Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF VIDEO GAME USING KINECT FOR REHABILITATION OF POST STROKE PATIENT

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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Bachelor of Electronics Engineering Technology with Honours

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DEVELOPMENT OF VIDEO GAME USING KINECT FOR REHABILITATION OF POST STROKE PATIENT

MAHRAN BIN MAHAZIL

A project report submitted
in partial fulfillment of the requirements for the degree of
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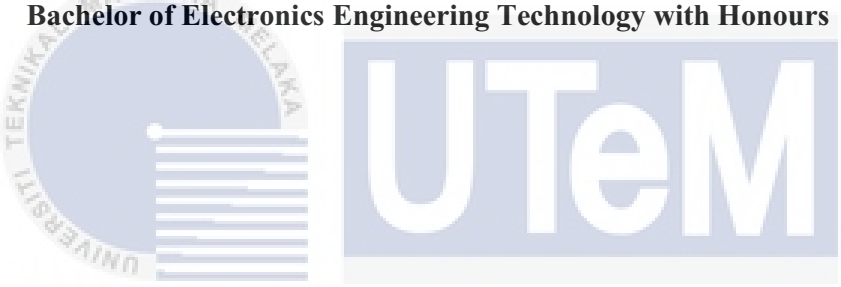

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DECLARATION

I declare that this project report entitled "**Development of Video Game using Kinect for Rehabilitation of Post Stroke Patient**" is the result of my own research except as cited in the references.

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DEDICATION

I'd want to dedicate this to my dear parents, Mahazil Bin Abdul Rahman and Adura Binti Zainal, who have always been a source of inspiration and strength throughout my life. To my siblings, who have always inspired me to be a better person in the future. Also, not to forget, Dr. Haslinah Binti Mohd Nasir, my humble and kind-hearted supervisor, for her guidance and counsel. Finally, I want to express my gratitude to Allah S.W.T. for His guidance, strength, protection, and long life.

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ABSTRACT

A new exercise training strategy for patients with post-stroke needs to work out efficiently through the game. The goal of this stage of treatment is to enhance the movement of stroke patients so that they can conduct daily tasks on their own. Traditional therapy is a time-consuming process that often saps a patient's motivation to complete the exercises. A video game can both inspire and assist patients in regaining their movement skills while also acting as a relaxant to help people who have had a chronic stroke or post stroke to regain movement and increase their physical activity. Thus, this program aims to develop video game rehabilitation as therapy technique for post-stroke patient that use of common video game consoles and methodologies to target and improve physical and mental. This project compares standard of care stepping activities to self-paced or game-paced external networks video games for improving neuromuscular intensity and accuracy, cardiovascular intensity, enjoyment, and perceived effort. The project was to see how virtual reality training using the Xbox Kinect-based game system to help patient recovery. As the results this project has been completed and is completely working. The analysis has shown the project is a good foundation as a rehabilitation game. In conclusion, the developed rehabilitation game is anticipated that will aid in the rehabilitation of post-stroke patients. For future work, this project is required for real testing with post-stroke patients in a rehabilitation center. The importance of real testing is to confirm the effectiveness of this rehabilitation game in the post-stroke recovery process.

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ABSTRAK

Strategi latihan latihan baru untuk pesakit dengan post-stroke perlu bersenam dengan cekap melalui permainan. Matlamat tahap rawatan ini adalah untuk meningkatkan pergerakan pesakit strok sehingga mereka dapat melakukan tugas harian dengan sendiri. Terapi tradisional adalah proses yang memakan masa yang sering melemahkan motivasi pesakit untuk menyelesaikan latihan. Permainan video boleh memberi inspirasi dan membantu pesakit dalam mendapatkan kembali kemahiran pergerakan mereka dan juga bertindak sebagai penenang untuk membantu orang yang mengalami strok kronik atau strok pasca untuk kembali bergerak dan meningkatkan aktiviti fizikal mereka. Oleh itu, program ini bertujuan untuk mengembangkan pemulihan permainan video sebagai teknik terapi untuk pesakit pasca strok yang menggunakan konsol permainan video dan metodologi untuk menargetkan dan meningkatkan fizikal dan mental. Projek ini membandingkan standard aktiviti melangkah penjagaan dengan permainan video rangkaian luaran yang bergerak sendiri atau pantas untuk meningkatkan intensiti dan ketepatan neuromuskular, intensiti kardiovaskular, kesenangan, dan usaha yang dirasakan. Projek ini adalah untuk melihat bagaimana latihan realiti maya menggunakan sistem permainan berasaskan Xbox Kinect untuk membantu pemulihan pesakit. Memandangkan keputusan projek ini telah siap dan berfungsi sepenuhnya. Analisis telah menunjukkan projek itu adalah asas yang baik sebagai permainan pemulihan. Kesimpulannya, permainan pemulihan yang dibangunkan dijangka akan membantu dalam pemulihan pesakit selepas strok. Untuk kerja akan datang, projek ini diperlukan untuk ujian sebenar dengan pesakit pasca strok di pusat pemulihan. Kepentingan ujian sebenar adalah untuk mengesahkan keberkesanan permainan pemulihan ini dalam proses pemulihan selepas strok.

