# THE EFFECT OF MEDITATION ON BRAIN RELAXATION INCORPORATING DIFFERENT PHYSIOLOGICAL ACTIVITIES

BY

NURUL NABILAH BINTI ABD RAZAK

A dissertation submitted in fulfilment of the requirement for the degree of Master of Science (Communication Engineering)

Kulliyyah of Engineering
International Islamic University Malaysia

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# ABSTRACT

Anxiety and depression have become such a widespread illness. It has been affecting people's health which can lead to suicidal tendencies. According to the World Health Organization, every year close to 800 000 people take their own lives and there are also many more attempts of suicidal cases reported. It is due to an imbalance in the control of brain activities which relates to a lack of brain relaxation. Studies related to depression and stress with the nervous system had been conducted and Electroencephalogram signal is found to have the potential to detect brainwave signal in real-time data. Dissimilar physiological activities may react differently towards brainwave activities which will result in the various effects of brain relaxation. Therefore, this study was proposed to investigate the effect of meditation on brain relaxation incorporating different physiological activities. In this study, Electroencephalogram data were acquired from 12 subjects consisting of 6 males and 6 females aged ranged between 10-50 years old with normal health condition using the BrainLink device. Butterworth filter was applied to smoothen the signal. Later, based on the filtered signal, Alpha, Beta and Delta waves were segmented as the extracted features. For the final phase, the average value of amplitude differences and t-value test were conducted as to complete the decision-making stage. All the signals utilized in this study were obtained from three set of experiments, which consisted of three physiological actions performed by the volunteers. The first activity was to sit at rest in the most comfortable position for three minutes. The second activity involved listening to and recitation along with a *zikr* (supplications) playlist (*Allah, Ya Allah*) for three minutes. Finally, the third activity involved the subjects walking for three minutes. Based on the average amplitude values, it was observed that different physiological activities caused diverse shape of the brainwave. Alpha waves were dominant as compared to other brain waves while sitting at rest in the first experiment. The second physiological activity, which is listening and reciting to the *zikr*, shows that delta wave is the most prevailing signal as compared to Alpha and Beta waves. As for the third experiment which is walking, the signals showed prominence in the Beta waves. Based on the *t*-value test, it was found out that for all the experiment the *t* values were less than 0.05 which obeys the t-test prediction. In other words, this study is a better alternative to the current approaches since it proves that *zikr* will change a person's state of brain to be more relaxed and tranquil. In a nutshell, this research has investigated the effects of meditation initiated through different physiological activities, on brain relaxation and has the potential to assist anxiety and stress patients to relax and stay calm.

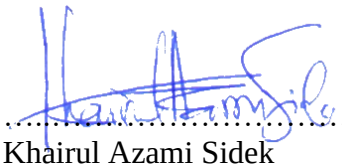
DR. KHAIRUL AZAMI SIDEK
*Associate Professor*
Department of Electrical & Computer Engineering
Kulliyyah of Engineering
International Islamic University Malaysia

