A Survey Paper for Brain Tumor Detection and Classification

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Abstract—*Brain tumor detection and classification using different types of image processing technologies available in today's world the most effective algorithms used for detection and classification. Some of the classification techniques are Random forests classifier, Naïve Bayes Classifier, Support Vector Machine (SVM), Back-Propagation Neural Network, AdaBoost classifier. And most of the procedures use Gray Level Co-occurrence Matrix (GLCM) for feature extraction. The above classifiers are compared to find the most efficient classifier considering the data set they use for the classification because data set also plays a prominent role in brain tumor classification.*

Keywords—Brain tumor, Random forests classifier, Naïve Bayes Classifier, Support Vector Machine (SVM), Back-Propagation Neural Network, AdaBoost classifier, Gray Level Co-occurrence Matrix

I. INTRODUCTION

Brain Tumor is one of most commonly found disease from ancient mankind but it's presence from 20th century has rapidly increased in the world and the reasons for the brain tumor are normal cells acquire (mutations) in their DNA .These mutations allow cells to grow and divide at an increased rates and to continue living when healthy cells would die and this results in a mass of abnormal cells, which forms a tumor.

There are basically two types of brain tumor and they the primary brain tumor which originates in the brain or the secondary brain tumor which begin in other parts of the body and then spread to the brain it is also called by other names like metastatic and secondary brain tumor is most commonly caused by the lung cancer.

The main issue is brain tumor detection and classifications, because the tumor is not visible to naked hence we image processing techniques .The few of image processing techniques are compared in this paper. Some of the image processing techniques for brain tumor classification are AdaBoost classifier, Back-Propagation Neural Network, support vector machine (SVM), Artificial Neural Network, Naïve Bayes Classifier, eXtreme GBMs (Gradient Boosted Machines).

II. LITERATURE REVIEW

In paper [3], a multi-modality framework for brain tumor detection was proposed, fusing different Magnetic Resonance Imaging modalities including T1-weighted, T2-weighted, and T1 with gadolinium contrast agent. The intensity, shape deformation, symmetry, and texture features were extracted from each image. The AdaBoost classifier was used to select the most discriminative features and to segment the tumor region. Multi-modal MR images with simulated tumor has been used for the ground truth training and validation of the detection method. The preliminary results show 100% detection rate in all of our test sets Including simulated and patient data with an average accuracy of about 90%.

In paper [4], a method for characterizing brain tumor texture in MR images was presented .The efficacy of the model was shown in patient-independent brain tumor texture feature extraction and also brain tumor segmentation in MR images. To evaluate the efficacy of brain tumor segmentation using proposed multifractal feature was compared with that using Gabor-like multiscaletexton feature. Here they have even described about modification of AdaBoost algorithm which involves assigning weights to component classifiers based on their ability to classify difficult samples and confidence in such classification. The proposed modified AdaBoost algorithm considers wide variability in texture features across hundreds of multiple-patient MRI slices for improved tumor and non-tumor tissue classification. Experimental results with 14 patients involving 309 MRI slices confirm the efficacy of novel multiFD feature and modified AdaBoost classifier for automatic patient independent tumor segmentation.

The paper [5], proposed Neural Network techniques for the classification of the MR human brain images. The demonstrated Neural Network technique had three stages, pre-processing, dimensionality reduction, and classification. The first stag deals with MR image being obtained and converted to data form (encoded information which can be stored, manipulated and which can be transmitted by digital devices), the second stage defines about obtaining the dimensionally reduction of MR image using principles component analysis (PCA), and In the classification stage the Back-Propagation Neural Network has been used as a classifier to classify subjects as normal or abnormal MRI brain images. Experimental result using this technique is workable with accuracy of 96.33%. This technique is fast in execution, efficient in classification and easy in implementation.

In the paper [2] the proposed methodology used for classifications of brain MR image data as normal and abnormal and to consider only those cases which have the possibility of having brain tumor is achieved by using support vector machine (SVM) but SVM actually couldn't work efficiently for a large data set due to its training complexity, because SVM is highly dependent on the size of data set.

