The Effect of Meditation on Brain Relaxation Incorporating Different Physiological Activities

The Effect of Meditation on Brain Relaxation Incorporating Different Physiological Activities

A R Nurul Nabilah [1], **S Khairul Azami** [1], **A K Y Dafhalla** [2], **M R Huda Adibah** [1], **Y Naimah** [3]

[1]Department of Electrical and Computer Engineering, Kulliyyah of Engineering International Islamic University Malaysia.
[2]Department of Computer Engineering, College of Computer Science and Engineering
University of Ha'il, Kingdom of Saudi Arabia.
[3]Advanced Computing, Centre of Excellence (CoE), Universiti Malaysia Perlis (UniMAP), Perlis, Malaysia

Corresponding author email: irbellrazak@gmail.com

Abstract. Anxiety and depression have become such a widespread illness. It has been affecting people's health which can lead to suicidal tendencies. Studies related to depression and stress with the nervous system had been conducted and showed that slow music could be one of the methods to reduce stress. Electroencephalogram (EEG) signal is found to have potentials to detect brainwave signal as in real time data as well as history data through Bluetooth wireless communication. All the signals utilized in this paper are obtained from few experiments done, which contains of various physiological activities done by the volunteers. The features of EEG signal then will be extracted using EEG recorder. Based on the experimentation result, it can be observed that different physiological activities will result in different dominant brainwave signal. For sitting at rest, shows alpha wave dominant compared to others. For the second physiological activity which is listening and reciting the zikr, shows delta wave is the most dominant compared to alpha, beta, theta, and gamma and for walking in the park showed presiding in beta wave. As for the benchmarking, all the three physiological activities were compared to know which brainwave is the most ascendant. In addition, this study is a better alternative to the current approaches since it proves that zikr will change a person state of brain to be more relax and calming. Thus, the research will propose a study of the effect of brainwave on brain relaxation in corporation with different physiological activities to help anxiety and stress patient to relax and stay calm.

Keywords: Alpha wave, Brain Relaxation, Brainwave, Delta wave, Electroencephalogram (EEG), Physiological Activities.

1. Introduction

The main organ of human that act as the coordinating center of the nervous system is known as brain. It is found within the head, near to the tactile organs for senses such as vision. It is also known as the most complex organ in human's body. Cerebrum, brainstem, and the cerebellum are the three main parts that comprises in the brain [1]. Signal of brain waves activity can be detected by using electroencephalogram,

which is common test used to evaluate the electrical activity in the brain. It can moreover distinguish the potential issues related with movement of brain. The electrical impulses in an EEG waves recording allow doctors to quickly assess whether there are any abnormal patterns. Any impairment or abnormalities may be a sign of seizures or other brain disorder [2].

Apart from that stress which can leads to suicidal is also related to brain activity whereby the brain can think of the rationality and the impact of suicidal. According to WHO close to 800000 people die due to suicide every year, which is one person every 40 seconds. It is a global phenomenon and occur throughout the lifespan. It is the second leading cause of death among 15-29 years olds globally [2]. Thus, it is very important to know the current brain state and to ensure that our brain is in relax mode and the activities in the brain is balance. Several methods have been proposed to measure mental health status such as Heart Rate Variability (HRV) and Electrocardiography (ECG). However, these previous techniques are invasive, not portable, and use only one physiological activity. Therefore, this study will design a system which could overcome the shortcoming of the previous method. The pro- posed system will use the effect of brainwave and use Electroencephalogram (EEG) that offers port- able, non-invasive and use different physiological activities. Thus, the effect of brainwave on brain relaxation of different physiological activities system will be proposed and developed.

2. Literature Review

This subtopic consists of two parts which are the basic terminologies and related works of this study. The basic terminologist will further discuss on the theoretical information with regards to the research whereas the related works will discuss on the findings of previous studies linked to the study.

2.1. Basic Terminologist

First and foremost, a brief on the basic terminologies of the various types of brain wave will be explained in detail. Generally, the study conducted is to study and prove that zikr can helps to relax the brainwave activity by reading and listening to the zikr. Monitoring the brainwave activity of human is very important since it can help to have early detection of serious disease such as distress and insomnia. Insomnia usually happens when the blood flow to the brain is blocked due to many factors such as distress, mental health disorder and lifestyle. Besides that, the study also use wireless as medium of transferring data from the device to phone. Bluetooth is a wireless technology standard for exchanging data over short distance from fixed and mobile devices [10]. Bluetooth is preferred as the medium of transmission as it produces less radiation.

Brainwave signals mainly categorized into five types of waves which are Delta, Theta, Alpha, Beta and Gamma as Tab. 1. Each of the brain waves has its normal frequency ranges in which it operates. Gamma waves usually associated with higher mental activity, including perception, problem solving and consciousness. The frequency range more than 40Hz. Beta waves relates to active, busy thinking, active processing, active concentration, arousal and cognition. The frequency range is from 13Hz to 39Hz. Alpha waves having frequency from 7Hz to 13 Hz associated usually with calm relaxed yet alert state. Theta waves is mainly when a person is in deep mediation or relaxation besides rapid eye movement sleep which is in the range of 4Hz to 7Hz of frequency. Finally, Delta waves which is less than 4Hz is when a person is in deep dreamless sleep and loss of body awareness [6]. Figure 1 shows the types of brainwaves signal.

Table 1: Type of Brainwaves

Types of brainwave	Frequency (Hz)	Decision Making
Delta	0.2 – 4	Dreamless and deep sleep. It is the slowest level of brainwaves. In Calm and relax state [6].
Theta	4 - 7	The peak of relaxation or light sleep. Theta is very receptive mental state [6].
Alpha	7 – 13	Awake in state of relaxed and not handling much information [6].
Beta	13 – 29	Wide awake. This is basically the mental state of most people during the day and awaken lives [6].
Gamma	> 40	Gamma is related to the production of memory processing, ideas, various types of learning and learning of language [6].

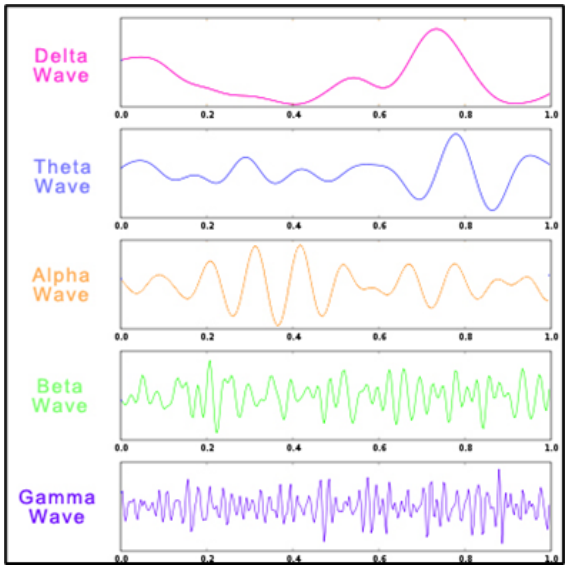

Figure 1: Types of brainwave signal.

2.2. Related Works

As mentioned previously, there are many techniques used to detect EEG of human brain waves. In this section, several sample techniques and methods are discussed and compared based on few studies that had been done for the effect of zikr on the brain signal. This study will focus on the EEG signal.

First and foremost, Nanda et al. in [3] proposed a technique to measure EEG by using brain computer interface (BCI). A group of volunteers of various age range which are from 5 to 75 years old were asked to wear a device called Mindwave Mobile Headset and the reading of their focus and meditation were measured. The result shows that the female subject had lower focus level while answering math question within 100 seconds than male subjects. However, the male subject had lower meditation level than the female subject according to the experiment done. The author also compares the data measured with and without noise. However, based on the research, the author did not mention the exact number of subjects of the experiment. Thus, the accuracy of the data gain for the result cannot be confirmed.

Abdurrochman et al. in [4] conducted a study whereby 5 subjects were to be tested by asking the subjects to listen to the relaxation music and Al-Quran recital for certain duration. Based on the test done, the author proved that Quran recital are dominant in Delta waves as compared to relation music.

Apart from that, the author also conducted another test where different zikr and Quran recital were played, based on the second test, the author proved that pass-praying zikr recital were the most dominant in its Delta signal. However, the author is not consistent in which certain recital duration is longer than another which might cause the data captured to be imbalanced, besides, there is no ana- lytical result explained in the paper. The author explained the results with only graph representation.

Helman et. al. in [5] proposed to measure EEG signal of 5 subjects by using Emotiv EPOC, a device to capture raw EEG signal while the subjects were asked to listen to zikr and slow rock music for 2 minutes. As a result, the author found out that during the zikr playlist were played, Alpha wave is high as compared to Beta wave which conclude that during zikr was played, the subjects were in calm state as compared to when slow rock music were played. Besides that, the author also proves that the usage of EEG device as meditation tool for individual self-regulatory purposes. However, this research was to compare between Alpha and Beta waves during zikr meditation. The author did not mention the other waves which related to the study which is Delta waves which is more likely to describe a person relaxation state. Besides, the paper also explains its result in graph representation, no analytical data was explained.

Besides that, Norsiah and Normardina in [7] applied eEEG Mitar to 10 subjects of 7 females and 3 males to measure their dominant brain activity. The research was done to identify which brain waves are dominant in response to Al-Quran and Zikir recitation. Based on the research done, the author found that Delta waves are the most dominant with regards to the test done. The study specifies the data gained based on the test precisely and explained the results in detail. However, the result shows less accuracy as the number of female and male are imbalance. Apart from that the subject were selected randomly without knowing their ability to recite Al-Quran which might affect the data acquired. Besides that, the author mentioned that the data was collected in limited time thus some of the data imbalance.

Other than that, Nadia et al. in [8] performed a study which is to investigate university students stress level and brainwave balancing index (BBI) in the early and end of semester. In this study, the brainwave was recorded by using g-Mobilelab. Volunteers consist of 29 students were tested their brainwave balancing index (BBI) and stress level whereby their EEG signal were taken. The author introduces comparative study from same subject and analyze each subject brainwave activity with regards to the stress level of the subject in the beginning and towards the end of semester and found out that BBI level of the students is inversely proportional to the stress level of the students. The result showed that at the end of semester the percentage of stress among student is higher besides the BBI level is also high during end of semester compared to beginning of semester. However, the author shows more graphical analysis and less analytical analysis which is hard to be verified. Besides that, the method used was not explained in detail. Apart from that, the author also did not analyze the data obtained from the experiment done.

As a summary, different types of sensors can be used to measure brainwaves of a person like Mindwave Mobile Headset, Emotiv EPOC, Heart Rate Variability (HRV) device and others. How- ever, Brain-Link can provide a low-cost solution as it is easily available in the market. Besides that, it should be user friendly and portable since the user must wear it at their head without have to take off the cap or scarves for Muslim female. Thus, there is a potential for it to be used frequently in the future. Regarding the above matter, the research study the effect of meditation on brain relaxation incorporation with different physiological activities by using BrainLink.

3. Methodology

Methodology is the analysis of techniques or approaches used to analyse the data to attain the result required. This subtopic basically covers the details explanation of methodology that is being used to make this project complete. There are mainly four major phases to evaluate this project which are data collection, pre-processing, feature extraction, and classification. Every stage will be further expounded in the next subsections. Figure 2 shows the block diagram of the proposed method.

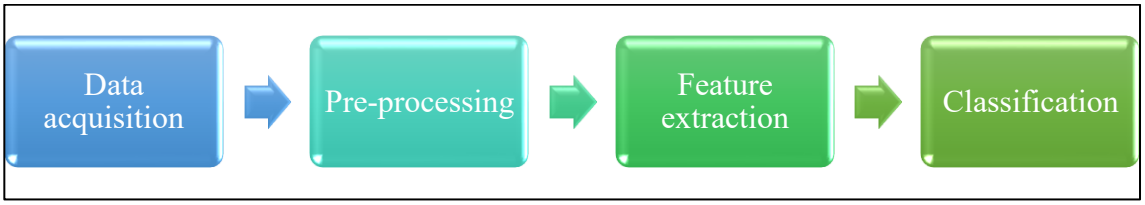

Figure 2: The proposed method used for remote healthcare monitoring system.

The inputs to the plant consist of three main electrode which will collect the data read from the volunteer brain. Each sensor has its own function and carries different data type after the data being captured by the dry electrode, it will be sent via Bluetooth to the EEG recorder.

