FINAL YEAR PROJECT 1 (EDB4012)

Extended Proposal

TITLE: DEVELOPMENT OF APPS TO IMPROVE MOOD STATES

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ABSTRACT

It is normal to experience a range of moods which is high and low in daily life. Bad emotional states often link to the stress which is common in the workplace. Employees' moods, emotions and overall dispositions have an impact on job performance, decision making, creativity, turnover, teamwork, negotiations and leadership at work. Positive mood leaders also more likely to encourage and notice positive behaviours performed by group and reinforce the group while negative emotions make anti-social behaviours more likely. One study shows the discreet negative emotions that is induced in unjust and stressful environment increase likelihood of frequency of anti-social or deviant organisational behaviours. Besides, people with higher emotional intelligence is also perform well on problem- solving tasks. Hence, the needs for portable system which can detect emotional state is very important to improve the workers' productivity and reduce risk of getting neuropsychiatric disorders. By far, an arithmetic app is created to act as a stimulus in order to measure the user's brain during a task-based basis. Besides, another app of forest virtual reality is created to improve the user mood states. However, the apps are still in developing stage and need constant improvement and the app for measuring the user's mood state using fNIRS is still in progress. At the end of the day, we are going to create an apps with the ability to measure user's mood states using portable fNIRS and improve their mood states with virtual reality application.

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1.0 INTRODUCTION

1.1 BACKGROUND STUDY

Poor mental health is a common problem in adolescence. Negative mood states can cause a lot of social issues such as, problematic alcohol use, perceived mistreatment and or abuse, drug abuse, lower academic performance and feeling isolated.[1] In a study shown, if the student has negative emotional states and traits towards faculty, the students are more likely to have a short-term and possibly a long term disruptive experience in writing and negatively impacted his or her overall development. [2] This shows that the emotional states do affect academic performance and hinder students' interest in study.

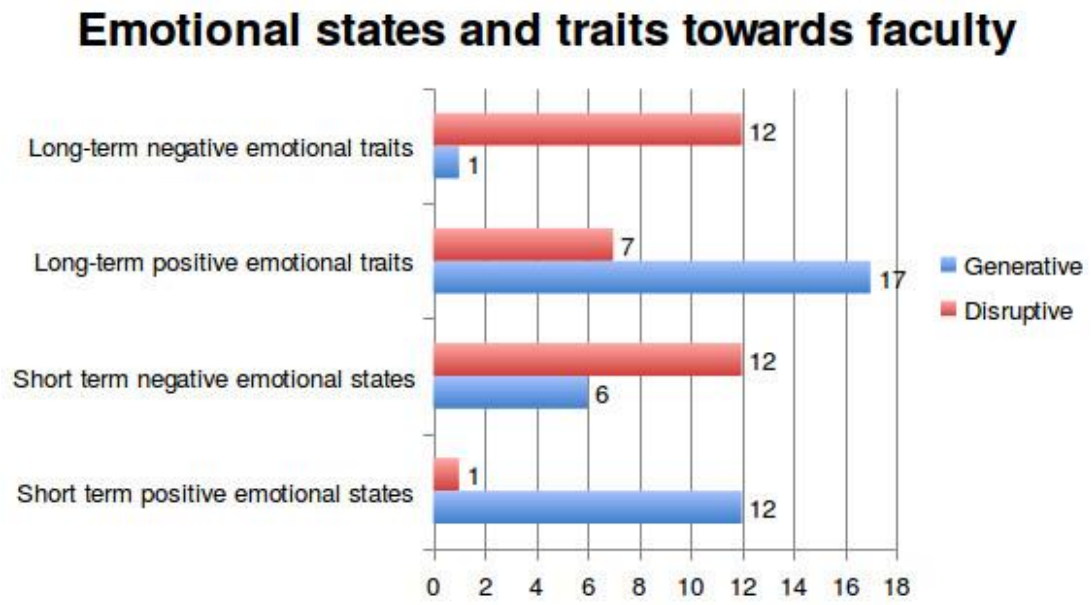
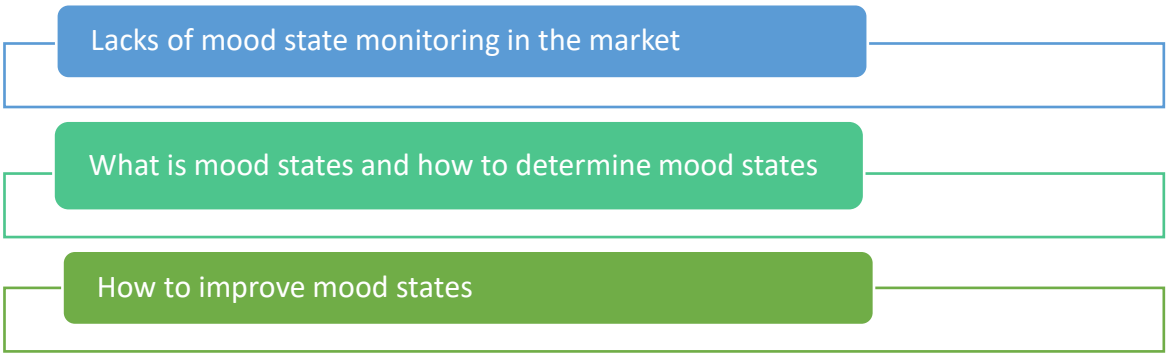


Figure 1 Effect of Emotional States and Traits towards faculty on Student Writing Performance[2]

In the workplace, employees moods, emotional does have an impact on job performance and decision making. [3]A study shown that positive mood leader leads better than negative mood leaders which is due to the encouragement given. [4]People with higher emotional intelligence also perform well in problem solving task which can solve the problem in a short amount of time and helps organization to be more successfully and productive. [5]Hence, the study of mood states improvement is very important for an organization and students.

There are many equipment that can be used to determine brain activities like electroencephalography (EEG), functional Near-Infrared Spectroscopy (fNIRS), and functional Magnetic Resonance Imaging (fMRI) which target different brain area and each of them has advantages and disadvantages. Emotional response affects many different areas of brain which includes prefrontal cortex and parts of the limbic system.[6-8] EEG studies shows that left frontal inactivation shows that subject has a negative emotion while right frontal inactivation shows that subject feeling positive. [9]The studies of severe major depressive disorder (MDD) also shown that left dorsolateral prefrontal cortex (DLFPC) of the MDD patients is hypoactive while right dorsolateral prefrontal cortex is hyperactive. [10]In addition, psycho-physiological research also shown that a more active left frontal area indicates positive reaction while right frontal area activation means negative effect. [11]According to Yu (2017), the right areas of prefrontal cortex increase in oxy-haemoglobin when the urban picture is shown. [12]These studies consistent with the valence-specific hypothesis which is left cerebral hemisphere specialized for positive emotions and right hemisphere specialized for negative emotions. [13-15]FNIRS uses near infrared spectrum which is between 700-900nm to create an optical window where skin and tissue are almost transparent and utilises light absorption properties of oxyhaemoglobin (HbO) and deoxy-haemoglobin (HbR) to measure the concentration of HbO and HbR inside the superficial layer of scalp. [16, 17]FNIRS has many advantages which makes it suitable for detecting the blood oxygen level dependent(BOLD) over the other techniques such as fMRI and positron emission tomography (PET) which we will discuss later. [18]

1.2 Problem Statement



Negative mood states can affect the productivity and efficiency of the workers. Long period of negative mood will increase the likelihood of a person becoming depressed. The negative mood states often associated with stress. Stress can lead a person to get hardly-curable mental related illness such as depression, anxiety, bipolar disorders and schizophrenia. [4, 5, 19]Severe stress and depression can also increase risk of early death or have a heart attack by 48%.

