Brain Tumour detection in MRI images using Thresholds Algorithm

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Abstract –

Image processing is used frequently in detecting tumour from MRI images. Detecting Brain tumour takes special skills and techniques because they are difficult to detect – specially in early stages. I, student of VIT, Vellore have been trying to make a project on "Brain Tumour Detection in Medical Images" as my Image Processing project for the Fourth semester. My goal is to implement a threshold method so that we can detect tumour in the medical image of the brain. I am trying to implement a method successfully using Thresholds algorithm. Threshold segmentation is the simplest method of image segmentation and also one of the most common parallel segmentation methods. It is a common segmentation algorithm which directly divides the image grey scale information processing based on the grey value of different targets. The advantage of the threshold method is that the calculation is simple and the operation speed is faster. In particular, when the target and the background have high contrast, the segmentation effect can be obtained.

Keywords **– Image Processing, Medical Images, Segmentation, Threshold, Brain Tumour, MRI**

Introduction

In the last few decades there has been an enormous increase in the research work being done in the field of cancer diagnosis, especially cerebral cancer.

Nearly 2000 children in India are diagnosed with brain cancer. About half of them will die before the age of five. The factor mainly responsible for causing deaths due to cerebral cancer is it's late detection. Through my project I aim at providing an efficient method of detecting brain tumour in the cerebral MRI images. The most widely used clinical diagnostic and research technique is MRI. It's an efficient medical imagery tool that has different methods each of which has a particular property. In Brain Tumour detection, separation of the tumour is of immense importance. Consequently, segmentation is a very crucial step in building an efficient tumour detection system. In literature, there are different definitions of segmentation .

Methodology

From general point of view segmentation is the partitioning of an image into a set of homogeneous and significant regions having a single label and common or similar properties. Therefore, keeping in mind the immense importance of segmentation, many algorithms were designed to execute it.

Segmentation is usually preceded by a process called enhancement. Enhancement is used to improve the quality of the image so that it becomes easier to separate out the regions showing similar properties like contour, contrast, colour etc. This forms the basis of the process of segmentation.

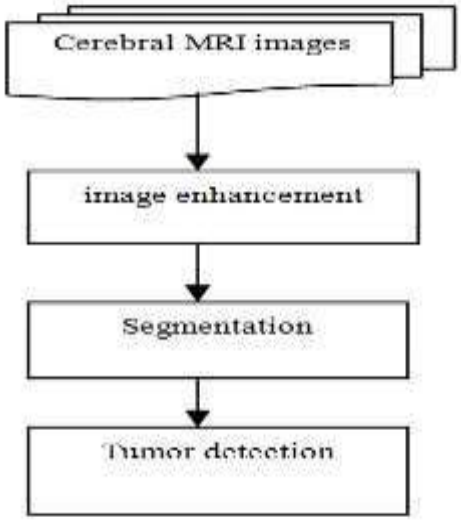

Fig. 1 Flowchart of the Methodology

The segmentation phase is then followed by the classification phase. This is the phase where tumour detection is actually performed. After enhancement and segmentation, the suspicious regions of the MRI image are scanned to detect tumour. Classification of the medical images is a fundamental procedure in many medical applications and diagnosis involving the fields of cerebral cancer, psychology and medicine etc. A few methods to perform classification are discussed in this literature. In the last decade, there has been huge advances in the development of classification algorithms involving machine learning. The integration of machine learning with the classical classification algorithms has made it possible to categorize the detected tumour into malign or benign.

