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A Survey on Detection and Classification of Brain Tumor Using Image Processing Techniques

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ABSTRACT

A brain tumor is an uncontrolled growth of abnormal brain tissue that can interfere with normal brain function. Although various methods have been developed for brain tumor classification, tumor detection and multiclass classification remain challenging due to the complex characteristics of the brain tumor. Brain tumor detection and classification are one of the most challenging and time-consuming tasks in the processing of medical images. MRI (Magnetic Resonance Imaging) is a visual imaging technique, which provides a information about the soft tissues of the human body, which helps identify the brain tumor. Proper diagnosis can prevent a patient's health to some extent. This paper presents a review of various detection and classification methods for brain tumor classification using image processing techniques.

Keywords : Brain Tumor, Magnetic Resonance Imaging (MRI), Detection, Classification.

I. INTRODUCTION

The field of medical imaging is gaining importance through the increasing need for automated, reliable, rapid and healthy diagnosis that can provide better picture insight than the human eye. The abnormal growth of cells produced within the human body is called Tumor. Brain Tumor is a strong intra-cranial neoplasm that occurs within the brain or central spinal cord. A brain tumor is a serious and life-threatening isease because the brain is the most fragile part of the human body. However, the brain tumor can be a victim of cancer or benign non-cancer. Treatment of brain tumors depends on proper diagnosis and depends on different factors such as tumor type, location, size and developmental status. Tumors in the brain are painful and can lead to various diseases if not treated properly. Examination of the tumor is an important part of the treatment. Identification plays a major role in the identification of tumor. The main reason for the increase in the number of cancer patients worldwide is the ignorance of tumor treatment in its early stages.

A brain tumor is an unwanted growth of a diseased / abnormal cell in the brain in an irreversible manner. Brain Tumor increases intracranial pressure within the skull affecting the cerebrospinal fluid (CSF) region, gray matter (GM), white matter (WM).

Tumor can affect any part of the brain and its size depends on the size of the tumor, the type and location. Tumor cells grow in uncontrolled growth, and like adult immune cells, they do not die. The tumor continues to grow as the number of cells accumulates in the formation of the cyst. Brain tumors are of two types, either Benign or Malignant.

II. BENIGN TUMOR

Cells from benign tumors do not invade the surrounding tissue. They do not spread to other parts of the body. However, benign tumors can complicate sensitive areas of the brain and also cause serious health problems. Benign tumors can be removed, and rarely return.

MALIGNANT TUMOR

Malignant tumors are cancerous cells, invading healthy surrounding tissue and spreading to another part of the brain or spinal cord. This type of tumor grows much faster and is more deadly than benign tumor. The edge is less visible due to the presence of adjacent cells. It grows rapidly and attacks the surrounding brain tissue.

The proposed methodology involves four stages: Pre-processing, Segmentation, Feature Extraction and Classification. In pre-Processing the input MRI image is converted from the RGB model to Gray Image which makes the image fit for segmentation process. In the second step the quality of image is enhanced using histogram equalization technique and enhanced image is passed through median filter inorder to eliminate the noise present the image and make noise free image. After pre-processing, the tumor is segmented using K-Means algorithm from noise free enhanced MRI brain image. The texture and intensity features are extracted from segmented tumor and classifies the tumor using Deep Neural Network (DNN) classifier. The features are extracted using Gray Level Co-occurrence Matrix (GLCM) and the extracted features are reduced to low dimensional feature vectors using Principal Components Analysis (PCA).After feature extraction classification is done using DNN which classifies as cancerous tumor (Malignant Tumor) or non-cancerous tumor (Benign Tumor). A major advantage of using this approach is that the classification using DNN classifier is able to effectively reduce the computation cost and improve the recognition performance. This system helps to detect the tumor at earlier stage.

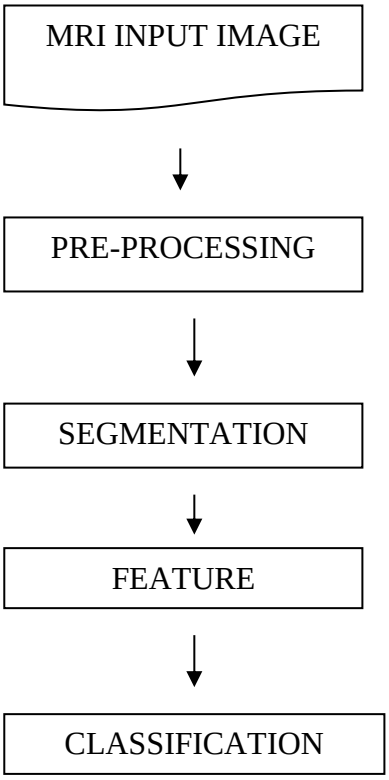

Fig - 1 : Stages in Brain Tumor Detection

III. LITERATURE SURVEY

The main purpose of this review section is to present a survey of tumor detection and classification methods. The main goal is to highlight techniques used and limitations of these methods.