Current issue:

To date, there are no mood states monitoring device which can track your mood states from time to time like how fitness tracker track a person fitness level at all time. The measurement of mood states is even more important than the fitness monitoring because negative mood states can have many bad implications to human health.

Apps need to know:

The application created need to determine the current mood states of the person to improve the user's mood states. Hence, an algorithm is needed to determine the mood states of a person and improve the mood states.

Technical challenge:

Mood states improvement is kind of challenging as it varies from person to person. Hence, a suitable way to improve mood states need to be investigated in order to build an apps for mood states improvement.

1.3 Objectives

i. Determine the suitable method to measure the mood state of the users
ii. Create an application which can detect mood states based on the data collected using fNIRS
iii. Create an application which able to simulate a virtual reality forest to improve mood states

1.4 Scope of Study

Since the number of probes for portable fNIRS measurement was limited, only certain regions can be measured. Therefore, an effective method has to be used to The project starts by studying the following items to gain deeper understanding on the project so that the comparison of theory and practical studies can be made:

1. Brain anatomy and the terms used to describe the position of the brain
2. Differences between fMRI, fNIRS and EEG and each of their working principal
3. How stress and mood affect prefrontal cortex
4. Ways to improve mood states
5. Different types of test to stimulate brain for the measuring of the brain signal
6. Ways to develop an apps
7. Development of a virtual reality forest to reduce stress

After research phase is all done, the development of the apps for the portable fNIRS should be start immediately. To measure the brain states of the patient, tasks are used to test their mood states were designed. While the participants underwent the designated task, the brain signal is being recorded. Other than pen-and-paper screening test, the data collected is being analysed and processed to determine the mood states of the user. To test the effectiveness of the mood states improvement application, the designated application will be used by user to improve their mood states.

1.5 The Report

This report contains several chapters, ranging from introduction to conclusion.

Chapter 2 shows the literature review on what have been discovered by other researchers in the related field such as self-reported mood states monitoring and fNIRS and other neuroimaging modalities.

Chapter 3 describes a system of methods which was deployed to achieve the goals of the study. The system of methods includes ways of apps development, hardware and software used, system overview and a gantt chart.

In chapter 4, the results of the apps development are shown and this shows my current progress in FYP1.

Chapter 5 wraps up what have been discussed in report and my current progress in FYP1. It also includes the future works that need to be completed during FYP2.

2.0 LITERATURE REVIEW

Introduction

This section briefly discusses some of the self-reported mood states questionnaires that are widely used – SAM, PANAS and POMS. Other than that, this sections also compares different neuroimaging modalities which are commonly used -fNIRS, EEG and fMRI. In the third section, we discussed about the correlation between mood states and working memory tasks. At the last section, we also discussed on how to determine mood states by looking at hemispheric asymmetric activation.

2.1 Mood States

Negative mood states are often associated with the stress related problem. Hence in this study, we learned about how stress affects human health condition and performance in workplace. According to WHO Collaborative Study of Psychological Problems in General Health Care, there are about 10.4% of patients is suffered from depression or stress-related anxiety. [20, 21]Poor heartrate outcome is all related to the stress, lower education level, low income and social isolation. [22]Patients who suffered from myocardial infarction also has a high mortality rate when they are depressed. [23]According to Mental Health Foundation in United Kingdom, British Industry has spent over 3 billion British Pound annually for the stress related problems.[24] Stress evokes negative mood states which can cause a lot of losses to a company. This especially happened for high profile nature job which a slight mistake can cost a huge amount of losses. [25] Hence, mood states must be monitored from time to time to ensure that the work demands and pressure must be matched to their knowledge and abilities to face the challenges given. The workers' mood states data can also be used as an analytic tool to analyse the mood states when different type of jobs is given. This can provide the employers an insight on the kind of task the employee is suitable for and distribute the task accordingly. This kind of analytical data is very important to enhance the productivity of the workers and increase the competitiveness of a company in the market.

Stress also increases risk of depression and evoke negative emotion for a long period of time. [26] In this study, we study emotional states using self-reported emotional state test.

There are many other questionnaires that can be used to measure emotional states as well:

i. Self-Assessment Manikin (SAM) [27]

ii. Positive and Negative Affect Scale (PANAS)[28]

iii. Profile of Mood States (POMS)[29]

2.1.1Self-Assessment Manikin (SAM)

Self-Assessment Manikin (SAM) is a questionnaire based on cognition on arousal and valence which is proposed by Lang [27].

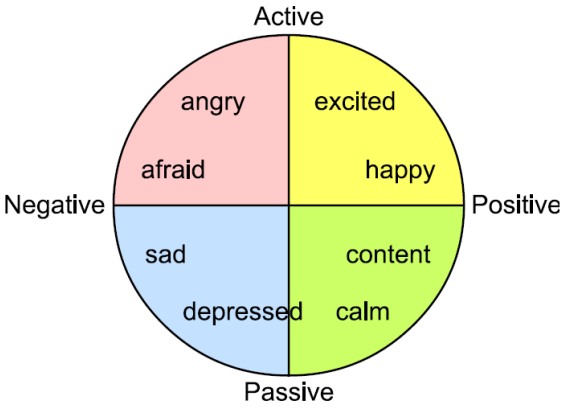


Figure 2 Arousal-Valence Model

This arousal-valence model *shown in figure 1* is used in many research studies as well as Self-Assessment Manikin (SAM) which is a self-evaluation test for the affective dimension of valence, arousal, and dominance. It provides a fast, intuitive and simple way of evaluating emotional state. The participants are required to fill in this questionnaire based on rating of 1-9 for each category.

For the valence scale of 1-9:

i. 1-3 : Negative

ii. 4-6 : Neutral

iii. 7-9 : Positive

For the arousal scale of 1-9:

i. 1-3 : Passive

ii. 4-6 : Neutral

iii. 7-9 : Active

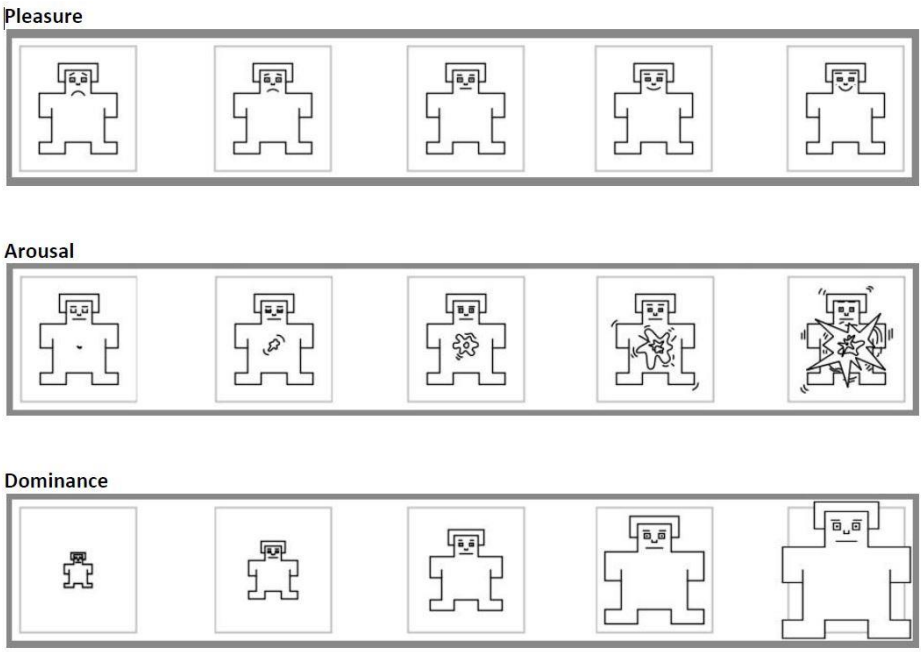


Figure 3 Self-Assessment Manikin with Valence(negative-positive), Arousal(passive-active), Dominance(dominated-dominant)

According to new scale mapping, the system provides 9 states of classification which is shown in figure 3.

