

PC BASED DC MOTOR SPEED CONTROLLER

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ABSTRACT

These projects is PC-based DC motor speed controller allows to controlling the speed of a DC motor from PC's parallel port. There were combination of hardware and software. The hardware is a circuit and the motor. The dc motor is connected to the PC through an interface circuit, where the motor will rotate 360° clock wise and anti clock wise. For the software, Visual Basic will be used to create control graphic display which it will be used to control the speed of the motor. At the control graphic display on PC, there are buttons being locate which function as control speed level, ON and OFF button and direction button. To make sure the speed of motor is in the right rpm, the infrared sensor is used to detect the speed reading. The measured of speed will be displayed at the seven segment. In additional, alarm will be function when motor speed increase over limit that have been set up either it rotate clock wise or anti clock wise.

ABSTRAK

'PC-based DC motor speed controller' merupakan satu projek yang digunakan untuk mengawal kelajuan motor arus terus melalui computer peribadi. Projek ini adalah gabungan antara perkakasan dan perisian. Perkakasan terdiri daripada litar dan motor. Motor arus terus akan bersambung dengan computer peribadi melalui litar permukaan, dimana motor arus terus ini boleh berpusing sebanyak 360° mengikut arah jam dan lawan jam. Untuk perisian pula, 'Visual Basic' digunakan untuk membuat kawalan paparan grafik yang digunakan untuk mengawal kelajuan motor arus terus. Terdapat beberapa butang pada kawalan paparan grafik yang berfungsi untuk mengawal tahap kelajuan, 'ON' dan 'OFF' dan juga butang untuk menunjuk arah. Untuk memastikan kelajuan motor arus terus berada pada nilai rpm yang betul, sensor infrared digunakan untuk mengesan nilai kelajuan. Nilai kelajuan akan dipaparkan melalui '7-segment' Tambahan lagi, siren akan berfungsi bila kelajuan motor arus terus melebihi tahap yang telah ditetapkan.

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CHAPTER I

INTRODUCTION

1.1 INTRODUCTION

PC based DC Motor Speed Controller is a project which is combination of hardware and software. The hardware is control circuit with DC motor and the software is C.Turbo (C language). The DC motor will be running when the programming through the interface circuit. During the DC motor running, the measured of speed in rpm will be measured using the by using the Infrared sensor. at the same time, the measured of speed will be displayed at the 7-segment. The pulse width modulation (PWM) method is used for efficient control of the motor. The output of the PC is decoded to select a particular preset (VR1 through VR8).

1.2 OBJECTIVES

The objectives for this project are:

- To learn the concept of electrical DC motor system and the speed controlling system.
- To learn and implement about the Visual Basic.
- To learn troubleshooting and analyzing.
- To design and implement the circuit.

The first objective is to learn the concept of electrical DC motor and speed control. Before do the project, it is important to know about the concept of DC motor. How the DC motor will be operating and how the speed motor will control the system. Second, learn about the visual basic and how to implement the visual basic with the hardware. From this project, the troubleshooting and analyzing will be learn and know how to design and implement the circuit.

