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Design of Hybrid Method PSO & SVM for Detection of Brain Neoplasm

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Abstract. In the field of medical field ,Magnetic resonance imaging (MRI) provides detailed anatomic information of any part of the body .This methodology consist of 4 steps: image processing ,image enhancement ,feature extraction and image classification. Image preprocessing is done with the help different gradient operator. Image enhancement step uses the noise removal and histogram equalization. Wavelet based texture feature are extracted from normal and tumor regions. At last optimization is done with the help of PSO and SVM classifier.
Keywords- MRI, GA , HAAR wavelet, ANN, PSO

1. INTRODUCTION

Medical image analysis and processing has great deal of significance in the medical field .MRI are very important diagnostic tool for emerging trends in cancer and other dangerous disease. Brain tumor is one of the major causes of death among the people. It is found that chances of survival can be increased if the tumor is detected correctly at early stages .so visual detection of these tumor can result in misdiagnosis of unwanted tissue due to human errors caused by visual fatigue.

2. MRI BRAIN ANALYSIS

Many techniques have been developed for the classification of brain MRI. A hybrid approach for classification of brain tissues in magnetic resonance images had been proposed by Ahmed Kharat et.al in [1] using GA &SVM. A wavelet based texture feature set is derived. The optimal texture features extracted from normal and tumor regions by using Spatial Gray level Dependence Method (SGLDM). These features are given as input to the SVM classifier. The choice of feature, which constitutes a big problem in classification technique, is solved by using GA. In [2] author has proposed computer based method involving the two segmentation technique canny edge and adaptive threshold. The comparison between SVM proposed computer based method for defining tumor region in the brain using MRI images using two different segmentation steps canny edge detection and adaptive threshold. The comparison between SVM with and without the implementation of principle Component analysis has been proposed in [3].The architecture of three partially adaptive space time adaptive processing (STAP) algorithm are introduced, which reduces the dimensionality and improve the tractability in [4]. A hybrid classification of brain MRI image is proposed in [5] using DWT, PCA, K-NN and ANN.

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3. METHODOLOGY AND DESIGN

3.1 The model for the proposed hybrid algorithm

The Fig 1 explains the flow diagram for the proposed algorithm. it has six stages namely ,preprocessing, noise removal, histogram equalization , optimization with the PSO, feature extraction , feature selection, image classification to find the abnormal parts.

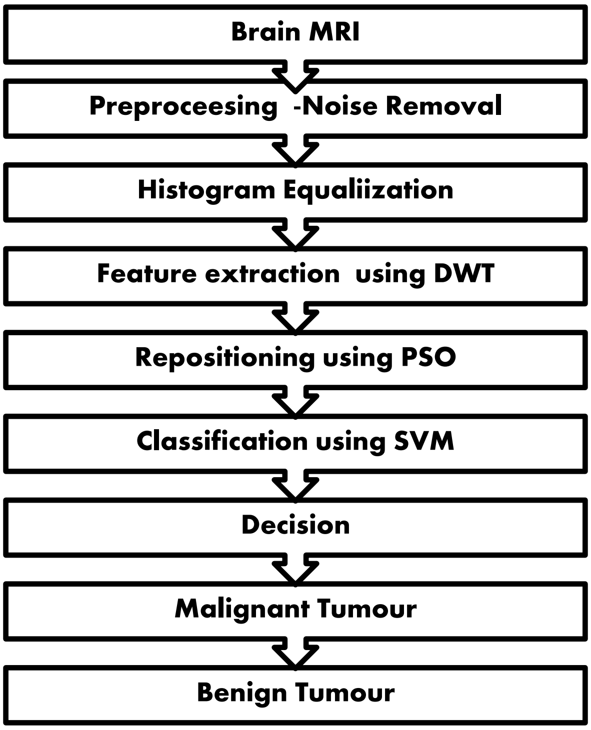

Fig1. Proposed methodology

3.2 Techniques used in proposed algorithm

3.2.1 Preprocessing

In medical images, due to diagnostic and therapeutic application, noise cannot be used easily. It is quite critical. specially in MRI due to patient motion, external noise, inhomogeneous magnetic field are some sources of artifacts and other undesired result. This causes the computational errors. Therefore it is necessary to remove them in the preprocessing procedure before any analysis.

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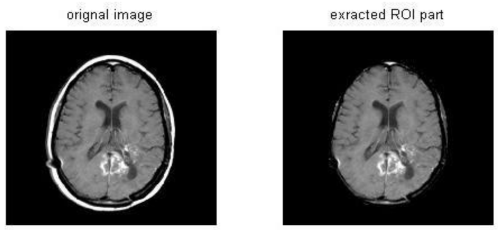

Fig 2. Extracted ROI part

3.2.1 Histogram equalization

It is method of increases the contrast of an image.basically histogram is a graph which shows the frequency. In histogram equalization process, it maximizes the contrast of an image by applying a gray level transform which tries to flatten the resulting histogram. To transfer the gray levels so that the histogram of the resulting image is equalized to be constant .

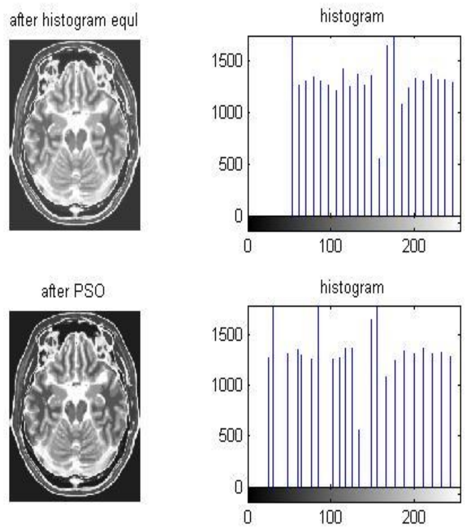

Fig 2.After histogram equalization

h[i]=constant ,for all i

$$s_k = \sum_{i=0}^{k} p_r / r_j \qquad (2)$$

$$s_k = \sum_{j=0}^{k} n_j / n \qquad (3)$$

Where k=0, 1,2,……………L-1,Sk is the intensity value in the output image corresponding to value (rk)in the input image . Histogram equalization is implemented in the toolbox of MATLAB by a function histeq,

g= histeq (f,nlev) (4)

if nlev is equal to L(total no. of possible levels in input image) histeq complements the transformation function directly. If nlev is less than L than histeq attempts to distribute the level so that they will approximate after histogram.

3.2.3 Discrete wavelet transform

The discrete wavelet transform (DWT) is a linear transformation that operates on a data vector, whose length is an integer power of two, transforming it into a numerically different vector of the same length. It is a tool that separates data into different frequency components, and then studies each component with resolution matched to its scale. DWT is computed with a cascade of filterings followed by a factor 2 sub sampling (Fig3)

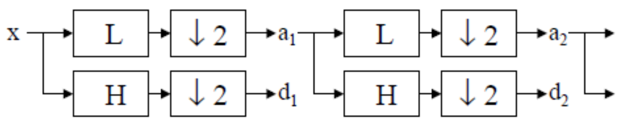

Fig 3 DWT tree[5]

H and *L* denotes high and low-pass filters respectively, ↓ 2 denotes sub sampling. Outputs of these filters are given by equations (1) and (2)

$$a_{j+1}[p] = \sum_{n=-\infty}^{+\infty} l[n-2p]\, a_j[n] \qquad (5)$$

$$d_{j+1}[p] = \sum_{n=-\infty}^{+\infty} h[n-2p]\, a_j[n] \qquad (6)$$

Elements a_j are used for next step (scale) of the transform and element d_j called wavelet coefficient. It determine output of the transform l[n] and h[n] are coefficient of low pass filter respectively

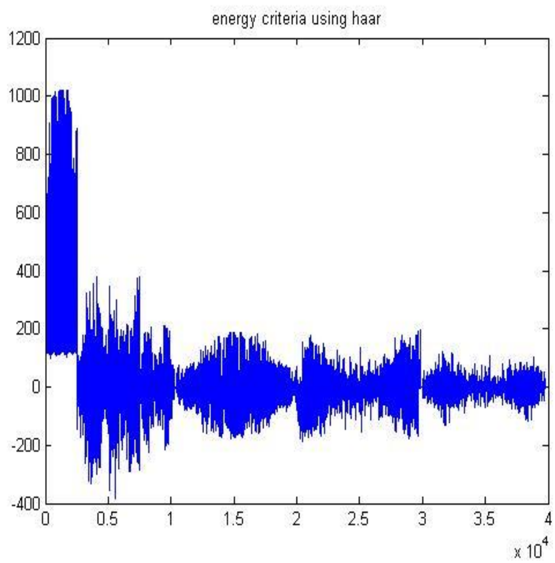

Fig .4 Energy criteria using HAAR

3.2.3Training an SVM Classifier

Train an SVM classifier with the svmtrain function. The most common syntax is:

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SVMstruct=svmtrain(data,groups,'Kernel_Function','rbf');
The inputs are:

- data — Matrix of data points, where each row is one observation, and each column is one feature.
- groups — Column vector with each row corresponding to the value of the corresponding row in data. groups should have only two types of entries. So groups can have logical entries, or can be a double vector or cell array with two values.
- Kernel_Function — The default value of 'linear' separates the data by a hyperplane. The value 'rbf' uses a Gaussian radial basis function. Hsu, Chang, and Lin [4] suggest using 'rbf' as your first try.

The resulting structure, SVMstruct, contains the optimized parameters from the SVM algorithm, enabling you to classify new data.

4. PERFORMANCE MEASUREMENT

In this section, the performance is evaluated by three factors that are sensitivity, specificity and accuracy. Accuracy is defined as the degree of closeness of measurement of quantity actual value. Sensitivity is called true positive cases. It means proportion of actual true cases, which are correctly classified as true cases. Specificity is known as true negative cases. It defined as proportion of negative cases which are correctly classified as true cases.

$$Sensitivity = \frac{TP}{TP+FN} \quad \text{(i)}$$

$$Specificity = \frac{TN}{TN+FP} \quad \text{(ii)}$$

$$Accuracy = \frac{TP+TN}{TP+TN+FN+FP} \quad \text{(iii)}$$

5. PSO AND SVM

The proposed PSO-SVM system of classification. This study initially aims at optimizing the accuracy of the SVM classifier by detecting the subset of best feature and estimating and estimating the value for regularization of kernel parameters of SVM model. The PSO-SVM algorithm is the combination of two machine algorithm.PSO stars with n randomly selected particles and searches for the optimal particle iteratively.

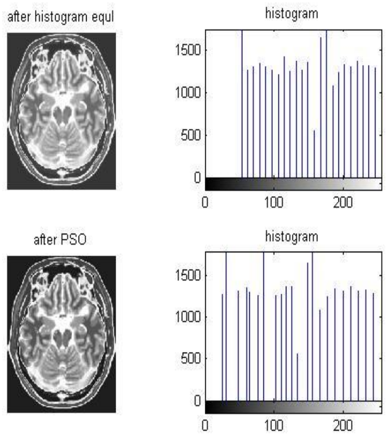

Fig 5. After applying PSO

The procedure is described proposed PSO-SVM approach is as follows:

1. Initializing PSO with population size, inertia weight and generations without improving.
2. Evaluating the fitness of each particle.
3. Comparing the fitness values and determines the local best and global best particle.
4. Updating the velocity and position of each particle till the value of the fitness function converges.
5. After converging, the global best particle in the swarm is fed to the SVM classifier for training.
6. Training the SVM classifier. The PSO-SVM takes the advantage of minimum structural risk of SVM and the quick global optimizing ability of PSO.

The application of the algorithm of optimization by particulate swarm, like any evolutionary algorithm, is influenced by factors such as the criterion of the stop, the structure of the particle, the objective function.

6. EXPERIMENTAL RESULT AND VALIDATION

This proposed hybrid technique is implemented on a real data set consisting of transaxial images of brain MRI. It consists of 247 images: 82 are normal, 82 are benign and 82 images are taken as malignant tumor suffering from a low grade glioma, meningioma. These normal and pathological images are axial, T2-weighted of 256*256 sizes and acquired at several positions of tranaxial plane, images are taken from [6] In this case total no images 247 are used for training purpose and overall 18 images are normal, 20 are benign and 20 are malignant.

Table 1. Classification performance in terms of Accuracy with other methods.

Sl no.	Technique	Accuracy
1	DWT+PCA+ANN	95.7
2	DWT+SOM	94
3	STATISTICAL CLASSIFIER KNN	89.78
4	HAAR+PSO+SVM(Proposed Method)	95

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Where
TP (true positive) = correctly classified positive case
TN (true negative) = correctly classified negative cases
FP (false positive) = incorrectly classified positive cases
FN (false negative) = incorrectly classified negative cases

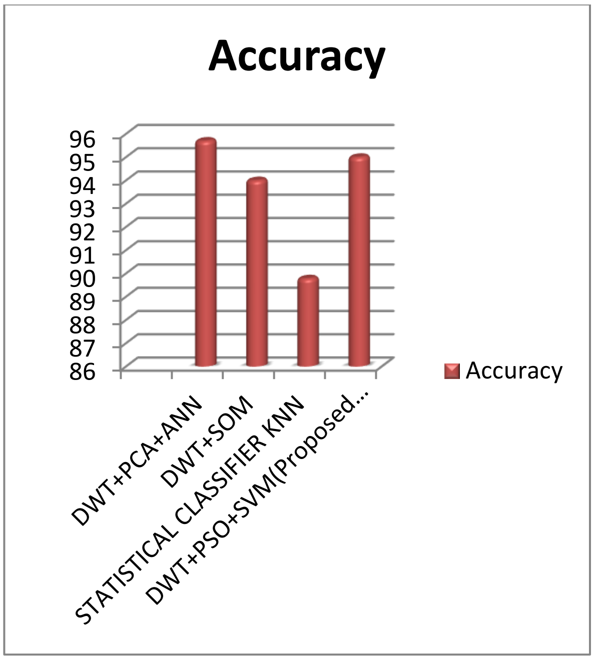

Fig. 6 Comparisons of Different Methods

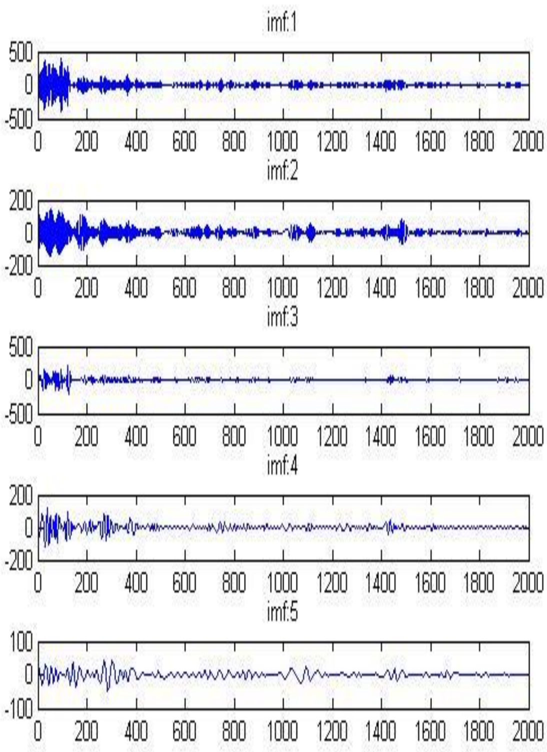

Fig 7. Empirical mode distribution(emd) showing different intermediate frequency(imf)

5. CONCLUSION AND FUTURE WORK

The paper developed a hybrid technique with normal and benign or malignant neoplasm. This method proposed a system consisting of wavelet transform using HAAR, PSO (particle swarm optimization) and SVM (support vector machine). This system helps doctor to take the decision for classifying the tumorous brain into normal and abnormal classes using confusion matrix. This technique is accurate, robust easy to operate, non invasive and inexpensive. But it necessitates fresh training each time whenever there is change in database.

REFRENCES

[1] Kharrat , A; Gasmi K.; Ben Messaoud ,M; Benamrane N. and Abid M. " A hybrid approach for automatic classification of brain MRI using genetic algorithm and support vector machine", Leonardo journal of sciences, Issue 17, pp 71-82, July-Dec ,2010.

[2] E.F Badran,.; E.G Mahmoud, N Hamdy ."An algorithm for brain tumor in MRI images", International Conference on Communication Computer Engineering and Systems(ICCES), Networking & Broadcasting, pp 368-373, June, 2010.

[3] Abdullah, N.; Lee Wee Chuen; Ngah, U.K.; Ahmad, K.A. "Improvement of MRI brain classification using Principles Component Analysis", IEEE International Conference on Control System, Computing and Engineering (ICCSCE), ,pp 567-571, March, 2011.

[4] Lejian Huang, Elizabeth A. Thompson, Vincent Schmithorst, Scott K. Holland, and Thomas M. Talavage. "partially adaptive STAP algorithm approaches to functional MRI" ,IEEE transaction on biomedical engineering ,vol56, no2,February 2009

[5] M Kociolek , A.Materka,M.Strzelecki P.Szczypinski "Discrete wavelet transform –derived features for digital image texture analysis ,proc. of international confrernce on signal and Electronic System, 18-21 ,sep 2001,Lodz,Poland ,pp.163-168

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