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Review: Segmentation and Morphological Operators Detection of Human Brain Tumor Using MRI Image

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Abstract: ***In this paper, The brain is an anterior or most part of a nervous system. Tumour is rapid uncontrolled growth of cells. Magnetic Resonance Imaging is the device required to diagnose brain tumour. The Normal MR images are not suitable for fine analysis, so segmentation is an important process required for efficiently analyzing the tumour images. Clustering is suitable for biomedical images segmentation as it uses unsupervised learning. Current study uses K-Means clustering where the detected tumour shows some abnormality which is then rectified by the use of morphological operators along with basic image processing techniques to meet the goal of separating the tumour cells from the normal cells. Also tumour growth can be analysed by plotting graph which can be obtained by studying sequential images of tumour affected patient.***
Keywords: Magnetic Resonance Imaging, Brain tumor, K-Means clustering, Thresholding, watershed segmentation, morphological operators, high pass filter, median filter

I. INTRODUCTION

The brain is most important part of the central nervous system. A brain tumor is a collection, or mass, of abnormal cells in brain. Your skull, which encloses your brain, is very rigid. Any growth inside such a restricted space can cause problem. Brain tumours can be cancerous(malignant) or non cancerous(benign).Around half of all brain tumours another part of the central nervous system, are malignant. The other half are benign tumours where the diagnosis is not known. Why we use MRI image in brain tumor treatment? Because MRI provides detailed information about the structure of cell, vascular supply and anatomy . The MRI has become widely used in medical field, especially in brain imaging where MRI data tracks the size of brain tumor and respond to treatment accordingly the brain tumor detection can be done through MRI images. In image processing and image enhancement tools are used for medical image processing to improve the quality of images(3). The contrast adjustment and threshold techniques are used for highlighting the features of MRI images. The Segmentation and Morphological operations play a vital role for classification and detecting the tumor of brain. There are several steps of image processing to be considered to detect the tumor in 2D MRI images whereas Image denoising and image segmentation are the two processes employed mainly (4).

Many methods has been introduced to detect damaged cells of brain but this paper is to sort particular abnormal cells of human brain by using combination of thresholding and watershed segmentation along with applying the morphological operators which is possible to for dectors to detect accurately where the tumor is located. This paper work uses K-means clustring where the detected tumor shows some abnormality which is then rectified by the use of morphological operators.

Section II describe literature review, Section III the proposed methodology Section IV consist of some basic image processing techniques. Section V will conclude the whole paper.

II. LITERATURE REVIEW

Many of the researchers proposed many methods, and algorithms for to find brain tumor, stroke and other Kinds of abnormalities in human brain using MR Images.

J Vijay et al proposed method, in this method combine segmentation and K-means clustering. The results unsupervised segmentation methods are better than supervised segmentation methods This study can be applied to the minimal amount of data with reliable results. The use of K-Means clustering method is fairly simple when compared with fuzzy clustering method. But sometimes I t fails to give accurate results (4)

Deepthi Murthy et al proposed that a method for image acquisition, image pre-processing using sobal filter, image enhacement using histogram equalization ,segmentation using Thresholding and morphological operation and then the detection of tumor but

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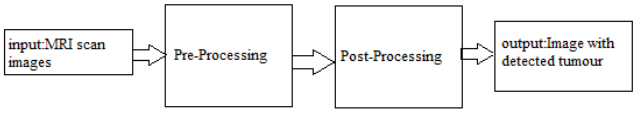
this segmentation method is not used for more images with more features which classifying different types of tumors.(5)
Nishant Verma et al proposed that region growing is region based image segmentation. Here the intensity of same image is grouped in to one region using 4-connected neighborhood or 8-connected neighborhood. If the intensity belong 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. Probabilistic region-based active contour model uses both region growing approach and probabilistic atlas based approach to segment the tumor. This combined segmentation method is stable and gives more accurate result. The drawback of this method is that the seed of the region should be selected manually which effects the segmentation process and it is not fully automatic segmentation process. The segmentation using thresholding and morphological operations is based on the intensity of the pixel, which does not depend on the seed of the region which reduces the manual intervention and complexity of the algorithm.(6)
A.R Kavita et at. propose an effective modified region growing technique for detection of brain tumour. They modified region include comparative for modified region growing using both the Feed Forward Neural Network (FFNN) and Radial Basis Function (RBF) neural network. The MRI image dataset taken from the publicly available sources contains 40 brain MRI images in which 20 brain images with tumour and the other 20 brain images without tumour.(7)

III. PROPOSED METHODOLOGY

The algorithm has two stages, first is pre-processing of given MRI image and post processing given segmentation and then perform morphological operations.



