

REAL TIME EMOTION DETECTION OF STUDENTS USING EEG SIGNALS

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Abstract - Electroencephalogram (EEG) is mainly used in various medical applications, in sleep analysis and also used in brain-machine interfacing systems. EEG signals emanated while a human subject is in a state of mental task have been used to classify the type of mental tasks. To determine the states of emotion and the changes of mental stress of students, EEG signals are processed by Linear Dimensionally Analysis (LDA), Common Spatial Pattern (CSP), and so on for classifiers, for example, K-Nearest Neighbor method (KNM), Kernel Support Vector Machine (SVM), and Artificial Neural Networks (ANN). In the proposed technique, the recorded EEG signals have been processed and analyzed using FFT (Fast Fourier Transform) and windowing technique and compared using MATLAB software for pro-active assessments on the teenagers' mental health. This is important to determine the product of the educational system may not only excel academically but also possess a healthy mental state when living the college to face their post-education lives. Feature Extraction of the EEG signals has been done using filters to separate the signals of various frequencies.

Key Words: Mental states, Emotion, EEG signals, ICA, Neural networks

1. INTRODUCTION

School and faculty life area unit the foremost pressing stage among the teenagers' lives which is able to typically impose major challenges to review, play, socialize and live at

the same time. Failure to manage these challenges effectively could cause poor condition among the teenagers and negative repercussions. Among them teenager's area unit usually vexed and to a fault anxious for his or her future. Some extreme cases could cause depression, extreme anxiety and even suicide. Pro-active assessments on the teenagers' condition ought to be administered sporadically therefore on beat such attainable incidences. This can be vital to figure out the merchandise of the tutorial system won't solely surpass academically however additionally possess a healthy condition once living the college to face their post-education lives [1]. Automatic feeling recognition algorithms doubtless bridge the gap between

human and machine interactions. Automatic feeling recognition is one amongst the foremost difficult tasks. To find feeling from non-stationary graph signals, a cultured learning algorithmic program which is able to represent high-level abstraction is needed.

2. Methodology

The goal of BCI Competitions is to validate the strategies accustomed signal process and classification within the BCI systems. The organizers offer many sets of BCI knowledge pertaining graph trials. The provided knowledge is going to be divided into 2 parts; tagged knowledge for coaching and unlabeled knowledge for activity the performance of the algorithms. The diagram of the projected methodology is shown in Figure 1.

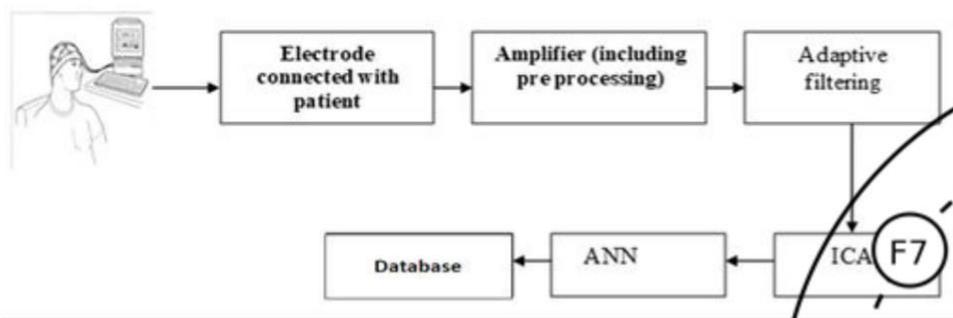


Fig -1: Block diagram of the proposed technique

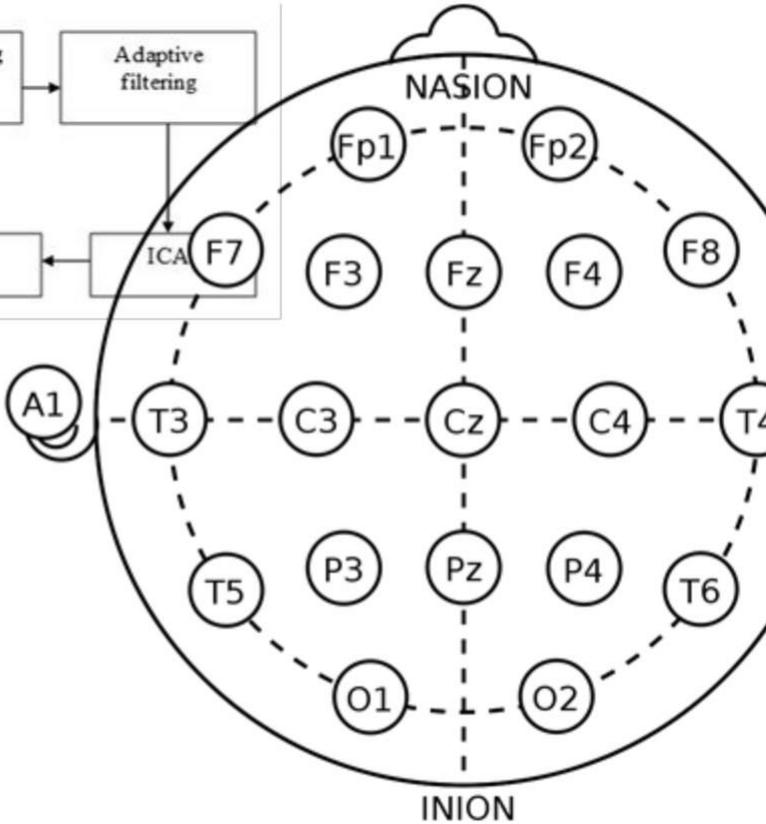


Fig -2. 8-channel set up of 10-20 electrode system

The various steps concerned within the methodology given below:

A. Knowledge Acquisition

External stimuli like photos, sounds and videos area unit usually accustomed induce emotions within the participants and therefore the graph signals area unit captured with the assistance of the graph electronic equipment. The "International 10-20" system, associate degree internationally recognized technique to clarify matters of scalp electrodes for graph recordings is utilized throughout recording. The naming convention of the conductor positions is said to the underlying brain space. The "10" and "20" raise the actual fact that the actual distances between adjacent electrodes area unit 10% of the whole front-back or right-left distance of the skull.

8-channel setup of 10-20 system along with the electrode positions are shown in Figure 2.

B. Process of information mistreatment EEGLAB

EEGLAB could be a MATLAB tool case distributed beneath the free BSD license for process knowledge from electroencephalography (EEG), generator X-ray photography (MEG), and alternative electrophysiological signals . in conjunction with all the fundamental process tools, EEGLAB implements freelance element analysis (ICA), time/frequency analysis, artefact rejection, and a number of other modes of information image. EEGLAB permits users to import their electrophysiological knowledge in regarding twenty file formats, preprocess the data, visualize activity in single trials, and perform ICA.

Data containing twenty -two.4 second brain activity as a digital dataset fed into EEGLAB as associate degree code computer file with a 240-cycle rate with one epoch channel to convert to analog time-frequency signal. A Fast-Fourier remodel is deployed to convert the time domain sign al into frequency-domain signal.

The DFT is obtained by a sequence of values into elements of assorted frequencies. The distinction in speed area unit usually monumental, particularly for long knowledge sets wherever N might even be among the thousands or millions. within the presence of round-off error, several FFT algorithms area unit much more correct than evaluating the DFT definition directly or indirectly. Since FFT is that the solely Fourier remodel allowed during this computer code, FFT is applied to the signal set for conversion. Characteristics of the noninheritable graph signal to be analyzed area unit computed by power spectral density (PSD) estimation therefore on by selection represent the graph samples signal. However, four

frequency bands contain the foremost characteristic waveforms of graph spectrum [2].

The live given here, the Event-related Spectral Perturbation (ERSP), are often viewed as a generalization of the ERD. The ERSP measures average dynamic changes in amplitude of the broad band graph frequency spectrum as a perform of sometime relative to associate degree experimental event. That is, the ERSP measures the standard time course of relative changes among the spontaneous graph amplitude spectrum elicited by a bunch of comparable experimental events. These spectral changes usually involve over one frequency or band, therefore full-spectrum ERSP analysis yields a lot of info on brain dynamics than the narrow-band ERD.

Inter-trial coherence (ITC) is also a live that is computed from single trial graph, that reflects the temporal and spectral synchronization among graph, elucidating the extent to that underlying phase-locking happens. Thus, ITC provides an instantaneous live of plant tissue synchronizing that's not accessible within the mixture induced response wave [3].

Considered along, the ERSP and ITC offer a abstract framework for perceptive and modeling the event-related brain dynamics that occur systematically across a bunch of trials. the 2 measures area unit usually aforesaid to form a 'time/frequency state space' that, at every trial latency, has dimensions: (1) graph frequency, (2) graph power relative to baseline (measured by ERSP), and (3) absolute level of section consistency (measured by ITC). The spectral state-space model emphasizes that event-related graph phenomena

typically have each 'evoked' and 'induced' aspects measured by ITC and ERSP severally.

Independent element Analysis (ICA) is also a process technique for separating a variable signal into additive subcomponents. this can be done by presumptuous that the subcomponents area unit non-Gaussian signals that they are statistically freelance from each other. ICA is also a special case of blind supply separation.

Semi-Automated choice of freelance parts (SASICA) of the graphical record for whole thing correction. Rejecting ICs before EEG information analysis inescapably needs some level of direction. SASICA offers observers elaborated data to guide choice of whole thing ICs. as a result of it uses quantitative parameters and thresholds, it improves objectiveness and duplicability in news pre-processing procedures. SASICA plugin contains multiple algorithms like change, quicker and parts like autocorrelation etc. These supervised learned algorithms facilitate to not ice and take away the artifacts gift within the channel readings of the EEG dataset fed to them. The whole thing to be removed square measure set by many factors by that they decide the channels to get rid of by keeping a restricted threshold by scrutiny every and each channel.

Several classes of signals square measure promptly isolated by single ICs. Specifically, ICs will capture (1) a supply of neural activity, (2) variations of potential due to blinks, (3) eye movements (saccades), (4) contraction, or (5) line noise or a misconnected (high impedance) conductor, ordinarily mentioned as a "bad channel". The success of ICA in EEG analysis is actually due to the credibility of the solution came back by ICA. Indeed, in most cases, once performed on a full-rank long enough dataset, the topography and time course of a minimum of some of parts compellingly enable distinguishing them as capturing selective neural activity.

C. Neural Network

A neural network is also a series of algorithms that endeavors to acknowledge underlying relationships throughout a collection of information through a method that

mimics the manner the human brain operates . during this sense, neural networks raise systems of neurons, either organic or artificial in nature. A neural network is also a series of algorithms that endeavors to acknowledge underlying relationships throughout a collection of information through a method that mimics the manner the human brain operates . during this sense, neural networks raise systems of neurons, either organic or artificial in nature [5].

The neural network coaching is finished in Neural web Fitting tool cabinet in Matlab. Out of the 3 coaching algorithms, i.e., Levenberg -Marquardt, Bayesian regular, Scaled Conjugate Gradient, Bayesian regular is suggested because it offers additional correct results with minimum mean square errors .

Bayesian regular artificial neural networks (BRANNs) square measure additional strong than commo nplace back-propagation nets and should scale back or eliminate the need for extended cross -validation. Bayesian regularization is also a mathematical process that converts a nonlinear regression into a "well-posed" applied mathematics drawback at intervals the way of a ridge regression. The advantage of BRANNs is that the models square measure strong and so the validation method, that scales as $O(N^2)$ in traditional regression ways, like back propagation, makes no sense . These networks offer solutions to kind of issues that arise in QSAR modeling, like alternative of model, strength of model, alternative of validation set, size of validation effort, and improvement of specification.

3. RESULTS AND DISCUSSION

The brain waves collected from the information tell United States of America the distinction within the emotions the coed goes through. This study focuses on brain waves of alphabetic character, alpha, delta, and beta that square measure aroused throughout anger, sadness, happiness or in ease, and stressed mentality severally. throughout anger, alphabetic character waves square measure at peak compared to alternative frequencies . During sad, each delta and

alphabetic character waves peak compared to alternative frequencies . Alpha waves square measure acknowledged for rest and happy state of mind and beta waves square measure ascertained throughout stressed levels . every line of result focus on the share of anger, sad, happy, and stressed levels severally on a zero to one scale. the varied frequency parts , Alpha, Beta, Gamma and Delta extracted from the first Brain wave square measure given in Figure five.