# خلاصه البحث

أصبح القلق والاكتئاب مرضًا واسع الانتشار. لقد كان يؤثر على صحة الناس مما قد يؤدي إلى ميول انتحارية. ووفقًا لمنظمة الصحة العالمية ، ينتحر ما يقرب من 800000 شخص كل عام ، وهناك أيضًا العديد من محاولات الانتحار المبلغ عنها. يرجع ذلك إلى عدم التوازن في التحكم في نشاط الدماغ الذي يرتبط بقلة استرخاء الدماغ. أجريت دراسات تتعلق بالاكتئاب والتوتر مع الجهاز العصبي. إشارة تخطيط كهربية الدماغ لديها القدرة على اكتشاف إشارة الموجات الدماغية في بيانات الوقت الحقيقي. قد تتفاعل الأنشطة الفسيولوجية المختلفة بشكل مختلف تجاه أنشطة الموجات الدماغية التي ستؤدي إلى تأثيرات مختلفة لاسترخاء الدماغ. لذلك ، تم اقتراح هذه الدراسة للتحقيق في تأثير التأمل على استرخاء الدماغ باستخدام أنشطة فسيولوجية مختلفة. في هذه الدراسة ، تم الحصول على بيانات تخطيط كهربية الدماغ باستخدام جهاز BrainLink من مجموعة مكونة من 12 شخصًا. تتكون المجموعة من 6 ذكور و 6 إناث، وتراوحت أعمارهم بين 10-50 عامًا مع حالة صحية طبيعية. تم تطبيق مرشح باترووورث لتنعيم الإشارة. في وقت لاحق ، بناءً على الإشارة المصفاة ، تم تجزئة موجات Alpha و Beta و Delta باعتبارها الميزات المستخرجة. بالنسبة للمرحلة النهائية ، وتم إجراء متوسط قيمة اختلافات السعة واختبار قيمة t لإكمال مرحلة اتخاذ القرار. تم الحصول على جميع الإشارات المستخدمة في هذه الدراسة من ثلاث مجموعات من التجارب تتكون من ثلاثة أنشطة فسيولوجية قام بها المتطوعون. كان النشاط الأول هو الجلوس براحة في الوضع الأكثر راحة لمدة ثلاث دقائق. أما النشاط الثاني فقد اشتمل على الاستماع والتلاوة مع قائمة تشغيل (الله ، يا الله) لمدة ثلاث دقائق. أخيرًا ، تضمن النشاط الثالث المشي لمدة ثلاث دقائق. وبناءً على قيم السعة المتوسطة، لوحظ أن الأنشطة الفسيولوجية المختلفة أدت إلى أشكال متنوعة من الموجات الدماغية. كانت موجات ألفا هي السائدة مقارنة بموجات الدماغ الأخرى أثناء الجلوس في حالة الراحة أثناء التجربة الأولى. أما النشاط الفسيولوجي الثاني ، وهو الاستماع إلى الذكر وتلاوته ، فيظهر أن موجة دلتا هي الأكثر انتشارًا مقارنة بموجات ألفا وبيتا . أما بالنسبة للنشاط الثالث وهو المشي فقد أظهرت الإشارات مكانة بارزة في موجات بيتا. من التحليل باختبار قيمة t وجد أنه بالنسبة لجميع التجارب ، كانت قيم t أقل من 0.05 والتي تخضع لتنبؤ اختبار t. بمعنى آخر، تعد هذه الدراسة بديلاً أفضل من الطرق الحالية لأنها تثبت أن الذِّكر سيغير حالة دماغ الشخص ليكون أكثر استرخاءً وهدوءًا.وباختصار ، فإن هذا البحث تركز في فحص آثار التأمل الذي بدأ من خلال أنشطة فسيولوجية مختلفة ، على استرخاء الدماغ لمساعدة مرضى القلق والتوتر على الاسترخاء والهدوء.

# APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of Science (Communication Engineering).



……
Khairul Azami Sidek
Supervisor

……...
Huda Adibah Mohd Ramli
Co-Supervisor

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of Science (Communication Engineering).

……...…….
Hasmah Mansor
Internal Examiner

……
Ahmad Zamani Jusoh
Internal Examiner

This dissertation was submitted to the Department of Electrical and Computer Engineering and is accepted as a fulfilment of the requirement for the degree of Master of Science (Communication Engineering).

……...….
Md Rafiqul Islam
Head, Department of Electrical and Computer Engineering

This dissertation was submitted to the Kulliyyah of Engineering and is accepted as a fulfilment of the requirement for the degree of Master of Science (Communication Engineering).

……
Sany Izan Ihsan
Dean, Kulliyyah of Engineering

# DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيم
*"In the name of Allah, the Most Gracious and the Most Merciful"*

First and foremost, I would like to present my heartiest gratitude to Allah S.W.T for the strength, health, and perseverance that He gave me to complete my Master project and report.

I would like to express my most profound gratitude and appreciation towards my supervisor, Assoc Prof. Dr. Khairul Azami Sidek for his continued support and encouragement of my Master's studies and research, and his patience, motivation, enthusiasm, and immense knowledge. His guidance and vast knowledge helped me a lot throughout the years. I appreciate his confidence and trust in my knowledge and abilities.

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# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# LIST OF ABBREVIATIONS

| | |
|---|---|
| AIS | American Institute of Stress |
| ANS | Autonomic Nervous System |
| DWT | Discrete Wavelet Transform |
| EEG | Electroencephalogram |
| FFT | Fast Fourier Transform |
| HRV | Heart Rate Variability |
| PSD | Power Spectrum Density |
| ICSP | In-Circuit Serial Programming |
| WHO | World Health Organization |

# LIST OF SYMBOLS

| | |
|---|---|
| abs | Absolute |
| α | Alpha |
| β | Beta |
| δ | Delta |
| % | Percentage |
| θ | Theta |
| mV | Milli Volt |

# CHAPTER ONE

# INTRODUCTION

## 1.1 BACKGROUND OF THE STUDY

Brain is an organ that functions as the coordinating centre of the nervous system to human. It is located in the head, close to the sensory organs for senses such as vision. It is the most complex organ in a human's body. The brain consists of 3 main parts which are cerebrum, the brainstem, and the cerebellum (N. Ibrahim, 2014). Figure 1.1 shows the structure and parts of human brain.

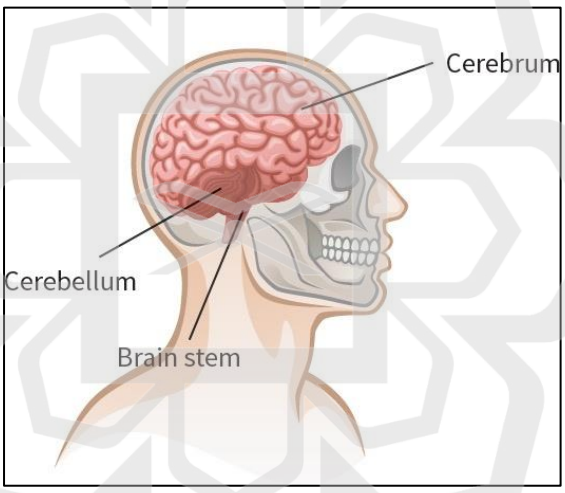


Figure 5.1: Structure and Parts of Human (N. Ibrahim,2014).

Signal of brain waves activity can be detected by using electroencephalogram, which is a common test used to evaluate the electrical potential of the brain. It can also detect the possible problems associated with activity of brain. The electrical impulses in an EEG wave 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 (WHO Performance Unit, 2017).

Apart from that, stress which can leads to suicidal is also related to brain activity whereby the brain cannot 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 for every 40 seconds. It is a global phenomenon and occurs throughout the lifespan. It is the second leading cause of death among 15-29 years olds globally as shown in Figure 1.2. Figure 1.3 shows the number of suicides globally in young people in the year 2016 (WHO, 2017), (World Bank, 2020).

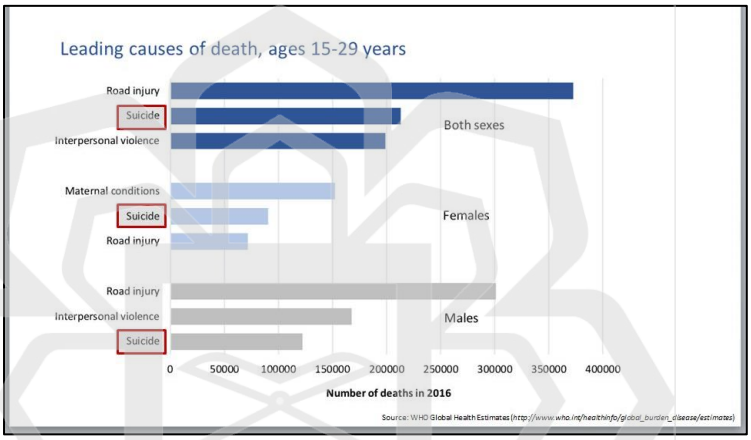


Figure 1.2: The leading cause of death among 15-29 years old (WHO, 2017).

