Review: Brain Tumour Extraction from MRI Images Using Image Processing

[1]Rina Bopche, [2]Dr. Pankaj Kumar Mishra, [3]Prof. Amit Kolhe

Rungta College of engineering and technology
Kohka road kurud Bhilai Chhattisgarh

Abstract: Matlab has played very important role in biomedical and it has many technique we are working on image segmentation and by using matlab we can solve so many problem for example the accurate data of tumor to cure it. This project is mainly to solve the disadvantage of region based segmentation. As we knows the tumor is abnormal growth of tissue and MRI can't tell the exact location of tumor up to now doctors were treating it by approximation and analysis so, to give complete information about brain tumor we are using image segmentation in matlab. This project includes noise removal technique (median filter), gray scale, thresholding, hist. equalization, segmentation and morphological operation (performing iterations). People affected by different category of tumor in India are 43%, 36% in US, and 31% in UK. By using this matlab based technique we can get accurate data for its size, location and stage of the tumor. Detection and extraction of tumour from MRI scan images of the brain is done by using MATLAB software (programming).

Keywords: tumor; median filter; histogram equalization; segmentation; morphological operations; MRI; MATLAB;

I. INTRODUCTION

Tumour is defined as the abnormal growth of the tissues. Tumor and cancer are not same cancer will be always malignant but not tumor. Brain tumor is an abnormal mass of tissue in which cells grow and multiply uncontrollably and to cure it we should have accurate data which we can get by this technique (*Reference- Wikipedia*). Brain tumors can be primary or metastatic, and either malignant or benign. Generally doctors will use approximation to cure the brain tumor but now with the help of this technique we can cure it easily and these Brain tumors are classified into:

- Primary brain tumor (benign).
- Secondary brain tumor (pre malignant).
- Tertiary brain tumor (malignant).

(Reference- Kalpana U. Rathore, Prof. Y.D. Kapse IJRTCC)

To achieve high quality image of brain tumor we are using magnetic resonance imaging (MRI) technique and these give high resolution images. Median filter is used to select the mid value by this it will reduce the noise this is a great technique to remove the noise from the image, it is also applied to the gray scaled output and then we will be applying thresholding to distinguish between black and white colour and then we will use histogram equalization for equalization, which will equalize the image and then some morphological operations are applied to detect the tumor in the image. The morphological operations are basically applied on MRI for some information for example size and shape of the tumour and at the end the tumour is mapped on the basis of threshold to define the stage and density of tumor and it will tell either it is a malignant tumor or benign growth of cells and after this we will be doing area selection of tumor by using GUI. By applying some iterations and this technique at last we will get the area covered and critical stage and intensity and all important data of tumor. There are several technique to do segmentation namely toboggan algorithm, watershed algorithm, visual dictionary algorithm, clustering method, splat feature segmentation, region based algorithm, edge based segmentation, soon. Compared to other methods Otsu segmentations offer segmented regions they have similar picture intensity.

Image processing is a technique which is used to improve the quality of the image and accurate parameter of the desired image for this purpose image filtering, image segmentation and histogram equalization is use, which will helpful to detect tumor parameter during processing. Image processing involves two main steps that is

1. Image enhancement technique (preprocessing).
2. Image segmentation technique.

Both are having their own properties and important role for improving the quality of the image. Both the process having a different technique for the image enhancement and segmentation for the more accurate result the best will choose.

(Reference- Rajesh c. Patil, Dr. A.S. Bhalchandra IJECSCSE)

I. METHODOLOGY

1. Preprocessing-
    - Denoising.
    - Gray scale image.
    - Thresholding.
    - Histogram equalization.
2. Segmentation-

- Segmentation.
- Area selection
- Morphological operation.
.

```
┌─────────────────────────┐
│  Take MRI image of tumor │
└─────────────────────────┘

┌─────────────────────────┐
│ Denoising by median filter │
└─────────────────────────┘

┌─────────────────────────┐
│    Gray scale imaging    │
└─────────────────────────┘

┌─────────────────────────┐
│  Thresholding of colour  │
│          level           │
└─────────────────────────┘

┌─────────────────────────┐
│  Histogram equalization  │
└─────────────────────────┘

┌─────────────────────────┐
│       segmentation       │
└─────────────────────────┘

┌─────────────────────────┐
│  Morphological operation │
└─────────────────────────┘

┌─────────────────────────┐
│          Output          │
└─────────────────────────┘
```
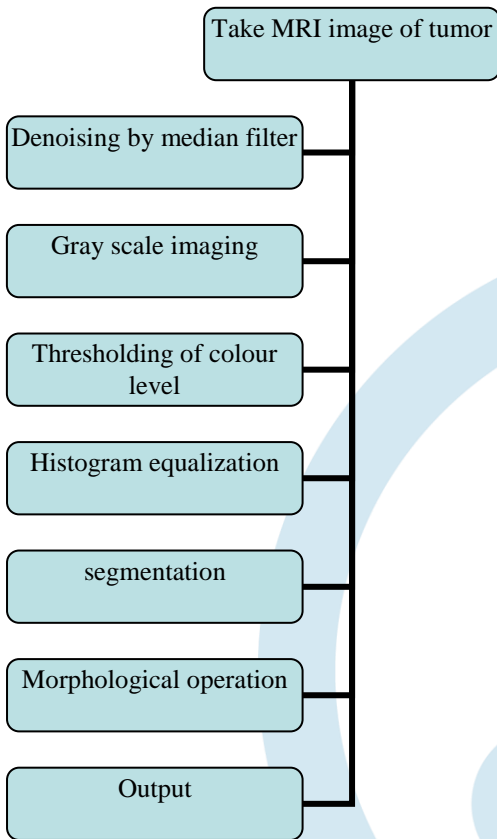
The algorithm steps which we are going to perform are as follows –
1. Take MRI image as input.
2. Then denoise this image by using median filter.
3. Gray scale imaging.
4. Apply thresholding.
5. Apply histogram equalization for good quality.
6. Apply segmentation.
7. Do area selection.
8. Compute morphological operation.

II. LITERATURE SURVEY

The process where we divide the image in various category according to various algorithm so many people has been worked on this project they have worked a lot so, according to comparison of this survey this project has been implemented.

No	Date	Author	Conclusion	Remark
1IJRRA	June2016	Bandana Sharma, Brij Mohan Sharma	Image acquisition, segmentation, preprocessing, feature extraction process has been applied.	Fuzzy-c means technique has been applied.
2IJDER	2016	Samriti, Paramveer Singh	They have used preprocessing; watershed segmentation watershed segmentation has some disadvantage which they are solving by preprocessing.	Hybrid of watershed and contrast technique has been used.
3 IEEE	2015	HMW Thomas	FPGA technique has been used and segmentation. Image has converted in binary form, VHDL algorithm used for edge detection.	Computation technique has been used.
4IJSET	July	Sonu Suhag, LM	FCM, CAT, segmentation is used	Feature extraction is done.

	2015	Saini	preprocessing, morphological operation is applied to get brain tumor data.	
5IJECSE	2015	Rajesh c. Patil, Dr. A. S. Bhalchandra	Watershed segmentation, High pass filter, median filter and morphological operation has been applied, and This will provide information about tumor which is benign or malignant.	Tumor with accurate result has been detected.
6IJCST	MayApr 2015	Yogita Sharma, Parminder Kaur	Fuzzy-k means clustering technique is used for segmentation and here we will get information about area of tumor.	Mean square error will be removed.
7IRJET	May 2015	Pankaj kumar Saini, Mohinder singh	Image preprocessing contrast enhancement for getting accurate data of tumor.	Density and intensity of tumor can be calculated.
8 IEEE	2014	Kailash Sinha, G.R. sinha	Worked on k means and fuzzy-c means clustering technique to do segmentation.	They did colour based segmentation.
9IJAIT	Feb. 2014	Ed. Edily Mohammad Azhari	Automatic segmentation, Edge detection segmentation is used.	Filters were used for accurate output.
10IEEE	2010	Badran, Esraa Galal Mahmoud.	Image segmentation and neural network technique has been used and laplacian Gaussian parameter also used.	Area of tumor has been calculated.