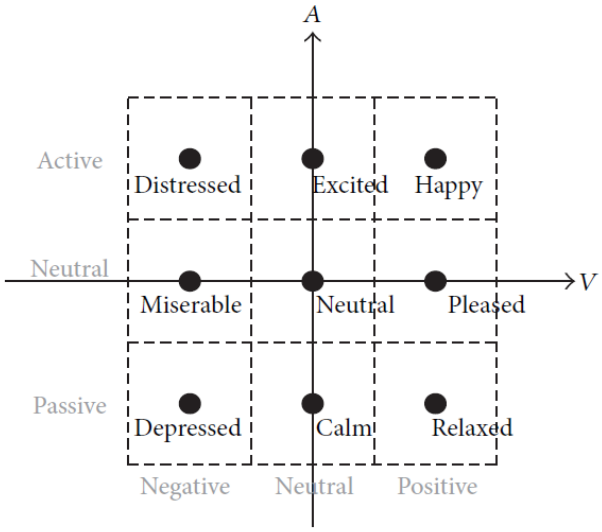


Figure 4 9-states emotion classification[30]

2.1.2 Positive and Negative Affect Scale (PANAS)

This emotional state study is a self-assessment based on Dutch-English translation. The translation is done by Engelen (1988). [28]The PANAS is a list of 20 adjectives used to describes different emotional states which consisted of:

- 10 states of Positive Affect (PA)
- 10 states of Negative Affect (NA)

PA is used to measure activity and pleasure while NA is used to measure fear and stress. Due to its length of questionnaire, PANAS is more suitable to measure longer lasting emotional states. The participants are required to fill in the questionnaire on a rating scale from 1-5:

1= not at all or very slightly

2= a little

3= moderately

4= a lot

5= extremely

PANAS Scale

	Original PANAS items	Dutch translation
NA1	Distressed	Bedroefd[1]
NA2	Upset	Terneergeslagen[1]
NA3	Guilty	Schuldig[1]
NA4	Scared	Angstig[1]
NA5	Hostile	Vijandig[1]
NA6	Irritable	Prikkelbaar[2]
NA7	Ashamed	Beschaamd[1]
NA8	Nervous	Nerveus[2]
NA9	Jittery	Rusteloos[2]
NA10	Afraid	Bang[1]
PA1	Interested	Geïnteresseerd[1]
PA 2	Excited	Opgewekt[1]
PA 3	Strong	Sterk[1]
PA 4	Enthusiastic	Enthousiast[1]
PA 5	Proud	Zelfverzekerd[1]
PA 6	Alert	Alert[1]
PA 7	Inspired	Geïnspireerd[2]
PA 8	Determined	Vastberaden[1]
PA 9	Attentive	Aandachtig[1]
PA 10	Active	Energiek[1]

[1] = from Engelen et al., 2006

[2] = from Peeters et al, 2006

2.1.3 Profile of Mood States (POMS)

POMS test is a questionnaire for psychological test that are widely used in research. This questionnaire is developed by Douglas (1971).[29]The participant are required to fill in each of the areas based on rating of 0 (not at all)- 4(extremely). The questionnaire is divided into seven subscale which consists of : tension(TEN), anger (ANG), fatique (FAT), depression (DEP), esteem-related affect (ERA), vigour (VIG) and confusion (CON). Then the total scores of the questionnaire is calculated using Total Mood Disturbance (TMD) formula:

$$TMD=[TEN+DEP+ANG+FAT+CON] – [VIG+ERA]$$

The score is calculated by summing up negative emotion (tension, depression, fatique, confusion, anger) and the subtracting the positive emotions (vigor and esteem-related affect). Grove and Harry (1992) have done an experiment using this POMS test. They require netball player to fill in the POMS questionnaire twice which once is during post win and another one during post loss experience. The experiment found out when the player lost in the game, the negative emotion (tension, depression, anger, confusion) is higher compared to winning a game while the positive emotion (vigour and esteem) is exactly the opposite. [31]This shows that the POMS test can determine the mood states of the participants quite well.

	Not at all	A little	Moderately	Quite a lot	Extremely
Tense	0	1	2	3	4
Angry	0	1	2	3	4
Worn out	0	1	2	3	4
Unhappy	0	1	2	3	4
Proud	0	1	2	3	4
Lively	0	1	2	3	4
Confused	0	1	2	3	4
Sad	0	1	2	3	4
Active	0	1	2	3	4
On-edge	0	1	2	3	4
Grouchy	0	1	2	3	4
Ashamed	0	1	2	3	4
Energetic	0	1	2	3	4
Hopeless	0	1	2	3	4
Uneasy	0	1	2	3	4
Restless	0	1	2	3	4
Unable to concentrate	0	1	2	3	4
Fatigued	0	1	2	3	4
Competent	0	1	2	3	4
Annoyed	0	1	2	3	4
Discouraged	0	1	2	3	4
Resentful	0	1	2	3	4
Nervous	0	1	2	3	4
Miserable	0	1	2	3	4
Confident	0	1	2	3	4
Bitter	0	1	2	3	4
Exhausted	0	1	2	3	4
Anxious	0	1	2	3	4
Helpless	0	1	2	3	4
Weary	0	1	2	3	4
Satisfied	0	1	2	3	4
Bewildered	0	1	2	3	4
Furious	0	1	2	3	4
Full of pep	0	1	2	3	4
Worthless	0	1	2	3	4
Forgetful	0	1	2	3	4
Vigorous	0	1	2	3	4

Uncertain about things	0	1	2	3	4
Bushed	0	1	2	3	4
Embarrassed	0	1	2	3	4

Comparison table for three types of questionnaires:

	Self-Assessment Manikin (SAM)	Positive and Negative Affect Scale (PANAS)	Profile of Mood States (POMS)
Ease of use	Easy	Easy	Easy
Analyse	Easy	Medium	Hard
Data Interpretation	Too little data	Medium	Easy
Straightforward	Straightforward	Not Straightforward	Not Straightforward
Time	Very Fast	Slow	Very Slow

Based on the table, the positive affects and negative affects (PANAS) is recommended for the mobile application as the users might lose interest to do long list of questionnaires. The PANAS comes with less adjectives which makes it easier to understand compared to SAM and POMS which uses different kinds of picture and adjectives which makes it slightly harder to understand and interpret. The ease of understand will help reduce the time taken to complete a questionnaire as you can see completion of PANAS questionnaire is significantly faster than the rest of the questionnaire.

