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Human Emotions Detection using Brain Wave Signals

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Abstract – *Here we focal point on issues and challenges of research project that was designed to assess the different human emotions through Electroencephalogram (EEG). EEG capacity is noninvasive and reasonably priced, and have a very high sensitivity to receive information about the internal (endogenous) changes of brain state, and offer a very high time resolution in the millisecond range. Because of the latter possessions, these data are particularly suited for study on brain mechanisms of cognitive-emotional information processing which occurs in the millisecond range. It has been well known that specific cortical and sub-cortical brain system is utilized and have been differentiated by regional electrical activities according to the associated emotional states. There are important challenge we face while rising efficient EEG signal emotion thanks are: (i) designing a set of rules to stimulate unique emotion than multiple emotions, (ii) extend a efficient algorithm for removing noises and artifact from the EEG signal, (iii) utilize the appropriate and efficient artificial intelligence technique to classify the emotions. In addition, emotional activities of the brain causes difference EEG characteristics waves, it has been attempted to examine the brain activity related to emotion through analyzing EEG.*

***KeyWords*-- Electroencephalogram (EEG), DWT, Brain Computer Interface (BCI).**

1. INTRODUCTION

Emotions are a great asset in communication and a key element in social interactions. They can be used as device for signaling, direct thought, inspiring and controlling interactions. The connections can happen through vote commands, visually, using gesture recognition and at present in the field of science directly with the human brain.

Too much or too less emotions can effect rational thoughts and also presentation. Emotion plays a serious role in rational and intelligent behavior. Since long it is argued that emotional intellect is a better predictor than IQ for measure how successful a person is in his life time. When we are happy, our insight is biased at selecting happy events, equally for negative emotions. Similarly, while creation decisions, users are often influenced by their affective states. Reading a text while experience a negatively valence emotional state often leads to very dissimilar explanation than evaluation the same text as in a positive state. Feeling is an omnipresent and main factor in human life. Measuring emotion from brain activity is a comparatively original method. Popular the doldrums heavily changes as per the way of communication.

EEG is a recording of the brains electrical activity, in most cases made from electrodes over the surface of the scalp. The neuron components producing the currents are the dendrites, axons and cell bodies. The architecture of the brain is not standardized but varies with dissimilar location. Thus the EEG can vary depending on the location of the recording electrodes. EEG gamut contain characteristic waveforms which fall in 4 frequency bands viz alpha (8-13 Hz), beta (13-30 Hz), theta (4-8 Hz) and delta(¡ than 4 Hz).

2. Problem Definition and Objective

Nonverbal information appearing in human facial expressions, gestures, and voice plays an important role in human communication. Especially, by using information of emotion and/or affection the people can communicate with each other more smoothly. In order to achieve this smooth communication we first need to discover the emotions of a human being.

Human emotion detection till now was a mostly carried out on the basis of facial recognition, thermal immagiary of brain, blood volume pressure etc. All these methods are not much effective. In order to predict the correct emotion the most effective way is analyzing human brain signal. In this project we focus on predicting the accurate human emotions with the help of EEG headgear. Here we aim on providing mobility to the subject and parallely monitoring the brain signals and making the project dynamic one.

Objective:

1. Enables an individual to analyse their emotions.
2. Raw data is collected from EEG headgear and delivered to the server via Bluetooth.
3. This raw data is filtered using Feature Extraction, Wavelet Transform, Feature Reduction and Emotion Classification.

3. System Architecture

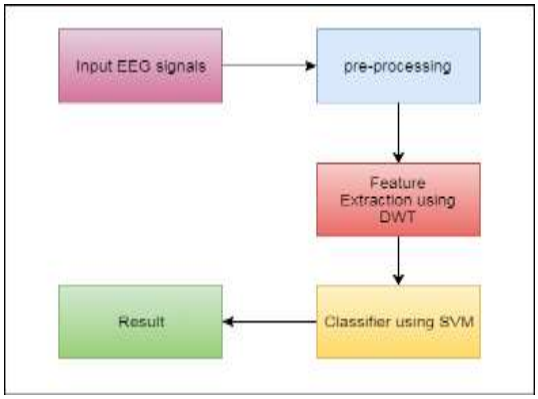


Fig -1: Block Diagram of System

Description:

Electroencephalography (EEG) is an electrophysiological monitoring technique to record electrical activity of the brain.

3.1. Noise fall:

Noise lessening is the procedure of removing noise as of a signal. All signal dealing out devices, both analog and digital, have traits that craft them disposed to noise.

3.2. Data:

Live data: Run Time monitor EEG signals from EEG Device.

3.3. Feature Extraction:

Feature extraction starts from an initial set of measured data and builds derived values (features) intended to be revealing and non-redundant, facilitating the next scholarship and generalization steps, and in some cases leading to better human interpretations.

3.4. Feature Classification:

A pattern credit technique that is used to categorize a huge figure of data into different classes.

3.5. Emotion:

This module will represent emotional state of human.

4. Algorithm

4.1. DWT Algorithm:

The discrete wavelet transform (DWT) algorithms have a firm position in processing of signals in several areas of research and industry. As DWT provides both octave-scale frequency and spatial timing of the analyzed signal, it is constantly used to solve and treat more and more advanced problems.

The discrete wavelet transform (DWT) is an implementation of the wavelet transform using a discrete set of the wavelet scales and translations obeying some defined rules. In other words, this transform decomposes the signal into mutually orthogonal set of wavelets, which is the main difference from the continuous wavelet transform (CWT), or its implementation for the discrete time series sometimes called discrete-time continuous wavelet transform (DT-CWT).

The wavelet can be constructed from a scaling function which describes its scaling properties. The restriction that the scaling functions must be orthogonal to its discrete translations implies some mathematical conditions on them which are mentioned everywhere, e.g. the dilation equation,

$$\phi(x) = \sum_{k=-\infty}^{\infty} a_k \phi(Sx - k)$$

Where *S* is a scaling factor. Moreover, the area between the function must be normalized and scaling function must be orthogonal to its integer translations, i.e.

$$\int_{-\infty}^{\infty} \phi(x)\, \phi(x + l)\, \mathrm{d}x = \delta_{0,l}$$

Following steps are performed for compression :

a) Load the image which is compressed.

b) Applying the transform-The compression algorithm starts by transforming the image from data space to wavelet space. This is done on several levels.

c) Chossing the threshold- neglect all the wavelet coefficients that fall below a certain threshold. We select our threshold in such a way as to preserve a certain percent of the total coefficients - this is known as ||quantile|| thresholding.

4.2. KNN Algorithm:

KNN can be used for both classification and regression predictive problems. However, it is more widely used in classification problems in the industry. To evaluate any technique we generally look at 3 important aspects:

1. Ease to interpret output.

2. Calculation time.

3. Predictive Power.

Here is step by step on how to compute K-nearest neighbors KNN algorithm:

Determine parameter K = number of nearest neighbors.

Calculate the distance between the query-instance and all the training samples.

Sort the distance and determine nearest neighbors based on the K-th minimum distance.

4.3. SVM Algorithm:

If you want to relate the two, an SVM might be used to perform image classification. For example, given an input image, the classification task is to decide whether an image is a cat or a dog. The image, before being input into the SVM might have gone through some image processing filters so that some features might be extracted such as edges, color and shape.

SVM is fundamentally a binary classification algorithm. It falls under the umbrella of machine learning.

5. Advantage

1. User Friendly
2. Wireless EEG Signal Acquisition.
3. Mobility.

6. Outcome

1. The main aim of our project is to identify the human emotions by using cost effective means.
2. The other focus is to provide mobility to the user while he/she is capturing the brain waves.
3. The system captures the brainwaves of the subject and processes it to predict the correct emotion.
4. The result is the human emotion displayed in the form of an emoji and the graphs which displays the brainwave attributes.

7. Application

1. Medical applications:

Healthcare field has a variety of applications that could take advantage of brain signals in all linked phases including avoidance, detection, diagnosis, rehabilitation and restoration.

2. Games and entertainment:

Entertainment and gaming applications have opened the market for non-medical brain computer interfaces. Various games are accessible like in where helicopters are made to fly to any point in either a 2D or 3D virtual world. combine the features of existing games with brain controlling capabilities has been subject to many researches such as which tend to provide a multi-brain activity experience. The video game is called Brain Arena. The players can join a collaborative or competitive football game by means of two BCIs. They can score goals by imagining left or right hand movements.

3. Neuromarketing and advertisement:

Marketing field has also been an interest for BCI researches. The research in have explained the benefits of using EEG valuation for TV advertisements related to both commercial and following fields. BCI based assessment measures the generated attention connected watching activity. On the other hand, the researchers of have considered the impact of another cognitive function in neuromarketing field. They have been involved in estimating the memorization of TV advertisements thus providing another method for advertising evaluation.

4. Educational and self-regulation:

Neurofeedback is a promising approach for enhancing brain performance via target human being brain activity intonation. It invades the educational systems, which utilizes brain electrical signals to determine the degree of lucidity of studied information. Personalized interaction to each learner is recognized according to the resultant response experienced. Learning to self-regulate through noninvasive BCI have also been studied. It provides a mean for improving cognitive therapeutic approaches.

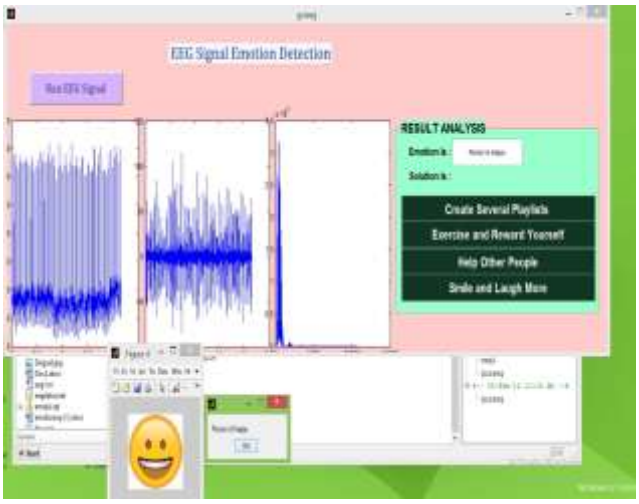
5. Smart Environment:

Smart Environments such as smart houses,workplaces or transportations could also exploit brain computer interfaces in offering additional safety, luxury and physiological control to humans daily life. They are also expected to

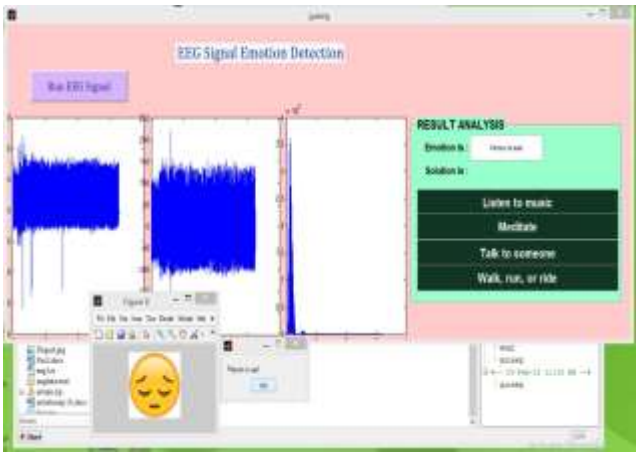
witness cooperation between Internet Of Things (IOT) and BCI technologies.

8. Screen Shot:

1. **HAPPY:**



2. **SAD:**



9. CONCLUSION

The emotion recognition from the EEG signal, and also the findings of effectual data recording from physiological signal, feature extraction , data reduction, mark categorization through SVM, real time applications and the scope for future research.

10. Future Scope

1. Using advanced algorithms for prediction of emotions.

2. PC games where the player can control the game based on his/her thoughts.

3. To identify if the patient will suffer from subconsciousness.

4. Brain controlled wheelchair.

5. Brain controlled robotic arm.

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