"EFFICIENT HUMAN EMOTION RETRIEVAL USING BCI AND SPEECH"

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Abstract - *This paper reports on the human emotion recognition using different set of electroencephalogram (EEG) channels using discrete wavelet transform . Emotion recognition could be done from the text, speech, facial. In the past few days, many studies have been done on emotion recognition. Anderson utilized facial expressions to recognize emotion . However, these signals shared the same disadvantage. They are not reliable or perfection is not theirto detect emotion, especially when people want to conceal their feelings. In this paper, The EEG-based emotion recognition algorithm based on spectral features and neural network classifiers is proposed. In this algorithm, spectral, spatial and temporal features are selected from the emotion-related EEG signals by applying wavelet transform. we concentrate on recognition of "inner" emotions from electroencephalogram (EEG) signals as humans could control their facial expressions or vocal intonation. We observe the different brain position as Left Hemisphere and Right Hemisphere to recognize the significance according to different moods. The powers of alpha are more alert during National, Happy, Romantic mood as compared to Sad mood. We have used "db6" wavelet function for deriving a set of conventional and modified energy based features from the EEG signals for classifying emotions.*

Key Words: EEG, Human Emotion, Discrete Wavelet Transform, Speech etc…

1. INTRODUCTION

A brain–computer interface (BCI) is a system that can be communicated in between brain and a computer by which a person can send messages without any use of peripheral nerves and muscles. The ability to effectively classify electroencephalograms (EEG) is the basic building block for Brain-Computer Interfaces. In this proposed work EEG signals will be used to specified the extract data and classify with different variety of human emotions using speech.

Emotion is most important for humans. It is not only contributes to communication between humans, but also plays a critical role in rational and intelligent behavior. Its functions can be seen in many aspects of our daily lives. It is needful system in human. Thus, the study of emotion recognition is indispensable. The system defined a mechanism of quantification of basic emotions using emotion model. In this study we show that it is possible to recognize the different moods of person using EEG signal. We observe the different brain locations as Left Hemisphere and Right Hemisphere to recognize the significance according to different moods like (happy ,sad ,surprise ,anger) The powers of alpha are more exciting for during National, Happy, Romantic mood as compared to Sad mood. So it is possible to distinguish these different moods using alpha power values. The distance matrices also show that it is possible to differentiate the emotions of persons using alpha power values. Traditionally, EEG-based technologies were used only in medical applications like epilepsy and seizures .EEG used in many sophisticated place that given to perfect result.In the past few decades, many studies have been done on emotion recognition. Anderson and Mc Owan utilized facial expressions to recognize emotion . Ang and colleagues did emotion recognition based on prosody. However, these signals shared the same disadvantage. They are not reliable to detect emotion, especially when people want to conceal their feelings. In recent years, more and more researchers have started to use EEG signals in recognizing emotion because they are reliable.

2. RESEARCH METHODOLOGY

2.1. EEG Data Acquisition

A good database is highly essential for developing intelligent emotion recognition system in EEG. There is no universal database is existing for this work. Hence, we designed a acquisition of customize data protocol using audio-visual stimuli (video clips) to induce discrete emotions . All the video clips and songs are collected from various sources such as international standard internet database, etc. Before showing the stimuli to the experimental subjects, a pilot panel study is conducted over 15 university students to select the most dominant emotional stimuli for evoking unique emotion on the subjects during the data collection. As a result of this pilot panel study, eight (8) video clips for four emotions (happy, sad ,fear ,normal) and four (4) video clips have been selected .

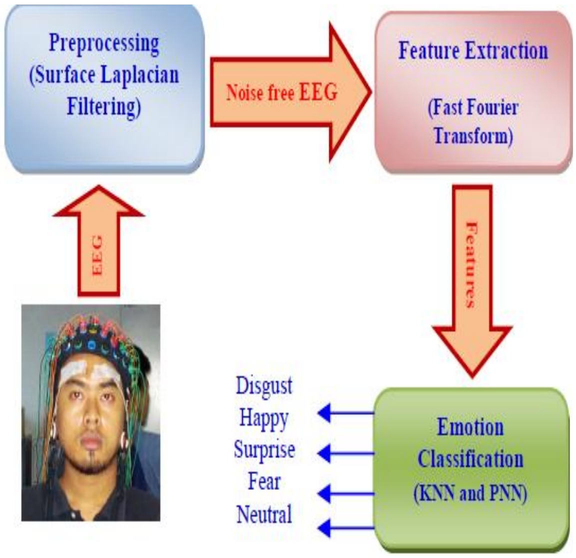

Fig. 1. Emotion Recognition system overview

The selection of video clips is based on self assessment questionnaires mentioned . The flow of research methodology of this work is given. Two females and two males in the age group of 21~25 years were employed as subjects in our experiment. Once the consent forms were filled-up, the subjects were given a simple introduction about the research work and stages of experiment . Between each video emotional clips, under self assessment section, the subjects were informed to answer the emotions they have experienced . Finally, 3 trials for happy and sad emotions and 3 trials for fear and neutral emotions are considered for further analysis.

