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A Survey on Brain Tumor Detection and Segmentation

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Abstract: In recent times, biomedical imaging & medical image processing have become one of the most challenging fields of engineering & technology. Imaging modality like Magnetic Resonance Image (MRI) provides detailed information about the anatomy, it also helps in monitoring disease, and it is beneficial for effective diagnosis. Brain tumor is an abnormal cell formation within the brain leading to brain cancer. Thus it is very important to detect and extract brain tumor. The main thing behind the brain tumor detection and extraction from an MRI image is the image segmentation. It means dividing an image into regions based on some specific criteria. Various algorithms have been proposed for this purpose. Like Decision Trees, Support Vector Machine, Artificial Neural Networks and Fuzzy C-Means, K-means cluster. The segmentation of brain tumor is measured to be one of the complicated procedures in medical field. This paper gives a brief study of some algorithms highlighting their methodology and advantages and disadvantages if any.

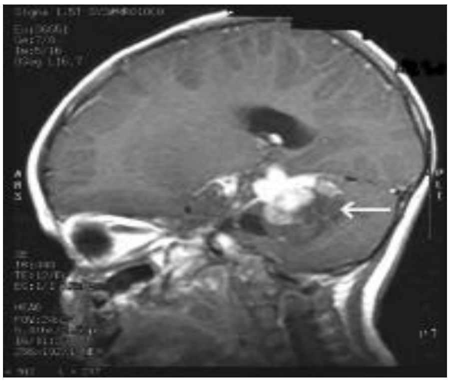
Keywords: Brain tumor; Image Segmentation; Magnetic Resonance Image; Tumor detection.

I. INTRODUCTION

In the last few years, many image processing techniques have been presented in order to perform brain tumor detection and segmentation task in magnetic resonance image (MRI). In medical science, MRI is a very popular technique which is used in Radiology to analyze internal structures of the body such as brain, kidney etc. Other techniques in comparison to MRI are Computed Tomography (CT) and X-Ray. X-Rays are a type of radiation, and when they pass through the body, dense objects such as bone block the radiation and appear white on the x-ray film. These covers Knowledge-Based Technique, Component Labeling Algorithm, Content-Based Retrieval Method, Fuzzy C-means Algorithm, PNN (Probabilistic Neural Network) Technique, Computer Aided System.

Brain tumor segmentation is one of the competitive task to analyze the characteristics of tumor in medical treatment planning. In medical terms, brain tumor cited as Intracranial Neoplasm, is induced due to extraordinary development of brain tissues. Brain tumor can be easily detected and extracted from an MRI image. The word tumor is a synonym for a word neoplasm which is formed by an abnormal growth of cells Tumor is something totally different from cancer. Tumors can damage the normal brain cells by producing inflammation, exerting pressure on parts of brain and increasing pressure within the skull.

Healthy Brain - MRI Image



Tumor in Brain - MRI Image

Types of Brain Tumors:- Primary brain tumors and Metastatic brain tumors. The former develops in the brain and stay there only; the latter begin as a cancer elsewhere in the body and spreads to the brain.

For some applications, such as image recognition or compression, we cannot process the whole image directly for the reason that it is inefficient and unpractical. Therefore, several image segmentation algorithms were proposed to segment an image before recognition or compression. Before segmenting an image following steps are taken for improving the image quality:

1) *Noise Removal*: Median filter acts as noise removal non linear tool. In this filtering technique, each image pixel is replaced by the neighborhood median pixel.

2) *Morphological Opening*: Morphological opening is another important preprocessing (skull removing) step.

Two gray scale morphological operations, Erosion and Dilation is used for this purpose. Here, 3 x 3 square Structuring Element (SE) is considered for tumor detection.

II. LITERATURE SURVEY

Shaheen Ahmed [2] gives the study on brain segmentation of MRI images used for medical image processing. In this study, a set of arithmetic analysis technique are used for interface tracking with shapes. The application set of medical image analysis are complex shapes of extraction. Their MRI neurological infection and shapes based approach to segmentation of medical image. The feature of many different images in fractal texture, intensity, and shape in segmentation. The four different feature techniques such as PCA, KLD, boosting, and entropy. However it does not suitable for multiclass tissues.

Chun- Hou Zheng [3] has suggested in his paper about least absolute shrinkage and selection operator (LASSO) algorithm is based on meta samples sparse representation classification. Tumor classification using gene expression data is Sparse Representation (SR) based method. The proposed method is called Meta Sample-Based SR Classification (MSRC) is capable for tumor classification. This classification is used for achieving higher accuracy in brain tumor. This is used in face identification and tumor classification effectively for SRC method. The SR technique use training set and test set. The more experiments of more databases performed in the expectations to advance validate the proposed method.

Andac Hamamci et.al [4] In this article, the brain tumor segmentation is used for radio surgery application using cellular automata (CA) algorithm. The medical classification of brain tumor is segmentation of, different presentation of the tumor –cut algorithm in medical treatment of radio oncology. In this gradient based techniques used for better performance of robustness to noise. However the motivation of CA algorithm is fast implementation of hardware, appropriate both availability of increasing in low cost graphical hardware and CA algorithm is used appropriateness to run on the similar processors.

Zhan-Li Sun et.al [5] has suggested Independent Component Analysis algorithm Then tumor classification is used eigengene and SVM is based on the classified Committee Learning Algorithm. The applications are DNA microarray technology is involved interest in both industry and scientific community. SVM is used to improve the show based on different subspace methods and aggregation models. However optimal percentage value is still needed to be investigate.

