BORANG PENGESAHAN STATUS TESIS*

COMPUTER AIDED VISION THERAPY FOR VISUALLY

JUDUL : IMPAIRED PEOPLE

SESI PENGAJIAN : 2011 / 2012

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COMPUTER AIDED VISION THERAPY FOR VISUALLY IMPAIRED PEOPLE

MUHAMMAD SYAFIQ BIN ABDULLAH SHATRI

This report is submitted in partial fulfilment of the requirements for the
Bachelor of Computer Science (Media Interactive)

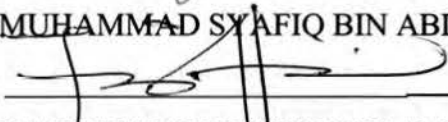FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
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I hereby declare that this project report entitled

**COMPUTER AIDED VISION THERAPY FOR VISUALLY IMPAIRED
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is written by me and is my own effort and that no part has been plagiarized
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DEDICATION

This project is dedicated to the community of vision disorder all around the world.

ACKNOWLEDGEMENTS

ABSTRACT

Having children with vision disorder could make parents worried about the future of their children. Job opportunity and daily life activities depend much on vision and eye sight. Amblyopia is one of the vision disorders where the eye sight does not develop properly during childhood. If not treated from young age, Amblyopia can be permanent and can't be treated. This project was carried out to identify information on Amblyopia, current treatments available for it and how computer games can be used in the vision therapy of Amblyopia. Current study shows that in Malaysia, there is still no computer game used in vision therapy process. Hence, it is important to make sure younger children with Amblyopia having vision therapy exercise they enjoyed with. In this project, a computer game focussing on vision therapy for Amblyopia is being created and tested by several optometrists to measure its effectiveness. This project will contribute to the vision disorder community as well as other researchers.

ABSTRAK

Mempunyai anak dengan masalah mata membimbangkan para ibu bapa tentang masa depan anak tersebut. Peluang pekerjaan dan kehidupan seharian banyak bergantung pada penglihatan. Amblyopia merupakan salah satu daripada penyakit mata di mana daya penglihatan tidak terbentuk dengan sempurna ketika kecil. Jika tidak dirawat ketika masih muda, Amblyopia boleh menjadi tetap dan tidak mampu dirawat. Projek ini dijalankan bagi mengetahui informasi mengenai Amblyopia, rawatan yang disediakan untuknya dan bagaimana permainan computer boleh digunakan dalam terapi mata Amblyopia. Kajian terkini menunjukkan di Malaysia masih tidak ada permainan komputer digunakan di dalam proses terapi mata. Oleh itu, amatlah penting untuk memastikan kanak-kanak dengan penyakit Amblyopia mempunyai terapi mata yang mereka sukai. Di dalam projek ini, permainan komputer yang diciptakan khas untuk terapi mata Amblyopia diuji oleh beberapa optometris bagi menguji keberkesanannya. Projek ini akan menyumbang kepada komuniti masalah penglihatan dan juga para pengkaji.

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LIST OF ABBREVIATIONS

PSM	-	Projek Sarjana Muda
OBVT	-	Office-Based Vision Therapy
HBVT	-	Home-Based Vision Therapy
3D	-	Three Dimension
2D	-	Two Dimension
NEI	-	National Eye Institute
HTS	-	Home Therapy Solutions
VS	-	Versus
SDM	-	Systems Development Method
SWF	-	Shockwave Flash
PNG	-	Portable Network Graphics
CD-ROM	-	Compact Disc, Read-Only-Memory
I/O	-	Input Output
CS4	-	Creative Suite 4
JPEG	-	Joint Photographic Experts Group
API	-	Application Programming Interface

CHAPTER I

INTRODUCTION

1.1 Project Background

Today's innovations are racing towards 3D world. Watching 3D movies in cinema, playing 3D games, enjoying 3D animation and the 3D television are no longer shocking news. People enjoying how they can see the world of 3D but how about the one without this ability. There are between 2 to 12 percent of the population unable to perceive 3D world[3]. The one who cannot see 3D at all is called the stereo-blind, otherwise they may refer as having monocular vision, being flat-viewer or lacking depth perception. People with stereo-blind see the world as a flat canvas of 2D and have a problem in determining distance and depth. People with one eye also experience the same problem. One of the cause of stereo-blind is Amblyopia or so been called the "lazy-eyes".

