Brain Tumour Extraction from MRI Images Using MATLAB

IMAGE PROCESSING - J COMPONENT

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INTRODUCTION

I. Tumour is defined as the abnormal growth of the tissues. Brain tumour is an abnormal mass of tissue in which cells grow and multiply uncontrollably, seemingly unchecked by the mechanisms that control normal cells. Brain tumours can be primary or metastatic, and either malignant or benign. A metastatic brain tumour is a cancer that has spread from elsewhere in the body to the brain

II. Epilepsy is a brain disorder in which clusters of nerve cells, or neurons, in the brain sometimes signal abnormally. Neurons normally generate electrochemical impulses that act on other neurons, glands, and muscles to produce human thoughts, feelings, and actions. In epilepsy, the normal pattern of neuronal activity becomes disturbed, causing strange sensations, emotions, and behaviour or sometimes convulsions, muscle spasms, and loss of consciousness [3].

III. Magnetic Resonance Imaging (MRI) is an advanced medical imaging technique used to produce high quality images of the parts contained in the human body MRI imaging is often used when treating brain tumours, ankle, and foot. From these high-resolution images, we can derive detailed anatomical information to examine human brain development and discover abnormalities. Nowadays there are several methodology for classifying MR images, which are fuzzy methods, neural networks, atlas methods, knowledge based techniques, shape methods, variation segmentation. MRI consists of T1 weighted, T2 weighted and PD (proton density) weighted images and are processed by a system which integrates fuzzy based technique with multispectral analysis [2].

Pre-processing of MRI images is the primary step in image analysis which perform image enhancement and noise-reduction techniques which are used to enhance the image quality, then some morphological operations are applied to detect the tumour in the image. The morphological operations are basically applied on some assumptions about the size and shape of the tumour and in the end the tumour is mapped onto the original gray scale image with 255 intensity to make visible the tumour in the image. The algorithm has been tried on a number of patients MRI data of brain tumour images in.

METHODOLOGY

The algorithm has two stages, first is pre-processing of given MRI image and after that segmentation and then perform morphological operations. Steps of algorithm are as following:-

1) Give MRI image of brain as input.
2) Convert it to gray scale image.
3) Compute threshold segmentation.
4) Compute watershed segmentation.
5) Compute morphological operation.
6) Finally output will be a tumour region.

All above steps are explained here in detail.

1. Grayscale Imaging

MRI images are magnetic resonance images which can be acquired on computer when a patient is scanned by MRI machine. We can acquire MRI images of the part of the body which is under test or desired. Generally when we see MRI images on computer they looks like black and white images. In analog practice, gray scale imaging is sometimes called "black and white," but technically this is a misnomer. In true black and white, also known as halftone, the only possible shades are pure black and pure white. The illusion of gray shading in a halftone image is obtained by rendering the image as a grid of black dots on a white background (or vice-versa), with the sizes of the individual dots determining the apparent lightness of the gray in their vicinity. The halftone technique is commonly used for printing photographs in newspapers and as MRI image is taken on computer then In the case of transmitted light (for example, the image on a computer display), the brightness levels of the red (R), green
(G) and blue (B) components are each represented as a number from decimal 0 to 255, or binary 00000000 to 11111111. For every pixel in a red-green-blue (RGB) grayscale image, R = G = B. The lightness of the gray is directly proportional to the number representing the brightness levels of the primary colours. Black is represented by R = G = B = 0 or R = G = B = 00000000, and white is represented by R = G = B = 255 or R = G = B = 11111111. Because there are 8 bit s in the binary representation of the gray level, this imaging method is called 8-bit grayscale
Grayscale is a range of shades of gray without apparent colour. The darkest possible shade is black, which is the total absence of transmitted or reflected light. The lightest possible shade is white, the total transmission or reflection of light at all visible wavelengths. So because of the above reasons first we convert our MRI image to be pre-processed in grayscale image

2. Threshold Segmentation

The simplest method of image segmentation is called the thresholding method. This method is based on a clip-level (or a threshold value) to turn a gray-scale image into a binary image.

The key of this method is to select the threshold value (or values when multiple-levels are selected).

Image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyse.[1] Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.

Each of the pixels in a region are similar with respect to some characteristic or computed property, such as colour, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s).[1] When applied to a stack of images, typical in Medical imaging, the resulting contours after image segmentation can be used to create 3D reconstructions with the help of interpolation algorithms like Marching cubes.

3. Watershed segmentation

A grey-level image may be seen as a topographic relief, where the grey level of a pixel is interpreted as its altitude in the relief. A drop of water falling on a topographic relief flows along a path to finally reach a local minimum. Intuitively, the watershed of a relief correspond to the limits of the adjacent catchment basins of the drops of water.

In image processing, different watershed lines may be computed. In graphs, some may be defined on the nodes, on the edges, or hybrid lines on both nodes and edges. Watersheds may also be defined in the continuous domain. There are also many different algorithms to compute watersheds.

Meyer's flooding Watershed Algorithm

One of the most common watershed algorithms was introduced by F. Meyer in the early 90's.

The algorithm works on a gray scale image. During the successive flooding of the grey value relief, watersheds with adjacent catchment basins are constructed. This flooding process is performed on the gradient image, i.e. the basins should emerge along the edges. Normally this will lead to an over-segmentation of the image, especially for noisy image material, e.g. medical CT data. Either the image must be pre-processed or the regions must be merged on the basis of a similarity criterion afterwards.

1. A set of markers, pixels where the flooding shall start, are chosen. Each is given a different label.
2. The neighbouring pixels of each marked area are inserted into a priority queue with a priority level corresponding to the gray level of the pixel.
3. The pixel with the highest priority level is extracted from the priority queue. If the neighbours of the extracted pixel that have already been labelled all have the same label, then the pixel is labelled with their label. All non-marked neighbours that are not yet in the priority queue are put into the priority queue.
4. Redo step 3 until the priority queue is empty.

The non-labelled pixels are the watershed lines.

4. Morphological Operations

Morphological image processing is a collection of non-linear operations related to the shape or morphology of features in an image. According to Wikipedia, morphological operations rely only on the relative ordering of pixel values, not on their numerical values, and therefore are especially suited to the processing of binary images. Morphological operations can also be applied to greyscale images such that their light transfer functions are unknown and therefore their absolute pixel values are of no or minor interest. Morphological techniques probe an image with a small shape or template called a structuring element. The structuring element is positioned at all possible locations in the image and it is compared with the corresponding neighbourhood of pixels. Some operations test whether the element "fits" within the neighbourhood, while others test whether it "hits" or intersects the neighbourhood:

The structuring element is a small binary image, i.e. a small matrix of pixels, each with a value of zero or one:

- The matrix dimensions specify the *size* of the structuring element.
- The pattern of ones and zeros specifies the *shape* of the structuring element.

An origin of the structuring element is usually one of its pixels, although generally the origin can be outside the structuring element

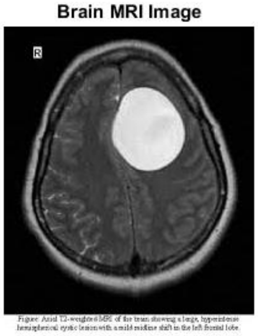
MATLAB CODE

```
I=imread('C:\Users\Naren Adithya\Desktop\5.jpg');
figure, imshow(I); title('Brain MRI Image');
I = imresize(I,[200,200]);
I= rgb2gray(I);
I= im2bw(I,.6);%binarising with thresold .6
figure, imshow(I);title('Thresholded Image');
hy = fspecial('sobel');
hx = hy';
Iy = imfilter(double(I), hy, 'replicate');
Ix = imfilter(double(I), hx, 'replicate');
gradmag = sqrt(Ix.^2 + Iy.^2);
L = watershed(gradmag);
Lrgb = label2rgb(L);
figure, imshow(Lrgb), title('Watershed segmented image ')
se = strel('disk', 20);
Io = imopen(I, se);
Ie = imerode(I, se);
Iobr = imreconstruct(Ie, I);
Iobrd = imdilate(Iobr, se);
Iobrcbr = imreconstruct(imcomplement(Iobrd), imcomplement(Iobr));
Iobrcbr = imcomplement(Iobrcbr);
I2 = I;
fgm = imregionalmax(Iobrcbr);
I2(fgm) = 255;
se2 = strel(ones(5,5));
fgm2 = imclose(fgm, se2);
fgm3 = imerode(fgm2, se2);
fgm4 = bwareaopen(fgm3, 20);
I3 = I;
bw = im2bw(Iobrcbr);
figure
imshow(bw), title('only tumor')
```

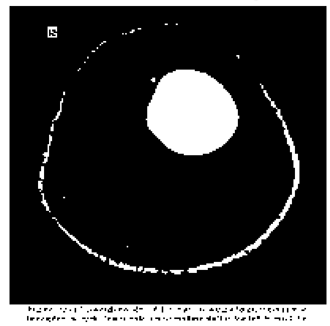
OUTPUTS

SAMPLE A

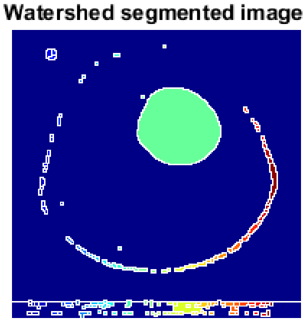
Brain MRI Image



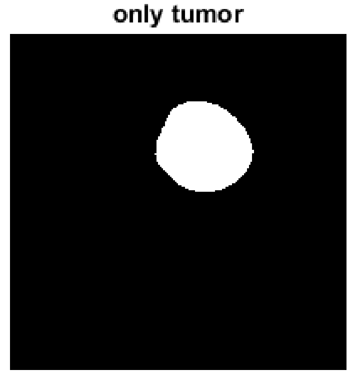
Thresholded Image



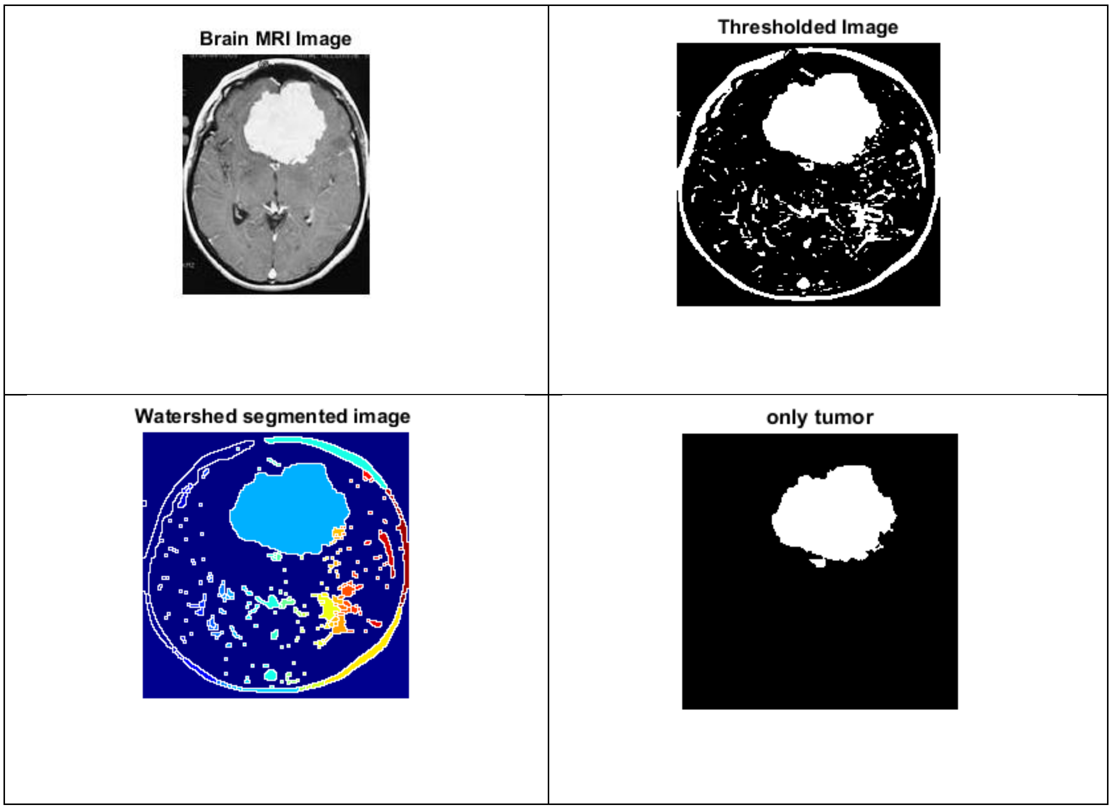
Watershed segmented image



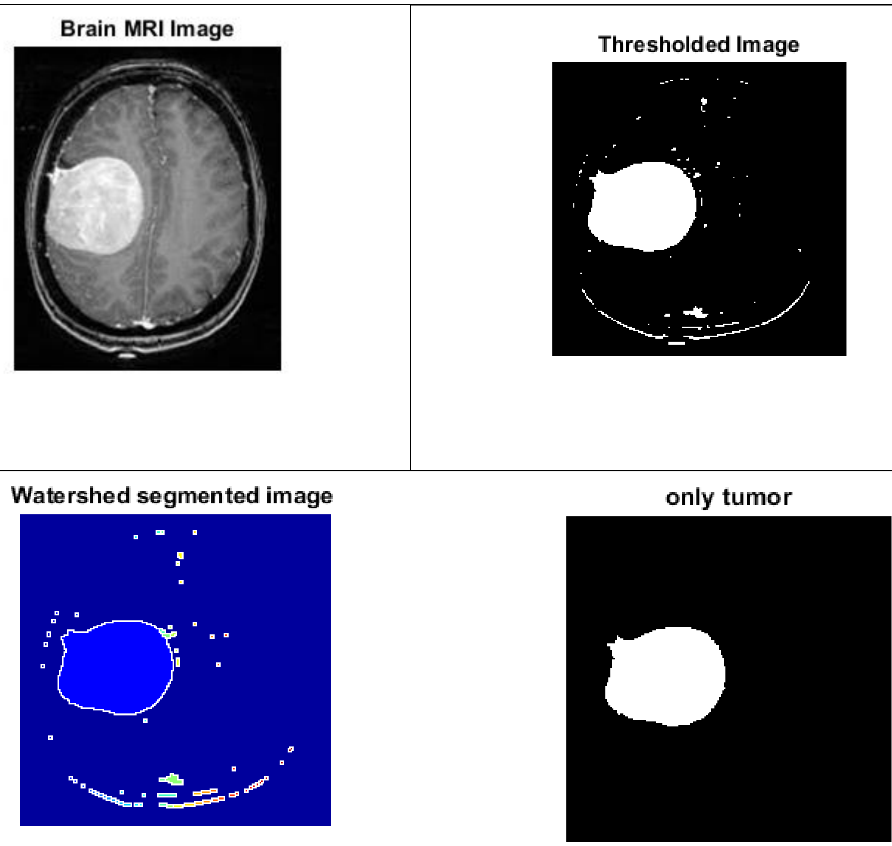
only tumor



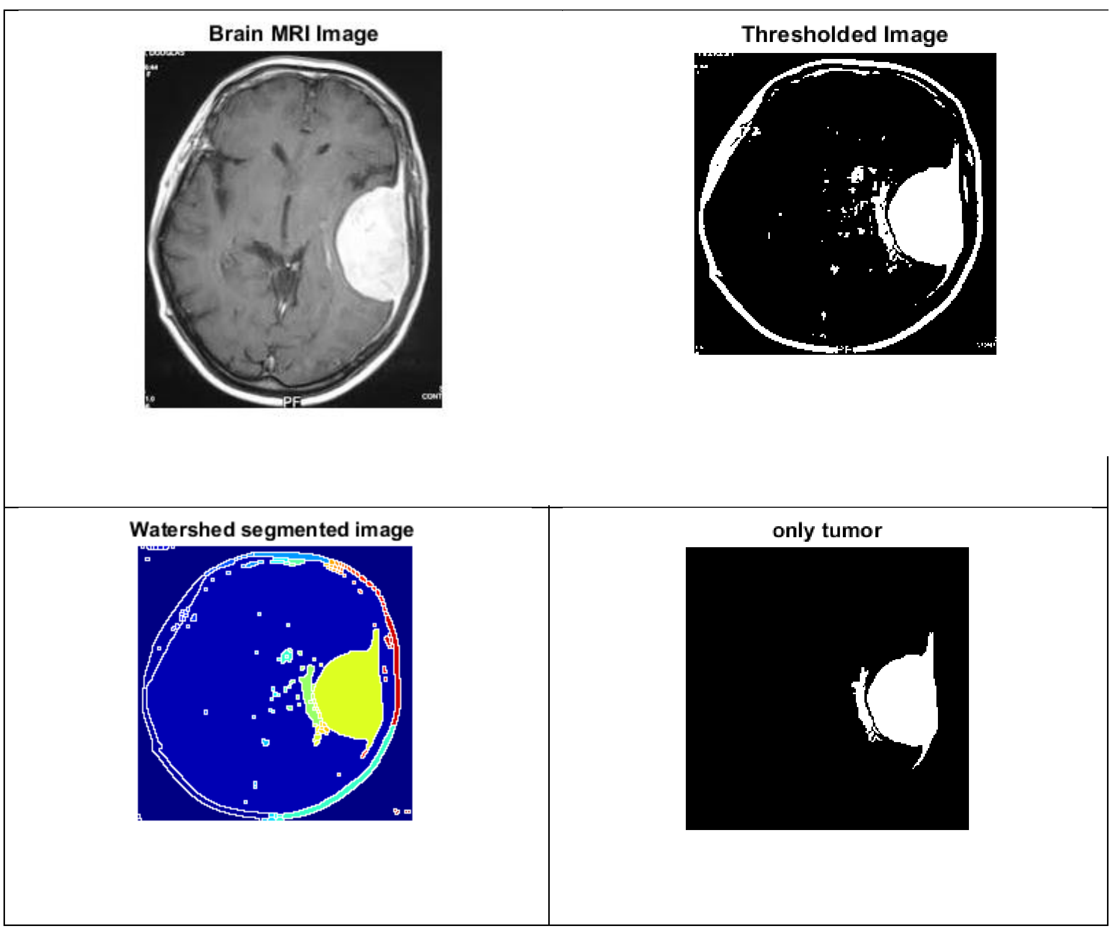
SAMPLE B


Brain MRI Image
Thresholded Image
Watershed segmented image
only tumor

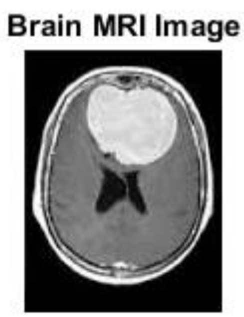
SAMPLE C

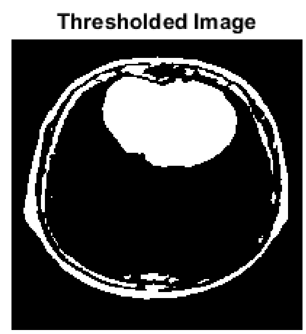

Brain MRI Image
Thresholded Image
Watershed segmented image
only tumor

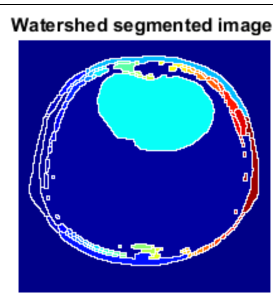
SAMPLE D

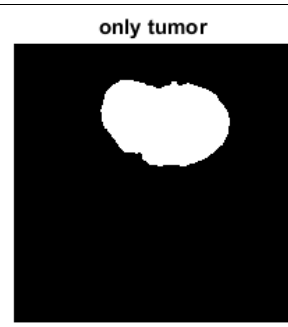

Brain MRI Image
Thresholded Image
Watershed segmented image
only tumor

SAMPLE E


Brain MRI Image


Thresholded Image


Watershed segmented image


only tumor

RESULT

From the results we can intervene that these process can be used to identify the location of tumour from an mri.as we can see the processing time of code from MRI image to image containing tumour is very less we can use this application in real time system which will very helpful in field on medicine

SCOPE

From this processed image we can create a database and use it for training an artificial neural network or deep learning algorithm which can identify even more details of tumour such as whether it is malignant of Benign .this can change the future of identification tumour. This scope will be revolution in field of medical science.

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