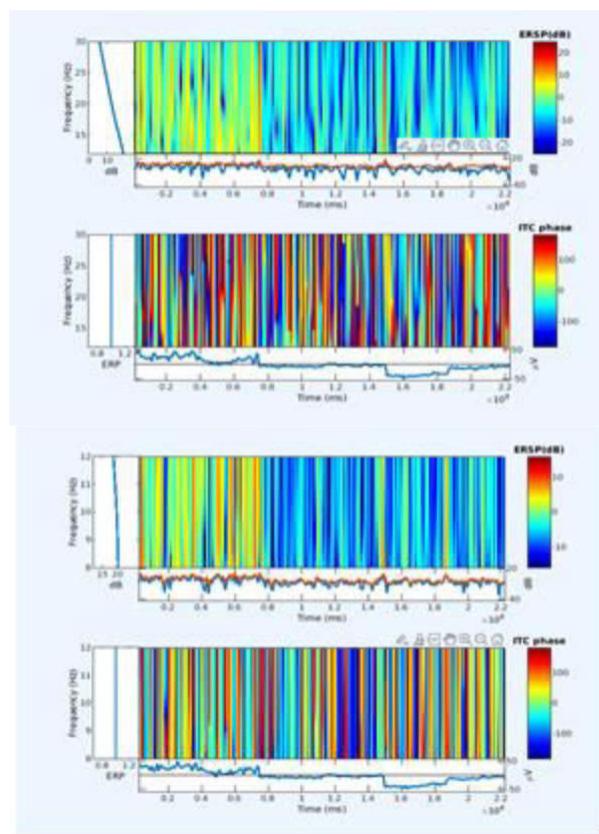


Fig- 5. The various frequency components, Alpha,Beta extracted from the original Brain wave

ICA is employed for spatial property reduction. Then the reduced information set is given to a man -made Neural Network (ANN) for classification of the mental tasks . If the classified wave is Beta, then that refers to busy active mind and alphabetic character refers to relaxed state. Around ten information sets tested for the varied tasks, the network provided Associate in Nursing accuracy of ninety -two.