Heba Mohsen, El-Sayed A. El-Dahshan, El-Sayed M. El-Horbaty, Abdel-Badeeh [1] proposed a classification of tumor using Deep Neural Network which is one of the deep learning architecture for classification. MRI Brain images are classified into four classes such as normal, glioblastoma, sarcoma and metastatic bronchogenic carcinoma tumors. Discrete wavelet transform (DWT) the powerful feature extraction tool and principal components

analysis (PCA) is used for feature extraction and the evaluation of the performance was quite good over all the performance measures.

Astina Minz, Prof.Chandrakant Mahobiya [2] proposed a classification of tumor using Adaboost machine learning classifier. The system consists of three modules such as Pre-processing, Feature extraction and Classification. In first stage pre-processing has been done, in which the image is transferred from RGB to grayscale, median filter is used for removing the noise present in the image and thresholding segmentation is applied. After segmentation 22 features are extracted using GLCM technique. Adaboost classification method is used for classification which classifies as normal or benign or malignant tumor and gives an accuracy of 89.90%.

Rasel Ahmmed, Anirban Sen Swakshar, Md. Foisal Hossain, and Md. Abdur Rafiq., [3] have proposed a new method that consists of modules such as pre-processing, image segmentation, feature extraction, SVM classification and tumor stage classification using the Artificial Neural Network (ANN). In pre-processing stage weiner2 and Median2 filter is applied for de-noising and for contrast enhancement. The segmentation is performed by the TKFCM algorithm that combines the K-Means and Fuzzy c-means with certain transformations. Feature extraction is performed in two orders. In the first order the statistical features are extracted and in the Second Order region the characteristics based on the statistical features are derived. Subsequently SVM classify the MRI image of the brain into a normal or abnormal brain. The Brain Tumor stage is classified by an ANN classifier. The number of data used for each MRI image of normal brain, tumor, and benign tumor was obtained from 39 images of which 3 were normal, 9 benign, 17 malignant I, 6 malignant II, 3 malignant II, and 1 malignant IV.

Garima Singh, Dr. M. A. Ansari [4] proposed a novel technique which includes Normalization of Histogram and K-means Segmentation. First, input image is pre-processed in order to remove the unwanted signals or noise from it. To de-noise filters such as Median filter, Adaptive filter, Averaging filter, Un-sharp masking filter and Gaussian filter is used in the MRI images. The histogram of the pre-processed image is normalized for the purpose of contrast enhancement and classification of MRI image is done. Finally, the image is segmented using K-means algorithm in order to take out the tumor from the MRI. The segmented MRI image is classified using NB Classifier and SVM so as to provide accurate prediction and classification. Naive Bayes and SVM Classifier give accuracy 87.23%. The proposed method has some limitations that it could not find out the precise or accurate boundary of the tumor region.

G Rajesh Chandra, Dr.Kolasani Ramchand H Rao [5] proposed a technique in which the MRI image of brain is de-noised using DWT by thresholding of wavelet co-efficient. Genetic algorithm is applied to detect the tumor pixels. In order to determine the best combination of information extracted by the selected criterion genetic algorithm is used. The present approach uses k-Means clustering methods into Genetic Algorithms for guiding this last Evolutionary Algorithm in his search for finding the optimal or sub-optimal data partition. Segmentation accuracy of 82 percent to 97 percent of detected tumor pixels based on ground truth has been achieved using this method. The limitation of this work is that wavelet transform requires large storage and its computational cost is high.

Sudharani., Dr. T. C. Sarma., Dr. K. Satya Rasad [6] author Proposed Methodology which include methods like Histogram, Re-sampling, K-NN Algorithm, Distance Matrix. First, Histogram gives the total number of specified value of pixels

distributed in a particular image. For proper geometrical representation Re-sampling re-size image has been done to 629 X 839 .Based on the training of K classification and identification of brain tumor by using k-NN technique has proposed.In this work the distance of the classifier has been calculated by applying Manhattan metric . The algorithm has been implemented using the Lab View. Algorithm has been tested on 48 images. The identification score for all images are about 85%.

Amitava Halder, Chandan Giri, Amiya Halder [7] proposed Brain Tumor Detection using Segmentation based Object Labelling Algorithm. In this method extraction of tumor is done by using K-means

algorithm followed by Object labelling algorithm. Also, some pre-processing steps (median filtering and morphological operation) are used for tumor detection purpose. It is observed that the experimental results of the proposed method give better result in comparison to other techniques.

Guruvasuki, A. Josephine Pushpa Arasi [8] have designed the method using multi support vector machine classifier. The image is pre-processed with median filter. Extraction of feature is done by using Gray Level Co-occurrence Matrix (GLCM). Multi-Support Vector Machine (M-SVM) classifier is used for classification of three types of image. The system performance can be improved by using the multiple image queries than single image query.

