Faculty of Electrical and Electronic Engineering Technology

WIRELESS CONTROL FOR RETROFIT WHEELCHAIR SYSTEM USING MICROCONTROLLER

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MUHAMMAD SYAFIQ BIN MOHKTAR

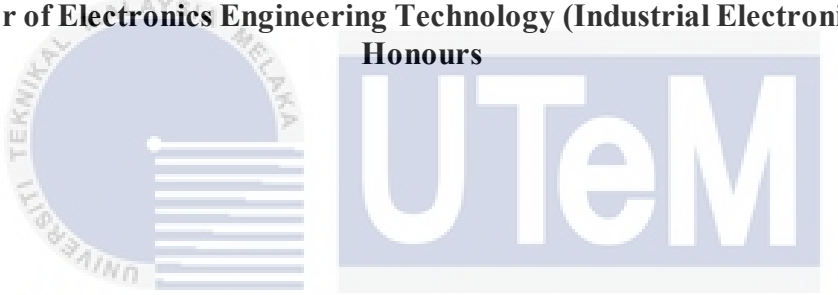
Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours

2023

WIRELESS CONTROL FOR RETROFIT WHEELCHAIR SYSTEM USING MICROCONTROLLER

MUHAMMAD SYAFIQ BIN MOHKTAR

A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours



Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2023

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : WIRELESS CONTROL FOR RETROFIT WHEELCHAIR SYSTEM USING MICROCONTROLLER

Sesi Pengajian : Sem 1 2022/2023

Saya MUHAMMAD SYAFIQ BIN MOHKTAR mengaku membenarkan laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (✓):

☐ **SULIT*** (Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

☐ (Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

☑ **TIDAK TERHAD**

Disahkan oleh:

(TANDATANGAN PENULIS)
Alamat Tetap: 7901-C RUMAH AWAM 1,
BATU 7 BUKIT RAMBAI,
75250 MELAKA

(COP DAN TANDATANGAN PENYELIA)
Ts. KHAIRUL AZHA BIN A AZIZ
Pensyarah Kanan
Jabatan Teknologi Kejuruteraan Elektronik Dan Komputer
Fakulti Teknologi Kejuruteraan Elektrik Dan Elektronik
Universiti Teknikal Malaysia Melaka

Tarikh: 22/2/2023

Tarikh: 22/2/2023

*CATATAN: Jika laporan ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali tempoh laporan ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I declare that this project report entitled "Wireless Control for Retrofit Wheelchair System using Microcontroller" is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Student Name : MUHAMMAD SYAFIQ BIN MOHKTAR

Date : 22/2/2023

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours.

Signature :

Supervisor Name : TS. KHAIRUL AZHA BIN A AZIZ

Date : 22/2/2023

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Signature :

Co-Supervisor Name (if any) : TS. SAIFULLAH BIN SALAM

Date : 22/2/2023

DEDICATION

Alhamdullilah, praise to the Almighty Allah S.W.T
This thesis is dedicated to:

My beloved family,
My Parents,
My Supervisor,
And all my friends
Thanks for their encouragement and support

UTeM
اونيۏرسيتي تيکنيکل مليسيا ملاک
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ABSTRACT

This project is related to the wireless retrofit wheelchair microcontroller. The system is designed to control a wheelchair using the smartphone . The aim of this project is to facilitate the movement of the people who are disabling or handicapped and elderly people who are not be able to move well. The result of this design will allow the certain people to live a life with the less dependence on other. The smartphone is a key which may provide a new way of human interaction with the machines or tools. Thus problem are that they are facing can be solved by using the smartphone technology to move the wheelchair. This can be achieved with the used the Bluetooth as an intermediary. For this project, the MIT app inventor software is designed therefore to develop the program for installing to the smartphone device that will controls the movement of the wheelchairs. This project is uses the Arduino UNO board and direct current motor to create the movement of the wheelchair. Futhermore, we had build the electrical appliance, this build from the aduino we use the master and slave circuit use the Node MCU and the Bluetooth, we control using the apps. At the end of this project we had create the two box, first box is for the microcontroller and motor driver, and second box is for the electrical appliance. This project had work from move the wheelchair and to light up the electrical appliance. The result and analysis of this innovation described in this report. The result of this project show that this project can be used for the future research works and to design excellence innovation that meet the market needs and public interest.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ABSTRAK

