WALL AVOIDING ROBOT

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This thesis is submitted as partial fulfillment of the requirement for the award of the Bachelor Degree of Electrical Engineering (Electronic)

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NOVEMBER 2008

DECLARATION

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Date : 12 NOVEMBER 2008.

DEDICATION

Specially dedicate to

My beloved parents, brothers and sisters.

ACKNOWLEDGEMENT

Firstly, I would like to express my acknowledgment and gratitude to my supervisor, Nurul Hazlina Bt Noordin for the guidance and co-operation that been given throughout the progress and to complete this project.

I also deeply thank to my family whose have giving me chance to continue my study at University Malaysia Pahang and support me for all these year. Thanks for their encouragement, support, love, my little brother, sister and many more. ALHAMDULILLAH.

Finally, my great appreciation to my house mate that giving me so many opinion till I don't know which one to comprehend, especially Khawarizmi, Faizan and Hanis thanks for their brilliant idea and my class mate whom involve directly or indirectly with this project. Thank You very Much.

ABSTRACT

This project is called “wall avoiding robot” which is used to avoid wall or obstacle. To make the robot avoid, ultrasonic sensor is used as an input to the PIC16F877A microcontroller board and two RC servomotors to move the robot. During the robot is move, ultrasonic sensor is ON to detect the obstacle. If the sensor detects the wall or obstacle it will give logic ‘1’ to PIC board. PIC board will stop one of RC servomotor to make the robot TURN. The turn depend on where the position of the robot. If the obstacles are at the right sigh, it will turn to the left. If the obstacles are at the left sigh, it will turn right. It will ON back the RC servomotor if ultrasonic sensor didn’t detect obstacle.

ABSTRAK

Project ini dipanggil “Wall Avoiding Robot” dimana ianya digunakan untuk mengelak dinding dan halangan. Bagi membuat robot ini mengelak, penderia ultrasonic digunakan sebagai masukkan ke micro kawalan PIC16F877A dan dua RC servo motor untuk mengerakkan robot. Sepanjang robot ini berjalan, penderia ultrasonic dipasang bagi mengesan halangan. Jika penderia mengesan dinding atau halangan dihadapan, ia akan memberikan logic ‘1’ kepada micro kawalan. Micro kawalan akan memberhentikan salah satu RC servo motor untuk membuatkan robot itu berpusing. Robot akan berpusing bergantung pada kedudukan robot. Jika halangan berada disebelah kanan robot, ia akan berpusing ke arah kiri. Jika halangan berada disebelah kiri robot, ia akan berpusing ke arah kanan. Kedua-dua RC servo motor kembali dipasang jika penderia ultrasonic tidak mengesan halangan.

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LIST OF SYMBOL.

ms	-	millisecond
I/O	-	Input Output.
RAM	-	Random Access Memory.
ROM	-	Read Only Memory.
PROM	-	Programmable Read Only Memory.
EPROM	-	Erasable Programmable Read Only Memory.
IC	-	Integrated Circuit.
R	-	Resistor.
C	-	Capacitor.
LED	-	Light Emitter Diode.
IR	-	Infrared.
k	-	kilo.
V	-	volt.
mA	-	mili ampere.

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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

Now days, there are many ways for a robot to move and avoid obstacle. Wheels and legs were two common options to move the robot. Robot becomes widely used in industrial or daily life due to their characteristics. Robot able to work in 24 hours continuously without feeling tired unlike human that confine to certain time. The cost to setup the robot nowadays becomes more affordable and their long term prospect is bright judging from their capacity to perform

Normally, wheels robot is commonly used like vacuum robot. Wheels vehicles are mechanically easy to control and construct. Speed of wheels robot more fast compare to the legs robot because needs to set the angle of each servo motors.

This project try to use ultrasonic sensor on mobile robot to see to see whether the robot perform efficiently compare to infrared sensor. Distance of ultrasonic sensor is longer because of ultrasonic using wave to transmit and receive.

1.2 OBJECTIVE OF THE PROJECT

The main objective of the project is to design a system and programming to control the RC servo motor of wheels robot so it can move by using microcontroller. The system and the programming will be able to control the movement of the wheels so the robot able to move straight ahead, make turns and avoid obstacle.