3.1. Signal Acquisition

In this study, 8 volunteers which consist of 4 males and 4 females of various aged, range between 20-30 years old. All volunteers were tested whereby they were to wear the device shown in Fig. 3. Volunteers were asked to wear the device. Then, they were asked to sit in their most comfortable position, eye closed and the eyes were blond folded so that noise will be reduced, and the device will be on to capture raw EEG signal. After 3 minutes, the volunteer will listen and recite to the zikr playlist for 3 minutes. Then, internal of 2 minutes to relax and again capture fresh signal. Finally, the volunteer was asked to wear and walk for another 3 minutes. The device will capture real time all brainwave signal which are Alpha, Beta, Theta, Delta, and Gamma. It will later be transferred via Bluetooth to the EEG recorder and processed accordingly.

Figure 3: The device used to capture EEG signal [15].

3.2. Pre-Processing

In this process, the raw EEG signals will consist of many undesirable signals for instance, noise and baseline wandering which is caused by the environment and instrumentation during EEG signal acquisition. In order to filter out the unwanted signals, Butterworth filter which the script written in MATLAB were used. It processes low pass filter which is a type of signal processing filter intended to have as flat as frequency response as possible in the pass band and indicated to as a maximally flat magnitude filter [14]. The reasons to choose the filter as the technique of filtering is because it has most flat pass band, thus it can simulate pass band as an ideal filter. Therefore, the results obtained will be smooth, and monotonically decrease in frequency response. Apart from that, it will also preserve the shape of the graph of the brainwave signal.

3.3. Feature Extraction

Feature Extraction is the process of withdrawing the quality or information from the result that we obtain. For the brainwave activity which were captured with EEG signal, Segmentation process is done in feature extraction stage. For this step, the Alpha, Beta and Delta waves were extracted from the previous steps. The data were segmented, and the useful data features were tabulated for classification. It is basically taking the whole Alpha, Beta and Delta wave data during the sit and relax, listening and during the recitation of the zikr and walking. It is due to these waves are the most related to the activities done. The important of this process are it allows all the data captured throughout the test to be considered and taken into account for the next step which is the classification or decision making.

3.4. Classification

Classification stage is the last stage in the methodology before the output is displayed. Based on the feature extraction of the EEG signal, and the plotted filtered signal of each volunteer, the result will be classified based on the two tests. Each data from the first test will be graphed to know which group of volunteers are the most relaxed and influenced by the zikr. Besides that, both test result was compared to know if recitation of zikr will makes a person more relaxed and balanced its brainwave activity. Apart from that, the graph of the data gathered were plotted and the average of the reading within 3 minutes was calculated. The Delta waves of each volunteer was calculated by using the formula in (1) [9]. Alpha, Beta and Delta wave were chosen for analysis and these three waves is the closest related to all the experiment done.

$$y = \frac{x_1 + x_2 + x_3 + \cdots + x_n}{60 \times 3} \quad (1)$$

y= the average of the EEG wave in three minute
x= EEG signal in every seconds

4. Result and Analysis

This subtopic discusses details of the results that is obtained during the signal acquisition, pre-processing, feature extraction and classification of the output signal reading. The higher the signal reading value shows the more dominant the brainwave at that time. The methodology steps were repeated for all three different physiological activities. First experiment was taken brainwave reading of eight volunteers for 3 different conditions which is normal condition whereby the volunteer sit and relax. The second condition is when the volunteers were listening and reciting the same zikr and third condition is when the volunteer is doing work like walking, sweeping the floor, studying and others. Table 2 shows the results of the volunteers after running through the methodology. Eight volunteers consist of four males and four females, who aged between 20 to 30 years old, having normal health status and Body Mass Index (BMI) were taken. The result shows the reading of their brainwave for all the physiological activities of each volunteer.

Table 2: The results of volunteers after going through all steps in methodology.

Volunteer	Sit and Relax (mV)	Listen and Recite Zikr (mV)	Walking (mV)
Male 1	α: 836.708	α:23.650	α: 67.033
	β: 44.729	β:13.453	β: 170.813
	δ: 21.525	δ: 261.713	δ:11.349
Male 2	α:841.159	α: 43.660	α: 40.402
	β: 40.386	β: 19.184	β: 895.207
	δ:17.300	δ:547.2052	δ:19.873
Male 3	α: 382.558	α: 23.272	α: 15.446
	β: 14.826	β: 12.182	β: 333.57
	δ: 29.0923	δ: 429.442	δ: 27.029
Male 4	α: 955.198	α:32.931	α: 34.412
	β: 30.922	β: 13.166	β: 903.017
	δ: 65.5016	δ: 328.844	δ:17.133
Female 1	α: 428.065	α: 20.258	α: 12.991
	β: 18.670	β: 12.991	β: 214.216
	δ:27.066	δ:214.216	δ:20.258

