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Analysis of Brain Region Segmentation Methods

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ABSTRACT: Brain Region segmentation is a challenging problem in medical image analysis and the techniques are of major concern for researchers. The uncontrolled expansion of cells/tissues in the brain area forms the “brain tumor”. Early recognition of these tumors is profoundly needed to give Treatment to patients. The patient's life chances are improved by its early recognition. The paper focuses on the preface to Brain Tumor, Convolutional Neural Networks (CNN), and few existing methods of Brain Tumor segmentation. In this paper, the difficulty and problems faced in the process of tumor segmentation be explained. The author discussed the prospects in this area using CNN, the bounding box method, and the support Vector Machine.

KEYWORDS: Tumor Grades, Segmentation, Computed Tomography, Magnetic Resonance Imaging, Convolutional Neural Network.

I. INTRODUCTION

In general, abnormal or uncontrolled growth of cells found in the brain is defined as “Brain tumors”. New cells take place of normal cells as they grow old or die. Sometimes, the ratio of new and old cells disturbed new cells produced in excess and forms a mass of tissue called a tumor. A brain tumor can occur at any age. The tumors are further classified into two main categories, based on the cell initial location from where the tumors are initiated. The tumors begin inside the brain are primary and the secondary tumors also known as brain metastasis tumors originate somewhere else but spread throughout the body. Further, the primary tumor can be sub-classified as (i) Benign tumor (harmless growth) and (ii) Malignant (cancerous tumor). Most brain tumors are non-cancerous and less than one-third of brain tumors are cancerous [1]. The categorization of tumors is on the basis of:

- (1) The spot of the tumors.
- (2) The tumor development rate, severity, and how it exaggerated close by tissues/cells.
- (3) The cells which cite the tumor.

The classification of brain tumors according to WHO is by cell origin and it's behavior, from least aggressive (benign) to the most aggressive (malignant). Some tumor types are assigned a grade, ranging from Grade I (least malignant) to Grade IV (most malignant) [2,3]. Table 1 shows the salient features of four grades of tumors.

Table 1. Salient Features of Tumor Grades.[1]

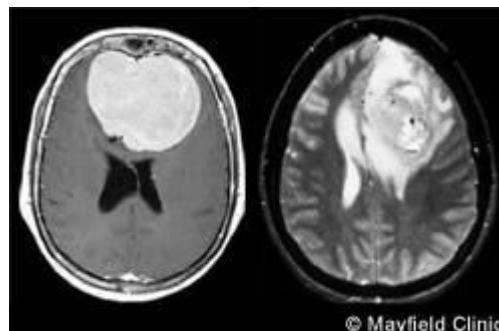
Grade/ Features	Name (WHO)	Expansion rate	Boundaries	Occurrence
Grade I	Pilocytic Astrocytoma (JPA)	Expansion rate is slow	fairly well – distinct borders	Most often in children and teens.
Grade II	Low-grade Astrocytoma	Relatively slow expansion	Borders are not well distinct	Men and women in their 20s-50s
Grade III	Anaplastic Astrocytoma	Active expansion	Cells are not uniform in appearance	Men and women in their 30s-50s. more common in men
Grade IV	Glioblastoma Multiforme (GBM)	Abnormal expansion	Can be compose of several different cell types	Older individuals but more common in men than women

The three familiar ways that verify the existence of tumors in brain cell/tissues are;

(1) Computed Tomography (CT): For two-dimensional brain images, CT Scan testing is a secure and non-invasive procedure that utilizes an X-ray beam to build the image. A layer-by-layer approach is done to visualize the brain structure, which is utilized to investigate more about the anomalies in the brain tissues.

(2) Magnetic Resonance Imaging (MRI): The MRI, another noninvasive test, uses radiofrequency waves and a magnetic field to create a meticulous view/image of the brain tissues.

(3) Biopsy: While the analysis of CT and MRI scan is not exact, then the biopsy is the only choice to decide the grade of the brain tumors. Pathologists follow this method to remove tiny tumors that are present in the brain region(s) using a microscope. This can be done either as a part of open surgery or as a needle biopsy. Types of biopsy include (1) Needle biopsy (the exaggerated tissues are removed by passing a hollow needle through a narrow hole in the skull) and (2) Stereotactic biopsy is the method used when tumors are rooted in complex locations[1]. Fig. 1 shows the typical MRI scan images of the brain with benign and malignant tumors, respectively.

