A Hybrid Detection Model for Epilepsy Seizure using FCM with MPSO and Decision Tree

C. V. Banupriya, D. Deviaruna

***Abstract**: An Electroencephalogram (EEG) plays momentous role in appraising tolerant with irregular motion in their brain, EEG soundtrack of the tolerant occupied to scrutinize irregularity and categorize type of confusion there in the brain activity. An Electroencephalogram is a bioelectrical signal that records the brain's electrical activity versus time. The illumination of EEG indication is a function of outline detection. The future system engaged DWT change for factor withdrawal and got measure EEG signals recurrence range identifying with seizure, partition them into five diverse space, for example, α-alpha, β-Beta, γ-Gamma, δ-Delta and θ-Theta wave forms are identified with the summative range, and arrange of repetition circulation through DWT of EEG symbols to think about the dissimilarity amongst seizure and normal focus and Clustering the data with FCM with MPSO is used for optimize the data with decision tree classifier is utilized for the order to classify seizure and non-seizure conditions from traced EEG indication then estimation the Predictor Importance of the dataset. The outcome illustrates that the proposed working model would be supportive in EEG normal and epilepsy seizure classification. The recital of the classifiers are examined and observed that FCM with MPSO and decision tree engaged a smaller amount of time to make depiction and away carry out in estimate the predictor importance.*

Keywords : Fuzzy C-means, EEG, Seizures, MPSO, Clustering, Classification, Decision Tree, Epilepsy.

I. INTRODUCTION

Epilepsy is invariable disorders of the nervous system or brain with the aim of distresses further or fewer 60 millions of individuals worldwide. Harmony in the direction of the World Health Organization (WHO), epilepsy seizure is natures by regular attacks, which are intention responses towards sudden, frequently succinct, in large amounts of electrical exonerates in a cluster of mind chambers [1]. Clinically an epileptic seizure is a discontinuous, normally meaningless, conventional, disorder of awareness, behaviour, feeling, motor function or consciousness that is behind consequence of cortical neuronal release [2]. Anything that aggravates the emblematic model of cerebrum cells (neuron) faction from sickness to cerebrum harm to irregular mental health - can prompt seizures. Encompassing a seizure does not as a matter of pathway entail that a person has Epilepsy. Presently when people have two or more seizures, he or she considered to encompass epilepsy. Patient experience distinctive sorts of manifestation through the phase of seizures, it's relies on the measurement and expansion of the exaggerated brain hankie.

In neurological disorders are the standard blueprint of neuron movement grow to be distressed, reasoning weird opinions, feelings, and actions, or occasionally tremors, influence shudders and also defeat of perception [3]. Convenient are combinations of realizable sources of nervous system. Incredible to facilitate alerts of the standard illustration of mind system movement collecting from illness to intellect smash up to irregular mind improvement is able to conduct to attacks [4].

The categorization of seizure has been institutionalized by the International League against Epilepsy (ILAE). Epilepsy is primarily classified into two types Namely, Partial Epilepsy and Generalized Epilepsy. Partial seizures persuade little part of the brain and generalized seizures persuades all parts of the brain [5].

Epileptic Seizure are scrutinized by EEG signals, Electroencephalography (EEG) is the footage of electrical feat beside the inside of the head. EEG instruments energy differences coming out commencing ionic in progress streams in the inside part of the brains activities.

In neurology, the sketch indicative use of electroencephalograms are on description of nervous system, as irregular action be capable of make obvious variations from the regular on a standard EEG study [6]. EEG is premeditated with 10-20 electrode system as revealed in Fig 1.
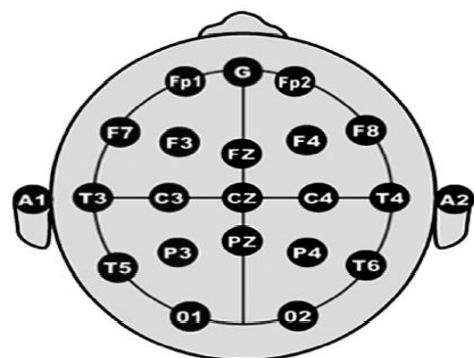

Fig 1. 10-20 Electrode placement system

Electroencephalography is the largest component helpful and outpouring successful methodology for the analysis of epilepsy.

C.V.Banupriya∗, Department of Computer Science, PPG College of Arts and Science, Coimbatore, India. Email:banupriya.venkat@gmail.com

Dr. D. Deviaruna, Department of Computer Applications, Dr.NGP Arts and Science College, Coimbatore, India. Email:drdeviaruna@drngpasc.ac.in

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The recognition of these dissimilarities from the norm by the illustration examination of EEG signs is intelligence boggling and time consuming system and it necessitates profoundly talented specialists. In the enormous majority of the cases, epilepsy is controlled by the best feasible remedial action. For that motive, the reasonable and prior determination of epilepsy is required.

In some cases, surgical treatment for evacuation of the epileptic part is likewise accessible. Epilepsy is showed by a sudden and intermittent cerebrum glitch which has its starting point in extreme and hyper synchronous movement of neurons. The seizures happen indiscriminately and hinder the typical capacity of the mind. As of late, another technique is presented, in which, a portion of cerebrum is electrically re-enacted to maintain a strategic distance from the landing of seizure. Programmed discovery of seizure is vital part of such a treatment.

During the prior pair of lifetimes, the electroencephalograms are scrutiny be predominantly alert on brain attack recognition identification. A brain attacks means seizure recognition configuration canister be alienated addicted to three phases: facts acquirement also pre-processing, processing and attribute withdrawal, clustering, categorization also Estimates the Predictor Importance.

The respites of the proposed systems are planned as pursues: the descriptions of the correlated effort are presents in Section Two (II). A systematic depiction of the seizure recognition methods used in this system is obtainable in Section Three (III). The properties of the proposed works are explained in Section Four (IV). Section Five (V) Concludes the work based on provisional result.

II. RELATED WORK

Sutrisno Ibrahim et.al [7], an abduction calculation algorithm predestined resting on extracting Shannon entropy from electroencephalography (EEG) brain wave signals. The KNN method is worn to continuously scrutinize the EEG rain wave signals by evaluating the current descending porthole with regular and pre-attack symptoms to foretell the upcoming brain wave attacks. Both symptoms are continuously rationalized predestined on the whole current forecast consequence with detachment- predestined process. This techniques is able to foretell accurately 42 from 55 brain wave attacks (76 %), hardened using up to 570 hours EEG taken from the MIT dataset. With its minimalism and immediate processing time, this methodology is appropriate to be executed in embedded system or mobile application that has limited processing resources.

Neha Sharma et.al [8], K-mode group algorithms is functioning to divider resounding facts addicted to previous part is define k group, though the group in consequence effectively depends upon the assortment of haphazard preliminary group interior, so as to be able to source non repeatable consequence in addition to produce offensive group constitutions. Around is numerous probable explore instructions might be alive employment resting on in the potential to additional broaden and improve the occupation obtainable in this manuscript. The proposed method is used to explicit data concert. This performance worn as kernel to

k-modes clustering algorithm, get better result and also the execution time.

Harikumar Rajaguru et.al [9], the proportions of the EEG brain wave signal is abridged using the Non Linear ICA after that the diagonally moderated ideals are confidential through Logistic Regression (LR) methodology. This recital investigation demonstrates to facilitate a usual show file of regarding 91.39%, a regular precision of in relation to 95.88 down through a fewer period wait of 2.085 second is attained.

Nicolaou et al. (Nicolaou et al., 2012) haul out the alteration entropy feature from EEG brain wave signals. They applied SVM as a classification algorithm also accomplished the utmost correctness on the University of Bonn dataset A to E folder. However, uppermost exactness for previous folders such as B to E, C to E, D to E, and ABCD to E folders .Gandhi et al. (Gandhi et al., 2011) extorted the entropy, standard deviation and energy attributes from EEG signals using DWT. They are working with SVM and PNN as a classification techniques and explained the utmost accurateness for ABCD to E folder.

In our previous work [10], we presented in evaluate an haul out the attributes of EEG brain wave signals with wavelet convert coefficients (WCC) and unproven knowledge method like grouping the information using FCM with Modified Particle Swarm Optimization (MPSO) and K-Mode Clustering techniques. The presentation of the Clustering techniques are analyzed and scrutinized that FCM with MPSO fewer fault pace and exposed carry out than K-Mode Clustering technique in accurateness.

III. METHODOLOGY

The proposed structure endeavors at Classification of EEG signal as seizure and non-seizure, then do the frequency analysis of vigorous and epileptic signal. This proposed taxonomy is executed by clustering and classification then estimates the predictor importance.

A. Data Collection: The EEG database for dealing out is extorted with the University of Bonn (UB) [11], [12]. This group restrains EEG brain wave information originating from singular interval, to be detailed, dynamic subjects and epileptic subjects. The worshippers these statistics encloses five types of datasets conventional as: Z, O, N, S and F; every one of the set contains hundred fragments of EEG gesture of 23.6 seconds. Sets Z and O be gotten as of healthy subjects among eyes open and shut individually; sets N and F be gotten along with seizure free conditions in diverse regions of the brain wave signals and rest S was gotten from a theme with seizure condition [13]. Sets S and Z were utilized immediately for the outcomes description now.

B. Creation of EEG Wave signal using Dataset: The anticipated system constructs use of the dataset to spawn the EEG signal using MATLAB code. There are five sets of EEG dataset containing both vigorous as well epileptic. The system builds use of both the signals to spawn EEG signals. Each set have 100 signals, and obtain few in that and continue

for further process i.e. disintegration of these created EEG signals.

C. Decomposition of EEG signals: Now the system builds use of these generated EEG signals and molder it using Daubechies Wavelet Transform (DWT) with eight coefficients db8, which decomposes EEG brain wave signal to 8 levels. Based on the attributes extraction, 8- various attribute sets (D-1, D-2, D-3, D-4, D-5, D-6, and D-7 and D8) for preparation and taxing data were build. The disintegration of the signals gives us the co-efficient values and also the length of those co-efficient of unique festering levels.

Table –I: Wavelet coefficient and its signal data

Wavelet coefficient	Frequency (Hz)	Signal information
D1	250 – 500	Noise
D2	125 – 250	Noise
D3	63 – 125	Noise
D4	32 - 63	Gamma
D5	16 - 32	Beta
D6	8 - 16	Alpha
D7	4 - 8	Theta
D8	0 - 4	Delta

The above Table-I demonstrates the wavelet co-efficient frequency series and its signal in sequence. afterward than applying Daubechies Wavelet Transform db8 it crumble EEG signal addicted to 8 level i.e. 8 wavelet co-efficient as exposed in on top of table- 1.The proposed system is concerned only in extorting the distinctiveness of EEG signal five types wave forms namely (α, β, γ, δ and θ) and exterminate better frequencies which are basically clatter.

D. FCM with MPSO:

The circumstance of leased space is only one such instance for the fuzzy C - means clustering [14]. At present the FCM algorithm turn into an optimization predicament with minimizing gap among the position and the huddle centre known as the "limitation". Encompassing seized the essentials to a rational quantity; at present walk off to the calculation of the complete dilemma.

The imperative system velocity for Fuzzy C-Means is,

1. Distribute a most important arbitrary centroid to each cluster (Faction).

2. Calculate the aloofness among both location and the bunch centre using an uncomplicated algorithm.

3. Supported on space among both position and the cluster centre, re-calculate the relationship function.

4. Supported on the new association function, re-calculate the centroid.

5. If the difference among the original centroid and the subsequently one is lower than an assured threshold value then the algorithm prevents, in addition it persists plot this stipulation is true.

We can acquire improved initial clustering centroid using several other methods and thus it may express FCM clustering technique to accomplish superior during the progression of finding the superlative probable clustering centers by the mode of humanizing the clustering centroid.

The MPSO clustering technique is a problem solving algorithm that optimizes a predicament by iteratively demanding to progress a contestant answer with observe to a given calculate of excellence. The enhanced initial cluster centroid can be attained using Modified PSO.

The propose Modified PSO combined with Fuzzy C-means algorithm that fabricates a speedy and improved clustering and also it tries to keep away from in getting mesmerized towards a restrained best potential outcome.

E. Decision tree and Estimates the Predictor Importance: Decision trees or taxonomy trees are rejoinder in the direction of data. To foretell a reaction, pursue the verdicts in the hierarchy beginning the origin (starting) lump is also called as node downward to a side lump (node). The side lumps enclose the rejoinder. Categorization of the decision trees provide rejoinder to be small, such as `'accurate'` or `'fake'`. Figures and ML (Machine Learning Toolbox) trees are dual value. Every action in a calculation contains inspection the worth of single interpreter (variable). For instance, at this point a simple categorization tree is described:
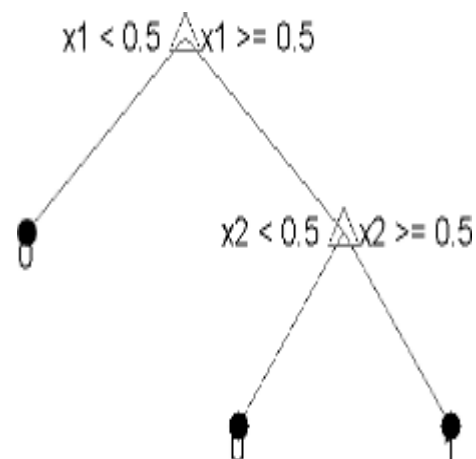
This type of categorization forecasts supported on 2 forecasters, `x1` and `x2`. To expect, begin at the peak lump, symbolized by a triangle shape (∆). The initial verdict if `x1` is lesser than `0.5`. Therefore, pursue the moved out limb; also observe that the hierarchy categorize the statistics as category `0`.

But, though, `x1` go beyond `0.5`, after that pursue the truthful limb to the inferior-exact triangle limb. At this time the hierarchy asks if `x2` is lesser than `0.5`. But also, next pursue the absent limb to observe to the hierarchy categorizes the statistics as category `0`. If it is not, then pursue the correct limb to observe that the hierarchy categorizes the statistics as category `1`.

Decision hierarchy perception is solitary of the largest part stylish processes in mining the data categorization for the rationale that it is easy to recognize.

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Decision Tree is a classification method of the statistics which the responds are in the past famous and worn meant for construction of the hierarchy. This is pre-eminence is extremely connected by the categorization precision make on the guidance data set, in addition to the scope of the hierarchy.

Arrangement is an imperative assignment of transfer substances to single of a number of built-in types.

This is the spreading out of reproducing unusual statistics modules in preparation information set to foretell the group of objects or this predictable importance of unfamiliar feature. Pre defined information sets employed in categorization consists of features so as to can include distinct and also or everlasting chattels. The group label (tag), resting on the supplementary offer, have to be a take apart feature.

Decision hierarchy method is a methodical advance to constitution categorization replicas from the time when a preparation information set. Decision hierarchy constructions be building or construct in a pinnacle-downwards repetition split-also-beat tactic method. Their edifices comprise knobs with twigs modelling from the predefined information. This proposed method will discover the mainly prevailing attributes that determination be used to take apart teaching information into dual or additional separations predestined going on the standards of that attribute.

The primary nodule is entitled the foundation lump. Both statistics partition is then unconnected in anticipation of a execution principle is pleased. The resultant conclusion hierarchy consists of four major attributes, They are like that (1) origin lump: a feature is picked as the foot to construct the hierarchy ahead, (2) Interior lump: features that lives on internal element of the hierarchy, (3) Stems downward of a lump: probable ethics for the feature the stem commences, and (4) Side lump: the predescribed class labels along with decision tree result, cross validation and prediction important variables is also calculated.

IV. EXPERIMENTAL RESULTS

The Hesitant results for EEG signals at a variety of stages are described underneath. First, create database which includes EEG signal values extracted from Bonn University, from this data generate EEG signal. Later Query signal is selected and decomposed using db8 as shown in Fig 2. Then feature vectors are calculated using DWT and given to Fuzzy C-Means with modified PSO is compared with K-Mode for clustering the data. To estimate the efficiency of k-mode and fuzzy C-means with modified PSO performance carry out research on EEG Seizure Detection dataset. Then Decision tree is second-hand to categorize the signal in addition to also estimates predictor importance. The decision tree end results are outperformed than other classifiers.
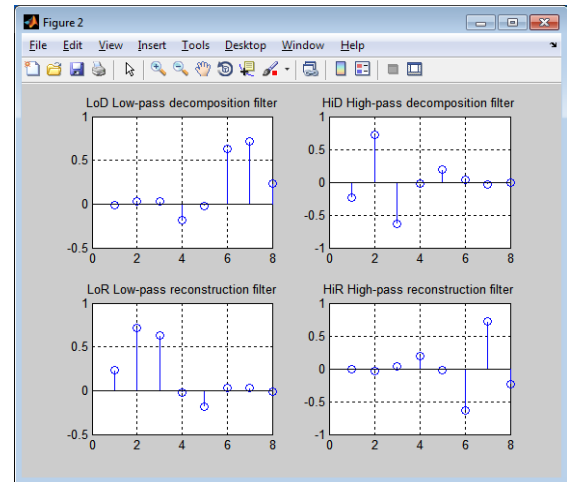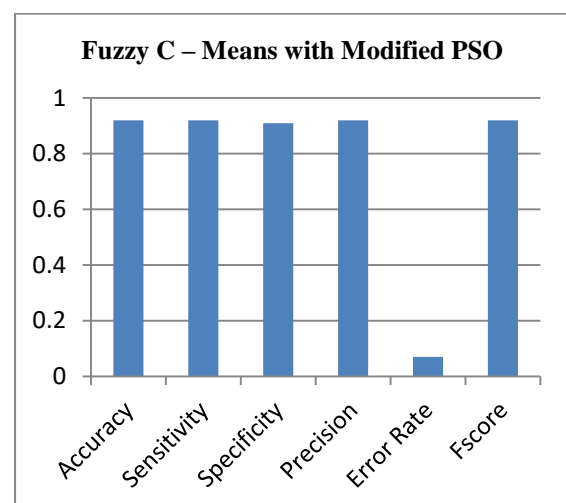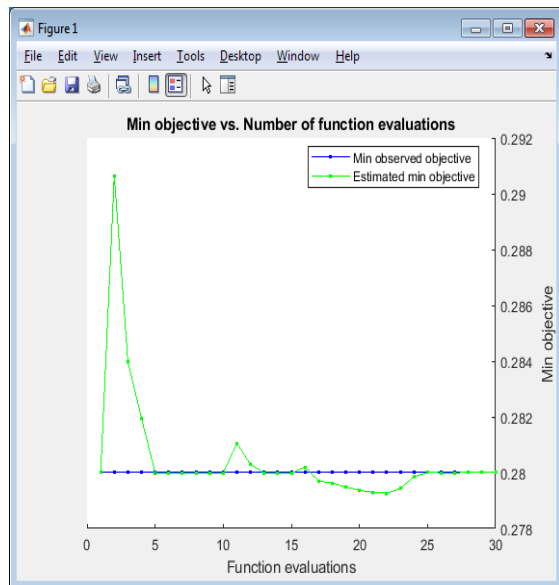

Fig 2. Decomposition of EEG

The Fuzzy C-Means with Modified PSO clustering accuracy, sensitivity, specificity, error rate, precision and fscore are shown in Table - II as follows.

Table - II: Parameter Measures

Parameter Measures	Fuzzy C – Means with Modified PSO
Accuracy	0.92
Sensitivity	0.92
Specificity	0.91
Precision	0.92
Error Rate	0.07
Fscore	0.92

V. CONCLUSION

An Electroencephalogram (EEG) recording of a tolerant is significant medical in order for the remedial specialist to analyze the brain activity of the serene or consider the tolerant earlier than any treatment centre.

The projected effort computerized the EEG signal both supervised and unsupervised mission uses hybrid model namely Fuzzy C-Means with modified PSO and Decision Tree Classification with estimates the predictor importance. The effect of the research signifies that the methodologies are more perfect and quicker than the other techniques. Computerized structures are more reliable for classification of given EEG signal and also it facilitates to recognize the given signal is seizure or seizure free without facilitate of the neurologist. It is also point in time saving and proficient user gracious tool for the neurologist.

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AUTHORS PROFILE

Mrs. C V Banupriya, Assistant Professor in Department of Computer Science, Bharathiar University affiliated College since 2014 at Coimbatore. She is currently pursuing Ph.D in Computer Science under the guidance of Dr.Deviaruna.D in Dr. NGP College of arts and science. She has published many research papers in reputed international journals and conferences including Springers and it's also available online. Her main research work focuses on Data Mining. He has 5 years of teaching experience and 3 years of Industrial Experience.

Dr. D. Devi Aruna, is the Assistant Professor in Department of Computer Applications, Dr.N.G.P Arts and Science College, Coimbatore. She has 8 years of teaching experience and three years research experience. Her areas of interest include Network security and Cryptography, Data mining and Image Processing. She has 25 publications at national and International level.