ANALYSIS OF THE EFFECTS ON HUMAN BRAIN DUE TO VARIOUS LEVELS OF DEPTH IN 3D TV

By

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FINAL PROJECT REPORT

Submitted to the Department of Electrical & Electronic Engineering
in Partial Fulfillment of the Requirements
for the Degree
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(Electrical & Electronic Engineering)

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CERTIFICATION OF APPROVAL

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Approved:

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AP Dr. Nidal Kamel
Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK

May 2013

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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Siti Nurshafiqa Binti Mohd Yohani

ABSTRACT

The popularity of 3D nowadays is no doubt. This technology has been used in lifestyles of human being in order to give more entertaining to their life. We can found it for example watching TV in 3D mode viewing, playing 3D games, and also watching movies in cinemas which is a common thing for a movie lover. Although 2D is still being used by the people around the world, but 3D is a demand technology in this era. The way the 3D displaying its technology is indeed a brilliant idea to the human being. When the image on the screen is pop up from it give an excitement to the viewers and it is also seems that the object inside the screen is try approaching and go near to the viewers. 3D is indeed a great technology for human, but it also can give some bad effects to them. Accordingly, the purpose of this report is to identify and analyze the effect on each different level of the depth in 3D TV to human brain. Along in this project, we can learn and understand the structures of human brain and also its functions. The project also includes the understanding of the 3D technologies, the signal of human brain during recording using the electroencephalogram (EEG) and types of the brainwaves occur during measurement. In addition, the data collection and the data analysis are included in this paper. With a data analysis, the conclusion and recommendations has been made in other to make some improvement in the future.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my humble gratitude to Allah S.W.T, because of His blessings and guidance to overcome the challenges and problems in completing the whole two semesters of my final year period here. I would also like to thank my parents for their tremendous contributions and support both morally and financially towards the completion of this project.

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LIST OF ABBREVIATIONS

2D	two-dimensional
3D	three-dimensional
EEG	electroencephalogram

CHAPTER 1
INTRODUCTION

Any object that can be represented on a three- axis; x-axis, y-axis, and z-axis system is 3D. Three-dimensional technology is a technology which is found to be the most interesting topic in terms of imaging and visualization. A lot of researchers have done paper works regarding this topic because of the idea on how to produce it only by using a 2D image.

1.1 Background of Study

The 3D technology actually is related with our brain. The way we can see it also is a part of the working of the brain. Using electroencephalography (EEG), we can detect and analyze how the brain is functioning through the signal produce inside the brain.

Electroencephalography (EEG) is a device like scalp with a multiple of electrodes attached that use for reading an electrical activity of the brain. The device is then connected to a computer and the brain's electrical activity is recorded in wavy lines [1]. The wavy lines produces is actually the frequency of brainwave signal.

The device which is the EEG is going to be use for the purpose of this project which is to analyze the effects of depth in 3D TV to human. A data from the brain will be collected from the EEG for various depth levels of the 3D TV by showing 3D movies.

According to Angelo G Solimini, study finds that watching 3D movies makes 54.8% from 497 samples of people want to vomit. Only14.1% from the total samples wants to vomit after watching the 2D movie [2].

Another source for the effects is that a mother stated that her son feeling

dizzy and nauseous after a few minutes watching a movie Bolt in 3D. Although her son wears glasses during reading and schoolwork, but he is never had other problems with his vision which makes her confuse is watching movies in 3D wearing glasses and wearing glasses for reading are actually related or not [3].

1.2 Problem Statement

The increasing popularity of commercial movies showing 3D images has raised concern about possible adverse side effects on viewers.

Some of the side effects include:

- Eye strain
- Eye fatigue
- Blurred vision
- Dizziness
- Decreased postural stability - losing balance and falling

1.3 Objective

The main purposes of this project are:

i. To identify and analyze the effects on human brain due to different levels of depths in 3D TV viewing.

ii. To utilize EEG signals for analyzing such affects and compare them with normal 2D viewing.

1.4 Scope of study

i. The structures of the brain and its functions.

ii. Electroencephalogram (EEG) which is the device that were using in the experiment.

iii. Types of brainwaves.

iv. Understand the technology of the 3D.

v. The differences between 2D and 3D.

1.5 Feasibility of the project

This project will be based on the 3D viewing through the TV screen. The equipments and devices that going to be used is available at the place of study and also the materials or information can be found whether in the place of study or by using online material. In completing this project, there are several constraints that need to be aware of such as:

1.5.1 Time

The time given to complete the Final Year Project I (FYPI) is 14 weeks which is in one semester only and the Final Year Project II (FYPII) also given 14 weeks in the next semester. In order to complete the project in a given time, the project will be focused on an important selection features only.

1.5.2 Budget

Due to the budget limitations, the selections of devices also need to be considered thoroughly. Even though the equipments are limited for each student at the place of study, the budgets may be is not enough due to the expensive devices in the market.

CHAPTER 2
LITERATURE REVIEW

Each human gives different brainwave signal in different situation. A baby and an adult give different signals. Two students doing a same task can give a result with a different brainwave signal. It shows that people have their own brain signals depending on the situation there are it.

2.1 Brain Structures and Functions

Brain is one of the most important parts in human body and also the most complex. It controls and gives commands for all the movements and activities we made. Learning, focusing, hearing, watching, etc. are the activities that control by our brain.

2.1.1 Cerebral Cortex

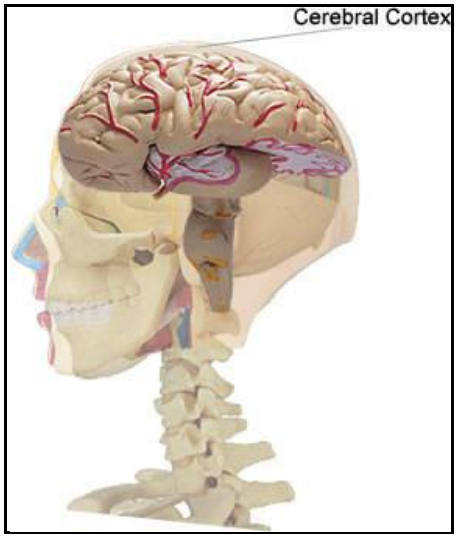

Figure 1 Cerebral Cortex

The cerebral cortex is a thin layer of gray tissue that covered the cerebrum. It is consists two hemispheres; right hemispheres and left hemispheres [4].

Each side of the hemispheres has specific tasks. For example, learning, focusing, and all the tasks mention above occurred in a specific area of the brain. Most of the movements and activities that human made are take place in the cerebral cortex.

There are 4 main lobes inside the cerebral cortex with their specific functions. The lobes are frontal lobe, parietal lobe, occipital lobe, and temporal lobe.

2.1.2 Frontal Lobe

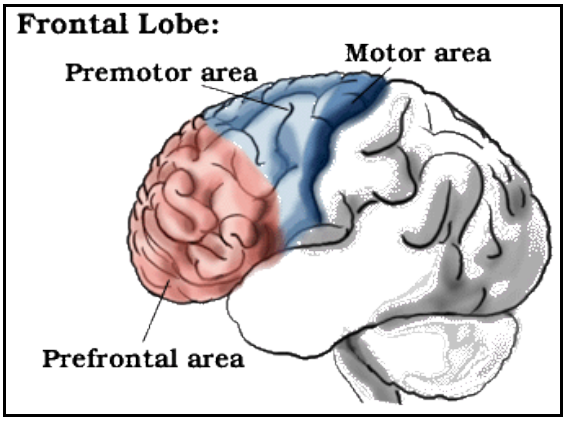

Figure 2 Frontal Lobe

The frontal lobe is located in the anterior or front portion of the cerebral cortex [5] . This is the part where decision making, problem solving, facial muscular activities, and mental activities occur. As shown in Figure 3 above, frontal lobe consists of three parts which are:

i. Prefrontal area: responsible for the personality expression and the planning of complex cognitive behaviours.
ii. Premotor area: contain nerves that control the execution of voluntary movement.
iii. Motor area: control the execution of voluntary.

2.1.3 Parietal Lobe

Figure 3 Parietal Lobe

The parietal lobe plays a role in orientation, recognition, and perception of stimuli. It also receives and processes sensory information from the body. The parietal lobe contains coordination between speech and movement where the Wernicke's area is responsible for it [6].

2.1.4 Occipital Lobe

Figure 4 Occipital Lobe

The occipital lope is the one that involves with visual processing and interpretation [7]. It is located at the back of the brain as shown in Figure 4 above.

2.1.5 Temporal Lobe

Figure 5 Temporal Lobe

The temporal lobe is located at about the level of the ears. The functions of the parietal lobe are involved with the language, emotion, and memory [8]. It is consists of two parts which are:

i. Right lobe: involved in visual memory (memory of faces and pictures)
ii. Left lobe: involved in verbal memory (memory of words and names)

2.2 Brainwaves

Brain is made up of billions of cells called neurons, which use electricity to send signals and communicate with each other. An enormous amount of electrical activity is produced in the brain, because millions of these signals are sent simultaneously. This combined activity is commonly described as a "brainwave" because it rises and falls like a wave.

The electrical activity originate from the brain creates frequencies called brainwaves. Brain waves are measured in cycles per second, Hertz (Hz). The more cycles per second, the greater the Hertz value.

There are five types of brainwave which are gamma waves, beta waves, alpha waves, theta waves, and delta waves [9] [10]. Figure 6 is the illustrated waves for each of the brainwaves.

The purpose of the classification of the brainwaves is to differentiate the waves and also to detect the changes of the electrical activity of the brain during the recording.

2.2.1 Gamma Brainwaves

Gamma brain waves are the highest frequency brain wave type. A variety of studies have associated gamma with the formation of ideas, linguistic processing and various types of learning. Gamma waves have also been linked to the cognitive act of processing memories- the rate of the waves seems to correlate with the speed at which a subject can recall memories; the faster the waves, the faster the recollection.

Gamma waves have been shown to disappear during deep sleep induced by anesthesia, but return with the transition back to a wakeful state.

2.2.2 Beta Brainwaves

Beta activity is quick-connect, fast activity and tends to dominate the normal waking state of consciousness when-attention is directed towards the outside world.

Typically detected in the frontal lobes (where decisions are managed), Beta is usually seen on both sides of the brain in geometric distribution. It may be absent or

reduced in areas of brain damage. It is generally regarded as a normal rhythm and tends to be the dominant rhythm in those who are alert, anxious or have their eyes open.

2.2.3 Alpha Brainwaves

This rhythm is seen when the brain sets itself to rest or reflect. Alpha rates are increased by closing the eyes and relaxing, yet are offset by opening one's eyes or any concentrated effort.

Alpha is usually best detected in the frontal regions of the head, on each side of the brain. Alpha is the major rhythm seen in normal relaxed adults and is typically regarded as the common relaxation mode beyond the age of 13.

2.2.4 Theta Brainwaves

Theta activity is not often seen in awake adults (unless engaged in a meditative practice), but is perfectly normal in alert children up to 13 years and in most sleep.

A Theta state can be regarded as a gateway to hypnologic states that lay between being awake and falling asleep. Often Theta entrainment can promote vivid flashes of mental imagery as one becomes receptive to brain/mind information beyond one’s typical conscious awareness. Theta has also been identified as a part of learning, memory and reductions in stress.

2.2.5 Delta Brainwaves

Much like bass sound, Delta tends to be the highest in amplitude and the slowest waves. Delta is often associated with deep sleep. Certain frequencies, in the delta range, have been shown to trigger the body's healing and growth mechanisms.

Interestingly, Delta is the dominant rhythm in infants up to one year, as well as stages 3 and 4 of dreamless sleep.

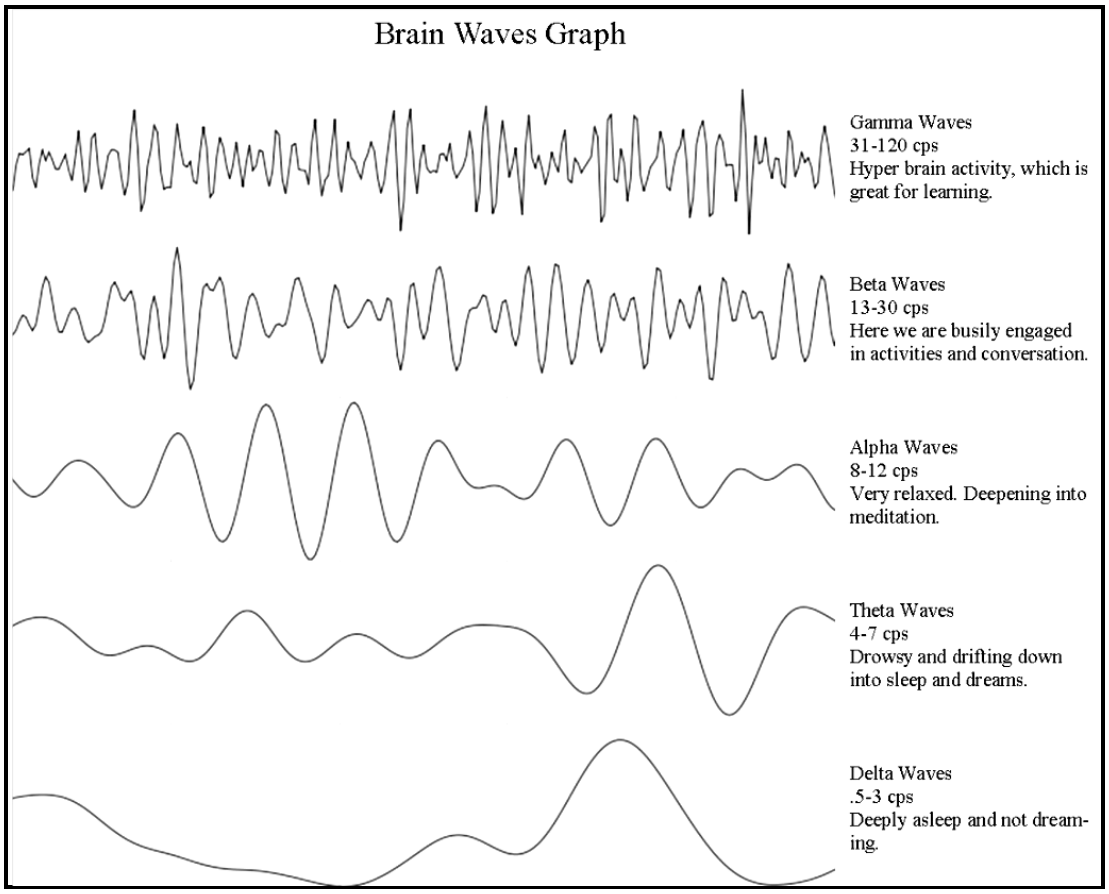

Figure 6 Brain Waves Graph

2.3 Electroencephalogram (EEG) Recording & Measurement

There are varieties of methods to read and record the activities of the brain and EEG is one of the non-invasive brain imaging methods [1]. The EEG is going to be use in this experiment to measure the electrical activity that produces from the activation of the brain cells [11].

EEG, like all other brain imaging techniques, provides a window into the functioning of the brain. By observing behaviour and brain activity researchers can gain insight into how the two are correlated. Typically this involves monitoring brain activity during well defined cognitive tasks as in cognitive neuroscience.

Figure 7 below shows the 10/20 system of the electrode placement of the EEG. The 10/20 is actually the distance between Nasion-Inion with the fixed points measured in percentages. The 10/20 a system is applies to all the version of the EEG

electrode placement. These points are marked as the Frontal pole (Fp), Central (C), Parietal (P), occipital (O), and Temporal (T). The electrodes at the line between Nasion and Inion at the middle are marked with a letter z, which stands for zero. The odd numbers used at the electrodes represents points over the left side of the head and even numbers are for the right side [12].

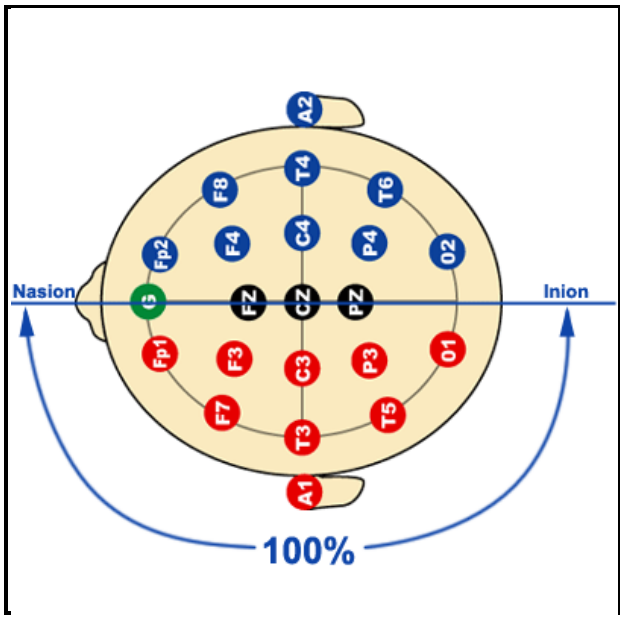

Figure 7 10/20 System of Electrode Placement

2.4 Artifacts from EEG

Artifacts are the disturbance of a signal not originated from the brain when measuring the brain signal. The artifacts that can be the disturbance during the recording of the brain signal is for example eye movements, eye blinking, muscle movements etc. It is a serious problem for EEG interpretation and analysis because the artifacts can give a lot of impacts to the recorded signals.

Basically, remove the artifacts are the first thing to do before analyzing the data collected. The method that was being used in removing the artifacts is through the MATLAB as shown on the Figures 8 & 9.

i. Mark stretches of continuous data for rejection by dragging the left mouse button.

ii. Click on marked stretches to unmark.

iii. When done, press reject to excise marked stretches.

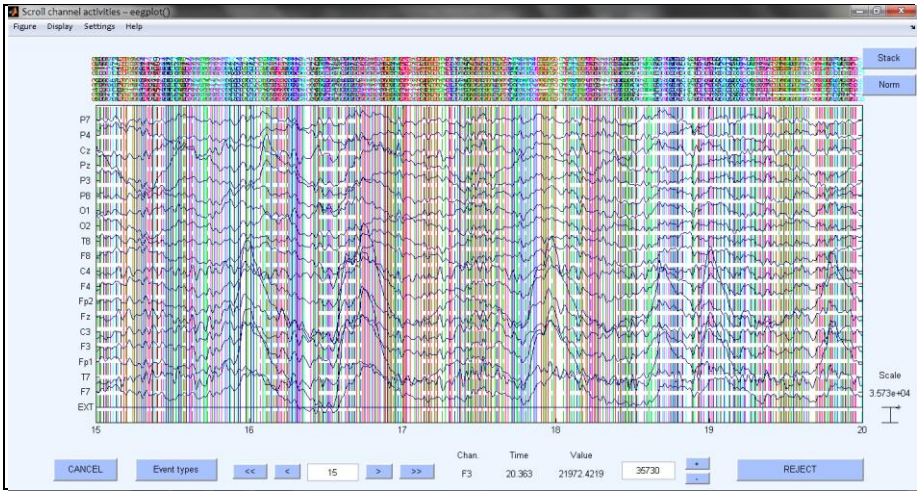

Figure 8 Before Marked

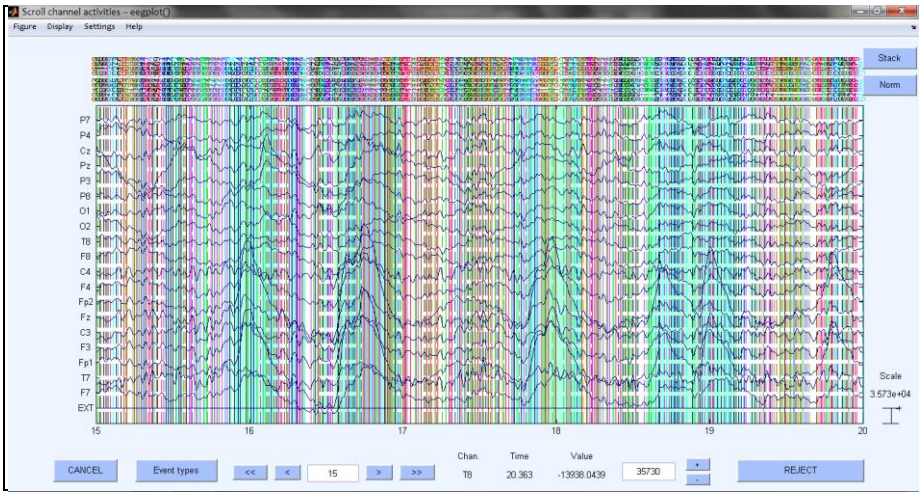

Figure 9 After Marked

2.5 3D Technologies

3D imaging and visualization technologies can be categorized as the most latest and advanced form of visual content delivery. This technology brings a new experiences and excitements to the users.

The earliest form of 3D video is stereoscopy which is the delivery of two 2D videos and capture by the different positions of human eyes. Due to the positions, the 2D image is been seen pop up from the screen and become 3D [16] [17].

The two current methods to see the level of the depth of a 3D TV are called active and passive. Using the active 3D as the equipments is still available in the campus. One of the active 3D technologies is active shutter. The left and right lenses of the glasses open and close at high speed, in rapid alternation, to view separate images (frames) shown on the screen.