Female 2	α: 248.971	α: 55.253	α: 56.151
	β: 17.049	β: 22.006	β: 877.560
	δ:4.127	δ:894.03	δ:26.789
Female 3	α:103.671	α: 34.373	α: 42.169
	β: 24.455	β: 23.369	β: 953.5
	δ: 66.091	δ: 513.657	δ: 18.608
Female 4	α: 878.963	α: 33.436	α: 18.476
	β: 21.234	β: 20.22	β: 758.761
	δ: 50.608	δ: 624.246	δ: 26.598

4.1. Analysis and Discussion for Physiological Activity 1: Normal (Sit and Relax).
In this subtopic, the experimentation and result of the proposed brain relaxation technique is explained in more detailed. Referring to Subtopic 3, the stages involved are Data Collection, Pre- processing, Feature Extraction and Classification. Figure 4 shows the histogram of the EEG signal reading for Alpha, Beta and Delta of the volunteer.

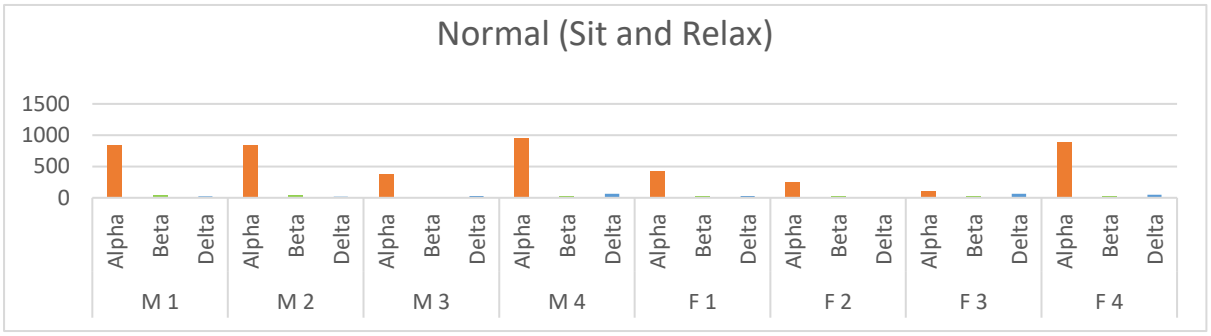

Figure 4: The histogram of the EEG signal reading for first physiological activity of the volunteers.

Based on the graph above, it can be observed that Alpha wave have highest EEG signal value as compared to the other waves. As it can be seen, gender does not affect the trend of which brainwave is dominant and ascendant. The brain produces these waves when the brain is not focusing too hard on anything in particular time. In this state, the brain is feeling relatively calm and relaxed. When the brain is producing these waves, it is responding to activities like meditation and rest that can reduce your stress levels and help you feel calmer [11]. If the brain is able to produce Alpha brain waves, then it probably able to tap into a state that can help the person get some rest and relaxation. Boosting the Alpha waves might also increase the person's creativity levels. Thus, this study proved that when a person is sitting in relax mode, Alpha waves of the person is preceding compared to other wave.

4.2. Analysis and Discussion for Physiological Activity 2: Listen and Recite Zikr.
In this subtopic, the experimentation and result of the second physiological activity which is listen and recite zikr is explained in more detailed. Figure 5 shows the histogram of EEG signal reading of 8 volunteers which refer to the Table 1. The value gained after going through the processes mentioned in the research methodology.

