A Survey on Brain Tumor Classification & Detection Techniques

Mrunal H. Suthar
M. Tech (Student), Dept of E.C.E.
J.D.C.T.
Indore, INDIA
e-mail: mrunalsuthar89@gmail.com

Yeshvanht Birla
M.Tech, Asst. Prof., Dept. of E.C.E.
J.D.C.T
Indore, INDIA
e-mail: yeshvantbirla@gmail.com

***Abstract*—** A cancerous or non-cancerous mass or growth of abnormal cells in the brain. The research shows that in developed countries the main cause of death of people having brain tumor is incorrect detection of brain tumor. The X-ray, CT, MRI is used for initial diagnostic of the cancer. Today Magnetic Resonance Imaging (MRI) is widely used technique for the detection of brain tumor because it provides the more details then CT. The classification of tumor as a cancerous (malignant) or non cancerous (benign) is very difficult task due to the complexity of brain tissue. In this paper, review of various techniques of classification and detection of brain tumor with the use of Magnetic Resonance Image (MRI) is discussed.

***Keywords*—** *Brain tumor, Magnetic Resonance Image, classification, feature extraction tumor detection,*

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I. INTRODUCTION

A tumor is an abnormal growth of body tissue. Tumors can be cancerous (malignant) or non cancerous (benign). A brain tumor is mass or collection of abnormal cells in the brain. It is one of the most dangerous diseases and therefore it should be detected quickly and accurately.

There are three common types of tumor Benign, Pre-Malignant, Malignant.

Benign Tumor: A benign tumor is a tumor is the one that does not expand in an abrupt way; it doesn't affect its neighboring tissues and also does not expand to non-adjacent tissues. It is non cancerous.

Pre-Malignant Tumor: Premalignant Tumor is a stage before the cancer, if it is not treated properly it may lead to cancer.

Malignant Tumor: Malignancy (mal- = "bad" and -ignis = "fire") is the tumor type, that grows worse with the passage of time and ultimately leads to the person death. Malignant tumor is a term which is used to describe the cancer.

Detection of the brain tumor in its early stage can only cure of the disease followed by the proper treatment. There are many different types of brain tumors that make the decision very complicated. So the along with detection, classification of brain tumor is also most important. In order to classify what type of brain tumor really the patients suffered from good classification technique is required.

As each year neuro patients are increased which lead to lot of manual workload on small Radiology group. So, a system is needed that help the Radiologists to get essential information like type of MRI Image, tumor extraction, tumor area and similar case images from the large database and take these data as a reference for taking accurate decision for treatment planning for Neuro patients. This can be done by using automatic tumor detection techniques on medical images.

II. LITERATURE REVIEW

In recent years, various methods have been proposed for image segmentation, classification and detection techniques for brain tumors.

Parveen and Amritpalsingh [1], proposed data mining methods for classification of MRI images. Classification is performed in four stages: pre-processing, segmentation, feature extraction, and classification. In the first stage, enhancement and skull stripping is performed to improve the speed and accuracy. Segmentation was done by Fuzzy C-Mean (FCM) clustering. Grey level run length matrix (GLRLM) is used for extraction of feature from the brain image, after which SVM technique is applied to classify the brain MRI images, which provide accurate and more effective result for classification of brain MRI images.

Hatice Cinar Akakin and Metin [2], propped the system for multi image queries. Feature is extracted in two part; For Color extraction they have used the color spaces are CIELab (Lab) and hue–saturation–value (HSV) color spaces additional to RGB. The total 26 color and gray-scale features are extracted using three different color spaces for a given image. Texture feature is extracted using Co-occurrence histograms. They have used the two separate classifier (SVM and k-NN) for the classifications of images. They have achieved about 93% and 86% average classification accuracy.

R. Guruvasuki and A. Josephine Pushpa [3], have designed the method using multi support vector machine classifier. The image is preprocessed with median filter. The Gray Level Co-occurrence Matrix is used for feature extraction. Multi-

Support Vector Machine (M-SVM) classifier is used for classification of three types of image. System performance is improved by the multiple image queries than single image query.

Mohanapriya.S and Vadivel.M [4], propose a robust retrieval using a supervised classifier which concentrates on extracted features. Gray level co-occurrence matrix algorithm is implemented to extract the texture features from images. The feature optimization is done on the extracted features to select best features out of it to train the classifier. The classification is performed on the dataset and it is classified into three categories such as normal, benign and malignant. They have used the SVM (Support Vector machine) classifier followed by KNN (K-nearest neighbor).

B.Ramasubramanian, G.Prabhakar and S.Murugeswari [5], designed the Multitier system for microscopic images having more than one disease. The features based on colour and texture is extracted. In the first tier, the images are classified by recursive SVM classifier with the help of extracted features. In the next tier, the similar images are retrieved using Decision tree algorithm. They have achieved the accuracy 96% (for FL) and 98% (for NB).

Yudong Zhang, Zhengchao Dong, Lenan Wua, Shuihua Wanga [6], have developed a novel hybrid classifier to distinguish normal and abnormal brain MRIs. In this paper, they present a neural network (NN) based method to classify a given MR brain image as normal or abnormal. This method first employs wavelet transform to extract features from images, and then applies the technique of principle component analysis (PCA) to reduce the dimensions of features. The reduced features are sent to a back propagation (BP) NN, with which scaled conjugate gradient (SCG) is adopted to find the optimal weights of the NN.

Hashem Kalbkhania, Mahrokh G. Shayesteha, Behrooz Zali-Vargahan [7], have proposed method which can classifies MRI into normal or one of the seven different diseases. The coefficients of two-level 2D DWT of brain MRI are computed. The calculated coefficients of detail sub-bands are modeled by GARCH. After feature vector normalization, principal component analysis (PCA) and linear discriminant analysis (LDA) are used to extract the proper features and remove the redundancy from the primary feature vector. 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.

