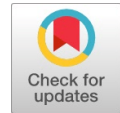


Detection of Human Brain Activities in a Normal Human being



Ashima Sindhu Mohanty, Krishna Chandra Patra, Akshya Kumar Sahoo

Abstract: Detection of artifacts produced in EEG data by eye blinks is a very common problem in EEG research. In this paper we address the detection of eye blink artifacts in a motor imagery (MI) EEG data. Artifacts are nothing but some kind of disturbances present in the brain signal whose origin is not the brain itself. Detection of unwanted artifacts plays a crucial role to acquire artifact free and clean brain EEG signals to analyze and detect brain activities. There are generally two ways of generation of artifacts. From a recorded signal most common and important artifacts in the form of eye blinks are recognized and encapsulated. In this paper a new software tool named BRAINSTORM is introduced for the detection of eye blink artifacts.

Keywords: EEG, MI data, artifacts, BRAINSTORM

I. INTRODUCTION

The EEG is the electrical signals from brain which are evaluated by putting electrodes over the scalp of the head.[1] Generally, the magnitude of an EEG signal generally ranges from 40 μ V to 100 μ V with 0 to 100 Hz range of frequencies. [2] Inside the brain, the bioelectrical signals are associated with ionic operation which arises due to electrochemical activities resulting in electric current.[9] When membrane channels of cells open, there is a increase in potential. Hence ion may diffuse across the membrane, and hence there is an existence of positive electric charge. In the biological neural system, the axon channel and dendrite are joined through a synaptic weight, which carries the signal from one neuron to the next as shown in fig1.[9] The artifacts are present in EEG signals which are generally considered as some kind of disturbances or interferences in a signal. There are numerous artifacts which can be divided into external and internal. According to research and study, it is justified that external activities of brain results in external artifacts whereas actions within the brain gives rise to internal artifacts. The frequency content of an artifact is generally 50Hz. The same scenario arises in recordings which use a battery as power source. A uniform electric field is produced by the surrounding walls and electric cables. Along with this,

due to generation of electromagnetic fields, the measured signals get interrupted by external devices. [3]

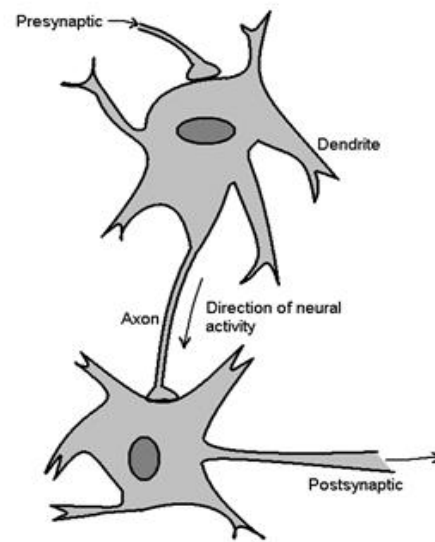


Fig.1

II. COLLECTION OF DATA

The Motor imagery EEG data is collected from PhysioNet online data storage, which offers free web access to large collections of recorded physiologic signals (PhysioBank) and related open-source software (PhysioToolkit). Different databases like clinical database, waveform Database, Multi-parameter database, ECG database, Interbeat (RR) Interval Databases, Other Cardiovascular Databases, Gait and Balance Databases, Neuroelectric and Myoelectric Databases. EEG, EHG, Image Databases and Synthetic Data. The EEG Motor Movement/Imagery Dataset is present in Neuro electric and Myoelectric Databases. [4] This data set collected, has of over 1500 one- and two-minute EEG recordings, obtained from 109 Subjects performed different motor/imagery tasks while 64-channel EEG were recorded using the BCI2000 system clearly explained in the data set. 14 experiments are performed by each subject including 2 one minute baseline runs with eyes opened and closed one after another and 3 two minute runs with the following activities[4]

Manuscript published on 30 August 2019.

*Correspondence Author(s)

Mrs. Ashima Sindhu Mohanty, Dept. of Electronics and communication engineering, GIET University, Gunupur, india

Mr. Akshya Kumar Sahoo, Dept. of Electrical Engineering, GIET University, Gunupur, india

Dr. Krishna Chandra Patra, Dept. of Electronics and communication engineering, GIET University, Gunupur, india

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an open access article under the CC-BY-NC-ND license <http://creativecommons.org/licenses/by-nc-nd/4.0/>

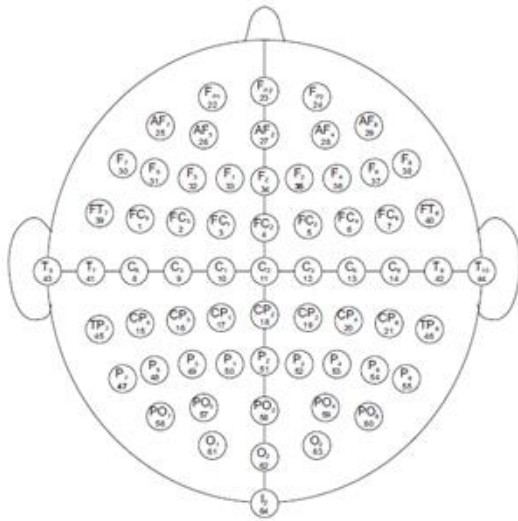


Fig.2

1. On the left or right side of the screen, a target emerges. As long as the target does not disappear, the subject opens and closes the corresponding fist.
2. On either left or right side of the screen, a target emerges. As long as the target does not disappear, the subject conceptualizes the opening and closing of corresponding fist.
3. On either left or right side of the screen, a target emerges. Till the target disappears, the subject opens and closes either both fists (if the target is at top) and both fists (if the target is at the bottom). Then the subject relaxes.
4. On either left or right side of the screen, a target emerges. Till the target disappears with the target at the top, the subject opens and closes either both fists or both feet with the target at the bottom. Then the subject relaxes.

The data are imparted in European Data Format (EDF) with 64 EEG channels collecting the signals at a sampling rate of 160 SPS, and an observation channel.

To be implemented with physio Toolkit software, Physio Bank-compatible observation file (with the suffix `.event`) was generated by a `rdedfann` for each recording. Similar data are contained in the `.event` files and the observation channels in the corresponding `.edf` files.

Any of the three codes given by T0, T1, or T2 is contained in each observation

- T0 indicates to rest
- T1 indicates to start motion (real or imagined) of left fist (in runs 3, 4, 7, 8, 11, and 12) and both fists (in runs 5, 6, 9, 10, 13, and 14)
- T2 indicates to start motion (real or imagined) of right fist (in runs 3, 4, 7, 8, 11, and 12) both feet (in runs 5, 6, 9, 10, 13, and 14)

According to international 10-10 system (which excludes electrodes Nz, F9, F10, FT9, FT10, A1, A2, TP9,

TP10, P9, and P10), the EEGs were recorded from 64 electrodes as shown in fig.2

III. SOFTWARE TOOL USED

In this paper collaborative, open-source software named BRAINSTORM is used for analysis of brain recording. BRAINSTORM is an open-source software supported by MATLAB scripts. The language used is either Java or MATLAB commands. The use of MATLAB along with Java makes BRAINSTORM platform a completely portable and user-friendly application.[5][6]

The advantages of above mentioned languages in a research environment are the simplicity to modify, maintain, exchange, and reuse functions and libraries. Now a days, Python has become a better choice for any projects as it is a non-commercial and open source software and also easy for understanding, BRAINSTORM was built fundamentally from of pre-existing MATLAB scripts. The MATLAB is a high-performance prototyping tool. One important feature as well as advantage for users of BRAINSTORM, is that even MATLAB licence is not there still the BRAINSTORM toll can be supported by MATLAB scriptsand it is freely available as an open source to be downloaded for any kind of operating systems, readily available as 32 bit or 64 bit.

By using this software there is necessity of opening MATLAB window and no interaction is required, hence no requirement of license, but still all MATLAB functions can be accessible through the GUI, BRAINSTORM can also be used without any MATLAB Programming languages. For the advanced applications, where the MATLAB license is readily available with anyone, it is also possible to use and run the MATLAB commands as generally it is performed in MATLAB environment , and all data structures manipulated by BRAINSTORM could be easily accessed from the command window of MATLAB. BRAINSTORM also has the features of automatic updating system which automatically checks the command

A. Simulation and result discussion

The different artifacts available in the signal are cardiac and eye blink and the signal S001R01.edf is simulated by BRAINSTORM software to detect the artifacts. The motor imagery EEG signal is recorded through 65 channels and displayed for 60 seconds. The artifact contents are shown in different colors. The cardiac's are shown in the display at different positions (seconds).

In channel x1 following artifacts are visualized at different positions in table.1

Artifacts	Location (seconds)	Channel
blink10	9.644 s	x1
blink11	11.463s	x1
blink12	12.281s	x1
blink13	14.213s	x1
blink14	15.093s	x1
blink15	16.150s	x1
blink16	30.512s	x1
blink17	33.215s	x1
blink18	44.031s	x1
blink19	46.664s	x1
blink8	4.800s	x1
blink9	7.719s	x1

Table.1

In channel x2 following artifacts are visualized at different positions in table.2

Artifacts	Location (seconds)	Channel
blink3	10.650s	x2
	36.962s	
blink4	25.113 s	x2
	26.469 s	
blink5	28.56 s	x2
	34.800 s	
blink6	39.769s	x2
	49.350 s	
blink7	47.419s	x2
	55.763s	

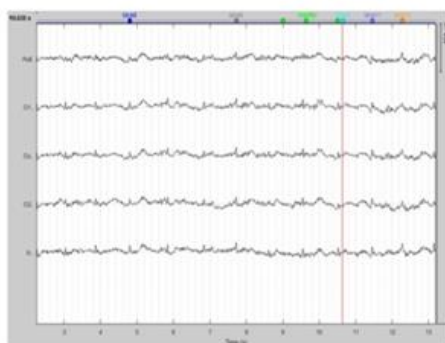
Table.2

In channel x3 following artifacts are visualized at different positions in table.3