The ultrasonic sensor is use as a sensor of this robot. This sensor will detect a wall or obstacle in front of the robot and the robot will turn to avoid obstacle.

1.3 SCOPE OF THE PROJECT

In order to make this project achieve successfully, there are several scope had been outlined. The scope of this project include the programming of the PIC microcontroller will be use is PIC Basic language, build a hardware system of PIC microcontroller and two RC servo motors, develop program so the robot able to move, make turn and to design ultrasonic sensor so that the robot able to avoid obstacle.

1.4 PROBLEM STATEMENT

Infrared sensor that use in common robot has disadvantages which is distance, can't work properly under direct sun light and sensitivity. Because of mobile robot require an operator's vision for guidance and navigation, it need a high sensitivity sensor to make this robot work effectively.

1.5 OUTLINE OF THESIS

This thesis consists of five chapters. This chapter discuss about overview of project, objective research, project scope, problem statement and thesis organization.

Chapter 2 it will discuss more on the literature review that have been done. It will discuss about the function of DC servo motor, PIC16f877A microcontroller, about robotic and about various type of sensor.

Chapter 3 includes the project methodology. It will explain how the project is organized and the flow of process in completing this project. Also in this topic discusses the methodology of the system, circuit design, software design and the mechanical design.

Chapter 4 will be discussing about the result obtained in this project and a discussion about the result.

Finally, in Chapter 5 the conclusions for this project are presented in chapter 5. This chapter also discusses about the recommendation for the project and for the future development.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter include the study of servo motor, PIC microcontroller and types of sensors.

2.2 MOTOR SELECTION

Robot builders generally need to choose three types of motor which is stepper motor, DC motor and servo motors. Each type of motor has its own advantages and disadvantages.

2.2.1 STEPPER MOTOR

Stepper motors are special motors that are used when motion and position have to be precisely controlled [1]. The stepper motor is closely related in design to three-phase AC synchronous motors where an internal rotor containing permanent magnets or a large iron core [2] with salient poles is controlled by a set of external magnets that are switched electronically. A stepper motor may also be thought of as a cross between a DC electric motor and a solenoid. As each coil is energized in turn, the rotor aligns itself with the magnetic field produced by the energized field winding. Unlike a synchronous motor, in its application, the motor may not rotate continuously; instead, it "steps" from one position to the next as field windings are energized and de-energized in sequence. Depending on the sequence, the rotor may turn forwards or backwards.

Simple stepper motor drivers entirely energize or entirely de-energize the field windings, leading the rotor to "cog" to a limited number of positions; more sophisticated drivers can proportionally control the power to the field windings, allowing the rotors to position "between" the "cog" points and thereby rotate extremely smoothly. Computer controlled stepper motors are one of the most versatile forms of positioning systems, particularly when part of a digital servo-controlled system.

Stepper motors can be rotated to a specific angle with ease, and hence stepper motors are used in computer disk drives, where the high precision they offer is necessary for the correct functioning of, for example, a hard disk drive or CD drive. Only very old hard drives (from the pre-gigabyte era) use stepper motors; newer drives use systems based on voice coils.

Stepper motors were up scaled to be used in electric vehicles under the term SRM (switched reluctance machine). The stepper motor is turned one step at a time or can turn at a specific rate [3] (specified by the speed in which the steps are executed). In term of hardware interface, the stepper motor requires a bit more complex to wire and more current. But this motor has more advantages in software control. A stepper motor can be controlled by stepper-motor controlled chips, such as the UC1517.

2.2.2 DC MOTOR

Based on figure 2.1, we have a simple dc electric motor. When the coil is powered, a magnetic field is generated around the armature. First, the left side of the armature is pushed away from the left magnet and drawn toward the right, causing rotation. Second, the armature continues to rotate.