PROPOSED BLOCK DIAGRAM OF SYSTEM

A. *Preprocessing*

Pre-processing of MRI images which perform image enhancement and noise reduction techniques which are used to enhance the image quality, also segmentation and edge detection additive to this pre process. This step is improve the image quality in detecting the tumor.
Pre-processing algorithmic steps

1) Give MRI image of brain as input.
2) Convert original image to gray scale image
3) If any noise detect in image pass through high pass filter.
4) Apply median filter to enhance the quality of image.

B. *Post-Processing*

Post-processing which perform threshold segmentation, watershed segmentation and morphology operators. Threshold image analysis technique is a type of image segmentation that isolates objects by converting gray scale images into binary images. Watershed segmentation which is one of the good method of segmentation but it suffers from over and under segmentation as affected by local minima of image. After this segmentation an opening operation of morphology has been used
Post-processing algorithmic steps

1) Compute threshold segmentation.
2) Compute watershed segmentation.
3) Compute morphological operation.
4) Finally output will be a tumour region.

IV. IMAGE PROCESSING TECHNIQUES

A. *Grayscale Imaging*

Gray scale imaging is sometimes called "black and white," but technically this is a misnomer. In true black and white, also known as

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halftone, the only possible shades are pure black and pure white [8]. Gray shading in a halftone image is obtained by considering the image as a grid of black dots on a white background (or vice versa), and the sizes of the individual dots will determine the apparent lightness of the gray in their vicinity. 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. So the very first step in this method is the conversion of the input image i.e. MRI image to be pre-processed into a Grayscale image.

B. Image Enhancement

Image enhancement is one of the major research fields in image processing. In any applications such as medical application, military application, media etc., the image enhancement plays an important role. Recently, neural networks turn to be a very effective tool to support the image enhancement. Neural network is applied in image enhancement because it provides many advantages over the other techniques [4]. Also, neural network can be suitable for removal of all kinds of noises based on its training data. This paper provides survey about some of the techniques applied for image enhancement.

C. Image Segmentation

Image segmentation is the process of partitioning a digital image into multiple segments. The goal of segmentation is to simplify and change the representation of an image into something that is more meaningful and easier to analyze.

Segmentation using only intensity as a parameter is called Thresholding. This is the basic type of Segmentation which classify the tumor based on graylevel. Thresholding mostly used for gray scale images to converts it into a binary image based on a particular intensity level. Next segmentation technique is watershed transformation. Local minima of the gradient of the image may be chosen as markers, in this case an over-segmentation is produced and a second step involves region merging.

D. Morphological Operators

Morphological techniques for digital images rely only on the relative ordering of pixel values thus they are most suitable for binary or gray scale images. Image enhancement using morphological approaches have been widely experimented in previous researches to subjectively improve the appearance of an image. Meanwhile, also employed mathematical morphology operations to reduce noise existence in images.

1) *Erosion*: Erosion is an operation on an image M which contains labels 0 and 1, with a small structure such as disk, diamond, square etc known as structuring element Q, changes the value of pixel h in M from 1 to 0, if the result of the sliding Q with M, centered at h, is not greater than some previously determined value This value is set to be the area of Q, i.e. the number of pixels that are 1 in the structuring element. The structuring element determines how much thinning will be required.

$$M \Theta Q$$

2) *Dilation:* The basic effect of the operator on a binary image is to gradually enlarge the boundaries of regions of foreground pixels. Thus areas of foreground pixels grow in size while holes within those regions become smaller. The first is the image which is to be dilated. The second is a (usually small) set of coordinate points known as a structuring element.

$$M \oplus Q$$

E. Noise detection and Filtering techniques

1) *High pass filter:* A high pass filter tends to retain the high frequency information within an image while reducing the low frequency information. The kernel of the high pass filter is designed to increase the brightness of the center pixel relative to neighboring pixels. The kernel array usually contains a single positive value at its center, which is completely surrounded by negative values.
2) *Median Filter:* The median filter is a nonlinear digital filtering technique, often used to remove noise. Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise.

This filter enhance the quality of the MRI image.

V. RESULTS OF THE IMPLEMENTATION

A. K-Means clustering

1) The image is taken as input and it is then read and saved in a matrix form.

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2) Size of the image is then stored.
3) The input image is then reshaped for representing it linearly.
4) The algorithm k-means is then applied on the original image. When k-means algorithm is applied on the input image then that algorithm first starts to cluster or group the objects based on the attributes feature and determine the centroids
5) Number of clusters is the user input and is variable With the increase of clusters the goal image becomes clearer.
6) Maximum number of cluster centroids are chosen as true value and all other are chosen as false value.
7) The resultant image is then shown highlighting the dead cells among all the normal cells of the brain and all the cells which are not considered as dead cells but are getting affected due to the defected regions are also shown in the output image.

