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EEG Brain Signal Classification for Disease Diagnosis

ShaziyaParveen.B, Durai Kumar.D, Balaji. S

Abstract— The paper proposes an automatic support system for stage classification using artificial neural network for brain tumor and epilepsy detection for medical application. The detection of the brain tumor is a challenging problem due to the structure of the tumor cells. The artificial neural network will be used to classify the stage of brain EEG signal that is tumor case or epilepsy case or normal. The manual analysis of the signal is time consuming inaccurate and requires intensive trained person to avoid diagnostic errors. Back Propagation Network with image and data processing techniques was employed to implement an automated Brain Tumor classification. Decision making was performed in two stages feature extraction using Principal Component Analysis and the classification using Back Propagation Network (BPN). The performance of the BPN classifier is evaluated in terms of training performance and classification accuracies. Back Propagation Network gives Fast and accurate classification than other neural networks and it is a promising tool for classification of the Tumors.

Keywords- medical application , EEG signal, Brain Tumor, Back Propagation Network etc

I. Introduction

The computer assistance is demanded in medical institutions due to the fact that it could improve the results of humans in such a domain where the false negative cases must be at a very low rate. It has been proven that double reading of medical images could lead to better Tumor detection. But the cost implied in double reading is very high, that's why good software to assist humans in medical institutions is of great interest nowadays. Conventional methods of monitoring and diagnosing the diseases rely on detecting the presence of particular features by a human observe. 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.

Automated classification of Brain signals by using some prior knowledge like intensity and some anatomical features is proposed. Currently there are no methods widely accepted therefore automatic and reliable methods for Tumor detection are of great need and interest. The application of BPN in the classification of data for EEG signals problems are not fully utilized yet. These included the feature extraction and classification techniques especially for CT images problems with huge scale of data and consuming times and energy if done manually.

Shaziya Parveen. B is with Department of Information Technology, GanadipathyTulsi's Engineering College, Kaniyambadi, Vellore, India
Durai Kumar. D is with Department of Information Technology, GanadipathyTulsi's Engineering College, Kaniyambadi, Vellore, India
Balaji. S is with Department of Information Technology, GanadipathyTulsi's Engineering College, Kaniyambadi, Vellore, India

II. BRAIN COMPUTER INTERFACES

Brain–Computer Interfaces (BCI) is the best feasible way of providing the communication between the human and the system by means of brain signals. By using this BCI the patients can put across their views or needs by means of their brain signals just by thinking process. The signal classification module is composed of the obtained EEG signal features extraction and the transformation of these signals into device instructions. The EEG classification tactic depends on the inducement and, thereby, the reaction to detect motor imagery, event related potentials, slow cortical potentials, or steady-state evoked potentials. The predicted EEG drives the classification to some precise feature extraction methods. Doing brain surgery is a complicated task in order to that they take MRI scan and CT scan but in some cases the image may provide complementary information and make difficulty in finding the tumor from the white matter of the brain the latest advances in computer technology and reduced costs have made it possible to develop such systems.

Segmentation methods vary depending on the imaging modality, application domain, method being automatic or semi-automatic, and other specific factors. There is no single segmentation method that can extract vasculature from every medical image modality. While some methods employ pure intensity-based pattern recognition techniques such as thresholding followed by connected component analysis, some other methods apply explicit vessel models to extract the vessel contours.

The actual fusion process can take place at different levels of information representation, a generic categorization is to consider the different levels as, sorted in ascending order of abstraction: signal, pixel, feature and symbolic level. This site focuses on the so-called pixel level fusion process, where a composite image has to be built of several input images. To date, the result of pixel level image fusion is considered primarily to be presented to the human observer, especially in image sequence fusion (where the input data consists of image sequences).The fusion process should be shift and rotational invariant, i.e. the fusion result should not depend on the location or orientation of an object the input imagery .In case of image sequence fusion arises the additional problem of temporal stability and consistency of the fused image sequence. The human visual system is primarily sensitive to

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moving light stimuli, so moving artifacts or time depended contrast changes introduced by the fusion process are highly distracting to the human observer. So, in case of image sequence fusion the two additional requirements apply.Temporal stability: The fused image sequence should be temporal stable, i.e.graylevel changes in the fused sequence must only be caused by graylevel changes in the input sequences, they must not be introduced by the fusion scheme itself; Temporal consistency: Graylevel changes occurring in the input sequences must be present in the fused sequence without any delay or contrast change.