With these great and advanced technologies, the level of the depth of 3D TV is going to be analyzed further in this project and also for the purpose to know which level give a good impact and which level is not inconvenient to the users.

CHAPTER 3

METHODOLOGY

3.1 Flow Chart

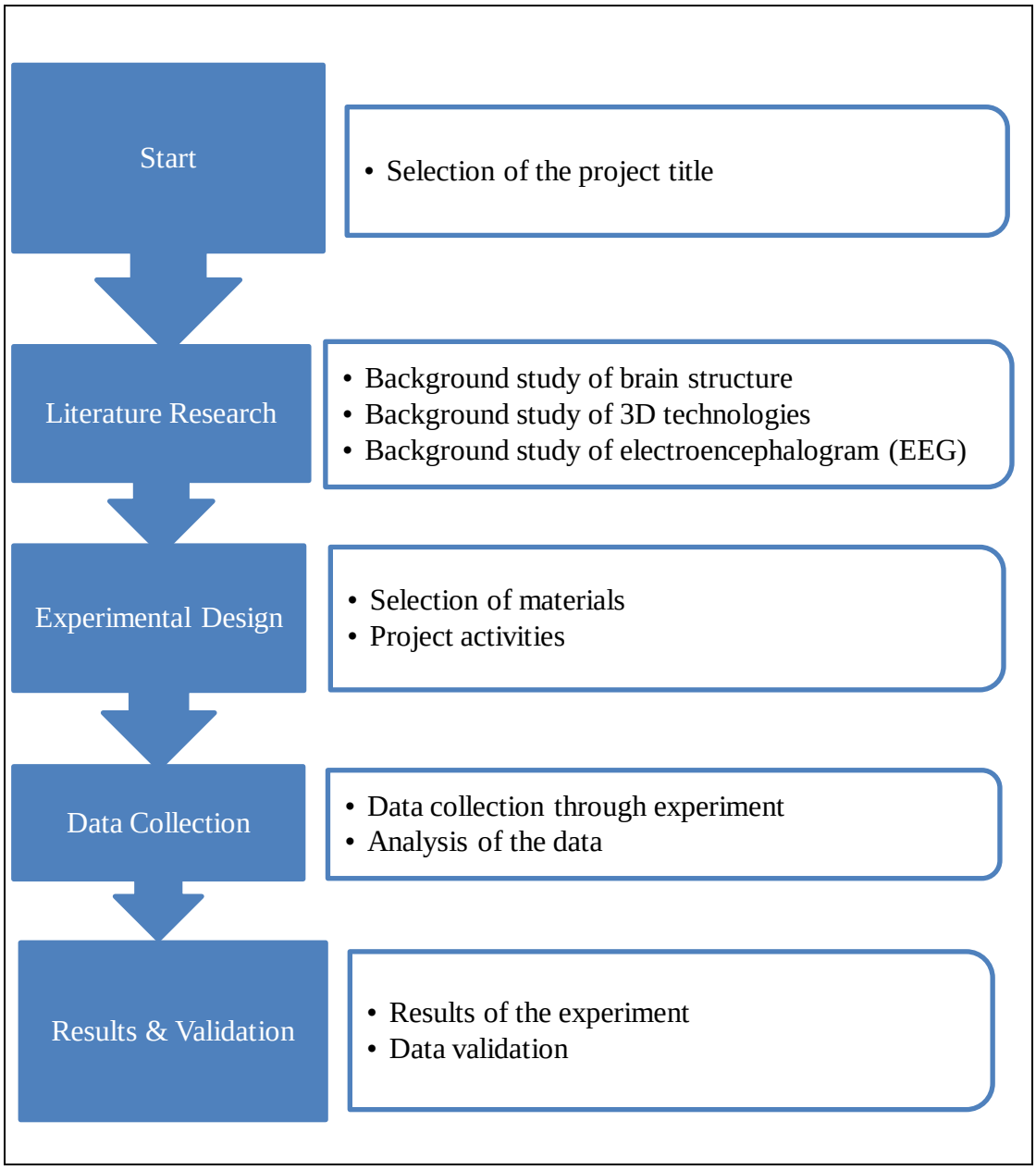

Figure 10 Flow of the Project

3.2 Equipments and tools

The equipments that will be going to use in this project are:

- Enobio EEG with the 20 electrodes attach at the scalp
- Software: MATLAB and NIC
- The active 3D TV which is available in the laboratory.
- The 3D active glasses.
- Avatar 3D movie.

3.3 Experimental Design

The experimental design is the first step before proceeds with the experiment. It is represents the experiment plan for the project. It is important to have efficient plans to avoid some conflicts during the project progression.

3.3.1 Selection of Movie

The top-grossing movie of all time, 3D Avatar direct by James Cameron is going to be used for the purpose of this project [19]. The movie is picked as the selected movie because the director's sense of stereoscopic design for the 2-hour 40-minute epic movie is so thoroughly nuanced and it does not strain the eyes of the viewers unlike a lot of 3D movies. Rather than superficial coming-at-you effects, Avatar uses depth to suck the viewers into its sci-fi world.

For this project, the author has selected a specific scene from the movie which is during the war between the human and avatar. This scene is selected because there are a lot of movement, thus it believe perhaps will give more impacts toward the brain.

3.3.2 Participant Qualification

Before proceeding with the experiment, the selection of subjects is important. The participants need to meet the requirements in this study. The participant cannot participate if they did not meet all the qualifications.

Some of the requirements to be in this study are:

- Age between 18 years to 28 years.
- Physically and mentally healthy.
- No head injury in past.
- Have a good vision.
- Have experience in 3D.

In order to get accurate results, the total number of subjects participate must be specified. By using G*Power, I can simply calculate the exact number of sample size which is the subjects. Below is the calculation of the sample size determined by the G*Power.

t tests - Means: Difference between two dependent means (matched pairs)
Analysis: A priori: Compute required sample size
Input: Tail(s) = One
Effect size dz = 0.5
α err prob = 0.05
Power (1-β err prob) = 0.8
Output: Noncentrality parameter δ = 2.598076
Critical t = 1.705618
Df = 26
Total sample size = 27
Actual power = 0.811832

From the calculation shows above, the total sample size that can give accurate results in this study is 27 subjects. However, due to the time constraint, the author only manages done the experiment with the 20 subjects only.

3.3.3 Project Activities

This study comprised only one session due to the time constraint. The first session will take up to 2 hours. So, the subject participation in this experiment is expected to last within 2 hours in this session plus minus with the time for setting up the experiment.