2.2 fNIRS and other neuroimaging modalities

FNIRS is a neuroimaging technique that able to monitor the brain activity non-invasively. [32]FNIRS uses near infrared light of wavelength 700 to 900 nm to create an optical window where infrared light can easily penetrate living organisms. Absorption of near infrared light decreases in water as the wavelength getting longer than 900nm. Therefore, it is safe to use fNIRS as it does not internally penetrate living organism.

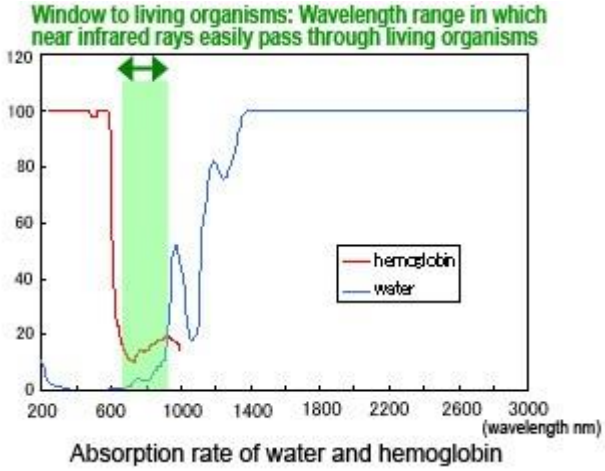


Figure 5 Absorption Rate of Haemoglobin and water at different wavelength

Absorption of light in this wavelength region is caused mainly by oxygenated haemoglobin (HbO) and deoxy-haemoglobin (HbR). Both HbO and HbR has different absorbing spectrum and the isobestic point of both is 805nm. Hence the concentration of HbO and HbR can be measured based on the absorption at two different wavelength as shown in figure 5. [33]

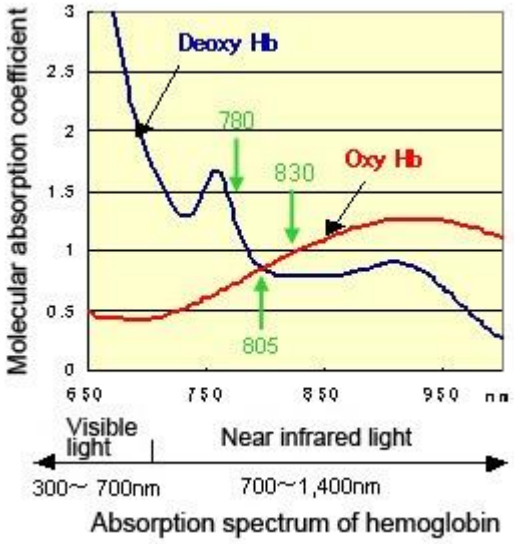


Figure 6 Absorption Spectrum of Oxy-Hemoglobin and Deoxy-hemoglobin and the isobestic point

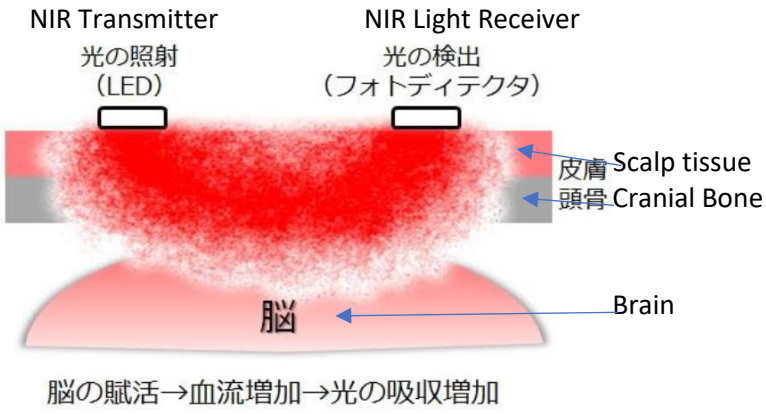


Figure 7 Technique of Fnirs measuring the brain neural activity[34]

As you can see from the figure 6, the fNIRS transmitter is being placed a few centimetre away from the NIR light receiver. This is due to the measuring of the brain neural activity highly dependent on the blood flow rate. The higher the blood flow rate, the absorption of light will also increase. This protable fNIRS system designed by Hitachi has a lightweight of approximately 125gram which make it suitable for daily use and the movement artifact is reduced due to its lightweight properties. The transmission of data from fNIRS system is also done by using Bluetooth. Hence, the movement is less constraint due to lightweight and wireless properties.

FNIRS has several disadvantages compared to other non-invasive measurement such as it has lower spatial resolution compared to fMRI and PET and temporal resolution if compared to EEG. [32]However, in comparison with other modalities, fNIRS has higher temporal resolution than fMRI and higher spatial resolution than EEG. [35]Besides, the fNIRS does not has movement constraint unlike fMRI which the movement is almost restricted which made it impossible to be made use as portable measurement device and movement constraint will cause environmental stress while taking measurement. [36]Besides, the fNIRS has a superior signal-to-noise ratio compared to EEG system. [35, 37]Hence, fNIRS has many benefits including safety, portability and non-invasiveness and suitable to be developed as a tool for measuring emotional-related neural activation in prefrontal cortex.

2.3 Correlation of Mood States during Working Memory Task

Working memory task is a dedicated system that temporary store information in the short term and this system underlies human thought processes and cognitive function. [38]

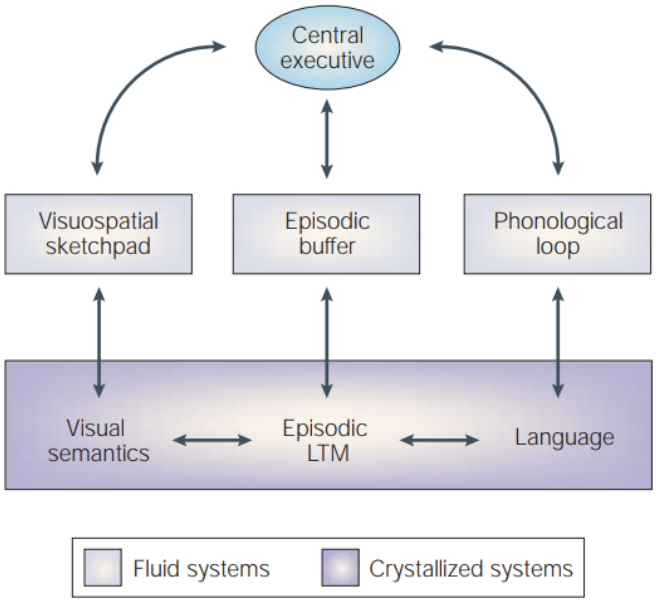


Figure 8 Working Memory Model Components[38]

As you can see from figure above, the working memory is comprises of short term memory with is in the second tier and long term memory which is in third-tier. The system consists of different components to process and store different kind of information just like a computer. The several components can be explained as follows:

- **Central executive:** control the whole system and allocates data to whole subsystems. It deals with cognitive tasks such as problem solving task and mental arithmetic tasks.
- **Visio-Spatial Sketchpad**: Spatial or visual memory and used for navigation.
- **Episodic Buffer**: Acts as a to 'backup' to store the long term memory and other working memory components.
- **Phonological Loop**: Working memory that related to spoken and written material eg. Memorizing a phone number . It is further divided into two parts:
  - **Phonological Store**: Temporary store information in speech forms for a short period of time
  - **Articulatory control process**: Related to speech production.