III. RELATED WORKS

3.1 ARCHITECTURE

EEG samples are to be collected and features extracted such as dimensionality is reduced and samples are trained using back propagation network. EEG unknown samples that is samples from the patient are collected and features extraction are to be done and then trained using BPN and compared with already trained known samples and then disease is classified. Using classification algorithm disease is classified that is tumor case or epilepsy case or normal.

3.2 ARCHITECTURAL DESIGN OF ANALYSING OF BRAIN IMAGE BASED ON IMAGE FUSION AND SEGMENTATION

The cell which contains the tumor is found here.The above diagram shows the tumor extraction from brain. It should undergo several processes to find the tumor. At first scanning is done, then the two scans should be fused using algorithms. The fused image then undergoes segmentation. In segmentation first it performs centroid calculation and then image is segmented. In segmentation white matter is extractedwhich is called as tumor .Thus tumor is found.

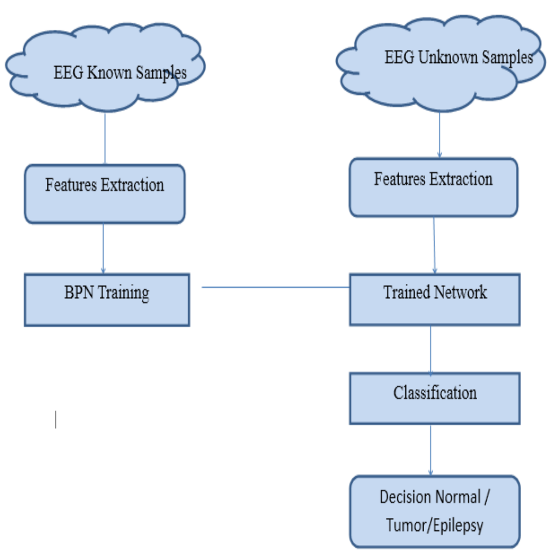

Figure 3.1 Disease Detection Architecture

The scanned images are preprocessed. Pre-process technology enhances class1 semantic content immediately before images are sent to a 3D Segmentation Process. In preprocessing we get four types of images from scanned image. We consider the best and clarity image. These images undergo fusion process. Semantic content in a class1 sense refers to the correct classification of a blob of pixel as a

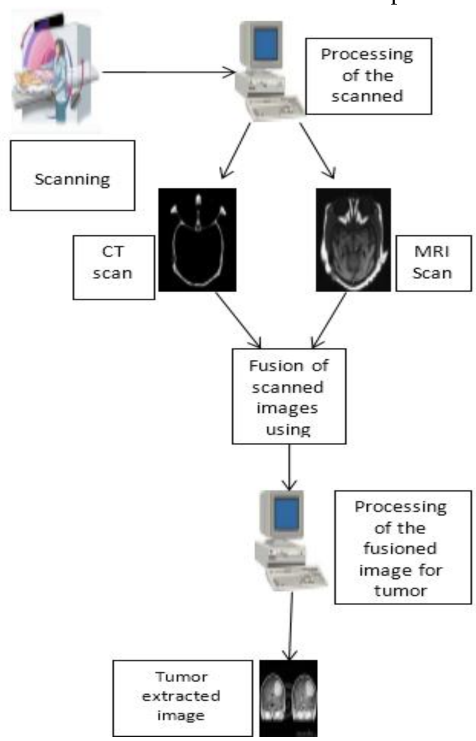

Figure 3.2 Architecture for Image Fusion and Segmentation

specific character, a line, a part of animage, or noise by implementing several powerful and proprietary noise removal and Pixel grouping enhancement algorithms.The preprocessed image is translated using Fuzzy algorithm method. The fusion process is performed by using wavelet transformation. Fusion means compressing the data i.e. byreducing the number of dimensions, without loss of information. It identifies patterns in data , and expressing the data in such a way as to highlight their similarities and differences. Since patterns in data can be hard to find in data of high dimension, where the luxury of graphical representation is not available.