A. MRI *(magnetic resonance imaging)-*

Magnetic resonance imaging (MRI) is a technique where we are using that magnetic field and radio waves. This is just a simple report on which we want to do analysis. This imaging modality produces images of soft tissues. The acquired medical images show the internal structure, but the doctors want to know more than peer images, such as abnormal tissue, quantifying the size, depicting its shape in MRI image. If such tasks are covered by doctors themselves, it may be inaccurate, time consuming and burden them heavily. By using this project we can solve all these problem we can get the size, exact location and stage of tumor (*Reference- math works).*

B. Denoising by median filter -

The median filter is a nonlinear digital filtering technique often used to remove noise from an image or signal. Such noise reduction is a typical pre-processing step to improve the results of later processing. The median filter replaces a pixel by the median, instead of the average, of all pixels in a neighborhood. It is widely used as it is very effective at removing noise while preserving edges of the MRI image of brain tumor. It is particularly effective at removing 'salt and pepper' type noise. The median filter works by moving through the image pixel by pixel, replacing each value with the median value of neighbouring pixels. *(Reference- Sivasankari, Sindhu, Sangeetha, Shenbaga Rajan IJIRSET)*

The pattern of neighbours is called the "window", which slides, pixel by pixel over the entire image and removes the noise from it. For 1D signals, the most obvious window is just the first few preceding and following entries, whereas for 2D (Two dimensional) signals such as images, more complex window patterns are possible (such as "box" or "cross" patterns). Note that if the window has an odd number of entries, then the median is simple to define: it is just the middle value after all the entries in the window are sorted numerically. For an even number of entries, there is more than one possible median. This filter enhances the quality of the MRI image. At the last we got image without noise. Instead of this filter we can use other filter also but we will not get correct output this filter is more convenient then other filter *(Reference- Sivasankari, Sindhu, Sangeetha, Shenbaga Rajan IJIRSET)*

C. Gray scale imaging-

The gray scale image will separate the black and white part of MRI image of brain tumor with accuracy by sharpening the image. To get gray scale image first we need to take MRI magnetic resonance image, 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 image but technically this is a wrong theory. In true black and white, also known as halftone, the only possible shades are pure black and pure white. Grayscale images can be the result of measuring the intensity of light at each pixel of the given image according to a particular weighted combination of frequencies. 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 (vice versa), with the sizes of the individual dots determining apparent lightness of the gray in their vicinity. Generally the halftone technique is commonly used for printing photographs in newspapers and as MRI image is taken on computer then while getting the gray scale image we will be getting three colour red, green, blue it is represented by R, G, B in this condition when we are transmitting light these

data are represented by 0 to binary 00000000 to 11111111 means 0 to 255. For every pixel in a red-green-blue (RGB) grayscale image the red green blue will be having same value. The lightness of the gray is directly proportional to the number representing the brightness levels of the primary colors. Black is represented by 0 means all colour red green and blue will be zero R = G = B = 0 or R = G = B = 00000000, and white is represented by 1 means all colour will be 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 (*Reference- Rajesh c. Patil, Dr. A.S. Bhalchandra IJECSCSE*).

D. Thresholding-

After gray scale imaging just to distinguish between black and white colour we are doing thresholding, it will explain gray scaled output clearly on the basis of thresholding. Thresholding will enhance the colour and contrast of MRI image then this output will be equalized by histogram equalization (*Reference- Wikipedia*)

E. Histogram equalization-

Histogram equalization is a technique for adjusting image intensities to enhance contrast of image. Histogram (Hist.) equalization is a specific case of the more general class of histogram remapping methods. These methods seek to adjust the image to make it easier to analyze or improve visual quality. Here we are using this technique to get more clearity to detect the brain tumor.
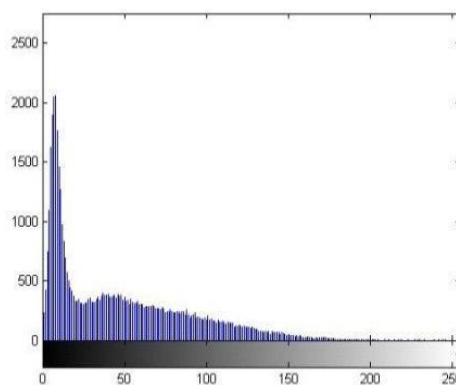

Fig 3. Histogram output

If the histogram of any image has many peaks and valleys, it will still have peaks and valley after equalization, but peaks and valley will be shifted. Because of this, "spreading" is a better term than "flattening" to describe histogram (hist) equalization. In histogram equalization each pixel is assigned a new intensity value based on its previous intensity level.

