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A survey on Brain Tumor detection using deep learning

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ABSTRACT: *Image processing plays an important role in medical field and medical imaging is growing and challenging field. Now a day's tumor is second leading cause of cancer, and due to that, large numbers of patients are in danger. If proper detection of tumor is possible that doctors can keep a patient out of danger. We used many techniques to detect brain tumor from MRI images. These methods face challenges like finding the location and size of tumor. Image segmentation is used for detect the tumor from the MRI images. It is most important and difficult part of Brain tumor detection. In image processing various algorithms are developed for image segmentation. In this review paper we covered different techniques of brain tumor detection from MRI Images.*

Keywords: *Brain tumor, CNN (Convolution neural network), MRI (magnetic resonance imaging), Image segmentation*

I INTRODUCTION

Tumor is the unusual growth of tissues. A brain tumor is a quantity of unnecessary cells growing in the brain. Tumors have different forms, features and treatments. Presently brain tumors are categorized as primary brain tumors and metastatic brain tumors. Brain tumors have various shapes and dimention and they appear at different locations. Magnetic resonance imaging (MRI) is the test that makes use of the pulses of radio wave energy and magnet to create the pictures. That contains the structure inside the body and organs. At the MRI test, a particular part of body is placed inside the machine that contains strong magnet field and MRI test picture is obtained. It is digital image which stored in the computer for detail study [1]. Why do we use MRI image for brain tumor treatment? Because the MRI test provides detailed information about the structure of cell, vascular supply and anatomy. These things make it an important and efficient tool for the effective diagnosis, monitoring and treatment of the disease [2].

OVERVIEW OF BRAIN AND BRAIN TUMOR

Main part in human nervous system is human brain. It is located in human head and it is covered by the skull. The function of human brain is to control all the parts of human body. It is one kind of organ that allows human to accept and endure all type of environmental condition. The human brain enables humans to do the action and share the thoughts and feeling. In this section we describe the structure of the brain for understanding the basic things [4].

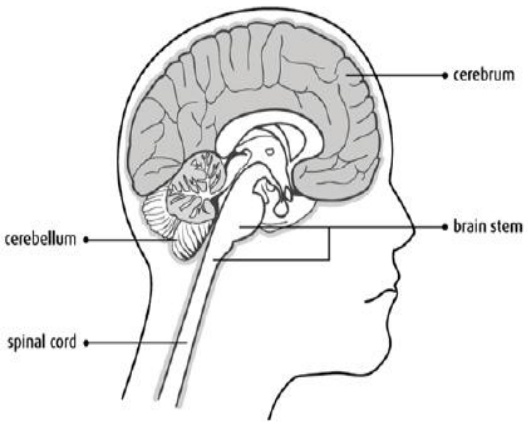

Fig.1: Basic Structure of human brain [5]

The brain tumors are classified into mainly two types: Primary brain tumor (benign tumor) and secondary brain tumor (malignant tumor).

The benign tumor is one type of cell grows slowly in the brain and type of brain tumor is gliomas. It originates from non neuronal brain cells called astrocytes. Basically primary tumors are less aggressive but these tumors have much pressure

on the brain and because of that, brain stops working properly [6]. The secondary tumors are more aggressive and more quick to spread into other tissue. Secondary brain tumor originates through other part of the body. These type of tumor have a cancer cell in the body that is metastatic which spread into different areas of the body like brain, lungs etc. Secondary brain tumor is very malignant. The reason of secondary brain tumor cause is mainly due to lungs cancer, kidney cancer, bladder cancer etc [7].

PROPOSED SYSTEM: The human brain is modelled by designing and implementing neural network. The neural network is mainly used for vector quantization, approximation, data clustering, pattern matching, optimization function, and classification techniques. The neural network is divided into three types of interconnection. Feedback, feed forward and recurrent network are type of neural network. In the normal neural network image is not scalable. But in convolution neural network image is scalable. It will take 3D input volume and 3D output volume [8].

II CONVOLUTION NEURAL NETWORK (CNN) MODEL

The Convolution neural network consists of input layer, convolution layer, rectified linear unit (ReLu) layer, pooling layer and fully connected layer. In the convolution layer the given image is separated into various small regions. It gives the output in matrix form. Relu layer is used activation function and it is responsible for transforming the summed weighted input from the node into activation of the node. Pooling layer is optional. Pooling layer is mostly used in down sampling. Fully connected layer is used to generate the class score or label score value based on probability between 0 and 1. In Dropout layer, randomly selected neurons are ignored during training. Flatten layer feed the output in fully connected layer and it gives the data in list form.

Activation is used the sigmoid function because we have to predict the probability as an output and it exists between the range of 0 and 1.

The block diagram of brain tumor detection based on CNN is shown in Fig 2.

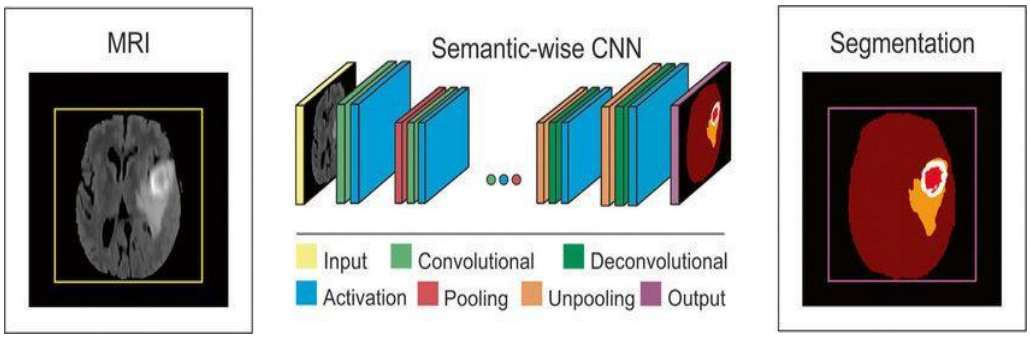

Fig.2: brain tumor detection based on CNN [9]

The CNN based brain tumor classification is divided into two phases such as training and testing phase. The number of images divided into two categories by using label name such as tumor and non-tumor brain image.

III METHODS

3.1 Pre-processing: In the MR image there are several irrelevant noises, so we have to improve the quality of the MR images by pre-processing methods. The main task in pre-processing is to improve the single noise ratio, enhancing the visual appearance of the MR image, removing the noise and undesired parts in the background, smoothing the inner parts and maintain the edge [10]

3.2 Skull Stripping: Skull stripping is an important process in biomedical image analysis with the help of this process we can examination of brain tumor from MR images. By this process it is possible to remove additional tissues such as fat, skin, and skull in the brain image. There are many techniques for skull stripping and other popular techniques like automatic skull stripping using image contour, skull stripping based on segmentation and morphological operation, and skull stripping based on histogram analysis or a threshold value [11].

3.3 Morphological operation: The morphological operation is used for the extract the boundary areas from the brain images. This operation is only rearranging the relative order of pixel value, not mathematical value, so it is suitable for only binary images. Dilation and erosion is basic operation of morphology. Dilation adds pixels to the boundary region of the object, while erosion removes the pixel from the boundary region of the object.

3.4 Feature extraction: Feature extraction is the process of collect higher level information about image like shape, texture, color and contrast. Texture analysis is an important parameter of the human visual perception and machine

learning system. Texture finding and analysis can improve diagnosis at different stage of the tumor detection. It is used for effectively improve the accuracy of diagnosis system by selecting statistic features like mean, contrast, energy, entropy ,standard deviation, skewness, kurtosis etc.

IV MAGNETIC RESONANCE IMAGING (MRI)

Raymond v. Damadian invented the first magnetic image in 1969. In 1977 the first MRI image were invented for human body and the most perfect technique. Because of MRI we are able to visualize the details of internal structure of brain and from that we can observe the different types of tissues of human body. MRI images have a better quality as compared to other medical imaging techniques like X-ray and computer tomography.[12].

MRI is good technique for knowing the brain tumor in human body. There are different images of MRI for mapping tumor induced Change including T1 weighted, T2 weighted and FLAIR (Fluid attenuated inversion recovery) weighted shown in figure.

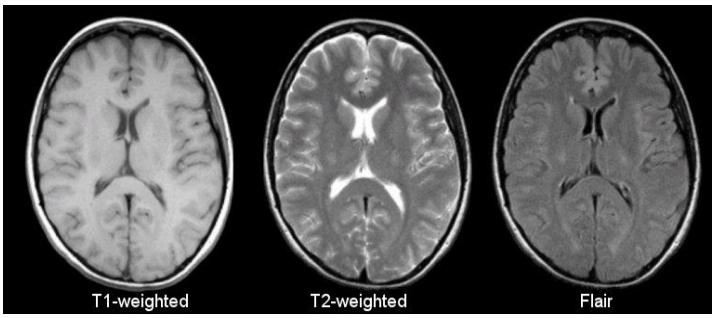

Fig 3: T1, T2 and Flair image [13]

The most common MRI sequence is T1 weighted and T2 weighted. In T1 weighted only one tissue type is bright FAT and in T2 weighted two tissue types are Bright FAT and Water both. In T1 weighted the repetition time (TR) is short in T2 weighted the TE and TR is long. The TR an TE are the pulse sequence parameter and stand for repetition time and time to echo and it can be measured in millisecond(ms)[13].

The echo time represented time from the centre of the RF pulse to the centre of the echo and TR is the length of time between the TE repeating series of pulse and echo is shown in figure.

