Vol. 3 No. 1 July 2015 ISSN: 2321 – 788X

BRAIN TUMOR CLASSIFICATION BASED ON NEURAL NETWORK AND REGION GROWING SEGMENTATION

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Abstract

Image classification recently becomes an essential high level process after segmentation in image processing. Image segmentation is the process by which the original image is subdivided into its constituent regions or objects. Image segmentation is an initial task for higher level image processing such as classification or objet recognition. In medical image segmentation, structures or objects of interest for segmentation include abnormalities like brain tumor. Detecting brain tumor in human brain using magnetic resonance (MR) image is important in medical imaging for diagnosis of the disease. Automatic detection of brain tumor in MRI provides the abnormal tissue which is necessary for treatment planning. The exact boundary tumor detect by using the image segmentation. In this paper we perform an objective comparision of region based segmentation techniques and classification of tumor. The performance of the segmentation algorithm are evaluated by using the methods Rand Index(RI), Variation of information (VOI) and Global Consistency Error (GCE) for MR image. Artificial neural network (ANN) is used to classify mainly in medical imaging. Radial Basis Function (RBF) and feed forward back propagation (FFBP) are trained the feature vector for classification. Features are calculated from the extracted image.

Keywords*: Classification, Feature Extraction, Region Growing Segmentation, Radial Basis Function Network, Feed Forward Back Propagation.*

Introduction

Brain tumors are abnormal and uncontrollable of cells. The brain tumor takes place when cancer cells extend to the brain from a primary cancer cells in a different parts of the body. Brain is the central part of the body which is responsible for controlling and co-ordinating all other body organs, so if a tumor is located in a portion of brain then activities which are controlled by that part of nervous system also affected. Brain tumor is most common for all type of age people and childrens. The MRI is the task of category voxels according to their tissue type which is White Matter (WM), Grey Matter(GM) and Cerebrospinal Fluid(CSF) and occasionally pathological tissues like tumor etc. Early detection and classification of brain tumors is very important in diagnosis.

There are two common types of tumors

1. Benign tumor
2. Malignant tumor

1. Benign Tumor:

A benign tumor is the tumor is the one does not expand in any way. It does not affect its neighboring healthy tissues and also does not expand to non adjacent tissues.

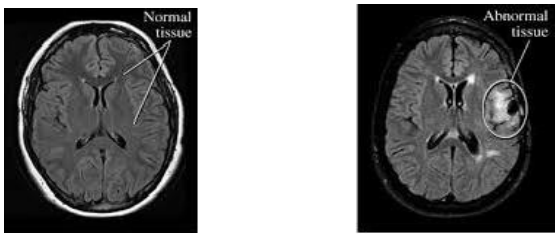
2. Malignant Tumor:

Malignancy is the type of tumor that grows worse with the passage of time and ultimately results in the death of the person.

Malignant is basically a medical term that describes a severse progressing disease. Malignant tumor is a term which is typically used for the description of cancer.

Magnetic resonance imaging (MRI) provides rich three-dimensional (3D) information about the human soft tissue anatomy. It reveals fine details of anatomy, and yet is non-invasive and does not require ionizing radiation such as r-rays. It is a highly flexible technique where contrast between one tissue and another in an image can be varied simply by varying the way the image is made.

Image segmentation is a mid-level processing technique used to analysis the image and can be defined as a processing technique used to classify or region an image by grouping the pixels to form a region of homogeneity based on the pixel characteristics like grey level, color, texture, intensity and other features. The main purpose of the segmentation process is to get more information in the region of interest in an image which helps in annotation of the object. The main goal of segmentation is to clearly differentiate the object and the background in an image.



Difference between the normal and abnormal tissue

Literature Survey

(Basava Prasad B and Ravi, 2013) comparing the segmentation methods pixel based, Threshold based, edge based and region based segmentation methods. Using these segmentation methods classify the feature based on graph based methods. Pixel based segmentation are more complexity for medical image processing. Edge based segmentation may provide the average complexity. Region based segmentation provide the very low complexity to the medical image.

(Swe Zin Oo and Aung Soe Khaing , 2014) worked with MR image is used to tumour

detection process. This system includes test the brain image pre- processing, image filtering, skull stripping, segmentation, morphological operation, calculation of the tumour area and determining the tumour location. In this system morphological operation erosion algorithm applied to detect tumour. The proposed method extracts the tumour region accurately from the MR image. The experimental results show the detection of tumour may provides the better result than previous.