In this paper [6], a new automatic CAD system for brain MR image classification was proposed. The method utilizes two-dimensional discrete wavelet transform to extract features from the MR images. The dimension of the features have been reduced using principal component analysis (PCA) and linear discriminant analysis (LDA), to obtain the more significant features. Finally, the reduced set of features were applied to the random forests classifier to determine the normal or pathological brain. A standard dataset, Dataset-255 of 255 images (35 normal and 220 pathological) was used for the validation of the proposed scheme. The classification accuracy and AUC on 'Dataset-

255' are 99.22% and 0.996 respectively .The results showed the efficacy of the scheme with considerably less number of features when compared to other schemes.

In paper [1] the proposed system uses computer based procedures to detect brain tumor blocks or lesions and classify them into different types of brain tumor using Artificial Neural Network in MR images of different patients with Astrocytoma type of brain tumors. The extraction of texture features from the detected tumor had been achieved by using Gray Level Co-occurrence Matrix (GLCM). These features were compared with the stored features to the Knowledge data set and finally a Neuro Fuzzy Classifier was developed to recognize different types of brain cancers. The whole system had been tested in two phases mainly Learning/Training Phase and the other was Recognition/Testing Phase. The known MRI images of affected brain cancer patients were used to train the system. The unknown samples of brain cancer affected MRI images were also obtained from TMH and were used to test the system. This system provided precision Detection and Classification of Astrocytoma type of cancer.

In this paper [7], a methodology to study and classify the image de-noising filters such as Median filter, Adaptive filter, Averaging filter, Un-sharp masking filter and Gaussian filter were used to remove the additive noises present in the MRI images i.e. Gaussian, Salt & pepper noise and speckle noise. The de-noising performance of all the considered strategies was compared using PSNR and MSE. A novel idea was proposed for successful identification of the brain tumor using normalized histogram and segmentation using K-means clustering algorithm. Efficient classification of the MRIs was done using Naïve Bayes Classifier and Support Vector Machine (SVM). The proposed method had some limitations because in some tumor images, the results were not satisfactory, the detection of tumor was not accurate. This algorithm could not find out the precise or accurate boundary of the tumor region.

The paper [9] proposed a novel automated approach for detection and classification, using the Modified K-Means Clustering algorithm with Mean Shift Segmentation for pre-processing MR images. Detection was done using Marker-Controlled Watershed Transform, and Gray-Level Co-Occurrence Matrix (GLCM) was used for feature extraction. For classification, the new and improved version of Gradient Boosted Machines (GBM) called eXtreme GBMs was used(Implemented using the XGBoost library).This supervised learning model has shown accurate results and in lesser time.

Here in the paper [8] proposed system had a four-step procedure, which includes k-means clustering method, Hierarchical Centroid Shape Descriptor (HCSD), Feature extraction and classification method. The brain extraction was used as the pre-processing step in order to remove the skull and noise present in the MRI. The k-means clustering method segment the tumor with surrounding healthy tissue based on the pixel intensities. Hence the HCSD method was used to segment the tumor section alone and then KNN classifier (k-nearest neighbour) method was used to verify the tumor by using the tumor features. This method consisted of training section and testing section. The result of this approach showed that it achieved better accuracy.

III. COMPARISON

Classification algorithm	Accuracy (%)
Random forests classifier	99.22%
Naïve Bayes Classifier	87.23%
Support Vector Machine (SVM)	91.49%
SVM Classification Without PCA	65%
SVM Classification With PCA	85%
Back-Propagation Neural Network	96.33%
AdaBoost classifier	90.11%

Fig 1: comparison of classification algorithms

IV. CONCLUSION

The aim of this paper is to find out the most accurate image processing technique from the above table we can say that the Random forests classifier but it use a large set of data hence using AdaBoost classifier is recommend because it will use less data set compared to the Random forests classifier.

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