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Detection and Quantification of Brain Tumor from MRI of Brain and it's Symmetric Analysis

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ABSTRACT

In this work a fully automatic algorithm to detect brain tumors by using symmetry analysis is proposed. Here we detect the tumor, segment the tumor and calculate the area of the tumor. The quantitative analysis of MRI brain tumor allows obtaining useful key indicators of disease progression. The complex problem of segmenting tumor in MRI can be successfully addressed by considering modular and multi-step approaches mimicking the human visual inspection process. The tumor detection is often an essential preliminary phase to solve the segmentation problem successfully. The experiments showed good results also in complex situations. Segmentation of images embraces a significant position in the region of image processing. It becomes more and more significant while normally dealing with medical images; magnetic resonance (MR) imaging suggest more perfect information for medical examination than that of other medical images such as ultrasonic , CT images and X-ray. Tumor segmentation and area calculation from MRI data is an essential but fatigue, boring and time unbearable task when it completed manually by medical professional when evaluate with present day's high speed computing machines which facilitate us to visual study the area and position of unnecessary tissues.

Keywords: *MRI image, Segmentation, Tumor detection, Morphological analysis, Symmetry analysis.*

1. INTRODUCTION

The principle of our task is to recognize a tumor and its quantifications from a particular MRI scan of a brain image using digital image processing techniques and compute the area of the tumor by fully automated process and its symmetry analysis. In recent years a great effort of the research in field of medical imaging was focused on brain tumors segmentation. The automatic segmentation has great potential in clinical medicine by freeing physicians from the burden of manual labelling; whereas only a quantitative measurement allows to track and modelling precisely the disease. Despite the undisputed usefulness of automatic tumor segmentation, this is not yet a widespread clinical practice, therefore the automatic brain tumor segmentation is still a widely studied research topic. The main difficulties in field of automatic tumor segmentation are related to the fact that the brain tumors are very heterogeneous in terms of shape, color, texture and position and they often deform other nearby anatomical structures. An healthy brain has a strong sagittal symmetry, that is weakened by the presence of tumor. The comparison between the healthy and ill hemisphere, considering that tumors are generally not symmetrically placed in both hemispheres, was used to detect the anomaly. One of the motivations to make the substandard segmentation of good organization is the occurrence of artefact in the MR images. One such artefact is the additional cranial tissues (skull). These additional cranial tissues repeatedly hamper with the ordinary tissues throughout segmentation that accounts for the substandard segmentation efficiency. Magnetic Resonance Imaging (MRI) is an advanced medical imaging technique used to produce high resolution images of the parts contained in the human body.MRI imaging is often used when treating brain tumors. These high resolution images are used to examine human brain development and discover abnormalities. Nowadays there are several methodologies for classifying MR images. Among all medical image processing, image segmentation is initial and important work, for example, quantification of specified area must based on accurate segmentation.

A tumor is a mass of tissue that grows out of control of the normal forces that regulates growth. The multifaceted brain tumors can be split into two common categories depending on the tumors beginning, their enlargement prototype and malignancy. Primary brain tumors are tumors that take place commencing cells in the brain or commencing the wrapper of the brain. An inferior or metastatic brain tumor takes place when cancer cells extend to the brain from a primary cancer in a different component of the body. The majority of investigations in developed countries demonstrate that the amount of people who develop brain tumors and depart this life from them has greater than before maybe as much as 300 over past three decades. The computationally efficient method runs orders of magnitude faster than current state of the art techniques giving comparable or improved results. Our quantitative results indicate the benefit of incorporating model aware affinities into the segmentation process for the difficult case of brain tumor. This paper expresses a well-organized technique for automatic brain tumor segmentation for the removal of tumor tissues from MR images. A well acknowledged segmentation trouble within MRI is the task of category voxels according to their tissue type which take account of White Matter (WM), Grey Matter (GM) , Cerebrospinal Fluid (CSF) and occasionally pathological tissues like tumor etc. A brain tumor is an

intracranial mass produced by an uncontrolled growth of cells either normally found in the brain such as neurons, lymphatic tissue, glial cells, blood vessels, pituitary and pineal gland, skull, or spread from cancers primarily located in other organs [1]. Brain tumors are classified based on the type of tissue involved, the location of the tumor, whether it is benign or malignant, and other considerations. Primary (true) brain tumors are the tumors that originated in the brain and are named for the cell types from which they originated. They can be benign (non cancerous), meaning that they do not increase in a different place or attack neighbouring tissues. They can also be malignant and invasive (spreading to neighbouring area). Secondary or metastasis brain tumors take their origin from tumor cells which increase to the brain from a different position in the body. Most frequently cancers that increase to the brain to reason secondary brain tumors begin in the lumy, breast, and kidney or from melanomas in the skin. The first aim of this work is to develop a framework for a robust and accurate segmentation of a large class of brain tumors in MR images. Most existing methods are region-based. They have several advantages, but line and edge information in computer vision systems are also important. The proposed method tries to combine region and edge information, thus taking advantage of both approaches while cancelling their drawbacks. We first segment the brain to remove non-brain data. However, in pathological cases, standard segmentation methods fail, in particular when the tumor is located very close to the brain surface. Therefore we propose an improved segmentation method, relying on the approximate symmetry plane.

2. RELATED WORK

Image segmentation represents a method of separation a portion of image into separate area. A great assortment of dissimilar segmentation approaches for images have been developed. The Segmentation of an image entails the division or separation of the image into regions of similar attribute. The ultimate aim in a large number of image processing applications is to extract important features from the image data, from which a description, interpretation, or understanding of the scene can be provided by the machine. Among them, the clustering technique have been comprehensively explore and used in T.Logeswari and M.Karnan [2], a clustering support come close to using a self organizing map (SOM) algorithm is projected for medical image segmentation. This paper illustrate segmentation scheme consists of two stages. In the opening stages, the MRI brain image is obtained from patient database. In that film artefact and noise are disconnected. In the subsequent stages (MR) image segmentation is to precisely recognize the major tissue arrangement in these image areas. In R. Rajeswari et al. [3] proposed a Spectral leakage has the effect of the frequency analysis of finite-length signals or finite-length segments of infinite signals. In brain the tumor itself, comprising a necrotic (dead) part and an active part, the edema or swelling in the nearby brain, As all tumor do not have a clear boundary between active and necrotic parts there is need to define a clear boundary between edema and brain tissues. Hassan Khotanlou et all [4] recommend a common automatic scheme for segmenting brain tumors in 3D MRI. Our scheme is valid in dissimilar types of tumors with MRI images. Its effect represent the initialization of a segmentation technique based on a mixture of a deformable model and spatial associations, principal to a particular segmentation of the tumors. P.Narendran, V.K. Narendira Kumar, K. Somasundaram [5] proposed a new method for segmentation of pathological brain structures. This method combines prior information of structures and image information (region and edge) for segmentation. The automated brain tumor segmentation method that we have developed consists of two main components: pre-processing and segmentation. The inputs of this system are two different modalities of MR images: CE-T1w and FLAIR that we believe are sufficient for brain tumor segmentation [6]. The Graph Cut [7] method attempts to solve the min cut/max flow problem. Snakes and Level Sets are active contour methods that evolve a curve based upon geometric and image constraints. For the problem of brain tumor segmentation, Lefohn et al. [8] implemented a level set solver on the GPU. Quantitative results of this level set formulation compare well with hand contouring results. Kaus et al. [9] used an atlas and statistical information to segment brain tumors. Edward Kim et al. [10] method utilizes statistical seed distributions to overcome the local bias seen in the traditional cellular automata framework. Our results show improved accuracy, robustness, and competitive usability. Further, with a GPU implementation, the method produces results at interactive rates.