As you can clearly see from the images that the new image contrast has been enhanced and its histogram has also been equalized. There is also one important thing to be note here that during histogram equalization the overall shape of the histogram changes, where as in histogram stretching the overall shape of histogram remain same (*Reference- Niladri Halder, Dibyendu Roy, Debarghya Roy, Nitin Kumar Jha IJIRCCE*).

F. Otsu segmentation-

Threshold is a simple but effective method for image segmentation techniques. Threshold is used to haul out an object from its background by using an intensity value t (threshold) for each pixel such that each pixel such that each pixel such that each pixel such that each pixel is classified either as an object point or a background point. The purpose of this operation is that objects and background are separated are separated into non overlapping sets. The Otsu method is a method that maximizes the between class variance and a popular non parametric method for its ease and effectiveness. Experimental method show that, it leads to a correct threshold value and get an ultimate result in segmenting. The algorithm assumes that the image contains two classes of pixels following bi-model histogram, it then calculates the optimum threshold separating the two classes so that their combined spread is minimal, or equivalently, so that their inter class variance is maximal. Consequently, Otsu's method is roughly a one dimensional, discrete analog of Fisher's Discriminate Analysis. Otsu's method is also directly related to the jenks optimization method. (*Reference- Wikipedia, Stormy Attaway*).

G. Texture segmentation

The texture is most important attribute in many image analysis or computer vision applications where the different colours are being used. In texture of an image we will be working on the concept of matrix in image processing and this concept we will be applying on the selected region of an image. When we will perform this operation, we will face texture problem, which are splits into four parts one is structural method, statistical method, model based method and filter based methods. Different definitions of texture are described, but more importance is given to filter based methods. An image texture can be used in segmentation or classification of an image, or to extract boundaries between major texture regions. The recognition of texture is a complex concept because it is obtained from 2-dimension gray scaled image level variation and lightness of combination of calculated pixels with contrast, sharpness and continuity directionally. There are two main types of texture segmentation that are region dependent and boundary dependent texture segmentation.

H. Watershed segmentation

The watershed Image segmentation theorem exists when the objects of same already explained class are in close degree to one another, for this pixel grouping is important to defined image into objects. It starts with finding and then deciding that which pixels belong to each object. If we imagine lighten areas are "high" and dark areas are "low", then it might look like surface, so that it is obvious to consider that in terms of catchment basins and watershed line which parts away the objects from the background and from other objects. The main benefit of watershed segmentation method is that the boundaries of each regions are continues. Watershed segmentation method falls into the edge base segmentation technique. The main aim of watershed segmentation technique is to find the "watershed boundary" of an image for separating the different regions.

The steps are involve in watershed segmentation are:- Compute a function of watershed segmentation, it reads the colour of the image and convert it to gray scale, uses the gradient method as the segmentation function, then it marks the main objects and back ground objects, then computes the watershed transform of the segmentation function. This algorithm works on the concept of low to high peak values. We may get some dis-continue peaks in catchment basins known as "dam". The value of the dam keeps changing with the height of the flood.

I. K-means segmentation

Very easy and unsupervised algorithm which is used to solve clustering problem. K means clustering will define some group of cluster and these cluster will be define by K letter which is fixed beforehand. K means clustering speed is depend on the distance of cluster if it is more than time consumption will also be more and if we are able to reduce that distance then the time required may reduce and it will become a faster technique and it will remove the problem of region based segmentation technique also because region based segmentation technique required more time than other.

J. Threshold segmentation

In threshold segmentation we will be defining some level on the basis of density of cluster and we will be deciding this level by doing observation of data base so on the basis of this threshold level we will be deciding that tumor is benign or malignant. If we are working in Threshold segmentation then we need to start from basic or low level like gray scale imaging in threshold segmentation we need to assume that images are multimodel that is, different objects of interest relate to distinct peaks (or modes) of the 1D signal histogram. In this segmentation we will not perform thresholding of colour level and image shown in Figure 20.

The thresholds have to optimally separate these peaks in spite of typical overlap between the signal ranges corresponding to individual peaks. The optimal threshold that minimizes the expected numbers of false detections and rejections may not coincide with the lowest point in the valley between two overlapping peaks.

