A detailed Survey on Brain Tumor Detection and Classification Systems based on Features and Classifiers

A. Selvapandian and DR. K. Manivannan

Address For Correspondence:
A. Selvapandian, Assistant Professor, Department of Electronics and Communication Engineering, PSNA College of Engineering and Technology, Dindigul, India.
E-mail: selvaphd2015@gmail.com

ABSTRACT
Brain tumors are the abnormal cell growth regions in brain Magnetic Resonance Imaging (MRI) image. These brain tumors are classified as low grade and high grade tumors. The low grade tumors are called as benign and high grade tumors are called as malignant. In this paper, various conventional methodologies for brain tumor detection and segmentation methodologies are presented with their tumor segmentation performance evaluation parameters. Conventional methods are classified as feature based tumor classification system and classifier based tumor classification system.

KEYWORDS: brain tumors, segmentation, abnormal, cell, classifier.

INTRODUCTION

Literature Survey:
A. Survey based on Classifiers:
Bhavana Ghotekar et al. [3] proposed a brain tumor detection and classification using Support Vector Machine (SVM) classifier. The authors used linear SVM approach to classify the brain MRI images into normal or abnormal image. In this proposed work, image was preprocessing with median filtering and skull stripping method. It showed better performance than the non-linear SVM classification approach. In that proposed method, the features were extracted using Grey Level Co-occurrence Matrix (GLCM) techniques and linear SVM classifier was used as a classifier in order to improve the classification accuracy. The authors achieved sensitivity of 91.52%, Specificity of 67.74% and Accuracy of 83.33%.
Fig. 1: Brain Images (a) Beningn (b) Malignant

Fig. 1 (a) shows the brain MRI beningn image which has low tumor area and Fig.1 (b) shows the brain MRI image which has high tumor area. Fig.2 shows the Generic brain tumor detection and classification system which classified the test source brain image into normal or abnormal brain image.

Fig. 2: Generic brain tumor detection and classification system

Kavitha et al [1] proposed a new efficient method for detecting tumors in brain images using Genetic Algorithm (GA) with SVM classifier. That proposed method segmented and classified the MRI brain tumor image as benign or malignant. This proposed methodology involved Preprocessing, Segmentation, Feature Extraction and Classification. This proposed work segmented the tumor using Genetic Algorithm and detected and classified the tumor in brain MRI image using SVM classifier. The authors applied GA on extracted feature set which increased the accuracy of the tumor region segmentation. This GA consisted of selection, mutation, crossover and fitness. Each intermediate function of the GA increased the accuracy of the tumor detection system. This methodology detected the inter region of the abnormal tumors in brain MRI image and this method did not support the low resolution brain MRI images.

Fig.3 shows the GA Process flow which contained selection of chromosomes (features which are extracted from brain MRI image), through which mutation and cross over were done. This GA used as optimization technique which increased the classification accuracy of the tumor segmentation system.

Fig. 3: GA Process flow
K. Vinotha et al. [2] proposed brain tumor detection and classification using Histogram Equalization (HE) technique and Fuzzy Support Vector Machine (FSVM) classification approach. The brain MRI image, using histogram equalization was pre-processed and segmented the suspicious portion from the image based on Markov Random Field (MRF) algorithm for segmentation method. MRF method increased the tumor segmentation accuracy through which the performance of the proposed method was improved. In that proposed method, Features were extracted based on texture, fractal and histogram features, finally the classification was done by using support vector machine approach. The reason behind this improvement of classification was that this proposed method enhanced the brain image for obtaining better tumor segmentation results.

B. Survey based on features:

Ajaj Khan et al. [5] proposed an image processing techniques for automatic detection of tumor in human brain Using SVM classifier. The proposed method had two stages: First was feature extraction and second one was classification. First stage was used to extract the features from images using GLCM. In the second stage extracted features that was used as input to Support Vector machine (SVM) classifier. This paper proposed an approach of classification using Support Vector Machine Classifier which had very good working efficiency and produced the accurate results as compare to other classifiers. So that by the SVM classifier accurately and effectively detected the tumor of human brain by the analysis of MRI images.

Eltaher Mohamed Hussein et al [4] proposed Brain Tumor Detection Using Artificial Neural Networks. That proposed method presented an automated recognition system for MR imaging using Artificial Neural Networks (ANNs). That was observed that when Elman network was used during the recognition process, the duration time and the accuracy level were high, compared with other ANNs systems. This neural network has sigmoid function which increased the level of accuracy of the tumor segmentation. Fig.4 illustrates the general architecture of the neural networks which contained input layer, hidden layers and output layer. The number of neurons in input layer is equals to the number of extracted features from brain MRI image.

![Fig. 4: General Architecture of Neural Networks](image)

Rajeshwar Nalbalwar et al [7] used Artificial Neural Network for the detection of brain tumors. In this paper, the authors used radial neural network for the classification of abnormal patterns in brain image. The authors tested their proposed algorithm in both supervised and unsupervised classifications approaches. This method achieved high tumor image classification accuracy in case of supervised classifier due to the internal weights setted in this internal architecture. This method provided best classification results of their proposed method on high resolution brain images. Initially, the authors applied histogram equalization on low resolution brain image which converted into enhanced image. The abnormal patterns were clearly identified on the enhanced brain image. The authors differentiated different normal and abnormal tissue patterns in brain images.

Shashi Kiran et al [8] proposed a new method of detection and classification of brain tumor using artificial neural network from EEG images. In this proposed method, the authors decomposed EEG signals which were obtained from brain, were decomposed using Discrete Wavelet Transform (DWT). These decomposed coefficients of DWT of normal EEG signals and abnormal EEG signals were trained by feed forward back propagation neural networks. The size of these coefficients matrix was equals to the number of neurons in neural network classifier. Then, the decomposition of source EEG signals were carried out and these decomposed coefficients were classified using trained patterns of neural network classifier. The authors tested their proposed EEG signal classification algorithms over 50 EEG signals and achieved 90% of average classification accuracy.

**Conclusions:**

In this paper, various conventional methods for brain tumor detection and segmentation were discussed in detail with their proposed methodology. The architectures and algorithms for various conventional classifiers
and feature optimization techniques were presented with clear illustrations. The experimental results as sensitivity, specificity and accuracy of the conventional brain tumor methodologies were stated.

REFERENCES