Sandeep Chaplot, L.M. Patnaik, N.R. Jagannathan [8], propose a novel method using wavelets as input to neural network self-organizing maps and support vector machine for classification of magnetic resonance (MR) images. In this paper, they have used the wavelets as input to support vector machine and neural network. Classification accuracy of more than 94% was achieved using the neural network self-organizing maps (SOM) and 98% from support vector machine.

Zafer Iscan, Zümray Dokur, Tamer Ölmez [9], proposed method for the detection of tumor in magnetic resonance (MR) brain images. First 2D continuous wavelet transform (CWT) and then each MR image is segmented into seven classes (six head tissues and the background) by using the incremental supervised neural network (ISNN). Symmetry axis of the head is determined by using moment properties. Asymmetry is analyzed using the Zernike moments of each of six tissues. The two vectors are individually formed for the left and right hand sides of the symmetry axis. The two vectors are used to determine the asymmetry and tissue with the tumor.

Shen Furao, Tomotaka Ogurab, Osamu Hasegawa [10], proposed an enhanced self-organizing incremental neural network (ESOINN), which is based on SOINN. The proposed method can realize all SOINN functions. Using single-layer network to take the place of two-layer network structure of SOINN, ESOINN can realize pure online incremental learning. By setting conditions for building a connection between nodes, ESOINN can separate high density overlapped classes. In fact, ESOINN only adopts between-class insertion to realize incremental learning. For that reason, ESOINN easily realizes a solution and requires fewer parameters than SOINN; using some smoothing techniques, ESOINN is also more stable than SOINN.

Monika Jain, Shivanky Jaiswal, Sandeep Maurya, Mayank Yadav [11], have proposed strategy for detection of tumor with the help of segmentation techniques in MATLAB; which incorporates preprocessing stages of noise removal, image enhancement and edge detection. Processing stages includes segmentation. Tumor region is extracted using over global thresholding method. Post proposing stage include histogram clustering, morphological operations. In this step the shape of tumor is determine and also area is calculated.

R. S. RajKumar and G. Niranjana [12], proposes segmentation using cellular automata and classification of tumors using Gray level Co-occurrence matrix features and artificial neural network. Seed pixel selection is done by using the GLCM and after selection by calculating the run length it is checked that the seed pixel is belong to abnormal region or not. The segmentation using cellular automata done and then classification done using Radial basis function which is the type of ANN. The approach is limited by the fact that it necessitates fresh training each time whenever there is a change in image database.

Ketan Machhale, HariBabu Nandpuru, Vivek Kapur and Laxmi Kosta [13], presented an intellectual classification

system to recognize normal and abnormal MRI brain images. For preprocessing Median filter and morphological operations are used. In feature extraction phase, gray scale, symmetrical and texture features are extracted. They have used the three classifier; Support Vector Machine (SVM), K- Nearest Neighbor (KNN) and Hybrid Classifier (SVM-KNN). They used these classifiers to classify 50 images. The result observation shows that the Hybrid classifier SVM-KNN demonstrated the highest classification accuracy rate of 98% among others.

Padma Nanda Gopal & R.Sukanesh [14], in their paper they presented a combination of wavelet statistical features (WST) and wavelet co-occurrence texture feature (WCT) obtained from two level discrete wavelet transform (DWT). is used for the classification of abnormal brain tissues in to benign and malignant. The proposed system consists of four phases: segmentation of region of interest, discrete wavelet decomposition, feature extraction and feature selection and classification and evaluation. The support vector machine is employed to segment the shape of tumor information. A combination of both WST and WCT texture features is extracted from tumor region of two-level discrete wavelet-transformed images. Genetic algorithm (GA) is used to select the optimal texture features from the set of extracted features. The probabilistic neural network classifier (PNN) is built to classify the abnormal brain tissues into benign, malignant tumor images. Comparing the classifications results of PNN, LVQ, BPN classifiers for the texture analysis methods, the results shows that best performence3 is achieved by PNN. The 97.5% accuracy is achieved.

Kailash Sinha and G.R.Sinha [15], presented a comparative study of three segmentation methods implemented for extraction of tumor in the MRI images. The methods include k-means clustering with watershed segmentation algorithm, optimized k-means clustering with genetic algorithm and optimized c- means clustering with genetic algorithm. Using all three methods exact position and the shape are determined. Results shows that genetic c-means algorithm provide fast and efficient clustering results and also eliminate the over-segmentation problem.

Pranita Balaji, Kanade and P.P. Gumaste [16], proposed brain tumor detection method for MRI images. In this paper, the brain tumor is detected & classified stages of the tumor by using testing & training the database. Proposed methodology consists of following main stages: image preprocessing, de noising, SWT & segmentation, feature extraction and classification. In the first step, median based filters and SWT technique are used for de-noising the image. Then spatial FCM technique is used for segmentation and Stationary wavelet transform (SWT) technique is used for feature extraction, as SWT coefficients will not change even if the signal is shifted. In the last step, using Probabilistic neural networks (PNN) images are classified with the help of extracted features,

III. CONCLUSION

In this paper we have accomplished a partial survey of various brain tumor classification and detection techniques for MRI brain image. A comparative study is made for various techniques. There are various methods which can detect the tumor efficiently and accurately. This work will be extended for the development of new algorithm for brain tumor classification and detection, which will provide more efficient result than the existing methods in near future. Accuracy, reliability and computational time are the most importance to be considered to compare this technique efficiently, as the diagnosis of brain tumor is a complicated and sensitive task.

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