UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF TONGUE DRIVEN SYSTEM FOR MEDICAL APPLICATION USING HALL EFFECT SENSOR AND ARDUINO

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Automation and Robotics) with Honours.

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APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Automation and Robotics) with Honors. The member of the supervisory is as follow:

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ABSTRAK

Disebabkan kecederaan tulang belakang, pesakit tetraplegia tidak dapat melakukan rutin kehidupan seharian mereka. Sistem pemacu lidah telah menjadi inovasi sokongan tanpa wayar baru yang dibangunkan untuk pesakit cacat atau pesakit tetraplegia untuk menguruskan pergerakan mereka dan menyediakan akses yang baik pada persekitaran. Alasan mengapa lidah dipilih sebagai median untuk sistem ini adalah kerana ia dikaitkan ke otak melalui saraf kranial yang biasanya mengelakkan kecederaan dalam beberapa kerosakan tulang belakang. Komponen utama projek ini adalah micropengawal Arduino, peranti pengesan medan magnet, peranti ultrasonik, pemacu motor H-Bridge, Modul RF dan motor tetingkap. Magnet kekal kecil telah dilekatkan pada lidah pesakit dan menghasilkan medan magnet yang diukur oleh peranti pengesan medan magnet yang dipasang pada alat pendengar di luar mulut. Isyarat yang diperolehi oleh peranti pengesan dihantar tanpa wayar ke mikropengawal dan mengerakan motor kerusi roda. Mikropangawal Arduino telah diprogramkan untuk mengawal pemacu motor dan kerusi roda bergerak mengikut arahan yang diterima. Terdapat empat gerakan yang utama dalam projek ini iaitu ke hadapan, belakang, kiri dan kanan. Untuk memastikan keselamatan pengguna peranti ultrasonic telah digunakan untuk mengesan halangan ataupun objek dihadapan. Analisis ketepatan dan kecekapan Modul RF dilakukan dengan membandingkan jarak dan kelewatan yang diambil untuk menghantar data. Berat beban yang berbeza telah digunakan untuk mengenal pasti maksimum kapasiti dan prestasi kerusi roda boleh memandu telah dijalankan.

ABTRACT

Due to spinal cords injuries and tetraplegia patients were struggling on society and families and cannot perform their daily routine of life. Tongue driven system had become new wireless support innovation developed for human with severe disability or tetraplegia patients to manage their movements and provide good access and effective environment. The reason why tongue was selected as a median for this system is because it is linked straigthly to the brain through cranial nerve which usually avoid injury in several backbone damages otherwise the neuromuscular illnesses tongue is extremely movable set of muscles which work negligible obtrusive, or subtle and powerful innovation. The main component of this project was Arduino, Hall Effect sensor, Ultrasonic sensor, H-Bridge motor driver, RF-Module and Power window motor. A tiny permanent magnet was held on the patient's tongue and generate a magnetic field measured by Hall Effect magnetic sensors attached to the headset outside the mouth. Signal were obtained by sensors were transmitted wireless to the microcontroller and moves the motor on wheelchair. Arduino microcontroller were programmed to driven the motor driver and the motor will moved it to direction. There were four corresponding movement in this project which is forward, reverse, left and the right. As the safety propose of the system, ultrasonic sensors was added in order to detect and avoided obstacles. An analysis of test the accuracy and efficiency of RF-Module was done by comparing its distance and delay taken to transmit and recive data. Different of load weight is used to test the performance and maximum capacity of wheelchair can drive.

DEDICATION

Specially dedicated to my dearest parents, Mr R.Danabal and Mrs Iswary, thank you very for help and support me much during this project.

