"I declare that I have read this thesis and in my opinion, it is suitable in term of scope and quality for the purpose of awarding a Bachelor Degree in Electronic Engineering (Industrial Electronic)"

Signature : .....

Supervisor : Soo Yew Guan

Date : 25/3/05

OBSTACLE AVOIDANCE PIC MOBILE ROBOT CONTROL

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"I hereby declared that this thesis is the result of my own effort except as clearly stated its references".

Signature : .....

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Date : 24/3/05

Dedicated to my beloved family especially my father, brothers and sisters. Also to all my friends.

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ABSTRACT

This project proposes to the problem of collision avoidance for mobile robots. The project is about mobile robot that can detect obstacles. The model-based on ultrasonic sensor, to generate collision-free motion. It should be detect obstacles before collision occurs. After that, the robot turns to the left or right. Obstacle mobile robots may need to carry out missions in hazardous or populated environments. A typical application is to assist human beings in indoor environments, like offices, homes and etc. This project use PIC Microcontroller to control the robot. Through of PIC, we can do program to control the robot by using a computer programming. After the programming done, all the data is transferred to PIC.

ABSTRAK

Projek ini dicadangkan untuk mengatasi masalah pelanggaran yang berlaku pada robot bergerak. Projek ini adalah berkenaan robot bergerak yang boleh mengesan halangan. Ia menggunakan pengesan ultrasonik supaya tidak berlaku perlanggaran. Ia sepatutnya boleh mengesan halangan sebelum berlanggar atau bersentuh dengan halangan. Selepas itu, robot akan bergerak ke kiri atau ke kanan berdasarkan kedudukan halangan tersebut.Robot pengesan halangan selalunya diperlukan untuk melakukan tugas-tugas bahaya atau pada persekitaran yang berbahaya. Di samping itu, ia boleh membantu manusia untuk melakukan tugas seharian di rumah, pejabat, kilang dan sebagainya. Projek ini menggunakan PIC Pengawal Mikro untuk mengawal pergerakan robot. Melalui PIC Pengawal Mikro, kita boleh membuat program untuk mengawal robot dengan menggunakan bahasa computer. Selepas itu, semua data tadi bolehlah dipindahkan ke dalam PIC Pengawal Mikro untuk digunakan pada robot.

CONTENT

II LITERATURE REVIEW

LIST OF TABLE

LIST OF FIGURE

LIST OF ABBREVIATION

ADC	-	Analog to Digital Converter
ASM	-	Assembler
B	-	Byte
CAD	-	Computer-Aided Design
CADD	-	Computer-Aided Design Directories
CCP	-	Compression Control Protocol
CD	-	Compact Disc
CIS	-	Component Information System
C-MOS	-	Complementary Metal Oxide Semiconductor
CPU	-	Control Processing Unit
dB	-	Decibel
DC	-	Direct Current
DIP	-	Dual-in-line Package
DOS	-	Disk Operating System
EEPROM	-	Electrically Erasable Programmable Read Only Memory
FF	-	Flip-flop
Gnd	-	Ground
H	-	High
Hex	-	Hexadecimal
Hz	-	Hertz
IC	-	Integrated Circuit
IDE	-	Integrated Development Environment
I/O	-	Input/Output
LED	-	Light Emitting Diode
Lib	-	Library
LSI	-	Large Scale Integration

MCU	-	Microcontroller Unit
MPU	-	Microprocessor Unit
NOP	-	No Operation
Pa	-	Pascal
PCB	-	Printed Circuit Board
PIC	-	Peripheral Interface Controller
PWM	-	Power Width Modulation
RAM	-	Random Access Memory
RC	-	Resistor Capacitor
Rx	-	Receiver
Sec	-	Second
RISC	-	Reduced Instruction Set Computer
SFR	-	Special Function Register
SCI	-	Scalable Coherent Interface
SPI	-	Serial Peripheral Interface
SR	-	Set Reset
SRAM	-	Static Random Access Memory
SPL	-	Sound Pressure Level
TMR	-	Timer
TTL	-	Transistor-Transistor Logic
Tx	-	Transmitter
UART	-	Universal Asynchronous Receiver/Transmitter
UV	-	Ultraviolet
V	-	Voltage
VLSI	-	Very Large Scale Integration
WIN	-	Window

LIST OF APPENDIX

CHAPTER I

INTRODUCTION

1.1 INTRODUCTION

This chapter will discuss on the term robots. What is a robot? Types of robots that have been built and its usage. Why building a obstacle avoidance mobile robot? This question will be discussed in details. The objectives of project, and a brief review on some of the robots built worldwide will also be presented.

