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Research Paper

Detection of brain tumour using segmentation

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Abstract

This paper presents the detection of the brain tumour by improvised image segmentation technique. The Magnetic Resonance Image is considered for the purpose of detecting the brain tumour. The human brain occupies 2% of the body's weight. The Magnetic Resonance Image is preferred over the CT scan image for accuracy of the MRI based brain tumour detection is high. Though there are several techniques of segmentations, the water shed proves to be advantages in detecting the region of interest. The score plot of the vertical and horizontal plane exhibits high efficiency and feasibility of the technique presented.

Keywords: *Human Brain Tumour, Magnetic Resonance Image, Water Shed Segmentation.*

1. Introduction

The brain is the central processing unit of any living being. The human brain consists of the billions of neurons referred as Gray Matter and billions of fibrous nerves referred as White Matter. Depending on the origin, the brain tumour might be classified into two types. They are a) Benign tumour and b) Malignant tumour. Benign tumour is developed from the abnormal behaviour of the brain cells. Malignant tumour is developed in other organs and spread into the brain. The malignant tumour is also referred as cancerous tumour.
Externally, the causes for brain tumor are exposure to vinyl chloride and ionizing radiations. Also, there are some inherited diseases which have different grades of tumours based on the severity level. In human brain, the nature of substances permissible inside the brain is controlled by the Blood Brain Barrier (BBB). If any tumour is to be developed in the brain, the BBB has to be broken. This BBB disruption of the BBB is well captured by using the MRI or CT image. The MRI scan is often used for scanning the benign brain tumours which indicates the tumour darker than brain tissues. The non-invasive MRI based brain tumour imaging technique is attractive and attentive in recent years [1].
There are several techniques used in image for the detection of tumour in human brain. The brain tumour identification technique using the intelligent water drops has detection accuracy increase by 20% and delay is reduced by 1.5 seconds [2]. The histogram differencing based approach is applied to segment the tumour pixels in the MRI scan [3]. The soft computing based image segmentation plays an important role in detection of tumour detections. The fuzzy logic based brain tumour from the MRI scan avoids misclustering of regions in the image by using morphological filter[4][5].The neural network based brain tumour identification techniques yields better sensitivity, specificity and accuracy compared to the conventional method [6]. Berkeley wavelet transformation (BWT) based brain tumour segmentation shows accuracy of 96.51%, specificity of 94.2% and sensitivity of 97.72%.[7].The Gaussian mixture model for the Glioblastoma feature extraction using the T1-WI and T2-WI depict the accuracy performance of 97.05% [8].
Nowadays fusion of two different technologies is used for collective advantages. The MRI and CT images are combined together could easily detect the tumour cells using the discrete wavelet transform [9]. The fusion of threshold segmentation and morphological extraction gives a perfect picture of the tumour structure [10].
In this paper, the water shed algorithm is utilized for the purpose of detecting the brain tumour using the MRI scan. The water shed algorithm for the detection of brain anomalous regions proves to be highly enhanced and accurate [11]. Controllers analyses for non-linear systems has been reported [12-21].

2. The Proposed Method

The proposed methodology involves in the conversion of MRI colour image to Gray scale Digital image. The GDI equivalent is detected for brain tumour in the image through the processes of filtering, marking and identifications. The final process of segmentation is performed for the brain tumour image. The design flow for the proposed method is given in Fig.1.

A. MRI Image

Magnetic Resonance Image (MRI) is utilized in the field of medical imaging. The basic concept behind the MRI scanning is the excitation of magnetic field over the hydrogen atom of the living organisms. Naturally, hydrogen atom is present in the form of water and fat content in the living organisms. For this reason, the MRI scans the water and fat in the area of interest. In this work, the MRI image of the human skull is considered. The human skull neuron image obtained is a T2-weighed image. Based on the type of organs scanned; the MRI could be used for medical applications.

B. Pre-processing

The MRI has to be converted into digital format for performing manipulation. The MRI is converted to the Grey scale Digital

Image (GDI) for processing. The GDI is also referred as black and white image composed with shades of gray. This GDI is useful in the measurement of the intensity of each pixel in a single band of the electromagnetic spectrum. The resolution of the GDI is 2^8 bits. The intensity scale for each pixel ranges from 0 to 255 values, where the value ‘0’ stands for black and ‘255’ stands for white. The corresponding binary equivalents are “00000000” for black and “11111111” for white. The MRI brain skull image is converted to the GDI for pre-processing.

C. Edge detection

Edge detection is the mathematical process performed on the GDI image pixels to identify the occurrence of the drastic intensity changes in the neighbouring pixels. The edge detection is a continuous iteration method that evaluates the discontinuous in the brightness of all pixels in the GDI converted image.

