Design and Classification of EEG and ECG Signals for Detection of Seizures based on Prototype Recognition

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Abstract— Nervous system disorder that causes huge problem to develop into persons unconscious suddenly, often with violent actions of the body the patient understanding the challenge in everyday life. When a seizure occur, it strength grounds injury or endangers the existence of the patient, the EEG (electroencephalogram) in arrange analysis the performance of the intelligence through seizures at the same time the brain signal might have an effect on the heart electrical activity. We have calculated the middle tendency and covariance of electroencephalogram (EEG) and electrocardiogram (ECG) signals as per study the heart is the hub of circulatory system whereas brain is the hub of the nervous system so; we can say that heart and brain interact with each other in a method that spirit can have an effect on intelligence and vice-versa. Epilepsy is a brain disorder in which a person has repeated seizures (convulsions) over time. Locate the signal era in EEG recording is database manually it tricky and occasion overwhelming i.e. the automatic finding of such action is of immense significance. One more positional practice of EEG signals examination forecast of epileptic behavior previous to they happen, as this will enable the patient to take suitable safety measures. In this research we proposed a new method ADAPTIVE COGNITION SIGNAL ANALYSIS (ACSA) Algorithm which implies to combination of signals extracted which is used to analysis and precaution disorder of seizures diseases. The result which ensures the name of diseases in predetermined manner by using of our proposed ACSA algorithm.

Index Terms— Adaptive Cognition Signal Analysis, ECG, EEG, Medical Image, Intelligent information acquisition, bipolar montage, Preprocessing.

1 INTRODUCTION

EPILEPSY is a frequent brain chaos that, according to an approximation of the World Health Organization, affects almost 60 million people about the world. Approximately one in every 100 persons wills knowledge a seizure at a number of times in their life [1]. Epilepsy is characterized by the recurring and unexpected occurrence of epileptic seizure which can lead to dangerous and perhaps serious situation [2]. The seizures are the result of a fleeting and unforeseen electrical trouble of the brain and extreme neuronal free that is obvious in the electroencephalogram (EEG) signal envoy of the electrical action of the brain. As a result, the EEG signal has been the bulk utilize signal in scientific appraisal of the state of the brain and discovery of epileptic seizures, and is very important for a good psychoanalysis of epilepsy. Scalp EEG sign are more frequently than not calm with electrodes located on the scalp by a figure of sort of following treat the scalp area. Electrodes are located in a straight line on Main current algorithms use electroencephalogram (EEG) and electrocardiogram (ECG) signals to become aware of the seizure start and seizure occasion. In these algorithms, a variety of skin are take out from the EEG sign alone or in presentation with the ECG signal pending the patients are clandestine into two classes, seizure and non-seizure. In adding, some other linked issues, such as dataset and evaluation measures, are also discussed. Lastly, the appearance of algorithms is evaluated, and their capability and limits are described.

The rest of the papers is organized as follows. In section 2, describes the realted work and problem identific ation in section 3. The proposed ACSA algorithm in section 4 and implementation, result analysis in explained in section section 5. Finally, conclusion are given in section 6

2 RELATED WORK

Dragoljub Gajic: Proposed to the electroencephalogram (EEG) signal is very significant in the analysis of epilepsy. Long-term EEG recording of an epileptic enduring hold a huge quantity of EEG data. The discovery of epileptic action is, so, a very difficult process that requires a full psychoanalysis of the whole distance end to end of the EEG data, usually perform by an expert. This paper describes a mechanical categorization of epileptic seizures by wavelet change and arithmetical prototype credit.

Nishant Saxena: Future to Principal part analysis (PCA) is single of the majority precious consequences leaning technique of practical linear algebra. PCA is used in abundance in all form of psychoanalysis from neuroscience to processor graphics since it is a simple, non-parametric method of extract pertinent in order from confusing data sets. Extract or decoding this in order or characteristic from ECG signal has been establishing very helpful in explanation and identify various pathological conditions. The characteristic removal process can be talented simple by analyzing the ECG visually on paper or screen.

