Detection and Classification of Brain Tumour Using Modified Region Growing and Neural Network in MRI Images

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Abstract: Medical image processing is the most demanding and promising field. The traditional method for detecting the tumor diseases in the human MRI brain images is done manually by physicians. In this paper a detection of brain tumour modified region growing technique is used. Modified region growing includes both orientation constraints and intensity constraints. For Detection of tumour the MATLAB software is used. This paper described proposed strategy to detect of brain tumour from patient's MRI scan images of brain.

Keywords: Image processing, Modified Region Growing, Tumour Detection

1. Introduction

Tumour is the abnormal growth of the tissues. Brain tumour is an abnormal mass of tissue; in this cells grow and multiply uncontrollably. Brain tumours can be primary or metastatic, and either malignant or benign, may be localized or extended while secondary tumors could be in different locations. Primary brain tumors can start from brain cells, the membranes around the brain, nerves, or glands. It can directly damage brain cells. They can also destroy cells by producing inflammation, placing pressure on other parts and increasing pressure within the head. A metastatic brain tumour is a cancer that spread from elsewhere in the body to the brain.

The incidence of brain tumour is increasing fast, mostly in the older population than compared with younger population. Over the last 20 years, the overall incidence of cancer, including brain cancer, has increased by more than 10% as reported in the National Cancer Institute statistics (NCIS). National Brain Tumour Society is committed to identifying and responding to the needs of the brain tumor community. In January of 2009, it released findings from a national survey of over 1,400 patients that were affected by brain tumour. Therefore it is becoming increasingly important for us to detect a brain tumour at the earliest stage of the tumour.

This proposed method is based on use of modified region growing and neural networks. According to the World Health Organization, brain tumour can be classified into the following groups as Pilocytic or benign. Astrocytoma, Anaplastic, Astrocytoma, Glioblastoma.

2. Literature Survey

A lot of work has been proposed by researchers for the MRI brain image segmentation and tumour detection technique. A short review of some recent research work is presented here. presented a quantization segmentation method to detect cancerous mass from MRI images. In order to increase radiologist's diagnostic performance, computer-aided diagnosis scheme have been developed to improve the detection of primary signatures of this disease: masses and micro classification. Morphological segmentation extracts other regions with tumour region. Thresholding is used to convert input image into binary image. Global threshold methods suffer from drawback as threshold value was given manually. The algorithms were tested on twenty one MRI images. Identification rate for Morphological Segmentation was 66.7%.S. Klein, et al [4] studied the likelihood in a premature period of detecting dementia, using no rigid registration of MRI. A k-NN classifier was train on the dissimilarity matrix and the performance is tested in a leaveone-out experiment on 58 images. A. El-Dahshan, T. Hosny, and A. M. Salem [5], presented proposed hybrid techniques consist from three steps, extraction of feature using DWT, reduce the large dimension using principal component analysis PCA and classify the output using two classifiers. The first classifier based on ANN and the other classifier is based on k-nearest neighbour (k-NN). S. Chaplot, L. Patnaik, and N. Jagannathan, [6], the authors used ANN and SVM to classify brain MRI. The pre-processing phase uses DWT and used as input for Neural Network NN and SVM.

3. Proposed System

In proposed technique, firstly the input MRI image is preprocessed to eliminate the noise and make the image noise free for the next process. Figure 1 shows the block diagram of proposed system which consist seven blocks The Gaussian filter and RGB to grey image converter were used in the preprocessing stage. Subsequently, the pre-processed image is segmented using the modified region growing and normal region growing technique. In modified region growing the orientation constraints in addition to the normal intensity constraints can be considered.

According to the literature study, B. Kekre et al [2] have

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Figure 1: Block Diagram of Proposed System

3.1 Input MRI brain images data

The MRI image dataset that have utilized in image segmentation technique is available from the publicly available sources. This dataset contains brain MRI images with tumour and without tumour. The figure 2 shows the sample MRI images with tumour and non-tumour images.



(b) Figure 2: MRI image dataset (a) MRI Normal Images, (b) MRI with tumours images

3.2 Pre-processing

MRI brain images cannot be fed directly as the input for the proposed technique. The input image is subjected to a set of pre-processing steps so that the image gets transformed suitable for further processing. The figure 2 shows input MRI image with tumour. There two step pre-processing procedure in which first the input image passing through the Gaussian filter which enhances the image quality. In the second step in the pre-processing, the image is converted from the RGB model to Gray Image which makes the image fit for region growing process which is shown in figure 3 and figure 4.