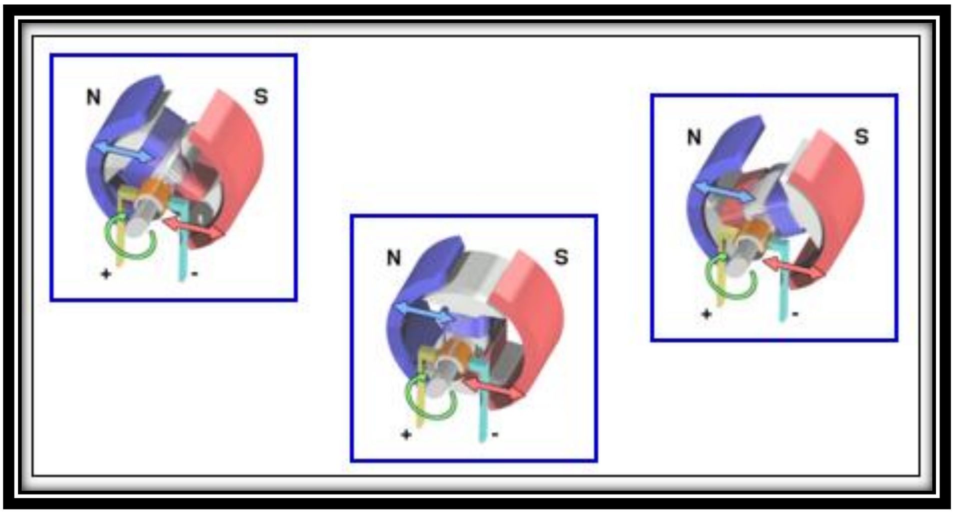

Figure 2.1: DC motor rotation.

Third, when the armature becomes horizontally aligned, the commutator reverses the direction of current through the coil, reversing the magnetic field. The process then repeats. If the shaft of a DC motor is turned by an external force, the motor will act like a generator and produce an Electromotive force (EMF) [2]. During normal operation, the spinning of the motor produces a voltage, known as the counter-EMF (CEMF) or back EMF, because it opposes the applied voltage on the motor. This is the same EMF that is produced when the motor is used as a generator (for example when an electrical load (resistance) is placed across the terminals of the motor and the motor shaft is driven with an external torque).

The CEMF is proportional to motor speed, when an electric motor is first started or is completely stalled, there is zero CEMF [2]. Therefore the current through the armature is much higher. This high current will produce a strong magnetic field which will start the motor spinning. As the motor spins, the CEMF increases until it is equal to the applied voltage, minus the parasitic voltage drop. Generally, the rotational speed of a DC motor is proportional to the voltage applied to it, and the torque is proportional to the current. Speed control can be achieved by variable battery tapping, variable supply voltage, resistors or electronic controls. The direction of a wound field DC motor can be changed by reversing either the field or armature connections but not both.

2.2.3 SERVO MOTOR

Servo motors were commonly used in robotics. This was because they were light-weighted, compact and durable. Since their control and power electronics were all built-in, interfacing hardware required by was much simplified. Compared to toy motors, the torque of servo motors were high. Due to these reasons, servo motors better suited to robots.

Each servo motor had three wires, one was for power, one was for ground, and one was for connecting to pulse-width modulated signal. This signal controlled the position which the shaft of a servo motor should rotate.

Pulse-width modulated signal was a train of pulses with varying width. For normal servos, these pulses could be repeated every 5ms to 20ms. As shown in figure 2.2, an on time of 0.7ms, 1.5ms and 2.3 ms signaled the motor shaft to turn to 0 degree, 90 degrees and 180 degrees respectively. The motor shaft could not go any further than below 0 degree and above 180 degree range unless modifications were made to the servo.

