DC CONTROLLED DROP COMPENSATED DC POWER SUPPLY USING PARALLEL PORT

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MEI 2009

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This Report Is Submitted In Partial Fulfillment Of Requirements For The Degree of Bachelor In Electrical Engineering (Power Electronic and Drive)

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ABSTRACT

This project was gyrated about the technique to control the DC motor speed by using programming from computer parallel port. The computer uses a software program to control the speed of the motor.

The components and equipment that consist in this project are 74LS06 (Hex inverter buffers / drivers with high-voltage outputs), 10kOhm and 1kOhm resistor, variable resistor (100k ohm), ULN2803, DC motor (12V), 4N33 (optoisolator), stripboard, Infineon Board as Microcontroller and parallel port.

Via programming, the motor speed and voltage will determine by adjusting the value duty cycle of motor. By using buck converter, the speed of the motor is simply controlled through direct voltage compensation. This adjustable speed drive controls the load in only one direction of rotation.

ABSTRAK

Pada dasarnya, projek ini berkisarkan tentang teknik untuk mengawal kelajuan DC motor dengan menggunakan pemprograman daripada lubang kecil yang sejajar pada komputer. Komputer ini menggunakan program perisian untuk mengawal kelajuan sesebuah motor.

Komponen dan peralatan yang terkandung dalam projek ini ialah 74LS06 (penampan berbalik/ keluaran voltan tinggi dengan pemacu). Perintang 10k ohm dan 1k ohm, perintang boleh laras (100k ohm), DC motor (12V), 4N33 (pengasingan), ULN2803 sebagai pemacu, Infineon Board sebagai Microcontroller, papan jalur dan lubang kecil yang sejajar pada komputer.

Pemprograman akan menyelaras voltan sekaligus menyelaras kelajuan DC motor. Melalui penukaran penurunan, kelajuan motor dengan mudahnya dapat dikawal secara gantirugi pada voltan terus. Penyelarasan kelajuan pemacu ini boleh mengawal beban hanya pada satu arah putaran saja.

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CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

1.1 Introduction

The title of this project is DC Controlled Drop Compensated DC Power Supply Using Parallel Port. The purposes of this project are to control the dc motor rotation by using buck converter with programming. The buck converter or chopper or step down DC to DC converter function as a switch mode power supply that uses two switches (a transistor and a diode) and an inductor together a capacitor. When load of DC motor increased, DC motor will take more current. Due to internal resistance of power supply, the terminal power supply voltage will drop below rating. By using analog to digital converter, then the voltage drop can be compensated through computer which adjusting duty ratio to the buck power supply. This project is combination between hardware and software where the software used is Microsoft Visual C++, while the hardware is buck switching power supply.

1.2 Project objective

Before start the project, each of designers usually confirm the objective of the project because the objective will be helpful to make sure the project is running smoothly. The objectives of this project are:

- To determine the relationship between voltage and speed of motor
- To make research about the functional of programming to control the motor
- To investigate the effect of varying duty cycle with the motor speed and voltage

1.3 Scope of the project

Scope for any project is a roughly pictured for someone to know the section that will be developed. This project has two sections; first section is to construct the hardware, while another section is to create control program.

1.4 Problem Statement

Nowadays in this technology world, many industries use motor to run their machine. But, many of them which use electric motor facing a currently challenge to make the high efficiency motor, to reduced the noise and to extended the motor lifetime. And all of these criteria should be reduced at optimum cost. Today, the demand for electronic motor control is increasing rapidly, not only in the automotive and computer peripherals markets but also in industrial application and home appliances.

The high cost needed to overcome this problem make many engineers to design the motor control using power electronic because less expensive and easy to implement. One of the designs is control the motor via buck converter in many ways such as using PIC controller, PWM, H-bridge and others. The suggestion to do this project is very suitable to overcome this problem.

1.5 Literature Review

1.5.1 Introduction of the research

The first step should do before start the project development is done the research about project background or knowledge research. This research is done to add the details knowledge about the project. In this process need sources from internet, books, and article. Also, the information gets from supervisor and other lecturer.

1.5.2 History and background of DC motor [12]

For most basic level, electric motors have a job to convert electrical energy into mechanical energy. This is done via two interacting magnetic fields and one stationary, and another one attached to a part that can move. A number of types of electric motors exist, but industries always use DC motors in some form or another. DC motors have the potential for very high torque capabilities (although this is generally a function of the physical size of the motor), are easy to miniaturize, and can be control via adjusting their supply voltage. DC motors are also the simplest and the oldest electric motors.

The basic principles of electromagnetic induction were discovered in the early 1800's by Oersted, Gauss, and Faraday. By 1820, Hans Christian Oersted and Andre Marie Ampere had discovered that an electric current produces a magnetic field. The next 15 years saw a flurry of cross-Atlantic experimentation and innovation, leading finally to a simple DC rotary motor.

1.5.2.1 Michael Faraday (U.K.)

Fabled experimenter Michael Faraday decided to confirm or denied a speculations surrounding Oersted's and Ampere's results. Faraday set to an experiment to demonstrate whether or not a current-carrying wire produced a circular magnetic field around it, and in October of 1821, he succeeded in demonstrating this.

Faraday took a dish of mercury and placed a fixed magnet in the middle. And above this, he dangled a freely moving wire (the free end of the wire was long enough to dip into the mercury). When he connected a battery to form a circuit, the current-carrying wire circled around the magnet. Faraday then reversed the setup, this time with a fixed wire and a dangling magnet. As a result, again the free part circled around the fixed part. This was the first demonstration of the conversion of electrical energy into motion, and Faraday is often credited with the invention of the electric motor.

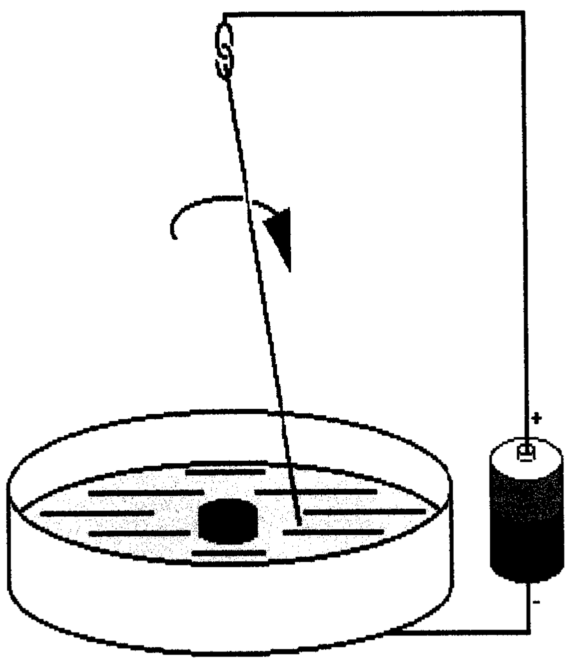

Figure 1.1: Faraday Motor Schematic

1.5.2.2 Joseph Henry (U.S.)

It took ten years, but by the summer of 1831 Joseph Henry had improved on Faraday's experimental motor. Henry built a simple device whose moving part was a straight electromagnet rocking on a horizontal axis. Its polarity was reversed automatically by its motion as pairs of wires projecting from its ends made connections alternately with two electrochemical cells. Two vertical permanent magnets alternately attracted and repelled the ends of the electromagnet, making it rock back and forth at 75 cycles per minute.

Henry considered his little machine to be only a philosophical toy, but nevertheless believed it was important as the first demonstration of continuous motion produced by magnetic attraction and repulsion. It being more mechanically useful than Faraday's motor, and being the first real use of electromagnets in a motor.

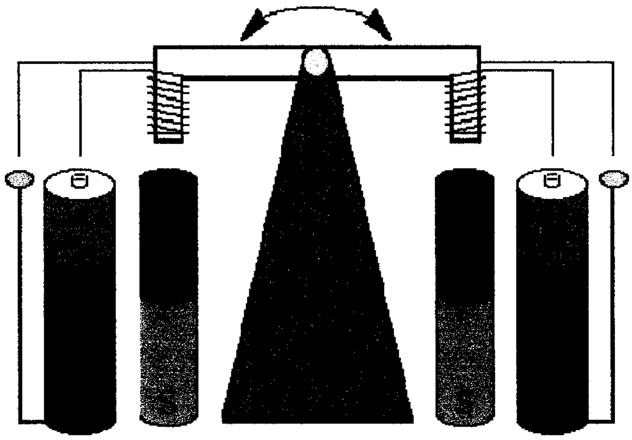

Figure 1.2: Henry Motor Schematic

1.5.2.3 William Sturgeon (U.K.)

Just a year after Henry's motor was demonstrated, William Sturgeon invented the commutator, and with it the first rotary electric motor in many ways a rotary analogue of Henry's oscillating motor. Sturgeon's motor, was the first to provide continuous rotary motion and contained essentially all the elements of a modern DC motor. Note that

Sturgeon used horseshoe electromagnets to produce both the moving and stationary magnetic fields (to be specific, he built a shunt wound DC motor).

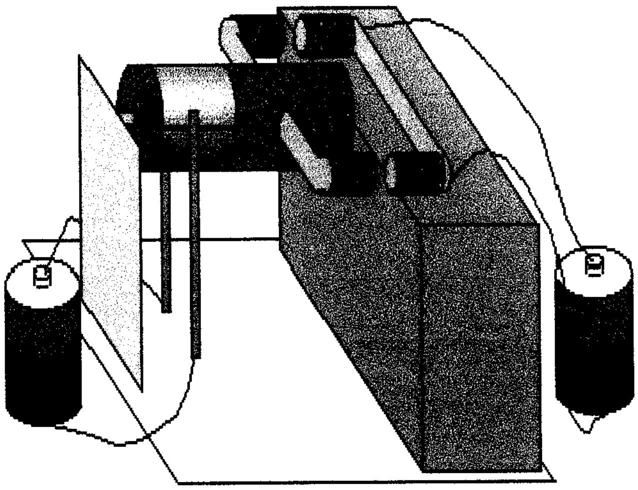

Figure 1.3: Sturgeon Motor Schematic

1.5.3 The Comparison of Motor Types

Table 1.1: The Comparison of Motor Types

Type	Advantages	Disadvantages	Typical Application	Typical Drive
AC Induction (Shaded Pole)	Least expensive Long life high power	Rotation slips from frequency Low starting	Fans	Uni/Poly-phase AC

		torque		
AC Induction (split-phase capacitor)	High power high starting torque	Rotation slips from frequency	Appliances	Uni/Poly-phase AC
AC Synchronous	Rotation in-sync with freq long-life (alternator)	More expensive	Clocks Audio turntables tape drives	Uni/Poly-phase AC
Stepper DC	Precision positioning High holding torque	Slow speed Requires a controller	Positioning in printers and floppy drives	Multiphase DC
Brushless DC electric motor	Long lifespan low maintenance High efficiency	High initial cost Requires a controller	Hard drives CD/DVD players electric vehicles	Multiphase DC
Brushed DC electric motor	Low initial cost Simple speed control (Dynamo)	High maintenance (brushes) Low lifespan	Treadmill exercisers automotive starters	Direct (PWM)

1.5.4 Types of DC Motor [9]

A DC motor is created to run on DC electric power. Two examples of pure DC designs are Michael Faraday's homopolar motor (which is uncommon), and the ball bearing motor, which is (so far) a strange. By far the most common DC motor types are the brushed and brushless types, which use internal and external commutation respectively to create an oscillating AC current from the DC source, so they are not purely DC machines in a strict sense.

1.5.4.1 Brush DC Motor

The classic DC motor designed to generates an oscillating current in a wound rotor with a split ring commutator, and either a wound or permanent magnet stator. A rotor consists of a coil wound around a rotor which is then powered by any type of battery.

Many of the limitations of the classic commutator DC motor are due to the need for brushes to press against the commutator and this can creates friction. At faster speeds, brushes have increasing difficulty in maintaining contact. Brushes may spring back off the irregularities in the commutator surface, and it creating sparks. All of this limits the maximum speed of the machine.

The current density per unit area of the brushes limits the output of the motor. The imperfect electric contact also causes electrical noise. Brushes eventually exhausted and require replacement, and the commutator itself is subject to wear and maintenance. The commutator assembly on a large machine is a costly element, requiring precision assembly of many parts.

There are three types of DC motor:

1) DC series motor
2) DC shunt motor
3) DC compound motor - these are also two types:
   (a) cumulative compound

(b) differentially compounded

1.5.4.2 Brushless DC Motor

Some of the problems of the brushed DC motor are eliminated in the brushless design. In this motor, the mechanical rotating switch or commutator/brush gear assembly is replaced by an external electronic switch that synchronized to the rotor's position. Brushless motors are typically 85-90% efficient, whereas DC motors with brush gear are typically 75-80% efficient.

Between ordinary DC motors and stepper motors, there is the brushless DC motor. Built in a very similar design to stepper motors, these often use a permanent magnet external rotor, three phases of driving coils, one or more Hall Effect sensors to sense the position of the rotor, and the associated drive electronics. When the coils are activated, one phase after the other, by the drive electronics as cued by the signals from the Hall Effect sensors. In effect, they act as three-phase synchronous motors that contained their own variable-frequency drive electronics.

A specialized class of brushless DC motor controllers utilizes EMF feedback through the main phase connections instead of Hall Effect sensors to determine position and velocity. These motors are used extensively in electric radio-controlled vehicles. When configured with the magnets on the outside, these are referred to by mode lists as out runner motors.

Brushless DC motors are commonly used to precise speed control that is necessary, as in computer disk drives or in video cassette recorders, the spindles within CD, CD-ROM (etc.) drives, and mechanisms within office products such as fans, laser printers and photocopiers. They have several advantages over conventional motors: