

# Detection and Transferring of Malignant or Benign Brain Tumor from an MRI Report via Bluetooth Device

Shreya Somani and Soumen Biswas

**Abstract:** The aim of this work is to design an algorithm for segmenting a tumor in brain using a set of MRI data sets. More specifically the aim for this work is to segment a tumor in brain in conjunction with inspecting the tumor being benign or malignant and conveying the reports through means of a Bluetooth device or an SMS. This will make the surgeons able to perform operations inside a patient without open surgery. This method could be used as preliminary step before opting for a biopsy test. Instruments needed for this could be ultra sound, Computer Tomography (CT Scan) and Magnetic Resonance Imaging (MRI). However, the technique used in this project is MRI. For detection of tumor in 2D the software used is MATLAB. 3D segmentation is also a reliable approach to achieve a proper estimation of tumor volume. But for detection of tumor in 3D, the software used are MATLAB and 3D slicer. Nevertheless, Watershed Segmentation is a powerful tool in MATLAB which uses the intensity as a parameter to segment the whole image data set thereby extracting the tumor surface.

**Keywords:** Brain tumor, Magnetic resonance Imaging (MRI), Image Segmentation, Watershed, Bluetooth Device, MATLAB, 3D Slicer.

## I. INTRODUCTION

An abnormal growth of cells in the brain is called a brain tumor. Brain tumors may be malignant (cancerous) or benign (non-cancerous). Suspicions of a brain tumor may first arise from abnormal behavior or other symptoms. Symptoms are typically investigated with a series of tests aimed at making a diagnosis. If a brain tumor is the diagnosis, further information about the cancer cells is necessary to determine the best possible approach to treatment. There are many types of brain tumors that differ based on which type of cells make up the tumor. Also, determining the extent of the cancer helps the doctor to understand the likelihood that the tumor will spread into other brain tissues, a characteristic which may also be referred to as the aggressiveness of the cancer.

Tumors are benign or malignant. There are three methods of segmentation. These are Snakes (Gradient Vector Flow), Level Set Segmentation and Watershed Segmentation [1]. This work is to design an automated tool for brain tumor quantification using MRI image data sets. This work is a small and modest part of a quite complex system. The whole system will when completed visualize the inside of the human body, and make surgeons able to perform operations inside a patient without open surgery. This will make the surgeon able to see the tumor and then ease the treatment. The instruments needed for this could be ultrasound, Computer Tomography (CT scan) and Magnetic Resonance Imaging (MRI). In this Paper, the technique used is Magnetic Resonance Imaging (MRI). For detection of tumor in 2D the software used is MATLAB. But for detection of tumor in 3D, the software used was MATLAB and 3D Slicer. 3D Slicer was used to create the 3D image using axial, saggital and coronal images. This 3D image was then used by MATLAB to detect the tumor in 3D.

## II. METHODOLOGY

A conceptually simple supervised block-based and image-based (shape, texture, and content) technique has been used to analyze MRI brain images with relatively lower computational requirements. The process flow of our proposed methodology may be shown as figure 1. The first section discusses how images are divided into regions using a block-based method. The second section shows how each classified block is studied individually by calculating its multiple parameter values. In this instance, the multi-parameter features refer to the following three specific features: the edges (E), gray values (G), and local contrast (H) of the pixels in the block being analyzed. The images we got from MRI are of three types: axial Images, saggital Images, coronal Images. The numbers of images depend on the resolution of the movement of the MRI magnets.

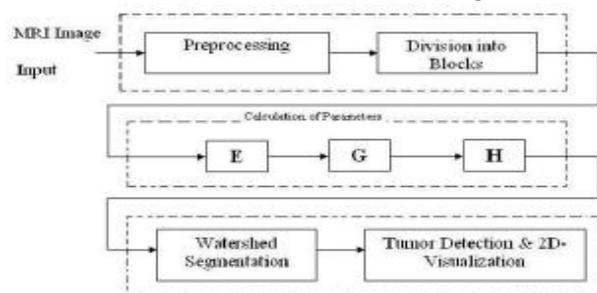


Figure1. Methodology

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### A. Edge (E) Parameter Calculation

Edge information is often used to determine the boundaries of an object. This is mainly used for analysis to derive similarity criterion for a predetermined object. The incidences of cerebral compression reduce the edge. Given this understanding, It can be use the Sobel edge detection method to detect image edges (IE) is obtained by filtering an input image with two convolution kernels concomitantly, one to detect changes in vertical contrast ( $h_x$ ) and the other to detect horizontal contrast ( $h_y$ ).

### B. Gray (G) Calculation

Gray parameter avoids the need to scale the data to color mapping, which would be required if we used a color map of a different size. The gray parameter (G) for each block of the brain is accumulated, and controlled by a binary image (IT) using the GD value as a threshold.

### C. Contrast (H) Parameter

An intensity image is a data matrix, I, whose values represent intensities within some range. MATLAB stores an intensity image as a single matrix, with each element of the matrix color-responding to one image pixel. The matrix can be of class double, uint8, or uint16. While intensity images are rarely saved with a color map, MATLAB uses a color map to display them. In essence, MATLAB handles intensity images as indexed images. Contrast (H) is often used to characterize the extent of variation in pixel intensity. In the present technique, the computational program analyses the differences, especially in instances of strong dissimilarity, between entities or objects in an image  $I(x,y)$ .

## III. WATERSHED SEGMENTATION

As watershed segmentation technique segregates any image as different intensity portions and also the tumor cells have high protein fluid which has very high density and hence very high intensity, therefore watershed segmentation is the best tool to classify tumors and high intensity tissues of brain. Watershed segmentation can classify the intensities with very small difference also. Unlike Snake and Level transformations, watershed transformation doesn't require an initialization inside the tumor. The limitation of watershed segmentation is that its algorithms produce a region for each local minimum. This normally leads to over segmentation. We can say the algorithm has solved the problem but left the result as a puzzle. Obviously there is a need for post processing these numerous regions. One way to face this problem is to recognize the regions in a hierarchy. Watershed Transform computes a label matrix identifying the watershed regions of the input matrix A, which can have any dimension. Figure 2 is shown below for two dimensional watershed Segmentation.

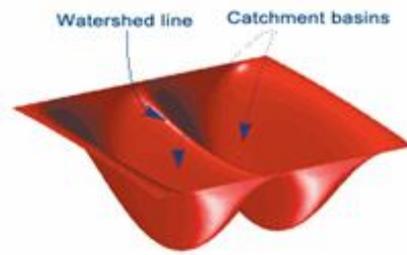


Figure 2. 2D Watershed Segmentation

### A. Watershed Segmentation (Pros & Cons)

It has been found that among the segmentation methods investigated in this work, the watershed segmentation, a classic in image segmentation, marked out as the most automatic method of the three. As watershed segmentation technique segregates any image as different intensity portions and also the tumorous cells have high proteinaceous fluid which has very high density and hence very high intensity, therefore watershed segmentation is the best tool to classify tumors and high intensity tissues of brain. Watershed segmentation can classify the intensities with very small difference also, which is not possible with snake and level set method. It has been found that the snake and the level set method were best initialized from the inside of the tumor. The program needs to be extending to handle segmentation with a probe through the tumor. This can be done by segmenting the probe or in combination with tracking information which provides the position of the probe. Improved robustness can be gained by segmenting the blood vessels inside the brain during preoperative image analysis. With the use of image registration the vessels can be found in the operative images and eliminate them from the feature map used in tumor segmentation. Such an extension also contributes to added complexity and there is no guarantee the added feature will increase the robustness of the complete system. The watershed method did not require an initialization while the others require an initialization inside the tumor. The limitation of watershed segmentation is that its algorithms produce a region for each local minimum. This will normally lead to over segmentation. We can say the algorithm has solved the problem but de-trains the result as a puzzle. Obviously there is a need for post processing these numerous regions. One way to face this problem is to recognize the regions in a hierarchy.

## IV. TUMOR BLOCK DETECTION AND VISUALIZATION

### A. Segmentation of brain tumor

It has been seen from the above result that high density images have been separated from the MRI images using Watershed Segmentation. Here main aim is to segment the tumor from the MRI images.

This can be achieved by executing the algorithm in MATLAB and the result obtained may be shown as figure 3.

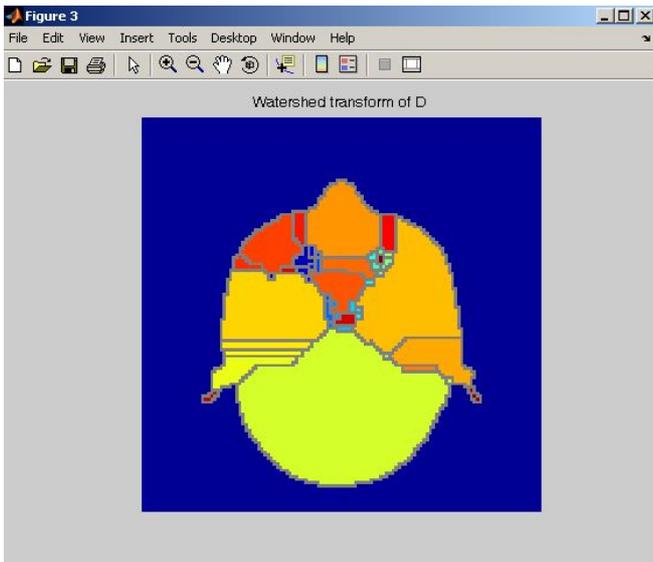


Figure3. Intensity Image of MRI Data Set using Watershed Segmentation

**B. Formation of 3D image of MRI Data Set using 3D Slicer**

As the MRI Image date set is collection of 2D images. The tumor cannot be segmented in 3D unless and until we have 3D MRI image data set. Therefore, software 3D SLICER has been used to get a 3D image , in the figure4 ,from a collection of 2D MRI data set of axial, saggital & coronal images. Then, applying watershed segmentation (3D) in MATLAB to this 3D image, the segmented tumor in 3D with all its dimensions can be obtained using 3D Slicer.

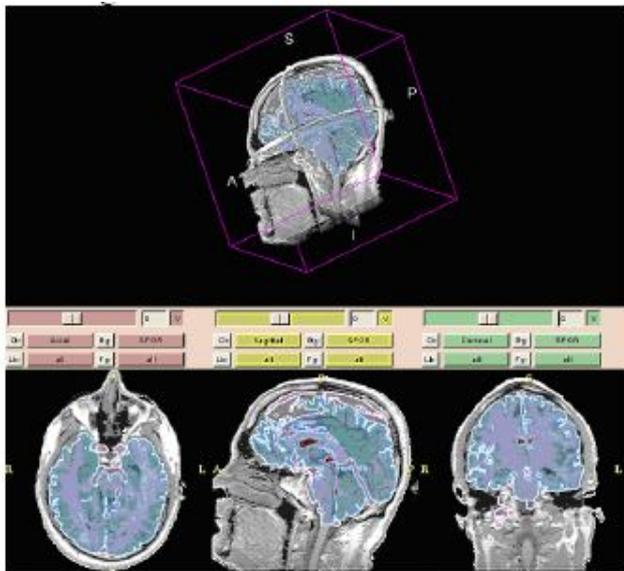


Figure4. Viewer of 3D Slicer

**C. Segmentation and Visualization of Brain tumor in 3D**

Now applying watershed segmentation (3D) by executing algorithm to the above MRI 3D image, we will get the image of tumor as Tumor image in 3D may be shown in figure 5.

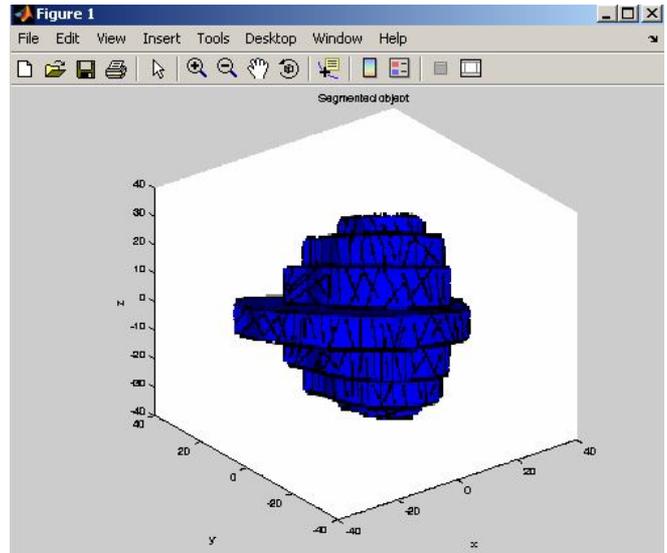


Figure5. Segmentation tumor image in 3D

**V. 3D WATERSHED SEGMENTATION**

A watershed segmentation biased occurs when the neighbors of a treated face are also the neighbors of the other faces not yet treated or in the case of the immersion of that region where the order of processing is arbitrary. To eliminate this biased, has proposed a technique to assign a pair-value to a final label, and an odd-value to a temporary label. A face that is stacked is analyzed: if it has two different neighbors of pair labels, it is a watershed. Otherwise it will take its own associated pair-label. For each face of the final label, we explore its neighborhood that we label on a temporary basis before placing it in the hierarchical queue. A simple stack (called alpha) that has higher priority is added to manage the faces of the neighborhood witch are of the same level.

The hierarchical queue is made up of several FIFO queues and each queue corresponds to a curve level. Queues are sorted by level and each queue can be un-stacked only if previous queues are emptied. The faces initially marked are the first to be stacked by assigning each a different label. The faces observed in the neighborhood of the faces treated throughout the immersion process will be placed in the queue corresponding to their level of curvature.

On applying watershed algorithm, shown in figure6, it is easy to identify the 3D view of tumor. By merging the generated regions based on Gaussian curvature, tumor is identified and specifications like height, width, length etc can be calculated.

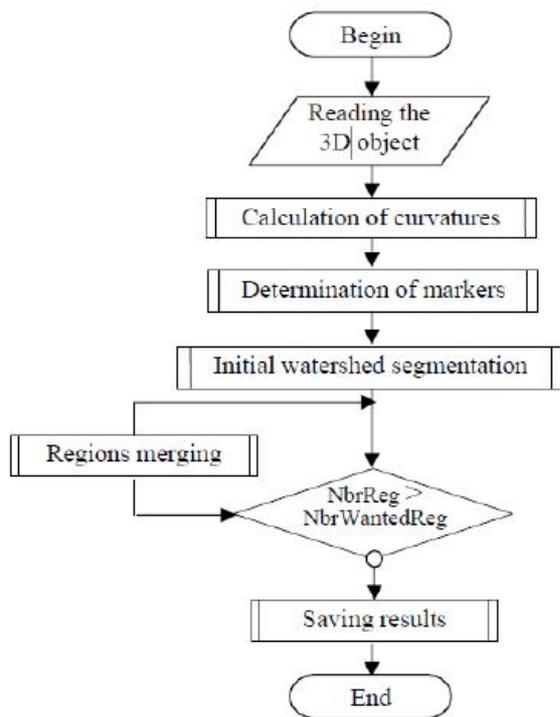


Figure6. Flowchart of 3D Watershed Segmentation

## VI. TRANSFERRING THROUGH BLUETOOTH

After segmentation of a tumor in brain conjunction, the tumor being benign or malignant and send the reports through means of a Bluetooth device or an SMS. This will make the surgeons able to perform operations inside a patient without open surgery.

### A. Advantages of Using Bluetooth

Bluetooth is a wireless technology standard for exchanging data over short distances from fixed and mobile devices, creating personal area networks (PANs) providing high levels of security. It's the future of high speed.

At any given time, data can be transferred between the master and one other device. The master chooses which slave device to address; typically, it switches rapidly from one device to another in a round-robin fashion. Since it is the master that chooses which slave to address, whereas a slave is (in theory) supposed to listen in each receive slot, being a master is a lighter burden than being a slave. Use of BT technology would lead to replacement of previous wired RS-232 serial communications in test equipment, GPS receivers, medical equipment, bar code scanners, and traffic control devices.

Using BT technology would save paper as the information (electronic report), would be sent through means of data transfer in cell phones or tabs. Report visualized in an LED/LCD screen will be much clearer to understand for both doctor and the patients. The level of transparency between doctor and patients will get increased. Use of Bluetooth technology is cost effective too. The receiver should have a Bluetooth device as the basic requirement. Also, such an idea would require low electricity consumption and would also work in the absence of electricity.

## VII. CONCLUSION AND FUTURE SCOPE OF WORK

This project tries to prove that methods aimed at general purpose segmentation tools in medical imaging can be used for automatic segmentation of brain tumors. Results show that Watershed Segmentation can successfully segment a tumor provided the parameters are set properly in MATLAB environment and 3D Slicer. The main program must receive the segmented image and present the image as an opaque volume. It would have only one limitation that the method be semi-automatic. Watershed transform is an unsurpassed and the finest routine to segment an image. It can also segment non homogeneous tumors providing the non homogeneity is within the tumor region. On detecting the tumor to its ultimate level, it could be calculated whether the detected element was benign or malignant. The entire report about the tumor for example the size, volume (position if possible), and carcinogenic nature can be conveyed to a device using Bluetooth technology or through an SMS.

Hitherto, this project could act as a second opinion to surgeons before conducting intricate tests, thereby providing some welfare and relief to unfortunate humans who have been a victim of tumors (whichever benign or malignant).

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## REFERENCES

- [1] Abbasi, S and Mokhtarian F. Affine-similar Shape Retrieval: Application to Multiview 3-D object Recognition. 131-139. IEEE Trans, Image processing vol.10, no. 1, -2001.
- [2] Deng, Y, Manjunath, BS, Kenney, C, Moore, MS, Shin, H. An efficient Color Representation for Image Retrieval. 140-147 IEEE Trans, Image processing vol.10, no. 1, 2001.
- [3] Yao Yao. Segmentation of breast cancer mass in mammograms and detection using Magnetic Resonance Imaging. IEEE Image Processing Society, 2004.
- [4] Black PM, Moriarty T, Alexander E. Development and implementation of intraoperative magnetic resonance imaging and its neurosurgical applications. 831- 845 Neurosurgery 1997.
- [5] Krishnan K, and Atkins MS. Segmentation of multiple sclerosis lesions in MRI – an image analysis approach. 1106-1116. Proc of the SPIE Medical Imaging 1998, vol. 3338, February 1998.
- [6] Epifano, I, and Ayala, G.A Random Set View of Texture Classification. 859-867 IEEE Trans, Image processing vol.11, no.8, 2002.
- [7] Vailaya, S, Figureueriodo, MAT, Jain, AK, and Zhang H-J. Image classification for content-Based Indexing. 117-130. IEEE Trans, Image processing vol.10, no. 1, -2001.



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