1.3 Problem Statement

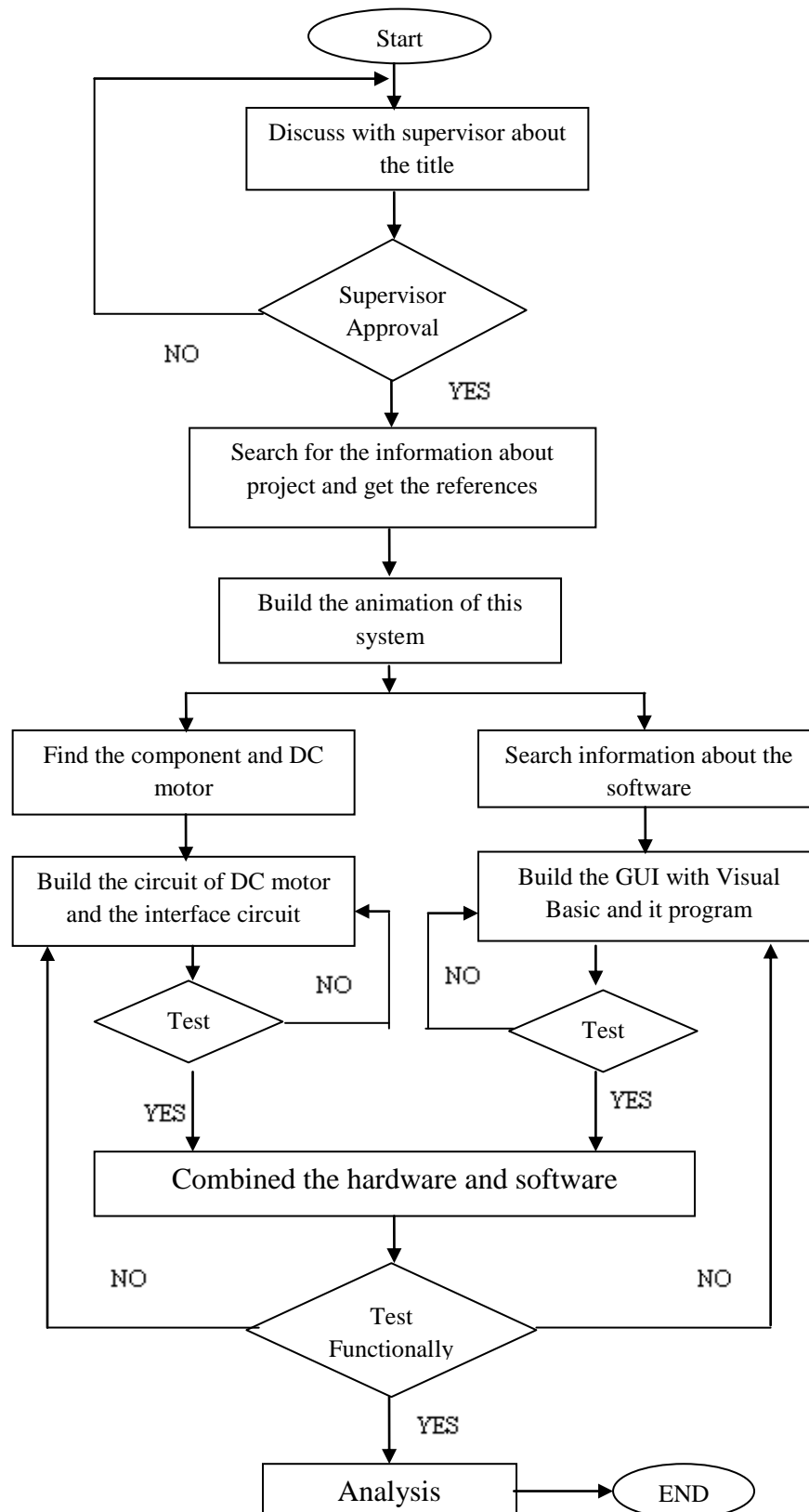
Nowadays, control system widely used to improve the technology. PC-based DC motor speed control was build for people to conduct the motor. Before that, motor was controlled manually. But, by using PC-based DC motor speed control, the motor can operate automatically. It just sets the PC by using software. It was so easy controlled motor by using PC. Besides that, the times also can be setting using the software through the PC. So, the speed motor will be operating followed the time setting.

1.4 SCOPE

The scopes of this project are:

1. Study literature
2. Find the parameter and calculation related.
3. Design animation of this system.
4. Design the GUI.
5. Design the hardware.
6. Test the function.
7. Analysis.
8. Report writing

1.5 METHODOLOGY



CHAPTER II

LITERATURE REVIEW

2.1 BACKGROUND STUDY

In Chapter II, the background of the project will be revealed. The past researches on the same topic and some scientific writings will be discussed and compared to this project. The literature review is made so that ones will understand the theory of the PC-based DC Motor Speed Controller that been discussed.

