A NOVEL APPROACH TO AUTOMATED BRAIN TUMOR CLASSIFICATION USING PROBABILISTIC NEURAL NETWORK

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Abstract

Conventional methods of monitoring and diagnosing the diseases rely on detecting the presence of particular features by a human observer. Due to large number of patients in intensive care units and the need for continuous observation of such conditions, several techniques for automated diagnostic systems have been developed in recent years to attempt to solve this problem. Such techniques work by transforming the mostly qualitative diagnostic criteria into a more objective quantitative feature classification problem.Probabilistic Neural Network (PNN) with image and data processing techniques will be employed to implement an automated brain tumor classification. The conventional method for Medical Resonance (MR) brain images classification and tumors detection is by human inspection. Operator-assisted classification methods are impractical for large amounts of data and are also non-reproducible. Medical Resonance (MR) images contain a noise caused by operator performance which can lead to inaccuracies in classification. The use of artificial intelligent techniques like neural networks, and fuzzy logic has shown great potential in this field.

Keywords: Principal Component Analysis, Probabilistic Neural Network, Medical Resonance

1. Relevance

Brain tumor is one of the major causes in increase in mortality among children and adults. A tumor is a mass of tissue that grows out of control of the normal forces that regulates growth. The complex brain tumors can be classified into two general categories depending on the tumor origin, their growth pattern and malignancy. Primary brain tumors are tumors that arise from cells in the brain or the covering of the brain. A secondary or metastatic brain tumor occurs when cancer cells spread to the brain from a primary cancer to the other part of the body. PNN are mathematical analogous to biological neuron system. They are made up of parallel interconnected system of nodes called neurons. Combining PNN with different types of learning schemes results in a variety of PNN systems. All the PNN systems do not yield a satisfactory result in all the practical applications. Depending on the specific requirement, PNN system is to be designed. This document describes the use of PCA and PNN in automated classification of the brain tumors. PCA is a mathematical technique that is used to reduce the large dimensionality of the data and then PNN can be used for classification of the tumors.

2. Significance of PCA

PCA is a mathematical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components are less than or equal to the number of original variables. This transformation is defined in such a way that the first principal component has the largest possible variance (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it be orthogonal to (i.e., uncorrelated with) the preceding components. Principal components are guaranteed to be independent only if the data set is jointly normally distributed. PCA is sensitive to the relative scaling of the original variables. Depending on the field of application, it is also named the discrete Karhunen–Loève transform (KLT), the Hotelling transform or proper orthogonal decomposition (POD).Technically, a principal component can be defined as a linear combination of optimally-weighted observed variables. In order to understand the meaning of this definition, it is necessary to first describe how subject scores on a principal component are computed.In the course of performing a principal component analysis, it is possible to calculate a score for each subject on a given principal compone

3. Present Theories And Practises

Artificial neural networks are finding many uses in the medical diagnosis application. According to Qeethara Kadhim Al-Shayea [1] Artificial neural networks provide a powerful tool to help doctors to analyze, model and make sense of complex clinical data across a broad range of medical applications. Most of the applications are providing solution to the classification problems. According to N. Kwak, and C. H. Choi [2] Feature selection plays an important role in

classifying systems such as neural networks (NN). In doing so higher performance with lower computational effort is expected. One of the most popular methods for dealing with this problem is the principal component analysis(PCA) method. This method transforms the existing attributes into new ones considered to be crucial. E. D. Ubeyli and I. Guler[3] used feature extraction methods in automated diagnosis of arterial diseases. Since classification is more accurate when the pattern is simplified through representation by important features, feature extraction and selection play an important role in classifying systems. T.Logeswari , and M. Karnan [5] used image segmentation based on the soft computing for improved implementation of the brain tumor detection. The MRI brain image is acquired from patients database and then Image acquisition, preprocessing, image segmentation is performed for brain tumor detection. Georgiadis. Et all [6] also did the work for improving brain tumor characterization on MRI by probabilistic neural network and non-linear transformation of textural features. According to Chettri, S. R. and Cromp, R.F., the probabilistic neural network architecture can be used for high speed classification of remotely sensed imagery. Probabilistic Neural Network can be applied to remotely sensed data.

4. Proposed Work

Here the automated classification of brain magnetic resonance images by using some prior knowledge like pixel intensity and some anatomical features are proposed[7]. Currently there are no methods widely accepted, therefore automatic and reliable methods for tumor detection are of great need and interest. The application of PNN in the classification of data for MR images problems are not fully utilized yet. These include the clustering and classification techniques especially for MR images problems with huge scale of data and consuming times and energy if done manually. Thus, fully understanding the recognition, classification or clustering techniques is essential to the developments of Neural Network systems particularly in medicine problems

Decision making will be performed in two stages:

1) Feature extraction using the Principal Component Analysis (PCA) and
2) Classification using Probabilistic Neural Network (PNN).

The performance of the PNN classifier will be evaluated in terms of training performance and classification accuracies. Probabilistic Neural Network gives fast and accurate classification and will be a promising tool for classification of the tumors.