1.1.1 Robot

There are many definitions of robots. It seems to be of difficulty to suggest an accurate meaning for the word robot, that there are various definitions of this word, different according to the points of view. Some view a robot through the aspect of reprogrammability while others more concern on the manipulation of the robot, behavior, intelligence and so on.

The British Robot Association (BRA) defines robot as:

"A programmable device with a minimum of four degrees of freedom designed to both manipulate and transport parts, tools or specialized manufacturing implements through variable programmed motion for the performance of the specific manufacturing task" [1].

The Robotic Institute of America, on the other hand defines the robot as:

"Reprogrammable multifunctional manipulator designed to move material, parts, tools or specialized devices through variable programmed motion for the performance of a variety of tasks." [2].

Based on the definition of robot by the two institute, it can be concluded that a robot must be an automatic machine and be able to deal with the changing information received from the environment.

Generally, robots have three main parts known as processor, sensor and motor control system. If robot is replaced by human sensor is represented eye, controller is represented brain and actuator is represented leg.

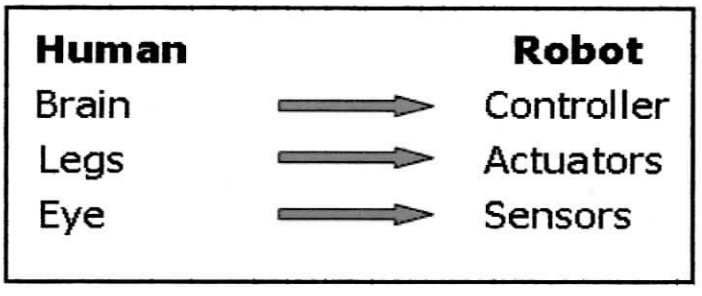

Figure 1.1 Robot Compared to Human

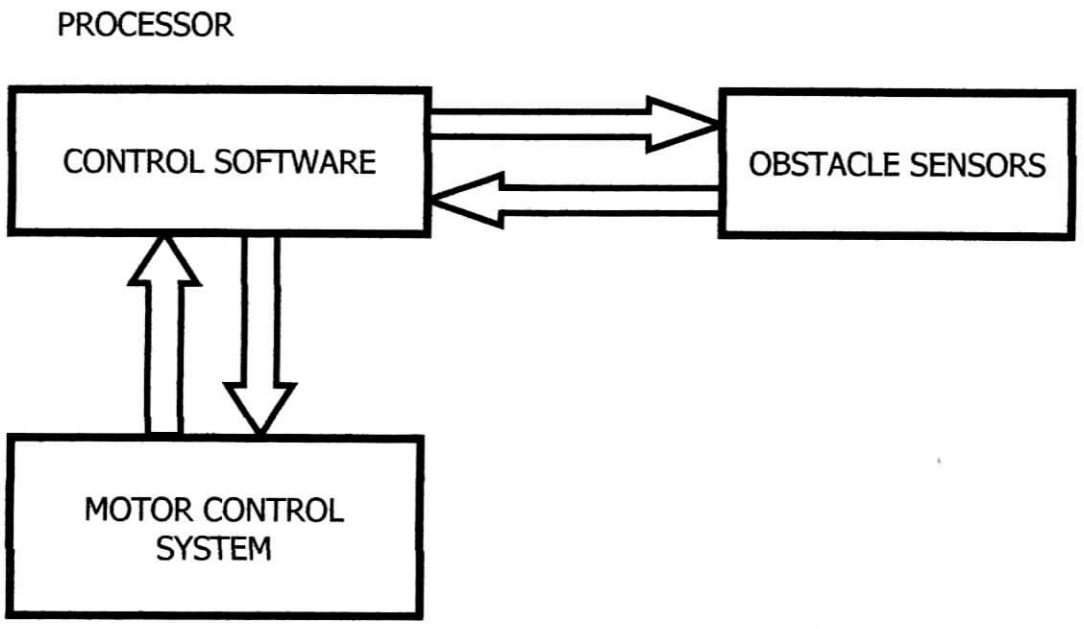

Figure 1.2: Basic Robot Block Diagram

Figure 1.2 shown a basic robot block diagram consist three main parts. A three main parts are sensor, processor and motor control system. Processor will send a message to sensors detect an obstacle. When sensor detected an obstacle it will send back a message to processor. Processor will give the instruction to motor for avoid an obstacles. After that, motor run forward.