Literature Survey

In this Research Paper, They presented a new FCM-based method for spatially coherent and noise-robust image segmentation. The contribution was the spatial information of local image features is integrated into both the similarity measure and the membership function to compensate for the effect of noise and an anisotropic neighbourhood, based on phase congruency features, is introduced to allow more accurate segmentation without image smoothing. The segmentation results, for both synthetic and real images, demonstrate that our method efficiently preserves the homogeneity of the regions and is more robust to noise than related FCM-based methods.[1]

In this Research Paper, They presented an improved fuzzy C-means (FCM) algorithm for image segmentation by introducing a trade-off weighted fuzzy factor and a kernel metric. The trade-off weighted fuzzy factor depends on the space distance of all neighbouring pixels and their gray-level difference simultaneously. Furthermore, the trade-off weighted fuzzy factor and the kernel distance measure are both parameter free. Experimental results on synthetic and real images show that the new algorithm is effective and efficient, and is relatively independent of this type of noise. Whereas Threshold algorithm is a common segmentation algorithm which directly divides the image gray scale information processing based on the gray value of different targets.[2]

In this Research Paper, Here SOM clustering was used for MRI brain image segmentation. To improve segmentation, feature extraction was required. Hence for feature extraction Histogram Equalization was used. In Threshold method, we use this histogram visualization to find threshold values. Further the grey level cooccurrence matrix was utilized to avoid the formation of misclustered regions. Principle component Analysis (PCA) method was proposed to improve the accuracy of classifier. For the automatic brain tumour detection from MRI brain image proximal support vector machines (PSVM) algorithm was used.[3]

In this Research Paper, They showed that DICOM images produce better results as compared to non-medical images. They found that time requirement of hierarchical clustering was least of three and that for

Fuzzy C means it was highest for detection of brain tumour. Where as we know that In threshold method ,the calculation is simple and the operation speed is faster.[4]

In this Research Paper, They proposed an interactive segmentation method that enables users to quickly and efficiently segment tumours in MRI of brain. They proposed a new method that in addition to area of the region and edge information uses a type of prior information also its symmetry analysis which is more consistent in pathological cases.[5]

In this Research Paper, This paper discussed the shortcoming of FCM clustering algorithm for MR images segmentation, which may performs very fast and simple, but this algorithm do not guarantee high accuracy. To improve the accuracy ant colony algorithm was introduced. Results show that fuzzy C means performs well as compared to K means algorithm. After applying the ant colony algorithm the accuracy and the PSNR value of both the algorithm increases but at the cost of time. Where as we know that In threshold method ,the calculation is simple and the operation speed is faster.[6]

In this Research Paper, According to their results, The segmentation accuracy of FCM is less due to the fact that it is practical to initialization. Thus to increase the accuracy of segmentation of FCM, Particle swarm optimization is used. The centre cluster is initialized to proper ideal value which gives the results in increased accuracy segmentation. The proposed algorithm results for 15 MRI images are shown. Hence with the help of FCM it is fast for cluster formation and with the help of particle swarm optimization we have found the rise in the time along with the segmentation accuracy. Whereas the most commonly used threshold segmentation algorithm is the largest interclass variance method (Otsu) , which selects a globally optimal threshold by maximizing the variance between classes.[7]

In this Research Paper, The regional growth method is a typical serial region segmentation algorithm, and its basic idea is to have similar properties of the pixels together to form a region. The method requires first selecting a seed pixel, and then merging the similar pixels around the seed pixel into the region where the seed pixel is located. Whereas my algorithm Threshold segmentation can be divided into local threshold method and global threshold method. The global threshold method divides the image into two regions of the target and the background by a single threshold. The local threshold method needs to select multiple segmentation thresholds and divides the image into multiple target regions and backgrounds by multiple thresholds.[8]

In this Research Paper, They presented a novel algorithm for obtaining fuzzy segmentations of images that are subject to multiplicative intensity inhomogeneities, such as magnetic resonance images. The algorithm is formulated by modifying the objective function in the fuzzy C-means algorithm to include a multiplier field, which allows the centroids for each class to vary across the image. Whereas the advantage of the threshold method is that the calculation is simple and the operation speed is faster. In particular, when the target and the background have high contrast, the segmentation effect can be obtained. The disadvantage is that it is difficult to obtain accurate results for image segmentation problems where there is no significant gray scale difference or a large overlap of the gray scale values in the image[9]