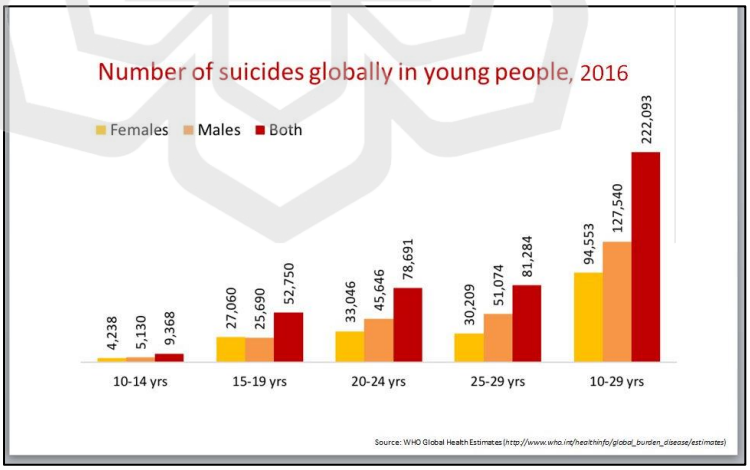


Figure 1.6: The number of suicides globally in young people in 2016 (WHO, 2017).

The suicide cases can occur at any age and different income level. There are many cases reported among people in low- and middle-income countries as compared to high income countries. Figure 1.4 shows the graph of suicides by age and income level (WHO, 2017).

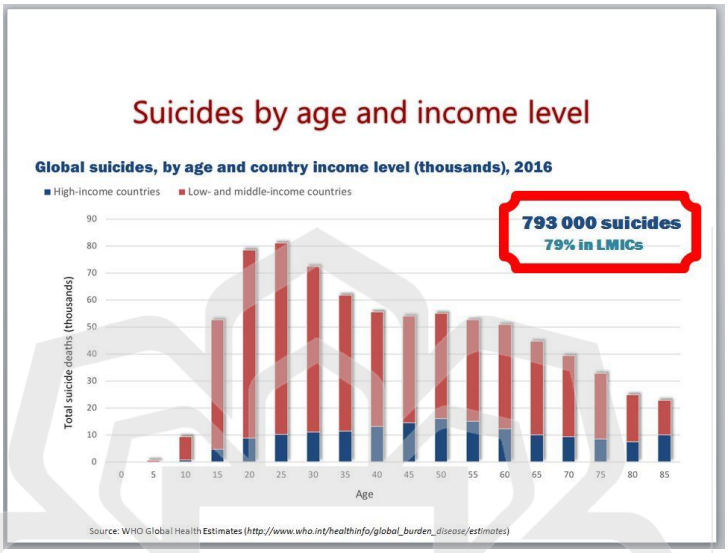


Figure 1.4: The graph of suicides by age and income level (WHO, 2017).

The act of committing suicide is forbidden in Islam. It has been clearly mentioned in The Holy Book of Quran which says that 'And do not kill the soul which Allah has forbidden [to be killed] except by [legal] right. This has He instructed you that you may use reason' [Al-An'am 6:151] (CelikTafsir, 2020), and do not kill yourselves [or one another]. Indeed, Allah is to you ever Merciful [An-Nisa 4: 29], besides, Prophet [peace and blessings be upon him] also said, "Whosoever kills himself with anything in this world, will be tortured with it on the Day of Judgment." (Narrated by the Sahih of Bukhari and the Sahih of Muslim.)

