

# Neurosky EEG Biosensor Using in Education

Mehmet Barış Tabakcioğlu<sup>\*1</sup>, Hüseyin Çizmeci<sup>2</sup>, Doruk Ayberkin<sup>3</sup>

Accepted 3<sup>rd</sup> September 2016

**Abstract:** Brain is composed by neurons using electricity to communicate to each other. There is a great amount electrical activity in the brain due to collection of numerous neurons sending signal. Neurons send brainwaves detected by sensitive equipment like electroencephalogram or electroencephalograph (EEG). Beta waves emanates from brains responsible for problem solving or decision making. Some equipment like neurosky biosensor intercepts these brain waves. In this study, neurosky biosensor is used in measuring the meditation level of students in the physics course. Developed program process the data of neurosky biosensor sent and make decision about meditation level of student in the course. Program says that “your meditation level is low to pass another subject or solve the exam”.

**Keywords:** Brainwaves, neurosky biosensor, EEG, education, neurolearning.

## 1. Introduction

Our brain is made up of billions of neurons using electricity to communicate to each other. There is a great amount of electrical activity in the brain thank to sending signals. This electricity can be detected by equipment such as electroencephalograph (EEG). Electrical activity in the brain composes brainwaves. Brainwaves are produced by synchronised electrical pulses from masses of neurons communicating with each other. Brainwaves are divided into bandwidths to describe their functions however are best thought of as a continuous spectrum of consciousness.

Brainwaves change regard to what we're doing and feeling. In the case of that slower brainwaves are dominant; we can feel tired, slow, sluggish, or dreamy. On the contrary in the case of that higher frequencies are dominant, we feel hyper-alert. Brainwaves are classified into groups with respect to frequencies in Hertz, like gamma, beta, alpha, theta and delta.

Frequency of delta waves changes between 0.5 and 3 Hz. Delta waves slowest whereas loudest brainwaves. Delta waves generated in deepest meditation and dreamless sleep as shown in Fig. 1.

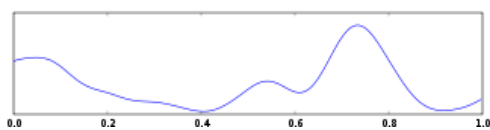


Figure. 1 Delta Waves

waves generated in deep meditation and sleep illustrated in Fig. 2.

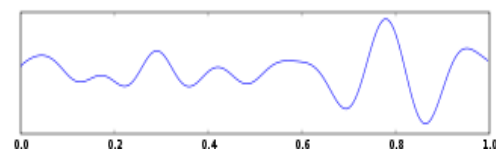


Figure. 2 Theta Waves

Frequency of alpha waves changes between 8 and 12 Hz. Alpha waves responsible for now and no quite meditation. Alpha waves generated in calmness and learning as illustrated in Fig.3.

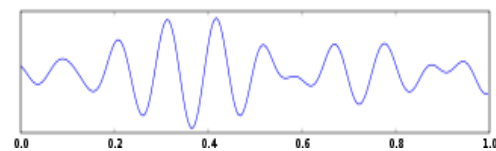


Figure. 3 Alpha Waves

Frequency of beta waves changes between 12 and 38 Hz. These waves are dominant in waking state of consciousness and engaged with problem solving and decision making.

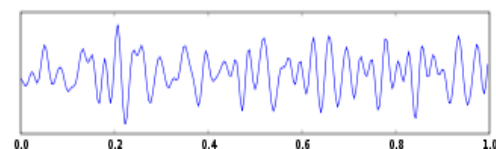
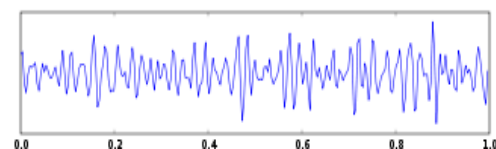


Figure. 4 Beta Waves

Frequency of gamma waves, fastest changes between 38 and 42 Hz [1, 2].



<sup>1</sup>Electrical and Electronics Engineering Department, Engineering Faculty, Bursa Technical University, Bursa, Turkey

<sup>2</sup>Computer Programming Department, Vocational School, Hitit University, Çorum, Turkey.