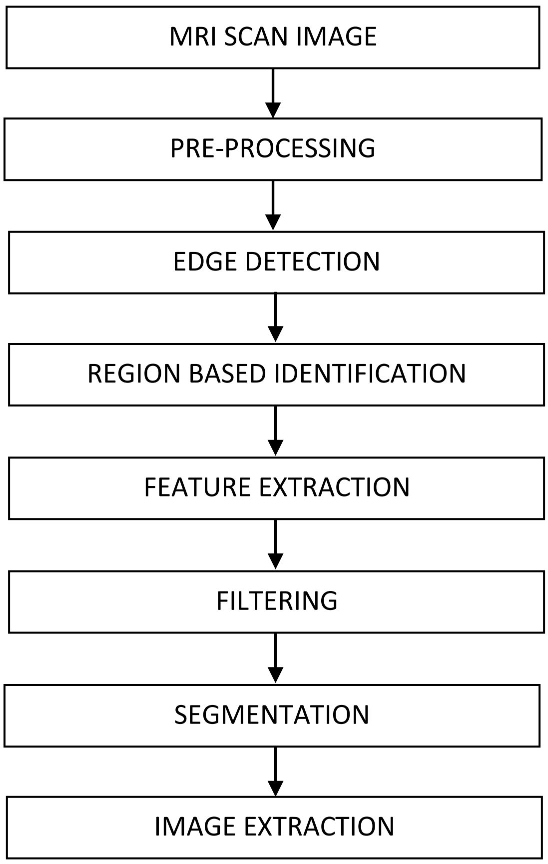

Fig. 1: Design flow for the brain tumour identification using water shed segmentation

D. Region based Identification

The edge detection of GDI helps in the determination of the boundaries of the tumour in the brain. The desired region of tumour or object is referred as the Region of Interest (ROI).

E. Feature extraction

The process of feature extraction is to reduce the number of pixels for particular operations. The isolation of desired portion of the image is obtained by the feature extraction algorithms. After the desired portion is identified, it is marked by the different colour.

F. Filtering

Filtering is the processing of eradicating unnecessary noise pixels in the image. The use of high pass filter improves the quality of image and reduces manipulation errors. The impulse noise of the image is subjected to another filtering technique called as “Median filter”. The median filter utilizes the statistical median calculation of each pixel by considering the surrounding neighbouring pixels.

G. Segmentation

Though segmentation is performed by several ways, the intensity based segmentation is prominent in operation. The water shed segmentation compares each pixel with the other pixels to separate the tumour from the image. The watershed algorithm was proposed by F.Meyer. After successful segmentation of the image, the morphological operation is performed. The process of probing a small shape of the image by placing over all possible regions of the image is performed; so as to compare with the corresponding pixels of the GDI.

The watershed algorithm utilizes the gradient magnitude as the function for segmentation. The foreground objects are marked by the morphological techniques. The background pixels in dark are computed with thin boundaries in the image to obtain the brain tumour. The desired output is obtained by taking the watershed transform of the gradient magnitude.

H. Image Extraction

The image of the desired portion is extracted for the tumour region. The analysis of the tumour properties like weight, dimension, size, and numbers are performed for any desired patient.

3. Results and Discussions

The MRI is converted into the GDI image with the resolution of 2^8 bits. Fig.1 shows the image of the 2^8 bit resolution of the human skull by pre-processing. Fig.2 depicts the detection of the edges for the desired region of interest. That is, the edge of the human skull in the GDI image. The desired region of the tumour is found by the ROI of the image as shown in Fig.3. The noises in the digital pixels are eradicated by the filtering process. The enhancement of the tumour region in the human skull in presented in the Fig.4. In order to separate the tumour region from the image, the segmentation is performed. The segmented image using the water shed algorithm is given in Fig.5. The image extracted with the tumour region is shown in the Fig.6. The extraction of the tumour region of the image is evaluated with the score plot each in vertical and horizontal direction as given in the Fig.7 and 8 respectively.

4. Conclusion

The diagnosis of the tumour in the human brain is successfully determined by using the water shed segmentation method. The water shed algorithm utilized for the segmentation proves to be efficient and effective in the analysis of the tumour cells in the MRI based Image. Future work could be extended with the segmentation of the colour images by contouring technique and image features could be extracted in 3-Dimensional form for detailed analysis.

