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Brain Tumor Detection and Classification using Image Processing

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***Abstract*—** Radiology is an area in medical field where images are used to diagnose and treat various diseases seen within the body. Medical image processing is used to assist the physicians in diagnosing the disease. The brain tumors detection Brain tumor detection has gained importance in medical field because it provides anatomical information of abnormal tissues in brain which helps the doctors in planning the treatment. For brain tumor detection MRI and CT scans are used. Here in this paper median filter has been used to remove noise from the image, GLCM is used to extract the needed features from the image so that we can find whether the tumor is present or not, fuzzy c-means is used for image segmentation and artificial neuro fuzzy technology ANFIS is used for classification of type of brain tumor.

***Keywords*—** image preprocessing;brain tumor;neuro fuzzy; imagesegmentation;feature extraction; image classification.

I. INTRODUCTION

The brain tumor is nothing but the growth of cells in brain that multiplies in an uncontrollable, abnormal way. It can either be malignant or benign. Brain tumors are graded from 1 to 4 according to their behavior, such as how quickly they grow and how likely they grow back after treatment.Radiology is a medical practice that makes use of imaging to diagnose and treat diseases. There are two main imaging methods namely CT and MRI.In the proposed method MRI image is used to detect and classify brain tumor.

A. *Magnetic Resonance Imaging (MRI)*

A strong magnetic field is first applied and then radio waves are applied for a short time in a different direction in magnetic resonance imaging. This sudden shift causes the certain atoms in patient's body to make special signals. The MRI scanner then detects those special signals caused by the radiation. The MRI scanner then sends the signal information to the computer, and then the computer creates an image of the inner body with the help of signal information.

II. RELATED WORK

KetanMachhale et al. (2015) [7] proposed an intellectual classification system to recognize the normal and abnormal MRI brain images. At present, decision and the treatmentof brain tumors is based on the symptoms and radiological appearance. Magnetic resonance imaging (MRI) is the very important controlled tool for anatomical judgment of the tumors in brain. Nowadays, various techniques were used for the classification of the brain cancer. Under these techniques used the modules like image preprocessing, image segmentation,image feature extraction and subsequent classification of brain cancer are performed. Support Vector Machine (SVM), K- Nearest Neighbor (KNN) and Hybrid Classifier (SVM-KNN) are the various machine learning techniques are used.

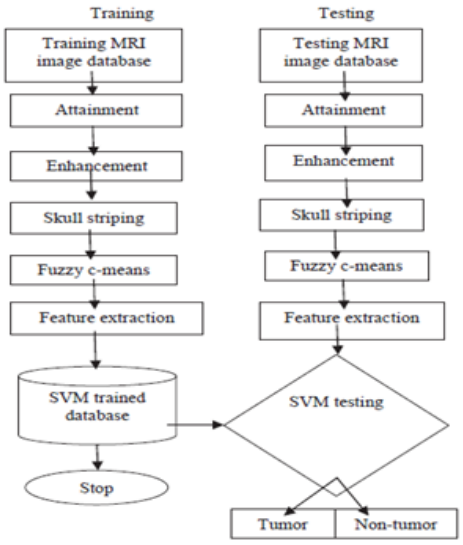

Figure 2.1: Hybrid Classifier

Trung Le et al. (2010) [10] proposed the new support vector machine technique for the two-class medical image classification. The main idea of the method is to construct an optimal hypersphere such that both the interior margin between the surface of this sphere, the normal data, and the exterior margin between this surface and the abnormal data are as large as possible. The proposed method is implemented easily and can reduce both the false positive and also false negative error rates to obtain very good classification results.The Support Vector Machine (SVM) classifier is a good classifier that works well on the wide range of classification problems, even problems in the high dimensions and the cases that are not linearly separable.Perhaps the biggest problem with the support vector approach is in choice of the kernel.

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Swarnalatha et al. (2013) [9] proposed a concept based on the novel fuzzy approach with bit plane FCMBP approach. The bit plane filtering method is used to slice the presented image for classification to find out destroyed region of the presented image. The sliced image must be normalized with old techniques and then compared with fuzzy technique for the better classification and the cluster of the spoiled portion. Thereby control points are extracted that are further needed for reconstruction of the images. The performance of the fuzzy approach with bit plane technique is evaluated with the help of simulation and it is found that our approach yields better results when compared to other accessible methods. Its disadvantage is only efficient for most significant bit-planes (MSB).

ZehraKarhan et al. (2015) [3] proposed a method that is used for determining whether the medical image belongs to that class or not, using textural features of the medical images. The study was conducted on the images in the IRMA (Image Retrieval in Medical Applications), in the international database. After performing the preprocess on medical images, discrete wavelet transform (DWT) was applied and then the discrete cosine transform (DCT) was applied to the each band components. After extrating the features, using of 3% , 1%, 5% and 7% of the obtained data were classified. K-Nearest neighbor algorithm was used in classification phase.The classificaiton performance was around the 87 persentage.One of the main highlight of the wavelets is that they offer a simultaneous localization in time and the frequency domain.

