A SURVEY ON BRAIN TUMOR DETECTION AND CLASSIFICATION FROM MEDICAL IMAGES USING SEGMENTATION METHODS

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Abstract: *In this era Biomedical Image Processing is a growing and demanding field. It consists many different types of imaging methods likes CT scans, X-Ray and MRI. These techniques allow humans to identify even the smallest abnormalities in the human body. The primary goal of medical imaging is to extract meaningful and accurate information from the images with the least error possible. Out of the various types of medical imaging processes available to us, MRI is the most reliable and safe. MRI (Magnetic Resonance Imaging) is a medical technique, mainly used by the radiologist for visualization of internal structure of the human body. MRI provides useful information about the human soft tissue, which helps in the diagnosis of brain tumor. Image segmentation refers to partitioning of image into multiple regions or segments such that it can meaningfully represent the image through which information can be extracted. Accurate segmentation of MRI image is important for the diagnosis of brain tumor After appropriate segmentation of brain MR images, tumor is classified to malignant and benign, which is a difficult task due to complexity and variation in tumor tissue characteristics like its shape, size ,gray level intensities and location. Taking in to account these challenges, this research is focused towards highlighting the strength and limitations of earlier proposed segmentation and brain tumor detection techniques discussed in the contemporary literature.*

Keywords*:* MRI Images, Brain tumor detection, Segmentation, Brain tumor extraction, Classification

I. INTRODUCTION

Cancer in a body occurs when the cell in the body grows and divides in an uncontrollable manner. If this happens in brain then it is called as brain tumor[1]. A brain tumor is a mass of unnecessary and abnormal cell growing in the brain or it can be defined as an intracranial lesion which occupies space within the skull and tends to cause a rise in intracranial pressure[1].

Intracranial Neoplasm or Brain tumor is abnormal growth of cells in the brain. Brain is the most complicated part of our body. The symptoms of a tumor may be frequent headaches and migraines. Over the years it may even lead to vision loss. At this moment science is scarce about the origins and factors leading to this abnormal growth[2]. Tumors are classified on two bases: whether they are cancerous or not and their place of origin. The noncancerous form of the tumor is referred to as Benign. These are easily distinguishable and have a slow growth rate. Cancerous tumors are called Malignant. These are very aggressive and can be life threatening as these are hard to detect. When it comes to detecting a tumor, doctors can opt for either an X-ray or an MRI. MRI's are appropriate when all other test fail to provide sufficient information. An MRI scan uses the properties of magnetism and radio waves to produce accurate images. Neurosurgeons most commonly prescribe MRI's as it provides them with sufficient information to detect even the smallest abnormalities[2].

Brain tumors are mainly classified in to two i.e. Benign and Malignant. Benign tumors are noncancerous and they seldom grows back where as malignant tumors are cancerous and they rapidly grows and invade to the surrounding healthy brain tissue[1]. The location of tumor in brain helps the individual to determine how the brain tumor effects an individual normal functioning.

Whole brain segmentation, or brain extraction, is one of the first fundamental steps in the analysis of magnetic resonance images (MRI) in advanced neuroimaging. applications such as brain tissue segmentation and volumetric analysis [3], longitudinal and group analysis [4], cortical and sub-cortical surface analysis and thickness measurement [5],[6], and surgical planning. Manual brain extraction is time consuming especially in large-scale studies. Automated brain extraction is necessary but its performance and accuracy are critical as the output of this step can directly affect the performance.

II. LITERATURE REVIEW

Many algorithms have been developed and continuously improved over the past decade for whole brain segmentation, which has been a necessary component of large-scale neuroscience and neuro-image analysis studies. As the usage of these algorithms dramatically grew, the demand for higher accuracy and reliability also increased. Consequently, while fully-automated, accurate brain extraction[10].

As suggested in [2] Processing an image is a complicated task. Before any image can be processed, it is important to remove any unwanted artifacts it may hold. Only then can the image be processed successfully. Processing a medical image involves two main steps followed by Post Processing. The first is the pre-processing of the image. This involves performing operations like noise reduction and filtering so that the image is suitable for the next step. The second step is to perform segmentation and morphological operations. These determine the size and the location of the tumor. After that post-processing of image takes place in which tumor portion is classified based on pre-determined classifier.

Pre-processing involves processes like conversion to greyscale, noise reduction and noise removal, image reconstruction, image enhancement and regarding medical images it may involve steps like skull removal from an MRI[2]. One of the most common pre-processing practice is the conversion to a greyscale image. Once the image is converted to a greyscale image, it is then filtered to remove excess noise[2]. Filters are of two types, one that allows the low-end frequencies to pass or filters that allow the high-end frequencies to pass.

The process of splitting an image into multiple parts is known as segmentation. It is also described as “The process of labeling each pixel in an image such that they share the same characteristics”. It creates various sets of pixels within the same image. Segmenting an image makes it easier for us to further analyze and extract meaningful information from it[2].

Successful Segmentation of the image is followed by the post-processing of the image. Post Processing of the image involves steps to judge the size of the tumor and its type. Post processing may also involve various optimization techniques to further improve the result[2].