Hashem Kalbkhani, Mahrokh G Shayesteh, Behrooz Zalivargahan., [9] proposed method which can classifies MRI into normal or one of the seven different diseases. The coefficients of the two-level 2D-DWT of brain MRI are computed. The calculated coefficients of detail sub-bands are modeled by GARCH. After feature vector normalization,to extract the proper features and to remove the redundancy from the primary feature vector principal component analysis (PCA) and linear discriminant analysis (LDA) are used . Finally, the extracted features are applied to the K-nearest neighbor (KNN) and support vector machine (SVM) classifiers separately to determine the normal image or disease type.

J. Vijay , J. Subhashini [10],the author describes an efficient method for automatic brain tumor segmentation for the extraction of tumor tissues from MR images. In this method K- Means clustering algorithm is used for segmentation process for better performance. This enhances the tumor boundaries, when compared to many other clustering algorithms the K-Means clustering algorithm is more efficient and fast.

III. COMPARATIVE STUDY OF DIFFERENT BRAIN TUMOR DETECTION AND CLASSIFICATION TECHNIQUES USING BRAIN MRI IMAGES

Table -1: Comparison of Brain tumor detection and classification techniques

Author	Title	Proposed Technique	Limitations / Benefits
Heba Mohsen, El-Sayed A. El-Dahshan, El-Sayed M. El-Horbaty , Abdel-Badeeh	Classification using deep learning neural networks for brain tumors	FCM for segmentation DWT+PCA for feature extraction DNN for classification	Evaluation of performance was quite good over all performance measures.
Astina Minz, Prof.Chandrakant Mahobiya	MR image classification using adaboost for brain tumor type	GLCM for feature extraction Ada boost classifier for Classification	Classifies as normal or benign or malignant turn

			or and gives an accuracy of 89.90%
Rasel Ahmmed , Anirban Sen Swakshar, Md. Foisal Hossain, and Md.Abdur Rafiq	Classification of Tumors and It Stages in Brain MRI Using Support Vector Machine and Artificial Neural Network	TKFCM for segmentation DWT+PCA for feature extraction SVM+ANN for classification	Difficulty in selecting features to distinguish different classes
Garima Singh, Dr. M. A. Ansari	Efficient Detection of Brain Tumor from MRIs Using K-Means Segmentation and Normalized Histogram	K-Means for segmentation NB +SVM for classification	This method has some limitations that it could not find out the precise or accurate boundary of the tumor region.
G Rajesh Chandra, Dr.Kolasani Ramchand H Rao	Tumor Detection In Brain Using Genetic Algorithm	DWT+PCA for feature extraction for Genetic Algorithm classification	The limitation of this work is that wavelet transform requires large storage
			and its computational cost is high
Sudharani., Dr. T. C. Sarma., Dr. K. Satya Rasad	Intelligent Brain Tumor Lesion Classification and Identification from MRI Images Using k-NN Technique	k-NN technique is used for classification	Large search problem to find nearest neighbour data
Amitava Halder, Chandan Giri, Amiya Halder	Brain Tumor Detection using Segmentation based Object Labeling Algorithm	K-Means for segmentation Object Labeling Algorithm for classification	Mis-identification of object
Guruvasuki, A. Josephine Pushpa Arasi	MRI brain image retrieval using multi-support vector machine classifier	GLCM for feature extraction M-SVM for classification	Simple and flexible to implement, handle multi-class cases
Hashem Kalbkhani, Mahrokh G Shayesteh, Behrooz Zalivargahan	Robust algorithm for Brain Magnetic Resonance Image Classification based on GARCH	DWT+PCA+LDA for feature extraction k-NN +SVM for classification	DWT requires large storage and its computational cost is high

	variances Series		
J. Vijay , J. Subhashini	An Efficient Brain Tumor Detection Methodology Using K-Means Clustering Algorithm	K-Means for detection	This enhances the tumor boundaries more and is very fast when compared to many other clustering algorithms.

IV. CONCLUSION

In this paper a survey for various detection and classification techniques for MRI brain image has been accomplished. A comparative study is made on various detection and classification techniques. After evaluation of well-known technique it is clearly shown the various methods which can detect and classify the tumor efficiently and provide accurate result . Though some algorithms producing accurate and reasonable results, at the same time they are having some limitations like it is not suitable for larger data set and having longer computation time. Computational time is also considered to compare this technique efficiently.

As the diagnosis of the tumor is a complicated and sensitive task, accuracy and reliability are always assigned to have much more importance. The proposed methodology uses deep neural network classification algorithm for detection and classification of brain MRI images into benign tumor and malignant tumor which is more accurate and efficient method for the early detection and classification of brain tumor.

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