

DETECTION OF BRAIN TUMOUR IN MR IMAGES USING MATLAB

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ABSTRACT: Digital Image Processing is the manipulation of digital images through a digital computer. It is used to convert signals from an image sensor into digital images, removes noise and improves clarity, compress images for transmission. It is a subfield of signals and systems but focus particularly on images. Effective techniques for processing digital images include using algorithms and tools that provide a comprehensive environment for data analysis, visualization, and algorithm development. Digital image processing is an ever expanding and dynamic area with applications reaching out into our everyday life such as medicine, space exploration, surveillance, authentication, automated industry inspection and many more areas. Applications such as these involve different processes like image enhancement and object detection. Medical image processing is one of the fast developing applications of DIP. MATLAB is a high level technical language used mainly for Image processing. In this paper, we have developed an algorithm using Lowpass, Highpass and median filters to detect tumour and to segment it using MATLAB. MR Images of the human brain with tumour are given as input. The position of the tumour in MRI is detected and segmented. This enhances the tumour boundaries precisely and gives better results about the location and the size of the tumour.

Key words: *Magnetic Resonance Image (MRI), Brain, Tumour, Filters, segmentation*

INTRODUCTION:

Digital image processing is the use of computer algorithms to create process, communicate, and display digital images. It deals with manipulation of digital images through a digital computer. It is used to convert signals from an image sensor into digital images, removes noise and improves clarity, compress images for transmission. It is a subfield of signals and systems but focus particularly on images. DIP focuses on developing a computer system that is able to perform processing on an image. Effective techniques for processing digital images include using algorithms and tools that provide a comprehensive environment for

data analysis, visualization, and algorithm development [1].

The input of that system is a digital image and the system process that image using efficient algorithms, and gives an image as an output. An image refers to a 2D light intensity function $f(x,y)$, where (x,y) denote spatial coordinates and the value of f at any point (x,y) is proportional to the brightness or gray levels of the image at that point. A digital image is an image $f(x,y)$ that has been discretized both in spatial coordinates and brightness. The elements of such a digital array are called image elements or pixels. They are stored in computer memory as a digital image. A typical size for a digital image is an array of 512 by 512 pixels, where each pixel has value in the range of 0 to 255. The digital image is processed by a computer to achieve the desired result (Rapp et al., 1996).

Digital image processing is an ever expanding and dynamic area with applications reaching out into our everyday life such as medicine, space exploration, surveillance, authentication, automated industry inspection and many more areas. Applications such as these involve different processes like image enhancement and object detection (Ross, 1994). Medical image processing is one of the fast developing applications of DIP.

Generally images are of two types, one is Gray Scale Images and other one is RGB images. Gray scale image has only one channel and RGB image have three channels. Noise may occur due to heat of camera sensors, analogue to digital conversion and communication channels. This type of noises cause to degrade the image quality, therefore it is very important to remove the positive and negative impulses by using filtering technique. Most probably the Linear Filtering technique will consider the two filtering techniques like Mean Filter (MF) and Least Mean Square (LMS). Median Filter considers under non-linear filtering technique[2].

There are different existing filtering techniques like Median Filter, Standard Median Filter, Adaptive Median Filter, average filtering, and Decision Based Algorithm.

MORHOLOGICAL IMAGE PROCESSING

Mathematical morphology is a tool for extracting image components that are useful in the representation and description of region, shape such as

boundaries, skeletons, and the skull. The morphological techniques are used for pre & post-process such as filtering, thinning and pruning. It offers a unified and powerful approach to numerous image processing problems. A set of white pixels in the binary images are the complete morphological description of the image. Erosion and Dilation are the two important and fundamental morphological processing. Erosion shrinks or thins objects in a binary image, whereas dilation grows or thickens objects in a binary image. The thickening is controlled by the shape of the structuring element. Morphological algorithms are used to extract the image components that are useful for representation and description of shape.

HUMAN BRAIN

The brain is the anterior part of the central nervous system. Along with the spinal cord, it forms the central nervous system (CNS). Brain tumour is an abnormal growth caused by cells reproducing themselves in an uncontrolled manner. A brain tumour usually involves a neurological examination, brain scans, and/or an analysis of the brain tissue. A neurological examination is a series of tests to measure the function of the patient's nervous system and physical and mental alertness. A brain scan is a picture of the internal structures in the brain. A specialized machine takes a scan in much the same way a digital camera takes a photograph. The most common scans used for diagnosis is MRI. MRI is a scanning device that uses magnetic fields and computers to capture images of the brain on film. It provides pictures from various planes, which helps doctors to create a three dimensional image of the tumour. The MRI detects signals emitted from normal and abnormal tissue provides clear images of most tumours. MRI uses radio frequency and magnetic field to obtain the image of a human body without using ionized radiations. Imaging plays an important role in the diagnosis of brain tumours. In MRI, the amount of data obtained is very large to manually analyze and interpret[4].