<sup>3</sup>Computer Programming Department, Vocational School, Bayburt University, Bayburt, Turkey.

\*Corresponding Author: Mehmet Barış Tabakcioğlu  
Email: [mehmet.tabakcioglu@btu.edu.tr](mailto:mehmet.tabakcioglu@btu.edu.tr)

Note: This paper has been presented at the 3rd International Conference on Advanced Technology & Sciences (ICAT'16) held in Konya (Turkey), September 01-03, 2016.

Figure. 5 Gamma Waves

Neurosky EEG biosensor, which is a non-invasive, dry and low cost, can intercept the brainwaves, measures the attention and meditation level is illustrated in Fig. 6.



Figure. 6 Neurosky Biosensor

Neurosky EEG biosensors can be used in education [4]. Meditation and attention rates shows difference in the case of different room colour. By changing the room colour these meditation and attention rates can be increased [5]. In order to observe how the rates changes, a lot of game is developed [6]. Neurosky EEG biosensor can be used for identifying the emotion while playing game [7]. In this study, neurosky EEG biosensors are used in measuring the meditation level of students in the course. Developed program process the data of neurosky EEG biosensors sent and make decision about meditation level of student in the exam. Program says that “your meditation level is low to solve the exam or pass to another subject”.

## 2. Education with Neurosky Biosensor

We have developed a program by means of using neurosky biosensor. Firstly, instructors and students have to be sign up this program as demonstrated in Fig.7.



Figure. 7 Sign up

Instructors sign in the program and load the course materials in the form of text, power point, image and video. Main menu of the developed program is illustrated in Fig.8.

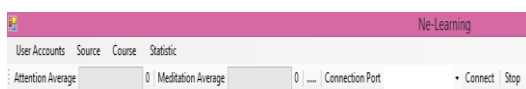


Figure. 8 Menu of program

As it is seen in Fig.8, average attention and meditation rate while studying is recorded. Instructor can enter the program and upload the course materials. The students can enter the developed

program; wear the neurosky biosensor while studying. Firstly, courses are offered as shown in Fig. 9.

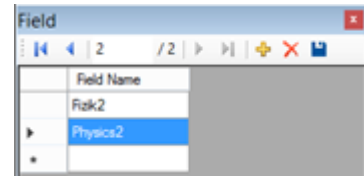


Figure. 9 Offering the courses

Secondly, subjects of courses are entered as depicted in Fig. 10.

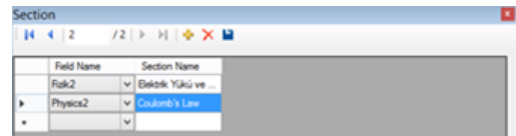


Figure. 10 Subjects of offered course

Thirdly, lesson names, required average attention and meditation rate for subjects are determined as illustrated in Fig. 11.

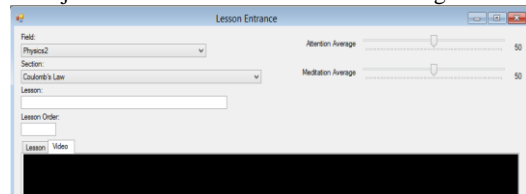
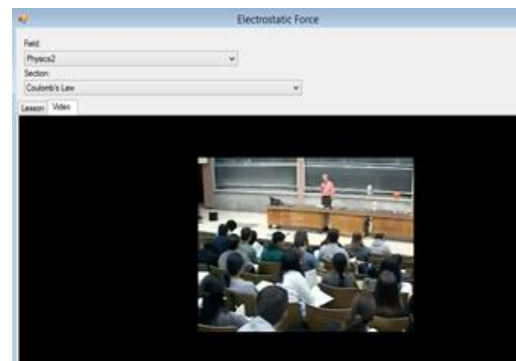


Figure. 11 Lessons of subjects

Fourthly, course materials are uploaded into developed program as demonstrated in Fig. 12 a-b for text and video upload respectively.



(a)



(b)

Figure. 12 Course material upload

Finally, after course materials are loaded, student can enter the system and study the subjects. During studying period, attention and meditation rates are recorded. When the students want to pass another lesson in the case of lower meditation and attention rate, the system gives the warning like “your attention and meditation level is lower than predetermined value for that reason you cannot pass another lesson”. Also instructor can see the statistical mean of the meditation and attention rate as shown in Fig. 13.

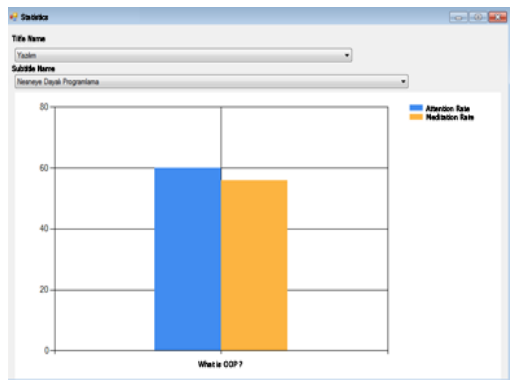


Figure. 13 Statistical mean of the recorded values

Students study while wearing the neurosky biosensor as shown in Fig. 14.

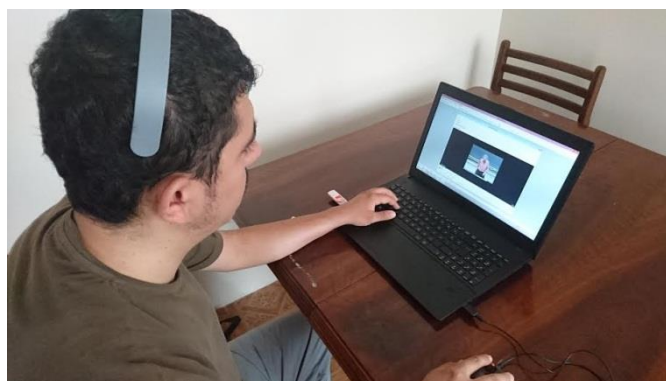


Figure. 14 Student studying while wearing biosensor

If the meditation and attention rate of the students are higher than predetermined rates, they can pass to another lesson. Otherwise they are not permitted to pass another lesson as illustrated in Fig. 15.

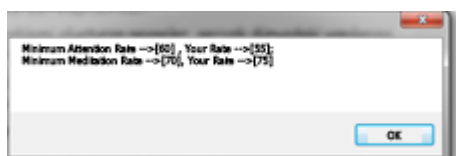


Figure. 15 Less attention rate case

### 3. Conclusion

Brain emanates brainwaves in doing or feeling something. These brainwaves can be intercepted and processed by equipment like neurosky biosensor. In this study, neurosky biosensor used for measuring meditation and attention rates of student. We have developed a computer program. Via the program, we load the course materials into system. Students enter the system with their user name and password. Then study the first subject. If meditation and attention rates are high students pass to second subject. Otherwise, students have to study the subject again. Whenever these rates are high, students pass to second subject.

### Acknowledgements

This work is supported partially by Bursa Technical University Scientific Research Projects Unit under the grant no. 2016-01-021.

### References

- [1] Transparent Cooperation homepage, [Online]. Available: <http://www.transparentcorp.com/products/np/brainwaves.php>
- [2] Brainworks homepage, [Online]. Available: <http://www.brainworksneurotherapy.com/what-are-brainwaves>.
- [3] Neurosky homepage, [Online]. Available: <http://neurosky.com/>
- [4] Crowley, K., Sliney, A., Pitt, I., Murphy, D., Evaluating a Brain-Computer Interface to Categorise Human Emotional Response, 10th IEEE International Conference on Advanced Learning Technologies, 276-278, 2010.
- [5] Bozkurt, F., Coskun, H., Aydoğan, H., Effectiveness of Classroom Lighting Colors Toward Students' Attention and Meditation Extracted From Brainwaves, Journal of Educational and Instructional Studies in the World, Vol. 4 Iss 2, 2014, pp. 6-12.
- [6] Yıldırım, N., Varol, A., Developing Educational Game Software Which Measures Attention and Meditation with Brainwaves: Matching Mind Math, ICEE ICIT Conference, 325-332, 2013.
- [7] Yoon H., Park, S.W., Lee, Y.K. and Jang, J.H., Emotion Recognition of Serious Game Players Using a Simple Brain Computer Interface, IEEE International Conference on ICT Convergence, 783-786, 2013.