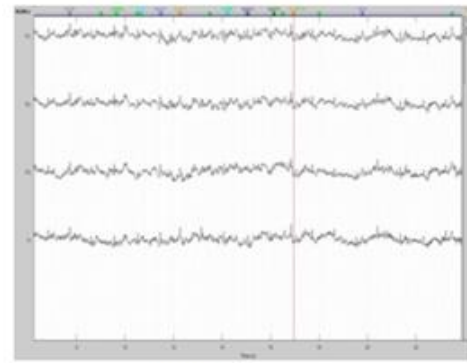
Artifacts	Location (seconds)	Channel
blink 01	19.788 s	x3
	38.156 s	
	42.888s	
blink2	16.956s	x3
	24.194s	
	32.075s	

Table.3

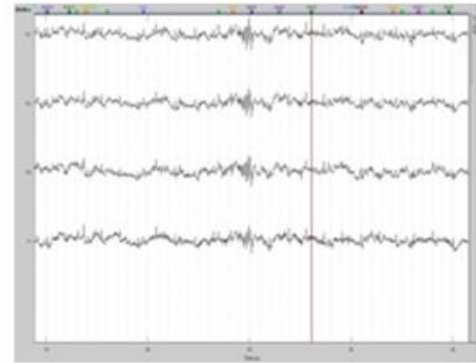
Different positions (in sec) for eye blink artifacts have been detected and some of them are shown in the figures below



Blink 2



Blink 3



Blink 5

IV. CONCLUSION

Artifacts are present differently in EEG signal and there is not such a one single method for dealing them. It is an important parameter that whether the artifacts are useful or non useful.[7]Here, in this paper a graphical way called brainstorm is presented for detecting the artifacts, After the artifacts have been detected, the unusual artifacts can be removed by different methods, the detected part of the signal is simply deleted. The same GUI can be used in future for the removal of severe artifacts from severe brain diseases like autism, epilepsy etc.

REFERENCES

1. Sornmo L, Laguna P. Bioelectrical signal processing in cardiac and neurological applications, Elsevier Academic Press, 2005. ISBN: 0-12-437552-9
2. Fisch, BJ. EEG PRIMER Basic principles of digital and analog EEG, 3rd edition, Elsevier Academic Press, 1999. ISBN: 0-444-82147-3
3. Binnie C, Cooper R, Manguire F, Osselson J, Prior P, Tedman B. Clinical Neurophysiology, Elsevier Academic Press, 2003. ISBN: 0-444-51257-8
4. <https://physionet.org/>
5. Francois Tadel, Sylvain Baillet, John C. Mosher, Dimitrios Pantazis, and Richard M. Leahy. Brainstorm: A User-Friendly Application for MEG/EEG Analysis. Hindawi Publishing Corporation, Computational Intelligence and Neuroscience Volume 2011, Article ID 879716, 13 pages doi:10.1155/2011/879716.
6. <https://neuroimage.usc.edu/brainstorm>
7. Antti Savelainen, An introduction to EEG artifacts, 63220J, 20 February 2010.

8. Vernon Lawhern, W. David Hairstonb, Kaleb McDowellb, Marissa Westerfieldc, Kay Robbinsa. Detection and classification of subject-generated artifacts in EEG signals using autoregressive models. Journal of Neuroscience Methods 208 (2012) 181– 189

AUTHORS PROFILE



Ashima Sindhu Mohanty completed her B.Tech in Applied Electronics & Instrumentation Engineering and Master degree in Electronics & Instrumentation Engineering both from BPUT Odisha. She is pursuing her Ph.D at SUIT(Sambalpur University), Sambalpur, Odisha. She has 8 years of experience in teaching field and at present she is working as an Assistant professor in Electronics & Instrumentation Engineering Department, GIETU, Gunupur. Her interest fields are Control systems, Signal and Image Processing



Dr. Krishna Chandra Patra has completed his M.Tech degree in Electronics & Communication Engineering from IP University, Delhi and PhD in from Delhi University. He is Presently working as an Assistant Professor in SUIT, Sambalpur University. He has published 17 papers in various National and International Journals. He has completed Collaboration Project b/ w MCIT and Japan Govt. on Ubiquitous Technology in Communication. [2006 -2008] His interest field includes Advance Communication Tech. and related Electronics and Photonics.



Akshya Kumar Sahoo completed his B.Tech in Electrical & Electronics Engineering and Master degree in Electronics & Instrumentation Engineering both from BPUT Odisha. He is pursuing her Ph.D at GIETU(Gunupur), Odisha. He has 12 years of experience in teaching field and at present He is working as an Assistant professor in Electrical Engineering Department, GIETU, Gunupur. His interest fields are Control systems, Signal and Image Processing.