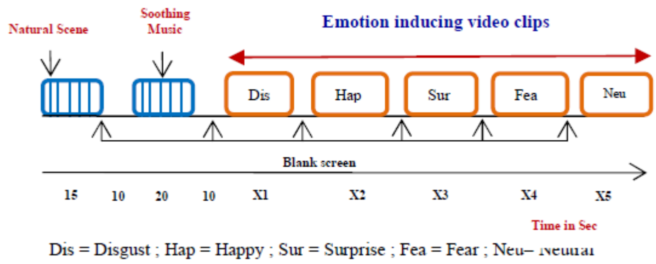

Fig. 2. EEG data acquisition protocol using audio-visual stimulus

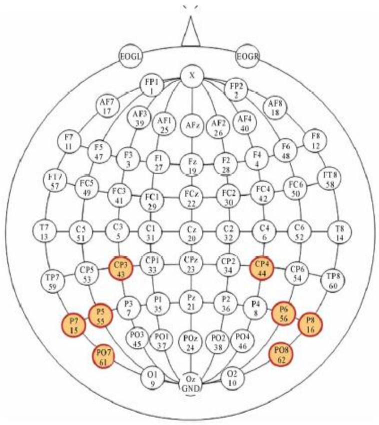

Fig. 3.Electrodes diagram 8 channel

Flow chart

No. of Emotion trials

(HAPPY,SAD,FEAR,NORMAL)

↓

Raw EEG signal

↓

Preprocessing Surface Laplacian filtering

↓

Feature Extraction

↓

80% training and 20%

Fig. 4. Experimental flow of emotion recognition using short time EEG signals

2.2. Preprocessing and Normalization

EEG signals recorded over different positions on the scalp are usually contaminated with artifacts Muscular noises Vascular (ECG) and Gloss. The complete removal of artifacts will also remove some of the useful information of EEG signals. This is one of the reasons why considerable experience is required to interpret EEGs clinically .A couple of methods are available in the literature to avoid noises in EEG recordings. However, removing artifacts entirely is impossible in the existing data acquisition process .In this project, we use of Surface Laplacian (SL) filter for removing the noises and artifacts. The SL filter is used to emphasize the electric activities that are spatially close to a recording electrode , filtering out those that might have an origin outside the skull. The activities of neural generated by the brain however it contain various spatial frequencies. Potentially useful information from the middle frequencies may be filtered out by the analytical surface Laplacian filters. Hence, the signal "pattern" derived from SL filters is similar to "spatial distribution of source in the head".

The mathematical modeling of Surface Laplacian filter is given as

$$X_{new}(t) = X(t) - \frac{1}{N}\sum_{i=1}^{N} X_i(t)$$

Where Xnew : filtered signal ; X(t) :raw signal ;

N : Number of neighbor electrodes

2.3. Feature Extraction

2.3.1.Wavelet Transform:

The different types of temporal and spatial approaches have been applied to extract features from the physiological signal. However, they are lacking in simultaneous frequency of time measurement with multi-resolution analysis (MRA) . The joint time-frequency resolution obtained by Wavelet Transform makes it as a good candidate for the extraction of details as well as approximations of the signal which cannot be obtained either by Fast Fourier Transform (FFT) or by Short Time Fourier Transform .Wavelet analysis transform allows the use of long time intervals where we want most correct low frequency information, and shorter-regions where we want frequency of high information.

Table 1. Decomposition of EEG signals into different frequency bands with a sampling frequency of 256 Hz.

Frequency Range (Hz)	Decomposition Level	Frequency Bands	Frequency Bandwidth (Hz)
0–4	A5	Delta	4
4–8	D5	Theta	4
8–14	**D4**	**Alpha**	**6**
14–32	**D3**	**Beta**	**18**
32–64	**D2**	**Gama**	**32**
64–128	D1	Noises	64

In this project work, the multi-resolution analysis of "db6"Discrete Wavelet Transform (DWT) has emerged as powerful technique in diverse areas such as Multi-Resolution Analysis (MRA), peak detection and feature extraction of physiological signals and biomedical images. Normally, the EEG signals are complex and non linear in nature. The non linearity and complexity of EEG signals can signify the different emotions of the human wavelet function is used for decomposing the EEG signals into three frequency bands (alpha, beta, and gamma) that are considered for deriving the statistical features.

2.4. Classification of Emotion

In this work, we can use the linear classifiers such as Probabilistic Neural Network (PNN) and K Nearest Neighbor (KNN) are used for classifying the discrete emotions.

2.4.1) PNN (Probabilistic Neural Network) : The radial basis network function (RBF) is a PNN and mainly used in pattern recognition applications. The person who firstly proposed the PNN is Specht.PNN is the implementation of a statistical algorithm called kernel discriminate analysis in which the operations are organized into a multilayered feed forward network.

2.4.2) K Nearest Neighbor (KNN): The KNN provides extremely fast evaluations of unknown inputs calculated by distance calculations between a new sample and mean of training data samples in each and every class weighed by their covariance matrix. This KNN classifier makes a decision on comparing a new labeled sample testing data with the training data.

3. RESULTS AND DISCUSSIONS

Among all Three subjects, 5 trials of emotions happy, surprise ,sad ,fear and normal and sampled for emotion classification. As a total, there are 25 EEG epochs from five discrete emotions. The number of data points in each epoch depends on the time duration of video clips. In our work process; the time slot of video clips vary from one another. In this work, a specific interest is shown on selecting the most dominant emotional provoking video clips through pilot panel study and thus confirms the originality of this EEG database. The entire feature vector is divided into 80% for training the classifier and 20% for testing the system. The next stage is to train the KNN and PNN classifier with a best value of K and P, respectively on classifying the emotions. we found that, the 62channel EEG data gives the maximum individual classification rate on five motions (happy, surprise, sad, fear and neutral) compared to other channel sets. The maximum subsets of emotions classification rate of 80% is achieved using 62 channels EEG signals. Hence, the 62 channel EEG performs better over other channels sets for classification of human emotion .The trajectory was almost consistent with the true changes.

4. CONCLUSIONS AND FUTURE WORK

This present work is aim to analyze the short time EEG to discrete emotion recognition based on the processing of EEG signal. Our research is that ,In our project the research is the lack of international standard data base. Here, the modified energy features classify the emotions better than the conventional features with higher classification rate. simple classifiers (KNN and PNN) is used in proposed work. we also analyzed the EEG signals over different frequency bands for emotion classification.

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