# BRAIN TUMOR DETECTION IN MEDICAL IMAGING USING MATLAB

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Abstract: Magnetic Resonance Imaging has become a widely used method of high quality medical imaging. Magnetic resonance imaging (MRI) is an advanced medical imaging technique providing rich information about the human soft tissue anatomy. Mathematical morphology provides a systematic approach to analyze the geometric characteristics of signals or images, and has been applied widely to many applications such as edge detection, object segmentation, noise suppression and so on. Image Segmentation is used to extract various features of the image which can be merger or split in order to build objects of interest on which analysis and interpretation can be performed. The paper focuses on the detection of brain tumor and cancer cells of MRI Images using mathematical morphology.

Keywords: Magnetic resonance imaging (MRI), Image segmentation, Digital Image Processing (DIP)

## 1. INTRODUCTION

Digital Image processing [1] is an emerging field in which doctors and surgeons are getting different easy pathways for the analysis of complex disease such as cancer, brain tumor, breast cancer, kidney stones, etc. The detection of brain disease [2, 4] is a very challenging task, in which special care is taken for image segmentation.  A particular part of body is scanned in the discussed applications of the image analysis and techniques such as MRI [2, 3], CT scan, X rays. The images are judged by physicians or surgeons to solve the problems. Brain tumor is a big cause of disability and death worldwide and related abnormalities constitute for major changes in life. A tremendous growth has been done in the last decade for brain tumor in the region of cerebral cancer diagnosis. Cerebral cancer [5] has been noticed that is spreading over the world and many colleges and university medical research centers are focusing on the issue. It can be understand with an example in US, in which 3000 children are facing the brain related diagnosis and brain tumors. Half of the children are dying at the age of 5 years and leaving a fatal cancer in other children too. The problem is more associated with neurological disabilities psychological problems, retardation that is leading the cause and risk of death. It has been noticed that African are having more chances of disease than other patients. In Tunisia, it is noticed for instance, that the cancers is mortality increasing among the elderly responsible for 14.8% of deaths. After cardiovascular diseases brain tumor is the second disease by which people are dying. The negative effect of the disease effects the economy of the country and society and disturb the family as well as and a high burden for the nation. There are several tests, conducted on the patient to detect the cancer. Most commonly test is Computed Tomography (CT) [1, 4] and Magnetic Resonance Imaging (MRI), which are used to locate brain tumor. The patient is influenced by the Information obtained and the patient will receive. The widely used diagnosis technique is MRI. The classification and detection of the tumor [6] is very expensive. MRI is an advance technique to detect the tissues and the disease of brain cancer. MRI provides the different information about different structures in the body which are achieved with the help of an X-ray, computed tomography (CT) scan, Ultrasound but MRI is the best technique for higher quality of its images and has the advantage of lack of side effects on the body tissues. MRI technology has a magnetic field and train pulses of radio wave energy that makes pictures of structures and organs within a body. Moreover, the amount of the resultant data is analyzed too much manually.  It constitutes the effective use of MRI images as main hurdle and obligates the effective application of computer aided automatic or semiautomatic methods [6] to analyze the product images. In the diagnosis analysis of MRI images, segmentation of image is required and analysis of image segmentation is very important part of any type of detection in image analysis. Image segmentation [1, 7] techniques help to get the meaningful

information, which is very much easy to analysis. Segmentation of tumor can be done based on the edge detection technique. It also segments other unknown regions too and limited to justify the brain tumor in a particular direction of left and right. When the algorithm is applied, the position of tumor should be known for the perfect detection in left or right direction. Finding of multiple tumors is also challenging and most of techniques user interface. Biomedical signal processing [6] in MATLAB is the integrated solution of the problems in tumor detection, real time access of tissue destruction, processing and time to time scaling for pathological and biological processes.