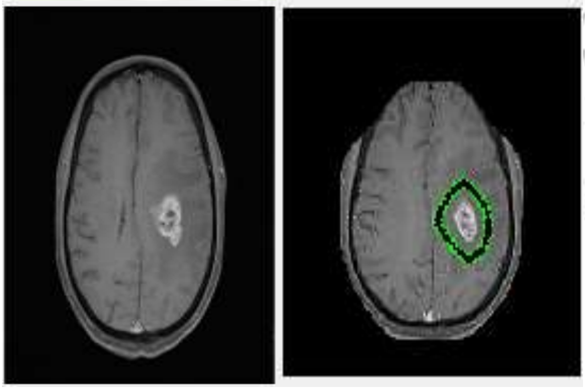
In [7] S. Réjichi and F. Chaabane, uses graph based multi temporal classification in the context of MRI time series classification in order to extract tumor region in a human brain. Here the proposed approach is mainly based on two steps. First, a Radial basis function (RBF) kernel for SVM classification is applied in order to identify regions in each MRI time series image. Then, a graph, called Spatial-Object Temporal.

In [8] Asit Subudhi,Jitendra Jena, Sukanta Sabut presents a technique for segmenting the brain from skull in a synthetic T1-weighted magnetic resonance images (MRIs) of the human head collected from Brain web database. The skull-stripping method consists of a series of sequential steps including image enhancement with particle swarm optimization (PSO) to improve the performance, background removal, histogram based thresholding with maximum divergence for extraction of brain region and morphological operation for removal of non-brain tissues.

In [9] Prakash Tunga P, Vipula Singh, focuses on extraction of brain tumor and its region description through segmentation from the brain MRI image. At first, pre-processing step for noise removal is carried out. Brain tumor extraction is done by considering the methods based on k-means clustering, morphological operations and region growing. K-means clustering has the advantage of being automatic, faster in execution and lesser computational complexity. Morphological operators based segmentation is more accurate than k-means clustering, effectively eliminates the noise and in-homogeneities due to irregularities in MR scanner, but is semi-automatic and not so accurate as region growing method. Region growing method, though semi-automatic, gives most accurate results among three methods, but the user has to select the initial seed which should be accurate and also this results in more execution time than the other methods.

In [10] Seyed Sadegh Mohseni, Salehi Deniz Erdogmus and Ali Gholipour Proposed and evaluated a new technique based on an auto-context convolutional neural network (CNN), in which intrinsic local and global image features are learned through 2D patches of different window sizes. They consider two different architectures: 1) a voxelwise approach based on three parallel 2D convolutional pathways for three different directions (axial, coronal, and sagittal) that implicitly learn 3D image information without the need for computationally expensive 3D convolutions, and 2) a fully convolutional network based on the U-net architecture. Posterior probability maps generated by the networks are used iteratively as context information along with the original image patches to learn the local shape and connectedness of the brain to extract it from non-brain tissue.

In [11] Asra Aslama,Ekram Khanb,M.M. Sufyan Bega, proposes an Improved Edge Detection algorithm for brain-tumor segmentation. It is based on Sobel edge detection. It combines the Sobel method with image dependent thresholding method and finds different regions using closed contour algorithm. Finally tumors are extracted from the image using intensity information within the closed contours. the edge detection method is modified so that it can be extended for object segmentation, which can be efficiently used for separation of tumor in the images. This method considers three parameters: gray level uniformity measure (GU), Q-parameter and relative ultimate measurement accuracy (RUMA).



(a) (b)

Fig 1.(a) Non-tumor image (b) Tumor detected image

III. COMPARISON

TABLE 1: Comparison Between Segmentation Methods

Sr.	Paper Title	Publication Details	Methods	Summary

No.				
1.	Brain Tumor Extraction Using Graph Based Classification Of MRI Time Series For Diagnostic Assistance[7]	International Symposium on Signal, Image, Video and Communications (ISIVC),IEEE,2016.	Graph Based Classification	This method helps experts to focus on tumor affected region and analyses temporal evolution but Adjacent regions leads to a graph aspect with several division and fusion
2.	Extraction of Brain from MRI Images by Skull Stripping using Histogram Partitioning with Maximum Entropy Divergence[8].	International Conference on Communication and Signal Processing, IEEE 2016.	Skull Stripping using Histogram Partitioning with Maximum Entropy Divergence.	This method provides accurate gray level range to detect brain and non-brain regions but it only consider entropy parameter.
3.	Extraction and Description of Tumors Region from the Brain MRI Image using Segmentation Techniques[9]	International Conference On Recent Trends In Electronics Information Communication Technology,IEEE 2016.	K-means clustering, Morphological operators based segmentation, Region growing method	These methods specifies area and location of center of mass of tumor.
4.	Auto-context Convolutional Neural Network (Auto-Net) for Brain Extraction in Magnetic Resonance Imaging[10]	Transactions on Medical Imaging, IEEE 2016.	Auto-context Convolutional Neural Network (Auto-Net)	Problem of extracting fetal brain from reconstructed fetal MRI is solved by this method but it is more complex and time consuming
5.	Improved Edge Detection Algorithm for Brain Tumor Segmentation[11]	Second International Symposium on Computer Vision and the Internet (VisionNet'15),Elsevier 2015.	Sobel method with image dependent thresholding	This method have less false edges and have closed contours but have limitations in tumor region area

IV. Conclusion

This paper mainly focuses on many related works of MRI image segmentation, detection of brain tumor and comparison between various methods of segmentation. Some methods focuses on better tumor region representation while in some techniques focus is on shape of tumor and some methods focuses on brain tumor size and area. As brain tumor is very sensitive problem related to health, main focus of MRI segmentation is on Accuracy. Every methods have it's own advantages and limitations though hybrid method for brain tumor segmentation is needed which can able to focus on more brain tumor parameters for giving more accurate information related to shape, size, region and texture of brain tumor.

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