Mostefa Mesbah: proposed to this paper a new system for

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seizure determination that uses message separated and delivered from both multi-channel Electro Energy Graph (EEG) and a one channel electrocardiogram (ECG). The goal of the analysis is to assess whether extra or more messages delivered from ECG can utilize the advancement of seizure detectors based solely on EEG. Too many approaches were used to combine this extracted information.

3 Problem Identification

The existing methodology investigates the presentation of a seizure discovery unit for offline and online monitor of epileptic patients. The unit is by as additional no of input information stream from electroencephalographic and electrocardiographic recording. The major drawback needs to analysis each database in both time and frequency and there is no proper combination factor for both EEG & ECG Data sets.

4 Proposed ADAPTIVE COGNITION SIGNAL ANALYSIS (ACSA) Algorithm over Medical Environment

The ultimate goal of proposed algorithm is to design and implement a novel technique for Adaptive seizure uncovering to use in order extract as of together canal electroencephalogram (EEG) and a solitary channel electrocardiogram (ECG). The aspire of the study is to charge whether additional in arrange take out from ECG can get improved the appearance of seizure detectors base wholly on EEG. Two unlike approach were used to unite this extract in order. The primary move toward, recognized as clever characteristic fusion, involve combine features extract from EEG and Adaptive heart rate variability (AHRV) into a solitary characteristic vector previous to feed it to a classifier. The next move toward, called Support Vector machine, is achieve by combine the self-governing decision of the EEG and the AHRV-based classifier. The schematic diagram of the ASCA is shown in figure 1.

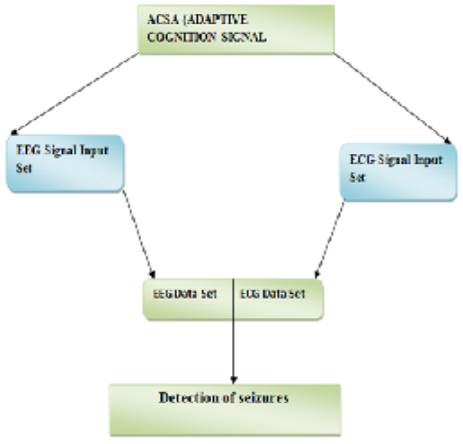

Fig.1: Blck Diagram of the propoed ACSA Algorithm

Seizures obvious themselves in the signal as recurring that are absolutely unlike from the usual random-like background intellectual action. This independence has been downtrodden by a figure of at what time deceitful regular seizures discovery methods. A figure of these technique are base on count this periodicity in (1) the occasion area using association purpose change in replica arrangement harmonization between channel and wave-sequence psychoanalysis the incidence area using power ethereal density and the time–incidence area by quadratic time–frequency The ultimate goal of proposed algorithm is to design and implement a novel technique for Adaptive seizure uncovering to use in order extract as of together canal electroencephalogram (EEG) and a solitary channel electrocardiogram (ECG). The functional diagram of the proposed algoritham is shown in figure 2.

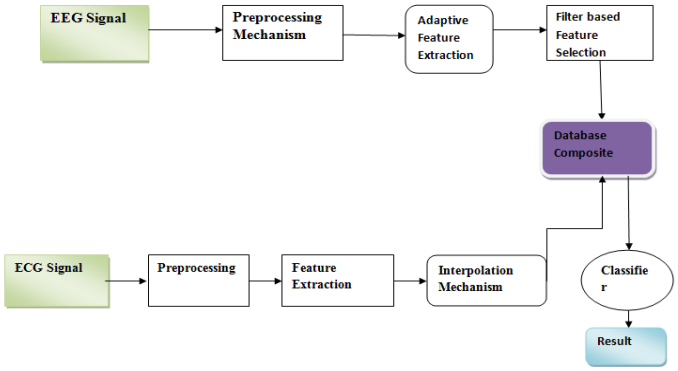

Fig. 2: **Functional Diagram of ACSA**

4.1 Intelligent information acquisition

The eight EEG–electrocardiogram (ECG) notes second-hand in this revise be acquire as of eight full-terms. The EEG seizures be documented and gloss by a pediatric neurologist as of Hospital. The EEG and ECG were drinkable by a band-pass with cut-off frequencies 0.5 and 70 Hz previous to life shape digitized at a rate of 256 Hz. A 50-Hz nick filter was then used to take absent the possessions of power line interferences. As the sleek of this sign is to unite the in place from EEG and ECG data, only EEG recording or part of the recording escort with ECG have been chosen. Also, part of the footage show big compilation remainder, dispersion, or those connected with split electrodes have been get rid of additional treat

Table: 1 bipolar montage used to acquire the EEG data

Right Hemisphere	Left Hemisphere
1(F4-T4)	4(F3-T3)
2(T4-T6)	5(T3-T5)
3(T6-O2)	6(T5-O1)
7(F4-C4)	10(F3-C3)
8(C4-P4)	11(C3-P3)

4.2 Preprocessing ECG

In the way of be traditional with the insignificant amount force of the job authority of the people of Cardiology and we estranged the ECG into 64-s segment (epochs). In this learn, we arbitrarily chosen 21 seizure-related and 13 non-seizure-related non-overlapping ECG part tranquil from the eight footage. In a first step, the raw ECG was drinkable using a 60th-order band-pass with frequencies of 8 and 18 Hz. A dependable QRS discovery algorithm was used to locate the R points in the Errors in the R point detection were correct using timing psychoanalysis. The RR gap time sequence was obtain

by captivating the time difference between successive R points. The immediate heart rate (IHR) was then computed as the conflicting of the RR gap. The AHRV time series was unclear into a time after time time-sampled one using cubic sp line shout follow by re-example at 4 Hz and detruding. The ensuing signal constitute the AHRV used in this study more facts can be recognized.

4.3 Preprocessing EEG

The multi-channel EEG was filtered by a low-pass filter by means of a cutoff incidence of 8 Hz and re sampled at 20 Hz. This option has be done for dissimilar reason It has be shown that more than 95% of ghostly energy in the EEG is intense in the delta and theta incidence bands select this sample rate appreciably reduce the computational burden, this filters out high sound and artifact such as EMG. The EEG from the dissimilar channel was segmented into non-overlapping 64-s EEG epochs. These epochs were additional alienated into five non-overlapping window of 12.8 s each? The cause for using shorter EEG window is that many researchers think that the smallest amount satisfactory period for an EEG seizure. The organization of AHRV and EEG epochs was wanted to attain the fusion between the two signals. The figure 3 describe the methodlogy grapgh of the ASCA system.

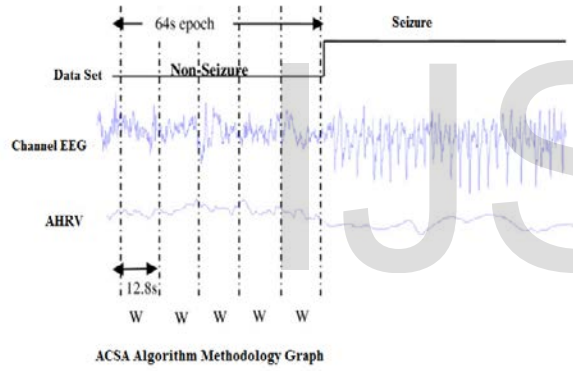

Fig. 3: Methodlogy Graph

4.5 Five Steps Implementaton Procedure ACSA Algorithm

4.5.1: AHRV Features

A sum of 96 skins is extract from the occasion and the TF domain for each AHRV era. A concise account of the extract skin is given below.

4.5.2 Time domain features

The denote, normal deviation, and limit (which give details the indication individuality in circumstances of action, mobility, and difficulty) were computed.

Time-Frequency features

Because AHRV is a non-stationary sign, we strong-minded to take out skin as of the time–incidence area in the direction of clarification for this. This procedure was not as easy as in the case of the occasion area skin. The time-frequency (TF) symbol was obtain by the Modified-B sharing (MBD) with its limit β set to 0.01The MBD has been selected to stand for the AHRV in the TF area as it is before set up to understand the best collaboration.

Step 2: EEG and HRV in order union in position to create the EEG–AHRV feature mixture likely, The EEG frame rate is five times that of the AHRV and as such, there is a disparity flanked by the skin of AHRV and EEG. To deal with this subject, we investigate three dissimilar solution allocate a stable value to all HRV windows, use linear exclamation, and use higher-order polynomials. The linear shout was adopted as it realized a good tradeoff flanked by look and difficulty and resulted in a smooth change flanked by characteristic values. The data flow diagram of the entire process is explained in figure 4.

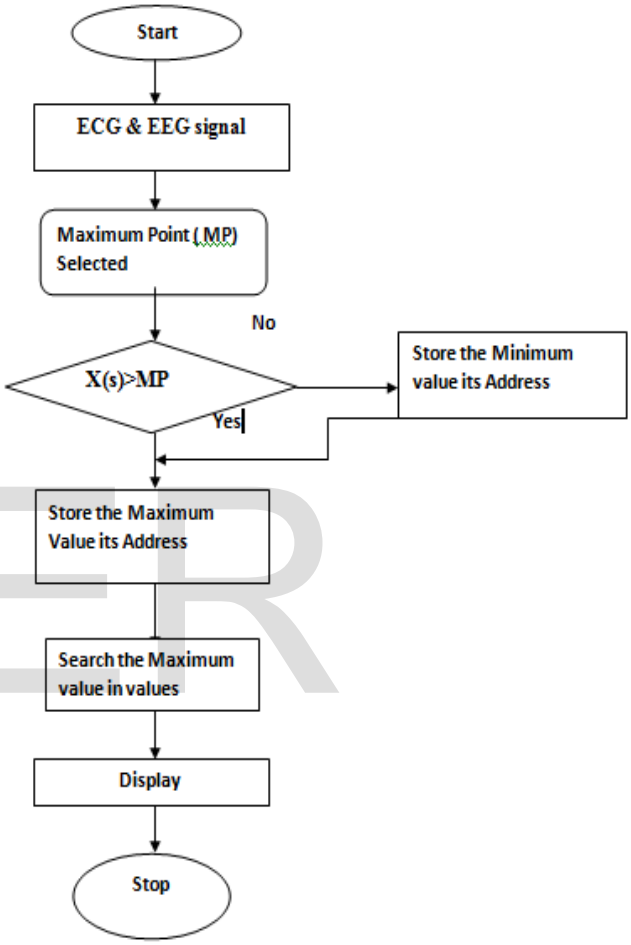

Figure 4: Flow Chart for ACSA Proposed Algorithm

4.6 Algorithm for Proposed ADAPTIVE COGNITION SIGNAL ANALYSIS (ACSA) Algorithm:

1: /*** EEG Data acquisition********/
2: X=[x1,x2…xn]
3:/****** ECG Data acquisition *******/
4: Y= [y1,y2..yn]
5:/****** Feature extraction*******/
Z= [z1, z2,.zn]
6:To reduce Dimension Reduction
A= $B^T Z$ = [a1,a2…..an]
7: The Advanced first classifier
h1(A) = $A^T Q_1 A + V_1^T A + V_{01} > 0$
If select normal EEG
Else
Select abnormal select vector D
End

Result
End

4.7 Real time Wavelet transform

Abnormality in EEG data through grave neurological disease such as epilepsy are too slight to be detect using conservative technique that more often than not transform mostly qualitative analytic criterion into a more object quantitative signal trait classification difficulty. The method that have been sensible to talk to this problem include the psychoanalysis of EEG signals for the discovery of epileptic seizures using the autocorrelation purpose, time domain features, incidence domain features, time frequency psychoanalysis, nonlinear time series psychoanalysis. The seizure detection system of ASCA is ishown in figure 5.

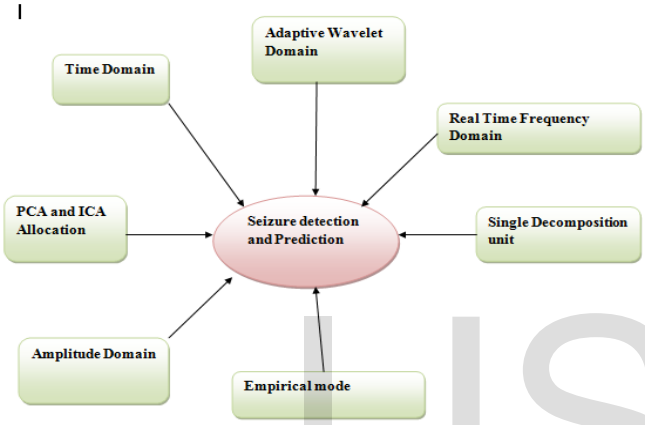

Fig: 5: Circle Flow Diagram of Seizure Detection

4.7 Database value Result Analysis

Show an example of an EEG signal including a seizure era. It is obvious that there is dissimilarity flanked by seizure and non-seizure interval. As we are able to differentiate flanked by these interval visually, time area detection and forecast method attempt to differentiate flanked by them automatically, and assess the presentation using dissimilar metrics such as the sympathy, specificity, correctness, and false-positive value. These metrics are distinct as follows.

Real Time Sensitivity = TP/TP+FN *100
Size of Specificity = TN/TN+FP*100
One time Accuracy = TP+TN/TN+FP+TP+FN*100
False Positive Value = TP/TP+FP*100

Where,
TP = True Positive
FN = False Negative
FP = False Positive
TN = True Negative

To become aware of EEG seizures in time area, there is a require to look at divide occasion sequence of EEG epochs. This psychoanalysis can be gifted from side to side histograms of the available a simple time-domain seizure detection technique that is bottom on tracing consecutive peak and minima in the sign part at hand and estimate the for two variables: the amplitude difference and occasion division flanked by peak main beliefs as well as minima [13]. The facial look used for classification of an epoch as an attack or non-seizure is the unsurprising values of the histogram bins. The authors used a support vector machine (SVM) classifier for this task and achieve a standard sympathy of about 90% on self-recorded data.

4.7.1 Seizure prediction methods

The investigate work on the subject of time-domain seizure guess is better-off than time-domain seizure discovery due to the significance of the seizure prediction difficulty. We can believe of the seizure forecast difficulty as a detection difficulty of the pre state on seizure minutes.

This requires a substantial long interstate for good forecast results. Alike figures to those used in seizure discovery like the zero-crossing rate can be used for seizure forecast used the zero crossing rate of EEG signal segment to develop a Patient-specific seizure forecast method. A moving window analysis is used in this technique. The histograms of the dissimilar casement intervals are predictable. The working mechanisum of ASCA system is shown in figure 6.

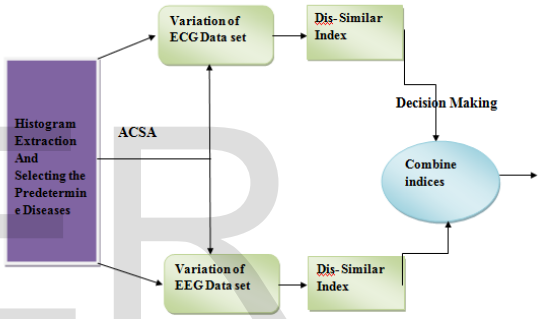

Fig: 6: ACSA working Methodology

Selected histogram bins are second-hand for categorization into pre-data and inter-data state base on contrast with orientation histograms. A difference Bayesian Gaussian combination model has be used for categorization. In this technique, a joint directory for the choice in use on chosen bins is compute and compare with a pre-defined patient-doorsill to lift a fear for awaiting seizures this method has been tested on 561 h of scalp EEG hold 86 seizures for 20 patients. It achieved a sensitivity of 88.34%, a false prediction rate of 0.155 h−1, and a standard forecast time of 22.5 min.

5. Implementation and Result Analysis

First the sign is in use and alienated into the blocks. Then the denote is full of the exacting beat. Then that denote is subtracted from the unique signal. Thus we got the main mechanism. If the covariance is taken of the ensuing we with the help of which we can rebuild the original signal. The process is performing with the help of MATLAB Software and consequences are being display. The principal part analysis is performing for each of the cases.

The key to obtain data density is signal representation, which concern the symbol of a given group of students of signals in a well-organized manner. If a separate signal comprises of n sample, then it can an n dimensional space. Each sample value

is then a part of the data n vector x, that represent a discrete signal in this space.

