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Brain MRI Classification Using PNN and Segmentation by K-Means Clustering

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ABSTRACT: Now a day's Brain tumor is one of the causes of death in peoples. So it becomes necessary to diagnose it in its early stage which can increase the survival rate. Conventional method is time consuming Which undergoes spinal tap, biopsy etc. to overcome the drawbacks of existing systems, it become necessary to design computer Aided Diagnosis system which gives good accuracy in identifying tumor with short period of time. This proposed method employs PNN classifier which can classify MRI images as normal or abnormal (Benign, Malignanat).This system follows four steps: wavelet decomposition, textural feature extraction, PNN classification, K- means clustering for segmentation. It has been observed that wavelet decomposition gives better image resolution by decomposing into various low and high level components. For texture feature extractor GLCM is used which can differentiate between Benign and Malignant. This system gives accuracy of 95.24% which is higher than previous methods. If the output of classifier is tumor then by means of k means clustering tumor is identified, also it calculates the area of tumor.

KEYWORDS: DWT, GLCM, classification, PNN, K-means, Segmentation.

I.INTRODUCTION

Brain Tumor can be defined as abnormal growth of mass of tissue within the brain which can affect the normal functioning of brain. Conventional method used for detecting tumor is time consuming and lengthy, which needs experts for correct identification. Brain tumor has various types depending on

- The type and grade
- primary or a secondary
- cancerous (malignant) or not (benign)
- Where in the brain the tumor is located

The type of treatment depends on

- Age of Patient
- Medical history
- Type of Tumor
- Location
- Size of Tumor

Different scanning methods are used to scan brain which includes CT scan, MRI, and PET etc. Out of these various methods MRI is best as it does not uses harmful radiations, can produce 3D image. So the objective of system is to design algorithm which can fast and accurately differentiate MRI.

II. LITERATURE SURVEY

Automated brain tumor diagnosis with MR images, becomes important in the medical field. The automated diagnosis involves two major steps:
(a) Image classification and
(b) Image segmentation.

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Image classification used to classify the image into normal or abnormal and classify the abnormality type whether it is benign or malignant. segmentation is used to extract the abnormal portion necessary for volumetric analysis. Following table summarizes comparisons of various methods

Table-1: Comparisons of various systems

Sr no	paper	Name of paper	Author	Work Discussed
1	(IJERA) 2012, ISSN: 2248-9622 [1]	Classification of MRI Brain images Using Neural Network,	Lalit P. Bhaiya and Virendra Kumar Verma,	Histogram equalization is performed to avoid the dark edges.BPN based classifier produces 77.56% and PNN produces 98.07% of accuracy in tumor detection.
2	EJSR, September 2012 [2]	Brain Tumor Identification in MRI with BPN Classifier and Orthonormal Operators	Meenakshi.R and nandhakumar	Segmentation task is performed using orthonormal operators and classification using BPN. Images having the tumor are processed using K-means clustering and significant accuracy rate of 75% is obtained.
3	IJEAT, April 2012. [3]	Brain Tumor Detection and Segmentation Using Histogram Thresholding	Manoj Kowar and Sourabh Yadav	presents the novel techniques for the detection of tumor in brain using segmentation, histogram and thresholding
4	IEEE, 2011. (IEEE Transaction) [4]	Classification of Brain MRI using the LH and HL Wavelet transform Sub-bands	Boukadoum, Salim Lahmiri and Mounir	This proposed approach shows that feature extraction from the LH and HL sub-bands using first order statistics has higher performance than features from LL bands.
5	JACSSE Volume 5, Issue 4, 2015 ISSN: 2277 128X [5]	An Improved Automatic Brain Tumor Detection	Yash Sharma, Megha Chabra	Artificial Neural Network to classify the grade of tumor. The tumor detection efficiently, with

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		System		accuracy (95.30%) & it detects, classifies tumor correctly
6	ICAESM -2012 March 30, 31, 2012 [6]	Brain Tumor Segmentation and Its Area Calculation in Brain MR Images using K-Mean Clustering and Fuzzy C-Mean Algorithm	J.selvakumar A.Lakshmi T.Arivoli	Segmentation using k-means and fuzzy C means,area of tumor calculated

III. PROPOSED SYSTEM

From literature survey, we observed that PNN gives better classification accuracy, and segmentation by K-meas also performs good. So this system follows different steps from preprocessing, image decomposition by DWT, texture feature extraction by GLCM, classification by PNN, finally if output is abnormal then segmentation by k means.

1. Preprocessing

During image acquisition, many artifacts such as name of patents, movement of patients etc. May add some error in image, so it becomes necessary to remove such errors for further processing. In this system MRI images from Sahyadri MRI Center, Aurangabad are taken for this purpose.MRI image though it looks like black and white but its color image, again it contains some thermal noise. Therefore this system uses median filter to remove such noise which also called as impulse noise or salt and pepper noise. To see the effect of median filter I add 0.02%of noise in image.

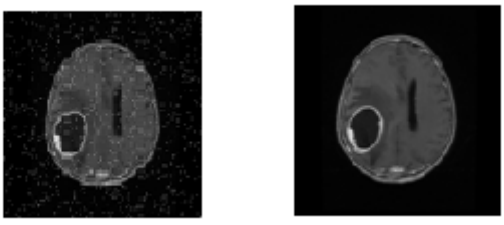

Fig. 1 output after removal of noise

2. DWT Image Decomposition

From literature survey, it is observed that feature taken from high level component of decomposed image gives better image resolution than low level. This system uses two level image decomposition which decompose image into low level also called approximate component and high level which is detail component of image. From these low and high level components first and second level statistical features are extracted.

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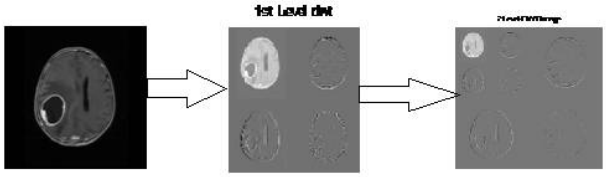

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Fig. 2 2 level DWT output

3. Texture feature Extraction

In previous step we get LL,HL,HL components. In this method first order statistical features such as mean, variance, kurtosis, skewness are extracted from histogram of image. While to extract second order features, Gray level co occurance matrix is used this finds the relation between pixels in different direction and angles. It also has advantage that it can easily differentiate between benign and malignant tumor. In this system contrast, correlation, homogeneity, energy, entropy these features extracted.

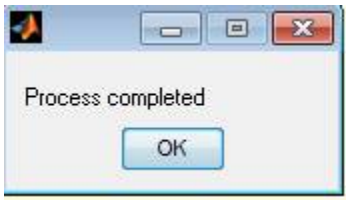

Fig. 3 Output after feature extraction

4. Training and Testing

Here features of training images are used to train the network. Once network is train then it is tested by finding the closeness between the features of testing image and training image.

5. Classification

Probabilistic neural networks are used for classification. it has three layers as input layer, Radial Basis Layer and Competitive Layer. When an input is presented, the first layer computes distances from the input vector to the training input vectors, and produces a vector whose elements indicate how close the input is to a training input. The second layer sums these contributions for each class of inputs to produce as its net output a vector of probabilities.
Finally, a compete transfer function on the output of the second layer picks the maximum of these probabilities, and produces a 1 for that class and a 0 for the other classes. Probabilistic neural networks (PNN) can be used for classification problems [1].
Their design is straightforward and does not depend on training. A PNN is guaranteed to converge to a Bayesian classifier providing it is given enough training data. These networks generalize well.

The network classifies input vector into a specific class as normal, benign, malignant because that class has the maximum probability to be correct. classifier classifies the images as normal or tumorous.

Fig. 4 Output of classifier as benign

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If it is tumorous the further process is the finding ROI. *i.e.* detecting the location of tumor. So next step is segmentation process.

6. Segmentation

Segmentation is the process of partitioning a digital image into multiple segments 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 Clustering can be considered the most important unsupervised learning problem, so, it deals with finding a structure in a collection of unlabeled data. A cluster is therefore a collection of objects which are similar between them and are dissimilar to the objects belonging to other clusters. This method uses k means clustering. K-Means is the one of the unsupervised learning algorithm for clusters Following are the steps followed in k means.

Give the no of cluster value as k.

- Randomly choose the k cluster centers
- Calculate mean or center of the cluster
- Calculate the distance b/w each pixel to each cluster center
- If the distance is near to the center then move to that cluster.
- Otherwise move to next cluster.
- Re-estimate the center.

Repeat the process until the center doesn't move.

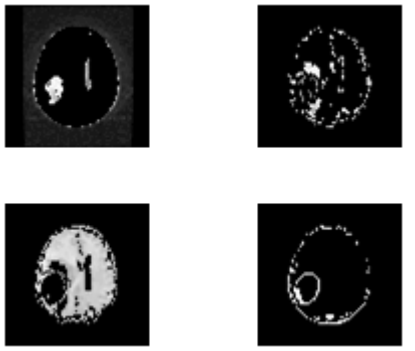

Fig. 5 4 clusters after k means

Once the tumor detected then next step is to find out area of tumor.

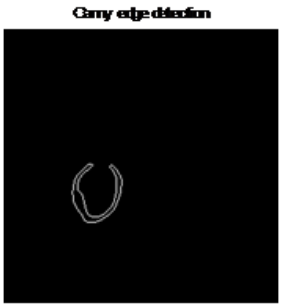

Fig. 6 Output of edge detection

To find area, binerization method is used .That is the image having only two values either black or white (0 or1). Here 256x256 .bmp images is a maximum image size.

The area calculation formula is
pixels=Width(W)XHeight(H) = 256X256

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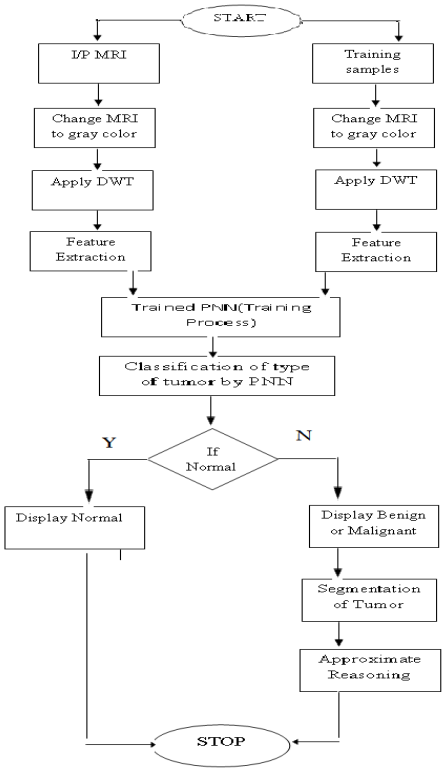
Size of Tumor S=$\left[\left(\sqrt{P}\right) * 0.264\right] mm^2$
P= no-of white pixels.

7. Flowchart of proposed system



IV. RESULT AND DISCUSSION

The performance of proposed system is evaluated by using set of 30 training 21 testing MRI images. The whole system is designed by MATLAB software.
Here various smoothing factor (SV) are used to obtain better accuracy in identifying correct class. SV from 1 to 5 used for accuracy checking. Following table gives effect of SV on performance of classifier.

Table 2 performance of classifier

SV	Training Samples	Testing Samples	SENSITIVITY (%)	SPECIFICITY (%)	ACCURACY (%)
1	30	21	78.57	85.71	80.95
2	30	21	92.86	85.71	90.48
3	30	21	100	85.71	95.24
4	30	21	78.57	85.71	80.95
5	30	21	78.57	85.71	80.95

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From above table we observed that system accuracy varies from 80.95 % to 95.24% with SV 1to 5.

Simulation Result

The same system is simulated on MATLAB GUI. GUI is nothing but pictorial representation of system. Following figure shows output at each step. Figure shows output after preprocessing.

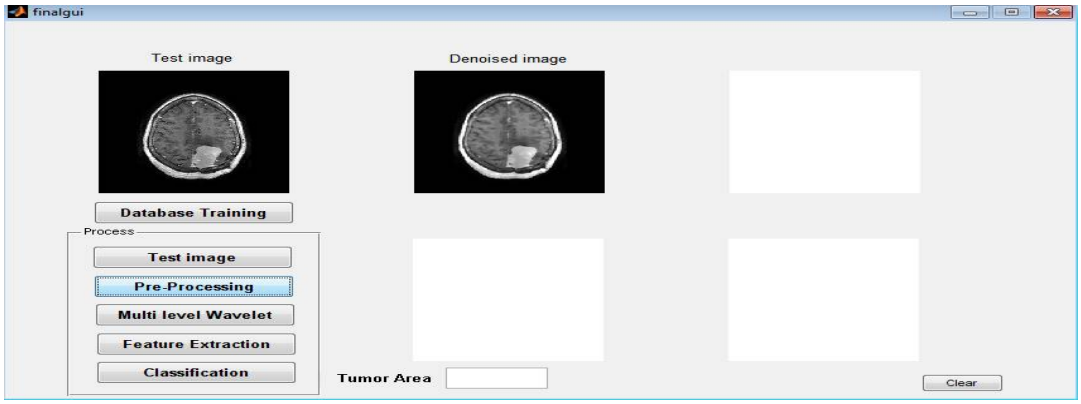

Fig. 7 Output after preprocessing.

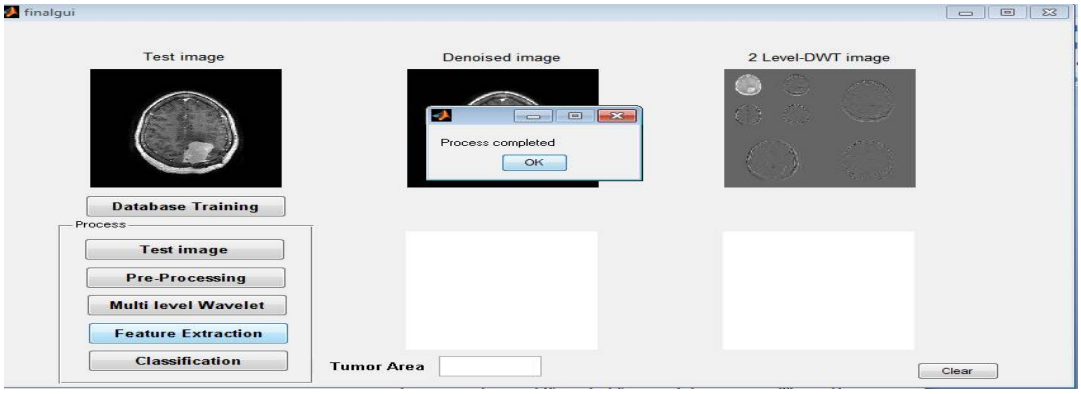

Fig. 8 Output after feature extraction

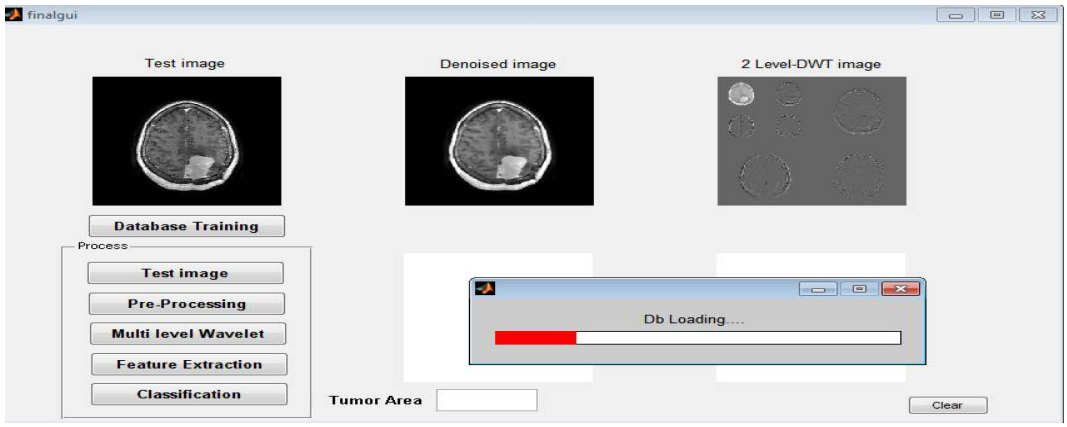

Fig. 9 Output during training

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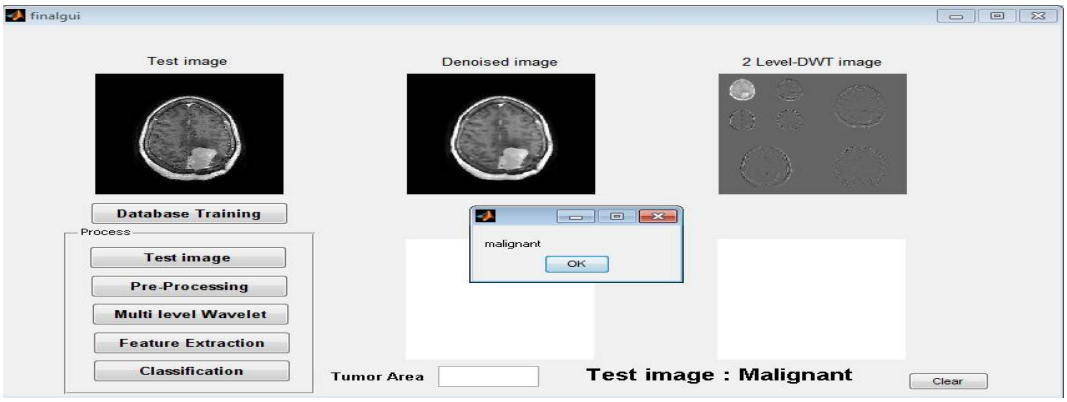

Fig. 10 Output of classifier

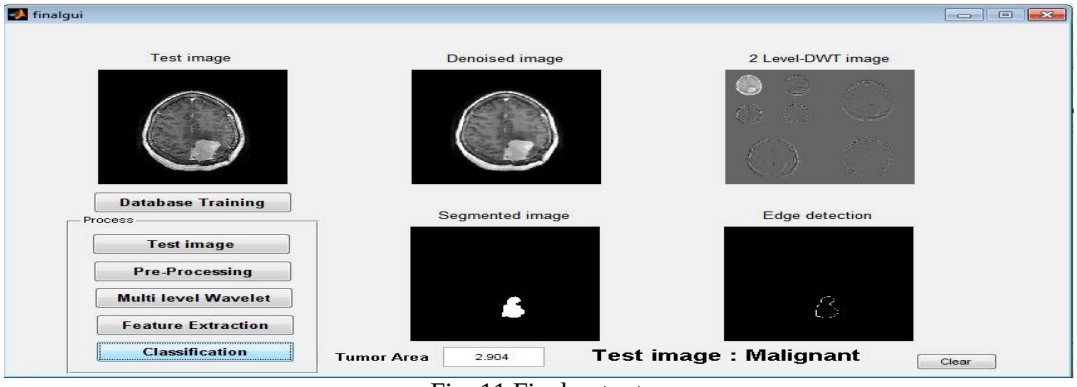

Fig. 11 Final output

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V. CONCLUSIONS

From above discussion, can conclude that texture feature extracted from LH,HL coefficients after DWT decomposition give better feature extraction, which helps to differentiate between normal, benign, malignant. Also SV helps PNN to improve accuracy from 80.95 % to 95.24% which is higher than other neural network. Area of tumor also helps radiologist for determining the size of tumor.

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