Below is the basic line of the conducted experiment:

- Training session (5-10mins)
- To get used to the setting as well as the tasks
- To reduce the artifacts (eye blinking, eye movements, and muscle movements)
- Resting condition as a baseline of the recording.
  - Eyes closed
  - Eyes open

  } 3mins
- Selected short scene of 2D movie (10mins) and 3D movie (10mins)

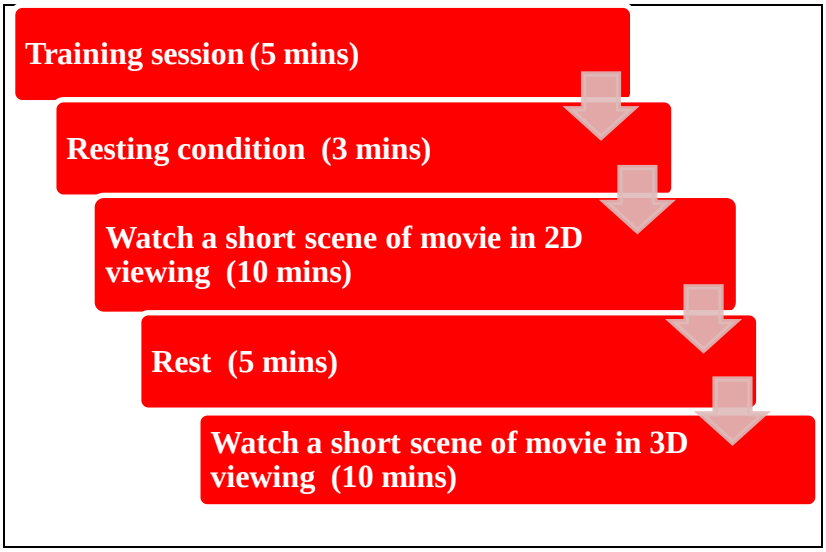

Figure 11 Basic Line of the Experiment

During the 10 minutes short movie, the subjects are going to watch the same scene for both of the 2D and 3D viewing.

3.3.4 Consent Form

Each subject that involve in this experiment will need to fill in the consent forms at the beginning of the experiment. There are two forms, which are "Subject Information and Consent Form" and another one is "Subject's Material Publication Consent Form". The purpose is to check whether the subject fulfill all the criteria for the experiment. For example, the subject must be physically and mentally healthy and have an age between 18 years and 28 years old. The information of the subject also will be keep confidential

The two forms will be given both in Malay and English as the subject needs to fill four forms in total. The "Subject Information and Consent Form" form is shown in Appendix A and Appendix B in Bahasa Malaysia and English respectively and the "Subject's Material Publication Consent Form" form is shown in Appendix C and Appendix D in Bahasa Malaysia and English respectively.

CHAPTER 4
PROJECT WORK & RESULTS

4.1 Project Work

The purpose of data collection is to achieve all the objectives stated. Without the data collection, the project cannot be done within the time given. The collection of data for this experiment is to gain the signal activity of the subject's brain and also to know which signal is referring to. For example, signals for eye blinking have their own pattern in the graph collected.

For the first data, the subject is in rest condition which means the subject doing the eyes opened and closed while seeing the 'X' mark in front of them. This recording takes about 3 minutes long. During the 2D movie, the recording of subject' brain signals was collected on the second data and this tasks takes about 10 minutes long. Last recording which is during the 3D movie was collected on the third data that taking 10 minutes long too.

Figure below shown is the print screen of the data collected during the experiment. The signals are collected through the EEG software, NIC and then using the MATLAB to analyze it.

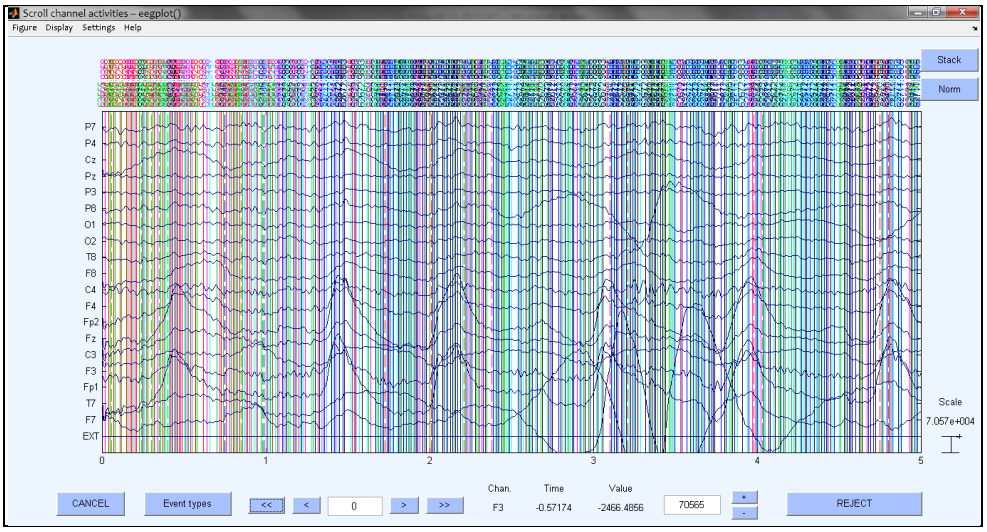

Figure 12 Print screen of The Data Collection

As you can see on the figure shown, some of the channels just give a straight line signals. This might happen due to the head movement of the subject. So, some of the electrodes of the channels is not attached to the skin of head. For your information, the total channels used are 20 channels.

4.2 Data Collection & Analysis

In order to transfer the data signal from the EEG software, NIC, using the MATLAB code, the data will transfer into a form of tabulated data in the MATLAB. There are two MATLAB code used in this project:

i. MATLAB code for convert the data signal into absolute power (Appendix E)
ii. MATLAB code for tabulating the data signal into absolute power with a specific coding for each of the brainwaves (Appendix F)

The experiment is actually conducted by using the visual content which is focusing only in **visual processing**. It does not involve with other content such as sound which is for hearing. So, the lobe that is responsible in this visual processing is the **occipital lobe**.

Table 1 and Figure 13 below are the data of the average signal waves on the occipital lobe of the 20 subjects.

Condition	Brainwaves			
	Delta	Theta	Alpha	Beta
Resting Condition	8.73E+09	3.52E+09	1.06E+08	96894534
2D	1.24E+10	3.76E+09	50911873	41929194
3D	1.81E+10	7.43E+09	54329486	39737501

