Automated Brain Tumor Detection using Image Processing

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***Abstract*—The most complicated structure of the human body is the brain. A brain tumour is a mass of cells that have grown and multiplied uncontrollably. There are two main types of tumours: malignant or cancerous tumours and benign tumours [3]. Medical imaging plays a central role in the diagnosis of brain tumours. The important factor in the medical diagnosis includes the medical image data obtained from various biomedical devices. This data is obtained from various imaging techniques like X-ray, CT scan and MRI [1]. Medical experts perform tumour segmentation on data obtained from magnetic resonance imaging (MRI) which is very time consuming. Brain tumour segmentation is a significant process to extract information from complex MRI of brain image. Segmentation assessment is done by human, which can involve human errors in the result. In our paper we proposed a system that is completely automated because we use conformed threshold rather than global threshold. It takes MRI of brain as input. It consists of two or more stages. In the initial stage pre-processing is required after that stages post-processing i.e. threshold segmentation is done. And the features are extracted from detected tumour. The entire paper is divided into four sections which are described in detail in the following sections.**

***Keywords*—tumour, MRI, segmentation.**

I. INTRODUCTION

Early and accurate brain tumour detection is highly essential for treatment planning. Denoising is the technique used to remove noise in the images. Especially in case of the medical imaging, denoising will provide better clearance in the image for easy diagnostics of diseases. Image segmentation is one of the main stages in medical image analysis. Brain makes tumour segmentation a very challenging task and manual one will require a lot of time and its result varies from expert to expert. The image is divided into a set of non-overlapping regions based on different parameters of an image like gray-level, color, etc. This is called Image segmentation [1]. As most of the medical images are gray-scale based [2] segmentation of brain tumour images is mainly based on the gray-level value of pixels. Clustering is used in image segmentation to gather set of pixels into groups based on the similarities [3]. The two main approaches for clustering are Crisp and fuzzy clustering techniques [3]. In crisp clustering method the image is clustered in such a way that each pixel belongs only to one cluster. Whereas fuzzy clustering method allows the pixel to belong to more than one cluster, which will give better result in brain tumour segmentation as the boundaries between clusters in brain tumour images cannot be clearly defined. In this paper the proposed method of brain tumour detection includes image denoising using fourth order partial derivatives and image segmentation using fuzzy c-mean thresholding.

II. LITERATURE REVIEW

Pradeep Singh Yadav et al [1] suggest that in the MRI reports cancer affected area is of high intensity pixels and normal tissue are of low intensity pixels. Segmentation using only intensity as a parameter is called Thresholding. This is the basic type of Segmentation which classifies the tumour based on gray-level. The basic morphological commands such as imerode and imdilate are used to extract the tumour but in our proposed method along with these commands, region of interest is detected and some of the features of the tumour are extracted.

Nishant Verma et al [2] proposed that region growing is region based image segmentation. Here the intensity of same image is grouped into one region using 4-connected neighbourhood or 8-connected neighbourhood. If the intensity belongs to the same seed, it belongs to one region and process is iterated. Region based geometric active contour models are more immune to noise in the MRI resulting in poor segmentation.

Deepthi Murthy T.S et al [3] Using thresholding and morphological operations efficient brain tumour segmentation is carried out. But the threshold value used is global threshold, hence not fully automated needs human intervention.

L. .Ramya et al [4]A seeded region growing segmentation is used to detect the tumour in MRI brain image. Also skull removal procedure is employed using morphological operators to increase the accuracy of brain tumour detection.

Different segmentation methods using computer- aided system for brain tumour detection were proposed[11]. Image segmentation is mainly applied using three methods: thresholding, clustering and region growing.

Maheshkumar S. Badmera et al (2013)[5] proposed a modified FCM approach for MR brain image segmentation to minimize the traditional FCM running time.

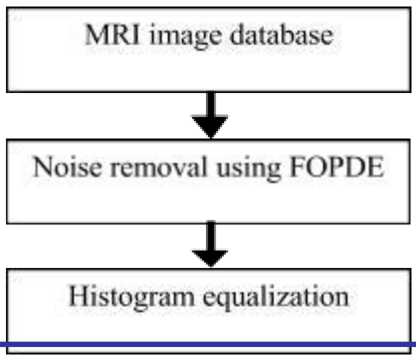
J. Selvakumar et al (2012)[6] proposed brain tumour segmentation using k-means and FCM with calculating the tumour area.

Akram et al (2011) proposed brain tumour segmentation technique using global threshold. This technique is so simple but its drawback is the threshold is chosen manually. Dalila Cherif et al [7] proposed that Expectation maximization algorithm is an iterative procedure to find maximum likelihood estimates of parameters in statistical model. It is used to estimate the parameters of different classes in an image. Normal and abnormal classification is carried out with more parameters such as mean, variance and weight of each tissue type. Extraction of these parameters are carried out using maximum likelihood principle. Here the algorithm is very complex. The extraction of tumors with intensity as a parameter and by using morphological operators the same efficiency can be achieved with less complexity by extracting additional features of the image.

Kailash Sinha et al (2014)[8] proposed a comparative study between three brain tumour detection methods (k-means clustering with watershed, optimized k-means clustering with genetic algorithm and optimized c-means algorithm with genetic algorithm). The results of this study show that the optimized c-means solved the over segmentation problem and gives better results than the other two methods.

III. PROPOSED METHOD

In this paper, Image denoising and Image Segmentation are the main steps to be employed to detect the tumour. Noise removal is done by using fourth order partial differential equation. Histogram equalization is employed for image enhancement and border removal is considered by using morphological operators, erosion and dilation. Segmentation is done by using a conform threshold rather than global threshold. The following is the flow graph (Fig.1) to be proceeded step by step for detecting the tumour efficiently in MRI images.



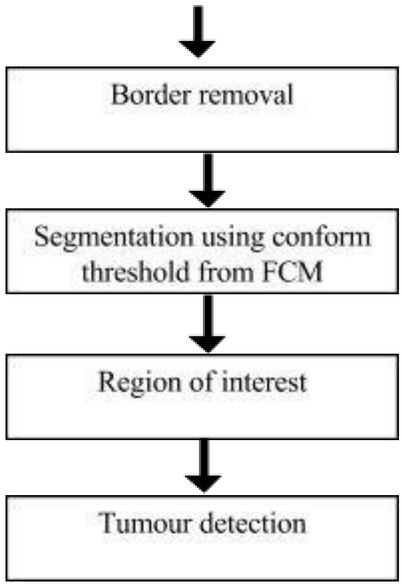


Fig.1. Methodology adopted for detection of tumour

3.1 Noise Removal By Fourth Order Partial Derivatives

There are number of techniques available for removing noise in the images. Filtering techniques are efficient to remove noises in the image but it is not suitable for edge preservation. Fourth order partial differential equation is very effective in case of the MRI denoising. This method can effectively preserve the edges of the image. In the second order PDE method (Anisotropic Diffusion model) it causes blocky effects that is gray values are same in some regions. In Fourth order PDE method we can overcome this blocky effects and false edges in the image. Also this method can be iteratively employed based on the amount of noise present in the input image. To optimize the trade-off between noise removal and edge preservation. A class of fourth-order partial differential equations (PDEs) are proposed. The following will be the fourth order partial differential equation for noise removal,

3.2HISTOGRAM EQUALIZATION

The Histogram equalization is used to enhance the quality of the image. The continuous probability density function and cumulative probability distribution functions are calculated. The equation is used to calculate the cumulative probability distribution function. The frequency of occurrence of each gray value is calculated and the Image is converted into a more useful form.

3.3 THRESHOLDING PERATION

The threshold of an image is calculated by using conformed threshold value. The output of the thresholded image is a binary image.

3.4 SEGMENTATION

Segmentation of image means dividing of image into multiple sub parts. It is required to cluster pixels into salient images and to focus in the region of interest . This step will convert the image in the more meaningful form. In this we will do thresholding of image i.e. convert grayscale image into binary image and perform segmentation. After calculating the number of clusters and their centres, the next precise threshold is used for segmentation. The value of the threshold affects the number of the white components in the binary image. When the threshold value is small, the numbers of white components are also small and tumour is not completely detected and when threshold value is large more numbers of white component occurs which are not part of tumour. So we have to define an appropriate threshold value for more accurate detection. The value of the threshold is equal to 15% from the maximum intensity level value in the image.

$$\delta = 0.15k \qquad [9]$$

Where, 'δ' is the conformed threshold and 'k' is maximum intensity level value in the image. If the distance between the pixel intensity value and the maximum value of the centres is more than 'δ', it is considered as background or black pixel, otherwise it is considered as foreground or white pixel.

3.5 TUMOUR DETECTION

The cluster with high intensity pixels are segregated from the MRI image which forms the tumour. and later features like area and perimeter of tumour csn be extracted

IV. CONCLUSION

In this paper we discussed our proposed method of detecting tumours from MRI. The system automates the manual process of tumour detection from MRI images and hence is economical in terms of time and human efforts. The system will be implemented in MATLAB. The system can be mainly used in medical institutions.

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