Chao Lu et.al [6] In this paper, he has presented the algorithm is based on Non Rigid Registration method (NRR) algorithm for the classification of inflexible two -D entry to three -D checks and pixel classification. This classification is used for entropy-based formulation. Also this method is used for PDE- based method, graph-based method. The biomechanical model of the brain image to imprison of the tissue induced the growth of tumor. The application is to check the anatomical atlases. However optimal percentage value is still needed to be investigated.

Atiq Islam [7] In this study, AdaBoost with decision trees, neural networks, or support vector machine (SVM) as component classifiers. AdaBoost algorithms are multi fractal feature extraction and supervised classification in improved brain tumor segmentation with detection. The proposed model is stochastic model brain tumor texture in Magnetic Resonance Images. The brain tumor texture is formulate used in MRF model recognized as multi fractional Brownian motion (mBm). However it does not used modified AdaBoost classification method when one incorporates atlas based prior information in the segmentation framework.

Marcel Prastawa [9] In this study for framework based on brain tumor segmentation is used fast algorithm for computing the Minimum Covariance Determinant (MCD). The application is used for clinical applications. The present algorithm different brain tumor segmentation including predictable methods, classification and clustering methods, and deformable model methods. In this segmentation model based with parametric and geometric deformable models. However the potential issue that is not handled by the proposed Method.

Annemie Ribbens [10] The proposed work for brain tumor segmentation is unsupervised and clustering populations of brain MRI images using Expectation maximization (EM) algorithm. This is used for multiple application, for regrouping images and clinical sub groups. The most preferable approach of classification is, to identify the image which are quality for the disease specific morphological different advance to classified images of training set. This model is build absolutely or implicitly by the segmentation algorithm..

Meiyan Huang [11] has presented, the brain tumor segmentation in brain tumor images is mostly performed automatically in clinical practice. In glioma, the tumor area is usually separated into necrosis, contrast-enhancing tumor, non enhancing tumor, and edema the local independent projection-based classification (LIPC) method is used to categorize each voxel into different classes. The learning of a soft max regression model, which can further improve classification performance. The experimental results displayed an improvement on the classification performance using the learned soft max regression model. They use project technical feature and evaluation methodology for application of two automated brain MRI tumor segmentation methods in radian therapy planning. These methods include thresholding and morphological techniques, watershed method, region growing approach, asymmetry analysis, atlas-based method, contour/surface evolution method, interactive algorithm, and supervised and unsupervised learning methods.

Ayse Demirhan [12] has proposed the work of brain tumor segmentation tissue using neural network and focusing the learning vector quantization (LVQ). They perform neural network classification by learning data. But it does not considered improving the segmentation accuracy of the system by using additional features such as prior knowledge, shape, and models.

III. Summary of Brain Tumor Detection and Segmentation Methods

The survey has been conducted based on the following findings.

S.No	Algorithms	Finding & Data Set	Limitation	Problem Identification
1	Hierarchical Self Organising Map(SOM)	Noises are removed and computation speed is achieved ar lowest level of weight vector, a high value of tumor pixels	The abstraction tree bears some resemblance to the major familiar quad tree data structures [1]	Brain tumor detection using segmentation
2	EM algorithm	High segmentation quality. & The used for level set.	It does not suitable for multiclass tissues [2]	Fossa Tumor Segmentation
3	Least Absolute Shrinkage and Selection Operator (LASSO) algorithm	Accurate identification. & The used for more data set	Not suitable for large data base [3]	Tumor Classification
4	Cellular automata (CA) algorithm	High robustness. & The used for level se	However user interaction time increases with the number of tumors [4]	Brain Tumor Segmentation
5	Support Vector Machine (SVM) based classifier committee learning (CCL) algorithm	Highly effective. & The used for training and test set	Optimal percentage value is still needed to be investigated [5]	Brain Tumor Classification
6	Non Rigid Registration (NRR) algorithm	High accuracy. & used for level set.	It does not include additional feature for improve accuracy [6]	Brain tumor detection
7	Eulerian approach using nonrigid registration	Achieves reasonable results in similar range	Computation times are significantly longer because several biophysical and biomechanical layers are taken into account.	Analysis of brain tumor
8	AdaBoost algorithm	Ability to classify difficult samples. & The used for level set.	It have ability to classify difficult samples [7]	Segmentation of Brain Tumors
9	Fuzzy clustering	the better results in highlighting the tumor in the segmented portion	It is not considered the noise removal	Segmented image will detect the brain tumor.
10	Expectation maximization (EM) algorithm	Automatic detection approach. & The used for Heterogeneous data set.	It does not suitable for all applications [10]	Brain image segmentation
11	Interactive Algorithm	To represent the testing sample and performance of the coefficients associated with the training samples. & The used for level set.	The extension of the level set method to 3D is straightforward and does not require additional machinery [11]	A one-versusall (OvA) strategy can be used. In the OvA approach, a classifier is trained per class to distinguish a class from all other classes.
12	Learning Vector Quantization (LVQ) algorithm	Highly effective. & The used for training and test set.	It does not consider additional feature for improve accuracy [12]	Segmentation of Tumor and Edema Along With Healthy Tissues of brain

IV. Conclusion

In this paper, different techniques are used to detect and segment the Brain tumors from MRI images. To detect the Brain tumor from MRI image is a tedious task. Though some algorithms producing accurate and reasonable results, at the same time they are having some limitations like it is not suitable for large data set and having longer computation time. One of the principal reasons might be the lack of standardized procedures. Another two reasons could be the consequential differences with the traditional specialists' way of work, and the deficiency of the existing methods In future work, the techniques will be compared on the basis of other parameters along with the execution time.

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