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Brain MRI Image Abnormality Detection using Performance Comparison between SVM and PNN Classifier

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***Abstract*— Magnetic resonance imaging (MRI) is an non-invasive medical imaging technique which is use to diagnose brain images.MRI uses the detection of radio frequency signals produced by displaced radio waves in a magnetic field. It provides detail view of brain in different directions. The proposed method consists of two stages: feature extraction and comparison of classification. In first stage features are extracted from images using GLCM with k-mean clustering. In the next stage, it compares SVM classifier and PNN classifier. It classifies the images between normal and abnormal along with stage of tumour depending upon features. It analyses the stage of tumour by using fuzzy clustering according to the size and position of tumour.**

***Index Terms*— GLCM, Image retrieval, Feature Extraction, MRI, SVM classifier, PNN classifier**

I. INTRODUCTION

Medical imaging is Non-invasive visualization of internal organs and tissues. Medical imaging techniques are used to determine the identification of possible disorders or disease.
Magnetic resonance imaging (MRI) is an imaging technique used primarily in medical settings to produce high quality images of the inside of the human body**.** There are several biomedical devices which are used to obtain medical images data such as Computed Tomography (CT), Magnetic Resonance Imaging (MRI) and mammogram.
MRI scan is one of the most sophisticated diagnostic tools available to help a referring clinician understand the cause of your particular health issue. Magnetic resonance imaging (MRI) is a safe and painless test that uses a magnetic field and radio waves to produce detailed pictures of the body's organs and structures. An MRI differs from a CT scan because it doesn't use radiation. Radio waves manipulate the magnetic position of the atoms of the body, which are picked up by a powerful antenna and sent to a computer. The computer performs millions of calculations, resulting in clear, cross-sectional black-and-white images of the body. These images can be converted into three-dimensional (3-D) pictures of the scanned area. These images help to pinpoint problems in the body. An MRI's ability to highlight contrasts in soft tissue makes it useful in deciphering problems with joints, cartilage, ligaments, and tendons. MRI can also be used to identify infections and inflammatory conditions or to rule out problems such as tumors. Brain is important part of human body which controls and coordinates most movement, behavior of body functions such as heartbeat, blood pressure, fluid balance and body temperature.
The brain MRI images are classified into normal and abnormal images which are important to identify normal patient.
Classification falls into two categories. First category is supervised learning technique such as Artificial Neural Network (ANN), Support Vector Machine (SVM) and K-Nearest Neighbor (KNN), Probabilistic Neural Network (PNN) which are used for classification purposes. Another category is unsupervised learning for data clustering such as K-means Clustering, Self Organizing Map (SOM). SVM classifier gives better accuracy and gives best performance than other classifiers.

II. SYSTEM DESCRIPTION

The principle of proposed method is to detect the tumor automatically from the cerebral images as follows. Proposed system consists of two main phases. First is Training phase and second is testing phase. The features are extracted from the image which is given as input to the SVM classifier. Various image processing techniques have been applied in both training and testing phase. Precisely, techniques like preprocessing, feature extraction, K-mean clustering, SVM classification and Diagnosis have been used. The pre-processing and feature extraction technique are common for both training and test phase. Images are required to be preprocessed for feature extraction process.

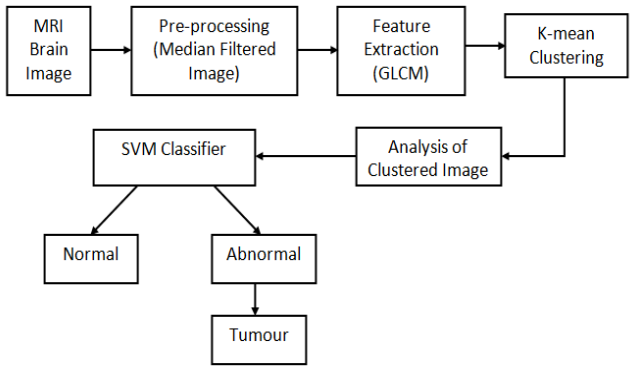


Fig.1. Stages of detecting tumour using SVM

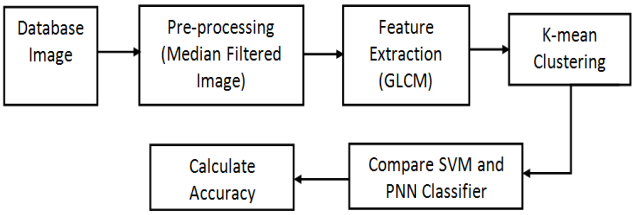


Fig.2. Comparison and analysis of SVM and PNN

III. PROPOSED BLOCK DIAGRAM

In this section, we give the materials, brain MR image datasets, and methods used to classify the images. Flow diagram of the overall algorithm that covers both training and testing processes are given in Fig.1 and Fig.2. The implementation details are discussed in the following subsections.

