A Survey On Segmentation Techniques for Brain Tumor Detection and Classification

Krunal V. Patel[1], Dr. Anil C. Suthar[2]

[1]*Research Scholar, Information & Technology Department, L.J. Institute of Engineering & Technology, Gujarat, India*
[2] *Director, L.J. Institute of Engineering & Technology, Gujarat, India*

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*

---

1. 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]. 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.

Processing a medical image involves two main steps. 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[2]. These determine the size and the location of the tumor

1) Image Pre-Processing:

- 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.

2) Segmentation:

- 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].

- Post-Processing:
- 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].

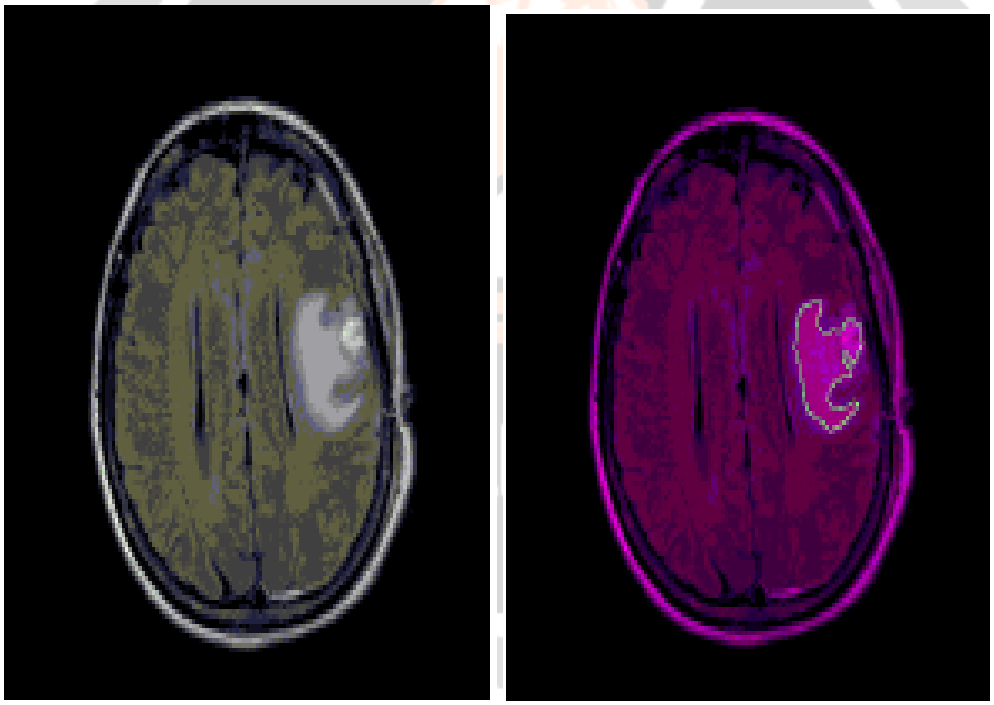

Fig.: Brain Tumor detection[5]

2. LITERATURE REVIEW:

2.1 Brain Tumor Extraction Using Graph Based Classification Of MRI Time Series For Diagnostic Assistance

- In [3] 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

Adjacency Graph (SOTAG), is constructed for regions of the MRI time series images. Second, a graph based kernel for SVM classification is applied on produced SOTAG in order to extract tumor region.

2.2 Extraction of Brain from MRI Images by Skull Stripping using Histogram Partitioning with Maximum Entropy Divergence.

- In [4] 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.

2.3 Extraction and Description of Tumors Region from the Brain MRI Image using Segmentation Techniques

- In [5] 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.

2.4 Auto-context Convolutional Neural Network (Auto-Net) for Brain Extraction in Magnetic Resonance Imaging

- In [6] 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.

2.5 Improved Edge Detection Algorithm for Brain Tumor Segmentation

- In [7] 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).

3. COMPARATIVE TABLE:

Table -1: Comparative Table

Paper Title	Methods/Techniques	Advantages	Limitations
Brain Tumor Extraction Using Graph Based Classification Of MRI Time Series For Diagnostic Assistance	Graph Based Classification	Helps to focus on the tumor affected region providing better accuracy	Adjacent regions leads to a graph aspect with several division and fusion
Extraction of Brain from MRI Images by Skull Stripping using Histogram Partitioning with Maximum Entropy Divergence.	Skull Stripping using Histogram Partitioning with Maximum Entropy Divergence.	Provide accurate segmentation of brain tissue by removal of non- brain tissues.	Extraction of tumor only considers entropy parameter
Extraction and Description of Tumors Region from the Brain MRI Image using Segmentation Techniques	K-means clustering, Morphological operators based segmentation, Region growing method	k-means is automatic, Morphological operators is more accurate than k-means	Compared to Region growing method Morphological operators are semi-automatic Providing less accuracy.
Auto-context Convolutional Neural Network (Auto-Net) for Brain Extraction in Magnetic Resonance Imaging	Auto-context Convolutional Neural Network (Auto-Net)	Better extraction of tumor shape and provide connectedness.	More complex and time consuming because of more expansion and contractions.
Improved Edge Detection Algorithm for Brain Tumor Segmentation	Sobel method with image dependent thresholding	Less false edges and have closed contours results in more accuracy than Sobel method	Limitations in tumor region area and thickness of boundary lines of region is more.

4. 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.

5. REFERENCES:

[1]. S.U.Aswathy,Dr G.Glan Deva Dhas,dr. S.S.Kumar, "A Survey on Detection of Brain Tumor From MRI Brain Images", International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT),IEEE 2014, DOI: 10.1109/ICCICCT.2014.6993081, Pages:871-877.

[2]. Luxit Kapoor, Sanjeev Thakur, " A Survey on Brain Tumor Detection Using Image Processing Techniques ", 7th International Conference on Cloud Computing, Data Science & Engineering - Confluence, IEEE 2017, DOI: 10.1109/CONFLUENCE.2017.7943218, Pages:582-585.

[3]. S. Réjichi and F. Chaabane, " Brain Tumor Extraction Using Graph Based Classification Of MRI Time Series For Diagnostic Assistance ", International Symposium on Signal, Image, Video and Communications (ISIVC), IEEE 2016, DOI: 10.1109/ISIVC.2016.7894008, Pages:320-324.

[4]. Asit Subudhi,Jitendra Jena, Sukanta Sabut, " Extraction of Brain from MRI Images by Skull Stripping using Histogram Partitioning with Maximum Entropy Divergence", International Conference on Communication and Signal Processing, April 6-8, IEEE 2016, DOI: 10.1109/ICCSP.2016.7754284, Pages:931-935.

[5]. Prakash Tunga P, Vipula Singh, " Extraction and Description of Tumour Region from the Brain MRI Image using Segmentation Techniques", IEEE International Conference On Recent Trends In Electronics Information Communication Technology, May 20-21, IEEE 2016, DOI: 10.1109/RTEICT.2016.7808097, Pages:1571-1576.

[6]. Seyed Sadegh Mohseni, Salehi Deniz Erdogmus and Ali Gholipour, "Auto-context Convolutional Neural Network (Auto-Net) for Brain Extraction in Magnetic Resonance Imaging", IEEE Transactions on Medical Imaging, IEEE 2016, DOI: 10.1109/TMI.2017.2721362, Pages:1-12.

[7]. Asra Aslama,Ekram Khanb,M.M. Sufyan Bega, "Improved Edge Detection Algorithm for Brain Tumor Segmentation", Second International Symposium on Computer Vision and the Internet (VisionNet'15),Elsevier 2015, DOI: 10.1016/j.procs.2015.08.057, Pages: 430-437.