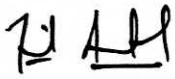
SUPERVISOR APPROVAL

I / We admit that to have read this report and it has follow the scope and quality in Partial Fulfillment Of Requirements For The Degree Of Bachelor of Electronic Engineering (Industrial Electronic)

Signature : 

Supervisor Name : Mr. Farid Arafat bin Azidin

Date : 10/05/06

FARID ARAFAT BIN AZIDIN
Pensyarah
Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
Kolej Universiti Teknikal Kebangsaan Malaysia
Karung Berkunci 1200
Ayer Keroh, 75450 Melaka

DC MOTOR DRIVE USING H-BRIDGE

WAN ZATEEL AQMAER BT WAN AB HALIM

This Report Is Submitted In Partial Fulfillment Of Requirements For The Bachelor Degree Of Electronic Engineering (Industrial Electronic)

Faculty Of Electronic And Computer Engineering
Kolej Universiti Teknikal Kebangsaan Malaysia

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DECLARATION

This Final Year Project contains information pertaining of DC Motor Drive Using H-Bridge. This project comes under the subject BEKU4983 Project offered by Faculty of Electronic Engineering and Computer Engineering, KUTKM. This documentation report aims to provide the reader about the overall information techniques about this project.

I here by admit that the paper is my own work except some of the parts which have been cited accordingly.

Signature : 

Author : WAN ZATEEL AQMAER BT. WAN AB. HALIM

Date : 10/05/06

DEDICATION

I dedicate this book to my beloved mother and father, family members
And last but not least, to all my K.U.T.K.M. lecturers and friends especially Dila.

ACKNOWLEDGEMENT

Bismillahirrahmanirrahim, with the name of God, the Most Merciful, I felt very grateful to Him at last I finished my project. Actually, this study could never have been completed without the help and support of many individuals.

I wish to express my most sincere gratitude to all of the people who helped me to make this project succesful especially to my supervisor, Encik Farid Arafat bin Azidin, for providing the excellent guidance, concern and informative discussions regarding to my project. Without his helped, I don't think I can fulfill this project requirement.

Secondly, I would like to express my gratitude to my beloved mother and father, and all of my family members for their support, unconditional love and and patience to me. Then, to my friends, especially Pirdaus bin Bachok and Hazuin Akmar bt Mohd Yusof, and all of my friends that I afraid I cant spell all. They gave me support and opinion to make my project successful.

Lastly, to whoever that helped me in making this project success directly or indirectly, I wish God blessing you all.

ABSTRACT

H-Bridge circuit is a popular circuit for driving Direct Current (DC) Motor and make it turn. It's called H-Bridge because it looks like the capital 'H' on classic schematics. The ability of H-Bridge circuit is that the motor can be driven forward or backward at any speed. H-Bridge circuit can be used for simple prototyping or really extravagant for added protection and isolation. So many thing should be look to make an H-Bridge circuit, depends on its usage and motor. Many switches can be used start from SPDT, transistors like BJT and FET transistors, MOSFET Transistors, or power MOSFET.

What's most important in this thesis is to acquire knowledge and learn the characteristics of the switches, H-Bridge circuits, and DC Motor Drive. Then, second important things come after that, that is to analyze all the characteristics and choose the best switches to the circuit especially looking to power efficiency. This is very important to do because people have a problem to choose best component in their H-Bridge circuits to make a project for example a robot. The circuit design also can be renew and modified that they can be completely separate boards, reusable to other project like toys, models, cordless tools, and robots.

ABSTRAK

Litar Tetimbang-H merupakan litar yang popular untuk memacu Motor Arus Terus (AT) dan memutarkannya. Ia dipanggil Tetimbang-H kerana litarnya kelihatan seperti huruf 'H'. kebolehan litar ini ialah motor dapat dipacu ke hadapan atau ke belakang pada sebarang kelajuan. Litar Tetimbang-H boleh digunakan untuk proptotaip mudah sehinggalah yang begitu kompleks. Namun, banyak perkara yang perlu dinilai dalam membuat litar Tetimbang-H, bergantung pada penggunaan dan jenis motor yang digunakan. Pelbagai suis boleh diambilkira bermula daripada SPDT, transistor seperti BJT dan FET, atau MOSFET kuasa dalam membina litar ini.