1.1.2 Mobile Robot

Basically, robots can be classified in to two categories that are fixed robot and mobile robot. Fixed robot is a robot mounted on fixed surface and the working materials are brought to the work space. A mobile robot moves from one place to another to do their task. The mobility of a robot is the robot's capability to move from one place to another in unstructured environments to a desired target. [1]. Mobile robots may further categorize into wheeled, tracked or legged robot.

Mobile robots are mostly used in difficult task and dangerous environment such as bomb defusing. Besides that, mobile robots are also used in manufacturing area and agriculture related activity such as in placing the seeds in the soil and fruit harvesting. Mobile robots may be used in houses to take care for the elderly and doing household chores.

1.2 OBJECTIVE OF PROJECT

To built a prototype of mobile robot model-based on ultrasonic sensor, to generate collision-free motion. It should be detect obstacles before collision occurs. After that, the robot turns to the left or right.

The objectives of this project:

i) To study how obstacle detection mobile robot operation.
ii) To study the ultrasonic sensors and their operation procedure.
iii) To design complete set of mobile robot with obstacle detection.
iv) To understand the operation of DC motor.
v) To study about programming using PIC micro-controller.

1.3 SCOPES OF WORK

As we are concern with scopes of work while doing the project, so it must be create properly. There must be a guideline, in which the student should attain, but yet never go beyond is as to fulfill the requirement of the project. A Scope of work as listed below

- ❑ Identify the suitable PIC Microcontroller
- ❑ Develop an algorithms for robot movement
- ❑ Develop programming from source code
- ❑ Design the circuit for robot and ultrasonic sensor
- ❑ Transfer schematic & making PCB
- ❑ Make a prototype of obstacle avoidance mobile robot

1.4 PROBLEM STATEMENT

Nowadays, obstacles avoidance robots usually make collision with an object before turn around. The collision can damage the robot or component inside. So, to make sure the robot not damage because of collision, the ultrasonic sensor for obstacle detection can be performs.

Obstacle mobile robots may need to carry out missions in hazardous and/or populated environments. Example if we want to clean up a nuclear logy, we need the robot to check whether it thoroughly clean or not. Obstacle robot with nuclear detection sensor is needed to do this task. Besides, a typical application is to assist human beings in indoor environments, like offices, homes and other places or buildings.

1.5 REPORT STRUCTURE

In chapter 1, is discussed on the term robots. What is a robot? Types of robots that have been built and its usage. Why building a obstacle avoidance mobile robot?

This question will be discussed in details in this chapter. The objectives of project and a brief review on some of the robots built worldwide will also be presented in this chapter.

Chapter 2 is mentioned about literature review. When doing a project, literature review is important to choose the best microcontroller, motor and sensor. After is done, I decide to use PIC Microcontroller, DC Motor and Ultrasonic Sensor in my project. The reason why I choose all of them and the theory is discussed below.

In chapter 3, to complete the project prototype model, project methodology was an important part which it shows the work procedure. Project methodology will created to make the time table for the overall project flow jobs. Without this procedure, this project will not ending completely.

Methodology is divided in two parts, hardware development and software development. Basically, this chapter discuss on hardware development, which involves circuit design, circuit testing, troubleshooting and PCB fabrication. First of all, we take a look to the circuit explanation. For software development is discussed in chapter 4.

In chapter 4, discuss about the software used to write the program and the software used to program the PIC Microcontroller. Also discuss about software used to simulate a circuits and software used to design a circuits.

Chapter 5 is discussing about analysis and finding from the project. In this project major analysis is made on ultrasonic sensor and H-Bridge circuit.