Research Journal of Engineering Sciences ______________________________________ ISSN 2278 – 9472
Vol. **10(1),** 54-57, January **(2021)** *Res. J. Engineering Sci.*

Short Communication

Human behavioral analysis using ECG and EEG

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Available online at: www.isca.in, www.isca.me
Received 8th September 2020, revised 23rd November 2020, accepted 27th December 2020

Abstract

To improve human and machine interaction, detection of positive or negative emotions play the lead role. There are some basic human emotions like anger, disgust, fear, happiness, sadness and surprise. Some emotions are positive like happy and surprise (at some cases) and some emotions are negative like anger, sadness, disgust, fear. Here, EEG (Electroencephalography) and ECG (Electrocardiography) can be mainly analyzed to get better result to detect these emotions more than the usual face expression recognition where the subject can have control over. Another part of this work is ERP which is also known as event-related potential is a measured response of cognitive behaviour or any motor event. While moving any part of our body human brain is the main controller. Brain Computer Interface (BCI) is a device that allows brain to communicate with computational devices. In this paper, a database has been taken where the subject is a 21 years old, right handed male without any medical condition. The database is recorded while the subject was moving both of his hands and when the hands were in baseline. Here, the difference between the two tasks and the effects on the brain because of the motor movements will be discussed. Not only in Brain Computer Interface but also in medical field, analysis of behaviour using hand gestures can be the most effective matter of interest.

Keywords: Emotion recognition, EEG, ECG, ERP, BCI, Motor Movement.

Introduction

The EEG is the process of an electrophysiology which is used to monitor and also this signal records all the electric activities of the brain[1]. In the health monitoring field, EEG and ECG signals are used to detect many diseases. Sometimes some clinical indications from the patients are observed by these signals and can be checked the consciousness of the patients[3]. Human behavioural analysis using EEG and ECG are mainly implemented through the technique of HMI and BCI[4]. In this present work, the output shows more accuracy as it is a part of emotions. Detecting the difference between positive and negative emotions, there will be a new path opened towards the improvement of the intelligence in humanoid robots as well as in the medical field[5]. In this paper, R.M.S (Root Mean Square) values are used to detect and calculate the difference between the two kinds of emotions and also in hand movements[6] which can bring a new era to the HMI (Human Machine Interface).

Methodology

Now-a-days in modern health care industry HMI is used in various treatment methods. In this research work, the analysis of EEG & ECG data has been used to understand the hand movement gesture of human body. The acquired signals has been processed acquiring data from sources[7]. Then the data are processed for feature extraction. All these data are used for monitoring and show the outputs and then used for hand or motor movements. Here internet can be implemented to show the parameters of all the analysed data of the patient in digital display to the doctors also from remote location[8].

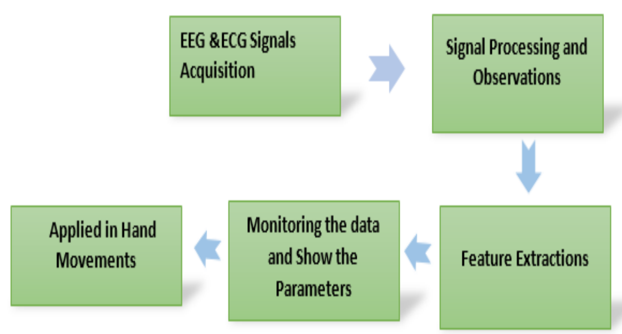

Figure-1: Block Diagram of the proposed work using EEG & ECG.

When a human brain is in negative emotional state, the temperature of the body rises and then the output gives signal and the electrical activity in brain changes as well[2]. The electrodes must be placed on the scalp properly and silver electrodes are used. Initially the body parameters are set as input, while the subject is in different emotional situations, the physiological parameters are triggered. After acquiring the raw data, they are being filtered, pre-processed regarding the noise or any kind of disturbances in the signal are to be performed. Then by using interfacing board the subject is tested.