When working with images, it is necessary to use the two dimensional Gaussian function. This is simply the product of two 1D Gaussian functions (one for each direction) and is given by:

$$G(x) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2 + y^2}{2\sigma^2}}$$
(1)



Figure 3: Input MRI image



Figure 4: Preprocessed MRI image

3.3 Modified Region Growing Technique

Region growing is a simple image segmentation method based on the region. This approach to segmentation is to check the neighboring pixels of initial "seed points" and checks whether the pixel neighbors should be added to the region or not, based on certain conditions. The process is iterated to yield different regions. In a normal Region growing technique, the neighbor pixels are examined by only the "intensity" constrain. For this, a threshold level for intensity value is set and those neighbor pixels that satisfy this threshold is selected for region growing. The normal region growing has the drawback that noise or variation of intensity may result in holes or over segmentation. Another drawback is that the method may not distinguish the shading of the real images. For improving the normal region growing and effectively tackling the draw backs of a normal region growing, they added an additional constrain of "orientation". In the modified region growing, there are two thresholds; one is for the intensity and the other for orientation. Region is grown if only both constrains are met. For evaluation of the propose technique, spilt the original image into 4, 18 and 24 grids. Gridding results in smaller grids so that analysis can be carried out easily which is shown in figure 5.



Figure 5: Gridded MRI Image

In this technique each of the grids is treated separately to which the region growing technique is applied. The initial step in region growing for the grid formed is to select a seed point for the grid. The initial region begins with the exact place of the seed. Also to find out the seed point of the grid histogram analysis is carried out. The histogram is found out for every pixel in the grid. As the image is a grey scale image, the values of this image is from 0 to 255. For every grid, the histogram value that comes most frequent is selected as the seed point pixel. From this, any one of the seed point pixel is taken as the seed point for the grid. After finding out the seed point, the region is grown from it. The neighboring pixels are compared with the seed point and if the neighbor pixel satisfies constrains, then the region is grown else it is not grown to that pixel. Figure 6 shows Normal Region Growing Segmented image.



Figure 6: Segmentation with Normal Region Growing method

From this matrix g, then get the orientation for each of the pixels. Suppose the pixel is having O_N and the orientation threshold is set as $T_{O,} \parallel O_P \cdot O_N \parallel \leq T_O$ then the orientation constrain is met and satisfied. When both the intensity constraint and the orientation constraint are satisfied by a neighboring pixel, the region is grown to the neighbor pixel and the region grows. When $\parallel I_P - I_N \parallel \leq T_I \text{ AND } \parallel O_P \cdot O_N \parallel \leq T_O$ then the neighbor pixel is added to the region. For every grid, the region is grown [1]. Figure 7 shows the Modified region Growing segmented image.

3.4 Feature Extraction

After finding out the regions for every grid, features are extracted from these regions. Normally in other techniques features are extracted from the pixels but in this technique features are extracted from the region. The extracted features include the area, orientation, mean, correlation and covariance of the region

3.5 Final Classification

In-order to detect the presence of the tumour in the input MRI image, in this technique use the neural network classifier to classify the image into tumourous or not and its disease type also.



Figure 7: Segmentation with Proposed Modified Region growing method

The neural network consists of three layers which are input layer, hidden layer and the output layer. Initially the neural networks are trained by the features that are extracted in the previous step. For the training purpose, we have used about 30 MRI images of which 15 are normal and the other 15 are tumourous. The neural network is trained with features of these images. We have utilized Feed Forward Neural Network (FFNN) and Radial Basis Function (RBF) neural network for comparative analysis. The input MRI image is fed into the trained neural network after the pre-processing and modified region growing. The classifier compares the trained data with those of the input image feature data and classifies it into tumourous or normal.

4. Results

The performance of the technique is compared with the region growing algorithm to evaluate the sensitivity, specificity and accuracy

Evaluation Metrics		Training Dataset		Testing Datasheet	
		Region Growing	Modified Region Growing	Region Growing	Modifie d Region Growing
Input MRI Image Dataset	TP	9	10	7	10
	FP	2	0	3	1
	TN	4	5	4	4
	FN	0	0	1	0
	Sensitivity	100%	100%	70%	100%
	Accuracy	86%	100%	78%	93%

Table 1: Performance Evaluation of two methods

5. Conclusion

The technique consists of pre-processing, segmentation; feature extraction of the region and final classification. The normal region growing has the drawback of noise or variation of intensity which may result in over segmentation. To overcome this drawback an additional constrains of "orientation" is added in the modified region growing. By analyzing the results, the performance of the proposed technique has considerably improved the tumour detection compared with the region growing algorithm based MRI segmentation.

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