An Insight on Brain Tumor Imaging Techniques Through MRI

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Abstract-*MRI imaging techniques is a non-invasive method which has established itself as a most commonly used imaging technique for brains. Brain tumors are demarked as benign or malignant tumors as per their growth pattern. Manually analyzing brain tumor on MRI is a cumbersome process which consumes a lot of time .This work deals with presenting an insight on various methods and techniques which have been used over the years and a brief comparison in terms of advantage and disadvantages*

Keywords-MRI brain tumor, segmentation techniques, feature extraction, classification.

I. INTRODUCTION

Over the years the clinical imaging has become almost synonymous as a basic diagnostic tool readily used by the physicians . In the present times the diagnosis is not carried without using imaging technologies. In the present day medicine domain , different medical images such as- MRI ,Ultrasound, CT, Scintigraphy, SPECT, PET, X-ray etc play a very crucial role in diagnosis and subsequent treatment [1]. Magnetic resonance (MR) imaging has several advantages over other medical imaging modalities such as a useful non invasive technique for assisting in clinical diagnoses, secondly its ability to provide high contrast resolution across the entire field of view and multispectral characteristics[2] supplemented by its ability to provide rich information about human soft tissue[3]. MRI has made a mark by providing relevant information in the field of like reparative surgery, radiotherapy treatment planning, stereotactic neurosurgery [4].

Segmentation is one of the most important tool and a first step of quantitative analysis of MR images.Segmentation is quite challenging in both normal and abnormal tissues,but specifically segmentation in abnormal tissues still has a long way to go[5][6] specifically in case of complicated structures. Tumors vary in size ,shape ,position ,appearance and intensities.[7] In a decade or two the researchers have focused on semi automatic and fully automatic tools for detecting and segmenting brain tumors from MRI scans[8].

An accurate and automatically segmented MRI image helps in assessing tumour growth and enhancing computer-assisted surgery, planning radiation therapy, and constructing tumour growth models[9].

The typical hindrance for segmentation of brain MRI is the Noise, Intensity inhomogeneity, Shading artefact, and partial volume.

The challenges are in terms of reducing the effects of the issues listed above and to improve the system efficiency.

This paper gives an insight on the methods and techniques used for assessing the brain tumor detection through MRI image segmentation. There are range of motivations for progressing in the domain of automatic medical image segmentation with lots of new work being carried out with every passing year.

This work gives an insight on different segmentation methods for brain MRI images. This paper is organized as follows. Section II discusses various automatic segmentation methods and techniques. Section III concludes this work.

II. REVIEW OF TECHNIQUES FOR BRAIN SEGMENTATION

The purposes of this study an automated detection and segmentation techniques for the extraction of brain tumor region and separation of tumor on the MR image. This MR image helps to overcome the time taking process of manual segmentation of large datasets.

2.1. Fuzzy based methods

Mathematical principles which represent knowledge based on degrees of classical binary logic can be categorized as Fuzzy logic.Fuzzy based system try to replicated human behavior to some extent and are categorized as intelligence techniques.

Dunn suggested image segmentation using fuzzy c-means (FCM) clustering algorithm [10] [11]. FCM has been

experimented by lots of researchers and provides an improved version for segmentation for brain MRI.

Arakeri et al. [12] worked on technique to overcome the intensity inhomogeneities in FCM proposed modified version of FCM called as MFCM. Accuracy is one of the important factors for brain image segmentation applications, they preferred computational techniques. MFCM works by approximating the image to segment the tumor and provides a lot of details of the images. [13]

Rajendran[14] proposed fuzzy logic processing using c-means clustering on MR images for brain tumor segmentation. FCM technique comes to a naught while dealing with significant properties of images, which leads to strong noise sensitivity. To counter this an algorithm called as PCM was proposed In this case possibilistic membership, are very sensitive to the choice of the additional parameters of PCM, which directly decide the clustering accuracy. The original PCM was modified to combine the objective function of PCM and FCM into a new objective function and PFCM, which can be seen as PCM and FCM, respectively, in some special cases where some proper parameter were adopted Xuan ji et al. [15] [16].

Pal et al. [17] Proposed EPFCM method, wherein the distance metric as done in PCFM is worked upon to include memberships, which are both local non local spatial neighbourhood information to overcome the noise effect in MRI brain medical images

Table 1 Insight on fuzzy based methods

Proposed Method	**Insight**
FCM	To improve the segmentation performance tremendously. This improves the segmentation Performance dramatically. Poor contrast, noise and intensity inhomogeneities can affect the results
MFCM	Best for segmentation. Less computational time. Converges To overcome the intensity inhomogeneities in FCM proposed modified version of FCM.
FPCM	Fuzzy rule-based system identification. Generates typical values when clustering unlabeled data Ignores the noise sensitivity deficiency of FCM Overcomes the coincident clusters

2.2. Thresholding based Methods

Thresholding methods basically work on achieving the segmentation using the gray level intensity value of pixels. Thresholding involves selection of a threshold values such that it is possible to divide the desired sections . Segmentation is then carried out by grouping the pixels above and below the selected threshold.

Prastawaet al. [18] proposed automatic brain tumor segmentation from MRI wherein the identification of edema is carried out The proposed work uses robust estimation and outlier detection giving a new concept for detecting abnormalities in the brain.

Rastgarpouret al. [19] have worked on an approach to segment the images that have light objects on dark background and have shown the image segmentation to be a simple and powerful.