Projek ini berkaitan dengan mikropengawal kerusi roda retrofit tanpa wayar. Sistem ini direka untuk mengawal kerusi roda menggunakan telefon pintar. Objektif projek ini adalah untuk memudahkan pergerakan orang kurang upaya atau cacat serta warga emas yang tidak boleh bergerak dengan baik. Hasil reka bentuk ini akan membolehkan orang tertentu menjalani kehidupan dengan kurang bergantung pada orang lain. Telefon pintar adalah kunci yang mungkin menyediakan cara baharu interaksi manusia dengan mesin atau alata n. Justeru masalah yang mereka hadapi boleh diselesaikan dengan menggunakan teknologi telefon pintar untuk menggerakkan kerusi roda. Ini boleh dicapai dengan menggunakan Bluetooth sebagai perantara. Untuk projek ini, penggunaan aplikasi MIT untuk reka bentuk aplikasi untuk program pemasangan pada peranti telefon pintar yang akan mengawal pergerakkan kerusi roda. Projek ini menggunakan papan Arduino UNO dan motor arus terus untuk mencipta pergerakkan kerusi roda. Tambahan pula, kami telah membina perkakas elektrik, binaan ini daripada aduino yang kami gunakan litar induk dan hamba menggunakan Node MCU dan Bluetooth, kami mengawal menggunakan aplikasi. Pada akhir projek ini kami telah mencipta dua kotak, kotak pertama adalah untuk mikropengawal dan pemandu motor, dan kotak kedua adalah untuk perkakas elektrik. Projek ini mempunyai kerja untuk mengerakkan kerusi roda dan menyalakan peralatan elektrik. Hasil dan analisi inovasi ini akan diterangkan dalam laporan ini. Hasil daripada projek ini akan menujukkan bahawa project ini boleh digunakan untuk kerja – kerja penyelidikan masa depan dan untuk mereka bentuk inovasi kecemerlangan yang memenuhi keperluan pasaran dan kepentingan awam.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ACKNOWLEDGEMENTS

Alhamdulillah, thank you Allah because of His blessing, I finally complete and finish my final year project successfully.

During the process to complete my project objective, I do a lot of research either by using internet, reading past year thesis, reference books and journal. With the guidance and support from peoples around me, I finally complete the project due to the time given. Here, I want to give credit to those who helped me to achieve what I had achieved in my final year project.

I would like to express My sincere and gratitude and respect towards my project's supervisor, En Khairul Azha Bin A.Aziz for his kind, encouragement and suggestion . Without his continued support and interest, the project would not be like what it likes today. May Allah bless and reward him for his sincere, endeavour and contribution in the way of knowledge.

I also want to thanks to my beloved parents because without them, I will not be able to do well in my final year project. They did give me a lot of support, both from money and moral support to help me continue for what I had started on.

Thank you to all lecturer, staffs, friend and all who has directly and indirectly involved on this project. Yours helps and cooperation will never be forgotten. May Allah bless and reward them for their sincere, endeavour and contribution in the way of knowledge.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

TABLE OF CONTENTS

PAGE

DECLARATION

APPROVAL

DEDICATIONS

ABSTRACT i

ABSTRAK ii

ACKNOWLEDGEMENTS iii

TABLE OF CONTENTS i

LIST OF TABLES iv

LIST OF FIGURES v

LIST OF SYMBOLS vii

LIST OF ABBREVIATIONS viii

LIST OF APPENDICES ix

CHAPTER 1 INTRODUCTION 10

1.1 Background 10
1.2 Problem Statement 11
1.3 Project Objective 12
1.4 Scope of Project 12
1.4.1 The basic concept of MIT app Inventor. 12
1.4.2 The basic movement of the wheelchair 13
1.5 Project Methodology 13
1.6 Thesis Structure 14

