ORIGINAL RESEARCH PAPER

Medical Science

ECG ANALYSIS FOR EMOTION DETECTION USING MACHINE LEARNING APPROACH

KEY WORDS:

Ms Rubina Khan Maharashtra ,India

ABSTRACT

Emotions are feelings which one can feel and are hard to be put in a form by a person. Emotions like joy and sadness can be somehow detected from the facial expressions or through the body language. But these emotions do have an impact upon our system. Electroencephalogram is one of the measure in Medical field through which one can know the impact of different parameters such as stress, joy, sadness, anger on the mechanism of our body. The emotions such as anger, sadness have a adverse effect on the cardio system which can be detected through the electroencephalogram. In other way we can be able to say that through an ECG one can be able to know the emotional state of a person.

I. INTRODUCTION

There are certain emotions which are easily detected through language or expressions.

These emotions could be because of the surrounding conditions or could be because of some external stimuli.

The emotions expressed by viewers could give an insight to the mental status of any individual.

This analysis of human emotions can be used in medical field, education and so on.

The greatest difficulty in correlating the emotions and the reasons giving rise to these emotions is that these factors or reasons are not visible .

Also one cannot be certain of the emotions using the facial or behavioral responses as maybe the individual could very well suppress ones true emotions.

So we cannot be certain that a person is emoting the expressions as he is exactly feeling at that particular instance.

hence the exact emotion cannot be inferred in such cases.
In this work, our main aim was to detect the emotions in a person based on their physiological response.

The response or the emotions are to be recognized using the electrocardiograph(ECG) obtained from the subjects.

The ECG signals are to be analyzed .

for different emotions such as joy, sadness anger and fear.

The ECG signal is a result of a stimuli from the circumstances or situations and is a cardiovascular original.

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The other physiological signal are the electroencephalogram ,electromyogram ,galvanic skin response responses, blood pressure and heart rate.

These signals are used for the clinical analysis but the amount of information they carry regarding the emotional status of an individual is very small percent.

The most difficult task related to this analysis is the gathering of data or data collection.

One can have a laboratory set up where the response is gathered by applying various emotional stimuli.

The standard data bank is used for training and creating model.

II. DENOISING &FEATURE EXTRACTION

The aim of this work was to detect emotions from ECG signals .

The utilized data set consists of a set of ECG images. The ECG signals were denoised and analyzed.

Analyzed ECG signals from multiple candidates were used.

The physiological signals are non-linear for which fourier transform being a conventional method may not provide resolution .

It is desirable to develop a method which do not assume stationary.

The HHT is a new tool for such type of non stationary data.

A combination of advanced signal processing and machine learning techniques can be used for the characterization of Physiological signals.

In feature extraction if the features extract are carefully chosen then it is expected that the feature set will extract information from the input data so as to work on the task.

After computation of large number of features the best emotion can be evaluated.

The four emotions use the Huang Hilbert transform as the feature extraction technique.

for de-noising the signals an adaptive low pass filters are used For an ECG signal we need to determine the R peaks from which we are able to extract the R-R interval.

The sampling frequency for this time interval is irregular.

Hence the need arises for the resampling of the signal with a proper resampling frequency of 4Hz is used.

Only the relative amplitude is considered by deleting the baseline signal.

The signal is normalized by its mean and standard deviation Once the de-noised signal is obtained the feature extraction is employed.

The HHT comprises of the empirical Mode Decomposition (EMD) and Hilbert transform. The most important step of the HHT process is the EMD process with which any data set can be decomposed into a finite and small number of Intrinsic Mode Functions(IMF).

Each IMF satisfies two conditions in the whole dataset. The number of extrema and the number of zero crossings must be equal or differ almost by one.2) at any set point the mean value of envelope defined by local maxima and envelope defined by the local minima is zero.

In the fission process the feature is extracted from each IMF.

The feature vector is composed of combination of these features. In the fission process For a given signal x(t) the algorithm used will include the following:

1. Identify all the extrema (minima and maxima) d0 (t)=X(t)
2. Interpolate between the minima and the maxima separetly to obtain the upper and the lower envelope eu (t) and el (t)
3. Calculate the average m(t)= eu (t) and el (t)/2
4. Extract the details d1 (t)= d0 (t)-m(t)
5. Repeat the steps till the detail signal meets the definition of an IMF.

The stopping criteria is really important for estimating IMFs which can affect other IMF components. A criteria based on two thresholds ϴ1 and ϴ2. which agree for small fluctuations in the mean value.

The value of ϴ1 =.o5 and ϴ2=10 ϴ1 .The mode amplitude is given by a(t)= eu (t) – el (t). The evaluation function is ∝ (t) The iteriation function is carried till ∝ (t)< ϴ1 for a time (1-∝) while ∝ (t)< ϴ2 for remaining

period. The original x(t) can be reconstructed using superposition

$$x(t)= \sum_{i=1}^{n} c1(t) + rn(t)$$

where n= number of IMFs

The second step in HHT is the Hilbert transform Which which is applied to each IMF component.

$$H[ci(t)]= I/\pi \ PV\int_{-\infty}^{+\infty} \frac{ci(t)}{t-t}$$

where PV is the Cauchy principal value

I. FISSION AND FUSION.

The fission process is based on the decomposition of the signal into n IMFs by applying EMD The number of IMFs for each biosignal can be varied from n_{max} to $n_{min.}$ We can calculate the root mean square ,maximum amplitude, mean instantaneous frequency and weighted mean instantaneous frequency of each IMF.

Features can be extracted from each IMF. The feature vector is formed from the features of the first(1.... n_{min}) IMFs. Comparing the performance of features based on different number (1....n_{min}) of IMFs we choose the feature of the first m.

Fusion Process: The fusion process aims at combining the information from the different IMFs and is calculated from the mean frequency(MNF) of signal. The classification system is based on the given steps fission, fusion of signals.the next step is feature extraction and then classification. The main difference when compared with fission is the estimation of MNF.Each signal is segmented using half overlapped windows EMD is applied to each segment. The weighted mean instantaneous frequency of each IMF with N samples is found out.

To obtain the instantaneous frequency information for every IMF the derivative of the phase is calculated

$$F_i(t)=\frac{1}{2\pi}\frac{d_i(t)}{d(t)}$$

Support Vector Machine

Support vector machine is one of the most popular machine learning algorithm. It is a discriminative classifier formally defined by a separating hyperplane. The algorithm outputs an optimal hyperplane which categorises new e xamples.The important characteristic of an SVM classifier is that it tries to achieve a good margin.A good margin is one where this separation is larger for both the classes. A good marginallows the points to be in their respective classes without crossing to other class. and applied it on emo- tion recognition from speech.

The SVM is done by transforming transforming the problem using linear algebra.We can use linear kernel,polynomial kernel or the exponential kernel.In the linear kernel method of SVM the discriminant function is given by:

$$F(x)= sgn(\sum_{j=1}^{M} yj(\alpha jK(xj,x) + b)$$

Where M =number of training examples

Xj =training example

Yj=correct sample of SVM of the i_{th} training example

K=kernel function

αj =lagrange multipliers

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