2.2 INTRODUCTION

A direct current (DC) motor is an electromechanical device that converts DC electrical energy into mechanical energy. When direct current is applied to the motor, it produces a mechanical rotary action of the motor's shaft, which is physically connected to a machine or other mechanical device to perform some sort of work. In other words, the DC motor converts electric power into mechanical work. Because DC motors require direct current, they cannot be plugged into a wall socket, so a battery or an AC-to-DC converter is needed to supply the input power. Because the DC battery is the portable power supply, the DC motor has a many of applications in mobile equipment such as electric tools and radio-controlled vehicles, carts and fans. In industrial electronics, DC motors are used in both high and low power applications. Control of the motor is accomplished externally with the electronic circuitry using solid-state devices such as the transistor or the SCR. Three functions of the DC motor that are controlled by external circuitry are:

- Speed – how fast its shaft is rotating.
- Torque – a particular type of force.
- Direction – its ability to reverse rotation.

DC motors are often compared by their speed regulations. The speed regulation (SR) of a motor is defined by:

$$SR = \frac{\omega_{n1} - \omega_{f1}}{\omega_{f1}} \times 100\% \dots\dots\dots(1)$$

$$SR = \frac{n_{n1} - n_{f1}}{n_{f1}} \times 100\% \dots\dots\dots(2)$$

It is a rough measure of the shape of a motor's torque-speed characteristic a positive speed regulation means that a motor speed drops with increasing load, and a negative speed regulation means a motor speed increases with increasing load. The magnitude of the speed regulation tells approximately how steep the slope of the torque-speed curve is.

DC motors are, of course driven from a dc power supply. Unless otherwise specified, the input voltage to a DC motor is assumed to be constant, because that assumption simplifies the analysis of motors and the comparison between different types of motor.

2.3 DC MOTOR STARTER

In order for a DC motor to function properly on the job, it must have some special control and protection equipment associated with it. The purposes of this equipment are:

- i. To protect the motor against damage due to short circuit in the equipment
- ii. To protect the motor against damage from long-term overloads.
- iii. To protect the motor against damage from excessive starting currents.
- iv. To provide a convenient manner in which to control the operating speed of the motor.

2.4 DC MOTOR COMPONENT

DC motors consist of many parts, and all are contained in three major components of the motor:

- i. The *armature*, which includes all the rotating parts.
- ii. The *motor frame*, which includes all the stationary parts.
- iii. The *end plates*, which include support for the shaft and the brushes

2.5 PERMANENT MAGNET MOTOR

In DC motors of 0.1 horsepower (74.60 watts) or less, a permanent magnet field is most useful. Comparing motors below 1.25" in diameter, permanent magnet motors run cooler than wound field types because no power is expended to maintain a magnetic field. The permanent magnet field functions perfectly for thousands of hours of operation and lasts indefinitely on the shelf. Permanent magnet motors are easily reversed by changing the polarity of the voltage applied to the connecting terminals. They are capable of high-stall torque and function perfectly in long-duty cycle applications. Dynamic braking is easily obtained by merely applying a short circuit to the motor terminals after voltage is removed. With Globe permanent magnet motors, this usually results in less than 20 armature revolutions coast. Figure 1 illustrates a speed-torque/current-torque curve for a permanent magnet motor. Each curve is a theoretical straight line since the permanent magnet field and armature winding are constant in a

given motor. Current varies in proportion to torque, and the slope of this curve is a torque constant (KT) in oz. in./amp. [12]

Figure 2.1 shows that with the permanent magnet motor, no load speed varies inversely with field strength and stall torque varies directly with field strength. In this illustration, curve “a” is the lowest value, curve “b” is the nominal and curve “c” is the maximum value of field strength. Figure 2.5.3 indicates the result of changing the applied voltage to a permanent magnet motor. No load speed changes proportionally to voltage, resulting in a family of parallel speed-torque curves. Remember that voltage determines speed, and only torque will determine current. [12]