After fusion it undergoes segmentation, here the centroid calculation is performed before the segmentation. In centroid calculation it assigns K value for each cluster. By undergoing some process a loop has been generated. As a result of this loop we may notice that the K centroids change their location step by step until no more changes are done. In other words centroids do not move any more. The centroid calculation process stops the clustering problem.

Segmentation is done using K-clustering technique, which separates the vessel structure from background. It refers to the process of partitioning a digital image into multiple regions (sets of pixels). The goal of segmentation is to simplify and change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. The result of image segmentation is a set of regions that collectively cover the entire image and thus the white matter region is found from set of regions. The white matter region is to be tumor part.

3.3 EEG SAMPLES COLLECTION

Collecting 15 Known EEG Samples from authorized medical centers for training the dataset using Neural Network.Collecting 9 Unknown EEG Samples for predicting Brain diseases from authorized medical centers.

3.4 PCA ANALYSIS

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.

Algorithm Flow:

1.Start procedure
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.

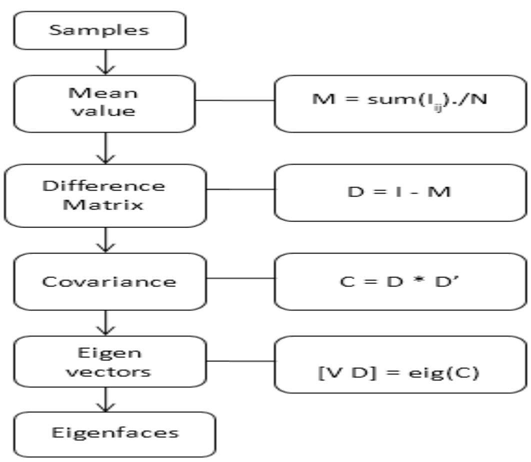

Figure 3.3 PCA Process

3.5 NEURAL NETWORK TRAINING

Neural networks are predictive models loosely based on the action of biological neurons.

Types of Neural Networks
1. Artificial Neural Network
2. Back propagation networks
3. General Regression Neural Networks

The performance of the Back Propagation network was evaluated in terms of training performance and classification accuracies. Back Propagation network gives fast and accurate classification and is a promising tool for classification of the tumors.Back propagation algorithm is finally used for classifying the pattern of malignant and benign tumor.The back-propagation learning rule can be used to adjust the weights and biases of networks to minimize the sum squared error of the network.

3.6 DISEASE CLASSIFICATION

Feed-forward: the input x is fed into the network. The primitive functions at the nodes and their derivatives are evaluated at each node. The derivatives are stored.The constant 1 is fed into the output unit and the network is run backwards. Incoming information to a node is added and the result is multiplied by the value stored in the left part of the unit. The result is transmitted to the left of the unit. The result collected at the input unit is the derivative of the network function with respect to x.

3.7BRAIN SIGNAL PREPROCESSING

The below diagram denotes the Pre-processing stage in this project. In this the Scanned images are taken as the input and it is subjected to the Wavelet Transform process by which the image is processed and got. Thus the output of this process is the Processed Image. Preprocessing is used to reduce the noise present in the EEG brain signals. It also reduces the computational cost. We employ a total of seven different preprocessing stages which are combined sequentially to generate a variety of different feature vectors. This set includes: subsampling, frequency filtering, channel scaling, channel selection, spatial filtering, frequency decomposition, and post processing.

Subsampling:The first preprocessing step is to reduce the dimensionality of the data by subsampling ECoG-ERD and EEG-MRP to 250 Hz and many more methods.

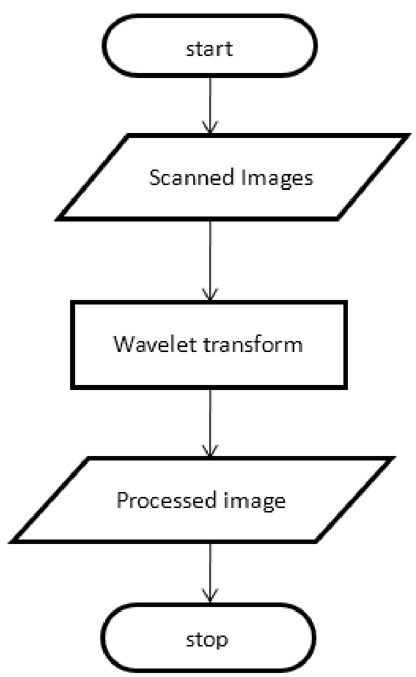

Figure 3.4 Preprocessing

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3.8 IMAGE FUSION

The below diagram denotes Image Fusion. The Processed Image is given as the input and this is subjected to the process of Image Fusion. After Image Fusion the process of Median Filtering is done. Furtherthe process of Pre-processing is done. The output of this process is the Fused Image. The fused image is used to calculate area of the tumor.

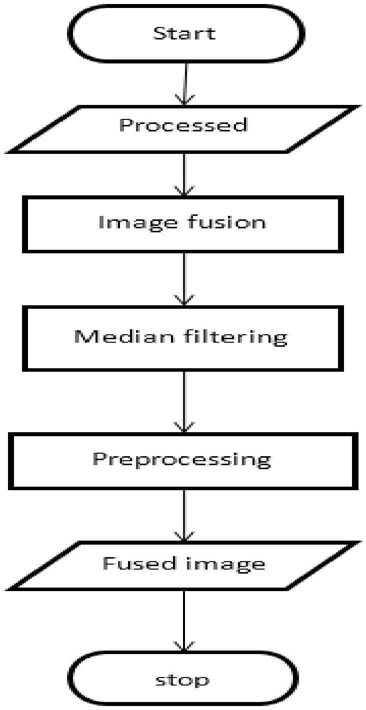

Figure 3.5 Image Fusion

3.9 IMAGE SEGMENTATION

The below diagram denotes for the process of Segmentation. The number of clusters to be considered is given as the input and then the Centroid Calculation is done. Further the distance between two points is calculated. Later the pixels are grouped. Based on the distance between the points. If the grouping is not done perfectly then it must be done again else the process is complete. Segmentation is used to divide white matter from gray matter in order to extract tumor.

Automatic Segmentation: The segmentation process proposed here is a three step refining segmentation process. The three steps are:

1. K - Means algorithm based segmentation.
2. Local standard deviation guided grid based coarse grain localization.
3. Local standard deviation guided grid based fine grain localization.

3.10 TUMOR EXTRACTION

Step 1: Start.
Step 2: Take brains CT and MRI scans.
Step 3: These scans undergo preprocessing and converted into clear scans without any noise in images.
Step 4: The CT and MRI scans are to be fused if the both are have same Pixel size.
Step 5: These fusion process is performed with the help of Fuzzy algorithm.
Step 6: Next these fused image sent to the segmentation, here the centroid calculation is performed for cluster formation.
Step 7: These clusters are grouped together based on the distance and white matter is extracted which is called as tumor.
Step 8: Then tumor is found from segmentation.
Step 9: stop

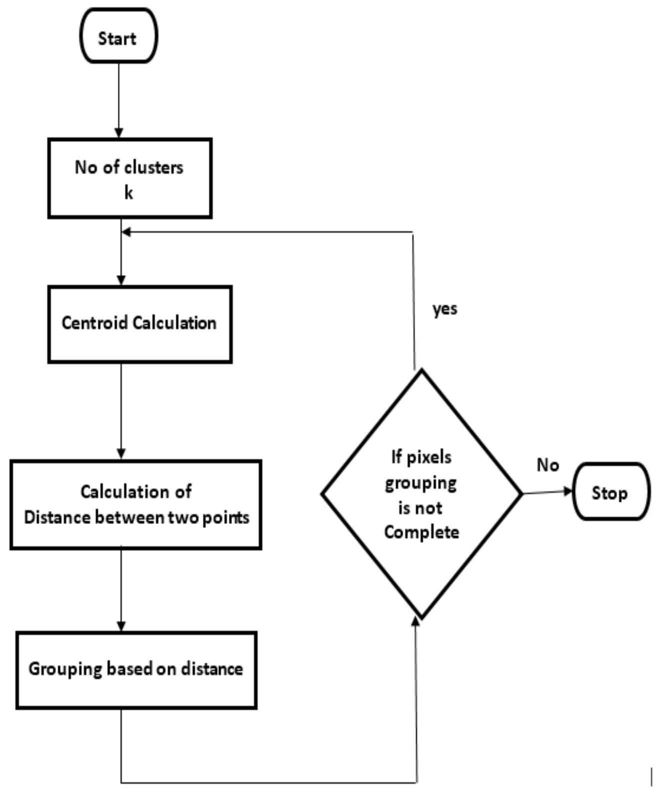

Figure 3.6 Segmentation

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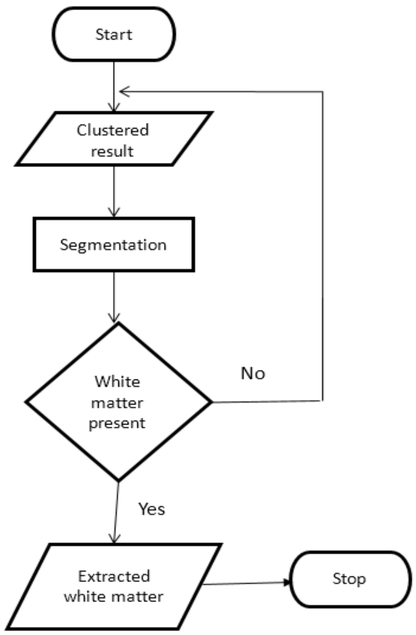

Figure 3.7 Tumor Extraction

IV. CONCLUSION

The project presented that an automated brain diseases diagnosis system with supervised back propagation with feed forward neural network to detect abnormality such as tumour and epileptic case. In order to improve the system performance, the classifier has trained with the features of principal components. The simulated system provided that the better classification accuracy of input samples and compatibility in this diagnosis. Modules would be implemented in the phase II of this project work.This algorithm does not require any user interaction, not even to identify a start point. Here pixel points are selected randomly which determines the main branches of the vessel structure. Random selection of pixel points does not yield accurate segmentation. Experimental results show that selecting centroid by our algorithm can lead to a better clustering. Our ongoing research focuses on the development of methods to segment coronary arteries in a sequence of angiographic images while preserving the topology of the vessel structure.

REFERENCES

[1] Jun Lu, KanXie, and Dennis McFarland,"AdaptiveSpatio-Temporal Filtering for Movement Related Potentials in EEG-Based Brain–Computer Interfaces" IEEE Transactions On Neural Systems And Rehabilitation Engineering, Vol. 22, No. 4, July 2014.

[2] P.poolman, R.Frank, P.Luu, S.Pederson, and D.Tucker, "A single trial analytic framework for eeg analysis and its application to target detection and classification" Neuroimage, 2008.

[3] Yonghong Huang, Erdogmus, D.Mathan, S.Pavel,"Large scale image database triage via EEG evoked responses" IEEE International Conference on ICASSP 2008.

[4] GorettiEchegaray, Imanol Herrera, IkerAguinaga, Carlos Buchart, and Diego Borro" A Brain Surgery Simulator" Centre of Studies and Technical Research (CEIT).

[5] Georgiadis. Et al, "Improving brain tumor characterization on MRI by probabilistic neural networks and non-linear transformation of textural features", Computer Method and program in biomedicine, vol 89, pp24-32, 2008.