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A Review on Some Classification Methods of Brain Tumor MRI Datasets

Nirmal Mungale[1], Snehal Kene[2], Amol Chaudhary[3]
[1, 2]Department of Information Technology, G. H. Raisoni College of Engineering, Nagpur, India
[3]Mechanical Engineering Department, G. H. Raisoni College of Engineering, Nagpur, India

ABSTRACT

Brain tumor is a life-threatening disease. Brain tumor is formed by the abnormal growth of cells inside and around the brain. Identification of the size and type of tumor is necessary for deciding the course of treatment of the patient. Magnetic Resonance Imaging (MRI) is one of the methods for detection of tumor in the brain. The classification of MR Images is a difficult task due to variety and complexity of brain tumors. Various classification techniques have been identified for brain MRI tumor images. This paper reviews some of these recent classification techniques.
Keywords : Magnetic Resonance Imaging, Brain Tumor, CT Scan, SPECT, X-Ray

I. INTRODUCTION

Brain is the most important part of human body. Brain tumor occurs when cells get abnormal formation within the brain. Tumors are classified as malignant(cancerous) and benignant (non cancerous). Benign tumors are less harmful than malignant tumors. To get the internal anatomy of the brain, the brain scan is done. Some of the medical imaging technologies are MRI, Ultrasound, CT Scan, SPECT and X-Ray. Amongst all these medical imaging techniques, MRI is the most common in brain scans as it provides better contrast images of the brain and cancerous tissues. There techniques of classification of MR images are commonly divided into supervised and unsupervised techniques. The supervised techniques are k-nearest neighbours, Support Vector Machine (SVM) and Artificial Neural Network(ANN). The unsupervised techniques are fuzzy c-means and self organization maps (SOM).

These image processing and image enhancement tools assist in the diagnosis of brain tumor.

In this paper, we have reviewed different pre preprocessing, localizing, segmenting, extracting the features and classification.

Dena Nadir George et el [1] propose a method in which supervised machine learning techniques are used. The machine learning approach proposed by the authors uses machine learning algorithms like multi layer perceptron (MLP) and C4. 5 decision tree algorithm. To extract MR images features, Shape feature method is used. The hospitals provided dataset for human MR images as well as from the internet. The noise from MR images is removed by applying stigma filter. Here, an adaptive threshold method is used where the input is gray or colour images. The binary image output represents segmentation. Adaptive threshold technique separates the object from image background. This proves to be a robust technique for changing the illumination. The next step is region detection which is performed on the binary image which is obtained from the previous step. The region detection process scans and labels new regions and merges old regions. By this, every pixel gets an identity and its own region. After this stage, the segmented objects undergo for shapes featuring. The precision of 91% was obtained with this method. 174 samples were considered for study and maximum precession of 95% was obtained.

Figure 1 shows the brain tumor classification method.

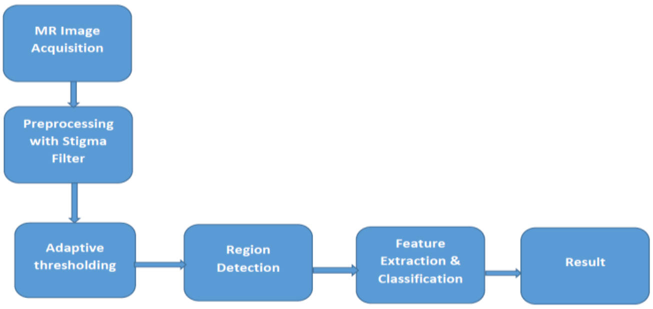

Figure 1. : Diagram for the Brain tumor classification Method.

Sanjeev kumar et al [2] propose an approach for differentiating benignant and malignant brain tumors. SVM is used as the classification algorithm for better accuracy. SVM maximizes the geometric margin and minimizes the classification error. It builds a maximal hyperplane and transforms it into a high dimensional space. With the help of support vectors and margins, it finds linear optimal hyperplane. A signal is decomposed into sinusoidal signals using Discrete Fourier Transform. To take into account the time information of signals, Discrete Wavelet Transform(DWT) is used. In the proposed methodology, . mha image files are converted into jpeg format. Features are extracted using DWT transformation. Principal component Analysis technique is used for reducing a large number of features. In the next stage, SVM classifier is designed for classification of normal and abnormal images. By using this approach, labelling time and human error is reduced. This method combines principal component analysis and discrete wavelet transform. Figure 2 shows flow chart of the methodology.

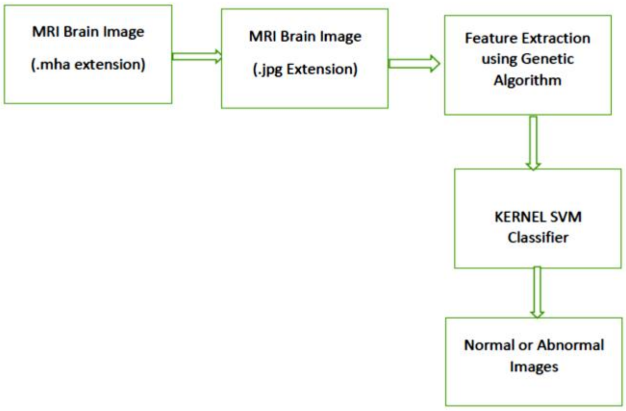

Figure 2. Flow chart showing Methodology

Heba Mohsen et al [3] use Deep Neural Network(DNN) for classification of Brain MRIs. Using this technique, the brain MRIs are classified into four classes. The tecnnique presented in this paper divides the brain MRI into four classes viz. , sarcoma, normal, glioblastoma and metastatic bronchogenic carcinoma tumors. The image segmentation task is performed with Fuzzy C- means clustering technique. Then the discrete wavelet transform (DWT) extracts the features of segmented tumor. The DWT decomposition obtains approximation component and detailed components of the image. In this methodology, Haar wavelet is utilized to extract 1024 features of each brain image. For the approximation of original extracted features, principal component analysis is used.