Table 1 Average Waves of Occipital Lobe

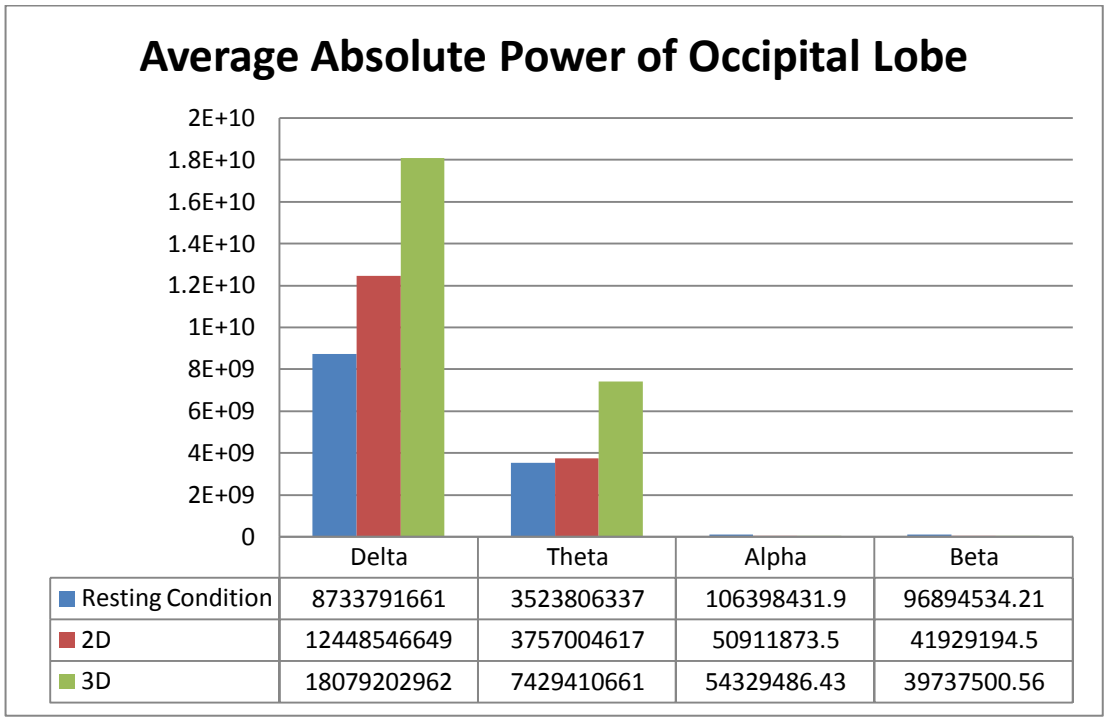

Figure 13 Average Absolute Power of Occipital Lobe

From the graph shown above, there are only small values of absolute power in occipital lobe for the alpha and beta waves occurred during the resting condition and during watching the movie in 2D and 3D viewing. There are changes in delta and theta waves and the pattern of the waves are increasing from resting condition to 3D mode. The green bar on the graph shows that the brain activity is highly active

during watching the movie in 3D viewing. While watching in 2D mode, the brain activity is slightly less active compared with the 3D mode.

The activeness in the brain activities can be categorized either in good or bad way. For this condition, the activeness is gone in the bad way and it is occurred due to the changes in viewing mode. The 3D mode may distract the subject to focus towards the screen. Thus, it is results with more delta waves compared with the others during the 3D mode.

From the results of the graph shown, only a few subjects meet the expectation of the results which meaning that a small number of subjects have the same absolute power with the average absolute power. Below is the example of data following with a graph of one subject that gives the same results with the average data collected.

Condition	Brainwaves			
	Delta	Theta	Alpha	Beta
Resting Condition	1.28E+10	5.4E+09	3.02E+08	2.82E+08
2D	1.9E+10	6.32E+09	1.02E+08	85821571
3D	4.02E+10	1.7E+10	77936031	58878528

Table 2 Subject's Absolute Power of Occipital Lobe

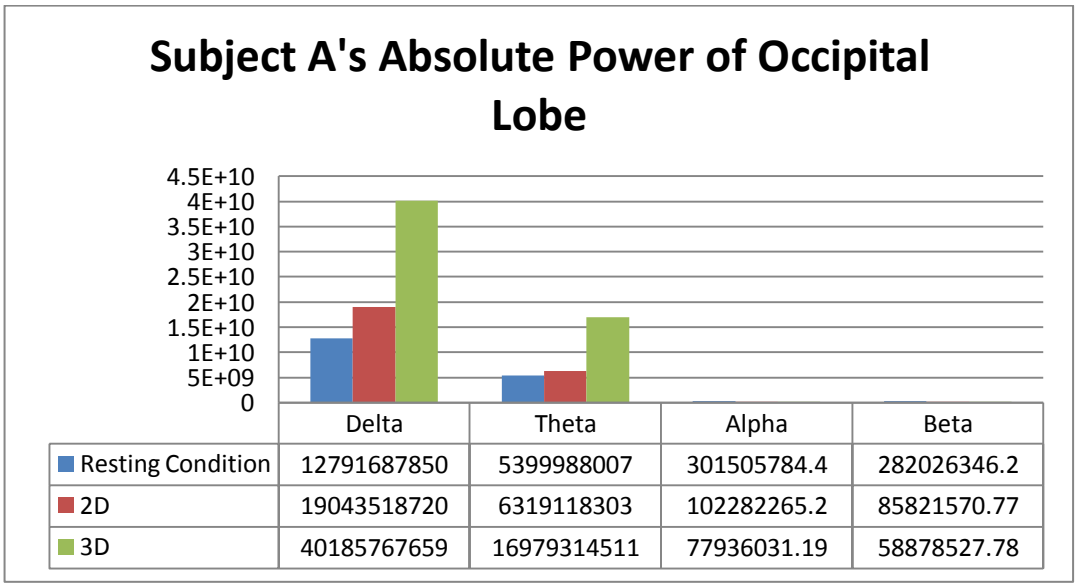

Figure 14 Subject's Absolute Power of Occipital Lobe

The ratio of the signal waves during the 2D and 3D can be calculated using the respective formulas shown below:

$$Ratio = \frac{Absolute\ power\ in\ 3D}{Absolute\ power\ in\ resting\ condition}\ or\ \frac{Absolute\ power\ in\ 2D}{Absolute\ power\ in\ resting\ condition}$$

- ❖ Ratio > 1: waves increased
- ❖ Ratio < 1: waves decreased

The ratio is calculated to identify which of the viewing gives more impacts towards the brain whether in 2D viewing or 3D viewing.

Ratio	Brainwaves			
	Delta	Theta	Alpha	Beta
2D/Resting condition	1.496721	1.423812	0.935984	0.926727
3D/Resting condition	1.693512	1.898995	1.018274	0.889113

Table 3 Ratio of Absolute Power of Occipital Lobe

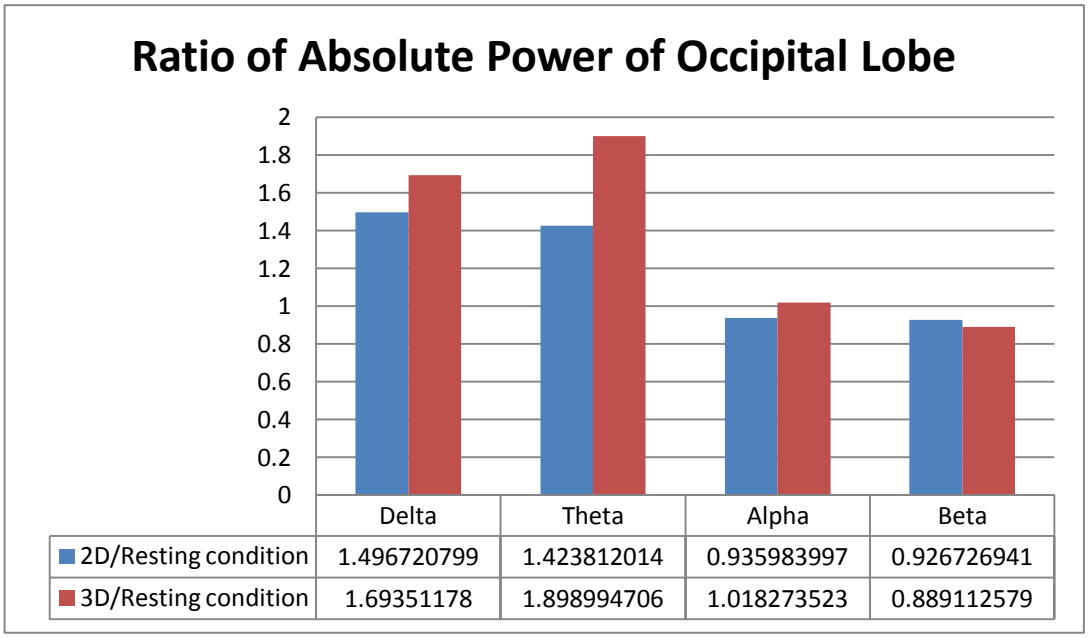

Figure 15 Ratio of Absolute Power of Occipital Lobe

Figure 15 shows that the ratios during the 3D mode in delta, theta, and alpha waves are higher compare with the 2D mode and just a slightly lower in beta waves compared with the 2D. This shows that the 3D viewing gives more impacts towards the brain.