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TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF SYMBOLS

mA	-	Milli Ampere
s	-	Second
kg	-	Kilogram
A	-	Ampere
V	-	Voltage
C	-	Velocity of ultrasonic
T	-	Transmitter
L	-	Length

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

RISC	Reduced instruction set computer
RAM	Random access memory
ROM	Read only memory
PWM	Pulse width modulation
TDS	Tongue driven system
PIC	Peripheral interface microcontroller
DSP	Digital signal processor
SCI	Spinal cord injury
IDE	Integrated development environment
LED	Light emitting diode
GUI	Graphical user interface
IR	Infrared radiation
PC	Personal computer
TV	Television
CI	Continuous integration
RF	Radio frequency
AC	Alternating current
DC	Direct current
IC	Integrated circuit

CHAPTER 1

INTRODUCTION

1.1 Project background

This project is to development of tongue driven system for medical applications using hall effect sensor and Arduino. Tongue driven system has been become new wireless support innovation developed for human with severe disability or tetraplegia patients to manage their movements and provide good access and effective environment. Tongue is extremely movable set of muscles which work negligible obtrusive, or subtle and powerful innovation. It encourages user to control numerous gadgets in their condition utilizing their unconstrained tongue movement. A tiny permanent magnet will be held on the patient's tongue and generate a magnetic field measured by Hall effect magnetic sensor attached to the headset outside the mouth. Signals were obtained by sensors were transmitted wirelessly to the microcontroller and moves the motors on wheelchair. Arduino microcontroller will be programmed to drive the motor and move to certain direction. As a safety propose of the system, ultrasonic sensor has been added as to detect and avid obstacles. This innovation delivers quicker, smoother and better control. In this project, Arduino has been used as a microcontroller for this project. The Arduino software is program to control and fulfill requirement of the system has been designed in this project.

1.2 Problem Statement

Since there were many new inventions in assistive technology that being helpful to people with tetraplegia, still there are some problems with those inventions. Tetraplegia is an inability to move the arms and legs. Some invention uses movement of body parts that is still having the ability to move in severely disabled people such as head movement, neck movement, and eye movement. Some people feel uncomfortable with these head and neck movement where excessive movement brings tiredness to the person

Moreover, tetraplegia's who are also suffering from neck pain find it unreliable and discomforts in using head or neck movement control system. Tongue is connected to brain through hypoglossal nerve plus it is free from any SCI and known that tongue lastly to be affected in neuromuscular degenerative disorders. Tongue is made up special muscles that help in quick and accurate movement and it doesn't fatigue easily. It shows that tongue driven system could be used up to hours as it creates neither discomfort nor tiredness in user.

Thus, factors that said above have brought up development of tongue drive system. This project was design of wheelchair that control by tongue that helps tetraplegia patients to make them more interactive and write community and society. In this project here are several factors that was considered such as accuracy, suitable speed, safety and inexpensive. Tongue driven systems acquires a low speed to ensure the safety of patients. Tongue driven system needs an accurate wireless connection to transmitting data from transmitter to receiver, and it allows wheelchair to move. An ultrasonic sensor has been

used to detect the obstacle's nearby wheelchair to ensure this system is more safety and convenient to use.

1.3 Project Objective

In this study, there are few objectives that will archive.

I. To design hardware of tongue driven wheelchair system by using the movement of tongue.
II. To develop software program of tongue driven system that controls wheelchair by using Arduino and Hall effect sensor.
III. To compare and analyze the performance of the wheelchair in term of accuracy and efficiency.

1.4 Work Scope

In order to archive the objective of the project, there was several important criteria that need to consider:

I. The wheelchair is design for spinal cords injuries and tetraplegia patients which use movement tongue to control.
II. Tongue movement will be detected by using hall effect sensor.
III. Movement of the wheelchair will be controlled by Arduino.
IV. Obstacles will be detected by using ultrasonic sensor.
V. Proteus will be used to stimulate software.
VI. This system is not for patients with hypoglossal nerve palsy
VII. This system is not for patients over 100kg body weight.

CHAPTER 2

LITERATURE REVIEV

2.1 Introduction

This section discusses and summaries overall tongue-driven wheelchair system concept and theory of the project. This chapter's main proposal was explain past research and existing research. This chapter discussed the theory and concept used to solve this project's problem. Journals, articles and case studies are the main sources of information. These sources have been selected based on the project scope similarity.