(Rosy Kumari, 2013) are discussed about the svm classification for abnormality of brain. In this feature extracted by using gray level co occurrence matrix and classification based on the support vector machine (SVM) for analysis. Then calculating the performance evaluation of the classifier. SVM Classifier having the problem of classification based on only two classes. More type of classes that does not discuss in these classifier.

In the pre-processing including by converting RGB image into grey scale image then resize an image. After passing that image to the median filter in order to remove noise and finally pass the enhanced image for post processing that perform region growing segmentation and extract the tumor for classification.

Proposed Method

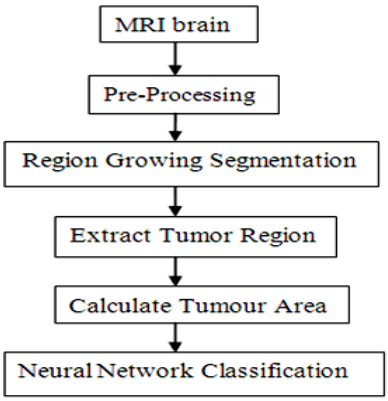


Fig 2 Steps used in brain tumor classification

Classification is the high level image processing for identifying the type of the object. The main objective of classification is to classify the tumor based on segmentation result. Segmentation is to partition an image into regions, region of interest that pixels with regions are homogenous with respect to criteria.

Proposed Method

1. Image Acquisition:

Images are obtained using MRI Scan image are displayed in a two dimensional having the elements. MR images are initially in RGB color that convert into grey scale

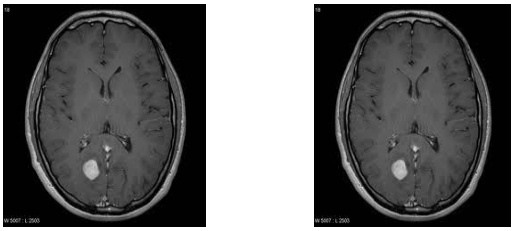
image of size 256 * 256. The elements in the grey scale image are ranging from 0 to 255. 0 belongs to black color and 255 belongs to white color.

The intensity of the image vary from black to white.

Identification of tumor based on the implementation we need to have the images of different MRI images. MRI images are stored as the data file for identifying.

2. Pre-Processing:

In the pre-processing phase image is enhanced by removing the noise in the MR Image. While taking MR image noise is occurred due to some error so noise is removed by applying the filters. Median filter is applied to remove noise because it preserves edge of the tumor part so tumor area is not affected by filters. Quality of the image and feature are enhanced and fulfilled the pre-processing techniques.



a) b)

Fig 3 a) Before filter b) After Filter

3. Segmentation:

Image segmentation is an important and challenging factor in digital image processing. Image segmentation is required to delineate the boundaries of the ROIs ensuring, in our case, that tumours are outlined and labelled consistently across subjects. Segmentation can be performed manually, automatically, or semi-automatically. The manual method is time consuming and its accuracy highly depends on the domain knowledge of the operator.

In the proposed method region growing segmentation used that is seeded region growing algorithm are applied to identify the tumor. Seed point is selected automatically in the proposed method. Selection of seed point based on intensity value of MR image because tumor region vary from other region. So the segmentation performed automatically by using seeded region growing algorithm. Segmented image consist of regions that formed based on the same intensity levels. Region of interest (ROI) that extracted from the segmented image. By applying the binary mask that easily extract the tumor region. So the extracted region is further applied in the classification.

Performance evaluation of segmentation is calculated by using Rand Index (RI), Global Consistency Error (GCE) and Variation of Information (VI).

4. Classification:

Artificial neural network classifiers are used to classify type of tumor. Feature of the extracted image are given as training vectors in the neural network. RBFN is a supervised learning method. The basic architecture for a RBF is a 3-layer network. The input layer is simply a fan-out layer and does no processing. The second or hidden layer performs a non-linear mapping from the input space into a (usually) higher dimensional space in which the patterns become linearly separable.

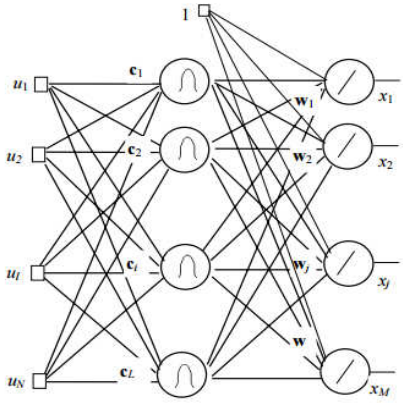


Fig.4 Structure of radial basis function network

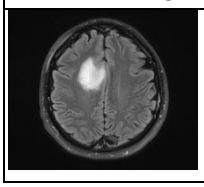
Area of the tumor is calculated in the extracted region from segmented image. Size of the tumor is given as the feature in the trained vectors. Features are trained in the network so that tumor is easily classified in neural network.