Each of these compenents are dependent of each other. Hence, we can conclude that the working memory is very important for cognitive function such as mental arithmetic task, problem solving task, spatial navigation and speech recognition and production.

The working memory performance is strongly affected by the mood as shown in several experiments. In one study by Mitchell (2007), performance of participants on several working memory tasks is affected by their mood states. [39] Prefrontal cortex also found to play a crucial role on working memory.[40] In a fMRI study, the activity of dorsolateral Prefrontal Cortex (DLPFC) reduced during a numerical n-back task (a type of working memory task) when they were exposed to stress which led to increasing negative mood.[41]

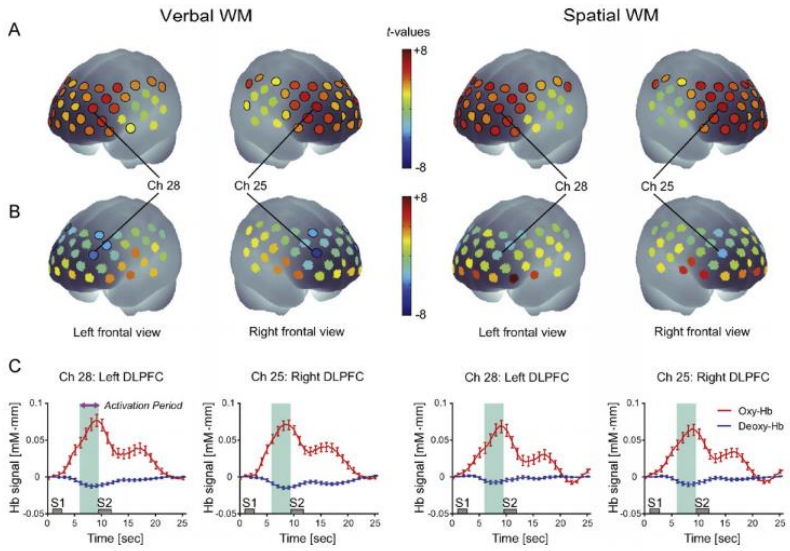


Figure 9 Haemodynamic changes in a verbal and spatial working memory tasks. A) Activation t-maps of oxy-HB increase B) Activation t-maps of deoxy-hb signal decrease. C) Oxy-hb and deoxy-hb signal of DLPFC in time domain. [42]

The figure above shows that when the Oxy-haemoglobin increases, the de-oxy haemoglobin decreases. This indicates that there is brain activity going on. [43, 44] Throughout the experiment, when participants have higher negative moods, the oxy-hb in DLPFC increases which signifies that the participants found it harder to do working memory problem when they are having bad moods. In this studies, the results shows that the positive correlation between PFC Activity and positive mood, which means if the better the mood states is , the higher the PFC activity (better cognitive function). [42]

2.4 Hemispheric Asymmetric in Emotional Processing

Prefrontal cortex (PFC) plays a vital role in emotion, therefore in this study we intend to learn interaction between hemispheric asymmetries in PFC on different types of emotion. According to Morinaga K. (2007), the increased in right frontal oxy-haemooglobin is positively correlated with the anxiety felt by the subjects during NIRS scan. [45] Besides, in a study shows that the right ventrolateral PFC hyperactive when participants response to fearful stimuli. [46] Another study also states that the participants experienced increase in blood volume and oxyhaemoglobin in the right hemisphere compared to left hemisphere when giving a speech. This can be relate to hemispheric asymmetric during times of anxiety. [47]

The studies show that all three hypothesis agrees with the right-hemisphere hypothesis (Borod et al., 1998) which the right half of the brain is used to process all emotions, regardless of affective valence[48] Besides that, the three studies also agree with the valence hypothesis by Ahern et Schwartz which states that relative left-hemisphere activation for positive emotions and relative right-hemisphere activation for negative emotions. [49] Hence, by measuring the hemisphere asymmetric of dorsolateral prefrontal cortex, we should be able to determine the mood states of the users.

Summary

Positive and Negative Affects is being to study about the mood states of the patients. This is a self-reported questionnaire to determine mood states of the user before using the apps and after using the apps. Besides, fNIRS is utilised throughout the study. This is because it is portable, non-invasiveness and low signal-noise ratio when compared to EEG and fMRI. The portability of this device makes it able to detect users' mood states in everyday activities and fulfil our second objective which is detect mood states based on the data collected using fNIRS. Besides, we also discussed about how mood states affect the working memory tasks which includes arithmetic tasks, problem solving tasks, spatial navigation etc. All of these tasks are related to cognitive function. In the study, we found out that positive correlation between positive mood states and cognitive function. Last but not least, we determined a suitable method to measure mood state of the users which is the first objective. In the study, we found out that right hemisphere activation is related to negative affect while the left hemisphere activation is related to positive affect.

3.0 METHODOLOGY

3.1 Apps Development

The development of apps to reduce stress is divided into five parts:

i. Stimulus

ii. Heartrate detection

iii. Stress Level Measurement

iv. Stress related Questionnaire

v. Stress reduction

Before begin of the experiment, the fNIRS tools is being placed at the frontopolar prefrontal cortex (FPPFC) of the participants. In this study, the 2-channel fNIRS is used to detect brain activity in FPPFC. According to 10-20 systems, the two probes is placed directly to FP1 and FP2 as shown in the figure. Since the probes is attached with a flexible headband, it is relatively easy , fast and convenient to wear the fNIRS even by using one hand. It is designed to be portable and for daily use.

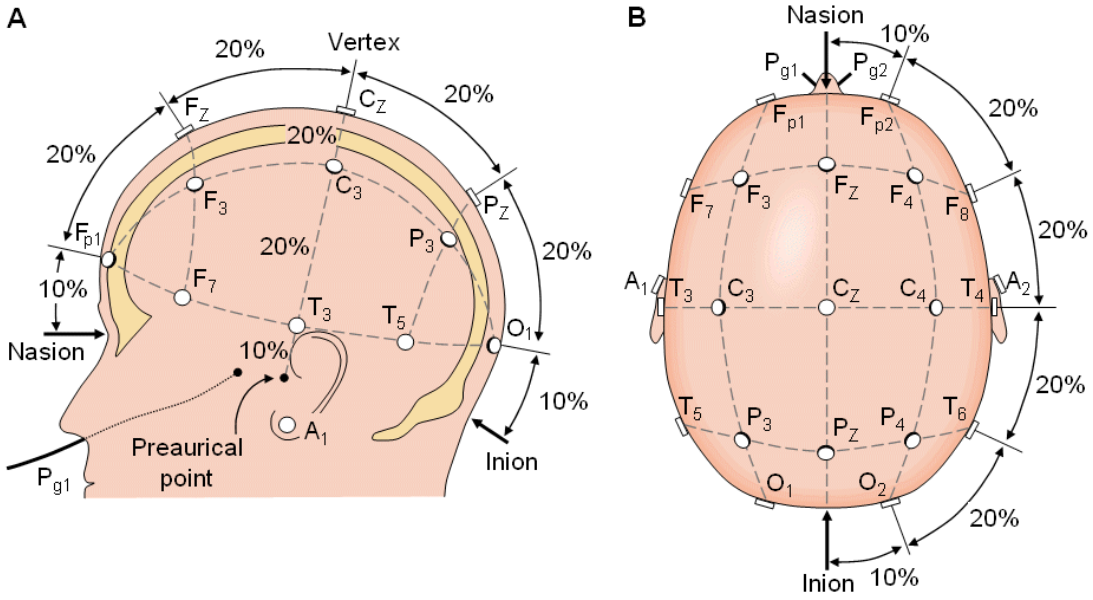


Figure 10 International 10-20 system [37]

3.1.1 Stimulus

The stimulus will be given to the participant as a task based activity to activate the brain region in this study which is FPPFC. This stimulus will be an arithmetic task to do some simple

subtraction and participants are required to answer as many questions as possible within 60 seconds.