The author believes that the viewing of the 3D might give stress towards the eyes of the subject, thus effect the brain signal of the subject's brain.

4.3 Gantt Chart

ACTIVITIES	WEEKS														
	1	2	3	4	5	6	7		8	9	10	11	12	13	14
FYP I															
Selection of the Project Topic								MID-SEM BREAK							
Preliminary research work															
Submission of Extended Proposal						☆									
Experiment Design															
Proposal Defense										☆					
Pre & post processing															
Draft Report														☆	
Interim Report															☆
FYP II															
Data Collection								MID-SEM BREAK							
Data Analysis															
Progress Report									☆						
ELECTREX												☆			
Draft Report													☆		
Final Report														☆	
Technical Paper														☆	
Viva/ Oral Presentation															☆

Work Progress:

Milestones: ☆

Table 4 Gantt Chart

CHAPTER 5
CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

A lot of people do not aware the existing of different level of depth in 3D technology. Majority of the viewers thought all of the 3D images display on the screen is the same, but actually is not. The various level of depth is actually given different experiences during the viewing.

Before watching the movie, which is during the resting condition with an eyes closed and open, the signals show most of the subjects were in a very relaxing condition.

During the 2D viewing, it is found that the subjects still relaxing while watching the movie with a little of stress in their eyes.

While in 3D mode, the subjects feel a lot more stress compared with the other conditions.

Thus, the results show that each of the subjects' brain does show some effects whenever they watch the movie from 2D to 3D viewing. Although the results are not fully successful, but the changes in the brainwaves from the 2D to 3D mode are still consider success.

Researchers around the world specialist in signal and image processing have given a lot of interest in researching the stereoscopic technology. It is believe that this brilliant technology will be investigate in more details day by day and it will continue give an impacts to the lifestyles of the human being.

5.2 Recommendations

For recommendations in the future, the limitations of equipment and time constraint prevents the author to apply some features into the project. The equipments that are available at the place of study are limited for each student whose wish to use it. Due to the short time given to complete the project, the author needs to divide her time efficiently to prevent from lagging in completing the project. So, to improve the performance and progression of the project, the addition of the equipments and duration for the project is very helpful.

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APPENDICES

1. Subject Information and Consent Form (in English and Bahasa Malaysia)
2. Subject's Material Publication Consent Form (in English and Bahasa Malaysia)
3. MATLAB Code for Convert & Transfer The Data
4. MATLAB Code for Specifying The Brainwaves

APPENDIX A

SUBJECT INFORMATION AND CONSENT FORM (IN BAHASA MALAYSIA)

Maklumat Subjek dan Borang Keizinan

(Halaman Tandatangan)

Tajuk Kajian: *Analisis Kesan Pelbagai Tahap Kedalaman TV 3-dimensi ke atas Otak Manusia*

Nama Penyelidik: *Siti Nurshafiqa Mohd Yohani, Dr. Aamir S. Malik, Dr. Nidal Kamel*

Untuk menjadi sebahagian daripada kajian ini, anda atau wakil sah anda mesti menandatangani helaian ini. Dengan menandatangi halaman ini, saya mengesahkan:

- Saya telah membaca semua maklumat di dalam Maklumat Subjek dan Borang Keizinan termasuk maklumat-maklumat lain berkaitan risiko yang ada dalam kajian ini dan saya mempunyai masa untuk berfikir mengenainya.
- Semua soalan-soalan saya telah dijawab dengan memuaskan.
- Saya secara sukarela bersetuju untuk menjadi sebahagian daripada kajian penyelidikan ini, mematuhi segala prosedur kajian dan memberi maklumat yang diperlukan kepada doktor, jururawat, atau ahli kakitangan yang lain, seperti yang diminta.
- Saya bebas boleh memilih untuk berhenti menjadi sebahagian daripada kajian ini pada bila-bila masa.
- Saya telah menerima satu salinan Maklumat Subjek dan Borang Keizinan untuk simpanan peribadi saya.

Nama Subjek (Dicetak/ tulis) _____

_____ _____

Subject Initials and Number No. I.C Subjek

_____ _____

Tandatangan Peserta atau Wakil Sah Tarikh (dd/mm/yy) (letakkan masa jika boleh)

Nama Individu yang mengendalikan Perbincangan _____
(Dicetak/Tulis)

_____ _____

Tandatangan Individu yang Mengendalikan Perbincangan Tarikh (dd/mm/yy)

_____ _____

Nama & Tandatangan Saksi Tarikh (dd/mm/yy)

Nota: i) Semua peserta yang terlibat tidak akan dilindungi oleh insurans.

APPENDIX B

SUBJECT INFORMATION AND CONSENT FORM (IN ENGLISH)

Subject Information and Consent Form

(Signature Page)

Research Title: Analysis of The Effects on Human Brain Due to Various Levels of Depth in 3D TV

Researcher's Name: Siti Nurshafiqa Mohd Yohani, Dr. Aamir S. Malik, Dr. Nidal Kamel

To become a part this study, you or your legal representative must sign this page. By signing this page, I am confirming the following:

- I have read all of the information in this Subject Information and Consent Form including any information regarding the risk in this study and I have had time to think about it.
- All of my questions have been answered to my satisfaction.
- I voluntarily agree to be part of this research study, to follow the study procedures, and to provide necessary information to the doctor, nurses, or other staff members, as requested.
- I may freely choose to stop being a part of this study at anytime.
- I have received a copy of this Subject Information and Consent Form to keep for myself.

Subject Name (Print or type) _____

_____ _____

Subject Initials and Number | Subject I.C No.

_____ _____

Signature of Subject or Legal Representative | Date (dd/mm/yy) (Add time if applicable)

Name of Individual Conducting Consent Discussion
(Print or Type)

_____

_____ _____

Signature of Individual
Conducting Consent Discussion | Date (dd/mm/yy)

_____ _____

Name & Signature of Witness | Date (dd/mm/yy)

Note: i) All subject/subjects who are involved in this study will not be covered by insurance.

APPENDIX C

SUBJECT'S MATERIAL PUBLICATION CONSENT FORM (IN BAHASA MALAYSIA)

Borang Keizinan Penerbitan Bahan yang Berkaitan dengan Subjek
(Halaman Tandatangan)

Tajuk Kajian: *Analisis Kesan Pelbagai Tahap Kedalaman TV 3-dimensi ke atas Otak Manusia*

Nama Penyelidik: *Siti Nurshafiqa Mohd Yohani, Dr. Aamir S. Malik, Dr. Nidal Kamel*

Untuk menjadi sebahagian daripada kajian ini, anda atau wakil sah anda mesti menandatangani helaian ini.

