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Comparative Analysis for Tumor Detection from EEG Signal Using Fuzzy and ANN

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ABSTRACT: Electroencephalograms are now a day's opened many new avenue of knowledge in the application and interpretation of signal, there by diagnosing of brain disease and abnormalities. This paper is a comparative analysis approach for deriving an efficient prediction of brain tumor, which is prevail in the EEG signal using Fuzzy and ANN (Artificial Neural Network). Generic feature present in the EEG signal are extracted using spectral estimation. Specifically, spectral analysis is achieved by using Fast Fourier Transform that extracts the signal features buried in a wide band of noise. The clean EEG data thus obtained is used as training input to the feed forward back propagation Neural Network, Fuzzy Logic and Neuro Fuzzy system. This paper aims to get a good methodology for automated detection of Brain Tumor by analysing all the three for n number of data sets.

KEYWORDS: Electroencephalogram, Artificial Neural Network, Feedforward Backpropotion

I.INTRODUCTION

Brain tumor is one of the most life threatening disorder. All brain tumors are serious because a growing tumor eventually will compress and damage other structures in the brain. A brain tumor is a growth of abnormal cells inside the brain. Most brain tumors that children get are called primary brain tumors, meaning that they originated in the brain and did not spread somewhere else. Tumors might be localized, remaining in one area, or they might be invasive, spreading into nearby tissues. Tumors are also categorized as benign (non-cancerous) or malignant (cancerous). However, it is difficult to call any brain tumor "benign", because all can cause serious problems. Each year more than 200,000 people in the United States are diagnosed with a primary or metastatic brain tumor. Primary brain tumors comprise approximately 40,000 of these diagnoses. Brain tumors are the leading cause of solid tumor cancer death in children under the age of 20, now surpassing acute lymphoblastic leukaemia (ALL). They are the second leading cause of cancer death in male adults ages 20-29 and the fifth leading cause of cancer death in female adults ages 20-39. Metastatic brain tumors, cancer that spreads from other parts of the body to the brain, are the most common types of brain tumors. They occur in 10-15% of people with cancer. Primary brain tumors generally do not metastasize to other parts of the body. Brain tumor detection is one of the most challenging and time consuming task in medical image processing. Since it is life threatening disorder, its detection should be fast and accurate. Although computer-aided MRI brain image has been studied over the last two decades, automated interpretation of segmentation still remains very difficult. Double readings, as carried out, for example, by two radiologists, usually improve the quality of diagnostic findings, thus, greatly reducing the probability of misdiagnosis.

EEG records electrical impulses from the nerves in the head. "Electro" refers to the electrical impulses send from one nerve cell to another .This impulses are the way nerves talk to each other and get information from the brain to the rest of the body. "Encephalo"refers to the head, and "gram" refers to the printed record .EEG exams are done by putting electrodes on the scalp and seeing what the electrical impulses look like when the patient is awake, asleep, in a room with a flashing light or some times when the patient is asked to breathe deeply over and over. The electrical signals that the brain produces are simply detected and printed out on a computer screen or a piece of paper. Generally it is accepted that brain tumors on superficially accessible portions of cerebral hemispheres involve some localized loss of electrical activity causing some localized slow waves on the scalp EEG. Here we proposes and derive an efficient model for Brain tumor detection from EEG using Fuzzy And Artificial Neural Network.

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II. EXISTING METHODS OF BRAIN TUMOR DETECTION

Diagnosis and following (early) treatment are either missed or delayed in 69% of the brain tumor cases due to the fact that the most of the brain tumor symptoms are highly misleading according to the studies. The advanced neuroimaging techniques such as MRI and CT or biopsy are not immediately suggested due to the following facts: they are either costly or invasive or do involve risks like hazardous radiation, especially in case of children, pregnant women and patients with implant devices. The delay in diagnosis worsens the outcome. Hence a better method that does not involve much cost, risks or complexity is required to detect the presence of a brain tumor (structural pathology) at an early stage.

Magnetic Resonance Imaging (MRI) is the procedure used in hospitals to scan patients and determine the severity of certain injuries. It produces high quality images of the human body part. Tumors in various body parts are also scanned using MRI. Brain tumor is an abnormal cell formation within the brain leading to brain tumor. Thus it is very important to detect and extract brain tumor. The main thing behind the brain tumor detection and extraction from an MRI image is the image segmentation. Segmenting an image means dividing an image into regions based on some specific criteria. Various algorithms have been proposed for this purpose. Medical Image processing has emerged as one of the major area of research. In medical science, MRI (Magnetic Resonance Imaging) is a very popular technique which is used in Radiology to analyse internal structures of the body such as brain, kidney etc. Other techniques in comparison to MRI are Computed Tomography (CT) and X-Ray.

Use of scalp EEG for the diagnosis of various cerebral disorders is progressively increasing. Though the advanced neuroimaging techniques such as MRI and CT SCAN still stay as principal confirmative methods for detecting and localizing brain tumors, the development of automated systems for the detection of brain tumors using the scalp EEG has started attracting the researchers all over the world notably since 2000. This is because of two important Facts that (i)Cheapness and easiness of methods of recording and analysing the scalp EEG (ii) Lower risk and possible early detection. It is the method of detecting the brain tumor first, second and third order statistics of the scalp EEG with a Modified Wavelet-Independent Component Analysis (MwICA) technique.

III.RELEVANCE OF BRAIN TUMOR DETECTION

In existing system analysis, Curing cancer has been a major goal of medical researchers for decades, but development of new treatments takes time and money. Science may yet find the root causes of all cancers and develop safer methods for shutting them down brain tumors are benign and can be before they have a chance to grow or spread. Approximately 40 percent of all primary successfully treated with surgery and, in some cases, radiation. The number of malignant brain tumors appears to be increasing but for no clear reason. The some methods for detection and classification of brain tumor is done by as follows: Image Processing-MRI and CT SCAN, Scalp EEG with Modified Wavelet-ICA, Artificial Neural Network (ANN) and Fuzzy Logic.

Existing system features are Important is the clinical practice is the early detection and classification of brain tumors, Diagnosis is done by experienced physicians with time consuming task, Irrespective of the techniques above it lags the extraction of information, analysis. Limitations of existing systems are Neuroimaging techniques not immediately suggested due to side effects, Involve risks like hazardous radiation, children, pregnant woman and patients with implant devices, Presently can only detect location, size not provide knowledge about the stage and degree. Ordinary people can't afford the money for the initial diagnosis by Magnetic Resonance Imaging and Computer Tomography scan.

IV.FUZZY AND ARTIFICIAL NEURAL NETWORK

Fuzzy logic is an approach to computing based on "degree of truth" rather than the usual "true or false". Fuzzy logic includes 0 and 1 as extreme cases of truth but also includes various states of truth in between..Fuzzy logic seems closer to the way our brain work .We aggregate data and form a number of partial truth which we aggregate further into higher truth. When certain thresholds are exceeded, cause certain further results. Fuzzy logic has two different meanings, in narrow sense fuzzy logic is an logical system which is an extension of multi valued logic and in a wider

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sense fuzzy logic is almost synonymous with the theory of fuzzy sets. Fuzzy logic is based on natural language. Fuzzy system widely using the artificial intelligence techniques. It is an artificial intelligence technique which depends on prior expertise knowledge for yielding superior segmentation efficiency. Accuracy of fuzzy is usually high and is depending on the availability of the prior knowledge.

Fuzzy Logic (FL) has appeared as one of the active area of research activity especially in control system application. FL is a powerful way of reasoning that is used when there is no mathematical model and input data are not precise. In the classical control paradigm, a lot of stress on the precision of input is placed. In spite of the defined way, it is observed that many a time such difficult classical controllers developed often find it complex to perform in real world control problems. The thinking process which is involved in fuzzy realm is simple complex not complex. It is elegant and easily applicable. Reason of simplicity is that it avoids mathematics to a great extent and style lies in its expressiveness.

ANN is expanded as “Artificial Neural Network”. ANN is an adaptive, nonlinear system that learns to perform a function from data. ANNs are networks of interconnected computational units, usually called nodes. Neural networks have been extensively utilized as pattern and statistical classifiers in biomedical engineering.ANN are a network of nodes mimicking the biological neural networks which include neurons, axons, dendrites and synapses. Neural network are adjusted or trained so that a particular input leads to a specific target output. The input of a specific node is the weighted some of the output of all the nodes to which it is connected. The output value of node is in general a nonlinear function of its input value. ANN’s parameters are fixed and the system is deployed to solve the problem in hand. ANN is an artificial intelligence technique.

V. DESIGN AND IMPLEMENTATION

We design a fuzzy logic/ANN for detecting tumor from EEG signal .It is done through several stages.
STAGE 1: First of all we want raw EEG data; the raw EEG data is taken from Open vibe. Then in order to analyses the data, we extract frequency component of individual leads by taking the Fast Fourier Transform. We find the maximum index value and find out the major frequency component individual lead.
STAGE 2: We have collect the EEG data raw data from different hospitals and National Neuro centers. We have discussed about the topic to various Biomedical Engineering Field students who have already done project in the Brain tumor detection EEG analysis area.
STAGE 3: Analysis is done for different EEG signal (both normal and abnormal).By analyzing it is concluded that

- Below 2Hz - Epilepsy.
- Between 2Hz to 5Hz - Normal EEG.
- Between 5Hz to 8Hz - Brain Tumor.
- Above 8Hz - 60% Brain Tumor.

STAGE 4: Fuzzy Logic/ANN Implementation - Fuzzy Implementation through the fuzzy controller logic and the ANN implantation through algorithmic function feed forward Backpropotion using training algorithm - Levenberg-Marquardt (trainlm) and trial and error method is used here for more accuracy and precise assessment

VI. RESULTS AND SIMULATION

FUZZY

In Fig. 1 shows the input parameters entered in triangular membership function termed as “trimf “and trapezoidal membership function “trapmf”. Fuzzification shows the range up to 0 to 10 and Defuzzification technique used as centroid. Three ranges are given named Low, Medium and High.

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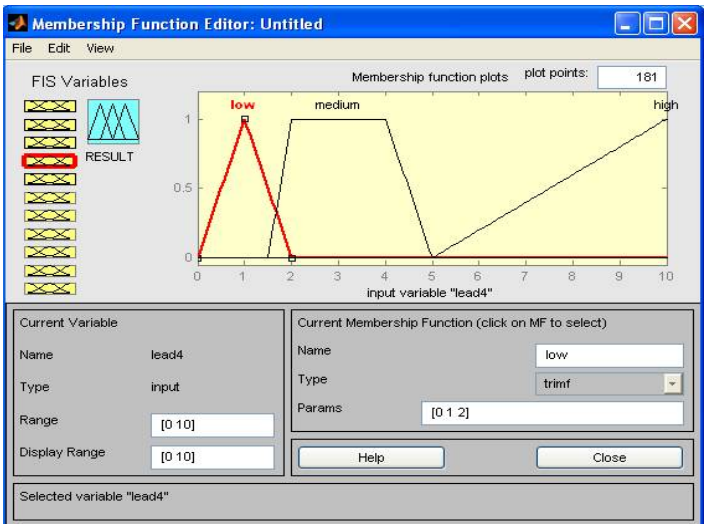

Fig.1 Input Membership Function

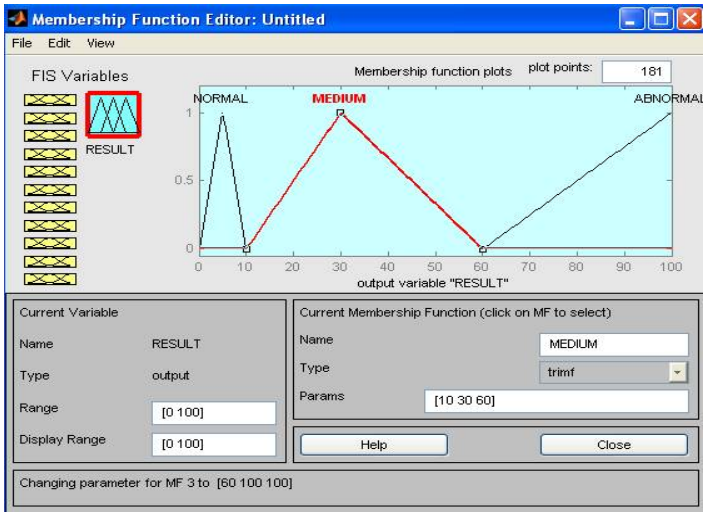

Fig.2 Output Membership Function

In Fig. 2 shows the output parameters are only entered in triangular membership function “trimf”. Ranges are in between 0 to 100.Three range level named Normal, Medium and Abnormal.

Here are the Fuzzy final results which represented in the following three figures named Fig.3 Epilepsy, Fig.4 Normal EEG and Fig.5 Brain Tumor EEG.

In the fig 3, it shows the EEG signal, Input Frequency below 2 Hz which shows the Epilepsy, Abnormality in EEG signal is shown in result 33.4 %.

In the fig 4, it shows the EEG signal, Input Frequency between 2 Hz – 5 Hz which shows the Normal EEG., Abnormality is of 5 %

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In the fig 5, it shows the EEG signal, Input Frequency 5 Hz which shows the Brain Tumor in EEG, Abnormality is of 86.6%.