3.1.2 Heartrate detection

The heartrate should be presence the moment the participant put the portable fNIRS on head. The absence of heartrate might be due to sensor is not attached properly or the fNIRS is not being used.

3.1.3 Stress Level Measurement

During the mental arithmetic task, the heartrate and the neural brain activity in the FPPFC is recorded throughout the activities for the analysis purpose. The measurement is started before the arithmetic task started to measure the resting state of the brain activity as a baseline. The data is then stored to the smartphone for analysis purpose. The measurement is done by comparing the brain neural activity between left hemisphere and right hemisphere which in this case is left FPPFC and right FPPFC.

3.1.4 Stress Related Questionnaire

A short questionnaire will be given to the participant to understand the mood state of the participants before the experiment and after the experiment. The questionnaire will be based on Self-Assessment Manikin (SAM) which measure the valence and arousal of the participant to understand the current mood state of the participants. The questionnaire will be given twice which is before mood improvement and after mood improvement to see the improvement.

3.1.5 Stress Reduction

If the fNIRS detects stress, it will prompt up with a new activity which is a virtual forest displaying the immersive view of the forest and accompanied by the sound of nature to improve the mood of the user. The video will last for 2 minutes and user are free to explore the landscape of the virtual forest. After the video is finish playing, the participant is required to fill up SAM again to understand how the apps is helping in stress reduction.

3.2 Hardware and Software

3.2.1 Hardware

- Android Phone with built in gyroscope – To run the virtual reality application
- Virtual Reality Headset – Let the user view virtual reality forest
- Noise Cancelling Headphone – To let user listen to nature sounds while using virtual reality application
- Portable fNIRS – To measure total haemoglobin during time of measurement

3.2.2 Software

- Android Studio – To create android apps for arithmetic application
- Sony Sound Forge – To produce nature sounds for the virtual reality application
- Matlab – For post data processing
- Unity – To create a virtual reality forest

System Overview

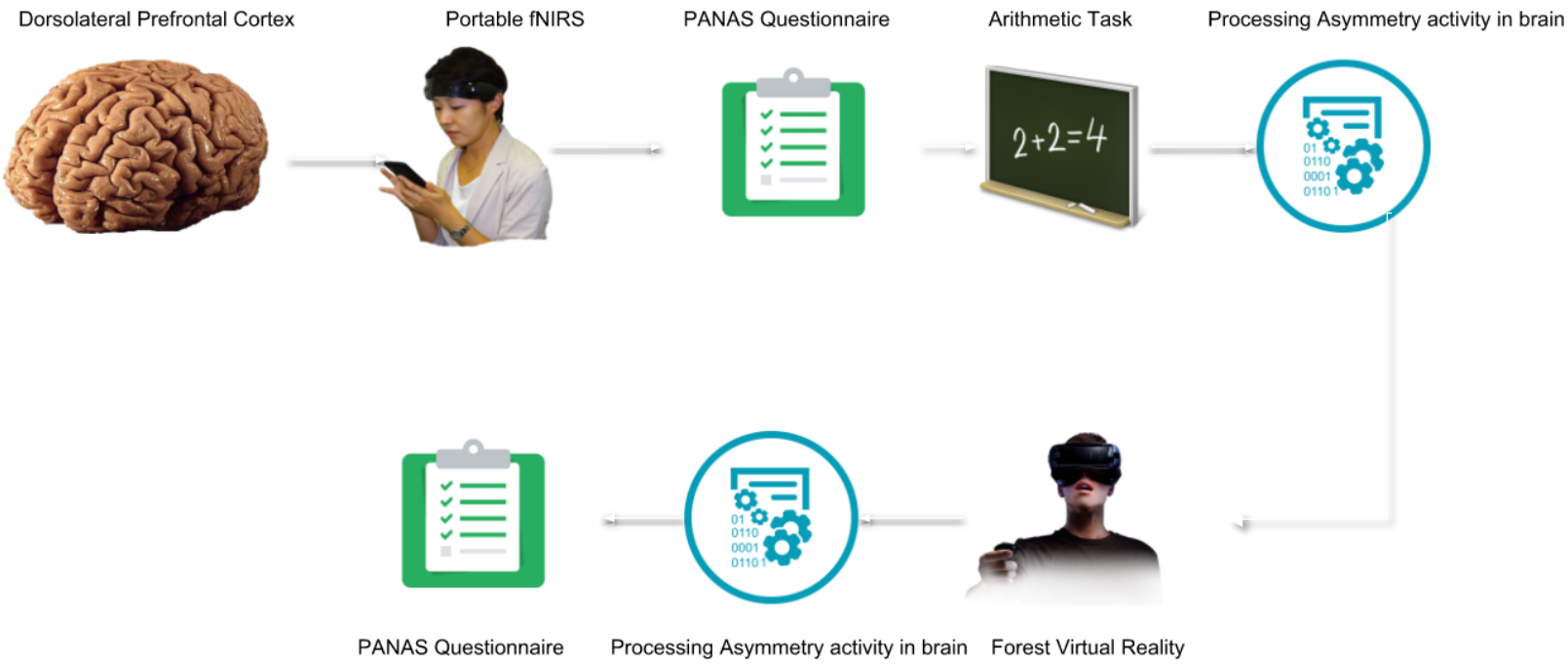
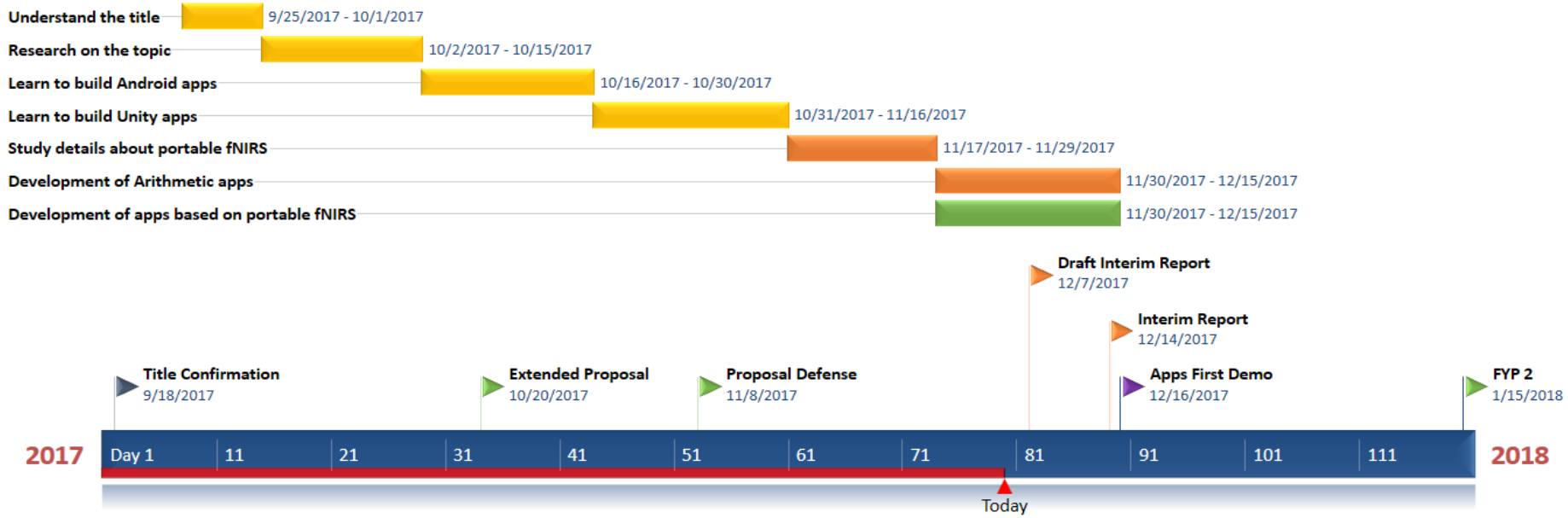


