DEVELOPMENT OF HAND ORIENTATION MEASUREMENT FOR A HAND MUSCLE

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BACHELOR OF MECHATRONICS ENGINEERING WITH HONORS
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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DEVELOPMENT OF HAND ORIENTATION MEASUREMENT FOR A HAND MUSCLE

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A report submitted
in partial fulfilment of the requirements for the degree of
Bachelor of Mechatronics Engineering with Honours

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DECLARATION

I declare that this thesis entitled "DEVELOPMENT OF HAND ORIENTATION MEASUREMENT FOR A HAND MUSCLE is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

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APPROVAL

I hereby declare that I have checked this report entitled ” **Development of hand orientation measurement for a hand muscle**” and in my opinion, this thesis it complies the partial fulfillment for awarding the award of the degree of Bachelor of Electrical Engineering with Honours

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Supervisor Name : .....

Date : .....

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DEDICATIONS

To my beloved mother, father and sisters.

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First of all, I would like to thank the God for his blessings to complete this Final Year Project 2 with successfully. I would like to express my deepest gratitude to my advisor, Dr Nik Syahrim, for his excellent guidance, care, patience in providing me suggestion, tips and encouragement throughout the completion of this Final Year Project 2.

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ABSTRACT

In today's era human machine interaction is becoming widespread. So, with the introduction of new technologies the gap between the machine and human is being reduced to ease the standard of living. Rehabilitation is probably one of the most significant phases of recovery for stroke survivors. Its goals are to build strength, capacity and self-care skills by which the survivors can continue their daily activities despite the effect of effect of stroke. The main purpose of this project is to develop a rehabilitation device for stroke patients which integrated 2-dimensional board game that motivates hand muscles movement.This thesis, describes the hand motion orientation measurement, where an accelerometer ADXL335 are used to measure the angle of the human hand motion.The project design a 2 degree of freedom accelerometer hand orientation measure device for hand gesture detection. Furthermore, the Arduino Nano is used as a controller to calculate the angle and transmit the data to receiver. Besides that, there is some mathematical calculation to measure the angle of hand motion. The main purpose of this project is to measure the performance in terms of orientation accuracy and precision. The Arduino Nano is a microcontroller that controls the overall performance of the system and it converts the angles in analog voltage given by the accelerometer ADXL 335 to the digital output. Moreover, there are three analysis to acheive the objective which are analysis on the real hand capture of maximum sampling data, filtering the unwanted signal, and the vibration identify the type of patients. The data was calculated and collected through the arctangent 2 argument algorithm of the ADXL335 accelerometer. This project acheived 10 sampling sata in 1 sec it captures real hand motion. Moreover, the infinite impulse filter k=0.1is used to reduces the unwanted signal from the hand vibration. In conclusion, there are some minor challenges faced to complete this project, all the objective were acheived successfully in this project. For the future work, there will be clinical test conduct to measure the effectiveness of the project and may want to include integration with the board game, example stewart platform.

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ABSTRAK

Dalam era hari ini interaksi mesin manusia semakin meluas. Oleh itu, dengan pengenalan teknologi baru, jurang antara mesin dan manusia dikurangkan untuk meringankan taraf hidup. Pemulihan mungkin salah satu daripada fasa pemulihan yang paling penting untuk mangsa strok. Matlamatnya adalah untuk membina kekuatan, keupayaan dan kemahiran penjagaan diri yang membolehkan para penyelamat meneruskan aktiviti harian mereka walaupun kesan kesan strok. Tujuan utama adalah untuk membangunkan alat pemulihan untuk pesakit strok dengan permainan papan dimensi 2 dimensi yang memotivasi pergerakan otot tangan, dan bukannya mengelakkan kebosanan terhadap pesakit dengan mengulangi pergerakan yang sama. Dalam kajian ini, ia menerangkan tentang pengukuran orientasi gerakan tangan, accelerometer ADXL335 digunakan untuk mengukur sudut gerakan tangan manusia. Reka bentuk projek merancang peranti pengukur orientasi tangan 2 dimensi berasaskan accelerometer untuk mengesan isyarat tangan. Selain itu, Arduino Nano digunakan sebagai pengawal untuk mengira sudut dan menghantar data kepada penerima. Selain itu, terdapat beberapa pengiraan matematik untuk mengukur sudut gerakan tangan. Tujuan utama projek ini adalah untuk mengukur prestasi dari segi orientasi ketepatan, ketepatan masa dan tindak balas. Arduino Nano adalah mikrokontroler yang mengawal keseluruhan sistem dan ia menukarkan sudut dalam voltan analog yang diberikan oleh pecutan ADXL 335 ke dalam output digital. Selain itu, terdapat tiga analisis untuk menyelaraskan objektif yang menganalisis penangkapan tangan sebenar bagi data pensampelan maksimum, penapisan isyarat yang tidak diingini, dan getaran mengenal pasti jenis pesakit. Dalam aplikasi sebenar, dalam 1 data per detik gerakan menangkap lambat terlalu perlahan, projek ini adalah dapat 10 data dalam 1 saat ia kelihatan seperti menangkap gerakan tangan sebenar kerana setiap 0.1 alogrithm yang dikumpul data. Lebih-lebih lagi, dari getaran tangan, projek ini menghasilkan beberapa penganalisis isyarat yang tidak diingini penapisan membuat isyarat kepada pengurangan untuk menilai ketepatan. Sebagai kesimpulan, accelerometer ADXL335 ini menggunakan algoritma arctangent, algoritma mengira dan mengumpul data, terdapat beberapa cabaran kecil yang dihadapi untuk menyelesaikan projek ini, untuk kerja masa depan akan ada uji klinik untuk mengukur keberkesanan projek. kerja masa depan, akan ada kelakuan ujian klinikal untuk mengukur keberkesanan projek dan mungkin ingin memasukkan integrasi dengan permainan papan, contoh platform stewart.

