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Decoding Brain Eeg Signals To Find State Of Mind Using Ai

Kiruthiga Devi M[1], Shivakami A[2],Aravindha Mira R[3],Karpagam A[4]
[1]Assistant Professor, Sri Sai Ram Engineering College,
[2,3,4]Student, Sri Sai Ram Engineering College

Abstract

Emotions are primordial for human beings and they play a key role in human intelligence. Emotion is basically connected with sight, human correspondence and logical decision making. Now a days the need for attested and dependable remedies for the recognition of human emotional states is obligatory due to the rise in interest of upcoming researchers towards establishing some significant emotional interactions between humans and computers.By analyzing the features of electroencephalography (EEG) signals, which are generated from EEG sensors that noninvasively measure the electrical activity of neurons inside the human brain, we select the optimal combination of the features for recognition. Then the signals are pre-processed using Hjorth parameters that measure signal activity of time-series data. The classification of signals obtained is based on supervised pixel classification. By using convolutional neural networks(CNN) the signal feature obtained is compared with the parameters set and thus it detects the state of mind whether the patient is happy, depressed or anger and the output generated will be in a text format. This is very much beneficial in many sectors especially in health sector where dealing with patients diagnosed from Locked In Syndrome, coma and various neuropsychiatric disorders .By detecting the emotional state of the patient which means to detect whether they are depressed or anger or happy and it will help the doctors in treating them in a better way and the patient can recover soon. In case of depression it is mandatory to treat those kind of patients or else they may take some psychotic decisions like suicide or they may become mentally weak. Similarly if the emotional state detected is anger, then we can make them happy by doing what they like which will help to make them normal In patients diagnosed with locked in syndrome their full body will be paralyzed except their eye muscles They can think,feelemotions,sense smell but cannot move. If we detect their state of mind it will be more beneficial in treating them..The accuracy of the overall project will be around 83%.Our approach shows better performance compared to existing algorithms

Keywords*:*-CNN,Hjorth.parameters,Electroencephalography(EEG),Coma,neuropsychology,Locked in Syndrome

I INTRODUCTION

Identifying the emotional state of human ,particularly for patients suffering from some disorders or syndromes is much important. It is achieved by using electroencephalography by which electrical activity of brain can be recorded. One such syandromeis Locked-in syndrome (LIS), also known as pseudocoma, is a condition in which a patient is aware but cannot move or communicate verbally due to complete paralysis of nearly all voluntary muscles in the body except for vertical eye movements and blinking. The individual is conscious and sufficiently intact cognitively to be able to communicate with eye movements. Electroencephalography results are normal in locked-in syndrome. Total locked-in syndrome, or completely locked-in state (CLIS), is a version of locked-in syndrome wherein the eyes are paralyzed as well. Locked-in syndrome is usually characterized by quadriplegia and the inability to speak in otherwise cognitively intact individuals. Those with locked-in syndrome may be able to communicate with others through coded messages by blinking or moving their eyes, which are often not affected by the paralysis. The symptoms are similar to those of sleep paralysis. Patients who have locked-in syndrome are conscious and aware, with no loss of cognitive function. They can sometimes retain sensation throughout their bodies. Some patients may have the ability to move certain facial muscles, and most often some or all of the extra ocular muscles. Individuals with the syndrome lack coordination between breathing and voice. This prevents them from producing voluntary sounds, though the vocal cords may not be paralysed. New brain-computer interfaces (BCIs) may provide future remedies. One effort in 2002 allowed a fully locked-in patient to answer yes-or-no questions. In 2006, researchers created and successfully tested a neural interface which allowed someone with locked-in syndrome to operate a web browser. Some scientists have reported that they have developed a technique that allows locked-in patients to communicate via sniffing. Electroencephalography (EEG) is an electrophysiological monitoring method to record electrical activity of the brain. It is typically non invasive, with the electrodes placed

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along the scalp, although invasive electrodes are sometimes used, as in electrocorticography, sometimes called intracranial EEG and thus finding the state of mind of the patients.

SCOPE OF THE PROJECT

1.The aim of our proposed system is to detect the state of mind using Image Processing methodology and predicting the mood of the patients diagnosed with Locked in Syndrome and Neuro psychotic disorders through Machine Learning technique.

2. EEG signals are decomposed into the gamma, beta, alpha and theta frequency bands using discrete wavelet transform (DWT), and spectral features are extracted from each frequency band. Principle component analysis (PCA) is applied to the extracted features by preserving the same dimensionality, as a transform, to make the features mutually uncorrelated.