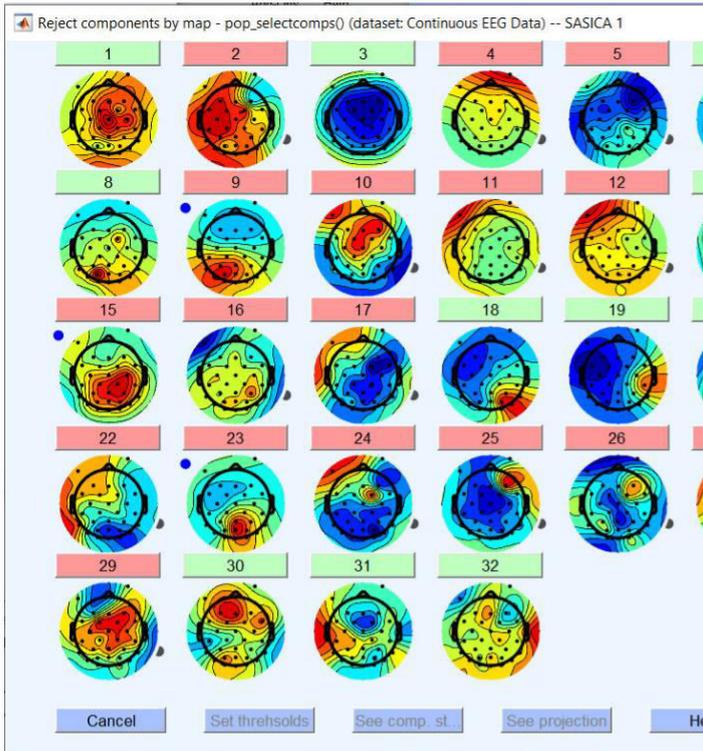


Fig- 6. ICA Showing Rejection and Acceptance Components

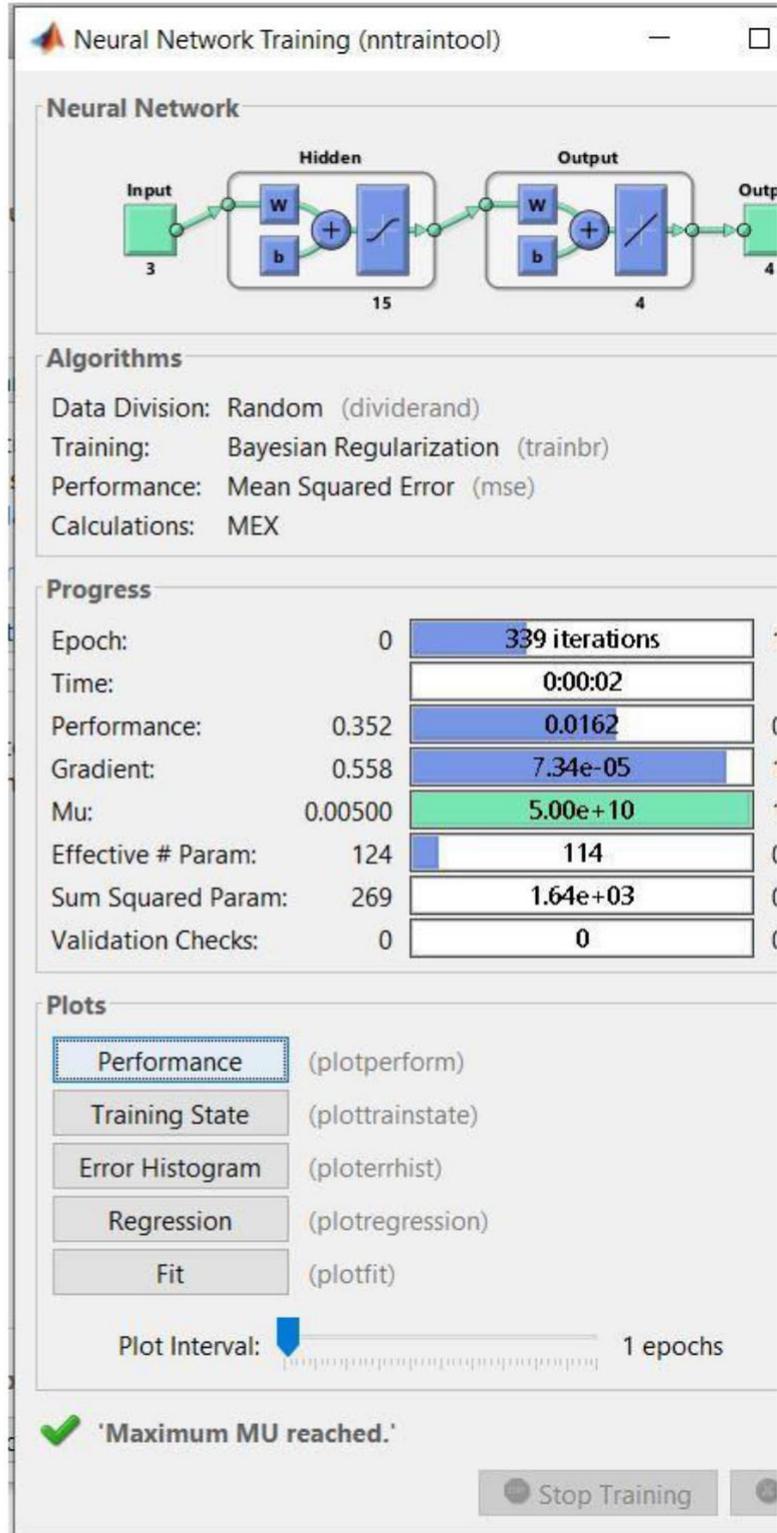


Fig- 7. Neural Network Trained

The final results obtained from the neural network is shown in fig 8. The number of rows indicates the number of samples taken for testing. The columns represent the strength of emotions which ranges from 0 to 1 and from -1 to 0. Each column represents calm, happy, sleep, stress respectively.

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Command Window
>> nftool
>> result=net(testing)

result =

    -0.0098    0.0013    0.7829    0.
     0.0063   -0.0004    0.2213   -0.
     0.0187    0.0117   -0.0070    0.
     0.9848    0.9874    0.0027   -0.
    
```

Fig- 8. Final Result

3. CONCLUSIONS

Human emotions are very complex. In order to be able to classify the features of brain wave emotions, many studies have used different techniques to extract these features. This paper introduces the type of brain wave and describes the emotion features of different types of brain waves. Then the existing classification scheme of the emotion features of brain waves is classified and described. In order to be able to more accurately classify the feature of brain wave emotions.

The neural network system is used to classify the emotions, as ANNs have the ability to learn and model non-linear and complex relationships, which is really important because in real-life, many of the relationships between inputs and outputs are non-linear as well as complex. By knowing and learning the emotions the students are going through in their various parts of their lives, one can easily access and guide them to a bright future and help in those who are out of shape.

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