The ability to see in 3D, believe by the scientists and physicians, must be develop during first month of life or else the brain will set itself to permanently prevented the ability to see in stereo[4]. However, Susan R. Barry, professor of neurobiology at the Mount Holyoke College has developed her stereo vision in the age of 50[4]. This project will be focussing in developing a game for vision therapy to treat Amblyopia symptoms. In treating a Stereoblind, the treatment for Amblyopia is the first stage in the process.

1.2 Problem Statements

The first problem statement is less information on Amblyopia and the possible treatment for it. Although lots of people know about blind and colour blind, only several of them know and understand Amblyopia. Peoples also do not know about the treatment available for Amblyopia. Another problem statement for this project is less interactive therapy for Amblyopia. The usual way for Amblyopia therapy is not interactive and the involvement of computer games in the therapy is still new.

1.3 Objectives

i.   **To investigate a possible treatment for people with Amblyopia.**
      To do a research and investigation on the various possible way of
      treatment for people who experienced 3D blind caused by Amblyopia.

ii.   **To develop a vision therapy for people with Amblyopia by using
      computer games.**
      To develop an interactive computer games to be used in the vision
      therapy for people with Amblyopia.

iii. **To evaluate the effectiveness of the vision therapy for people with
      Amblyopia by using computer games.**
      To do evaluation on the effectiveness of computer games vision therapy
      by doing testing on the application.

1.4 Scopes

As there are several causes of vision problems, this project only focussing on vision therapy that can be used to treat Amblyopia. The vision therapy will use game as the main platform in the therapy process. This technique is still new but it is suitable in engaging the user. Patient with mild and severe Amblyopia conditions will be used as the target user. In developing the vision therapy games, Adobe Flash Professional CS4 is chosen because the game is a 2D game.

1.5 Project Significance

This project intended to provide a game vision therapy as one of the alternatives in vision therapy techniques. This is because while children with Amblyopia can be successfully treated through occlusion therapy, only a few choices of therapy available for the adults. Moreover, the therapy available is not interactive. By using games in the therapy process, it will engage the user to be motivated and continue in their vision therapy treatment. This will also help the vision therapist in their way of doing the therapy for the patient.

1.6 Conclusion

From this project, the patient who had Amblyopia, resulting in stereo-blind will find a new way of their therapy session. The new vision therapy game not only can be used in the office-based vision therapy (OBVT) but also in home-based vision therapy (HBVT). With this new enhancement, the patient no longer needs special devices which are expensive to do the therapy.

They can have the therapy session by themselves at home. The therapist themselves, can manage the therapy session in more interesting and efficiently way. Without a sufficient knowledge on how to administer various traditional vision therapy devices such as stereoscopes, the therapist and the patients can handle the game vision therapy easily.

The first chapter is basically focussing on the brief introduction of the game that will be developed and who is the target user. The problem statements, objectives and hardware requirements also been explained. Next chapter will comprise on more detail of the previous research on vision therapy. What is actually Amblyopia, methodology that will be used in this project and some comparison can be found on the next chapter.

CHAPTER II

LITERATURE REVIEW AND PROJECT METHODOLOGY

2.1 Introduction

The term literature is describe as anything from creative writing to more technical or scientific works, but it is commonly used to refer to works of the creative imagination, including works of poetry, drama, fiction and non-fiction[1]. Methodology, in the other hand, is the theoretical analysis of the methods appropriate to a field of study or to the body of methods and principles particular to a branch of knowledge[2]. By understanding the terms literature, literature review is explain as a critical and in detail evaluation of previous research.

So, this chapter is focussing on understanding of the previous research that had been done in vision therapy and the approach or techniques that will be use to conduct this project study. Apart from that, this chapter also explain on the hardware that will be needed to develop and testing the product.

2.2 Domain

This project is under the domain of games. Games, without doubt, are one of the strongest elements in carry out learning experience. Although there are many educational multimedia techniques in teaching and learning, only computer games and simulation are the most effective and engaging. This is based on the dynamic elements of games and simulations that can be control by the user. Games are different from simulations in terms of the goals and challenges even though they are same in many ways. With its highly interactive control and response, many people agree that games can promote learning. There are some critics however, argue on what's being learnt may be inappropriate.