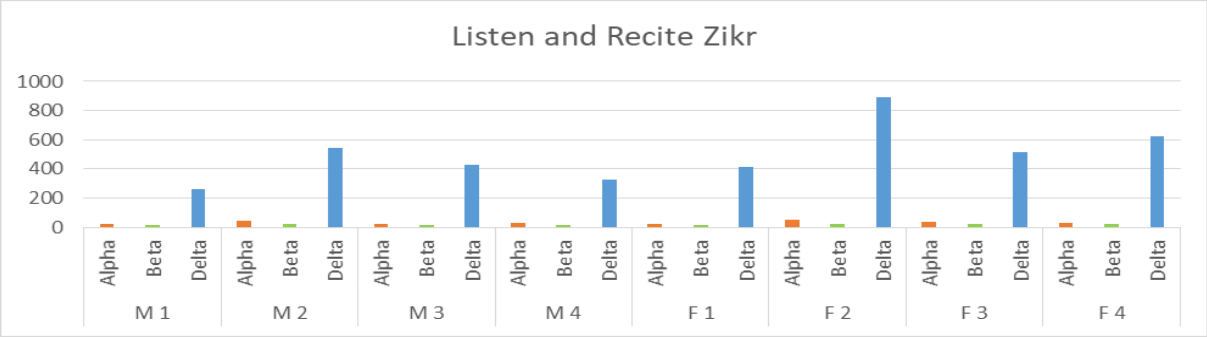

Figure 5: The histogram of the EEG signal reading for second physiological activity of the volunteers

Based on the graph above, it can be observe that Delta wave have highest EEG signal value as compared to the other waves. As it can also be seen that, gender does not affect the trend of which brainwave is dominant and ascendant. The brain produces these waves usually when a person is in deep sleep. In this state, the brain is feeling highest calm and relaxed state. When the brain is in dominant of Delta wave, it can reduce pressure or stress since the brain is in ultimate calmness. Boosting the Delta waves might also increase the person's calmness in a person as the brain is central processing organ that play an important role in oneself [12]. Thus, this study proved that when a person is listening and reciting zikr, Delta waves of the person is preceding compared to other wave, in another word, listen and recite zikr can help to reduce stress of a person.

4.3. Analysis and Discussion for Physiological Activity 3: Walking in Park.

In this subtopic, the experimentation and result of the third physiological activity which is walking in the park is explained in more detailed. Figure 6 shows the histogram of EEG signal reading of 8 volunteers while walking. The value gained after going through the processes mentioned in the research methodology.

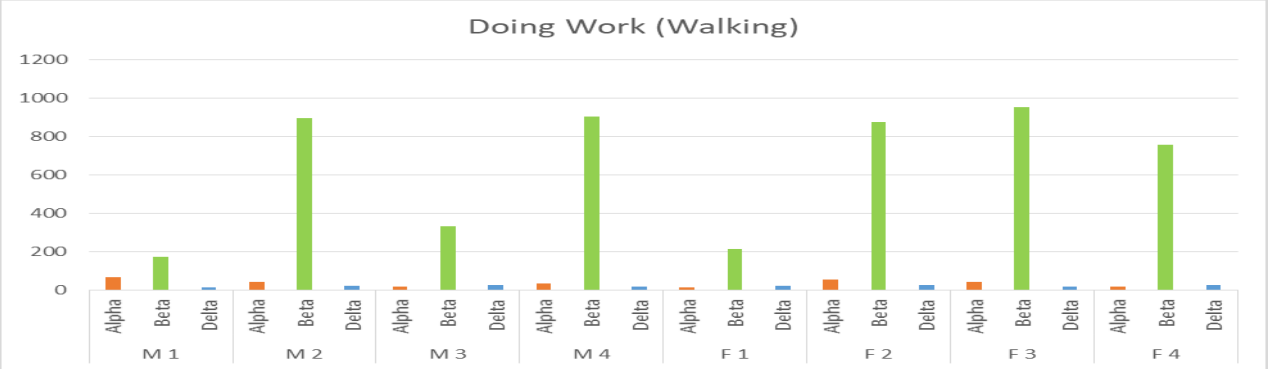

Figure 6: The histogram of the EEG signal reading for third physiological activity of the volunteers.

Based on the graph above, it can be observed that Beta wave have highest EEG signal value as compared to the other waves. As it can also be seen that gender does not affect the trend of which brainwave is dominant and ascendant. Beta wave will be active when a person is wide awake. This is basically the mental state of most people during the day and most of their awaken lives. When the brain is in dominant of Beta wave, it means that neurons are firing faster in order for our brains to process information better to keep up with what is happening in our environment [13]. Thus, this study proved that when a person is walking and other daily routine, Beta waves of the person is preceding compared to other wave.

5. Conclusion

In conclusion, the objectives of this project have been achieved. The objectives are to investigate the potential method for brain relaxation of various physiological activities and to design a mechanism using EEG signals incorporating different physiological activities with the effect of zikr. Besides that, to evaluate the performance of brain with the effect of meditation on brain relaxation technique was also achieved. By developing and evaluating the system for the brainwave for the brain relaxation incorporating different physiological activities, the investigation for this project is considered to be done. The results analysis and the evaluation process indicate that this project had been successfully done since it is proven that zikr can help to increase Delta waves thus reduce the stress and depression of a person. It also proves what is mentioned in the Quran (13:28) which says in the remembrance of Allah, do heart find rest. Thus, based on the result, the proposed system is capable and have potential to be used to reduce stress and anxiety, however, further investigation must be performed to achieve the target.

Acknowledgments

The authors would like to thank all the volunteers who contributed to the experiment conducted. The authors also would like to thank the Department of Electric and Computer Engineering, International Islamic University Malaysia for the support in this research work.

References

[1] Fu-Chien Kao, Yun Kai Lin, Brainwave Analysis on Relaxation Emotion, 2014 International Symposium on Computer, Consumer and Control IEEE, vol 987-1-4799,308-310.
[2] WHOWebsite,https://www.who.int/news-room/detail/mental-disorders, last accessed 2019/11/28.
[3] Prajna P Nanda, Ramesh K: Analysis of Meditation and Attention Level of Human Brain., 2017 International Conference on Information Technology, IEEE, vol ICIT.2017, 46–49, (2017).
[4] Abdurrochman,A,Wulandari, RD, Fatimah, N : The Comparison of Classical Msic, Relaxation music and AlQuran recital, 2017 Regional Symposium on Biophysics and Medical Physics, Bogor Indonesia.
[5] A.A. Helman, M.K.M Amin, AKM Muzahirul Islam, O Mikami, Neuroimaging EEG Application on Human Electrical Brain Activities during Meditation and Music Listening,Journal of Advanced Manufacturing Technol- ogy(JAMT), iDecon 2018,eISSN: 2289-8107, pp23-33.
[6] M. Alsolamy and A. Fattouh, "Emotion estimation from EEG signal during listening to Quran, "2016 7TH International Conference on Computer Science and Information Technology (CSIT), Amman, 2016, pp 1-5, doi:10.1109/csit,2016,7549457.
[7] Norsiah, Fauzan and Siti Naqiah, Shahidan (2015) Brain waves in response to Quran and Dhikir. In: Implementing Quranic Values in Society. Universiti Sains Islam Malaysia 2015, Perpustakaan Negara Malaysia, pp. 145-157.
[8] Nadia Adnan, Zunairah Hj Murat, Ros Shilawani S Abd Kadir and Noradibah Hj Mohamad Yunos, :University Student Stress Level and Brainwave Balancing Index: Comparison Between Early and End of Study Semester, "2012 IEEE Student Conference on R&D", pp 42-47,978-1/7/12
[9] A Helman, M Amin, A.M Islam,&OMikami,(2019),Neoroimaging EEG application on human electrical brain activities during meditation and music listening.
[10] R.M.Cody,Cody Rall MD with Techforpsych,(2016),How Personal EEG Device Works(Emotiv,Muse,Neurosky),youtu.be/8hyhljnq9Z4.
[11] Mohd Rozali Sinek,Muhammad Nubli Wahab, 'A pilot study of the effect of zikiron performance phychology using HRV', No.Vol. RDU1103101, Universiti Malaysia Pahang, Malaysia.
[12] A Habibi, (2015), 'Effect of Listening Recitation of Solat on EEG', The 5TH International Conference Information and Communication Technology for the Muslim World (ICT4M), Kuching 2015, pp: 1-6.

[13] N.F Kamal,n.f Mahmood,NA Zakaria(2013), Modelling brain activities during reading working memory task: Comparison between recitation Quran and reading book, Procedia Social and Behavioral Science, pp 83-89.
[14] D.Raja,' Butterworth Filter: First Order and Second Order Low Pass Buttereorth Filter',Cirsuit Design 24 Dec 2019, from circuit digest.com/tutorial/butterworth-filter-first-order-and second-order-low-pass-butterworth-filter.
[15] Rasaelecronic.n.d BrainLink Lite.[online] Retrieved on 17 November 2020 from www.rasaelectronic .com/media/userfiles/brainlink-lite.pdf.