Segmentation of Brain Tumor from MRI Images

[1]Keerthi M Rajan,[2]Sreeletha SH
[1]M.Tech Student,[2]Associate Professor
[1]Department of Computer Science and Engineering,
[1]LBSITW, Poojappura, Trivandrum, Kerala, India

Abstract— ***Brain tumor is one of the most life threatening diseases and hence its detection should be fast as well as accurate. In order to reduce the death rate of patients, tumor should be detected at an earlier stage. This can be achieved by the execution of tumor detection on medical images. Magnetic resonance images are used as a tool to detect the tumor growth in brain. The input image is taken from the available database or real time image so that the presence of tumor in input image can be detected and the region of interest can be analyzed. This paper is based on the segmentation of brain tumor from MRI images.***

Index Terms— **Brain tumor, MRI, Segmentation, Registration**

I. INTRODUCTION

A cell is considered as the basic structural and functional unit of any living thing. The human body contains about 100trillion cells and each cell has its own functions. In order for the correct functioning of the body, these cells have to divide to form new cells in a controllable manner. Sometimes, they divide and grow uncontrollably to form new cells that results in a mass of unwanted tissue called as a tumor. A Tumor can occur in any body parts. Brain tumor can be considered as one of the serious and life- threatening tumors. Early detection of brain tumor is necessary as death rate is higher among humans having brain tumor. Tumor is actually created either by the abnormal and uncontrolled cell division within the brain or from cancers primarily present in other parts of the body. Tumors are generally classified based on the location of their origin and its malignancy.

There are two types of tumors based on the location of the origin of tumors. Primary brain tumor and metastatic brain tumor. Primary tumors originate in the brain cells and sometimes they spread to other parts of the brain or to the spine. But spreading to other organs occurs only rarely. But the metastatic brain tumors or secondary brain tumors are those which originate in other parts of the body and then spread to the brain. These tumors are named according to the location which they originate. Based on the malignancy of tumors originated, they are classified as benign and malignant brain tumors. Benign tumors are the least aggressive ones. They originate from cells within the brain or from associated parts of the brain and they will not contain cancer cells. They only grow slowly and also they have clear borders i.e. their growth are self-limited and they will not spread into other tissues. While malignant brain tumors contain cancerous cells and their growth is not self-limited. Also their borders are not clear and they grow rapidly and invade surrounding brain tissues. Hence they will become life threatening if proper treatment is not taken at the correct time.

Medical imaging technique is used to detect tumor. Different types of imaging techniques like magnetic resonance imaging (MRI), computed tomography (CT), positron emission tomography (PET) etc. exist for the diagnosis of brain tumor. MRI is commonly used in the medical field for detection and visualization of details in the internal structure of the body and is basically used to detect the differences in the body tissues which have a considerably better technique as compared to computed tomography. CT uses ionizing radiation while MRI uses strong magnetic field and it provides greater contrast between different soft tissues of the human body. Experts can detect brain tumors manually from the MRI images but manual segmentation faces some difficulties such as over-time consumption, chances of variation of results from expert to expert.

Brain tumor segmentation is very difficult due to complex brain structure but early and accurate detection of tumors, edema and necrotic tissues is very important for diagnostic system. Tumors can damage normal brain cells by producing inflammation, exerting pressure on parts of brain and increasing pressure within the skull. Automatic brain tumor detection and segmentation face many challenges. Brain tumor segmentation requires the efficient knowledge of pathology and understanding the intensity and shape of MRI image. The main problem in tumor segmentation arises due each tumor being of different shape and shape. Different methods are there for semi-automatic detection of brain tumors but they also require human intervention which again makes the process time-consuming and expensive. There comes the importance of automatic brain tumor detection techniques from the medical images. They should be self-explanatory and easy to operate for the radiologists.

The image segmentation is the process of portioning a digital image into multiple segments. In this paper contour based segmentation is used for the detection of brain tumor from the dataset containing MRI images of a patient. Prior to segmentation, image registration is done on the two MRI images of the same patient taken at different periods of time. Registration [1] is the process of overlaying two or more images of the same scene taken at different times from different viewpoint. It geometrically aligns two images i.e., the reference and the sensed image. As tumor shape usually changes in time, comparison of images of the tumor acquired at different time points (e.g., before and after the course of radiotherapy) is

limited in showing in which region tumor growth or shrinkage has occurred. To make the result more accurate after the registration segmentation is further performed on the registered MRI image.

II. RELATED WORK

As tumor shape usually changes in time, the comparison of the images of the tumor acquired at different time points (e.g., before and after the course of radiotherapy) is limited in showing in which regions of the tumor growth or shrinkage has occurred. Spatial mappings can be obtained using registration, either rigid [2], or nonrigid [3]. Several authors suggested various algorithms for registration. B. B. Avants, C. L. Epstein, and J. C. Gee [4] develop a novel symmetric image normalization method (SyN) for maximizing the cross-correlation within the space of diffeomorphic maps and provide the Euler–Lagrange equations necessary for this optimization. They used Thirion's Demons algorithm. It produces better performance but was not robust. J. Corso, E. Sharon, S. Dube [5] present a new method for automatic segmentation of heterogeneous image data that takes a step toward bridging the gap between bottom-up affinity-based segmentation methods and top-down generative model based approaches. They use weighted aggregation algorithm. Even though it was highly robust this algoritham was not effective since the detection and quantification of brain tumor is very difficult. E. Konukoglu, O. Clatz, B. Menze [6] propose a parameter estimation method for reaction-diffusion tumor growth models using time series of medical images. Parameter estimation method segmentation algorithm is used.it has an advantage of high accuracy but lack diffusion tensor imaging for the patients. S. Jones, B. Buchbinder, and I. Aharon [7] present a novel computerized method of examining cerebral cortical thickness. Algorithm used is warping algorithm and adaptive algorithm. it has less sensitive to local segmentation errors but has High computing power. Its disadvantage is due to the limitation of signal contrast and image resolution. After the registration the registered image is segmented using different algorithms. Jianping Fan,Yau Elmagarmid & Aref's [8] paper presents an automatic image segmentation method using thresholding technique. This is based on the assumption that adjacent pixels whose value (grey level, color value,texture, etc) lies within a certain range belong to the same class and thus, good segmentation of images that include only two opposite components can be obtained. Jaskirat Kaur, Sunil Agrawal & Renu Vig.'s paper presented thresholding and edge detection being one of the important aspects of image segmentation comes prior to feature extraction and image recognition system for analyzing images. It helps in extracting the basic shape of an image, overlooking the minute unnecessary details. In this paper using image segmentation (thresholding and edge detection) techniques different geo satellite images, medical images and architectural images are analyzed [9]. Dzung L. Pham, Chenyang Xu, Jerry L. Prince proposed the basics that thresholding approaches segment scalar images by creating a binary partitioning of the image intensities. It attempts to determine an intensity value, called the threshold, which separates the desired classes. Segmentation is achieved by grouping all pixels with intensity greater than the threshold into one class, & all other pixels into another class. Determination of more than one threshold value is a process called multi thresholding.Rajeshwar Dass, Priyanka, Swapna Devi's paper describes the different segmentation techniques used in the field of ultrasound and SAR Image Processing. Firstly this paper investigates and compiles some of the technologies used for image segmentation. Then a bibliographical survey of current segmentation techniques is given in this paper and finally general tendencies in image segmentation are presented [10].Selvakumar's paper deals with the implementation of Simple Cluster Algorithm [11] for detection of range and shape of tumor in brain MR images. This uses computer aided method for segmentation (detection) of brain tumor based on the combination of two algorithms. At the end of the process the tumor is extracted from the MR image and its exact position and the shape also determined & the tumor's stage is displayed based on the amount of area calculated from the cluster.S. Thilagamani and N. Shanthi's paper is a survey on different clustering techniques to achieve image segmentation. In order to increase the efficiency of the searching process, only a part of the database need to be searched. For this searching process clustering techniques can be recommended. Clustering can be termed here as a grouping of similar images in the database. Clustering is done based on different attributes of an image such as size, color, texture etc. The purpose of clustering is to get meaningful result, effective storage and fast retrieval in various areas [12]. In this paper contour based segmentation is performed.

III. PROPOSED WORK

The images are collected from the website http://www.sadies-brain-tumor.org/mris/. The dataset contains two set of images taken at two different months. The first step preprocessing is done, in the second step registration of the two mri images are done and in the third step active contour based segmentation takes place. As a result of these steps, we get a final brain tumor segmented image.

Preprocessing of brain MR image is the first step in our proposed technique. Preprocessing of an image is done to reduce the noise and to enhance the brain MR image for further processing. The purpose of these steps is basically to improve the image and the image quality. Then apply registration on the two MRI images taken at two different time periods shown in the figure 1. Registration is the process of overlaying two or more images of the same scene taken at different times from different viewpoints. It geometrically aligns two images, the reference image and the sensed image as shown in figure 2. There are two types of registration rigid and non rigid. Rigid or affine registration is performed here. The affine transformation preserves the straightness of lines, and hence, the planarity of surfaces, and it preserves parallelism, but it allows angles between lines to change. It includes Translation, Rotation, Scaling and Shearing. Keeping one image as fixed overlap the other image and adjust it by applying the transformations in order to get the registered image. It is shown in the figure 3.

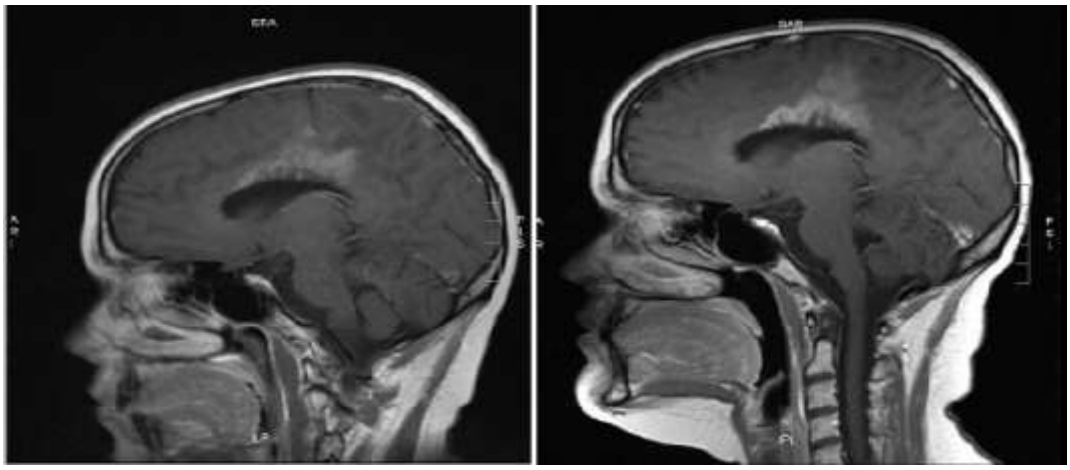

Figure 1. Two MRI Images with tumor

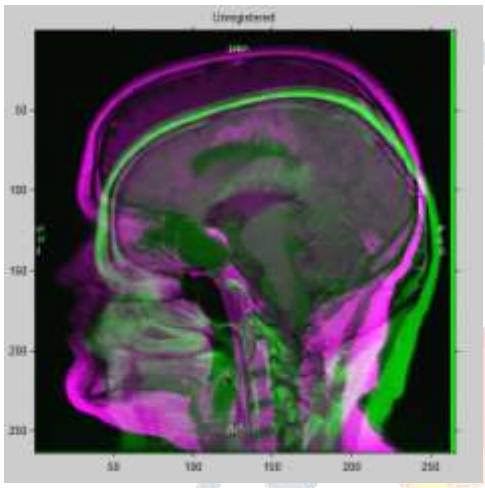

Figure 2. Unregistered MRI Image

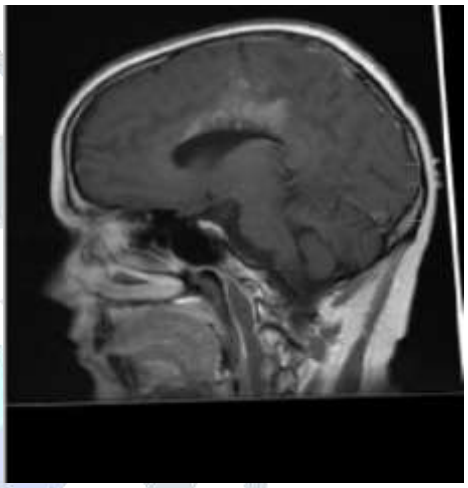

Figure 3. Registered MRI image

Image segmentation is the process of partitioning a digital image into multiple segments. After doing the registration process in the brain MR image, the next step of our proposed technique is to segment the brain tumor MR image. Segmentation is done to separate the image foreground from its background. Segmenting an image also saves the processing time for further operations which has to be applied to the image. We have used active contour based segmentation on the registered image by marking the tumor region detected manually. An initial mask is created by manually selecting the region of interest which is shown in figure 4. After obtaining the mask which is shown in the figure 5, the region of interest is segmented. The segmented image is shown in the figure 6. This work is simulated in MATLAB.

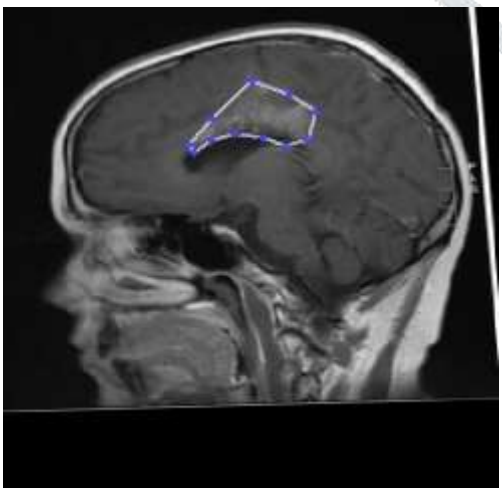

Figure 4.. Mask creation

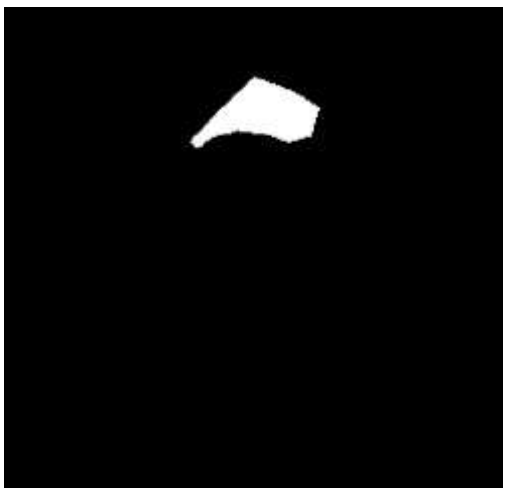

Figure 5.Created mask

Figure 6. Segmented output

IV. CONCLUSION AND FUTURE WORK

In this paper a contour based segmentation is proposed for the detection of brain tumor. We also applied the registration technique before segmentation in order to detect the growth of the tumor before and after the course of radiotherapy. Since segmentation is done on the registered image, tumor is segmented accurately. Simulated results show that the proposed method is an efficient brain tumor segmentation technique done to detect tumor.

The future scope of the proposed work is that it can be extended to detect multiple tumors from a single MRI image. Also a classification on artificial neural network can be done for classifying the cells as tumorous or not.

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