Figure 11 System Overview of the System

3.3 Key Milestones and Gantt Chart

Table 1. Gantt Chart and Key Milestone for FYP 1



4.0 RESULTS and DISCUSSION

4.1 Arithmetic Task Android Apps

4.1.1Current Progress

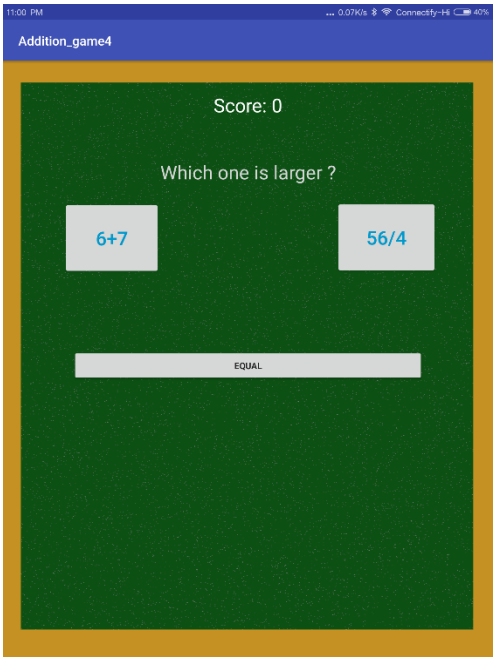


Figure 12 Arithmetic Application Screenshot 1

Before we measure the brain signal of the user, a suitable stimulus is needed to trigger the brain signal of the user. Hence, we use arithmetic task as stimulus to trigger the brain of the user and measuring the brain signal of user at the same time. This arithmetic application is consists of simple mathematical equation which user required to guess which number is greater or equal after perform mental arithmetic calculation.

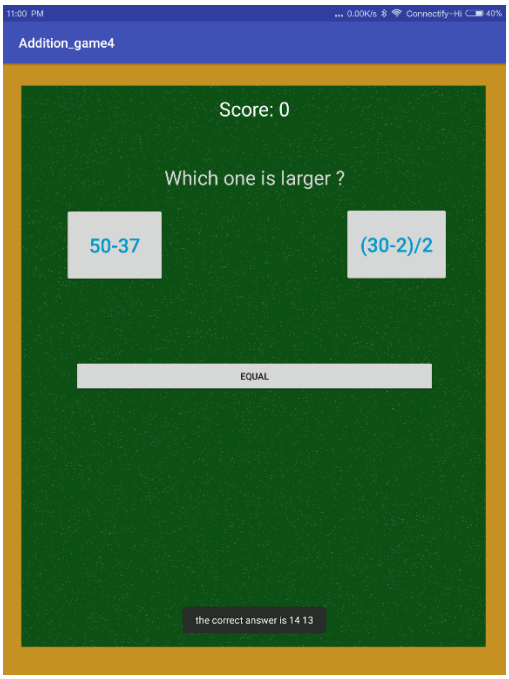


Figure 13 Arithmetic Application Screenshot 2

If wrong answer is entered , the toast will pop up to show the correct answer to the user as a hint and skip to next question.

Figure 14 Arithmetic Application Screenshot 3

When the user entered correct answer, one score will be given and one mark will be deducted if the answer is incorrect.

4.1.2 Future Work

The application can be further improved in FYP 2 which is by adding feature of feedback based on user input. The difficulty will changes based on the user input. For example, the difficulty of the question will increase based on the number of correct answer. This can stimulate the brain of the user better.

4.2 Stress Reduction Apps

4.1.1 Current Progress

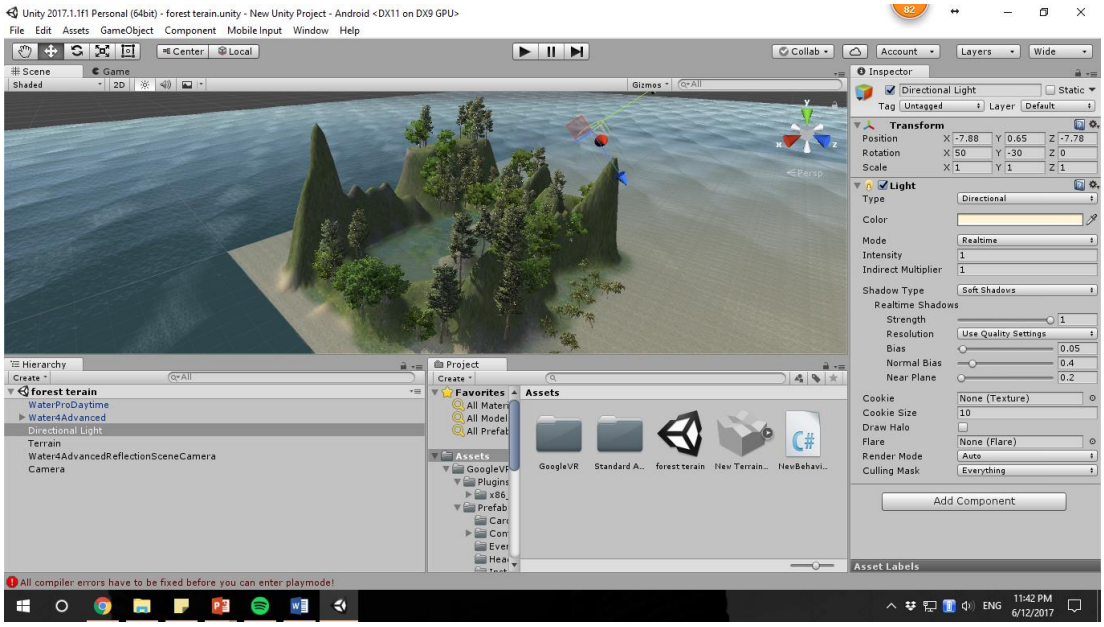


Figure 15 Designed Island with Trees and Lake surrounded by Ocean

For the stress reduction apps, we decided to build a virtual reality apps which simulate the condition of the forest. In this FYP1, I have done a virtual reality apps based on the island surrounded by the ocean. The reason I start building the island instead of forest is because I want to familiar with the all the tools in unity before start building a real application.