In this Research Paper, In addition to this, there are entropy-based threshold segmentation method, minimum error method, co-occurrence matrix method, moment preserving method, simple statistical method, probability relaxation method, fuzzy set method and threshold methods combined with other methods. Since it only takes into account the gray information of the image without considering the spatial information of the image, it is sensitive to noise and grayscale unevenness, leading it often combined with other methods[10]

Problem Statement

From the papers reviewed, it can be interpreted that in the previously similar projects, fuzzy C-Means algorithm has been used for brain tumour detection. In one particular paper comparing the performance of all Algorithms, it was found that In the Threshold method , the calculation is simple and the operation speed is faster in the process of image segmentation. After studying the review papers by the above mentioned authors it is evident that an efficient segmentation algorithm is must for successful brain tumour detection. Many efficient clustering /segmentation algorithms have been discussed so far such as the FCM clustering, KNN clustering, Hierarchical clustering etc. The segmentation technique that will be used for this project is the Thresholding Algorithm.

Research Framework

Steps to be followed are:

1) Image Enhancement

2) Segmentation Phase

3) Classification Phase (This is where Tumour is located)

A. Image Enhancement:

Image enhancement is a process of enhancing (or improving) the image for better analysis. It may be removing noise or improving the contrast, enhancing the intensity etc. Enhancement is used to improve the quality of the image so that it becomes easier to separate out the regions showing similar properties like contour, contrast, colour etc. This forms the basis of the process of segmentation

B. Segmentation Phase:

Segmentation is the partitioning of an image into a set of homogeneous and significant regions having a single label and common or similar properties. Here the algorithm used is Global Thresholding Technique. This is the simplest of all thresholding algorithms. Here, the histogram of the complete

image is partitioned by a single threshold 'T'. Segmentation is then achieved by scanning each pixel and comparing it to 'T' and grouping them into different regions.

C. Classification Phase:

Classification of the medical images is a fundamental procedure in many medical applications and diagnosis involving the fields of cerebral cancer, psychology and medicine etc. The identified region will be separated out using the process of dilation and erosion.

Implementation

```
img=imread('1.jpg');
ig=rgb2gray(img);
ig3=imadjust(ig);
threshold=170;
[m,n]=size(ig3);
ithresh=zeros(m,n);
figure,imhist(ig3);

for i=1:m
    for j=1:n
        if(ig3(i,j)>threshold)
            ithresh(i,j)=1;
        else
            ithresh(i,j)=0;
        end
    end
end

l=graythresh(ig3);
disp(l);
ss=strel('disk',3);
i1=imerode(ithresh,ss);
i2=imdilate(i1,ss);
subplot(2,4,1),imshow(img),title('Origina
l');
subplot(2,4,2),imshow(ig3),title('After
Enhancement');
subplot(2,4,3),imshow(ithresh),title('Aft
er Thresholding');
subplot(2,4,4),imshow(i1),title('After
Erosion');
subplot(2,4,5),imshow(i2),title('After
Dilation');
```

Results

This is the sample image which I took for experimentation.

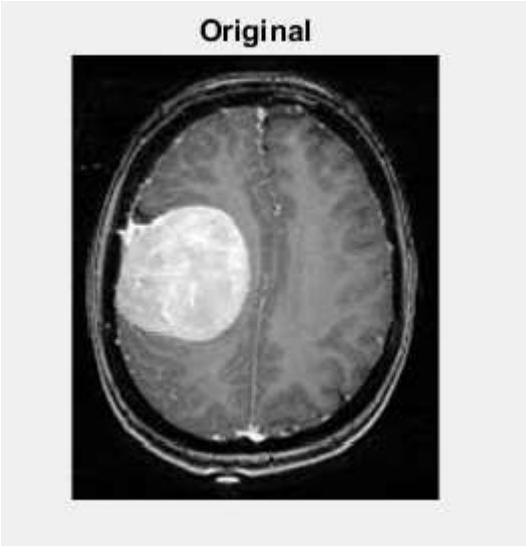

Fig2. Original Image

After Enhancing the sample image, the image obtained is displayed below.