After the extraction and selection of features, classification is done with DNN on the previously obtained feature vector. The selected classifier's performance is evaluated with other classification algorithms of machine learning. When DNN classifier is combined with DWT, it gives good results in all measures of performance.

Ali Mohammad Alqudah et al [4], proposes a new CNN classifier tool for classification of brain tumor images into pituitary tumor, meningioma and glioma. For effective classification of brain tumor, this CNN architecture consists of 18 layers. The architecture is applied on segmented, cropped and uncropped dataset. The confusion matrix of all these three cases is generated for performance evaluation CNN architecture. The generated confusion matrices are used to compare original image label with the CNN architecture output. The statistical indices such as accuracy, sensitivity, specificity and precision are calculated for evaluation of performance of the classification system. This system efficiently grades the brain tumor and the accuracy rate values are 97. 4 %, 99. 0 % and 99. 2 % for the input image sizes of 128 x 128, 64 x 64, and 32 x 32 respectively. This proves the effectiveness of the proposed convolution neural network as an efficient classification method for brain tumor. Figure 3 shows block diagram of the proposed methodology.

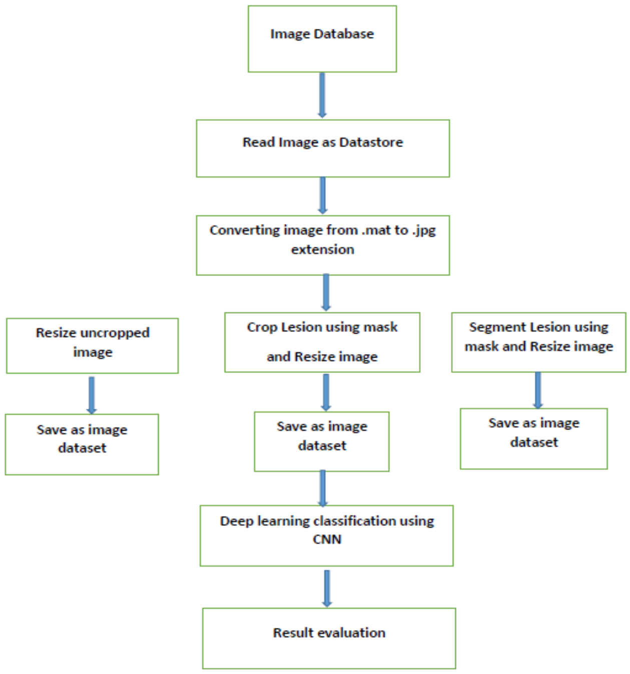

Figure 3 . Block diagram of the proposed methodology.

Parasuram kumar et al [5] proposes the application of ensemble classifier. Ensembler classifier combines processes of vector support machine, neural network and extreme learning machine (ELM). In the first stage, filtering algorithm is used for preprocessing. Then the clustering algorithm is used for segmentation. In the third stage, Grey Level co – occurrence matrix(GLCM) performs the feature extraction. The feed forward artificial neural network based classifier classifies brain images into tumors and non tumors. Median filter is used for noise elimination for better smoothing of images. For tumor diagnosis and calculation of tumor area in MRI images, clustering segmentation techniques are used. Fuzzy C- means algorithm is used for the division of pixel sets into fuzzy clusters. The feature vectors are formed by extracting relevant features. Diverse errors of individual classifiers are reduced by ensemble based systems. The accuracy, precision, sensitivity obtained with ensemble technique are 91. 17 %, 94. 17 % and 94. 81 % respectively. Figure 4 shows overview of the proposed methodology.

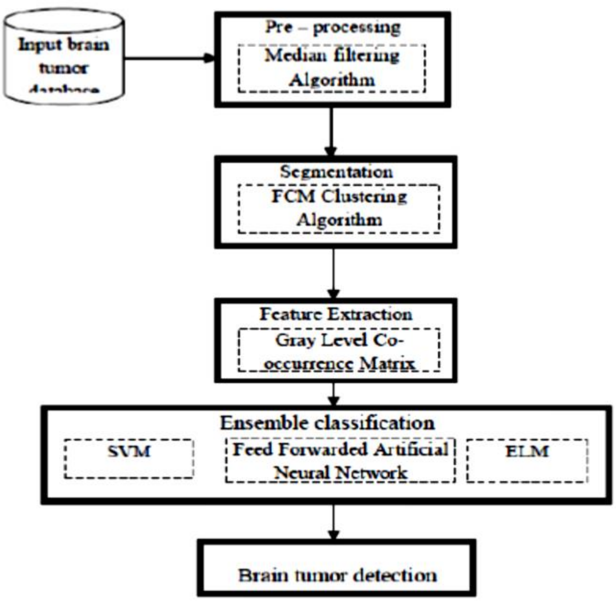

Figure 4. The proposed Methodology

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