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CHAPTER 1

INTRODUCTION

1.1 Motivation

The motivation behind rehabilitation is to re-establish a few or the majority of the patient's physical, tangible, and mental abilities that were lost because of damage, ailment, or disease. Rehabilitation includes assisting the patient to compensate for shortfalls that cannot be turned around therapeutically. Hand deterioration is a common action that contributes considerably to ailment in the U.S. and around the world. In the circumstance of stroke, it is predicted that relatively 80% of the 700,000 individuals who survive stroke each year needed hand therapy. Other conditions that have a high incidence of hand deterioration are hand, multiple sclerosis wrist trauma, and high-level spinal cord injury.[1] Half year after stroke, around 65 percent of patients cannot incorporate the influenced hand into their typical exercises. Poor upper-extremity outcomes are plausible after a hemispheric dead tissue when the leg cannot move for fourteen days and the hand has no development or just slight finger flexion with no opening for a month, steady with significant harm to the corticospinal tract.[2]

Stroke patients might be delegated being in an acute, chronic stage after stroke. Although few remedial ways can happen together in various stages after stroke it can be said that impulsive recovery through compensation.[3] People who experience the ill effects of utilitarian disability after stroke frequently have not achieved their maximum capacity for recuperation when they are released from healing centers, where they receive initial rehabilitation. Few devices can be used at home but the devices are very costly. Such as, the

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HandMentor and HandTutor cost several thousand dollars, and the Amadeo (TyroMotion) is of high cost.[1] A foremost obstacle for recovery after healing facility release is geological distance among patients as well as narrow obtainability of personnel. These prompt elevated amounts of patient disappointment for not getting satisfactory and adequate preparation for the potential outcomes after release from healing facility. Four years after stroke, just 6% of stroke patients are satisfied with the functionality of their disabled arm.[3]

