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Brain tumor detection techniques: A Survey

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Abstract - *Brain tumor is nothing but an uncontrollable and abnormal growth of cells within the brain. Most research in developed countries shows that main cause of death of people having brain tumor is incorrect detection of brain tumor. It is one of the most dangerous diseases and therefore it should be detected quickly and accurately. This can be done by using automatic tumor detection techniques on medical images. Generally MRI or CT scan that is directed into intracranial cavity produces the complete image of the brain tumor. Magnetic Resonance Imaging (MRI), a highly developed technique of medical imaging, is used to visualize internal structure of human body without any surgery. For the accurate detection of brain tumor, segmentation of MRI image is important. Classification of tumor, through segmented MR image, into normal and abnormal MRI brain images, is a difficult task due to complexity and alteration in tumor tissue characteristics like its location, size, gray level intensities and shape. In this paper, review of various techniques of automatic detection of brain tumor using Magnetic Resonance Image (MRI) is proposed.*

Key Words: *Brain tumor, Magnetic Resonance Image, detection, classification, feature extraction.*

1. INTRODUCTION

Brain tumor is an uncontrollable and abnormal growth of cells in the brain. Brain Tumors are of two types- primary or benign brain tumors and metastatic or malignant brain tumors. Primary brain tumors starts and spread only in the brain. Metastatic brain tumors can initiate somewhere in the body as cancer and extend to the brain. Various methods, which are available in diagnosis, are expert opinion, human inspection, biopsy, and etc. These methods have some drawbacks like time consumption, incorrect inspection etc. So image processing techniques can be helpful to detect brain tumor. There are various medical imaging techniques like x-ray, computed tomography (CT), positron emission tomography (PET), magnetic resonance imaging (MRI), are available for tumor detection. The MRI is the most commonly used modality for brain tumor growth imaging and location detection due to its higher resolution. Magnetic Resonance Imaging (MRI) is an imaging technique which non-invasively provides high contrast images of different anatomical structures. It provides better differentiation of tissues than other medical imaging techniques. Evaluation and analysis of MRI images by radiologists is error-prone and time consuming. Hence radiologists can use an algorithmic image processing in brain tumor diagnosis in MR images, especially due to large alterations in shape and size of structures needs to be considered for brain tumor detection and segmentation. Therefore automatic analysis and classification of such medical images is essential.

2. LITERATURE REVIEW

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

Kailash Sinha and G.R.Sinha [2], presented a comparative study of three segmentation methods implemented for extraction of tumor in the MRI images. Proposed methods are k-means clustering with watershed segmentation algorithm, optimized k-means clustering with genetic

algorithm and optimized c- means clustering with genetic algorithm. For comparison, the searching time and area of tumor region were considered as comparison parameters. Results depict that, clustering algorithm in case of optimized method perform much better segmentation than that of ordinary clustering algorithm. The problem of over segmentation has also been reduced. Also it is found that the optimized c-means perform better that optimized k-means method.

H. B. Nandpuru, Dr. S. S. Salankar and Prof. V. R. Bora [3], in their paper introduced classification techniques based on Support Vector Machines (SVM) and applied to brain image classification to recognize normal and abnormal MRI brain image. Proposed technique includes following stages: preprocessing, feature extraction, feature reduction, training, storing the database and testing. In this paper gray scale, symmetrical and texture features used for feature extraction from MRI Images. Extracted features reduced by using PCA method and then submitted to a support vector machine for training and testing. More accurate result than the other methods obtained.

R.S.RajKumar and G.Niranjana [4], introduces cellular automata based segmentation of MRI brain tumor and classification of tumors using Gray level Co-occurrence matrix features and artificial neural network. Grey Level Co-occurrence Matrix (GLCM) used for extracting Texture feature of the image. After the selection of seed pixel from co-occurrence features, it is checked that whether the selected seed pixel belongs to abnormal region or not and is checked by calculating the Run length features. For segmentation, cellular automata (CA) based seeded tumor segmentation method is proposed. Segmented images are fed to classification 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.

S.H.S.A. Ubaidillah, R. Sallehuddinand N.A. Ali [5], in their paper, presented a comparative study of cancer detection using artificial neural network and support vector machine using four different cancer datasets. The ANN and SVM classification models developed using four steps: input variable selection, data preprocessing and partitioning, and setting of model parameter and model implementation. In the first step, input variables selected depending on the type of datasets. Data normalization and data conversion is performed in data preprocessing and data partitioning consists of division of data into two partitions which are training and testing set. Various parameters are considered for setting of ANN and SVM model. The last step is model implementation in which classification model is created for ANN and SVM. The selected classification model is then tested on the testing dataset. Experimental results shows that the SVM classifier provided better result for tumor.

O.P. Verma, M. Hammandlu, S. Susan, M. Kulkami and P.K. Jain [6], proposed a region growing technique for color image segmentation. Proposed technique has used center pixel of the image as the initial seed which grows region according to grow formula using intensity based similarity index with the stopping criterion determined by Otsu's adaptive threshold technique. Proposed method is applied to the Berkley segmentation database images and discussed results based on Liu's F-factor. The segmented result obtained by the proposed method is compared to that of the watershed technique and is observed to have lower F values.