3.Using CNN algorithm the raw EEG signals are preprocessed,segmented and classified from which the output obtained gives the emotional state of the patient which in turn is helpful in treating patients

II EXISTING SYSTEM

The existing system uses multiple instance learning(MIL) which is a type of supervised learning .method for EEG based emotion recognition. They provide information about how to train the multiple instance learning method only. They detect emotions only via python IDE. The accuracy of the overall project will be low. Two combination strategies of feature extraction on EEG signals are used. One is Autoregressive coefficients and other is decomposing into sub-bands by wavelet packet de-composition. Wavelet packet coefficients are sent to the autoregressive model to calculate autoregressive coefficients, which are used as features extracted from the original EEG signals. These features are fed to support vector machine for classifying the EEG signals [1].On a dataset of physiological signals (electrocardiogram and galvanic skin response),by using a deep convolutional neural network, emotions are detected by correlating these physiological signals with the data of arousal and valence of this dataset, so as to classify the affective state of a person. Here dataset used is amigos dataset [2].Here the multi-channel neuro physiological signals are encapsulated into grid-like frames through wavelet and scalo gram transform. The hybrid deep learning model is designed that combines the CNN and RNN and thus extracts task related features[3].

III PROPOSED SYSTEM

In the proposed system CNN classifier is used to classify the emotion.Here canny filter and gaussian filter are used to remove noise from the signals.HSV model is used if the coloured images are used for image processing.CNN algorithm is used for segmentation and classification of the image signal. The input will be in the form of frequency images. The output result will identify the mood of the desired EEG frequency image whether happy, anger or depressed.CNN classifier provides the more accurate result when compared to other classification methods.

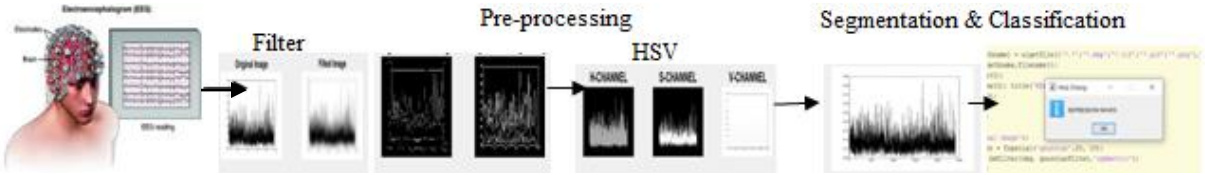

Fig1-Proposed System Diagram

IV.SYSTEM IMPLEMENTATION

The implementation starts with recording the electrical activity of brain by using electroencephalography. Once the signals are recorded they are fed as input for classification process to take place. Initial stage of classification is image pre-processing followed by segmentation and classification. Classification is the stage by which we detect the state of mind by undergoing comparison of the input image signal with the features set. It is done by using CNN algorithm. The final output will provide the emotional mind state whether happy, sad or depressed in a text format.

MODULE DESCRIPTION:

The entire implementation is split up into three modules for easier processing.

Module 1: Image Pre-processing

Module 2: Segmentation

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Module 3: Classification of emotion
The output of image pre-processing will be segmented in the next stage and by using convolutional neural network technique it undergoes classification process.

A. Image Pre-processing
In this module noise removal and soothing of the signals is performed by using various filters, as the signals initially contains noise, in order to remove them Gaussian filter and canny filters are used.

- Gaussian filter: It is used to reduce noise especially blurred noise. It is a linear filter that is used to soothe the images.
- Canny filter: It is the most common method for edge detection of an image.

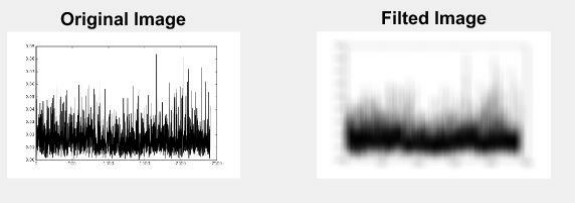

Fig 2-Image produced by Gaussian filtration

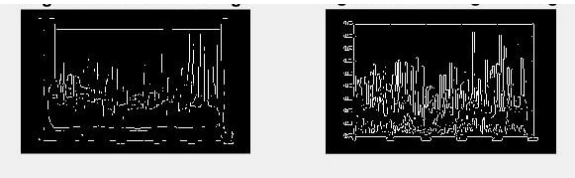

Fig3-Image produced by canny filtration

While the image processing is done for coloured images, various models are used. In our project we opted for HSV (Hue Saturation Value)model. By using this model the influence of light intensity from the external will be reduced by detecting the object with a certain colour.

Fig4- Output of HSV Channel

B. Dataset
We downloaded publicly available datasets from the internet, Example, Kaggle, and various other sources. The dataset is basically the signals that has been recorded by EEG to find electrical activity of the brain. The signals are frequency-amplitude graph from which various analysis could be done.

C. Segmentation
In this module, pre-processed image is used for segmentation and so enhanced image will be produced. Mostly the output of segmentation phase would be black coloured images, because during the pre-processing stage the grey scale images would have been used as input .Grey scale images are the one that has only shades of grey. The reason for using such grey scale images is that it needs less information to be provided for each pixel compared to coloured images.