Kang et al. [20] have shown that thresh holding is a technique which is based on image space region, that is, on characteristics of image.

Laxman et al. [21] employed marker controlled watershed segmentation method and used region property (parameters are used). Bhat et al. [21] have worked on to propose watershed and active contour algorithm as an hybrid solution to overcome computational complexity and insensities to noise.

R.B.dubeyet al. [23] has compared three methods for evaluating their relative performance in the segmentation of tumor.

Aliakseimaistrou [24] worked on modelling active contours, presented by Osher and Sethian in [25] to implement the Level Set methods. The basic difference between the Snakes method and Level Set methods is that in all Level Set methods works on active contour which is implemented implicitly through a value of scalar function.

The level set method had been regularly employed as numerical technique tracking interfaces and shapes. Contour based level set method represents as the zero level set of a higher dimensional function, is called a level set function. In the level set representation, the image segmentation problem can be solved and formulated by well established mathematical theories, including calculus of variation and

partial differential equations (PDE). Also represent contours/surfaces with complex topology. Level set method segmentation are presented as region based model and edge based models.

Chunming Li et al. [26] [27] uses the level set approach to segment the brain MR images in the presence of intensity inhomgenety where it helps to overcome the MR image intensity inhomogenety during brain tumor segmentation.

Another LI et al. [28] this paper proposed new variational level set formulation in which the regularity of the level set function is intrinsically maintained during level set evaluation.

Table II Insight on Thresholding based methods

Proposed Method	**Insight**
Threshold and outlier detection	The techniques detects the difference between normal and abnormal space. Focus in on Intensity features
Level set evolution	Suitable for segmentation. Less computational time. Specifically suitable for image with inhomogenous intensities. Works well for images with weak object boundaries.
Marker controlled watershed	Employs filtering method to improve image quality. Shape and size of tumor defines the threshold value. In significant minimas are excluded.

2.3 Region Growing based Methods

It is one of the simplest segmentation technique which groups pixels or sub-region into larger regions based on pre-defined criteria. A seed point is selected and the pixels are aggregated such that the corresponding regions grows by clubbing to each seed points those neighboring pixels that similar properties

Such as:

- Gray level
- Texture
- Color
- shape

Region growing is never employed a one stand off method and is quite often combined with other techniques. Pohle suggested that region growing can be an integrated technique using multi-level sets of boundary information [29]. As compared to edge detection method, the region based methods are quite simple and present excellent noise immunity [30]

Sato, lakareet al. [31] worked on a gradient magnitude based region growing algorithm which solves the partial-volume-effect problem on the boundary.

Region splitting:

- Select a set of seed points
- Splitting initiates with whole image as a single region
- Subsidiary regions are recursively subdividedy
- Process till the condition of homogeneity is not satisfied.

Region merging:

- Is the contrast of region splitting
- A tool to avoid over-segmentation.
- Takes small regions and merges the region that have similar characteristics such as
    - Gray level
    - Variance.

Carlos S et al. [32] suggests fast parameter free region growing segmentation wherein an adaptively sample contrast measure, and normalizing strategy allows for generalization of the contrast sampling rate.

Table III Insight on Thresholding based methods

Proposed Method	**Insight**
Fractal wavelet texture feature	Not able to work with multimodal MR images.
Texture feature	Give good overall result and is very accurate in terms of extracting the tumor region from brain MR images.
Seed-based region growing	Does not works well with images having high contrast Used for large gradient
Fast marching – based region growing	Accurate results of segmentation which effectively extract the tumor region from brain MR images.

2.4 Clustering based Methods

Clustering basically is the grouping of objects such that they have some similarity with the other objects as compared to those in other groups. Farley et al [33] suggested division of clustering methods into hierarchical and partitioning methods. Han et al. [34] classified methods as density-based methods, model-based clustering and grid based clustering.

Partitioning methods focus on relocating the instances by shifting them from one cluster to another, starting from an initial partitioning. The K-means algorithm serves as a simplest and most commonly used algorithm employing squared error criterion. K-mean is ab unsupervised learning tool having potential to resolve the basic problems involved in clustering. The K-mean clustering approach is to partition d-dimensional data into K clusters resulting in development of an objective function providing the desired properties of the distribution of feature vectors of clusters in terms of similarity and distance measures leading to optimization .

Haunget al. [35] presented the K-prototypes algorithm which modified the K-mean algorithm in terms of removing the numeric data limitation while preserving it efficiency. Kaufmann et al. [36] presents another method to minimize the SSE in k-medoids.

Hoppneret al. [37] suggests a soft clustering schema. In this each pattern is associated with every cluster using membership function called fuzzy set.

Table IV Insight on Clustering based methods

Proposed Method	**Insight**
k-mean clustering	Gives tight clusters as compared with the hierarchical in presence of globular clusters. Employs partitioning to minimize the number of false edges and over-segmentation
Cluster index. *K-means*	It is basically color converted segmentation combined with K-means clustering algorithm Efficiently separates the tumor from the colored image.
Fuzzy clustering(FCM)	Give a very impressive segmentation result.
Local correntropy-based *k-mean* cluster. Wang	It turns out to be robust to the outliers. Able to resolve the noise based distortions and intensity inhomogeneity.

III. CONCLUSION

This insight has focused on the study of different brain tumor segmentation on MR images.We observe that there are several of methods which are being employed to achieve the task of identifying the tumors from the MR images. Every technique has its strong and grey areas .Generally the hybrid approach is applied so as to maximize the result.

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