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An Effective Approach for Detection of Various Brain Diseases from MRI Using Classification

[1] Sibi K, [2] Palraj K, [3] Dr.V.Kalaivani
[1] PG Scholar, Department of Computer Science & Engineering, Sri Vidya College of Engineering & Technology, Virudhunagar
[2] Assistant Professor, Department of Computer Science & Engineering, Sri Vidya College of Engineering & Technology, Virudhunagar.
[3] Professor, National Engineering College, Kovilpatti

Abstract: **- Image processing is used in most of the medical applications to diagnose wide variety of diseases. Brain tumor or neoplasm is the abnormal growth of tissues in brain and its surrounding regions. Image processing consists of preprocessing, segmentation and classification techniques which consists of methods for noise removal, feature extraction and morphological operations approach which helps in detecting and extracting the brain tumor from MRI images. In this way, MRI has become an useful medical diagnosis tool for detecting abnormalities in brain images. MRI provides a better results than all other medical imaging tools. MR image is an sensitive tool in detecting the brain abnormalities such as tumors and infections during the early stage of the disease. Nowadays various applications are available for diagnosing the diseases from brain images. In our proposed method, a single system is used to detect various brain diseases such as birth defects in brain, brain tumors and stroke. The abnormalities present in the MRI image are diagnosed based on some metric values. A region based segmentation technique is used to extract the abnormalities such as brain tumors. A decision based classification technique is also used which gives optimized results on detecting the range and type of abnormality from the brain images.**

Key words:- Image processing, MRI Brain image, Region Growing Segmentation, Decision Based Classification

I. INTRODUCTION

Our human body is made up of several type of cells. Brain is a highly specialized and sensitive organ of human body. Brain tumor is a very harmful disease for human being. The brain tumor is an abnormal growth of tissue around the brain and it destroys all the healthy brain cells. The diagnosis of brain tumors is done by using various image processing methods and its techniques. Image Processing is a method of converting an image into digital form and perform some operations on it, in order to get an enhanced images or to extract some useful information from it. All the images used in today's world are in the digital format. Digital image processing is the use of computer algorithms to perform image processing on digital images. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them. It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too. The MRI image of brain can be divided into brain tissue and non-brain tissue structure. The brain tissue mainly includes gray matter (GM), white matter (WM) and cerebrospinal fluid (CSF). The non-brain tissues include skull, eyeball and so on. The analysis of the brain MRI image is done by using some segmentation algorithms. The brain tumors are of different sizes based on based on its locations and its positions. The brain tumors are generally classified as benign and malignant type tumors. The benign tumor is of non-cancerous type and it does not spread over its region. The malignant tumor is a cancerous type tumor, it spreads rapidly and entering into other tissues of the brain. The detection of brain tumor is very complex due to very complex structure of the brain. The brain tumor's measurement is not accurate in its initial stage and it is very difficult for tumor detection. The usage of various image processing and image enhancement tools improves the quality of the image and it plays a vital role in classification and

detection of brain tumor. The main objective of this paper is to extract the type of the brain tumor and to detect the disease corresponding to the tissue.

II. LITERATURE REVIEW

Many of the researchers proposed many methods and algorithms to find brain tumor and other abnormalities in human brain using MRI images. Jun Zhang and Mingxia Liu et al, 2017, in his paper "Alzheimer's Disease Diagnosis using Landmark-based Features from Longitudinal Structural MR Images", proposed a landmark based feature extraction framework for diagnosing Alzheimer disease using longitudinal structural MR images. It gives a low performance and it is limited for extraction of few features only. Ameer Mohammed and Majid Zamani et al, 2017, in his paper "Towards On-Demand Deep Brain Stimulation Using Online Parkinson's Disease Prediction Driven by Dynamic Detection" proposed a dynamic feature extraction and pattern classification method which is implemented with high accuracy in real time detection to diagnose Parkison disease. It has a real time detection method with high performance. It's computational cost id high and the dynamic system is difficult to implement.

Shuihua Wang and Yin et al,2016, in his paper "Pathological Brain Detection by Artificial Intelligence in Magnetic Resonance Imaging Scanning" proposed a comprehensive and quantitative comparison for PBD systems by artificial intelligence in magnetic resonance imaging scanning. It diagnoses four typed of brain diseases with greater accuracy. The initial registration step takes more time and the classification technique implemented is very poor.

Jun Zhang and Yue Gao et al, 2016, in his paper "Detecting Anatomical Landmarks for Fast Alzheimer's Disease Diagnosis" proposed a two layer voxel shape regression based landmark detection method which is used for normalization. The normalized features are then fed into a SVM classifier for Alzheimer disease diagnosis. It has low time and cost consumption and the performance and accuracy is very high. This system is implemented for only large scale objects.