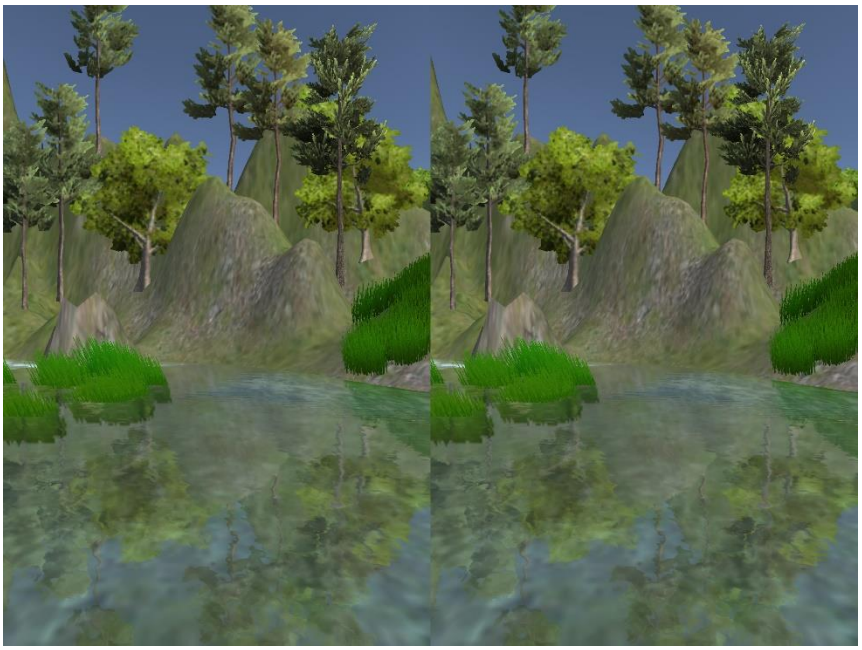


Figure 16 Virtual Reality Apps that show the condition Inside the Island

The island virtual reality is done which can be seen from the picture above. The island is displayed at both sides with the aid of the virtual reality headset, our mind will perceive the both picture into one landscape.

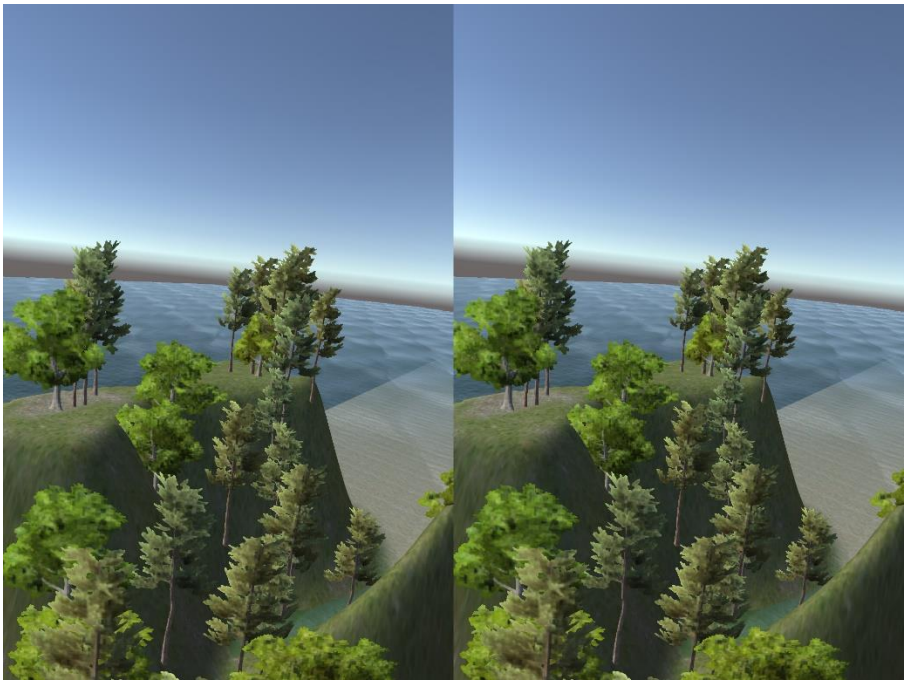


Figure 17 Some of the view from Top

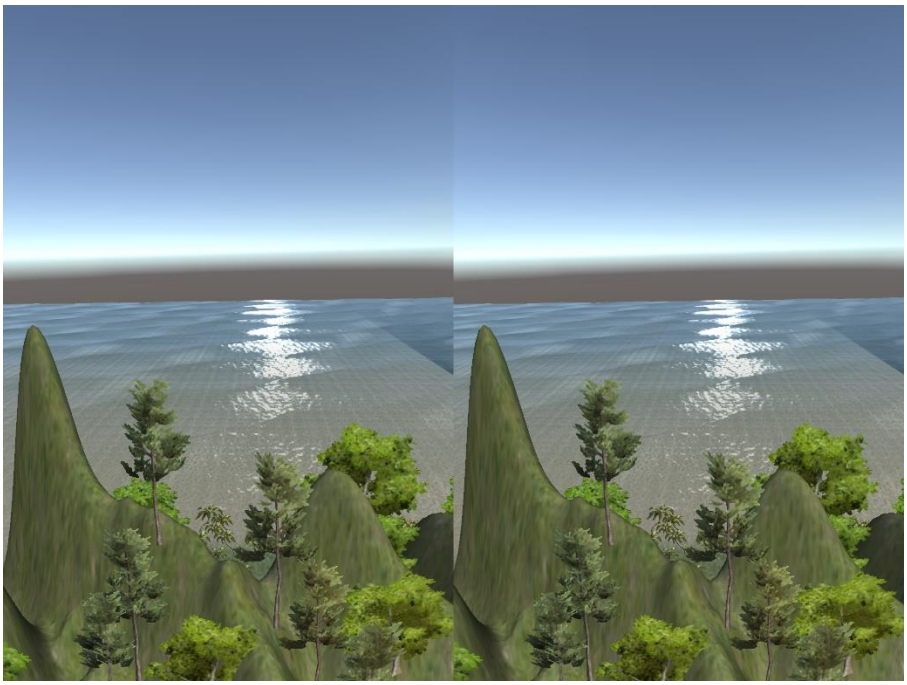


Figure 18 The simulated Ocean Scene Surrounded the Island

4.1.2 Future Work

The virtual reality landscape need to be improved because the rendered landscape is quite low quality and looks fake. In this experiment, we are trying to let the users have immersive experience as if the user is in the environment. Therefore, a lot of improvement need to be done. Besides that, I also plan to do the virtual walk in the forest to let user explore the landscape on its own.

5.0 CONCLUSION AND RECOMMENDATION

As of now, there is no stress monitoring system for the workers and students and hence many of the stress related disease cannot be prevented. Besides, the stress related disease is hard to be cured without medication. Hence, the portable fNIRS system is introduced for daily monitoring of the brain activity. Once the stress is detected, the user will be prompt with a video to help reducing stress.

This portable fNIRS system is designed to be light hence suitable for daily use. The transmission of data is done via Bluetooth and phone and hence the movement is not restricted at all. The detection of stress is done based on the mood state of the participant. Hence, by comparing the brain activity between left hemisphere and right hemisphere, we able to detect the mood state of the participants. The current portable fNIRS is limited to two probes which might reduce accuracy of the detection of mood state. In future, the probes number of probes can be increased to increase the accuracy of the stress detection.

Besides that, the virtual reality application should be as real as possible to let the user immerse in the simulated environment. This can help the user to improve mood states more effectively. Other than that, the arithmetic application should be designed to be able to respond based on user input. These need to be done during FYP2.

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