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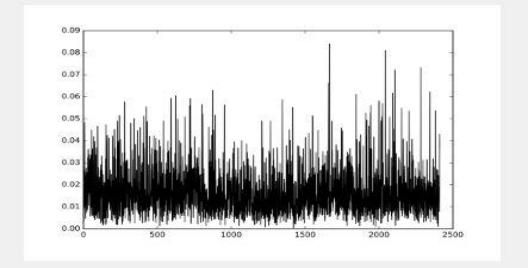

Fig5-image enhancement

D. Classification of emotion

A response, or activation, is generated by each layer of a CNN in response to an input image. However, only a few layers within a CNN are adequate for extracting image features. Basic visual elements such as edges and blobs are captured by the network's first layers. Visualize the network filter weights from the first convolutional layer. Deeper network layers integrate the early features to generate higher level picture features, which process these "basic" characteristics. Because they incorporate all of the primitive characteristics into a richer image representation, these higher level features are better suited for recognition tasks..Finally, by processing the image signals of the patient, we proposed convolutional neural network algorithm in the MATLAB software such that it concludes whether he/she is anger, depressed or happy. Now this will give the doctors an idea of the current scenario in their mental condition.

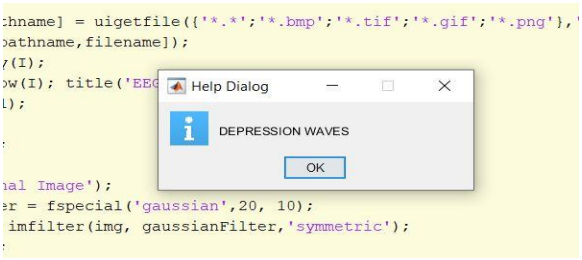

Fig6- output of classification stage

E. Performance

Accuracy:

Accuracy of the project is calculated by finding accuracy vs epoch accuracy calculation for the training data as well as testing data. From the graph obtained average accuracy is found to be greater than 90% .Epoch is defined as the one in which dataset having all the image signals are processed each once in both forward and backward to the network.

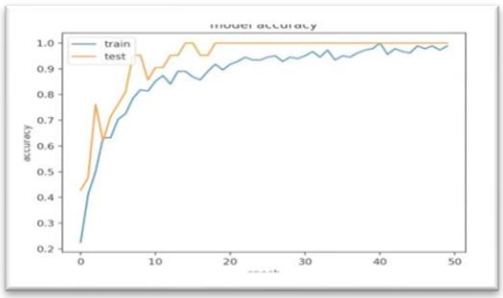

Fig7- Accuracy vs epoch

Loss : It gives us a snapshot of the training process and the direction in which the network learns.

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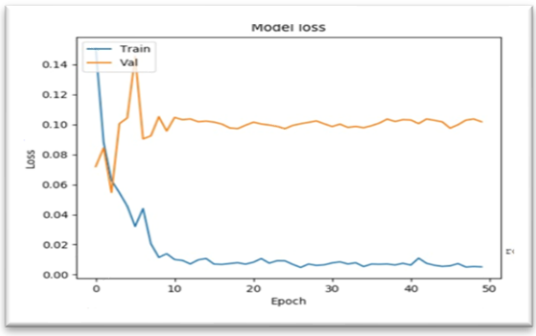

Fig9-Loss vs Epoch

Mean Square Error Vs Epoch

It is the validation performance graph between number of epochs and the mean squared error. The green circle in the graph shows that the training stopped when the validation error increased after certain iterations**.** Both the test set error and the validations set error have similar characteristics. It is shown in figure by green, red and blue color. It is understandable that with the increase in number of epochs the MSE decreases for all trained, validation and test data with insignificant variation in the slope.

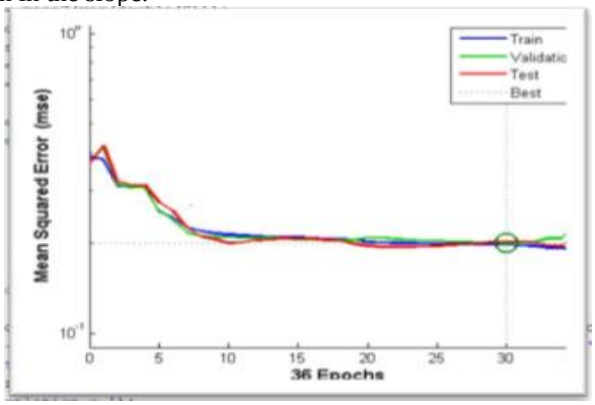

Fig8-Mean Square Error vs epochs

V CONCLUSION AND FUTURE ENHANCEMENT

Emotional Instability is a major problem nowadays that shouldn't be neglected and requires proper treatment. In many phycotic disorders and syndromes such as locked in syndrome finding the mind state of patients is much important so that the patients can be recovered from depression if they are found to be depressed or can undergo some anger management training in case of anger mind state. Thus, the novelty of our idea is to provide a diagnosis in more cost-effective and with greater evaluation accuracy, the proposed non-invasive method detects the emotional state of patients at an early stage. Furthermore, the results can be extended for therapeutic applications. With technology at its highest point of saturation, Also, automating the system involves the integration of all the modules by developing a core system that is fully automated. The future of this project is to provide an algorithm to find what the patients are thinking, that is finding the thoughts of people who are unable to express it. Mindreading has started showing its progress in the research field. Once researches related to mindreading has been made successful anything could be made possible and achieved successfully

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