Parveen et al. (2015) [4] proposed a new hybrid technique based on support vector machine (SVM) and the fuzzy c-means for brain tumor classification. This algorithm is an combination of support vector machine (SVM) and fuzzy c-means, a hybrid technique for prediction of the brain tumor. In this algorithm image is enhanced with the help of techniques such as contrast improvement, and mid-range stretch. Double thresholding and the morphological operations are used for the skull striping. The Fuzzy c-means (FCM) clustering is used for the segmentation of image to detect suspicious region in the brain MRI image. Grey level run length matrix (GLRLM) is used for the extraction of the feature from the brainMRI image, after which the SVM method is used to classify brain MRI images, which provide accurate and more effective results for the classification of brain MRI images.

Walaa Hussein Ibrahim et al. (2013) [5] proposed the Neural Network techniques for the classification of magnetic resonance brain images. The proposed technique which uses neural network consists of three stages, preprocessing, dimensionality reduction, and the classification. In first stage, MR image will be obtained and then image is converted into data form. Then in the second stage the dimensionally reduction is obtained using principles component analysis (PCA), then In the classification stage Back-Propagation Neural Network has been used as a classifier to classify as normal or abnormal MRI brain images.The main disadvantage of this method is the training of the ANN is time taking.

III. PROPOSED SYSTEM

In this approach the artificial hybrid neuro fuzzy technique is proposed .MRI images are used to detect and classify brain tumor. This system enjoys benefits of both the Artificial Neural network system and the Fuzzy Logic system and eliminates their limitations. The Neuro-Fuzzy system integrates the learning power of Artificial Neural Network system and explicit knowledge representation of fuzzy inference system. The proposed system consists of four stages.They are data collection through various repository sites or hospitals,the Preprocessing of various brain images,the Feature extraction using the Gray Level Co-occurrence Matrix (GLCM) method and the classification of the brain images using Hybrid Neuro-Fuzzy System. In this approach the Experimental results provides promising results in terms of classification accuracy,specificity and sensitivity.

A. Image Preprocessing

a. Noise Types

The noise is characterized by its pattern and probabilistic characteristics. There is a wide variety of noise types. The different types of noise are Gaussian noise, salt and pepper noise, poison noise, impulse noise, speckle noise. In this paper median filter is used to remove Gaussian noise.

Gaussian Noise: Gaussian noise is a statistical noise that has its probability density function equal to that of normal distribution. Gaussian noise is also known as the Gaussian distribution. The values that the noise can take on are Gaussian-distributed. A special case is white Gaussian noise, where the values at any pair of times are identically distributed and statistically independent. In many applications, Gaussian noise is most commonly used as additive white noise to yield additive white Gaussian noise.

b. Feature Extraction

Features are properties that describe the whole image. Feature is an important piece of information that is subjected to solve computational task related to the specific application. In the image analysis, feature extraction method is needed to reduce the processing time and complexity. This is done in order to get the most important features in an image. The extraction of important features for brain image classification is included in this proposed work. The extracted features provideproperty of the texture, and these are stored in the knowledge base. Methods like Discrete wavelet transform, Fast Fourier transform, Histogram leveling, Gray level co-occurrence matrix etc. can be used to extract features related to the brain. Gray-level co-occurrence matrix is statistical method that examines the textures which takes into account the spatial relationship of the pixels. Gray level co-occurrence matrix (p,d,θ,i,j) represents probability of occurrence of gray levels (i.j),(i,)j are separated by a distance d at an angle θ. GLCM is used to determine the co-occurrence matrix of an image. GLCM determines how a pixel with the intensity i, occurs in relation with the other pixel j, at a distance d, and angle θ.

C. Image Segmentation

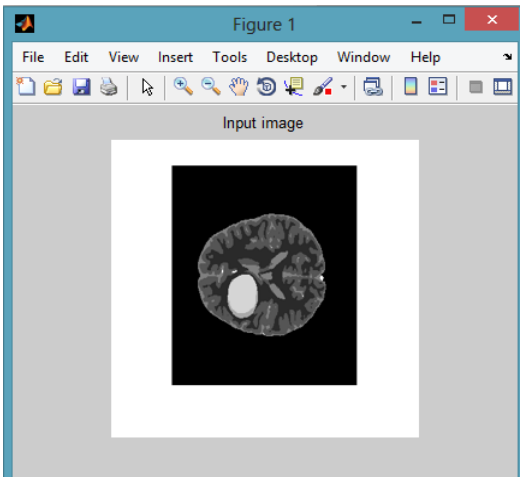
Image Segmentation is the process dividing an image into regions with similar properties like gray level, color, texture, brightness, and contrast. The Segmentation of CT and MR images involves three image related problems .The first one is *noise* that can alter intensity of a pixel such that its classification becomes uncertain. The second one is *intensityinhomogeneity* where intensity level of a single tissue class varies gradually over the extent of the image, and the third one is images that have finite pixel size and are subjected to *partial volume averaging* where individual pixel volumes contain a mixture of the tissue classes so that intensity of a pixel in the image may not be consistent with any one class.In our proposed system fuzzy c means segmentation technique is used which avoids above mentioned problems.

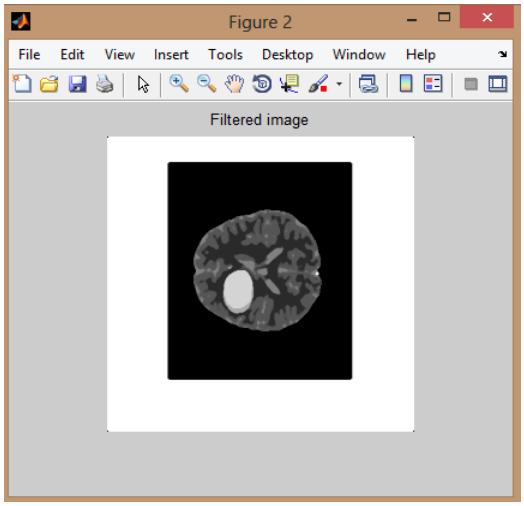
d.Classification

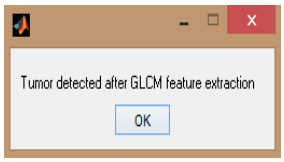
The Artificial neural networks employed for the image classification problems do not guarantee high accuracy besides being computationally heavy. The necessity for large training set to achieve high accuracy is another drawback of the artificial neural network. The neural network models try to emulate architecture and information representation schemes of the human brain .On the other side, fuzzy logic technique which promises better accuracy depends mainly on the expert knowledge, which may not always be available. Even though it requires less convergence time, it relies on the trial and error method in selecting either fuzzy membership functions or the fuzzy rules. The fuzzy logic models attempt to mimic the human reasoning and the capability of handling uncertainty. These problems are overcome by hybrid model namely, neurofuzzy model. This system removes the stringent requirements since it enjoys the benefits of both ANN and the fuzzy logic systems.In this work ANFIS is used for classification of brain tumor. This method provides better result when compared to other classification techniques.

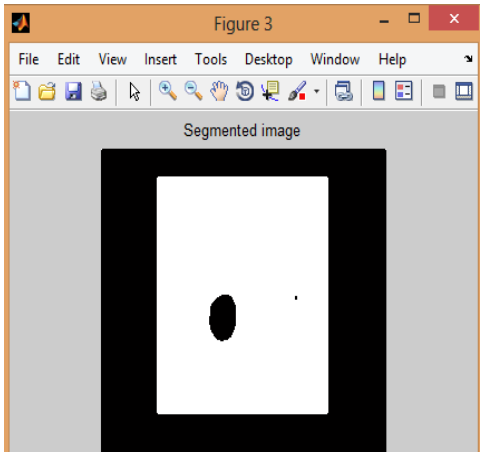
IV. EXPRIMENTAL RESULTS

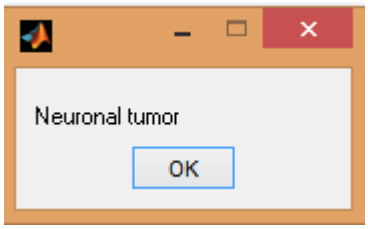
A. For Tumorous MRI Image:



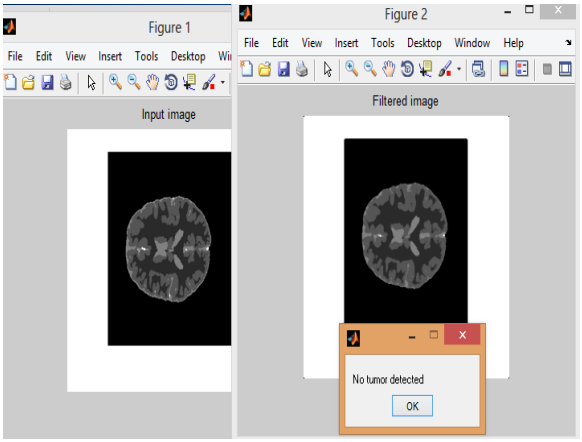








B. For Non Tumorous MRI Image



V. CONCLUSION

The essential concepts of medical image processing are analyzed, specifically MRI brain images are considered. The study focus on the detection of brain abnormalities and tumor from the MRI images and to classify which type of brain tumor it is. The related work First focuses on various image preprocessing methods for improvising the medical images,then image segmentation is used to effectively segment tumor parts from rest of the brain image so that the tumor is detected from the segmented image and then the feature extraction methods are studied. The final part is classification and this survey aims to analyze how the extracted features which can be used to classify whether the image comes under normal category or abnormal category. If it comes under the abnormal category, the type of abnormality is classified. The proposed method provides more accuracy,specificity,sensitivitythan other existing brain tumor detection methods.

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