Dr. A. S. Bhalchandra and Rajesh C. Patil, 2015, in his paper "Brain Tumor Extraction from MRI Images Using MATLAB" proposed a strategy to detect & extraction of brain tumor from patient's MRI images of the brain. This method incorporates with some noise removal functions, segmentation and morphological operations. It works well for real time analysis. This system does not detects the growth and the type of the tumor.

Yogita Sharma and Parminder Kaur, 2015, in his paper "Detection and Extraction of Brain Tumor from MRI images using K-means Clustering and Watershed algorithms" proposed a kernel based K-means clustering method which is proposed to extract the type of tumor from brain MRI images. This method works well also for low contrast images. The defined method needs more manual work for pre-processing operations.

Muthukumar Subramanyam, 2014, in his paper "An Automatic Brain Tumor Detection and Segmentation Scheme for Clinical Brain Images" proposed a prominent feature extraction method is proposed to reduce original data by measuring certain features to detect the tumors which increases certainty of fine extraction. This method reduces complexity and saves processing time. This method only extracts the structure of the tumors.

Saima Farhana and Muhammad Abuzar Fahiem et al, 2014, in his paper "An Ensemble-of-Classifiers Based Approach for Early Diagnosis of Alzheimer's Disease: Classification Using Structural Features of Brain Images" proposed an ensemble based classification method which is used to detect the Alzheimer disease. This approach is based on extraction of two types after pre-processing and segmentation which compares all the modalities to achieve better results. This method gives efficient and reliable results. The multiple modality detection method affects the accuracy of the system.

III. METHODOLOGY

The proposed method of this system consists of four major stages for detection and classification of brain tumors from brain MRI images. The four well known stages are

- Pre-processing
- Feature extraction
- Segmentation
- Classification

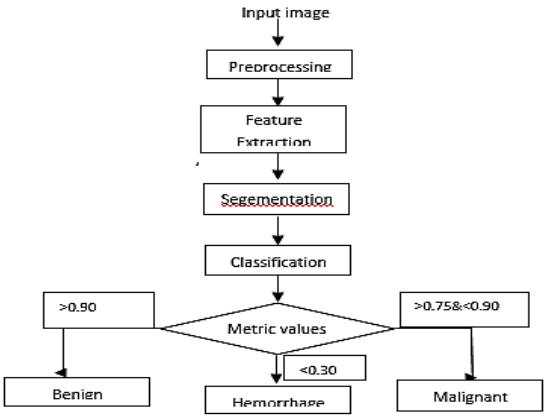

Fig: Proposed methodology

A. Pre-processing

The preprocessing is the foremost step in our proposed technique. The main aim of preprocessing of brain MRI images is to remove the unwanted distortions in the image called noise and to enhance and improve the quality of the image to ease the method of detecting the tumor. In our proposed method we are using the discrete wavelet transform method to remove the noise in the images. Wavelet transform is the commonly used tool in signal and image processing techniques for noise removal purposes and it also gives better results. The main task is to choose the type of the wavelet and a N stage of decomposition occurs to determine the threshold value of the images. By applying the threshold values the actual filtering takes place and the image is reconstructed from modified levels. This method captures both frequency and location.

B. Feature Extraction

Feature extraction technique is the important step in image processing for pattern recognition processes and it is another form of dimensionality reduction. When the given input data is very large for processing it detects the redundant data by transforming it into a reduced set of feature representations. This step analyzes the desired features from the input image to extract the most suitable features that are representative for various classes of objects. The desired features are then used as inputs to classify and assigning it to separate classes of objects. Determining a subset of the initial features is called feature selection. The selected features are expected to contain the relevant information from the input data, so that the desired task can be performed by using this reduced representation instead of the complete initial data.

- Shape Features – Irregularity, Area, Shape index
- Intensity Features – Mean, Variance, Intensity, Skewness
- Texture Features – Contrast, Correlation, Entropy, Energy, Sum of variances

C. Segmentation

Image segmentation is the process of partitioning a digital image into multiple segments. The main goal of segmentation is to simplify the representation of images that is something easier for analysis. The major process in segmentation is to assign a label for each and every pixel in the images. By using the labels the objects are located and the boundaries are marked. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. In medical imaging, the resulting contours after image segmentation can be used to create 3D reconstructions with the help of interpolation algorithms.

D. Classification

Image classification is the process which is based on the description of some textures and also the similarity of items or things. The classification technique rely only on the relative ordering of the pixel value of the images, not on their numerical values and this method is well suited for processing of binary images. Pixels are the unit values that are represented in an image. The classification technique groups the value of the pixels in different classes. There are some classification techniques such as Support vector machine (SVM), Artificial neural network (ANN), etc. In our method SVM classifier technique is used. SVM classifier constructs a set of hyperplanes in a high dimensional space, which is used for classification or regression. SVM uses non-parametric with binary classifier approach and handles more input data efficiently. Accuracy depends on hyperplane selection.

IV. RESULT & DISCUSSION

As per mentioned in the proposed work the test query MRI image is received from the user then the pre-processing, feature extraction and segmentation processes are done. In the final stage the classification approach is applied in the segmented image. The SVM classifier approach is used for assigning the exact label to each instances in the image. In this brain MRI classification approach various image processing techniques are applied in both training and testing phase. The pre-processing and feature extraction processes are common for both training and testing phase. In the training phase the input images are verified by the system by using image identifier, it detects the type of the image and searches for the same type of image in the database. If the related image is found it sends all the corresponding images from database for pre-processing. After this step, the noise in the images are removed using the discrete wavelet transform technique. In the segmentation process, the k-means segmentation will segment the input image. The feature extraction step is done and the SVM classifier classifies the image into type of tumor such as benign or malignant tumor, etc.

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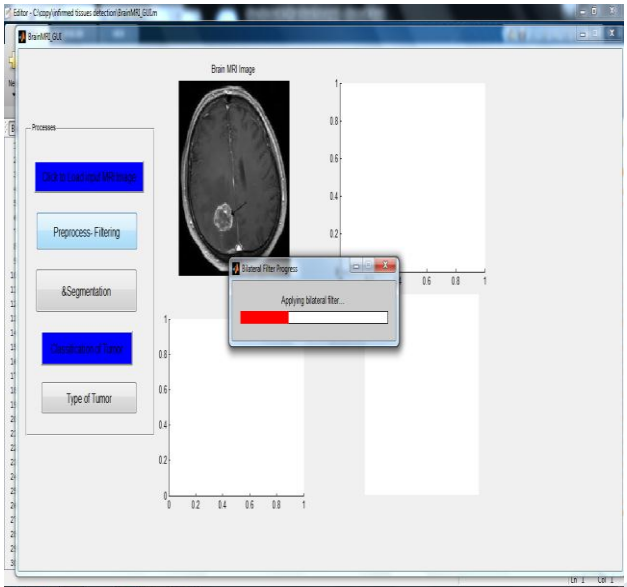

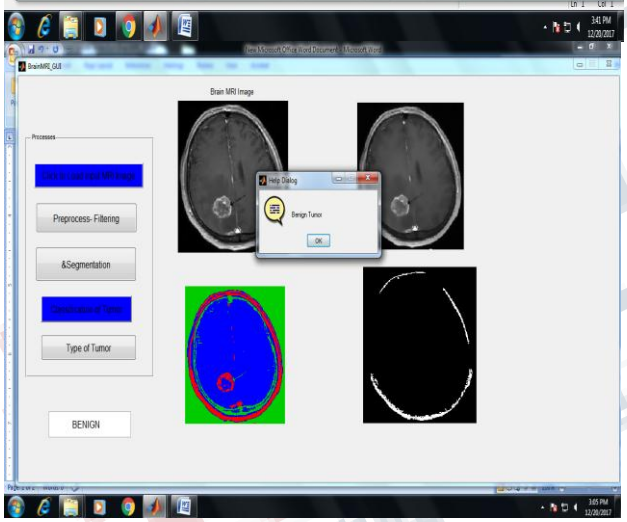

Classification of tumor in our system

In the system we have to give the MRI image as input. After the input section filtering process has to be done. After filtering segmentation takes place. In segmentation the normal grayscale image is converted into the color image. Once segmentation is done, the classification process is to be done. In classification, the SVM classifier classifies the tumor in the image into its types such as benign, malignant, etc. the classification of the type of tumor is based on the size, color and intensity of the tumor in image after the extraction of contours from the image. The processes present in both training and testing phase occurs here.

V. CONCLUSION & FUTURE WORK

In this paper a novel method for detection of brain tumor is proposed. The proposed method gives invariant results on the MRI images based on the size and type of the tumor. The usage of various techniques and methodologies in the proposed method helps in detecting the brain tumor and it also classifies the tumor into normal or abnormal tissue that will reduce the further complexity. This is concluded that the proposed method gives greater results for reducing the complexity in detection of brain tumor which is one of the challenging tasks in medical image processing. In future this work will be extended for newer classes of algorithms for detecting the brain tumor which will provide efficient results than existing methods for the upcoming researchers and scientists.

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