There are many techniques that had been taught to ensure a Muslim is in the best state of his mind like performing prayers, reading the Quran, recite zikr constantly and others. These techniques of meditation help a person to always stay calm, relax and

focus. Thus, this research is focused on the effect of meditation on brain relaxation of incorporating different physiological activities.

## 1.2 PROBLEM STATEMENT

Nowadays, suicidal cases which was due to distress increase day by day and it is reported that in 2016 close to 800 000 people die, which is one person for every 40 seconds (Malaysia Healthcare Performance Unit, 2017). Thus, it is very important to know the current brain state and to ensure that our brain is in relax mode and the activity in the brain is balanced. Besides that, it can also improve the mental health awareness of the populations especially people who live in rural areas as they can monitor the real time brain activity status which indirectly ease them to balance it out in case of abnormalities. 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, use a singular wave method of relaxation, and only focuses on one physiological activity. Therefore, this study will develop a system which could overcome the shortcomings of the previous methods. The proposed system will use the effect of meditation and use EEG signal, use BrainLink device which will capture the signal and transfer via Bluetooth for the processing and the output stages. It is a portable and non-invasive device. Besides that, multiple waves will be used as the method of relaxation. Moreover, this study specifies different physiological activities (at rest, while listen and recite to zikr and while walking) to prove scientifically that zikr is a good meditation alternative. Thus, the effect of meditation on brain relaxation incorporating different physiological activities system will be proposed and developed.

## 1.3 RESEARCH OBJECTIVES

The main objective of this study is to propose a technique of meditation for brain relaxation incorporating different physiological activities regardless of gender and age. The remaining objectives of this study are listed as follows:

i. To investigate the potential method for brain relaxation of different physiological activities.
ii. To design a mechanism using EEG signals incorporating different physiological activities with the effect of meditation.
iii. To evaluate the performance of brain with the effect of zikr and other physiological activities.

## 1.4 RESEARCH METHODOLOGY

This study proposed a novel method of brain relaxation using EEG signal incorporating different physiological activities. Four steps will be used to measure and recognize brain wave from individuals which are data acquisition, pre-processing, feature extraction and classification. Each step will be further discussed in Chapter 3. As so to achieve the objectives of the research, there are four main steps taken for examine and evaluation of the results. The first procedure is the data acquisition. Subjects consist of 12 volunteers which consist of 6 males and 6 females from various age range were taken. The age of the volunteers falls into three groups which are first below 20 years old, second group are volunteers of 20 to 40 years old and the third group volunteers of above 40 years of age. Each subject will be going through three sets of experiments. The first test is to sit at rest in the most comfortable position for three minutes while wearing the device which will capture their brain wave. Then, the volunteer will be asked to listen and recite to the zikr playlist which played *Allah, Ya*

*Allah* for another 3 minutes. The third test will require the volunteers to walk in a park for three minutes while their brain waves will be captured. This first procedure is basically to collect the data and signal from the volunteers or subjects from the three tests. The next procedure will be the pre-processing stage. In this phase, the redundant signal will be removed and the noise in the raw data will be filtered. Later, the unwanted information of the filtered signal will be withdrawn and finally is the classification or decision making which will categorize and distinguish the signal and the data which will be used for discussion and analysis.

## 1.5 SIGNIFICANCE OF THE STUDY

Monitoring human brain activities such as in a relaxation mode would be important to recognize early symptom of mental illness. It can help to save lives if the abnormalities of brain state are to be detected at an early stage. Suicidal cases due to stress among young people aged 15-29 all over the world is one of the problems faced in every country in the world today (WHO Performance Unit, 2017). Besides that, monitoring mental health from time to time can reduce the cost of medication since one of major expenses of most country is the medical expenses to the public.

Therefore, it is very essential to identify the brain sickness by tracking the root of the problem and monitor the illness regularly to prevent more chronic conditions. There are many ways and approach to detect brain health status such as HRV and ECG which relates to the heart status with brain state and others. Thus, this study will focus on EEG and relating the effect of meditation on brain relaxation incorporating different physiological activities.

## 1.6 LIMITATION OF THE STUDY

There are some limitations that exist during the completion of this study. Firstly, during the data collection process, all subjects are required to close their eyes and to avoid the volunteer from opening the eyes, the volunteers were asked to wear 'slip sleep mask as shown in Figure 1.5. This is due to the sensitivity of our physiological signals to body reactions which is the eyes, that will result in irregularities of the EEG signal taken. However, movement of the eyes which also effects the signal reading could not be avoided.

On the other hand, the 12 subjects are Muslims from different background and ability of understanding the *zikr*. Thus, this study does not consider these parameters. Therefore, due to these issues, it might have impact to the overall results.

Figure 1.5: Slip Sleep Mask wear by the volunteers during Activity 1 and Activity 2.

## 1.7 THESIS ORGANIZATION

The report is organized into five chapters. Each chapter is systemically organized to contain the many spectrums involved in this project. The next chapter, which is the Literature Review talks about the basic terminologies of the study which mainly includes the type of brain waves and EEG besides the related works with regards to the research. Chapter 3 covers the methodology involved in the study which are signal acquisition, pre-processing, feature extraction and finally the decision

making. Later, the discussion of results obtained at each level of this project will be discussed in Chapter 4. Finally, Chapter 5 presents the conclusions and further recommendations on how to further enhance the process. Limitations and other issues encountered throughout the project are also discussed here.

# CHAPTER TWO

# LITERATURE REVIEW

This chapter consists of three parts which are the basic terminologies of this study, related works, and summary of this chapter.

## 2.1 BASIC TERMINOLOGIES

This section discusses about brain waves, EEG signal and relaxation method in general and the fundamental of human's physiological signals.

First and foremost, a brief on the basic terminologies of the various types of brain wave will be explained in detail. Generally, the research conducted is to study and prove that zikr can helps to relax the brain activity by reciting and listening to the zikr.

Monitoring the brain 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 (B.Gaddipati, 2016). Figure 2.1 shows the common device used to monitor the brainwave signal (S.Pillay, 2017).

Besides that, the study also uses wireless as medium of transferring data from the device to the phone. Bluetooth is a wireless technology standard for exchanging data over short distance from fixed and mobile devices. It is preferred as the medium of transmission as it produces less radiation.

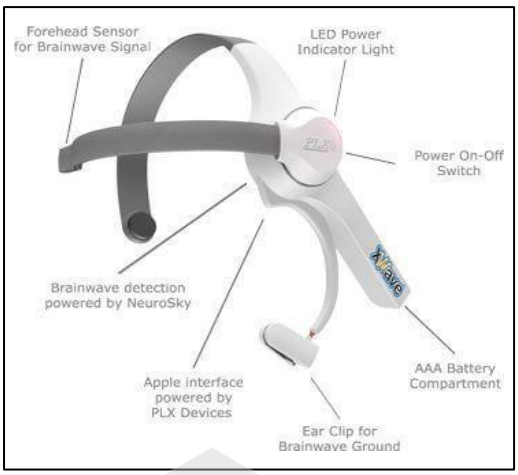


Figure 2.1: Example of a brainwave signal (S.Pillay, 2017).

### 2.1.1 Type of Brainwave Signal

Generally human brain had billions of neurons. Each individual neuron connects and communicate with another neuron through electrical currents that travel along the neurons and throughout enormous networks of brain circuits. When all of these neurons are activated, electrical pulse are produced. It can be visualized like a wave rippling through a confined space. Figure 2.2 shows how information is transferred between neurons in the brain (I.F Taha, 2014).

Figure 2.2: Information transfer between neurons in the brain (I.F Taha, 2014).

Brain wave signals are mainly categorized into five types of waves which are Delta, Theta, Alpha, Beta and Gamma. Each of the brain waves has its normal frequency