

# Implementation and Analysis of MR images to detect Brain tumor and its direction of propagation using MATLAB

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**Abstract**— This paper aims to build an innovative approach to monitor brain tumor, to find its direction of propagation by processing MRI. There are two main types of Brain tumor, Malignant and non-malignant. Radiologists can easily plan treatment sessions if they are aware of type of tumor and direction in which it spreads. This paper also helps to detect type of tumor so that radiologists can plan the treatment sessions effectively. This can be achieved by performing some operations on MR image. Firstly dividing the image into many segments i.e. Segmentation and then reconstructing and Enhancement. Later finding the tumor and non-tumor region. Finally dividing the image into quadrants to find out the direction of propagation of tumor.

**Keywords** — MRI, Segmentation, Bit plane slicing, Quadrant method, MATLAB, Malignant tumor, Benign tumor, Propagation.

## I. INTRODUCTION

At present Brain pathologies are monitored and diagnosed by existing Magnetic Resonance Imaging technology. But the MR imaging systems are not capable of processing the images, where these systems are only meant for imaging and could not provide an automated processing of the image. The automatic processing of the images reduces the efforts of radiologists in diagnosing the defects. For case study, we have considered brain tumor and try to process the MR images to reduce the efforts of radiologists. Brain tumor is growth of cells in abnormal way that multiplies uncontrollably.

According to Brain tumor statistics, performed by American brain tumor association, nearly 700,000 cases of brain tumors are found in U.S. Brain tumors categorized as malignant and non-malignant tumors. Malignant tumors are most common in children whereas non-malignant tumors are most seen in adults [1]. In such conditions, analysis of MRI report by physicians may not be accurate and can lead to delay in treatment. This results in severity of the case. Our approach provides way to process this MRI images by using computer which results more accurate results than those performed by physicians.

Many efforts are made to process these MRI images by using system. All these efforts gave results of only detecting the tumors. But our approach not only detects the tumor but also give us the information regarding the direction of propagation of the tumor. This helps the radiologists to plan the treatment sessions efficiently and effectively.

This is done by using MATLAB technique, where the MRI is processed by using Segmentation technique. MRI is segmented into quadrants and each quadrant is analyzed for the presence of tumor and by using the Law of inertia, direction of the propagation is determined using MATLAB.

## II. TECHNOLOGY

MATLAB stands for *Matrix Laboratory*. This is the high level language which takes every input and process the data and provides output in matrix form. All calculations in MATLAB are performed using matrix operations, which means in MATLAB, each variable is a matrix. This enables the user for interactive environment which is not possible in the traditional languages such as C, C++ and FORTRAN.

MATLAB is the easiest software for engineers. In case of analyzing data, developing algorithms, or creating models, MATLAB provides environment that provides invitation for discovery [8].

### Key features of MATLAB

1. High level language for scientific and engineering computing.
2. Desktop environment tuned for iterative exploration, design and problem solving.
3. Development environment for managing codes, files and data.
4. Mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, and numerical integration.
5. 2D and 3D graphics functions for visualizing data.
6. Add on tool boxes for a wide range of engineering applications.
7. Functions for integrating MATLAB based algorithms with external applications and languages, such as C, C++, FORTRAN, Java, COM, and Microsoft Excel [8].

### III. METHODOLOGY

The algorithm has three stages, firstly it is pre-processing of the image which includes segmentation, secondly performing morphological operations to detect tumor, and finally performing quadrant method to find the direction of propagation.

This algorithm is proceeded in the following steps,

1. Give the converted grayscale image of MR image as the input.
2. Noise is removed by applying High pass filter.
3. After noise removal, quality is enhanced by applying median filter.
4. Compute threshold and watershed segmentation.
5. Compute morphological operations.
6. The output obtained after these operations will be a tumor region.
7. Compare the valves with those of the normal person.
8. Detect the type of the tumor, whether benign or malignant.
9. Apply quadrant method to find out the direction of propagation of the tumor. [6]

All the above steps are performed by following operations, explained in detail below.

#### A. Segmentation of MRI.

This is done by using bit-plane slicing method in MATLAB. This technique is adapted in order to get enhanced image, as the images with more number of bits give more clarity. Considering the image to be divided into eight bits, from bit 0 to bit 7.

