ANALYSIS, APPLICATION AND FUTURE SCOPE OF EEG SIGNALS

1Ashok V, 2Kavin Kumar K, 3Bobby Chakravarthy B,
Department of Electronics and Communication, Kongu Engineering College, India.
vashok.research@gmail.com, kavinece07@gmail.com, bobbychakravarthyb.13ece@kongu.edu.

ABSTRACT

Electroencephalography provides the possibility of recording the electrical activity of the brain and analyzing them using the conventional techniques available. Moreover the collection of continuous EEG data is beneficial to record the activities of physically/mentally challenged persons and to perform research on them for elicited stimuli. By providing external stimuli we can help the physically or mentally challenged people to recover from their situation.

Keywords – EEG, Analysis, Estimation of EEG.

1. INTRODUCTION

Electroencephalography is the study dealing with the recording and analysis of the electrical activity of the various structures of the brain. The recorded data called electroencephalograph is the electrical activity of the brain recorded using metal electrodes and a conducting medium that supports propagation of EEG signals. The recording is obtained as a result of the local currents flowing in the brain. These potentials are created by K+, Na+, Ca++ and Cl- ions, which are pumped from one neuron to other. Since a single neuron activity is difficult to be recorded. EEG is taken as the summation of the synchronous activity of the neurons with spatial patterns [1]. The recorded data from the EEG is further classified into waves using wavelets transform as α-wave, β-wave, θ-wave and δ-wave. These waves are used for the research and developments for various diseases and treatment for them.

2. RECORDING TECHNIQUE

Various methods are used for measuring the electrical activity of the brain using EEG technique. The commonly used materials for EEG recording and analysis consists of components like Electrodes with conductive media, Amplifiers with filters, A/D converters and recording device. The electrodes fetch signals from the brain surface which will then be converted into a higher level range for estimation. The ADC converts the data into a digital form which can be used for processing and storage in a computer or for research purpose.

The neuron activity of the brain can allows measurement of the electrical changes on a time as well as frequency domain. The electrode placement is based on 10-20 International system. The number of electrodes may vary for different application since the required data for every application is not the same. However, a number up to 128
electrodes is recognized as a standard one [2]. Continuous EEG measurements are preferred in a large number of applications. So the electrical activity is noted for a time period and recorded.

3. LITERATURE REVIEW

The analysis of EEG signals can be done by conventional methods that are readily available in the industry. Bayesian Analysis can be used for the estimation of the Depth of Anesthesia administered to a patient as described in [3]. The measurement of DoA can be done by wavelet transformation techniques as denoted in [4]. Here the various responses that were recorded from the patient include respiratory effort, lacrimation, heart rate, movements, blood pressure, pupil status, etc. from this experiment the status of patients activity under anesthetic conditions were revealed.

In a study that deals with the estimation of brain death using EEG data in [5], Turning Tangent EMD algorithm (2T-EMD) was used. The late Empirical mode decomposition (EMD) algorithm that was used for time/frequency analysis was used for studying water surfaces. Later it was taken to study EEG energy between comatose patients and that of quasi/semibrain death. This was taken since the activity of the previous will always be higher than that of the non active components of quasi brain death [6]. However, the EMD algorithm cannot be used in the EEG decomposition for single channel processing. Hence EMD was replaced by 2T-EMD algorithm. Using this algorithm the analysis revealed that the patient had a strong physiological brain activity in case of comatose patients. For quasi brain death the physiological brain activity was extremely low.

A work based on P300 detection using Conventional Neural Networks (CNN) for Brain Computer Interfaces (BCI). The P300 which is an event triggered action potential that takes place as a result of the targets selected by the user. This is used for decision based events. A P300 speller is designed based on this principle. Based on the CNNs and the P300 speller, several experiments were conducted and hence a new system was developed. However the detection of P300 is a challenging task for machine learning communities. Further improvements in this research area can lead to object identification from character recognition as described in [7].

Extending EEG waves application in the field of Information security and biometric recognition, a study based on this can be taken under consideration [8]. Since EEG patterns of different persons are not the same the EEG recorded can be used under any circumstance without change or error with minimal failure of the system So Cognitive biometrics can be used in situations where more security is needed rather than taking images of iris, fingerprint, face, etc. EEG biometrics projections proves to be successful and with notable improvements in recognition rates are achieved with EEG signals with a set of electrodes at certain limited places. This can further be extended to implement brain computer interfaces.

The EEG data obtained for experimental analysis is never a single channel data. But a multichannel data, which needs to processed to get the wave patterns. Common Spatial Patterns is a Spatial filtering algorithm that can be used for the analysis of EEG waves by implementing the Fukunaga-koontz transform as described in [9]. The applied technology can be subjected to future use and research.

The analysis of EEG signals along with the facial expressions [10], [11] revealed that the EEG signals played a important role in the estimation of the positive and negative emotions and moods in [12]. According to the study
the EEG signals could render more information about the subject under study rather than the facial patterns which can be readily analyzed. Continuous emotion patterns were recognized and processed with a background study supporting the research. The conclusion that higher frequency component provided detailed information about the pleasantness of emotion and the results were superior for the sequences with positive emotions than the negative part. The future research of the project could be on the spontaneous expressions elicited by external stimuli.

4. EEG FOR THE PHYSICALLY / MENTALLY CHALLENGED

Based on the finding from the referenced papers, a new system can be thought of where the colour perception can elicit specific stimuli in the brain of the patient under study. From [12], it can be evident that video and objects can cause specific variations in the brain of the people. Thus by continuously monitoring and stimulating their visual cortex part by sensible colours the electrical activity can be recorded. Supporting information based on EEG based biometrics and brain death detection also reveal that the electrical activity is an important factor and is specific to a person. By separating the multichannel EEG obtained and analyzing them the wave patterns the normal characteristics and the elicited characteristics could be analyzed. Continuous recording of the neural activity and analysis is essential to obtain the anticipated results.

A separate system to process the obtained EEG signal is to be designed using signal processing algorithms that can filter out unwanted signals and further comparing them with normal values of wavelets by denoising and filtering out unwanted data. On successful implementation of the project with careful study and analysis, it could serve the physically challenged people in recovering to normal life by developing separate products based on the purpose.

CONCLUSION

The study made can be implemented and further improvements can be applied to get better solution to provide a solution for the physically challenged persons. EEG data can be collected and stored for a large number of persons and comparative study can be made for eliciting emotional stimuli.

REFERENCES


[2] Yannick Wamain, Francois Gabrielli and Yann Coello, “EEG μ rhythm in virtual reality reveals that motor coding of visual objects in peripersonal space is task dependent”, Univ. Lille, CNRS, CHU Lille, UMR 9193 – SCALab – Sciences Coginitive et Seicnces Affectives, Lille, France (Pg 20-30).