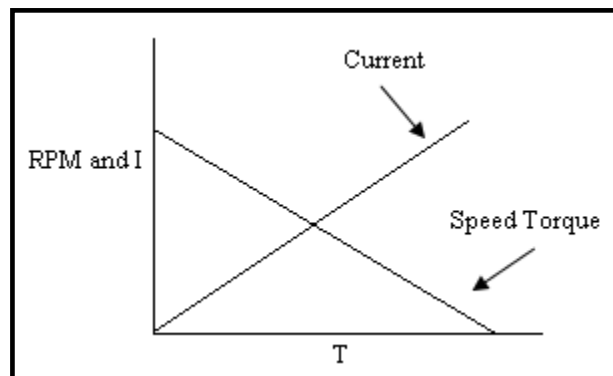


Figure 2.1 Permanent Magnet Motor Curves

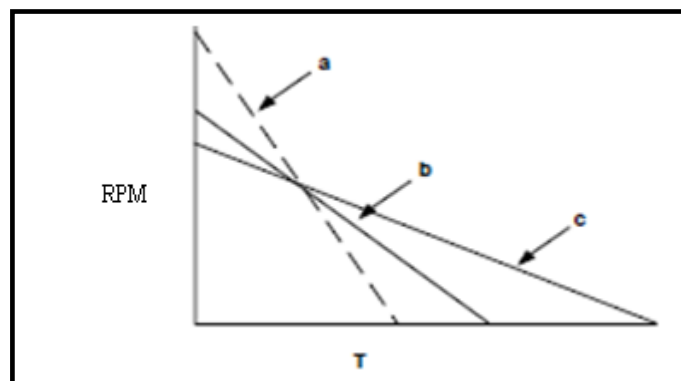


Figure 2.2 Speed Tolerance Characteristics

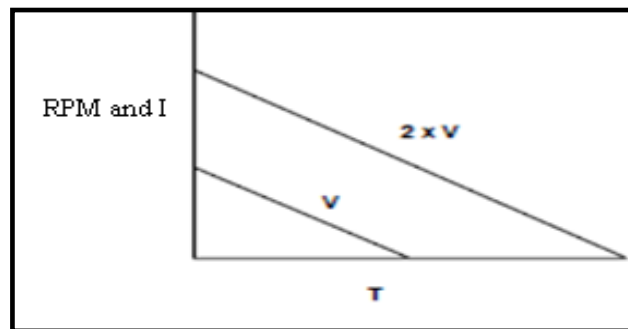


Figure 2.3 Voltage Effect on Speed

2.6 DC MOTOR CONSTANT

Motor constants are parameters used to define motor characteristics. Torque constant (K_T) and resistance (R) completely define a permanent magnet motor in terms of determining speeds, torques, efficiencies, currents, etc. DC motor brushes produce a non-linear voltage drop at the commutator somewhat similar to the forward voltage drop of a silicon diode. It is customary to add a 1- to 2-volt drop factor for this when calculating performance using K_T and R . However, the K_T and R values shown in this catalog are adjusted so that this is not necessary. Motor performance calculations for these motors will indicate actual performance when lead or terminal voltage is used and the torques are within the normal operating range of no load to one-half of stall. For motors 1.25" diameter and smaller, any errors out to stall should be less than 5%. At the power levels near stall on motors 1.50" and larger, both brush drop and field distortion due to input current are a much larger factor and actual torques near stall will be less than expected. In this catalog, all values of K_T are in oz. in./amp. Conversion to other units is as follows:

oz. in./amp x .706155 = Newton centimeters/amp

oz. in./amp x 7.06155 = milli-Newton meters/amp

oz. in./amp x 72 = gm cm/amp

oz. in./amp x .0625 = lb. in. amp

oz. in./amp x .0052 = ft. lbs./amp

The voltage constant K_E in volts/1000 rpm is obtained from the equation $K_E = K_T/1.35$. The motor constant $k_m = \sqrt{R}$. This constant is a measure of motor "size," but for comparison be sure that equal units are used. Units will be torque/ $\sqrt{\text{Watt}}$ while the physical realization of this constant is the stall torque at one watt input. The no-load-torque value shown in this catalog for each motor series includes all no load losses and can be considered a nominal value over the speed ranges where it is anticipated that the unit will be used. While brush and bearing friction are relatively independent of speed, other factors such as grease viscosity, wind age, hysteresis and electrical losses will change as exponential functions of speed. The most noticeable variation from unit-to-unit or test-to-test will be caused by temperature effects on grease viscosity. When more exact calculations are required, you may assume that one-half of the no load losses occurs at zero rpm and that these losses will follow a linear curve from this point to the listed catalog value at 8,000 rpm. K_T and R values in this catalog are all nominal values at +25°C and should not be considered as minimum or maximum. [12]