CHAPTER 2 LITERATURE REVIEW 15

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2.1 Introduction 15
2.2 Wheelchair History 15
2.3 Previous Development of Wheelchair Technology 16
2.3.1 A Hand Gesture Based Wheelchair for Physically Handicapped Person with Emergency Alert System.[1] 16
2.3.2 Wireless Gesture Controlled Wheelchair.[2] 16
2.3.3 Artificial Intelligence Based Wireless Smart Wheelchair.[3] 17
2.3.4 Multiple Robotic Wheelchair System Able to Move with a Companion Using Map Information.[4] 18
2.3.5 Smart Wheelchair based on eye tracking.[5] 18
2.3.6 Raspberry PI based Multi – optional Wireless Wheelchair Control and Gesture Recognized Home Assist System.[6] 19
2.3.7 Wireless Smart Wheelchair.[7] 19
2.3.8 Hands – Free Control of an Electric Wheelchair Using Face Behaviors.[8] 20
2.3.9 Brain Mobile Interfacing (BMI) System Embedded with Wheelchair.[9] 21
2.3.10 A Wireless Controlled Digital Car Lock For Smart Transportation.[10] 21
2.3.11 College Information System using Android.[11] 22
2.3.12 Home Automation using Android.[12] 23
2.3.13 Voice Control of Multiple Devices Based On Speech.[13] 23
2.3.14 Voice Activated Electronic Devices Control System For Home Appliances.[14] 24
2.3.15 Voice Operated Intelligent Fire Extinguishing Vehicle .[15] 25
2.3.16 Design of a low-cost Hand Gesture Controlled Automated Wheelchair.[16] 26
2.3.17 Voice – Controlled Home Automation System . [17] 27
2.3.18 Voice Controlled Vehicle using MQTT Server.[18] 27
2.3.19 Hands – Free Operation on Home Appliances using BCI.[19] 28
2.3.20 Construction of A Gesture – Controlled Robotic Car Using Node MCU.[20] 29
2.4 Arduino UNO 30
2.5 Node MCU (esp8266) 31
2.6 Bluetooth 33
2.7 Summary 34

CHAPTER 3 METHODOLOGY 35

3.1 Introduction 35
3.2 Methodology 38
3.2.1 Control Car 38
3.2.2 Arduino IDE 39
3.2.3 Voice Control 40
3.2.4 MIT App Inventor 42
3.2.5 Bluetooth,Node MCU (ESP 8266) and Relay 43
3.2.6 Arduino UNO and Motor Driver 45
3.3 Ghart chart 49

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

3.4 Summary 49

CHAPTER 4 RESULTS AND DISCUSSIONS 50

4.1 Analysis of the software part 50
4.1.1 Interface design. 50
4.1.2 Voice Control. 52
4.1.3 Controlling Electrical Appliances. 55
4.1.4 Improved and more Qibla Direction 57
4.2 Hardware analysis. 57
4.2.1 Movement of the motor 57
4.2.2 The Truth Table for Motor driver 58
4.2.3 Arduino PWM Analysis. 59
4.2.4 Ultrasonic Sensor Analysis 60
4.2.5 Design hardware box for relay. 61
4.2.6 Design Microcontroller Box 63
4.3 Discussion 64

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS 68

5.1 Conclusion 68
5.2 Future Works 69
5.3 Project Potential 69

REFERENCES 70

APPENDICES 72

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF TABLES

TABLE	TITLE	PAGE
Table 2.1	History about Node MCU.	32
Table 2.2	History about Bluetooth.	33
Table 3.1	Arduino Pin Connection.	46
Table 3.2	Function Motor for Control Car.	46
Table 3.3	Function Motor driver 30A DC.	47
Table 4.1	Word detect by google.	53
Table 4.2	Movement of the wheelchair.	58
Table 4.3	Truth table configuration for 30A DC Motor Driver.	59
Table 4.4	Actual distance and measure distance with wall.	60