The block diagram of the above proposed system, is as follows

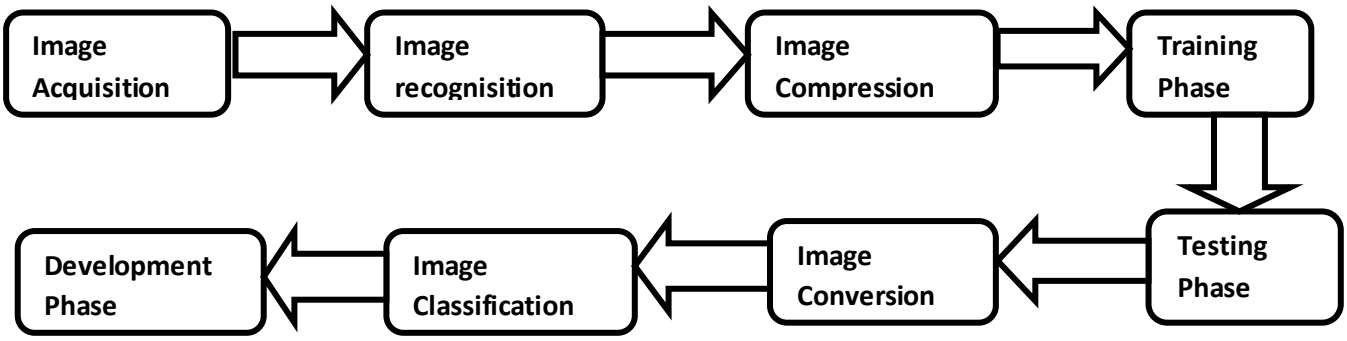

Figure 1. Block diagram of the proposed system

Image Acquisition :- Collect as many MR images of brain as possible from the Radiologists, Internet, Medical Atlases, Hospitals or other resources.

Image recognisition and Image compression :- Mathematical technique of Principal Component Analysis' will be used for Image recognisition and Image compression.

Training Phase :- In this phase, feature vectors for each image from the training set will be extracted.

Testing Phase :- In this phase feature vector of the test image will be computed

Image Conversion :- MR images will be converted into matrices form using MATLAB or SCILAB as a tool.

Image Classification :- Feed Forward PNN will be used to classify MR images.

Development Phase :- Performance analysis based on the result will be carried out in the development phase.

Proposed schematic diagram of MR image recognizer for automated classification of brain tumors is as shown below.

5. Proposed Schematic Diag. Of MR Image Recognizer [7]

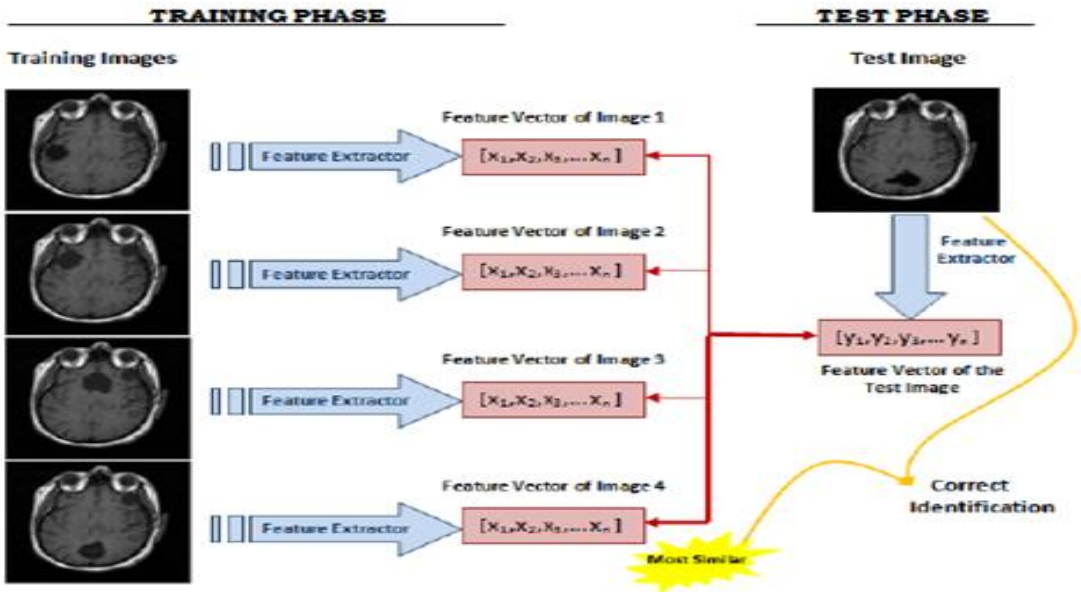

Figure 2. Proposed schematic diagram of MR image recognizer.

MR image recognition system find the identity of the given test image according to their memory[7]. The memory of a MR image recognizer is generally simulated by a training set. The training database consists of a set of MR images. The task of MR image recognizer is to find the most similar feature vector among the training set to the feature vector of a given test image.In the 'TRAINING PHASE' feature vectors are extracted for each image in the training set.
In the 'TESTING PHASE' feature vector of the test image is computed using PCA. In order to identify the test image, the similarities between the feature vectors is calculated using Euclidean distance and then output is obtained from the MR image recognizer. The MR image has been given to the input. The input image will be converted into MAT file and calculate weight also by using the Principal Component Analysis[7].
The purpose of PCA is to reduce the large dimensionality of the data. And calculate the weight also. After that create two layer network that is the PNN for classification purpose.

6. PCA Steps

1) Input MR Images.
2) Subtract the mean.
3) Calculate the covariance matrix.
4) Calculate the eigenvectors and eigen values of the covariance matrix.
5) Choosing components and forming a feature vector.
6) Deriving the new data set.

7. Conclusion

Automated classification and detection of tumors in different medical images is motivated by the necessity of high accuracy when dealing with a human life. Computer assistance is demanded in all medical applications as it will definitely improve the results of humans. The use of PCA to reduce the dimensionality of the data and the use of PNN for tumor classification will improve the speed and accuracy of the result.

8. Acknowledgement

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9. References.

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