Apa yang paling penting dalam projek ini ialah untuk memperoleh pengetahuan, kemahiran dan mempelajari ciri-ciri suis, litar Tetimbang-H, dan jenis motor arus terus. Perkara kedua ialah untuk membuat analisis suis yang terbaik yang patut digunakan dalam litar berdasarkan keefisien kuasa. Perkara ini amat penting kerana ramai orang bermasalah untuk memilih komponen yang terbaik dalam membuat litar Tetimbang-H mereka contohnya untuk membuat robot. Litar ini juga nanti dapat diperbaharui atau diubahsuai bergantung kepada fungsinya dan projek yang ingin dibuat seperti patung permainan, model, dan robot.

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LIST OF ABBREVIATIONS

BJT	-	Bipolar Junction Transistors
FET	-	Field Effect Transistors
MOSFET	-	Metal-Oxide Semiconductor Field-Effect Transistors
PWM	-	Pulse Width Modulator
DC	-	Direct Current
SPST	-	Single-Pole, Single-Throw
SPDT	-	Single-Pole, Double-Throw
DPDT	-	Double-Pole, Double-Throw
PCB	-	Printed Circuit Board
IC	-	Integrated Circuit

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APPENDICES

CHAPTER I

INTRODUCTION

1.1 INTRODUCTION

This chapter is mainly discussing overview of this project and its possible application. A superficial view of the project objectives, operation, design and scope of this project is clarified briefly. An expanded detail of these features can be found in the chapters to advance.

1.2 OBJECTIVES OF THE PROJECT

There are five objectives of doing this project. First is to study the DC Motor drive operation. Second is to study the H-Bridge circuitry concept for controlling brushed DC Motor. While the third is to study various of switches like BJT transistors, mode power MOSFET or MOSFET transistors, Darlington, and decide the best to the H-Bridge circuit. Other objective is to develop a better circuit to drive a DC Motor that can forward and reverse in any speed. Lastly, the objective is to improve my basic electronic circuit knowledge.

1.3 SCOPE OF THE PROJECT

This project needs first, basic electronic circuit knowledge. It will use tools and components like DC motor, battery, dynamo, PWM circuit to provide PWM pulses, and best switches. The software used are PSpice/Multisim that requires to simulate the design circuit and to make sure all the calculation related is right, so the right components choose. So, the wrong choosing components can be avoided. Finally the weaknesses of circuit can be solved. All lab instruments are using while complete this project.

1.4 OVERALL VIEW OF THE PROJECT

To make a motor turn, we take a battery, hook the positive side to one side of our DC motor then we connect the negative side of the battery to the other motor lead. The motor spins forward and reverse. But, if we want to be able to control the motor in both forward and reverse with a processor, we need more circuitry. H-Bridge circuit is a popular circuit for driving DC motors. The great ability of an H-Bridge circuit is that the motor can be driven forward or backward at any speed, optionally using a completely independent power source. The H-Bridge design can be really simple for prototyping or really extravagant for added protection and isolation.

1.5 METHOD OF RESEARCH

This project is being done by referred to the H-Bridge concepts to drive a DC motor. So, to make sure the objectives obtained, three two circuits were made using the H-Bridge concepts.

Reference material like journals are very important to make comparison in finishing this project. Based on understanding about the H-Bridge concepts, a good design circuit can be build to drive a motor in forward and reverse at any speed.

Result from analysis presented in tables and percentages to support this project. Beside, comparison data delivered in that way to make it more systematic, orderly and easy to understand.

1.6 THESIS SYNOPSIS

The thesis contains five chapters that explained deep about this project. First chapter will explain about introduction to give overall concept about this project like objectives, scope of project and thesis synopsis.

The second chapter will discuss about the research and information related to the project. Every facts and information found from any reference books will be observed and debated to choose the good way for the project. In easy word, this chapter is about theoretical chapter and study about the concept of this project until the best method found. The next chapter will discuss about the techniques and methods that have been choose in second chapter with deeply method. The techniques divide into two, the hardware and software used.

While the fourth chapter is about analysis, results and discussion parts. All the analysis results like tables, voltage drop, and all the comparisons between Darlington

and MOSFET will be discussed in this chapter. The analysis process has been done to both circuits and the motor.

The last chapter in this thesis is about conclusion and suggestion. In this chapter, conclusion made based on project achieving and learning experience gained from the starting until finishing of this project. Beside, some suggestions made to improve the project level so the project can be better in the future.

CHAPTER II

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will discuss about the theory and concept of the project in overall perspective. The purpose of discussion is to explain approach and method that used in past research and observe how far the project related with theory and research itself. Beside, this chapter also explained and showed the concept and theory used to solve the project problem statements. Theoretical understanding is very important as a guide in doing any research. The result or analysis can't be done if not compare to the theoretical parts.