Radial basis function network performances are better than feed forward backpropagation network in the classification of tumor. Gaussian function that is differ from the networks. Bias value in output layer is stable to classify the tumor .

4. Experimental Results

First the input image is performed pre-processing process as resize and apply filter to the image. The performance of the filters is calculated by Mean Squared Error (MSE) and Peak signal-to-noise ratio (PSNR). Quality of the filtered image is calculated by these matrices.

Table 1 Sample Filtered image and Quality

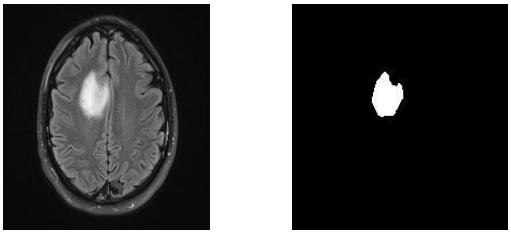
Filtered Image	PSNR	MSE
	49.96	0.031

Quality metrics values shows that by comparing the input and filtered image that quality increases after filtering the image.

After pre-processing, we are going to perform mid-level process segmentation. Seeded region growing segmentation provides better result than other region based methods. The Performance evaluation of segmentation is calculated by using Rand Index (RI), Global Consistency Error (GCE) and Variation of Information (VI).

Table 2 Performance evaluation for same image

Segmentation method	RI	GCE	VI
Region Growing	0.4015	0.4050	7.5717
Split & Merge	0.4459	0.3510	6.2741



a) b)

Fig 5 Segmentation Result

After the segmentation the size of the tumor is calculated. Area of the tumor is calculated by total number pixels in the tumor region are measured. Then the area of tumor is converted to inch square.

Area of tumor in pixels = 3570

Area of the tumor in inch2 = 0.089in2

Size of the tumor is given as the feature vector in the rbf network and ffbp network. Neural networks are classifying the type of tumor. The experimental results for normal and abnormal classification are listed in Table 3. The Accuracy, Specificity and sensitivity are calculated for classification measures.

Sensitivity (true positive rate)
= TP / (TP + FN)
Specificity (false positive rate)
= TN / (TN + FP)
Accuracy (percent of all samples correctly classified)
= (TP + TN) / (TP + TN + FP + FN)

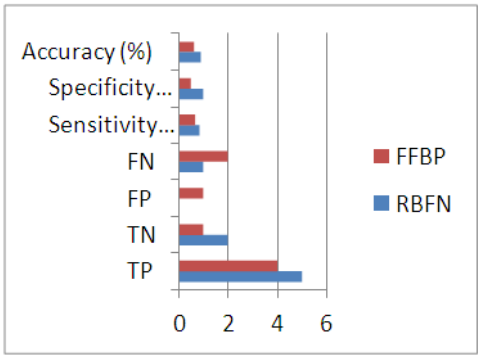
Table 3 Training and Test Images

Total Number of images	No. of images in Training Set		No. of Images in Testing Set	
	Class 1	Class 2	Class 1	Class 2
20	8	4	5	3

Table 4 Classification Rates

Performance	RBFN	FFBP
TP	5	4
TN	2	1
FP	0	1
FN	1	2
Sensitivity (%)	83%	66%
Specificity (%)	100%	50%
Accuracy (%)	88%	62.5%

Table 4 shows the radial basis function network classifies the tumor better than feed forward back propagation network. Classification provides better result in the proposed method.



Tested Images

Fig 6 Performance analysis of Network

Region based segmentation methods are performed and compared; in that region growing algorithm provides better result than other segmentation. Using region growing algorithm brain image is segmented based on the seed point. In the proposed method seed point selection provides accurate segment of tumor region. In classification RBFN and FFBP are classify the type of tumor as benign or malignant.

The accuracy of the both networks is calculated. Feed forward back propagation provides only 63% accuracy but radial basis function provides 88% accuracy of classification. Radial basis function network provides the better accuracy than other network.

Using these proposed method brain tumor is classified in efficient manner by using region growing segmentation and radial basis function network.

Conclusion

Magnetic Resonance Imaging (MRI) is an important examination and diagnosis method for brain tumors inmedical imaging. The Purpose of this study is to classify brain tumor using neural network and region growing segmentation.

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