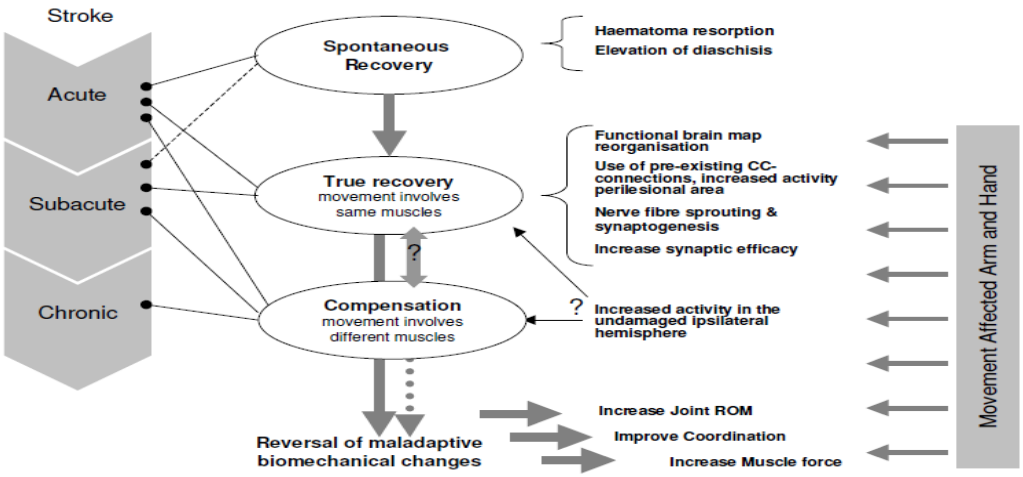

Figure 1.1 Declarative model recovery after stroke

For stroke patients with physical and mental challenges, robots may offer a chance for interaction and therapy. Robots provide a possible therapeutic role for using a mechanical device to improve social connections physical test because the personification of a robot provides unique chances not obtainable in other forms of technology. For example, researchers are working on designing robots that provide support for physical therapy. Endeavors incorporate giving recommended force and to help rebuild flexibility, strength, modify adaptability and quality that could incorporate identifying inspirational state and adjusting therapy to maximum benefits. Therefore, effective methods to encourage stroke patients who have survived stroke to make exercises at home by using the orientation tracking with the machine vision system attached to the entertainment box which enables

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them to be more independent. The entertainment box motion based input by the orientation of hand movement can provide a helpful way to help people therapeutic exercises at home.

1.2 Problem statement

Stroke is a “brain attack". It can transpire at any time; a stroke happens when the blood supply to part of your cerebrum is reduced, denying brain tissue of oxygen and supplements. When the brain cells die during the stroke, abilities controlled by that zone of the cerebrum, for example, memory and muscle control are lost. There are two major kinds of stroke, ischemic and hemorrhagic. In an ischemic stroke a blood vessel becomes blocked, usually by a blood clot and a portion of the brain becomes deprived of oxygen and will stop functioning. Therapy is restricted in light of the fact that on-going restoration practice conveyed one-on-one with a rehabilitation advisor is expensive. Gyms do not have suitable equipment to ease practice to improve hand skills. Stroke rehabilitation games can possibly help stroke patients to improve from a stroke. By lessening boredom of hundreds of frequent motions and providing show feedback, the games will increase the quality and quantity of patients’ home treatments.[4]

The aim of this project is to make an integrated 2-dimensional marble maze game that motivates hand muscles movement for the stroke patients as a part of their therapy session. There are several ways to measure the orientation of hand movement, for example the application practices the images from web camera located work area, where the predictable gestures act as input for the next step that transfer the gesture data to the game. The players, must change their hand gestures that can be found it by the game.[5]

In this project, the accelerometer and the hand gesture concept will be used as a tool for measuring the hand orientation tracking and also as an input for the any 2-dimensional

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entertainment box game. A hand orientation controlled is constrained by utilizing hand instead of some other techniques like catches or joystick. One just needs to move hand to measure the orientation angle for role and pitch. A transmitting device is attached with the Arduino Uno which contains RF Transmitter and ADXL335 accelerometer. This will transmit order to goal that it can do the required undertaking several angle from the hand orientation and the detection list will measure the performance in terms of orientation accuracy, precision and reaction time.

1.3 Objective

The objectives of this project are:

1) To develop a hand orientation rehabilitation device that motivates hand muscles movement

2) To design an accelerometer based on 2-dimensional hand for hand gesture detection

3) To measure the performance in terms of orientation accuracy and precision.

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1.4 Scope

The scope of this research includes:

1) Clinical test are systematic studies shown to discovery the better methods to avoid disease but in this project the device is not tested clinically and no integration to any games.

2) Limitation of this project is two degree-of-freedom that is roll and pitch, the yaw is out of the scope.

3) A transmitting device is attached with the Arduino Nano which contains ADXL335 accelerometer. This will transmit the angle of hand orientation measurement in the range of 0 degree to 360 degrees in the roll and pitch orientation only.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In 21st century, researchers have focused on a few perspectives inside robot-assisted therapy, for instance, appearance of the robot, and empowering clinicians to program robots in this part of the report, details and information collected from reading journals, books, papers, articles and other sources that written by the other researchers. The idea of this is to have a clear understanding of the key elements involved in this project. The ideas are originally taken from the authors, however it is all written in own words by synthesizing and paraphrasing.

Moral thoughts include whether robot-assisted rehabilitation delivers long-standing benefits and does not root cause expressive or cognitive. The motivation for allowing clinicians to program robots stalks from clinician's defective is to avoid defense of sameness, that is, repetitive robot performance. Robot-assisted treatment suggestions a hopeful methodology to neurorehabilitation, particularly for harshly to moderately reduced stroke patients.[6][7]

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