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LIST OF SYMBOLS

	-	Frame per second
h	-	Height (m)
m	-	Mass (kg)
cm	-	centimeters
m	-	meters
ms	-	milisecond
	-	
	-	

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LIST OF ABBREVIATIONS

	-	Application Programming Interface
WPF	-	Windows Presentation Foundation
MVC	-	Model View Control
UI	-	User Interface
RGB	-	Red/ Green/ Blue
SDK	-	Software Develop Kit
RGBD	-	Red/ Green/ Blue/ Depth
DOB	-	Date of Birth

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CHAPTER 1

INTRODUCTION

1.1 Background

Stroke is one of Malaysia's top five causes of mortality and one of the top ten reasons for hospitalization. Stroke is also one of the top five illnesses with the highest disease burden in terms of disability-adjusted life years. However, there are few prospective studies on stroke in Malaysia. Too far, neither the prevalence nor the incidence of stroke has been documented at a nationwide level. The greatest risk factor for stroke is after a stroke. Stroke victims in Malaysia range in age from 54-5 to 62-6 years old [1].

In current technology, in home gaming and simulations have been popular for rehabilitation. It can help to increase the motivation of the patients in the process of recovery. By using Microsoft Kinect, gaming rehabilitation can be developed which allow the patient to interact with a game using natural and free movement interface. By utilize a Kinect sensor as a console, the patient is no longer needed to hold any controller that limits the patient's movement.

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1.2 Problem Statement

Physical therapy is a treatment stage to improve stroke patients' movement so that they can perform daily tasks independently. Conventional therapy is a tedious exercise that usually reduces the patient's motivation to do the exercises [2]. The patient might be sluggish and lost interest doing the exercise, one of the reasons is they didn’t find it joyful and feel noideas to change exercise method. Compare with a video game exercise can inspire and help patients restore their

motor abilities while simultaneously acting as a pain prevention. In acute, rehabilitative, and community settings, video games are becoming an essential element of occupational therapy practice.

1.3 Project Objective

The objectives of this project are:

a) To develop virtual game rehabilitation for upper-limb body using Microsoft Kinect.

b) To analyze the recovery factor through the game score

1.4 Scope of Project

The scope of this project are as follows:

a) Study on the rehabilitation method for post stroke patients

b) Designing a rehabilitation game for post stoke patient by using Microsoft Kinect.

c) To focus upper limb of recovery factor.

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1.5 Thesis Organization

Chapter 1 presents the background; basic principles, history and with videogames performance modelling and to facilitate the rehabilitation process of post-stroke patients with mild movement deficits in the upper limbs. While chapter 2 provides an overview of available models and some research in rehabilitation recovery and conventional methods. In In chapter 3 explains the various step which is make up new method, and program flowchart Then the results of this project has been discussed in Chapter 4. Finally, chapter 5 conclude the project and proposed a recommendation for future work in long term performance model. For the coding, simulation interface and program design are presented in Appendix.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In today's technology, video games are used by physiotherapists, occupational therapists, and psychotherapists. Some therapists have attempted to incorporate off-the-shelf videogame systems into rehabilitation therapy to stimulate mental enjoyment and physical vitality, and they've found that it improves treatment outcomes and increases patient motivation [2]. This gives a wide opportunity for society to recover from chronic disease like stroke. All the ideas are very helpful in curing post stroke. Video games can create a new fantasy for the patient for their therapist rather than attempting normal exercises. Many therapists have tried to utilize off-the-shelf digital game devices in rehabilitation in order to encourage mental happiness and physical vitality in rehabilitation therapy and have discovered positive treatment outcomes in addition to boosting patients' treatment motivation. Number of studies on this topic, there is still a breach in the current recovery game because too many different demands must be satisfied for each form of therapy.