Chinnu A. [7], introduced MRI brain tumor classification using SVM and Histogram based image segmentation. Proposed methodology consist of following main steps: preprocessing, segmentation, feature extraction and classification. In the first step, noise reduction and edge detection is performed using median filter and Canny Edge detector algorithm respectively. Histogram thresholding method is used for segmentation. Feature extraction from MRI Images is performed by gray scale, symmetrical and texture features. Classification of MR images is carried out using support vector machine. A result indicates improvement of accuracy rate and reduction in the error rate of MRI brain tumor.

B. Gupta and S. Tiwari [8], proposed brain tumor detection using Curvelet Transform and Support Vector Machine. Proposed methodology consists of following main stages: image acquisition, feature extraction and classification. In the first stage, MRI brain images are obtained from the database. Feature extraction is done using curvelet transform which is more efficient than wavelet transform. Extracted features are then applied for classification of MRI brain images which is performed using support vector machine. Satisfactory performance achieved.

A. Padma and R. Sukanesh [9], presented new wavelet based dominant run length feature extraction method for classification of soft tissues in brain CT Images. The proposed methodology consists of mainly 3 phases: i) Discrete wavelet decomposition (ii) Feature extraction and selection (iii) Classification and Evaluation. In the first phase, two level wavelet decomposition of region of interest is performed to get better results. Feature extraction is performed using wavelet based dominant gray level run length feature extraction method. Extracted features are applied to SVM classifier to detect abnormal tumor region. Classification accuracy achieved using SVM is 98%.

G.V. Kumar and Dr G.V. Raju [10], in their paper, presented brain tumor detection using a neuro fuzzy technique. For the detection of brain tumor from MRI images, various image processing techniques like image segmentation, image enhancement, morphological operation, feature extraction and classification are proposed. Image segmentation is performed using histogram equalization followed by thresholding technique. For adjusting contrast of images, image enhancement and sharpening filter are used. Gray

Level Co-occurrence Matrix (GLCM) technique is used for feature extraction. Extracted features are then fed to neuro-fuzzy classifier for normal and abnormal MRI image classification. Experimental results demonstrates, about 50-60% improvement in iteration time and the accuracy level compared to the existing neuro classifier.

Pranita Balaji Kanade and Prof. P.P. Gumaste [11], proposed brain tumor detection using 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, segmentation, feature extraction and classification. In the first stage, image normalization and de-noising is performed. Spatial FCM technique is used for segmentation. For feature extraction of MR images stationary wavelet transform (SWT) technique is used. Finally, using these extracted features, images are classified using Probabilistic neural networks (PNN).

G. Kharmega Sundararaj and Dr. V. Balamurugan [12], developed a new approach for automatic classification of brain tumor in CT images. The proposed method consists of four stages namely preprocessing, feature extraction, feature reduction and classification. In the first stage, noise is reduced with Gaussian filter. Various texture and intensity based features are extracted and then reduced using principal component analysis (PCA). In the classification stage, two classifiers, k-nearest neighbor and second is Linear SVM, are used to classify the experimental images into normal and abnormal. Experimental results achieved are more than 94% in case of Linear SVM and 92% in case of k-NN.

Ketan Machhale, HariBabu Nandpuru, Vivek Kapur and Laxmi Kosta [13], in their paper, presented a classification system to identify normal and abnormal MRI brain images. Median filter and morphological operations are used for preprocessing. In feature extraction phase, gray scale, symmetrical and texture features are extracted and fed to the classifier. Support Vector Machine (SVM), K- Nearest Neighbor (KNN) and Hybrid Classifier (SVM-KNN) is used to classify 50 images and results shows that the Hybrid classifier SVM-KNN demonstrated the highest classification accuracy rate of 98% among others.

VijayaRekha.R, Sudha.S, Sangeetha.J and Shenbagarajan Anantharajan [14], proposed method of detection and classification of brain tumor using Decision Tree. The proposed technique consists of four stages: preprocessing, segmentation, feature extraction and classification. First stage involves, noise removal, resizing and filtering of image. Segmentation is performed using adaptive thresholding technique and GLCM technique is used for feature extraction. Finally, classification is done using decision tree classifier. The system is found efficient in classification of these samples.

Rohini Paul Joseph, C. Senthil Singh and M.Manikandan [15], proposed segmentation of brain MRI image using image processing techniques. The proposed method has three main steps: preprocessing, segmentation and morphological filtering. The preprocessing stage perform RGB to Grey conversion and noise removal. K-means clustering algorithm is used for image segmentation. In the last step, morphological filtering is performed to avoid the mis-clustered regions that can inevitably be formed after segmentation of the brain MRI image for detection of tumor location.

Pratik P. Singhai and Siddharth A. Ladhake [16], introduced a technique to detect brain tumor from Magnetic Resonance Image. The proposed methodology consists of following stages: preprocessing, Sobel Mask& Gradient Magnitude application, segmentation and tumor area calculation. In the first stage, RGB to gray conversion and Image resizing is performed. Using sobel mask, Gradient magnitude is computed before segmentation. Segmentation is performed using marker based watershed segmentation technique. In the last, using connected component analysis, tumor area is calculated.

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