2.2 DC MOTOR DRIVE

The Direct Current (DC) machine is popular in a number of drive applications due to its simple operation and control. The starting torque of dc machines is large, which is the main reason for using it in several traction applications. A special form of dc machines

can also be used with either ac or dc supply. A large number of appliances and power tools used at home, such as circular saws and blenders, are dc machines.

The study of Direct Current motor of the sort used in toys, models, cordless tools, and robots. These motors are particularly versatile because both their speed and direction can be readily controlled. When the motor is disconnected from the battery, it is off. When it is connected with the red wire to the positive terminal and black to negative it turns forward; and when the wires are reversed, the motor turns backwards.

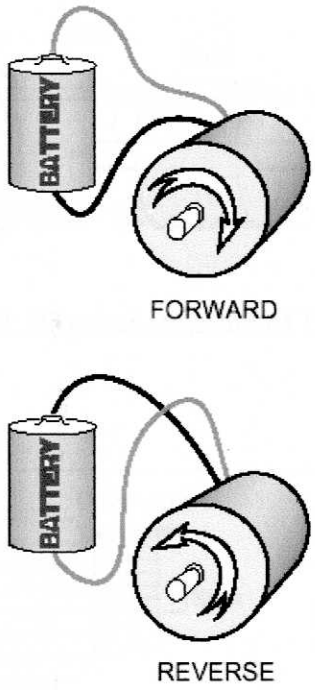

Figure 2.1: Basics DC Motor

The main components of the dc machines are; field circuit, armature circuit, commutator, and brushes. The field is normally an electric magnet fed by a dc power source. In small machines, the field is often a permanent magnet.

The armature circuit is composed of the windings, commutator, and brushes. The windings and the commutator are mounted on the rotor shaft and therefore rotate. The brushes are mounted on the stator and are stationary, but in contact with the rotating commutator segments.

The rotor windings are composed of several coils, each has two terminals connected to the commutator segments on opposite sides. The commutator segments are electrically isolated from one another. The segments are exposed, and the brushes touch two opposing segments. The brushes allow the commutator allow the commutator segments to be connected to an external dc source.

