. G. Gerig, O. Kubler, R. Kikinis, and F. A. Jolesz, “Nonlinear anisotropic filtering of MRI data,” IEEE Trans. Med. Imag., vol. 11, no. 2, pp. 221–232, Jun. 1992.
[8]. K.B.Vaishnavee and K.Amshakala, “An Automated MRI Brain Image Segmentation and Tumor Detection using SOM-Clustering and Proximal Support Vector Machine Classifier”, 2015 IEEE International Conference on Engineering and Technology (ICETECH), 20th March 2015, Coimbatore, TN, India.
[9]. K. S. Angel Viji and Dr. J. Jayakumari, “Modified texture based region growing segmentat ion of MR brain images”, IEEE Conference on Information and Communication Technologies, pp. 691-695,April 2013
[10]. L.Ramya and N.Sasirekha, “A Robust Segmentation Algorithm using Morphological Operators for Detection of Tumor in MRI”, IEEE Sponsored 2nd International Conference on Innovations in Information Embedded and Communication Systems ICIIECS’15.
[11]. Mangipudi Partha Sarathi, Mohammed Ahmed Ansari, Vaclav Uher, Radim Burget , and Malay Kishore Dutta, “Automated brain tumor segmentation using novel feature point detector and seeded region growing”, International Conference on Telecommunications and Signal Processing , July 2013.
[12]. Manoj Diwakar, Pawan Kumar Patel and Kunal Gupta, “Cellular automata based edge-detect ion for brain tumor”, International Conference on Advances in Computing, Communicat ions and Informatics,pp.53-59,August 2013.
[13]. Monica Subashini. M and Sarat Kumar Sahoo,“ Brain MR image segment at ion for tumor detect ion using artificial neural networks”, International Journal of Engineering and Technology, vol. 5, pp. 925-933 April 2013
[14]. M. Prastawa, E. Bullitt, S. Ho, and G. Gerig, “A brain tumor segmentation framework based on outlier detection,” Med. Image Anal., vol. 8
[15]. N. Nandha Gopal , Dr. M. Karnan, “Diagnose Brain Tumor Through MRI Using Image Processing Clustering Algorithms Such As Fuzzy C Means Along With Intelligent Optimization Techniques”
[16]. P. Perona and J. Malik, “Scale-space and edge detection using anisotropic diffusion,” IEEE Trans. Pattern Anal. Mach. Intell., vol. 12, no. 7, pp. 629–639, Jul. 1990.

IJIREEICE

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

nCORETech

LBS College of Engineering, Kasaragod

Vol. 3, Special Issue 1, February 2016

[17]. Sneha Khare, Neelesh Gupta and Vibhanshu Srivastava," Optimization Technique, Curve Fitting and Machine Learning used to Detect Brain Tumor in MRI", ,2014 IEEE International Conference on Computer Communication and Systems(ICCCS 114), pp.254-259,Feb 20-21, 2014, Chennai, INDIA

[18]. T.Rajesh, R. Suja Mani Malar, "Rough Set Theory and Feed Forward Neural Network Based Brain Tumor Detection in Magnetic Resonance Images", International Conference on Advanced Nanomaterials & Emerging Engineering Technologies" (ICANMEET-20 13), New Delhi, India, 24th _26th July, 2013,pp.240-244.

[19]. V. Amsaveni and N. Albert Singh, " Detect ion of brain tumor using neural network", Int ernational Conference on Computing, Communications and Networking Technologies, pp.1-5, July 2013.

[20]. Warfield, S., Duda, (2001): "K-Nearest Neighbour Classification".

[21]. W. E. Reddick, J. O. Glass, E. N. Cook, T. D. Elkin, and R. J. Deaton, "Automated segmentation and classification of multispectral magnetic resonance images of brain using artificial neural networks," IEEE Trans.Med. Imag., vol. 16, no. 6, pp. 911–918, Dec. 1997.

[22]. Y. Zhang, Z. Dong, L. Wu, S. Wang, and Z. Zhou, "Feature extraction of brain MRI by stationary wavelet transform," in Proc. Int. Conf. Biomed. Eng. Comput. Sci., Wuhan, China, 2010, pp. 1–4.

BIOGRAPHY

Reema Mathew A, B.Tech, M.E,(PhD) who is presently working as Associate Professor & HOD, Department of Electronics and Instrumentation, Vimal Jyothi Engineering college, Chemper, Kannur. Her research interest is in the area of digital image processing.