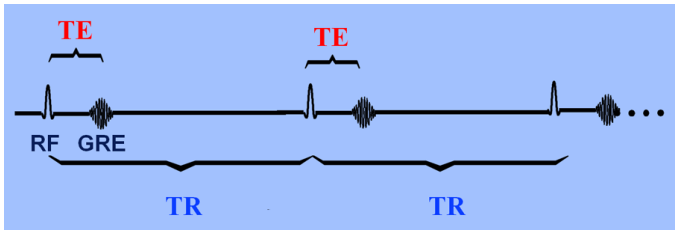

Fig. 4: Graph of TE and TR [14]

The third commonly used sequence in the FLAIR. The Flair sequence is almost same as T2-weighted image. The only difference is TE and TR time are very long. Their approximate TR and TE times are shown in table.

	TR (msec)	TE (msec)
T1-Weighted (short TR and TE)	500	14
T2-Weighted (long TR and TE)	4000	90
Flair (very long TR and TE	9000	114

Fig.5: Table of TR and TE time [13]

V IMAGE SEGMENTATION

Image segmentation is the process to distribute an image into minor parts to analyze and recognize the important information of a digital image. It creates several no of pixels in the image and given label to share particular feature information. Image segmentation has following three techniques Threshold segmentation, Region based segmentation, K-means techniques [15].

5.1 Threshold Segmentation: The segmentation means to divide a digital image into no. of segments that included no of set pixels and set of super pixel with the help of segmentation it could be simple and easy, to represent of an image and it will become more detailed, meaningful to the process of analysis. Placing of an object and boundaries in images such as lines, curves could be proceeding through image segmentation. Throughout the process of image segmentation every pixel have a label and some pixel consists of same label share certain visual feature. Each pixel in the region is similar in relation to some feature and contains properties such as color, intensity or texture. Threshold methodology is the simplest method of image segmentation. This method is used to convert a gray scale image to binary image. The main advantage of this method is selecting the threshold value to be used [16].

5.2 Region based: This method is based on continuity. This method spilt the entire image into sub region depends on some rules like all pixel in one region must have the same gray level. Region based techniques are depends on common patterns in the intensity value with in a cluster of neighbour pixels [17].

5.3 K-means algorithms: This method has no of image processing techniques for image segmentation. K means is the simplest way to cluster data. It is very useful for large image but has a poor contrast [16]. A cluster is a collection of objects which are similar between them and dissimilar to the objects belonging to other cluster. It deals with finding a structure in a collection of unlabeled data. A loose description of clustering could be the process of organizing object into group which has similar in some way. K means clustering is an algorithm to group objects based on feature into k number of groups where k is positive integer. K-means algorithm is commonly used for initialization methods are random partition [18].

VI DATA SET DETAIL AND RESULT

Nilesh Bhaskarrao Bahadure, A.K.Ray and H.P.Thethi [21] used two benchmark datasets and one dataset collected from skilled radiologists, that include fifteen sample images of patients with nine slice for every patient. The primary dataset is that the digital imaging and communication in medicine (DICOM) dataset. For analysis purpose it considered twenty two images from the DICOM dataset, that include tumor infected brain tissues. This dataset didn't have any ground truth image. The second dataset is that the brain web dataset [22]. It contains of full 3 dimensional simulated brain MR data obtained using three sequence of modalities, T1-weighted MRI, T2-weighted MRI, and proton density weighted MRI. The images used for our analysis are mostly included T2-weighted modulity with 1mm slice thickness, 3% noise and 20% intensity non uniformity. During this dataset thirteen out of forty four images included are tumor infected brain tissues. The last datasets collected from expert radiologist. It consist the 135 images of fifteen patients with all procedure. This dataset had ground truth images that help to match the results of our method with the manual analysis of radiologists. This section presents the result of proposed image segmentation techniques that obtained by using real brain MR images. The proposed algorithm was carried out using MATLAB7.12.0 (R2011a), which run on the windows eight operating system and has Intel core I3 processor and 4GB RAM.

Shubhashis Banerjee and Francesco Masulli used the BRATS 2017 dataset [19], which includes data from BRATS 2012, 2013, 2014 & 2015[20]. The dataset consisted of 210 HGG 75 LGG brain tumor cases. Every patient MRI scan set has four MRI sequences, encompassing native (T1), post contrast enhanced T1 weighted (T1C),T2 weighted and Fluid Attenuated inversion recovery(FLAIR) volume having 155 2D slices of 240X240 resolution.

Ali Isin, Cem Direkoglu, Melike sah take 2015 of the BRATS training dataset contains 274 multi modulity MRI of patients with gliomas scans (both high and low grades) at the side of their ground truth segmentations for evaluation. As for testing data 110 scans obtainable with unknown grade and unknown ground truths. The reportable results are indicates BRATS dice score of 83.7% is that the whole tumor region, 73.6% is that the core tumor region and 69% is that the active tumor region.

VII CONCLUSION

In this paper, survey on various techniques for brain tumor detection is done. Different techniques are used by various researchers to detect the brain tumor from MRI images are discussed. This paper talks about overview of the brain, braintumor and also about MRI images. Some segmentation techniques and conventional method are also discussed. According to this review we find that automation of brain tumor detection and segmentation using CNN from MRI images is most effective and helpful research area.

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