**Fig. 1 Benign tumor (a) Malignant tumor (b) [2]**

II. LITERATURE SURVEY

Segmentation of brain MRI images for clinical analysis is the most challenging task. Various methods for image segmentation to detect tumor in brain are proposed by analysts. Some of them are explained in this section.

[4] Luxit Kapoor et. al Biomedical Image Processing is a developing and requesting field. It includes a wide range of sorts of imaging techniques likes CT filters, X-Ray and MRI. These strategies permit us to recognize even the littlest variations from the norm in the human body. The essential objective of clinical imaging is to remove important and precise data from these images with the least blunder conceivable. Out of the different kinds of clinical imaging forms accessible to us, MRI is the most solid and safe. It doesn't include presenting the body to any sorts of destructive radiation. This MRI would then be able to be prepared, and the tumor can be fragmented. Tumor Segmentation incorporates the utilization of a few unique methods. This paper studies the different systems that are a piece of Medical Image Processing and are unmistakably utilized in finding brain tumors from MRI Images. From the outset the different strategies, that are in effect as of now utilized in clinical image processing were widely considered

[5] V. SalaiSelvam et. al Use of scalp EEG for the determination of different cerebral issue is logically expanding. In spite of the fact that the progressed neuroimaging strategies, for example, MRI CTSCAN still remain as head confirmative techniques for recognizing and limiting brain tumors, the advancement of robotized frameworks for the discovery of brain tumors utilizing the scalp EEG has begun pulling in the analysts everywhere throughout the world strikingly since 2000. This is a result of two significant realities:

- (i) efficiency and ease of techniques for recording and breaking down the scalp EEG
- (ii) lower hazard and conceivable early location.

[6] Dai and Yan propose An enhanced Fast Level set Matching Algorithm (FM) for detecting and segmenting brain tumor. The enhanced FM Method eliminate the problem of edge-leakage in the low-level gray region found in traditional FM Algorithm. Visual C++ environment is used to validate the efficiency of the improved FM method. Though, the improved FM method failed to provide the accuracy and efficiency rates on any typical dataset.

[7] Dr. Mohammad et. al proposed a Brain Segmentation method using Fuzzy Logic and Artificial Neural Networks (ANN). The proposed method was compared with existing methods and validated regarding Sensitivity (0.94) and Specificity (0.93) respectively. Fuzzy C-Means along with Support Vector Machine (SVM) and Fluid Vector Flow were used for comparison. even if the relative study shows the positive rate and not the error rates, there is no clear distinction in the number of images used for estimation.

[8] Prajapati and Jadhav proposed The negative Matrix factorization method for brain tumor segmentation. The proposed method consists of different sub-processes namely, grayscale conversion, histogram equalization, use of high pass filters for sharpening the image features, median filters used for denoising, thresholding followed by morphological processing operations. Finally, the tumor location is identified by subtracting the resultant image and the input brain image. Further, the region growing approach is used to justify the tumor location. Even though the authors discuss the steps for tumor segmentation in an elaborative manner, the data sets and segmentation accuracy of brain tumors from the input image were left unanswered.

[9] Swapnil R. Telrandheet. al Image processing is utilized in the clinical devices for recognition of tumor, just MRI images are not ready to distinguish the tumorous district right now are utilizing K-Means division with pre-processing of image. Which contains denoising by Median channel and skull veiling is utilized. Likewise, we are utilizing object naming for progressively itemized data of tumor district. To make this framework a versatile we are utilizing SVM (Support Vector Machine), SVM is utilized in unaided way which will use to make and keep up the example for sometime later. Likewise, for designs we need to discover the element to prepare SVM.

[11]Sanjay M.Shelke et. al To builds the endurance pace of the brain tumor patients and to have an improved treatment system in clinical image processing, brain tumor division is fundamental strategy for finding. The early and address conclusion of brain tumors assumes a significant job. Attractive Resonance Imaging (MRI) strategy is the most mainstream non-obtrusive system; in nowadays imaging of natural structures by MRI is a typical exploring technique.