Human cell [3, 10] is having cancer as a major disease. The human body is a group of cells united together to form organs and tissues such as bones and muscles, liver and the lungs. In each cell order, Genes inside each the cell work, reproduce, grow, and die. Generally, human cells follow these orders, and persons remain healthy. Sometimes, these instructions are mixed together and causing the cells to form lumps or tumors, and spreading through the lymphatic system and bloodstream to another regions of the bogy. Tumors can be either malignant (cancerous) or benign (noncancerous). The tumor cells which stay in one place in the body are called benign and are not generally life-threatening. The tumor cells are able to invade nearby tissues called malignant and scattered and spared to another parts of the body. The cancer cells, which are spreading over other parts of the body, are called metastases. Brain is affected by the brain cancer starts in the human brain cells. The brain is a soft collective mass of neurons (nerves) and glial cells or supportive tissue, covered by membranes and protected by the skull. The brain is covering 3 main parts as shown in fig. 1

(i) The cerebrum is the biggest part of the brain and consists of the left and right cerebral hemispheres. It permits human body to move, see, think, feel, and speak. The left side of our brain controls the right side of our body and vice versa.

(ii) The position of the cerebellum is exactly in the back of the brain and controls coordination and balance.

(iii) Vital bodily functions in human body, like breathing, heartbeat, and reflexes are controlled by the brain stem. Brain is connected to the spinal cord with the help of brain stem. The skull is tough and hard and cannot explore. Moreover, tumor increases the pressure and can damage brain cells or destroy cells. Brain cancer mostly involves either the glial cells or the neurons. Cancer is started in the glial cells as an adult state and called astrocytomas or gliomas. Neurological specialists perform different

diagnostic tests for brain tumors. The names of the tests are Electroencephalogram (EEG), Lumbar puncture (spinal tap), RN (radionuclide), computerized axial tomographer (CT or CAT), MRI, PetScan and Biopsy.
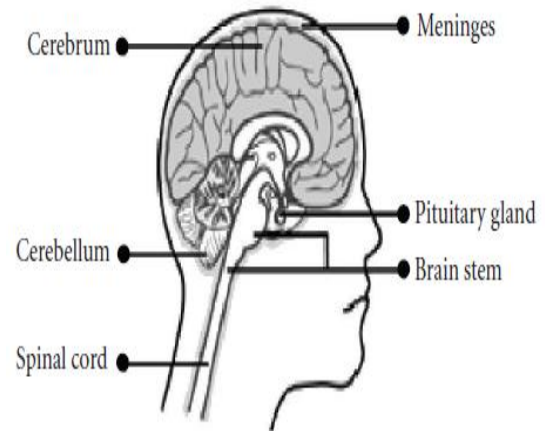


Fig. 1 Human Brain [11]

Brain tumor detection and extraction in MR image is an important digital image processing technique applied in radiology reconstruction of 2D and for 3D view. In real contours are rich indexes for any subsequent interpretation of the image. Contours in image are due to discontinuities of the reflectance function, and Discontinuities of the boundaries of the object or the depth. Intensity function is the characteristics counted by the contours are characterized by the discontinuities. **That's what**, the principle of contours detection is related to the study of the derivatives of the intensity function presented in the image. The contours are characterizing by the different boundaries of the objects, and separately defined as a transition mechanism between two regions of different characteristics available in parallel or simultaneously to within a single digital image.

Image segmentation is a technique of portioning of an image into groups of pixels which are homogenous with respect to some criterion. Different groups must not interact with each other, and adjunct groups must be heterogeneous. Segmentation algorithms are area oriented instead of pixel oriented. The result of segmentation is the splitting up of the image into connected areas. Thus segmentation is concerned with dividing an image into meaningful regions.

## 2. RELATED WORK

The review carried out on the following papers and discussed in brief, which is related to our research work. A.R Kavita et at.[1 propose an effective modified region growing technique for detection of brain tumour. They modified region include comparative for modified region growing using both the Feed Forward Neural Network (FFNN) and Radial Basis Function (RBF) neural network. The MRI image dataset taken from the publicly available sources contains 40 brain MRI images in which 20 brain images with tumour and the other 20 brain images without tumour. **AbidinAltıntaş**et at. [3] Extracorporeal Shock Wave Lithotrispy (ESWL) is a procedure based on sound waves to crash kidney stones on the focus. The sound waves are sent to the body of patient when the kidney stone is not even on the focus. Ali Gholipouret at. [5] Functional localization is a concept which involves the application of a sequence of geometrical and statistical image processing operations in order to define the location of brain activity or to produce functional/parametric maps with respect to the brain structure or anatomy. The problems addressed by these techniques differ depending on the application and the type of analysis, i.e., single-subject versus group analysis. EmmanouilSkounakiser at. [7] This research presents a new MRI diagnosis-assistive **platform that, after initial creation of a "template," is** capable of providing a more automatic 3-D identification of kidneys and their abnormalities (tumors, stones, and cysts). K. S. Angel Vijiet at. [9] presented a manual segmentation procedure the tumor identification, the investigations has been made for the potential use of MRI data for improving brain tumor shape approximation and 2D & 3D visualization for surgical planning and assessing tumor. MubbasharSaddiqueet at. [11] presented two hybrid segmentation techniques and their results are compared with well-recognized techniques in this area. The first technique is based on symmetry and we call it a hybrid algorithm using symmetry and active contour.