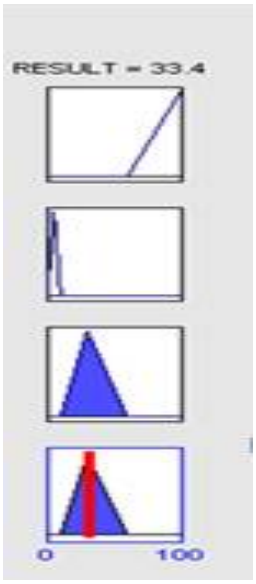

Fig. 3 Epilepsy

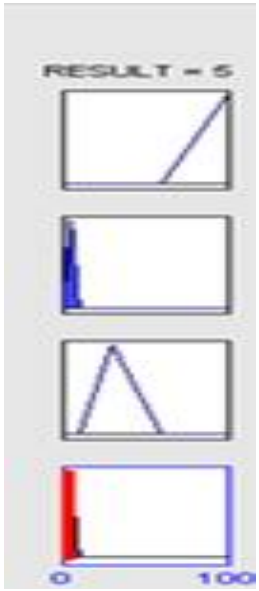

Fig. 4 Normal EEG

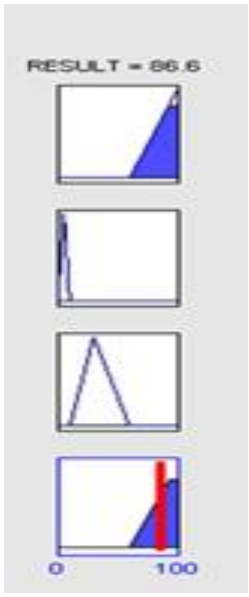

Fig. 5 Brain Tumor EEG

ARTIFICAIL NEURAL NETWORK

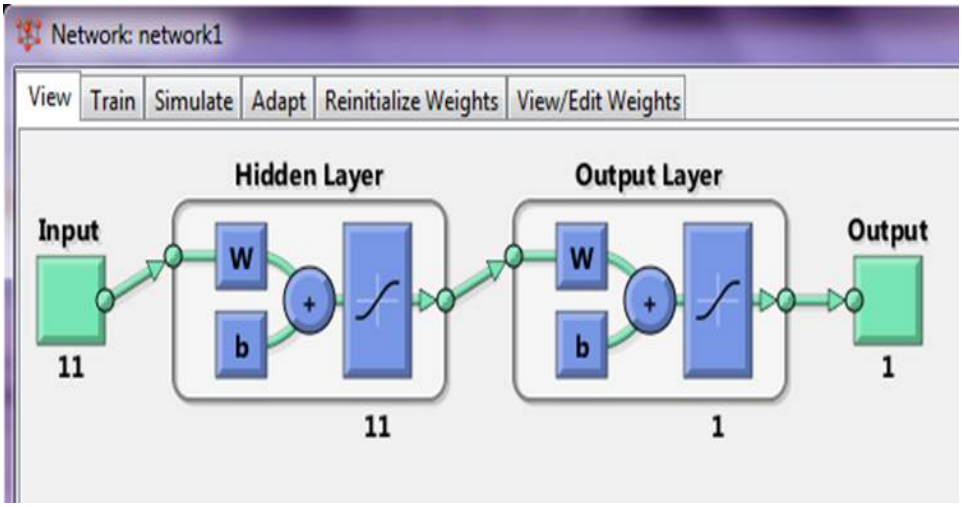

Fig. 6 View Network Window

In Fig.6 it shows that the network window obtained using the training algorithmic function feed forward Backpropotion and shows the input layer, Hidden layer and Output layer.

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Table 1 shows the selected 11 data sets results obtained from Artificial Neural Network.

DATA SETS	PERCENTAGE	RESULTS
[1 2 3 3 4 3 3 4 3 4 3]	50%	EPILEPSY
[1 2 1 3 4 3 3 4 3 4 3]	60%	EPILEPSY
[4 1.75 3 3 4 3 3 4 3 4 3]	1%	NORMAL
[4 2 3 8 4 3 3 4 3 4 3]	95%	TUMOR
[4 2 3 3 4 3 3 4 3 4 9]	98%	TUMOR
[1 2 3 3 4 3 3 4 3 1 3]	60%	EPILEPSY
[4 2 3 3 4 3 3 4 3 4 9]	.5%	NORMAL
[5 2 3 3 4 3 5.5 4 3 4 3]	87%	TUMOR
[4 2 3 6 4 3 3 4 3 4 3]	90%	TUMOR
[3 2 3 3 4 3 4 4 3 4 3]	.5%	NORMAL
[4 2 7 3 4 3 3 6 3 4 3]	96%	TUMOR

Table 1 Artificial Neural Network data set results.

VII.CONCLUSION

We developed an adaptive system for the analysis of EEG using Fuzzy and ANN to diagnose Brain Tumor.ANN with 95% accurate and Fuzzy with 90% accurate from this analysis, ANN is more accurate than Fuzzy Logic. It has numerous advantages such as, Ease to access at Initial stage, Percentage of brain tumor detected. Signals accurately detected, Record precisely, Comparing to MRI & CT scan, EEG's are less harmful, Cost effective technique,Electrode do not produce any sensation .Therefore, No risk of electric shock easy upgraded new rules to improve performance, Number of training set increases and thus accuracy increases.

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