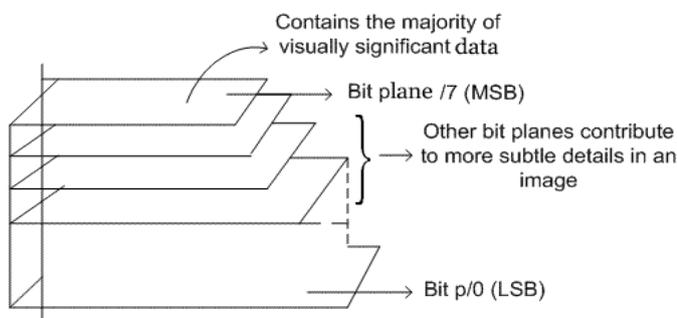


Figure 1: Bit plane slicing

As shown in the above figure, bit plane 0 contains all the bits of lower order and bit plane 7 contains all the bits of higher order.

Any digital method will be stored in the form of pixels. These pixels are expressed in terms of bits. Consider 8 bit image, in which each pixel is 8 bit as shown in figure below. These bits sliced and image is obtained for each bit by using bit get function in Mat lab. For every bit one image is formed.

For bit plane extraction of 8-bit image, the image obtained for bit plane 7 contains gray level transformation function which maps from 0 to 255 (i.e. 00000000 to 11111111). [4]

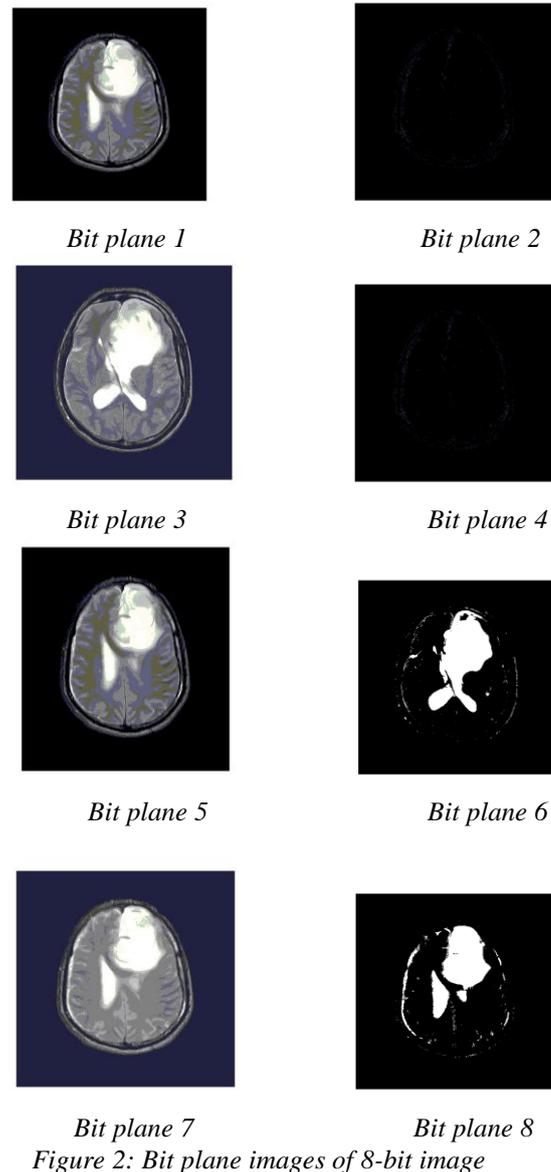


Figure 2: Bit plane images of 8-bit image

#### Reconstruction of image

Now bit plane images can be re-combined to get a clear image. Out of 8 bit plane images, any combinations can be combined to get a clear image. For example bit plane image 7 and bit plane image 8 is combined to get a clear image.

This image is further used for detecting the tumor and for morphological operations.