## 3. METHODOLOGY

Brain tumor and program code will be written and modeled in MATLAb image processing tool with the help of existing algorithms. The methodlogy followed is shon in fig.2
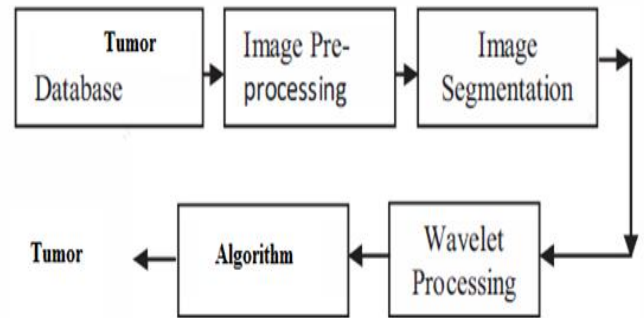


Fig. 2 detection methodology

*A. Tumor Image Database:* The 500 US Tumor images of both normal and abnormal kidney are collected from different hospitals of different patients and are stored in database. One of the image is taken from the database and subjected to tumor detection.

*B. Image Pre-Processing:* The acquired ultrasound (US) image consists of speckle noise and is of low contrast. Due to this, the image quality is may not be good for analyzing. For surgical operations it is very important to identify the location of kidney stone. To overcome speckle noise, and low contrast, pre-processing of image restoration is required.

*1. Image Restoration*

The very purpose of image restoration is to reduce the degradations that are caused during acquisition of US scanning. In this system for proper orientation, level set function is used. By the use of plan curve motion, curve smoothers, shrinks are eventually disappeared [1].

*2. Smoothing and Sharpening*

To obtained optimal resolution in both spatial and frequency domains, Gabor filter is used which act as band pass filter for the local spatial frequency distribution. The standard deviation of the Gaussian function can be varied to adjust degree of smoothening.

*3. Contrast Enhancement:* To improve contrast and to obtain uniform intensity histogram equalization is used. This approach can be used on whole image or part of an image. In this system, enhancing the contrast of images is done by transforming the values in an intensity image, such that the histogram of the output image approximately matches a specified histogram. The output signal is of same data type as the input signal.

**OTSU'S Method for Image Segmentation and Optimal** Global Thresholding

Let the components of an image histogram be denoted by

P=nq/n    q=0, 1, 2, 3...............................L-1

Where n is the total number of pixels in the image nq, is the number of pixels that have intensity level q, and L is the total number of possible intensity levels in the image (remember. Intensity levels are integer values). Now suppose that a threshold k is chosen such that c1 is the set of pixels with levels [0, 1, 2...k] and c2 is the set of pixels with levels [k=1 ...L-1].

Ostu's method is optimum,in the sense that it chooses the threshold value k that maximizes the between-class variance , defined as; {0, 1, 2... L-1},L means gray level intensity

M*N is the total number of pixel, Denote the number of pixels with intensity

We select $C_1$ a threshold and use it to classify: intensity in the range and $C_2$ ; $[k+1, L-1]$

$$P_1(k) = \sum_{i=0}^{k} p_i \qquad P_2(k) = \sum_{i=k+1}^{L-1} p_i = 1 - P_1(k)$$

; Apply this

$$P_1 m_1 + P_2 m_2 = m_G$$

After that

$$P_1 + P_2 = 1$$

$$\sigma_G^2 = \sum_{i=0}^{L-1} (i - m_G)^2 p_i \quad \text{It is } \textit{global variance.}$$

$$\sigma_B^2(k) = P_1 P_2 (m_1 - m_2)^2 = \frac{(m_G P_1(k) - m(k))^2}{P_1(k)(1 - P_1(k))}$$

Above is a Regional process

$$\eta = \frac{\sigma_B^2(k)}{\sigma_G^2} \qquad 0 \le \eta(k^*) \le 1$$

It is a measure of *seprability between classes.*

Onwards

$$\sigma_B^2(k^*) = \max_{o \le k \le L-1} \sigma_B^2(k)$$

$$g(x, y) = \begin{cases} 1 & \text{if } f(x,y) \ge k^* \\ 0 & \text{if } f(x,y) \le k^* \end{cases}$$

For x = 0, 1, 2... M-1 and y = 0, 1, 2..., N-1.