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 3.1	Overall Flowchart Project	36
Figure 3.2	Flowchart for the project.	37
Figure 3.3	For example, Control car apply as wheelchair.	38
Figure 3.4	Coding for five button L298N.	39
Figure 3.5	Coding for Five button 30A DC Motor Driver.	40
Figure 3.6	Coding key command and Voice record.	41
Figure 3.7	Middle button is the voice record.	41
Figure 3.8	Block for key command MIT app inventor.	42
Figure 3.9	Voice control Command.	43
Figure 3.10	After press on switch LED.	44
Figure 3.11	Simple circuit for electrical appliances.	45
Figure 3.12	Circuit Motor and Arduino.	47
Figure 3.13	The wheelchair.	48
Figure 3.14	Block diagram function app.	48
Figure 3.15	Ghart Chart.	49
Figure 4.1	The MIT App Inventor.	51
Figure 4.2	Example code button forward.	51
Figure 4.3	Example Block button forward.	52
Figure 4.4	The Build at smartphone.	52
Figure 4.5	The Voice record for Wheelchair.	53
Figure 4.6	Simple code for voice control.	54
Figure 4.7	Block Voice control at MIT app.	54
Figure 4.8	Simple code Switch 1 and Switch 2.	55

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Figure 4.9	Switch 1 and Switch 2.	56
Figure 4.10	Block for Switch 1 and Switch 2.	56
Figure 4.11	Turn on Lamp.	57
Figure 4.12	Example block at MIT app inventor for qibla.	57
Figure 4.13	Simple code for PWM.	60
Figure 4.14	The control PWM for wheelchair.	60
Figure 4.15	The graph ultrasonic sensor.	61
Figure 4.16	The relay box.	62
Figure 4.17	The Microcontroller and Motor Driver box.	63
Figure 4.18	The project attached to wheelchair.	64
Figure 4.19	The product successfully design.	66
Figure 4.20	The apps design.	67

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF SYMBOLS

V - Voltage

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF ABBREVIATIONS

V	-	Voltage
MIT	-	Massachusetts Institute of Technology
BCI	-	Brain – Computer Interfaces
DC	-	Direct Current
BMI	-	Body Mass Index
EEG	-	ElectroEncephaloGraphy
CPU	-	Centre Processing Unit
PWM	-	Pulse Witdh Modulation.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
Appendix A	Full Coding	72

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

CHAPTER 1

INTRODUCTION

1.1 Background

Wireless control for retrofit wheelchair system using microcontroller . This project is developed, using the Arduino UNO board to control this wheelchair wireless . This will help handicapped people to control the wheelchair when no one help them to move another place. In this project DC motor will be used and the motor base will clamp at the wheelchair. This wheelchair is control by the smartphone app, in the app its shows the button example like turn to the left, turn to the right, move forward and backward. Some add for electric appliance and make button for fan and lamp. The retrofit wheelchair system hardware had been developed using DC motor and using Arduino microcontroller.

Wireless control for retrofit wheelchair system they consist the smartphone device and make control box and that can be attached to standard wheelchair to make control the movement is using a DC motor and send that wireless signal to a Bluetooth. For the communication , used the Bluetooth protocol is used to communicate sensory and the command information that between the smartphone device and the control box.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

There have 4 options for the basic motions of the wheelchair to be applied by the user. The four condition of the wheelchair can be described as :

(a)Moving forward

(b)Moving backward

(c)Turning to the right

(d) Turning to the left

Other than basic motions, there have is also make a function to control electrical appliances using the smartphone. There some add is at the wheelchair control is the Qiblat direction.