As game has been found to be effective in motivating students to learn, it has been chosen to be used in vision therapy treatment for Amblyopia in this project. Traditional treatment of Amblyopia is not interactive where the patients just follow some instruction as being conduct by the therapist. With the implementation of game element in the vision therapy, it can motivate the patients to continue their therapy as well as provide a better response to the therapy itself.

Table 2.0 : Differences Between Computer Games And Simulation

Types / Differences	Computer Games	Simulation
Definition	What one can play in a computer game.	A combines strategy and skills along with the game.
Purpose	Designed for entertainment and educational purposes.	Designed for evaluative or computational purposes.
Upshot	Clarity.	Accuracy.
Design	Stylized.	Detailed.
Details	Suppress details.	Elaborate on all details.
Presentation	Artistic representation of some phenomenon.	Precise representation of a real phenomenon.

Based on the Table 2.0 information, domain of games is found to be more suitable than simulation to be used in vision therapy process. The purpose of games, its details and presentation are the keys to make the vision therapy more interesting to the user.

2.3 Existing System

A brain disorder, where the vision in one eye does not develop properly is called Amblyopia. According to the National Eye Institute (NEI), Amblyopia is the most popular cause of permanent visual impairment in childhood, affecting two to three of every 100 children[5]. Besides that, among young and middle-aged adults, it is the most frequent cause of one-eye visual impairment. Basically, Amblyopia can be divided into three types which are Strabismic Amblyopia, Refractive or Anisometropic Amblyopia and Form-deprivation Amblyopia.

Strabismic Amblyopia is the condition when the eyes are not properly aligned together or are crossed, also known as "cross-eyed". Strabismus will cause the eye to project different images into the brain, resulting from different projection from each eye. Normally the strengther eye or also called "fellow" eye will has a normal vision while the strabismic eye will have abnormal view. Since both eyes are not fixated on the same image, adult who has Strabismic Amblyopia usually have a double vision (diplopia). Children brains however, will adapt by suppressing the image from the weaker eye, so that they can see a single image.

The second type of Amblyopia known as Anisometropic Amblyopia is a result from unequal refractive power from each eye. In simpler words, one eye may be farsighted while another eye is nearsighted. With the difference in sight ranges, the brain will choose the eye with clearer image as the dominant eye. This type of Amblyopia is less severe than the Strabismic type as well as its lack of obvious physical manifestation. Form-deprivation Amblyopia happens when eye disease or injury causing the ocular media become opaque. Examples of these are cataracts and corneal scarring that makes the eye lens cloudy. In developing the vision therapy game for Amblyopia, several existing system been reviewed.

2.3.1 Simply Find It

This is a simple game developed by Simply Game with an objective to help in visual discrimination skills. With the goals to find difference between two pictures, Simply Find It is a unique game that has five different game modes. It is a kind of game that implements the "spot the differences" game technique. The game comes in two platform including iPhone version and iPad version. However, only the iPad version has the VS mode. This game is released on 5th April 2011. As usual, for

this type of game, the game play will have two pictures put side by side with three differences in each picture. User must tap on those differences to pass and move on next level.

The user will have a selection of several modes at the beginning of the game. This includes the classic mode, mirror mode, VS mode, endless mode and relax mode. In classic mode, there's a time limit for each level. User must finish three pictures in 180 seconds for 60 levels. User can unlock other modes by earning stars. Unlike the classic mode, endless mode will have the time continues over into the next level. To add the time into the ticker, user must pass each level to earn a clock. The goal is to survive as long as possible. Mirror mode is one the interesting mode in this game. In this mode, user will have the picture put next to each other but in mirror image position which will increase the challenge.

User can try the relax mode if they do not want to have a rush game. In relax mode, user can play the game without any time limit. To play the game with other friends, VS mode is the solution. However, this is only available for iPad version. In VS mode, the user who can achieve three of the five points will win. In terms of design, it has a simple design but functional. The button which is magnifying glass illustrates the theme in the game itself which is about to spot any difference. One of the problems is the background sound. Although it is relaxing and calm, the sound keep repeating itself and sometime can be annoying to the user. With 180 images, the game helps the user to enhance their visual discrimination skills even though it is not design specifically to treat Amblyopia.