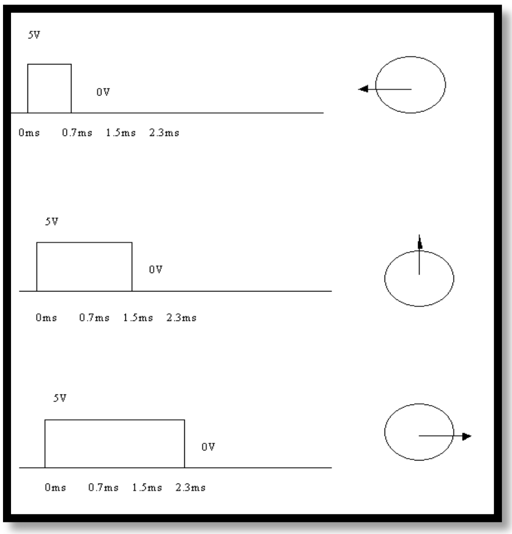

Figure 2.2: Position of motor shaft when time equal to 0.7ms, 1.5ms and 2.3ms.

The servo motor has some control circuits and a potentiometer (a variable resistor, aka pot) that is connected to the output shaft. In the figure 2.3, the pot can be seen on the right side of the circuit board. This pot allows the control circuitry to monitor the current angle of the servo motor. If the shaft is at the correct angle, then the motor shuts off. If the circuit finds that the angle is not correct, it will turn the motor the correct direction until the angle is correct. A normal servo is used to control an angular motion of between 0 and 180 degrees. A normal servo is mechanically not capable of turning any farther due to a mechanical stop built on to the main output gear.

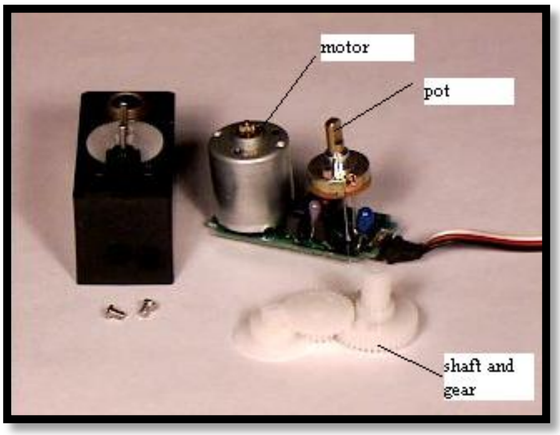

Figure 2.3: The inner part of servos

2.3 PIC MICROCONTROLLER

For this project, the controller for the movement is PIC microcontroller. We will describe about the PIC microcontroller and at the same time, it will give more understanding for me to employ this controller. Almost all type of PIC microcontroller is included in a class of 8-bit microcontrollers of RISC architecture. Basically, the PIC architecture is minimized to be a simpler item but it still operates at the same function. The Harvard architecture is a newer concept than von-Neumann's [4]. It was designed as a response for the need to speed up the work of a microcontroller. In Harvard architecture, data bus and address bus are separate [4]. Thus, the data will flow directly through the central processing unit and the address bus is neglected. This greater flow of data will impact for a greater speed of work. Besides that, the architecture will involve for a small number of a fixed length instruction. It means the instruction is not to have to be 8-bit words but it can uses 14 bits for instructions which allows for all instruction to be one word instructions. Microcontrollers with Harvard architecture are called "RISC microcontrollers". RISC is a short form for Reduced Instruction Set Computer [4]. Microcontrollers with von-Neumann's architecture are called 'CISC microcontrollers'. CISC is a short form for Complex Instruction Set Computer [4]. Same as discussion before, RISC microcontroller has a reduced set of instructions, maybe 35 instructions for one cycle. If we compared it with Intel’s and Motorola’s microcontroller, it has over hundred instructions. As a simplified point, we can say that the features of PIC microcontroller are:

I. Separate code and data spaces (Harvard architecture).

II. A small number of fixed length instructions.

III. Most instructions are single cycle execution (4 clock cycles), with single delay cycles upon branches and skips.

IV. All RAM locations function as registers as both source and/or destination of math and other functions.

V. A hardware stack for storing return addresses.

VI. A fairly small amount of addressable data space (typically 256 bytes), extended through banking.

VII. Data space mapped CPU, port and peripheral registers.

VIII. The program counter is also mapped into the data space and writable.

So, the result for PIC microcontroller reach of 2:1 in code compression and 4:1 in speed in relation to other 8-bit microcontrollers in its class. Generally, PIC microprocessor divides to 6 parts. Those are program memory, EEPROM, RAM,