For a well-organized symbol of X, we secure an orthogonal change of X, which results in Y=TX where Y denotes the change vector and T represent the transformation matrix.

For data compression we will select a subset of m mechanism of Y, where m is substantially less than n. The balance of (n-m) components will be discarded without introducing any grave error when the signal is reconstructed using the m saved components of the vector Y. To Whom It May Concern quantify this error of approximation an error criterion is needed and that is mean square error. The realtime parameter of the dataset is shown in figure 7.

This chapter describes in detail the analysis experiments and their characteristics – i.e. the analysis environment setup for the experiment ECG signal analysis. The ECG signal has been picked from various sources and then analyzed. Basically all we are doing is to compress the ECG signal and then its reconstruction. The method used for this purpose is principal component analysis. The color Map analysis of the proposed system is shown in figure 8a nd classification graph is shown in figure 9.

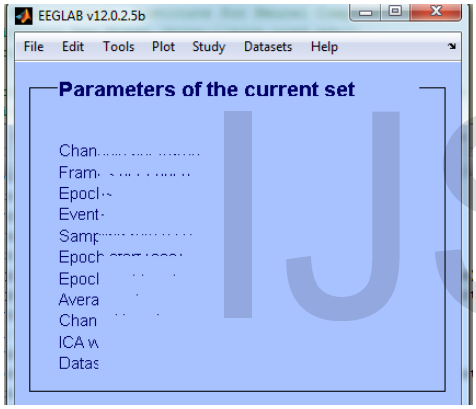

Fig: 7 Real Time parameters of the Current Set

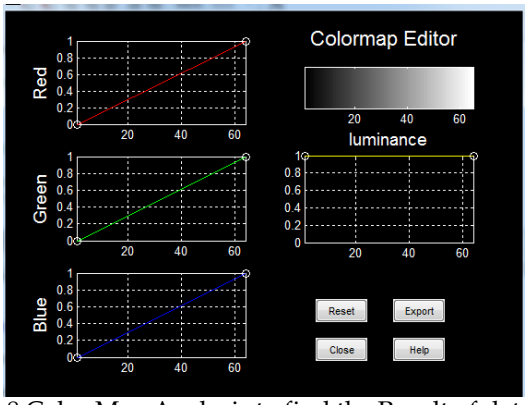

Fig: 8 Color Map Analysis to find the Result of data set

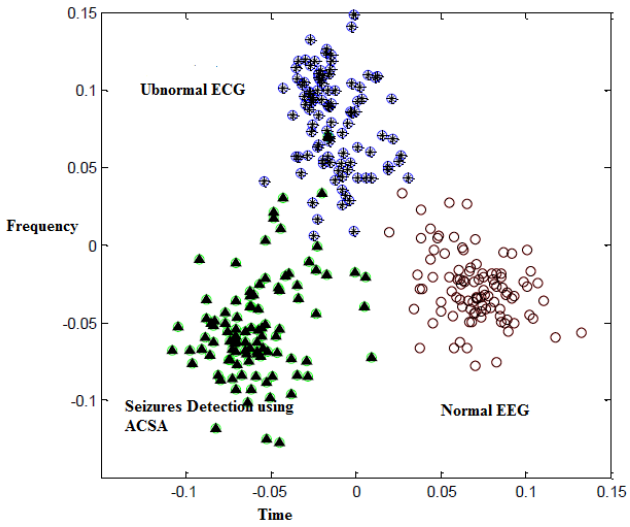

Fig: 9: Seizures Detection by using ACSA

6 Conclusion

This paper presented an EEG & ECG data classification algorithm which, based on a big numeral of features extract after wavelet change and arithmetical prototype gratitude, makes an object choice about the type of the EEG data process and thus the brain condition of an enduring. The main advantages of the algorithm the majority seizure discovery and forecast method take on time- or wavelet-domain features. For wavelet-domain method, more than little identification has adopted five-level decay for robust feature removal. Few method have second-hand cross features like occasion and wavelet-domain features and achieve improved presentation than using features from one domain only. It is clear also that the ACSA is a talented tendency for seizure detection and forecast so as to needs additional study. Too, we can speak that seizure discovery and prediction methods base on classifiers.

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