Figure 2.0 Screenshot of Simply Find It Application

2.3.2 Captain Lazy Eye

This Amblyopic treatment game develop by Ideabus is the first iPad application designed to help in keeping vision acuity and support in Amblyopic correction. With the experience from Dr. Sharon Chuang, a former Ophthalmology department director of both Changhua Christian Hospital and Chungshan Medical University in Taiwan, Captain Lazy Eye turns the tedious vision treatment into a fun game. By using a pirate theme, the children will have their eye patch like a pirate and execute necessary occlusion exercises in order to accomplish the training goals. The games have come in handy for the physicians and parents as the game have a feature to store daily user performed exercises and correctional results for assessment of progress.

The training results of the user can be easily view in a chart form. Captain Lazy Eye split the Amblyopia training exercises into six categories including rotating grating, colour-light training, eyeball muscle exercise, hidden object recognition, colour sensitivity training and eye-hand coordination. In rotating grating, the training is stimulated by looking at objects through gratings of different thickness and spacing. In colour treatment, colour-light training provides various colours and shades to stimulate the visual nerve while colour sensitivity training get the eyes to differentiate a specific colour from a selection of identical shaded colours. As the name says, hidden object recognition, focussing the amblyopic eye to recognize specific objects in a distracting background. Eyeball muscle exercise train the amblyopic eye to a frequent change of focal point while the eye-hand coordination train to master the visual muscles.
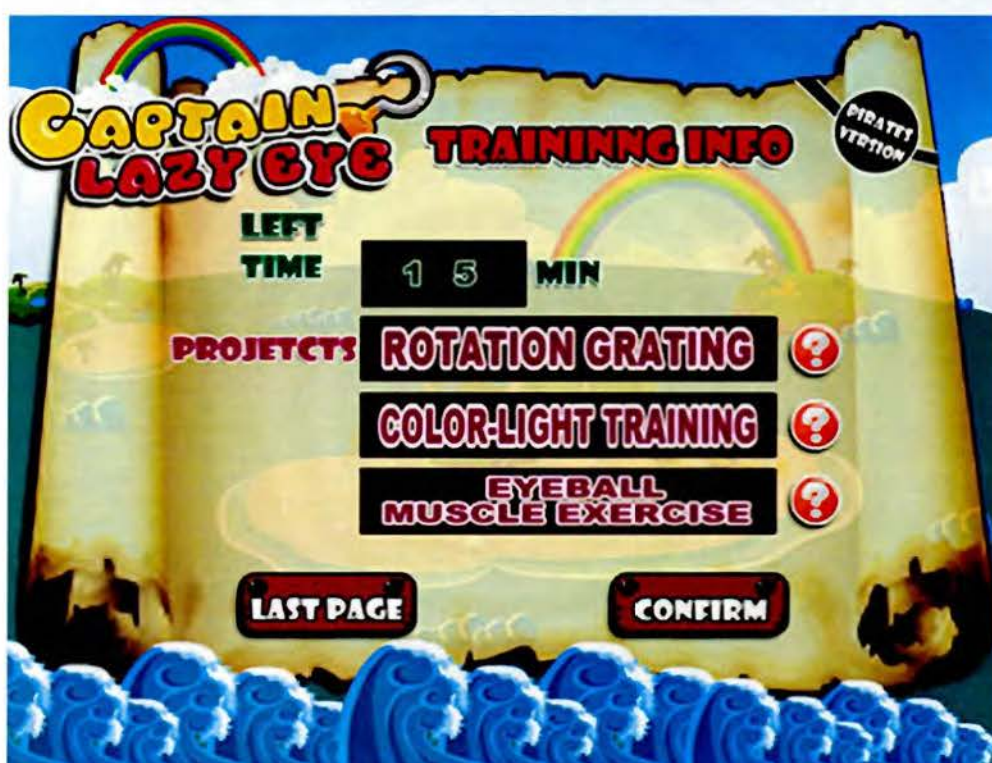
Figure 2.1 Screenshot of Captain Lazy Eye Application 1