III. BRAIN REGION SEGMENTATION TECHNIQUES

The brain region segmentation techniques are a major concern for researchers. Many neural network based techniques developed which may be classify as:

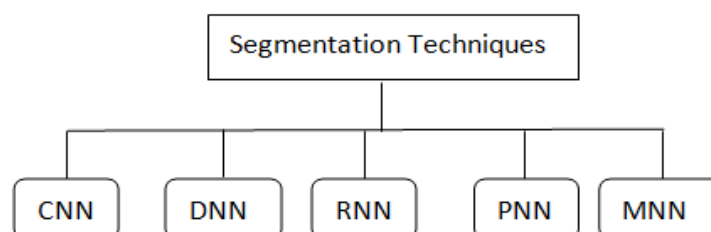


Fig. 2 Different segmentation techniques

3.1 CNN:

CNN is a profound learning system which is feed forward fake neural networks that are applied to visual images. These are likewise called as CONV NETS. These are joined arrangement of layers that can be taken a shot at bunch functionalities. CNN is utilized for figuring out how to section images. CNN extricates include legitimately from pixel images with negligible pre-processing. The network we use is Link Net. It is a light profound neural network engineering intended for performing semantic division. CNN works over volumes like neural networks where the information is a vector however if there should be an occurrence of CNN the info is a multidirected image. CNN has beaten image division challenges via naturally learning a chain of importance of progressively complex highlights straightforwardly from information. [12].

3.2 DNN:

DNN represent profound neural networks are the kind of neural networks those have a various number of layers. DNN focus towards additional on how the information from data is addressed by methods for a great deal of nonlinear limits before showing up at the yield layer. Profound Neural Networks (DNNs) are fundamentally sort of Feed Forward Networks (FFNNs) these are the networks where information streams from the info layer to the yield layer without moving in reverse and the connections between the layers are one way which is the forward way and they never contact a hub again.

3.3 RNN:

A Recurrent Neural Network (RNN) addresses an issue which is a FFNN with a period contort. This neural network isn't stateless, has associations among relaxes. They are a class of fake neural network where associations between hubs structure a coordinated diagram along a grouping like highlights joins from a layer to past layers, permitting data to stream once again into the past pieces of the network hence each model in the layers relies upon past occasions, permitting data to endure. RNNs additionally have issues like evaporating (or detonating) angle/long hauls reliance issue where data quickly gets lost after some time.

3.4 PNN:

Probabilistic neural network (PNN) is especially firmly identified with Parzen window pdf estimator. A PNN comprises of a few sub-networks, every one of which is a Parzen window pdf estimator for every one of the classes. Probabilistic neural networks can be utilized for grouping issues. At the point when information is introduced, the main layer processes good ways from the information vector to the preparation input vectors and produces a vector whose components show how close the info is to a preparation input. The subsequent layer aggregates these commitments for each class of contributions to create as its net yield a vector of probabilities. At last, a contend move work on the yield of the subsequent layer picks the limit of these probabilities, and produces a 1 for that class and a 0 for different classes[12].

3.5 MNN:

A particular neural network is a counterfeit neural network portrayed by a progression of free neural networks directed by some mediator. Every autonomous neural network fills in as a module and works on independent contributions to achieve some subtask of the assignment the network would like to perform. The middle person takes the yields of every module and procedures them to deliver the yield of the network all in all. The middle person just acknowledges the modules' yields—it doesn't react to, nor in any case signal, the modules. Also, the modules don't collaborate with one another. MNN can catch both the data from discrete clinical codes and the literary data from clinical notes.

IV. CONCLUSION

The brain segmentation process is still very difficult due to the size, different shape, and location of the tumor segmentation. MRI and CT scan methods are used to diagnose abnormalities in humans. Among the all other process, MRI is the noninvasive and efficient method to detect the brain tumor region(s). In this paper, The authors presented an general idea of the typical Brain tumor segmentation method along with a few existing procedures. By considering the benefits and limitations of the general Brain Tumor segmentation methods, the authors would like to offer efficient brain tumor localization and segmentation methods using the CNN.



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