2.2 Review of Current Situation

Based on the United State database of national spinal cord injury. Given the present populace size of 327 million individuals' ongoing evaluation demonstrates that the yearly frequency of spinal rope damage (SCI) is around 54 cases for every year. New cases of SCI do not include those who die at site of the SCI incidents. So far, there is an approximately 288,00 individuals staying in United States with SCI, ranging from 247,000 to 358,000. The average age of accident began in the 1970s to increase from 29 to 43 at current situation. Approximately 78 percentage males involve on SCI recent cases. Which brings to 22 percentage of non-Hispanic blacks were injured from 2015 onwards, while 12 percentage more from the general non-Hispanic blacks' population.

At current situation, the major cause of injury was vehicle accidents and falls were closely followed. The causes of violence, mainly gunshot accidents and recreational activity were still common. Stay lengths in the intense consideration unit at the emergency

clinic have dropped from 24 days during the 1970s to 34 days now. The most common neurological category now is incomplete tetraplegia. The frequency of paraplegia that is incomplete and complete is almost the same. Up to the season of emergency clinic release, under 1 percentage of individuals experienced total neurological recuperation [1]. There were also many assistive technologies developed to support people care. Wheelchairs are widely used by severely disabled devices. The normal electrical wheelchair should be manually operated by joystick.

However, some patients with severe disabilities might have limited or even unavailable hand function. The idea of an alternate solution wheelchair control is to use a different part of the body instead of a hand to operate a proportional control joystick. The alternative wheelchair control includes control of the sip-n-puff, control of the chin, control of the head, control of the speech, and also controlled by tongue.

2.2.1 Review of Tetraplegia

Tetraplegia, additionally alluded to as quadriplegia, is loss of motion brought about by ailment of damage bringing about halfway or all out loss of utilization of each of the four appendages and middle. Paraplegia is comparative however does not influence the arm. The collapse is generally sensory and motor, which resulting in both sense and control lose are affected by muscles weakness. It can be either flaccid or spastic. Even though impairment of the limbs is the most obvious symptom, functioning in the torso is also impaired. Tetraplegia leads to muscle weaken and may result intestine and bladder control loss or impairment, sexual functionalities, digestive system, respiration, and so on. Furthermore, sensations are typically impaired in areas affected. This might arise as engorgement, declining sense or burning nerve pain Additionally, individuals through

tetraplegia are far extra highly weak to wounds of pressure, frozen muscles and joints, breathing complications and viruses, autonomic dysreflexia, high-venous thrombosis and cardiovascular illness. Osteoarthritis and bone dislocations due to depressed function and immobility. The scale of the spinal injuries and extent of injury are valuable.

A person thru a CI damage is expected to drop function from the neck down and be reliant on the ventilator. A person with such a C7 illness may end up losing chest function however keep the use of arms and several hands. Tetraplegia is caused by damage to a high-level C1-C7 brain or spinal cord, especially secondary to cervical spine cord injury. The injury, known as a lesion, triggers victims to lose the majority or complete function among all four limbs, that mostly means the arms and legs. Tetraplegia stands described in several ways, though (C1-C4) typically influences arm motion worse than injury to (C5-C7), yet some of tetraplegics have finger dysfunction. Thus, having fully functioning arm is not uncommon in tetraplegia, without nervous finger and thumb control. While the vertebras are broken or dislocated without damage to the backbone or broken neck can leads to suffered without a tetraplegic disease. In addition, the spinal cord can be injured without breaking the spinal cord [2].

2.2.2 Level of Spinal Cord Injury

Sense and movement could be interrupted if spinal cord injury occurs, leading in temporarily or permanently loss of function, numbness and sensation. Part of the damaged spinal cord at the level and below corresponds to the spinal nerves. Injuries can be 1-8 (C1-C8), 1-12 (T1-T12), 1-5 (L1-L5) or sacral (S1-S5) cervical injuries [3]. The injury level of a person is defined as the lowest level of complete sensation and function.