Syntax for otsu method:-

[T,SM]=graythresh(f), Where f is input image.

T is resulting threshold normalized to range [0,1].

SM is separability measure.>>[T,SM]=graythresh(f)

T=.4902, SM=0.9437, >>T*255Ans=125

G=im2bw(f,T/255);Imshow(G);

$$[k+1, L-1]$$
$$C_2$$

## 4. RESULTS & DISCUSSIONS

To test the effectiveness of the proposed scheme, we have tested the density based morphological brain MR Image segmentation method on four different real brain MR Images. Proposed algorithm is applied on the image(grey , color), aerial image and a high-resolution image. This image Fig. 3(a) can be obtained after the rgb to grey conversion if the original image is colorful. Now we sharp and enhance the image, Fig. 3(b). Resulting image is shown after thresholding using Otsu's method, fig 3(c). By edge detection we get fine edges of gradient magnitude, fig. 3(d). Now we apply morphological operation and gets result as shown in fig. 3(e).
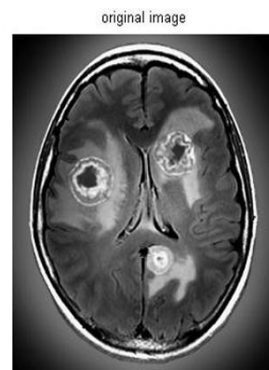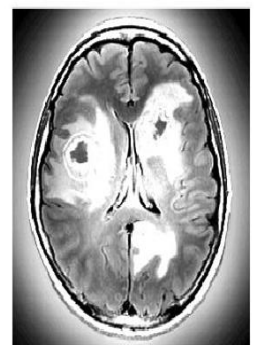


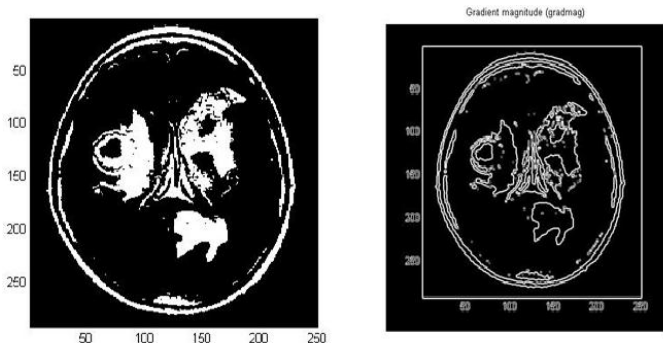Fig 3 (a) Original Image    Fig 3(b) Enhanced image
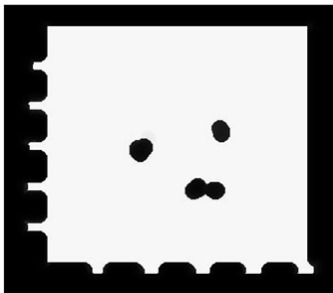
Fig 3(c) Threshold imageFig. 3(d) Gradient Image



Fig. 3(e) Tumor detected image

## 4. CONCLUSION

MR image segmentation is an important but inherently difficult problem in medical image processing. In general, it cannot be solved using straightforward, conventional image processing techniques. Due to the characteristics of MR images, development of automated algorithms is challenging. There is a significant inter-patient variation of signal intensities for one same tissue type because of partial volume effect, inherent noise and wide range of imaging parameters, which affect the tissue intensities. We have proposed an efficient classification system based on density-based clustering approach to detect the brain tumor. The MATLAB simulation is carried on different brain images and tumor is detected using OTSU'S method for image segmentationand optimal global thresholding. The brain tumor detection is a great help for the physicians and a boon for the medical imaging and industries working on the production of CT Scan and MRI imaging.

## ACKNOWLEDGEMENT

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BIOGRAPHIES



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