3. MATERIALS AND METHODS

We have used these basic concepts to detect tumor in our paper, the component of the image hold the tumor generally has extra concentration then the other segment and we can guess the area, shape and radius of the tumor in the image. We calculate the area in pixel. Noise existing in the image can decrease the capability of region growing filter to grow large regions or may result as a fault edges. When faced with noisy images, it is generally convenient to pre-process the image by using median filter. Median filters have the robustness and edge preserving capability of the classical median filter. In pre-processing some fundamental image enhancement and noise lessening procedure are applied. Apart from that dissimilar traditions to identify edges and doing segmentations have also been used. The intention of these steps is fundamentally to recover the image and the image superiority to get more guarantee and ease in identify the tumor. The noise is reducing by the conversion of gray scale image. Then this gray scale image pass in to the filter. We use here a high pass filter imfilter function in matlab to filter an image, replaces each pixel of the image with a weighted average of the surrounding pixels. The weights are

determined by the values of the filter, and the number of surrounding pixels is determined by the size of the filter used. Then the gray image and filtered image are merged together to enhanced the image quality. Here we use Median filtering which is a nonlinear operation often used in image processing to reduce "salt and pepper" noise. A median filter is more effective than convolution when the goal is to simultaneously reduce noise and preserve edges. We use here matlab command medfilt2. Then we convert the filtered image into binary image by the thresholding method which computes a global threshold that can be used to convert an intensity image to a binary image with normalized intensity value between 0 and 1.The uses Otsu's method [19], which chooses the threshold to minimize the intraclass variance of the black and white pixels. Then segment the threshold image by watershed segmentation because It is the best method to segment an image to separate a tumor but it suffers from over and under segmentation, due to which we have used it as a check to our output. It not give the better result after that some morphological operations are applied on the image after converting it into binary form. The basic purpose of the operations is to show only that part of the image which has the tumor that is the part of the image having more intensity and more area then that specified in the strel command. The basic commands used in this step are strel, imerode and imdilate, Imerode: It is used to erode an image. Imdilate: It is used to dilate an image. Marge these morphological outputs with grayscale image by the step9 to step19 and we get resultant output in which tumor detect sharply. Then we make the resultant image with sharp location of tumor by morphological output image and gray image from step9 to step18. Traces the exterior boundaries of objects, as well as boundaries of holes inside these image, in the binary image, it also descends into the outermost objects (parents) and traces their children (objects completely enclosed by the parents). It must be a binary image where nonzero pixels belong to an object and 0 pixels constitute the background. Output is shown only in the color portion of the image with tumor. Then tumor area is calculated from 2nd algorithms. From this area we can assume the dangerousness of tumor.

3.1 Algorithm for Detecting Brain Tumor

Input: MRI of brain image.
Output: Tumor portion of the image.

Step1:- Read the input color or grayscale image.
Step2:- Converts input colour image in to grayscale image which is done by forming a weighted sum of each three (RGB) component, eliminating the saturation and hue information while retaining the luminance and the image returns a grayscale colour map.
Step3:- Resize this image in to 200 × 200 image matrix.
Step4:- Filters the multidimensional array with the multidimensional filter. Each element of the output an integer or in array, then output elements that exceed the certain range of the integer type is shortened, and fractional values are rounded.
Step5:- Add step2, step4 image and a integer value 45 and pass it in to a median filter to get the resultant enhanced image.
Step6:- Computes a global threshold that can be used to convert an intensity image (Step5) to a binary image with a normalized intensity value which lies in between range 0 and 1.
Step7:- Compute watershed segmentation by matlab command watershed (step6 image).
Step8:-Compute the morphological operation by two matlab command imerode and imdilate and strel with arbitrary shape.
Step9:- Store the size of the step 8 image into var1 and var2 i.e no. Of rows and column in pixels by
[var1 var2]=size(step8 image)
Step10:- For i=1:1:var1 do
Step11:- For j=1:1:var2 do
Step12:- If step8 image (i,j) == 1 do
Step13:- step2 image (i,j) = 255
Step14:- Else do
Step15:- step2 image (i,j) = step2 image (i,j) * 0.3
Step16:- End If
Step17:- End For
Step18:- End For
Step19:- Convert in to binary image and traces the exterior boundaries of objects, as well as boundaries of holes inside these objects, in the binary image and into an RGB color image for the purpose of visualizing labeled regions.
Step20:- Show only tumor portion of the image by remove the small object area.
Step21:- Compute edge detection using sobel edge detection technique.

3.2 Algorithm for Area Calculation

Input: Tumor portion of the image.
Output: Area of the tumor.

Step1:- Read the input color or grayscale image.
Step2:- Converts input colour image in to grayscale image which is done by forming a weighted sum of each three (RGB) component, eliminating the saturation and hue information while retaining the luminance and the image returns a grayscale colour map and store it into variable I.
Step3:- Compute numbers of rows and column in pixels by
[r2 c2] = size (I)
Step4:- Initialize a variable a=0
Step4:- For i=1:1:r2 do
Step4:- For j=1:1:c2 do
Step4:- If I (i,j)==255 do
Step4:- a=a+0
Step4:- Else do
Step4:- a=a+1
Step4:- EndIF

Step4:- EndFor
Step4:- End For
Step4:- Display the area a.

Results are shown below with image name BT1. Figure 1 is the original MRI scan image; Figure 2 shows grayscale conversion of the image; Figure 3 is the output of the after grayscale image pass into the high pass filtered image and then Figure2 and figure3 image are superpose with a median filter image and get the resultant enhanced image of Figure 4; Figure 5 and Figure 6 shows the threshold segmentation with threshold value 0.35 and watershed segmentation to localize the tumor portion of the image. Morphological operations with arbitrary shape are applied in Figure 7; Location of the tumor with input image is shown in figure 8; Figure 9 is the edge detection with sobel parameter. Figure 10 and Figure 11 are the colour output tumor with noise and tumor without noise.

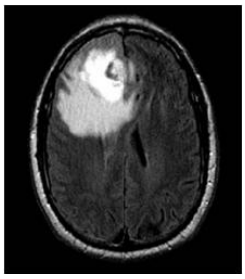

Figure 1: Original Input Image

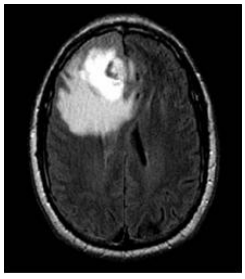

Figure 2: Grayscale Image

Figure 3: High pass filter Image

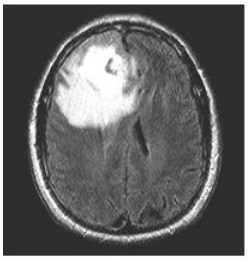

Figure 4: Enhanced Image

Figure 5: Thresh-hold segmentation

Figure 6: Watersh-ade segmentation

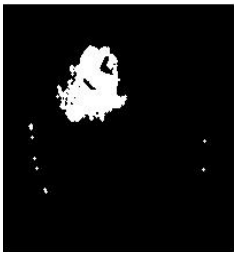

Figure 7: Morphol -ogical Output

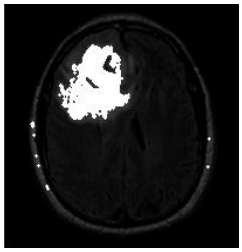

Figure 8: Output with Tumor Location

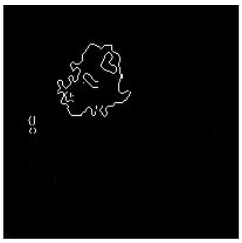

Figure 9: Sobel Edge Detection

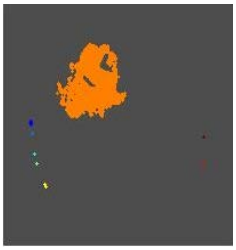

Figure 10: Tumor with Noise

Figure 11: Final output with Tumor Portion only

Table 1: Contains image size with tumor size in pixels i.e tumor area in pixels with different images.

Image name	Image size	Tumor size
BT1	200×200	6040
BT2	200×200	5080
BT3	200×200	4913
BT4	200×200	2144
BT5	200×200	2778
BT6	200×200	8080

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3.3 Some other Results are shown below

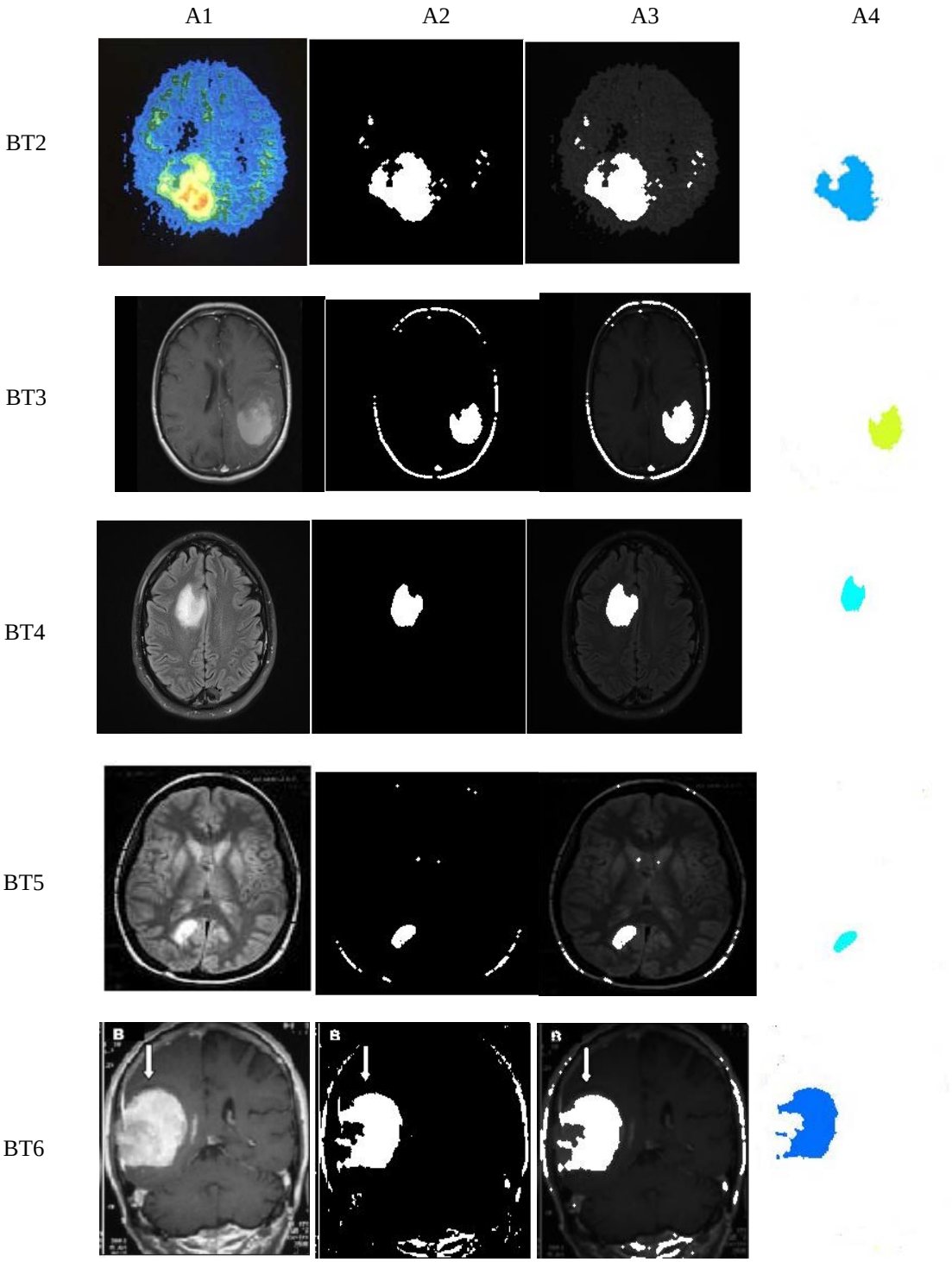
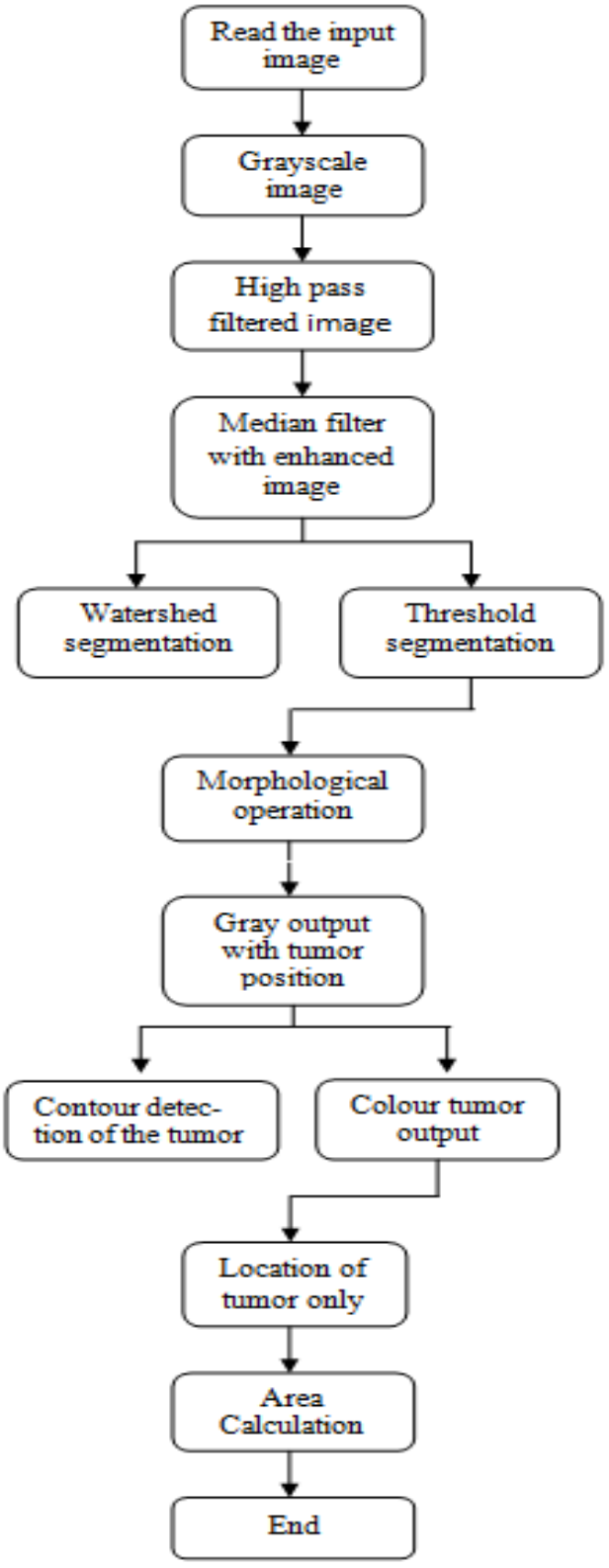


Figure 12: Shows the output image with different input MRI image where BT2,BT3,BT4,BT5,BT6 are the different input image name and A1,A2,A3,A4 are the input image , morphological output, tumor location with image, colored output with only tumor portion of the MRI image.

3.4 Flow Chart of our Proposed Method



4. CONCLUSIONS & FUTURE WORKS

We proposed an interactive segmentation method that enables users to quickly and efficiently segment tumors in MRI of brain. We proposed a new method that in addition to area of the region and edge information uses a type of prior information also its symmetry analysis which is more consistent in pathological cases. Since tumor is a rather general concept in medicine, limitations of the proposed approach might become apparent as soon as unforeseen pathologic tissue types that could not adequately be captured by the discriminative model appear in previously unseen patients. Especially secondary tumors might be composed of an enormous variety of tissue types depending on the primary tumor site. Its application to several datasets with different tumors sizes, intensities and locations shows that it can automatically detect and segment very different types of brain tumors with a good quality.

For our future work, we plan to work with a greater number of brain structures and explore incorporating additional information to guide our proposal. We would also like to explore higher dimensional data and improve our user interface and investigate possibilities to handle this issue. The goal is to detect, to segment, and to identify most types of pathological tissue that occur within pediatric brain tumors.

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