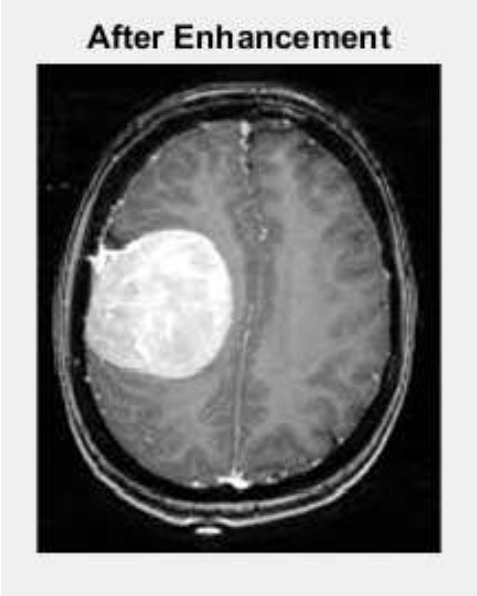

Fig 3 . After Enhancement

After applying Threshold algorithm, we get the below image.

Fig 4. After Thresholding

After applying Erosion, we get the below image.

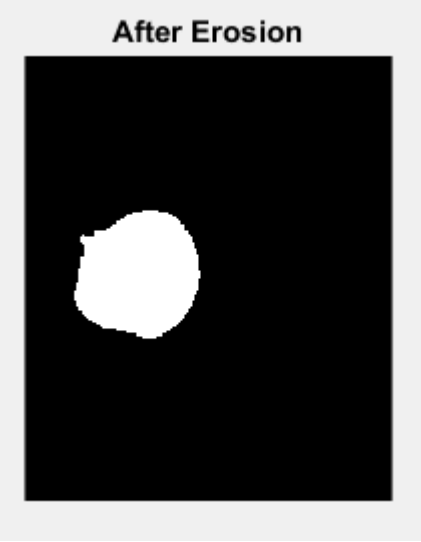

Fig 5. After Erosion

After applying Dilation, we get below image.

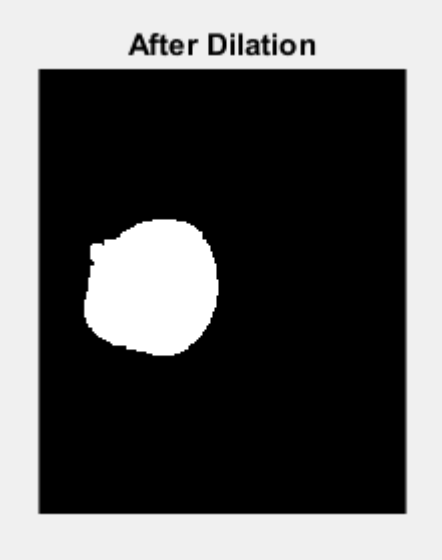

Fig 6. After Dilation

Conclusion

In this paper the summary of the pre-existing techniques and methods used for brain tumour detection has been listed out and discussed. On the basis of the study of the various review papers on "brain tumour detection", one more method of detecting tumour in the MRI images of the human brain has been proposed using the Thresholds algorithm for the purpose of segmentation.
Before implementing clustering and segmentation, the quality of the image can be enhanced using various techniques such as contrast adjustment, noise removal etc. The image can also be converted into a grey scale image or a binary image to make the process of segmentation easier.

Finally, the Thresholds algorithm can be used to segmentation. The Thresholds algorithm is fast and efficient as compared to various existing clustering algorithms used for the same purpose and therefore, can prove to be a promising method of brain tumour detection.

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