1.2 Problem Statement

In this day, many people have involved in physical injuries and disabilities. Because of that some of people after an accident they can't walk, or we can tell some people after that have permanently disability. So that them using wheelchair as a third leg for they can move any way they want. For make them easy, we create the device will connected with the wheelchair. so we make wireless control retrofit wheelchair connect with DC motor and will developed. Before that my senior is use IOIO board, so I convert to the IOIO board convert to Arduino UNO board. In this project from the user want to use the some electric appliance for their wheelchair like the lamp and fans.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

1.3 Project Objective

(a) To develop wireless control for retrofit wheelchair system using Arduino UNO board

(b) Design wireless system that can control the movement of a retrofit wheelchair through the smartphone.

(c) Design wireless system that can control electrical appliances using smartphone.

1.4 Scope of Project

This scope are listed for ensure the project it can be conducted with or within its intended boundary. The scope is useful to make ensure the project is heading and make the right direction to the achieve goal. In this scope for this project are study about the basic wireless for the wheelchair from the several published paper and books and also study about the code is use to control the movement for the wireless control retrofit wheelchair.in this scope we have create to make when someone cannot use their hand can use this application for the wheelchair. But for this concept had use for the user using the android, this because apple cannot use this application. For the last they have distance and limit of the movement.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

For the main project is focus on to apply what we have learned about the wireless application. The parameters for this project can be classified as:

1.4.1 The basic concept of MIT app Inventor.

In this project, the MIT app inventor is used to control the movement of the wheelchair. the MIT apps application is the software of the bunch for comprising not only operating system but also middleware and key applications. MIT apps inventor can control

two the electrical appliance and dc motor. This MIT app inventor has run are using the Arduino Uno coding for make the wheelchair movement.

1.4.2 The basic movement of the wheelchair

The movement of the wheelchair is controlled by the MIT app application. The wheelchair can move to the forward and backward as well can move right and to the left. This movement had made by using the coding from the Arduino Uno. The Arduino Uno has connect with the Bluetooth to connect with the App we create using the MIT app inventor.

1.5 Project Methodology

In order to make project, there must be have several procedure that must be taken. First of all, we must get the information about the wheelchair problem. After we get the problem, we must gather the journals, internet, and also article to know about the more information. Also that, have make the research about the wireless Bluetooth to put at the wheelchair. after the research complete and the coding have, so we must to simulated, so simulated we use at the control car to know the coding will operated or not for the hardware. After we know coding is don't have error, the hardware for this design will be create for the wheelchair. lastly, the hardware will combine with coding and make using the app to control the retrofit wireless wheelchair.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

1.6 Thesis Structure

Chapter 1:

The first chapter introduces brief the idea of the project. It is be focused on the overview for the project, detailing about the objectives, the problem statement, the scope and the outcome of the project.

Chapter 2:

The project background is discussed at the chapter. Method concept, theory, and the some characteristic of the component of hardware that are use in this project is discussed at the chapter. In this chapter also make defines terms we used in this project and make discussed about the concept research are related on the theory.

Chapter 3 :

In this chapter three has describe about the methodology used in this project. For this schedule or steps must need be to completed and make a detailed about the report of studies that were done and achieve the aim of the project are presented.

Chapter 4 :

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

This chapter four must have present about the result and discussion. For all simulation, data collection and analysis must obtained will be discussed in detail. And the result will be the objective outlined for the order to make arrived for some hypothesis and conclusion. Chapter 5 :

In the chapter five make the conclusion and the future work that can be undertaken. The some recommendations and the suggestion on how to make improve the performance of the system and the based on the desired result will be given.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter presents literature review about the development the wheelchair control and as well about the wireless part. In this development is about the different control the wheelchair this can help disabled people to move freely to be discussed. This chapter also presents for development of the wireless system as wireless will be use in this pro ject. So this chapter is discuss about the wheelchair history and develop and the wireless upgrades.

2.2 Wheelchair History

To many elderly and disable people, the responds for demands of the wheelchair is high. So many is make development or upgrade the wheelchair is with electrical controlled wheelchair, automated – guided whellchair, and many more have developed.

This have many variety they create about the wheelchair, I had take some of the design of the wheelchair and what they had use in their project.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA