UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF PROTOTYPE MOTOR CONTROLLER FOR BUGGY TO CONTROL DIRECTION AND SPEED

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Of Electronic Engineering Technology (Industrial Electronic) With Honours.

by

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DECLARATION

I hereby, declared this report entitled "Development of Prototype Motor Controller for Buggy to Control Direction and Speed" is the result of my own research except as cited in references

Signature : ……

Author's Name : ……

Date : ….....……

APPROVAL

This report is submitted to the Faculty of Engineering Technology of Universiti Teknikal Malaysia Melaka as a partial fulfilment of the requirement for the degree of Bachelor of Electronic Engineering Technology (Industrial Electronic) with Honours. The member of the supervisory committee is as follow.

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(Project Supervisor)

ABSTRAK

Projek ini adalah mengenai kawalan arah DC motor dan kelajuannya bagi kereta golf. DC motor adalah salah satu motor yang paling mudah untuk mengawal kelajuan dan arah. Bagi tujuan itu, DC motor tanpa berus (BLDC) telah digunakan. Untuk pengawal kelajuan, peraturan kelajuan untuk BLDC motor dicapai dengan berselang-seli antara tugas rendah dan nisbah kewajipan yang tinggi. Konsep baru ini membantu untuk mengurangkan kos dan kerumitan perkakasan kawalan motor. Antara kaedah kawalan yang berbeza untuk kaedah kawalan DC motor angker voltan menggunakan nadi modulasi lebar (PWM) adalah yang terbaik. Kuasa yang digunakan untuk motor boleh dikawal dengan mengubah lebar nadi yang digunakan dan voltan arus terus digunakan untuk terminal motor. Untuk mengawal kelajuan motor, CCP modul akan digunakan dalam pengekodan untuk mikropengawal. Konsep menukar arah itu menggunakan konsep jambatan H yang terletak di dalam pemacu motor. Pemacu motor akan memutar motor sama ada mengikut arah jam atau putaran arah lawan jam. Kawalan arah juga boleh dicapai dengan pengawal mikro yang sama menggunakan sedikit pengubahsuaian dalam bahasa pengaturcaraan. Gabungan ini menyediakan kawalan kelajuan yang licin di kedua-dua arah jam dan arah lawan jam. Keseluruhan projek ini boleh memberikan kecekapan dan kelancaran operasi kawalan yang lebih tinggi untuk apa-apa pembuatan industri.

ABSTRACT

This project is about controlling DC motor direction and speed for buggy. DC motor is one of the easiest motor to control the speed and the direction. For the purpose, brushless DC motor (BLDC) has been used. For the speed controller, speed regulation for BLDC motor is achieved by alternating between low duty and high duty ratios. This new concept helps to reduce the cost and complexity of motor control hardware. Among the different control methods for DC motor armature voltage control method using pulse width modulation (PWM) is the best. Power that applied to motor can be controlled by varying the width of applied pulse and DC voltage applied to terminal of motor. To control the speed of the motor, CCP module will be used in the coding create for microcontroller. Concept of changing the direction is using the H-bridge concept which located in motor drive. Motor drive will rotate the motor in either clockwise or counter clockwise rotation. Direction control can also be achieved by the same microcontroller using slight modifications in its programming language. The combination provides smooth speed control in both clockwise as well as anticlockwise direction. Overall this project can provide higher efficiency and smooth operations control for any industrial plant.

DEDICATION

To:

My Beloved Parents

Family

Lecturers

ACKNOWLEDGEMENT

Bismillahirrahmaanirrahim,

In the name of Allah S.W.T, the most compassionate and the most merciful.

Firstly, thanks to Allah S.W.T because giving me a good health and huge courage and strength to do this final year project.

Secondly, I would like to deeply express my gratitude and appreciation to my supervisor, Mr. Khairul Anuar bin A.Rahman for his guidance, support, encouragement and helping to finish my final year project.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

DC	-	Direct Current
PWM	-	Pulse Width Modulation
PIC	-	Programmable Integrated Circuit
ROM	-	Read Only Memory
RAM	-	Random Access Memory
IC	-	Integrated Circuit
CCM	-	Capture Compare Module
BLDC	-	Brushless DC
BDC	-	Brush DC
PCB	-	Printed Circuit Board
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode

CHAPTER 1

INTRODUCTION

1.0 Introduction

In this chapter the overall view of the research will be discussed. It will focus on the prototype development of motor controller for buggy to control the direction and speed. This chapter will also discussed on the problem statement, the objectives of this project and the scopes which limit the project. This research will bring significant changes to the buggy golf cart in terms of its safety due to the speed control.

1.1 Background of Study

Nowadays, the use of electric golf cart for roadway transportation is increasing in many regions. However there is injuries reported associated with the operation of these vehicles. The current buggy golf cart has no used of speed control which help in controlling the speed while passing by the unflatten road. In fact, they can help reducing the numbers of injuries related to buggy golf cart since speed control is one of the best solution. By using DC motor, we can reduce the cost and improve the safety of the buggy golf cart.

Although speed control is important, it is vital to remember the most important function of buggy golf cart is to provide safety and comfortable handling condition for the users. For example, if the new motor for buggy golf cart is built, a well design of speed control should attained the desired of buggy performance. Therefore, besides the numbers of speed control assigned, the comfortable in handling the speed must be consider too. Hence, this project which entitled as Development of Prototype Motor Controller for Buggy to Control Direction and Speed to emphasize the safety of buggy golf cart by controlling it using speed and direction control.

1.2 Problem Statement

The ideas for this project is come out after observing the current buggy and research on the issues related. Buggy are mostly used at the golf club for the people to move from one place to another while playing golf.

Such the issues will lead to several problems which is without any speed controller, buggy golf cart will be difficult to control especially when they are passing by unflatten road. The speed control in current buggy golf cart does not use the concept of PWM which is the speed are only limited to what have been set.

1.3 Objectives

The objectives of this project are:

1. To simulate the motor controller speed which have three speed and two major direction

2. To demonstrate the synchronization of the motor direction with its speed changing using simple prototype

3. To analyses the effect of load and slope against speed

1.4 Scope

The scopes of this project are to build prototype which is a synchronization of DC motor direction with speed for the buggy car. The circuit simulation will be proceed by demonstrate it on simple circuit by using the coding done with microcontroller.

In this project, Proteus Software will be used to design the circuit for the speed controlling as well as the motor movement direction. From the design done, PCB layout will be process for the prototype.

This project used DC motor of 12V at 100rpm, PIC16F877A as the microcontroller to generate PWM signal, four push button to control direction and speed, regulator IC which is voltage regulator to provide 5V power supply to the microcontroller. Speed is set to three value which is when duty cycle at 30%, 70% and 90% and been controlled by three push button. Direction is control by using one push button only.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Literature review can be defined as a background study about the knowledge and information needed to develop a project. To develop a complete and functional project it is necessary to writing literature review to go through before starting project analysis and design. This chapter will focus on the theory of each part and software used in my project. The sources from theory are taken from book, journal, article and website that are relevant. Besides, methods and tools used to handle project are described and discussed.

2.1 Study on Buggy

Buggy or its common name golf cart had widely known since in year 1930. Every golf cart have its own specification which made its different from one another. Mostly, the golf cart are compared in terms of its dimension, type of battery, the maximum speed it can go, the climbing capacity, maximum load capacity and the number of passengers. Other than that buggy are also choose based on its type of handling process.

2.1.1 Study on Golf Cart (2011)

For the comparison purpose, one of the golf cart model has been used. This model will be compared with the project done in term of its power, speed and ability. The special features will also be compared for the purposed of renewal. Figure 2.1 and Table 2.1 below explain the features and specifications for the golf car.

Figure 2.1: Electric Personal Golf Car

Table 2.1: Vehicle Power Overview

Power Source	48V DC
Motor Type	48V AC
Horsepower	3.3kW continuous
Batteries	48V

Table 2.2: Vehicle Dimensions Overview

Overall Length	240cm
Overall Width	119cm
Overall Height (No Canopy)	116cm
Overall Height (With Canopy)	174cm
Wheel Base	167cm

Table 2.3: Vehicle Performance

Seating Capacity	2 persons
Dry Weight	290kg without batteries
Curb Weight	425kg
Vehicle Load Capacity	360kg
Speed (Level Ground)	28 km/h up to 31 km/h

2.2 Brushless DC Motor

Darren Lance Gabriel, Johan Meyer and Francois du Plessis (2011) has stated that brushless DC motors eliminates the need for brushes used in shunt DC motors, thereby reducing maintenance costs. Instead, BLDC motors use electronic commutation through switching electronics to change the current direction. BLDC motors operate by means of stationary current-carrying coils and rotating permanent magnets.

A. Kusko, S.M. Peeran (1988) has proposed the definition for brushless DC motor. They proposed that motor have stator (armature) winding and permanent-magnet. Stator windings are supplied from primary DC supply through matrix of solid-state switches. The switches are controlled by rotor shaft of sensors and logic position. The motor speed are proportional to primary DC voltage with the absence of regulator.

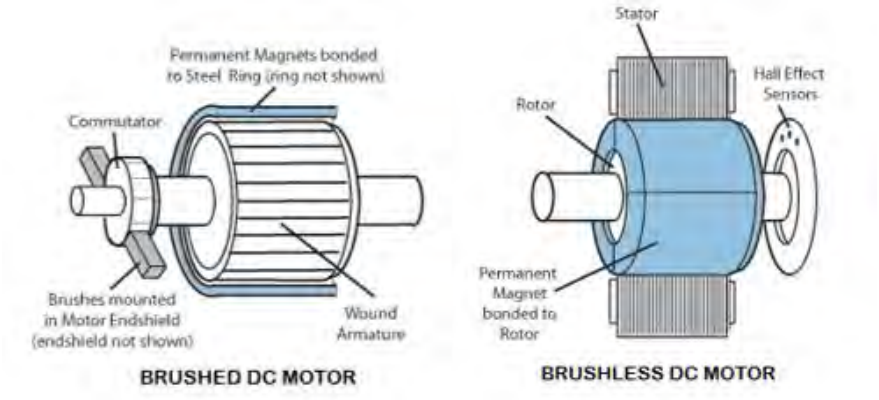

Figure 2.2: Difference Parts in BLDC and BDC Motor

Table 2.4: Difference in Feature between BLDC and BDC Motor

Feature	BLDC Motor	BDC Motor
Commutation	Based on hall position sensors	Based on brushed commutation
Maintenance	Less required due to absence of brush	Periodic maintenance is required
Life	Longer	Shorter
Speed/ Torque	Flat which is operation at all speed with rated load	Moderately flat which is higher speed, brush friction increase hence useful torque reduces
Efficiency	High with no voltage drop across brush	Moderate
Output Power	High	Moderate low
Rotor Inertia	Low	Higher
Speed Range	Higher	Lower
Electric Noise	Low	Arcs in brush generate noise causing EMI in the equipment nearby
Cost	Higher	Low
Control	Complex and expensive	Simple and inexpensive
Controller Requirements	Always required to keep motor running	No controller required for fixed speed

Table 2.5: Advantages and Disadvantages of BLDC and BDC Motor

	BLDC	BDC
Advantages	• Long life • Low voltage • Low noise • High torque • Easy control • Easy installed	• High start torque • Low voltage • High speed
Disadvantages	• Higher price	• Easy-attrite • High temperature • Regular clean is needed

B. K. Fussell and C. K. Taft has proposed several guideline to choose DC motor. They choose the DC motor based on the several factors which is by observing the motor and its associated drive cost, the capability of its acceleration, the torque delivery capability for a given size, complexity and the life and reliability.

2.2.1 Speed Control of DC Motor

Speed of DC motor can be vary in three ways. The first one is by using mechanical gears to obtain desired speed. The second is by reducing motor voltage in series resistor. Voltage drop across the series resistor will be larger when higher current give. The third way are by applying full supply of voltage to motor in pulse and series dropping effect will be eliminated. This is what we called as pulse width modulation (PWM).

Motor will run faster once the pulse given are increasing. Theoretically, speed of DC motor will increase once the voltage increase. Hence, DC motor can control its speed by varying average supply voltage. Based on Figure 2.2, the rotation for DC motor direction are changing when the polarity of current flow through drive gate are change.