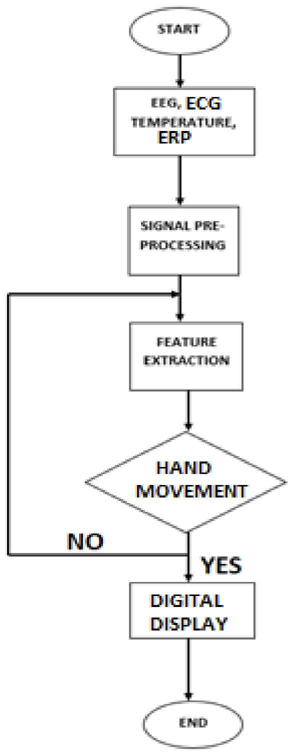

Figure-2: Flow Chart of Hand Movement analysis using Bio signals.

Results and discussion

The EEG and ECG data are collected from the UC Irvine Machine Learning Repository database.

After arranging the data for the left and right hands differently to calculate the deviation from the baseline, in MATLAB, the "Regression Learner" has been used. The "baseline" was chosen as the predictor parameter to analyse the deviation properly for each hand (left and right). From the graphs, it is observed that the left and right both hands have the highest average deviation (positive and negative) from the baseline at f8 (-263.352 & -167.06) electrode and f3 (245.108 & 201.08) electrode. On the other side, the lowest deviation (positive) from the baseline has been observed (left hand) at bo1 (19.56) electrode and PZ (-17.17) electrode whereas the negative lowest deviation has been observed at t3 (43.43) and t5 (48.71) electrodes. For every electrode the range is fixed for each deviation. Regression algorithms are done by the using of machine learning. In this process the input data are known as training data. In statistics, regression is used to get the relationship between two dataset (output and input). The data should depend on other one so that one can predict the cause behind all data one has.

Conclusion

In the present work, the EEG data are analysed with the help of regression algorithms. Using the output, can make a hand movement device or system based on these analysed data. It can be also used to detect the brain & muscle related problems in biomedical industry. In the observation, noticed that both the left and right hand movements show positive and negative deviation values. EEG and ECG both the data are taken from Physion et or online dataset. This work will be helpful for the patients and it will open a new treatment process in health care industry.

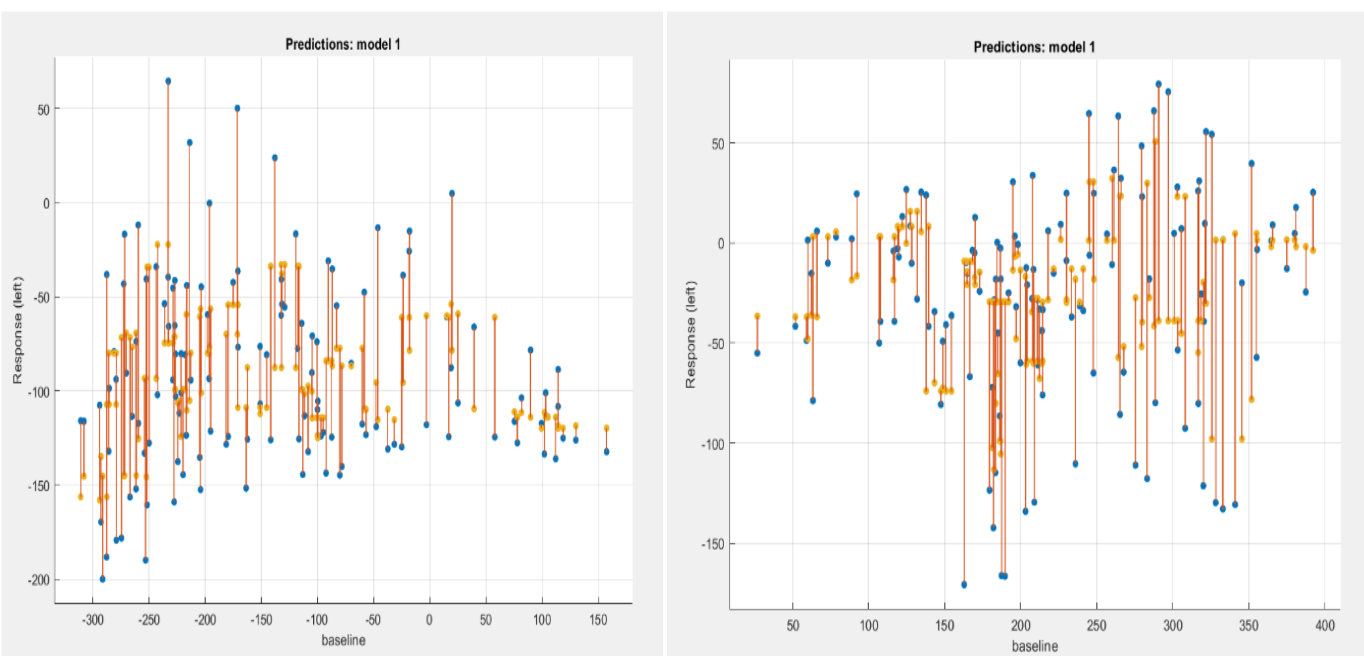

Figure-3: Deviation of electrode F3 from baseline (both left and right hand).

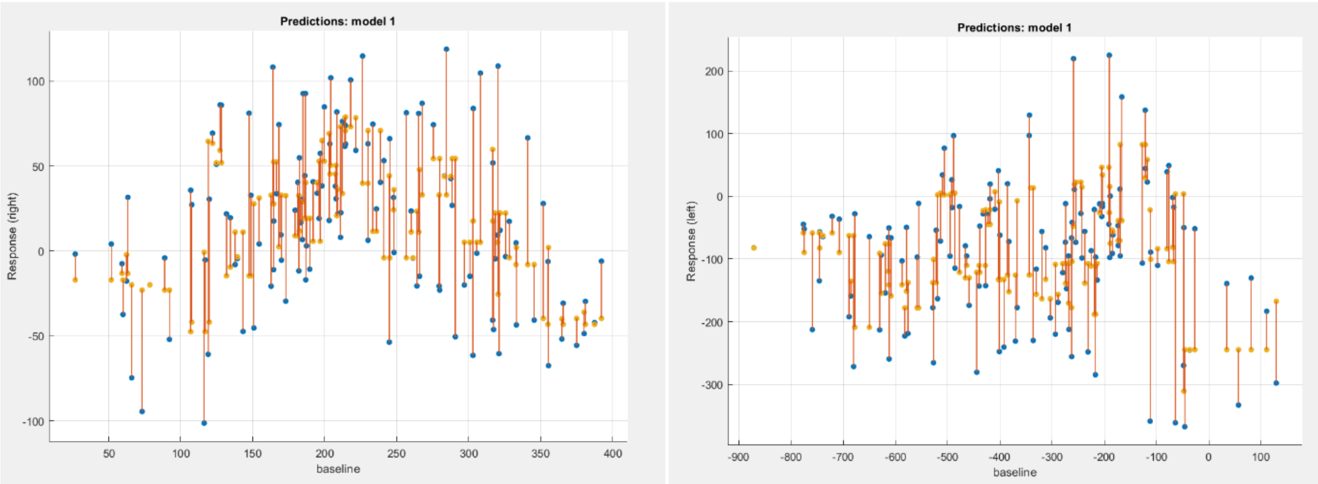

Figure-4: Deviation of electrode F8 from baseline (both left and right hand).

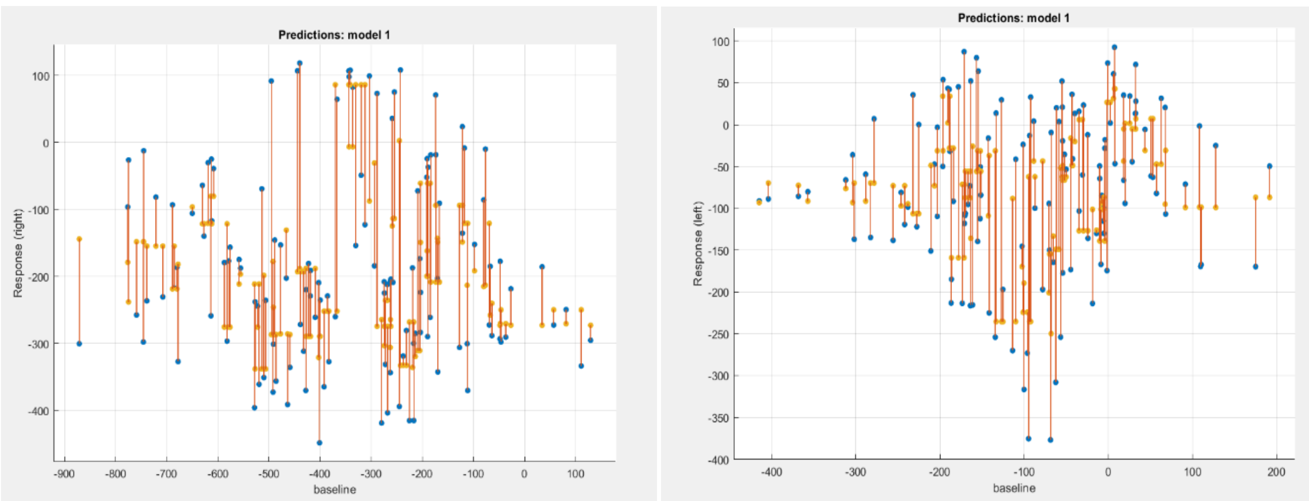

Figure-5: Deviation of electrode O1 & PZ from baseline (left hand).

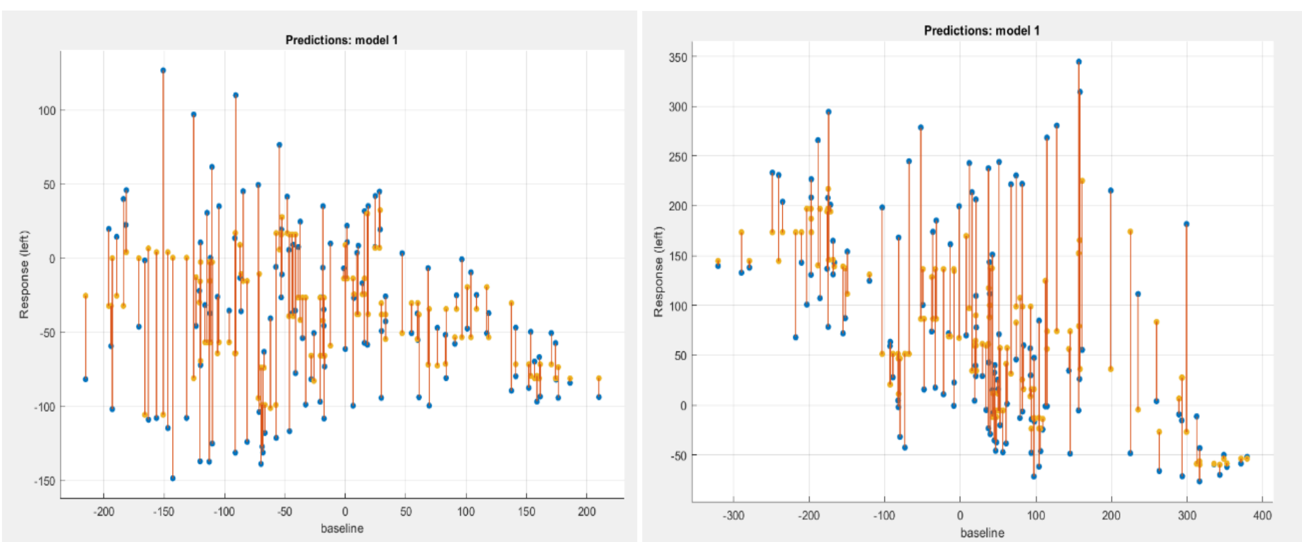

Figure-6: Deviation of electrode T3 & T5 from baseline (left hand).

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