A. Pre-processing

Pre-processing images commonly involves removing low-frequency background noise, normalizing the intensity of the individual particles images, removing reflections, and masking portions of images. We have used pre-processing for getting Median filtered image. Median filtering is a technique used to remove noise.

B. Feature Extraction

We used GLCM (Gray Level Co-occurrence Matrix) to extract features like PSNR, MSE, Maxerror, contrast, correlation from the MR images that will be used as input to K-mean clustering.

C. K-means Clustering

The process of partitioning a group of data points into a small number of clusters is known as clustering. K-means is a clustering method that aims to find the positions of the clusters that minimize the distance from the data points to the cluster.

IV. CLASSIFICATION

Classification analyses and categorized the image data. There are two phases:- training phase and testing phase.

A. SVM Classifier

Support Vector Machine (SVM) is a classification method introduced in 1992 by Vapnik. This classifier is used to classify both linear and non linear data. This is currently the best performing general purpose classifier. Support Vector Machines are supervised learning models that analyses data used for classification. It constructs a hyper plane or set of hyper planes in a high- or infinite-dimensional space, which can be used for classification. In the proposed work it classifies as normal and abnormal images along with type of abnormality.

B. Linear SVM

Linear SVM is the newest extremely fast machine learning algorithm. Linear support vector machines (SVM) is originally formulated for binary classification. Linear SVM is a linearly scalable routine meaning that it creates an SVM model in a CPU time which scales linearly with the size of the training data set. Our comparisons with other known SVM models clearly show its superior performance when high accuracy is required. Linear SVMs are binary and linear separable classification.

Assume that all data is at least distance 1 from the hyper plane, then the following two constraints follow for a training set $\{(\mathbf{x_i}, \mathbf{yi})\}$

$$\mathbf{w}^T\mathbf{x_i} + b \geq 1 \quad \text{if } y_i = 1$$
$$\mathbf{w}^T\mathbf{x_i} + b \leq -1 \quad \text{if } y_i = -1$$

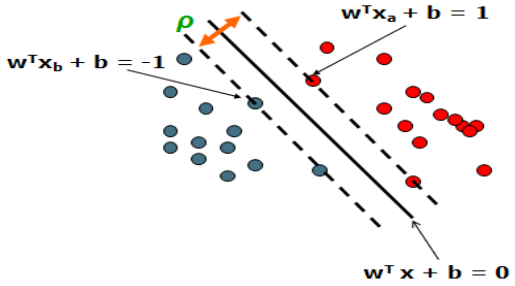


Fig.3. Linear SVM Classification

Training examples from the two different classes are separated by the hyper plane $\mathbf{w}^T\mathbf{x_i} + b = 0$, where w is the unit vector and b is a constant. Each $\mathbf{x_i}$ is a $\mathbf{p}$ -dimensional real vector.

The classifier is a *separating hyperplane*. The most "important" training points are the support vectors; they define the hyperplane. A support vector machine constructs a hyperplane or set of hyperplanes in a high- or infinite-dimensional space, which can be used for classification, regression, or other tasks. Intuitively, a good separation is achieved by the hyperplane that has the largest distance to the nearest training-data point of any class , since in general the larger the margin the lower the generalization error of the classifier.

C. Non linear SVM

In Linear Classifier, two classes can be distinguishing by hyperplane. But data points are not always separated by straight. The original optimal hyperplane algorithm proposed by Vapnik in 1963 was a linear classifier. Non linear classifier can be created by applying the Kernel Trick to maximum –margin hyperplanes. Kernal function is used to map low dimensional data into high dimensional feature space only when data points are linearly seperable. Any linear model can be turned into a non-linear model by applying the kernel trick to the model: replacing its features by a kernel function.

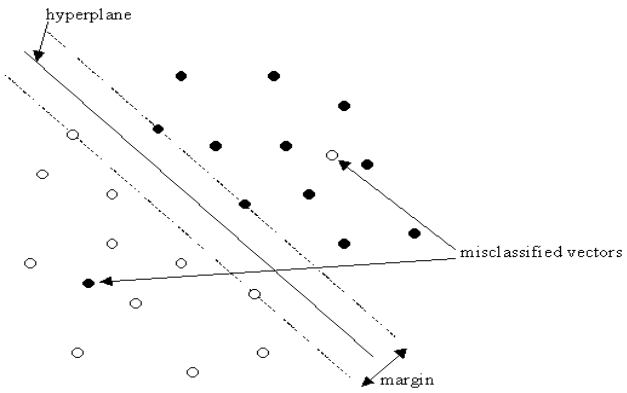


Fig.4.Non- Linear SVM Classification

D. Probabilistic Neural Network

A probabilistic neural network (PNN) is a feed forward neural network, which was derived from statistical algorithm called Kernel discriminate analysis. In a PNN, the operations are organized into a multilayered feed forward network with four layers:

- Input layer
- Hidden layer
- Pattern layer/Summation layer
- Output layer

PNN is often used in classification problems. When an input is present, the first layer computes the distance from the input vector to the training input vectors. This produces a vector where its elements indicate how close the input is to the training input. The second layer sums the contribution for each class of inputs and produces its net output as 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 (positive identification) for that class and a 0 (negative identification) for non-targeted classes.

In figure, Input layer does not perform any computation. Each neuron in the input layer represents a predictor variable. The input neurons feed the values to each of the neurons in the pattern layer(hidden layer).On receiving the pattern from input layer, it stores the value of predicator variable. The hidden neuron computes the distance from neuron's center point and computes it's output. In summation layer, there is one pattern neuron is available for each category of the target variable. The actual target category of each training case is stored with each hidden neuron. The output from hidden neuron is fed only to the pattern neuron that corresponds to the hidden neuron's category. The decision layer (output layer) compares each target category accumulated in the pattern layer.

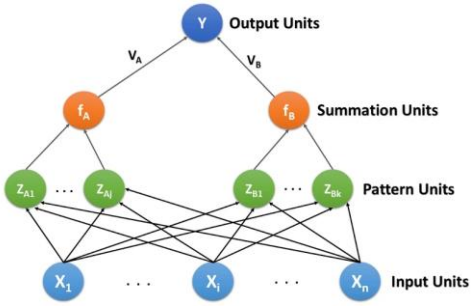
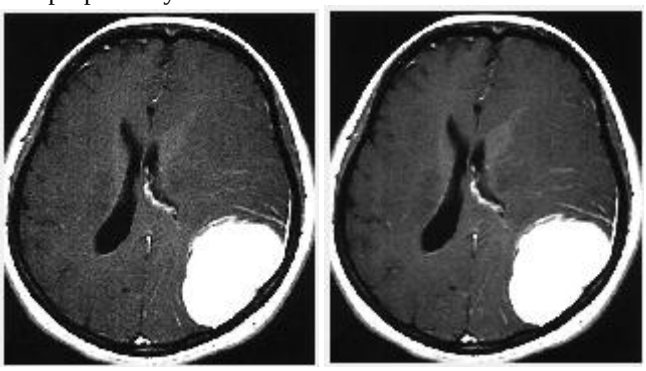


Fig.5.Probabilistic Neural Network

V. RESULTS

The proposed system shows results as follows:



(a) *(b)*

Fig.6.(a) Original MRI Image (b) Median Filtered Image

PSNR	31.1374
MSE	50.0431
Maxerror	151
Contrast	0.25151
Correlation	0.99577

Fig.7.Feature Extraction

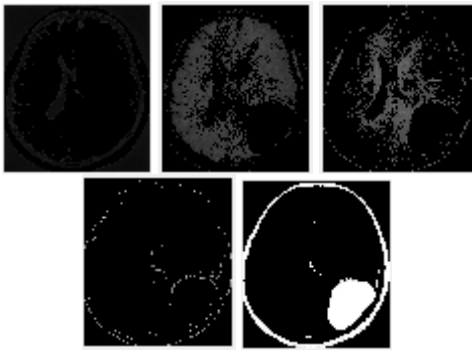


Fig.8.K-means Clustering (K=5)

Fig.9.Detected Tumour

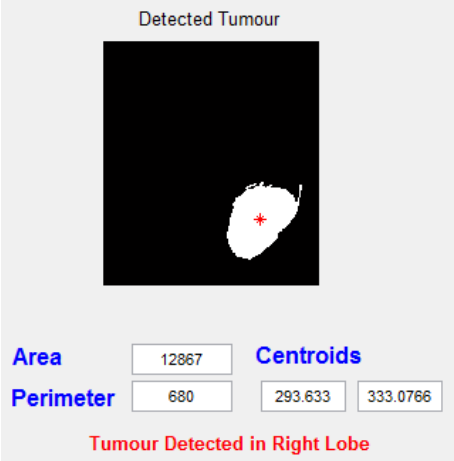


Fig.10.Analysis of Detected Tumour

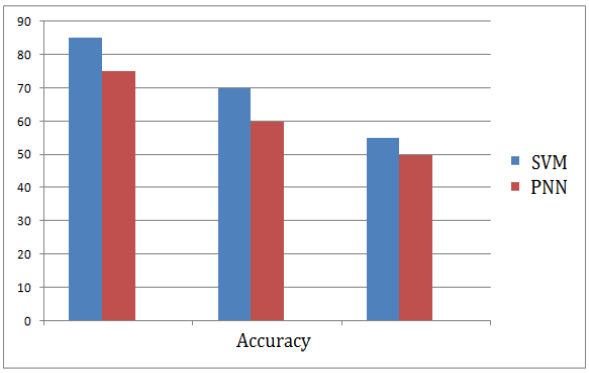


Fig.11.Performance comparison of classifier

VI. CONCLUSION

Aim of this paper is to classify tumour stage by using SVM classifier and compare SVM classifier and PNN classifier for different brain MRI images. Out of them SVM classifier gives better results of tumour detection.

REFERENCES

[1] D.F. Specht, "Probabilistic Neural Networks for Classification, mapping, or associative memory", Proceedings of IEEE International Conference on Neural Networks, Vol.1, IEEE Press, New York, pp. 525-532, June 1988.

[2] Prema K.V.,"A Multilayer Neural Network Classifier", Journal of Computer Society of India, Volume 35, Issue no: 1, January-March 2005.

[3] Ahmad Mubashir, Mahmood ul-Hassan, Imran Shafi, and Abdelrahman Osman, Classification of Tumors in Human Brain MRI using Wavelet and Support Vector Machine, IOSR Journal of Computer Engineering (IOSRJCE), 2012, ISBN: 2278-8727, Volume 8, Issue 2, PP 25-31.

[4] Daljit Singh, and Kamaljeet Kaur, Classification of Abnormalities in Brain MRI Images Using GLCM, PCA and SVM , International Journal of Engineering and Advanced Technology (IJEAT)2012,ISSN: 2249 – 8958, Volume-1, Issue-6.

[5] GladisPushpaRathi V.P and Dr.Palani, A Novel approach for Feature Extraction and selection on MRI images for brain tumor classification, S Computer Science & Information Technology (CS & IT) 2012.

[6] Kailash D.Kharat, Pradyumna P.Kulkarni and M.B.Nagori, Brain Tumor Classification Using Neural Network Based Methods, International Journal of Computer Science and Informatics ISSN (PRINT): 2231 –5292, 2012, Vol-1, Iss-4

[7] Lalit P. Bhaiya and Virendra Kumar Verma, Classification of MRI Brain Images Using Neural Network, International Journal of Engineering Research and Applications (IJERA) 2012, ISSN: 2248-9622 www.ijera.com

[8] Lei Guo, Youxi Wu, Xuena Liu and Xuena Liu, Research on the Segmentation of MRI Image Based on Multi-Classification Support Vector Machine, in the website http://www.paper.edu.cn.

[9] N. B. Karayiannis and Pin-I Pai, "Segmentation of Magnetic Resonance Images Using Fuzzy Algorithms for Learning Vector Quantization", IEEE Transactions On Medical Imaging, Vol. 18,No. 2, pp. 172-180, 1999

[10] http://www.braintumor.org/TumorTypes

[11] http://www.bio- edicine.org/Biology

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