K. Morphological operations-

In this morphological operation we are going to perform some iteration to get accurate data because if we will be performing the operation many time then our output accuracy will increase and if accuracy will increase then we can get the correct information and data about the tumor that's why it is essential to perform the morphological operation, once we will be getting the accurate data about the tumor then the doctors can cure it very easily without any assumption and approximation. This is used as a image processing tools for sharpening the region and filling the gaps for binarized image of brain tumor. The dilation operator is used for filling the broken gaps at the edges of the image and to have continuities at the boundaries of image. A structuring element of square matrix is used to perform dilation operation for image.

According to Wikipedia, morphological operations depends only on the order of pixel value, not on their numerical values, and therefore are especially suited to the processing of binary images because working with binary image is easy and it gives accurate output. Morphological operations can also be applied to grayscale 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 dimensions of matrix specify the structuring element size of image. The binary number one and zero specify the shape of the structuring element. This morphological operation will give accurate output because here we are performing operation many times. The structuring element has been generated from the binary value, pixels, although generally the origin can be outside the structuring element *(Reference- Rajesh c. Patil, Dr. A.S. Bhalchandra IJECSCSE).*

IV. RESULT AND DISCUSSION

The figures show the images as an output of median filter, grayscale image, threshold image, histogram image. Finally input image and extracted tumor from MRI image. Her we are enhancing the segmentation section as u can see in this project we have used Otsu segmentation and it is a time consuming technique so we are going to work on it, by using some technique we will be reducing the problem of region based segmentation. And for analysis purpose real time patient data is taken for analysis. As tumor in MRI image have an intensity more than that of its background so it becomes very easy locate it and extract it from a MRI image. After getting this output doctor can cure or work on brain tumor with accuracy ijnd accurate data and doctor will not feel difficulty because now he has correct observation and information about brain tumor.

V. FUTURE WORK

We can get the 3D image and observe the situation and condition of brain tumor. We can use threshold technique to get the stages of tumor that if we have tumor then we are in initial stage or in final so we can determine it by threshold technique. To determine

this that we have a tumor or not we can use this technique. These are some future scope where we can work and solve the problem of brain tumor matlab is one of the best programming technique to get accurate information about brain tumor.

a. Abbreviations and Acronyms

1. MRI- Magnetic resonance imaging.
2. Hist. - Histogram equalization.
3. RBG- Red, Green, Blue.
4. Vicinity- Around anything.
5. Malignant - Malevolent.
6. Benign - Soft.

REFERENCES

[1] Rajesh C. Patil, Dr. A. S. Bhalchandra International Journal of Electronics, Communication & Soft Computing Science and Engineering IJECSCSE @2015.

[2] Ehab F. Badran, Esraa Galal Mahmoud, and Nadder Hamdy IEEE @2010.

[3] Samriti, Mr. Paramveer Singh, Brain tumor detection using image segmentation IJEDR @2016.

[4] Sushma v. telrandhe, Divya chikate, pooja, Brain tumor detection using back propagation nueral network International Journal of Soft Computing and Artificial Intelligence, IJSCAI May-@2015.

[5] Bandana Sharma, Dr. Brij mohan singh, Brain tumor detection using pattern recognition technique, international journal of recent research @2016.

[6] Yogita Sharma, Parminder Kaur, Brain tumor detection International Journal of Computer Science Trends @2015.

[7] Book-MATLAB A practical approach by stormy attaway @2009.

[8] Vipin Y. Borole, Sunil S. Nimbhore, Dr. Seema S. Kawthekar, Image processing of brain tumor IJETTCS @Oct 2015.

[9] Kalpana U. rathore, prof. Y.D, Kapse, Matlab based brain tumor extraction using artificial neural network IJRITCC@2016.

[10] Monica subashini, sarat kumar sahoo, Brain MR Image segmentation for tumor detection using artificial neural networks IJET @Apr-May 2013.

[11] Sonu Suhag, L.M. Saini, Automatic detection of brain tumor by image processing in matlab IJASET @July 2015.

[12] Ed-Edily Azhari, Muhd. Mudzakkir, Mohd. Hatta, Zaw Zaw Htike and Shoon Lei Win, Tumor detection in medical imaging IJAIT@Feb 2014.

[13] Pankaj Kr. Saini, Mohinder Singh, Brain tumor detection in medical imaging using matlab IRJET@May 2015.

[14] Esmail Hassan and Abobakr Aboshgifa, Detection brain tumor from MRI image using matlab GUI programme IJCSES@Dec 2015.