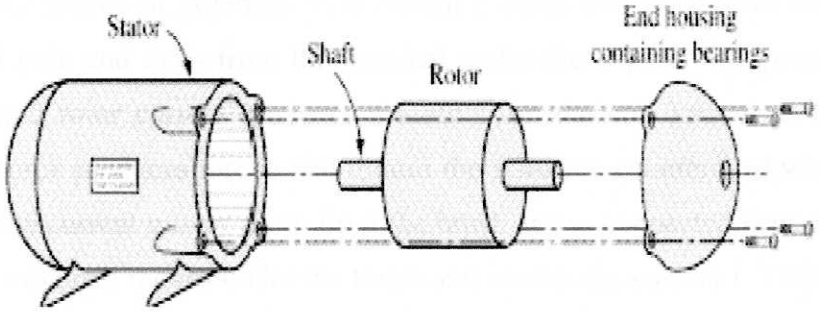

Figure2.2: Physical structure of DC Motor

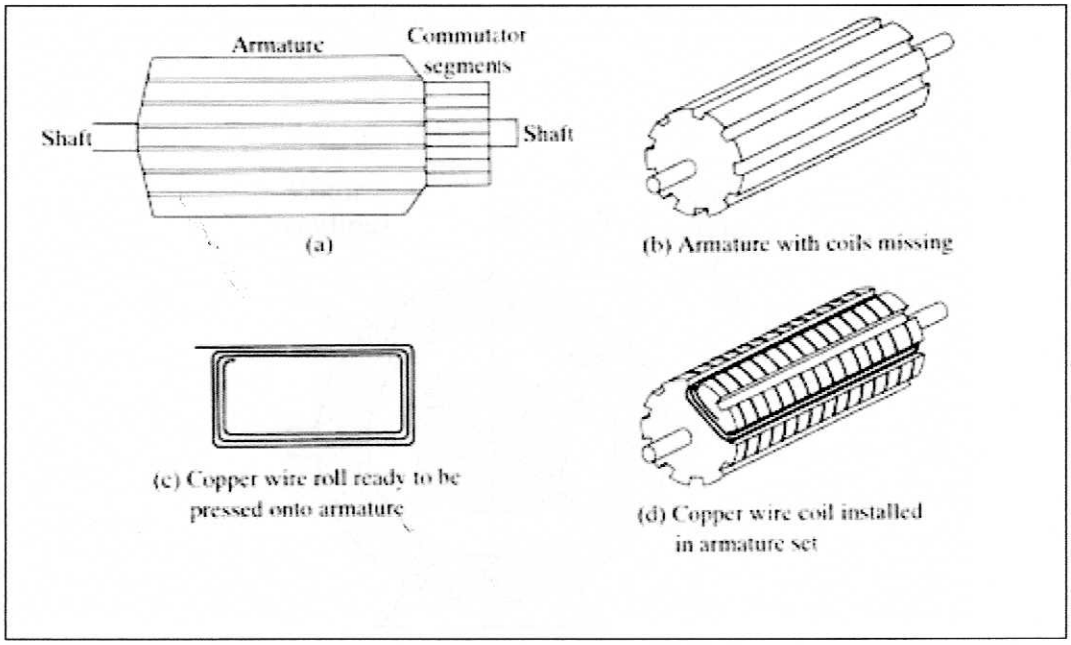

Figure 2.3: Part of DC Motor

2.2.1 DC Motor Operation

The stator field produces flux from the N pole to the S pole. The brushes touch the terminals of the rotor coil under the pole. When the brushes are connected to an external dc source of potential V, a current I enters the terminal of the rotor coil under the N pole and exits from the terminal under the S pole. The presence of the stator flux and rotor current produces a force F on the coil known as the Lorentz force. This force produces torque that rotates the armature counterclockwise. The coil that carries the current moves away from the brush and is connected from the external source. The next coil moves under the brush and carries the current I. This produces a continuous force F and continuous rotation. The function of the commutator and brushes is to switch the coils mechanically.

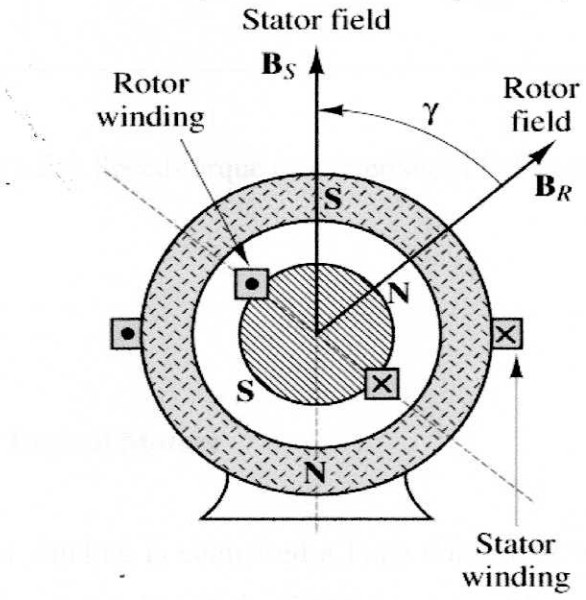

Figure2.4: Inside of DC Motor

2.2.2 Types of DC Motors

Direct current motors can be classified into four groups based on the arrangement of their field windings. Motors in each group exhibit distinct speed-torque characteristics and are controlled by different means. These four groups are separately excited motors, shunt motors, series motors, and compound motors.

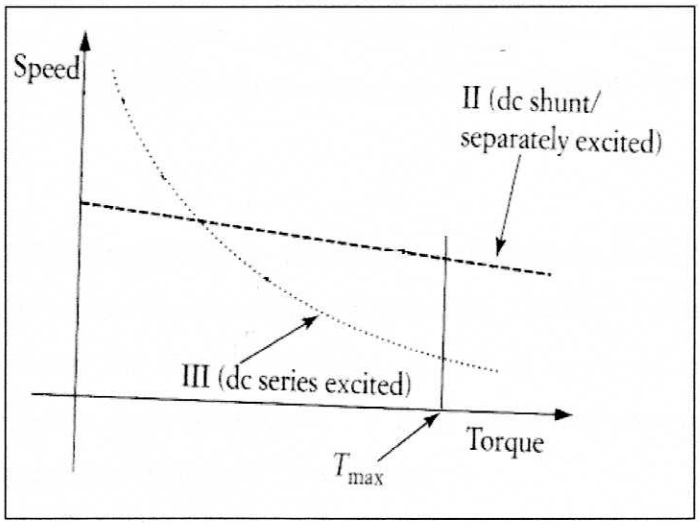

Figure 2.5: Speed-torque characteristics of electric motors

2.2.2.1 Separately Excited Motors

The field winding is composed a large number of turns with small cross-section wire. This type of field winding is designed to withstand the rated voltage of the motor. The field and armature circuits are excited by separate sources.