MRI strongly depends on computer technology to generate or display digital images. It takes a long time for diagnosis without using image processing techniques. It is very difficult to perform brain surgeries without using image processing techniques. Detecting brain tumors from MR Images is a complex medical process and cannot be done without image processing techniques. Structures like tumour, brain tissue and skull cannot be identified without image segmentation. Image Segmentation is necessary to extract complex information from images. Segmentation is an important process in most of the medical image analysis. It is an important process in medical image analysis and is a challenging problem due to noise present in the input images. In the present study, brain tumour image analysis and segmentation is performed using low pass, high pass and median filters. The tools used for image analysis are MATLAB 7.9.0 (R2009b).

MATLAB

MATLAB and the Image Processing Toolbox provide a wide range of advanced image processing functions and interactive tools for enhancing and analyzing digital images. The interactive tools allowed us to perform spatial image transformations, morphological operations such as edge detection and noise removal, region-of-interest processing, filtering, basic statistics, curve fitting, FFT, DCT and Radon Transform. Making graphics objects semitransparent is a useful technique in 3-D visualization which furnishes more information about spatial relationships of different structures. The toolbox functions implemented in the open MATLAB language has also been used to develop the customized algorithms.

The Image Tool is a simple which can contribute to a quick image processing and analysis without writing a code and use Matlab language. These properties makes it a very useful tool when deep analysis is not the ultimate goal but quick processing for better view is desirable. The Image Tool opens by simply writing the command `imtool` in the main function window. In the menu, there are many functions already installed in order to use it as simple image processing software.

The tools include image information appearance, image zooming in and out, panning, adjustment of the window level and width, adjustment of contrast, cropping, distance measurement, conversion of the image to a pixel matrix and colour map choices (grey scale, bone colour, hot regions among others). These are the most common functions likely to be performed in the initial processing approach. Moreover, the user can make some further manipulations such as 3D rotation to respective 3D images and plotting of pixel data.

To find out a transformation between two images precisely, they should be pre-processed to improve their quality. If these images are too noisy or blurred, they should be filtered and sharpened. In image processing, filters are mainly used to suppress either the high frequencies in the image, enhancing or detecting edges in the image. An image can be filtered either in the frequency or in the spatial domain.

A low pass filter is the basis for most smoothing methods. An image is smoothed by decreasing the disparity between pixel values by averaging nearby pixels. A high pass filter is the basis for most sharpening methods. An image is sharpened when contrast is enhanced between adjoining areas with little variation in brightness or darkness. Median filter is a non-linear process and is useful in preserving edges in an image. In this work all the three types of filters are used for segmentation.

Algorithm

The input is MR image and the output is normality- abnormality detection based on the symmetry value of the brain. The algorithm is carried out in six main steps.

- MR image of the human brain is given as the input.
- Remove background by thresholding.
- Calculate normalized grey level histograms of the left and right hemispheres, with the normalized integral of each histogram being 1.
- Reduce the shift between the left and right histograms caused by RF inhomogeneity .
- Calculate the similarity between the two histograms using symmetry measures
- Judge each data as normal or with suspicious tumours according to the quantified similarity value of each symmetry measure.
- Separate the tumour portion from the original image using various filters

RESULTS AND DISCUSSION

The MR images of the human brain with tumours were obtained from various sources. The location for input image is selected by clicking load button and it will lead to the location of image stored in file of user computer. Different format of images can be uploaded. After loading an input image its respective filtered image will be executed in two different forms in an adjacent box as written in program. Hence the filtered image is now considered as input to next step and its morphological segmented image will be executed. The resultant image shows the presence of tumour. with different segmentation process, the tumour present in the MRI is segmented and will be displayed. Fig.1(a) shows the command window in which input image is given and the various stages of processing are displayed when the “DETECT TUMOUR BUTTON “is clicked. Fig.1(b) & Fig.1(c) shows the input MR image and the image of the detected tumour. This is displayed when the output button is pressed.

Fig.1(a)Loading of a brain image, its filtered, segmented and approximated region of tumour.

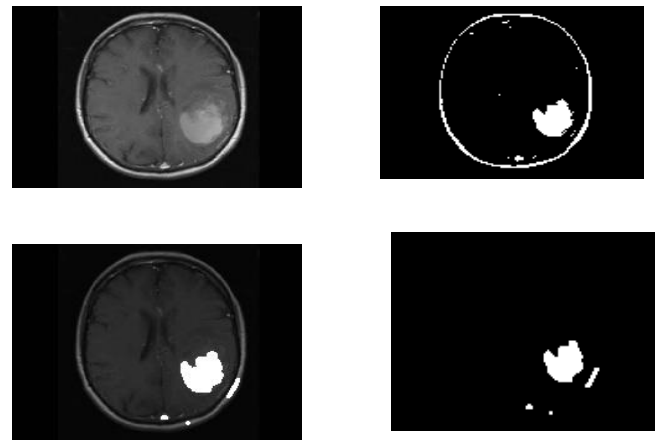


Fig. 1 (b)

Fig1. (c)

Fig.1(b)Input MR Image and Tumour Filtered
 Fig.1(c)segmented Detecte region of tumour

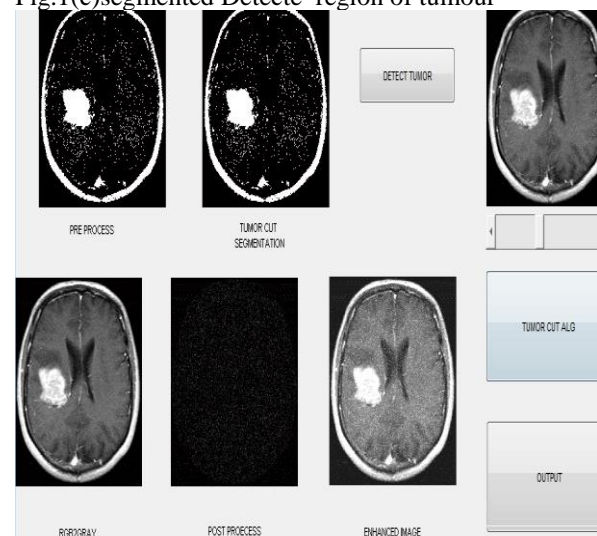
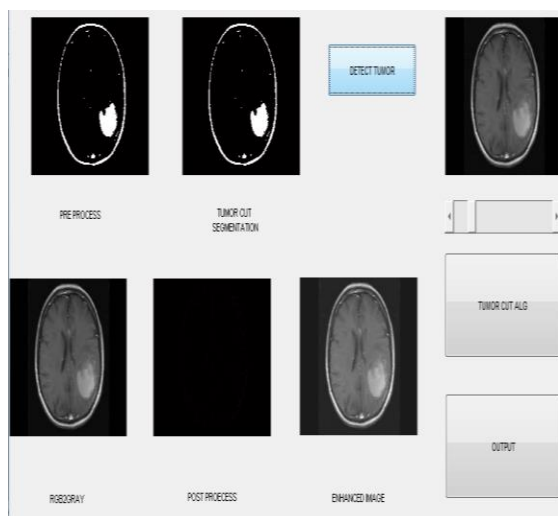


Fig.2(a)Loading of another brain image, its filtered, segmented and approximated region of tumour



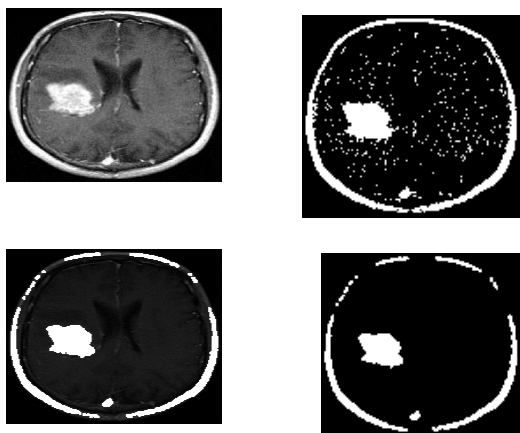


Fig.2(b)

Fig2. (c)

Fig.2(b)Input MR Image and Tumour Filterd

Fig.2(c)segmented Detected region of tumour

CONCLUSION

In this proposed work, Detection and Segmentation of brain tumours with MR Images were carried out using Lowpass, Highpass and Median filters and MATLAB. The filtering techniques reduce the noises to a greater extent and give a very good result. The image analysis using this method is simple and efficient. This enhances the tumour boundaries precisely and gives better results about the location and the size of the tumour.

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