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2.2 Rehabilitation Systems before the Advent of Kinect

Some of the rehabilitations are using a home-based Mocap paradigm that utilizes a digital camera. A camera is proposed for the rehabilitation facility's entertainment. If the system is tracked, a visual inspection is required [3]. As a systematically complete rehabilitation system with clinical evaluation which made use of digital imaging for motion capture. Another study created a low-cost image processing system that used two perpendicular cameras to monitor the stroke patient's hand and retrieve its 3D position. A

web-based VR game has been played using 3D positions as an input. By including the patient in games, repeated movement is made easier [4].

2.2.1 Commercial Video Games

The amount of intensity required to generate neuroplasticity alterations is considerably beyond the scope of any single therapist. VR and video games for rehabilitation are being developed as substitutes and adjuncts to conventional therapy. These games can be used to address a variety of therapeutic issues and research problems in a unique way. VR technology can be used to evaluate and supplement motor rehabilitation under a variety of objective and well-controlled stimulus situations. Real-world, objective, trustworthy, and valid measurements of these conditions, on the other hand, are frequently difficult to come by. The use of commercial video games as rehabilitation tools, such as the Nintendo Wii Fit, has sparked a lot of interest in the physical therapy community recently [5]. Although personal evidence shows that games might be effective motivators for physical activity, there is little published research on the feasibility and utility of employing commercially available gaming systems' motion sensing capabilities for rehabilitation [5-9]. Initial studies have demonstrated that using video games to help with balance rehabilitation after a stroke or neurological injury can be beneficial [7-10]. Development and Evaluation of a Low-Cost Game-Based Balancing Rehabilitation Tool Using the Microsoft Kinect Sensor. Usability studies have found that some commercially available games provide negative auditory and visual feedback during therapy tasks [6-11]. These observations highlight the significance of building games expressly for rehabilitation, a design approach that has recently been studied by a number of researchers [8]. After all, the limits of commercial video game motion sensor technology have made attaining this goal.

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2.2.1.1 Game Design and Evaluation

The authors created a game-based rehabilitation application utilizing Visual Studio game programming to further establish Kinect as a reliable VR rehabilitation tool [12-13]. The game initially mainly focuses on the neurological task of external rotation. The therapist can determine the amount and accuracy of the training intervention before the game begins by setting the motion task's starting and ending points in terms of geographical coordinates [13]. The game, on the other hand, keeps track of the elbow's position coordinates and offers real-time feedback on the movement's quality via a depiction of the hand's route. The route color is green when the patient exercises properly. When the patient begins to move outside the expected range or changes his or her body position, such as the shoulder moving away from the side of the body or the trunk starting to lean to one side to assist the movement, the path turns red and arrows are displayed on the screen to guide the player back into the correct position [13]. Finally, when the patient makes the right moves and the hand achieves the pre-recorded maximum external rotation, the virtual item is released from the patient's grip, and the patient is urged to return to the starting position to grab another object and repeat the action [13].

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2.3 Comparison Kinect V1 and Kinect V2 Image

Table 2.3 shows the method project concept is used by the Kinect v1 to estimate depth, in which a known infrared pattern is projected onto the image and the depth is estimated based on its distortion. The Kinect v2 has a duration (Structured light) camera that measures the time it takes for emitted light to go from the camera to the object and back. As a result, it continuously generates modulated infrared light and detects the changed phase of the returned light [14, 15].

Table 2. 1 Image resolution and frame size captured with the Kinect v1 and v2

	Microsoft Kinect Version 1.8	Microsoft Kinect Version 2
Frame Rate	30 Fps	60 Fps
Color Resolution	640 x 480	640 x 480
Depth Resolution	512 x 424	512 x 424
Infrared Resolution	512 x 424	640 x 480
Markers	No	yes

In Table 2.1 Shown the different specification of Microsoft Kinect version 1.8 and Microsoft Kinect version 2. In frame rate performance Microsoft Kinect version 1.8 only support until 30 Fps while the Microsoft Kinect version 2 can obtain until 60 Fps to capture the subject, color, and camera. The resolution performance is better with Microsoft Kinect version 2. For the Microsoft Kinect version 1.8 may be old but still support with some software to be perform.

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2.4 Modern vs Traditional

2.4.1 Classic treatment rehabilitation technique

At present, rehabilitation is largely based on physical therapy interventions with robotics and some support exercise approaches are still only marginally employed. The various physical therapies all aim to improve functional ambulation, with gait training being the most popular. the specific technique used, all approaches require specifically designed preparatory exercise, physical therapist observation and direct manipulation of the lower