#### B. 2X2 methods to find area.

The shape of tumor is irregular. Hence, the area of tumor cannot be found by using particular formula. Area can be determined by using 2x2 method. This method area calculating helps to compare the area of tumor before and after treatment. Each pixel's area is found separately and is summed to find the total area of the image. The segmented image will be in binary form, which means the tumored region will be 1 and the non tumored will be 0. The area of tumored region is found out by using pixels in 2x2 neighborhood method. There are 6 different combinations of finding area in 2x2 method which is explained figure below. [9]

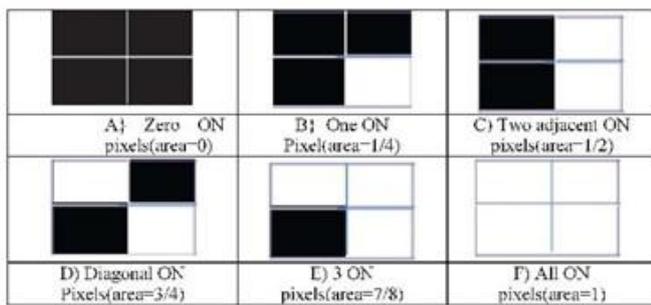


Figure 3: Visual representation of six patterns giving six different areas [9]

Tumor area is compared to normal area at every sessions of treatment to quantify the treatment for tumor.

C. Detection of direction of propagation

The direction of propagation of brain tumor can be determined by finding co-ordinates of the boundaries of the tumor from the centroid of the tumor. By finding the area of the brain tumor, co-ordinates of the boundaries of tumor can be determined by using following formulae.

$$X \text{ (co- ordinate)} = (1/A) \int_b^a xf(x)dx \dots\dots\dots (1)$$

$$Y \text{ (co- ordinate)} = (1/A) \int_c^a yf(y)dy \dots\dots\dots (2)$$

Where the image is divided into quadrants with x and y axis. A is the area of the tumor.

f(x) is the function defining area with limits a and b in x-direction.

f(y) is the function defining area with limits c and d in y-direction.

a and b are the limits of x-direction, c and d are limits in y-direction. [9]

Once the co-ordinates of boundaries are found, the farthest co-ordinate is used to determine the direction of propagation. The efficiency of treatment can be increased by finding the maximum distance of boundary point from centroid,

Quadrant method

This method is dividing the tumor region into quadrants. The image is divided into many segments and each segment into four quadrants. This method helps to detect the direction of propagation or shrinking. This can be done by, first rounding off the co- ordinates obtained from equation (1) and (2) to the nearest integers and values x and y are found. Corresponding rows and columns of the co- ordinates of boundaries are extracted to obtain quadrants. These rows and columns will be in form of array. The first element of columns corresponds to +y axis and the last element corresponds to -y axis. Similarly the first element of rows corresponds to +x axis and the last element corresponds to-x axis. The quadrants are formed as shown in the following figure.



Quadrants fig 1  
Quadrants fig 2  
Figure 4: Examples of Quadrants

These methods helps radiologists to plan the sessions efficiently, as the pre- processed information for the image is given by these techniques.

IV. RESULTS

The segmented is subjected to morphological operations and the Erode and Dilated images are obtained as shown in the below figure.



Figure 5: Morphological operators

After getting Erode and Dilated images as shown in above figure, the dilated image is divided into quadrants to classify and find the features of the image.

The feature such as entropy, contrast etc. are determined. These features explains the presence of tumor as shown in following figure.

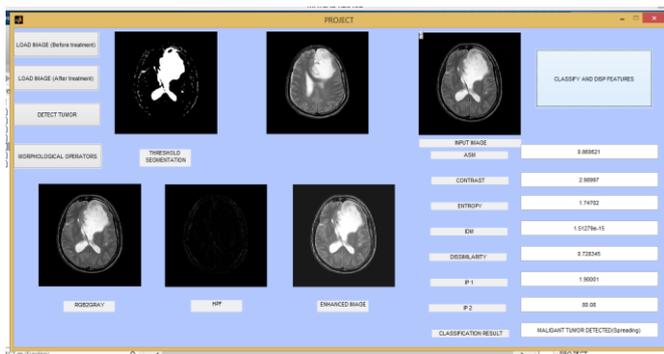


Figure 6: Tumor detection using Mat lab

The type of tumor will be shown in the display result as shown in the above figure.

## V. CONCLUSION

Detecting of type of brain tumor as well as its direction of propagation helps the radiologists to plan the treatment sessions efficiently and more effectively. This reduces the errors caused by manual analysis made by physicians so that the delay of treatment and ignorance can be avoided. This helps the patient to get treatment in the earlier stage of the tumor to avoid severity.

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