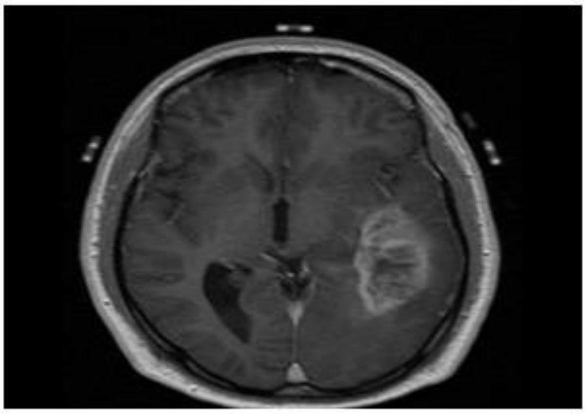

Fig. 1: GDI of the MRI with 2^8 bits resolution

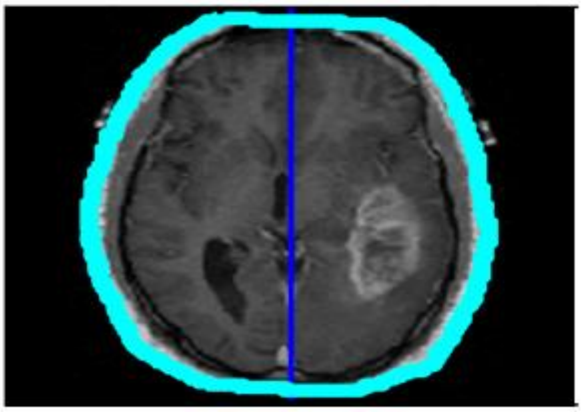

Fig. 2: Edge Detection of the skull

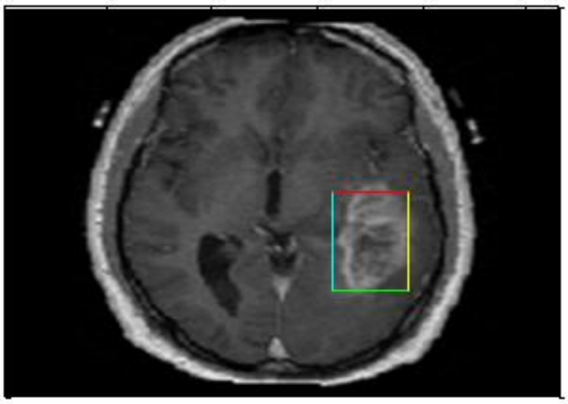

Fig. 3: Region of Identification of Tumour

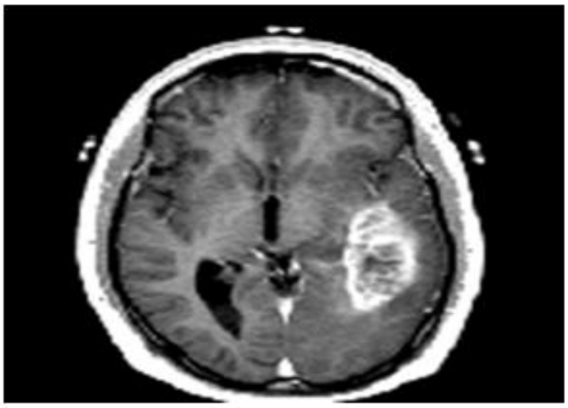

Fig. 4: Enhanced image of the ROI

Fig. 5: Water shed segmentation of the Human tumour skull

Fig. 6: Extracted image of the tumour

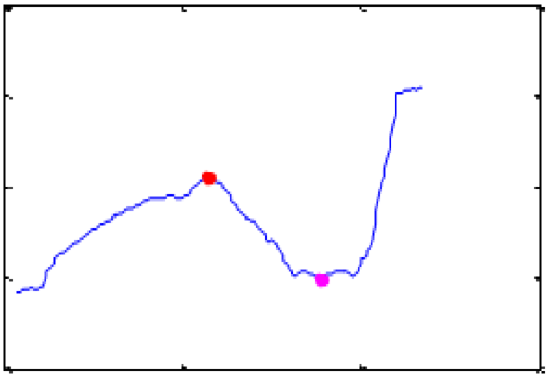

Fig. 7: Score plot for vertical direction

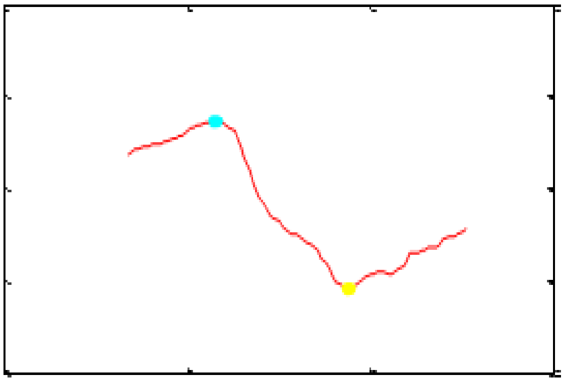

Fig. 8: Score plot for horizontal direction

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