Dengan menandatangi halaman ini, saya mengesahkan:

- Saya memahami bahawa nama saya tidak akan muncul pada bahan-bahan yang diterbitkan dan terdapat usaha untuk memastikan bahawa privasi nama saya dirahsiakan walaupun kerahsiaan tidak dijamin sepenuhnya sekiranya berlaku keadaan yang tidak diduga.
- Saya telah membaca bahan-bahan atau perihalan am mengenai baha-bahan yang terkandung dalam kajian dan telah mengkaji semua gambar-gambar dan gambarajah yang melibatkan saya yang mungkin disiarkan.
- Saya telah ditawarkan peluang untuk membaca manuskrip dan untuk melihat semua bahan-bahan yang mana mungkin akan melibatkan saya tetapi tidak mendesak untuk hak-hak tersebut.
- Semua bahan-bahan yang diterbitkan akan dikongsi di kalangan pengamal perubatan, saintis dan wartawan di seluruh dunia.
- Bahan-bahan kajian ini juga akan digunakan dalam penerbitan tempatan, penerbitan buku dan di akses oleh ramai doktor di seluruh dunia tempatan dan antarabangsa.
- Saya dengan ini bersetuju dan membenarkan bahan-bahan yang akan digunakan dalam penerbitan lain yang dikehendaki oleh penerbit lain dengansyarat-syarat ini:
    - Bahan-bahan tersebut tidak akan digunakan untuk pengiklanan
    - Bahan tersebut tidak akan digunakan untuk tujuan lain yang tidak berkaitan –contoh: Sampel gambar tidak akan digunakan dalam artikel yang tidak berkaitan dengan gambar.

Nama Peserta (Ditaip/ Tulis)	Subject Initials or Number

No. IC Peserta	Tandatangan Peserta	Tarikh (dd/mm/yy)

Nama dan Tandatangan Individu yang Mengendalikan Perbincangan	Tarikh (dd/mm/yy)

Nota: i) Semua peserta yang terlibat tidak akan dilindungi oleh insurans.

APPENDIX D

SUBJECT'S MATERIAL PUBLICATION CONSENT FORM (IN ENGLISH)

Subject's Material Publication Consent Form
Signature Page

Research Title: Analysis of The Effects on Human Brain Due to Various Levels of Depth in 3D TV

Researcher's Name: Siti Nurshafiqa Mohd Yohani, Dr. Aamir S. Malik, Dr. Nidal Kamel

To become a part this study, you or your legal representative must sign this page.

By signing this page, I am confirming the following:

- I understood that my name will not appear on the materials published and there has been an effort to make sure that the privacy of my name is kept confidential although the confidentiality is not completely guaranteed due to unexpected circumstances.
- I have read the materials or general description of what the material contains and reviewed all photographs and figures in which I am included that could be published.
- I have been offered the opportunity to read the manuscript and to see all materials in which I am included, but have waived my right to do so.
- All the published materials will be shared among the medical practitioners, scientists and journalist worldwide.
- The materials will also be used in local publications, book publications and accessed by many local and international doctors worldwide.
- I hereby agree and allow the materials to be used in other publications required by other publishers with these conditions:
- The materials will not be used as advertisement purposes nor as packaging materials.
- The materials will not be used out of context – i.e.: Sample pictures will not be used in an article which is unrelated subject to the picture.
- There may be financial implications associated with the data or findings of this study. I agree that I will not be entitled to receive any financial compensation or claim any financial value except the already agreed honorarium for this study.

Subject Name (Print or type)		Subject Initials or Number
Subject I.C No.	Subject's Signature	Date (dd/mm/yy)
Name and Signature of Individual Conducting Consent Discussion		Date (dd/mm/yy)

Note: i) All subject/subjects who are involved in this study will not be covered by insurance.

APPENDIX E

MATLAB CODE FOR CONVERT & TRANSFER THE DATA

```
clc;
clear all;
close all;
% [cnt,head,elec,event] =
edf2mat('C:\Users\ujser\Desktop\Academics\13May\FYPII\eeglab10.2.2.4
\piqa\eli\data_03.edf');
[cnt,head,elec,event] =
edf2mat('C:\Users\ujser\Desktop\Academics\13May\FYPII\eeglab10.2.2.4
\piqa\eli\data_03.edf');
% EEG = cnt.data(3,:);
EEG(1,:)=cnt.data(1,:);
EEG(2,:)=cnt.data(2,:);
EEG(3,:)=cnt.data(3,:);
EEG(4,:)=cnt.data(4,:);
EEG(5,:)=cnt.data(5,:);
EEG(6,:)=cnt.data(6,:);
EEG(7,:)=cnt.data(7,:);
EEG(8,:)=cnt.data(8,:);
EEG(9,:)=cnt.data(9,:);
EEG(10,:)=cnt.data(10,:);
EEG(11,:)=cnt.data(11,:);
EEG(12,:)=cnt.data(12,:);
EEG(13,:)=cnt.data(13,:);
EEG(14,:)=cnt.data(14,:);
EEG(15,:)=cnt.data(15,:);
EEG(16,:)=cnt.data(16,:);
EEG(17,:)=cnt.data(17,:);
EEG(18,:)=cnt.data(18,:);
EEG(19,:)=cnt.data(19,:);
EEG(20,:)=cnt.data(20,:);

%cd('E:\EEG data\removing artifacts\piqa')
%save('Awais_EO.mat','EEG');
% load Awais_EO.mat
```

APPENDIX F

MATLAB CODE FOR SPECIFYING THE BRAINWAVES

```
%%%%%%% FFT-based spectrum  analysis %%%%%%%%%%%%
%total = sum(abs(y.^2));
%y(isnan(y)) = 0;
clc
clear all
close all
cd('C:\Users\ujser\Desktop\Academics\13May\FYPII\eeglab10.2.2.4\piqa
\eli')
load data_03.mat
for i=1:20
y=EEG(i,:);
f0 = 128;
[Pxx,f] = periodogram(y(:),[],[],f0);
%Pxx = r*Pxx/length(Pxx);
%X.total = sum(Pxx);
X.FFT.ASpectrum = Pxx;
X.FFT.f = f;


%% Frrequency bands
%delta band

ix = (f>1)&(f<4);
X.delta = sum(Pxx(ix));

%theta band
ix = (f>4) & (f<8);
X.theta = sum(Pxx(ix));

%alpha band
ix = (f>8) & (f<13);
X.alpha = sum(Pxx(ix));

%beta band
ix = (f>13) & (f<30);
X.beta = sum(Pxx(ix));


A(i,:)=[ X.delta X.theta X.alpha X.beta ];


end
Avg = mean(A(:,:))
%
% X.FFT.TotalPower = sum(Pxx);
% X.FFT.LFHFratio = X.FFT.LF./X.FFT.HF;
% X.FFT.LFnu = X.FFT.LF./(X.FFT.TotalPower-X.FFT.VLF);
% X.FFT.HFnu = X.FFT.HF./(X.FFT.TotalPower-X.FFT.VLF);
```