B. Problem with K-Means Clustering

Although K-MEANS algorithm is simple and has relatively low computational complexity but sometimes it fails to give accurate results. This can be made understood by the following example: If we say that there are two clusters A and B, and centroids are c1 and c2 respectively, then if an object 'O' is in the cluster B and distance found from c1 of A to the object 'O' present in the cluster B is less than the distance of 'O' from c2 of B then sometimes K-MEANS assumes the object to be in the Cluster B, although the object 'O' belongs to cluster A according to the steps of algorithm. Again KMEANS fails to handle noise on the data and outliers clearly noticed in (TABLE 1).For these reasons, still now we have reached to our goal partially. In the above output images it is seen that due to the presence of tumor, the cells which are not yet damaged but are getting affected are also visible along with it which is not our ultimate mission.

VI. CONCLUSIONS

Thus the tumor regions from MRI brain images are segmented using threshold, watershed segmentation and morphological operators. The output image clearly shows the abnormal cells which have been separated from the normal cells. Also done comparative analysis of K-means clustering and morphological operators. Also tumour growth can be analysed by plotting graph which can be obtained by studying sequential images of tumour affected patient

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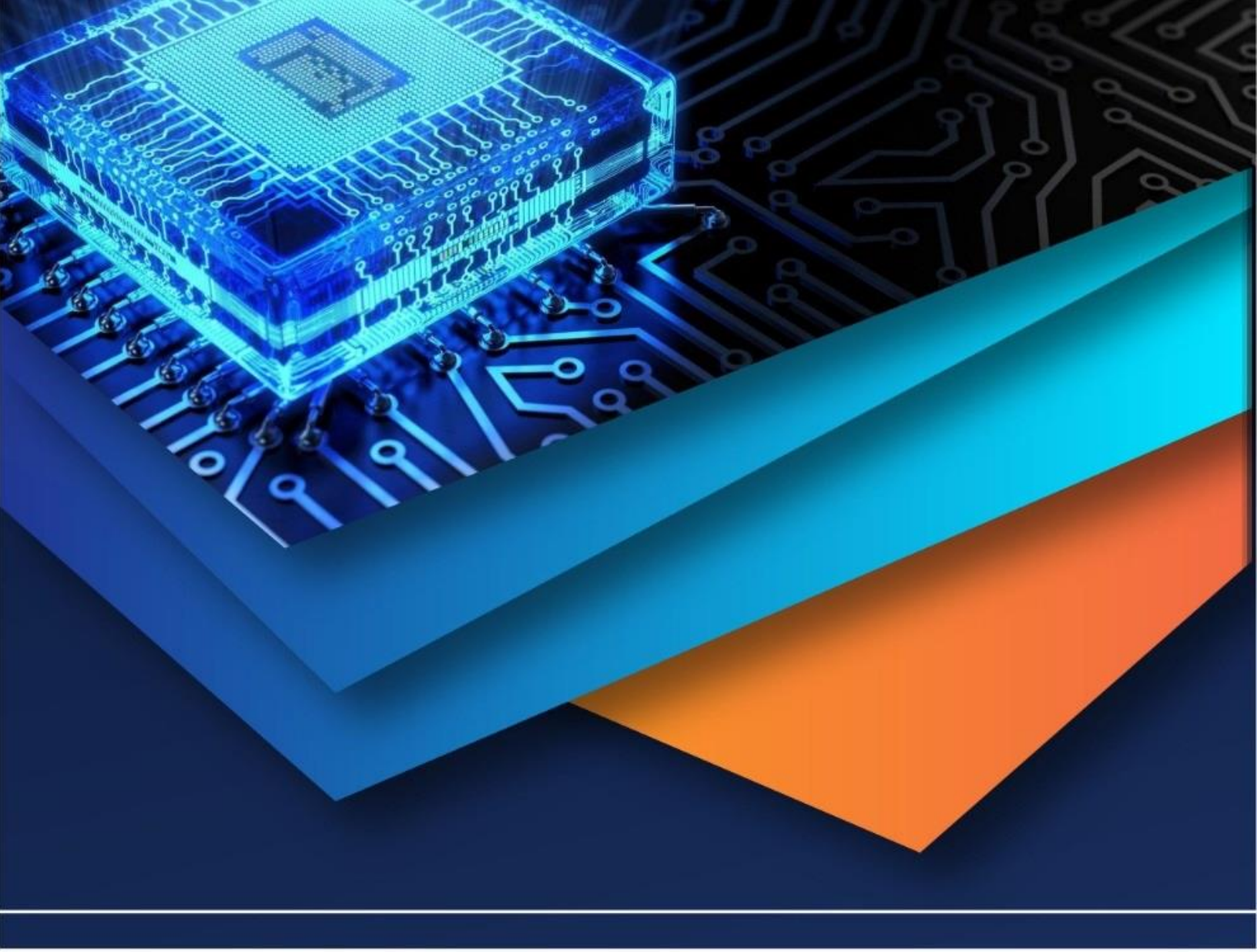

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