DEVELOPMENT OF PING PONG BALL COLLECTOR ROBOT (SOFTWARE)

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ABSTRACT

This project is about designing and building an autonomous mobile robot that can detect ping pong ball, collect the ball, and avoid obstacles. Project required the use of PIC, infra red sensor, DC Motor and Servo Motor as basic hardware. The source code was written using C language. PIC 16F877A is used as the main controller for the robot. Infra red sensor is used for object detection. DC motor is used as wheel while servo motor is used to generate gripper movement. Program is developed using C language. This kind of project is barely developed by higher institution in Malaysia as the autonomous mobile robot field is not so popular yet in Malaysia compare to other developed country which their people take it as their hobby. Actually, this project gives the opportunity to those who involve in electronic field to apply their knowledge in electronic. Besides that, the latest technology of sensors can be learned and applied as sensor is the most important parts in the world of autonomous mobile robot.

ABSTRACT

This project is about designing and building an autonomous mobile robot that can detect ping pong ball, collect the ball, and avoid obstacles. Project required the use of PIC, infra red sensor, DC Motor and Servo Motor as basic hardware. The source code was written using C language. PIC 16F877A is used as the main controller for the robot. Infra red sensor is used for object detection. DC motor is used as wheel while servo motor is used to generate gripper movement. Program is developed using C language. This kind of project is barely developed by higher institution in Malaysia as the autonomous mobile robot field is not so popular yet in Malaysia compare to other developed country which their people take it as their hobby. Actually, this project gives the opportunity to those who involve in electronic field to apply their knowledge in electronic. Besides that, the latest technology of sensors can be learned and applied as sensor is the most important parts in the world of autonomous mobile robot.

ABSTRAK

Projek ini bertujuan untuk membina dan membangunkan robot bergerak automatic- Pemungut Bola Ping Pong yang bukan hanya berupaya mengesan dan memungut bola ping pong, tetapi juga mampu mengelak halangan. Projek ini menggunakan PIC 16F877A sebagai pengawal mikro, Infra Red sebagai pengesan objek dan halangan, motor DC sebagai penggerak roda, dan motor servo untuk menjana pergerakan pengepit. Aturcara dibangunkan dengan menggunakan bahasa C. Projek seumpama ini jarang dibangunkan di institusi pengajian tinggi di Malaysia kerana bidang robot bergerak automatik masih belum mendapat tempat di kalangan rakyat Malaysia berbanding rakyat di negara-negara maju lain di dunia yang menjadikan bidang robotik ini sebagai hobi mereka di waktu lapang. Projek seperti ini sebenarnya memberi ruang kepada semua terutamanya kepada mereka yang terlibat dalam bidang elektrik dan elektronik untuk mengaplikasikan pengetahuan dalam bidang ini. Selain itu, teknologi terkini berkaitan dengan *sensor* yang banyak diguna pakai dalam pembangunan robot-robot seperti ini dapat diaplikasikan seterusnya pengetahuan ini dapat dibawa dan digunakan ke dalam industri yang diketahui banyak mengaplikasikan penggunaan *sensor* .

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

1.1 Introduction Of Robots

A study of robotics does not cover just a single area of knowledge but it brings together systems from many different fields. Different technologies need to be learn to understand about robotics Reactive robots are electronically created moving objects which respond to their environment. Classes for a robot are very hard to define. The term is generally considered as an artificial item that responds in some physical way to the environment around it.

This chapter describes the origin of robotics by moving through to the more specific aspects which affect the project. This include a studying at existing literature on robots that collect items as well as looking into possible methods which could be used for a robot to collect ping-pong balls. As a basic for such operations, robots require means for identifying and operating on specific objects. Importantly, the robot must have knowledge of its approximate position with respect to the objects.

1.2 Existing Robot Collection

1.2.1 A Line Follower Robot - Jaseung Ku (17 Dec 2005)

Figure 1.0 shows the example of existing collection robot designed by Jaseung Ku. It is a simple line-follower robot designed to be able to follow a black line on the ground without getting off the line too much. The robot has two sensors installed underneath the front part of the body, and two DC motors drive wheels moving forward.

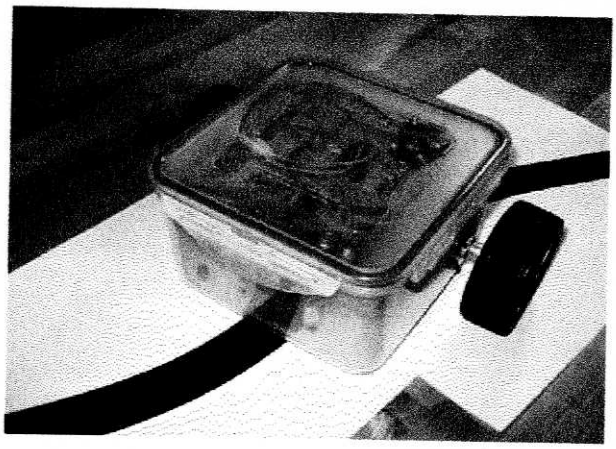

Figure 1.0: A Line-follower Robot

A circuit inside takes the input signal from two sensors and controls the speed of wheels' rotation. The sensors used for the project are the Reflective Object Sensors, 0PB710F. A light emitted from the diode is reflected off an object and back into the phototransistor. The output current is produced, depending on the amount of infrared light which triggers the base current of the phototransistor. In this case, the amount of light reflected off a black line is much less than the amount of light reflected by a white background. Somehow, it detects the black line by measuring the current which is converted to voltage.

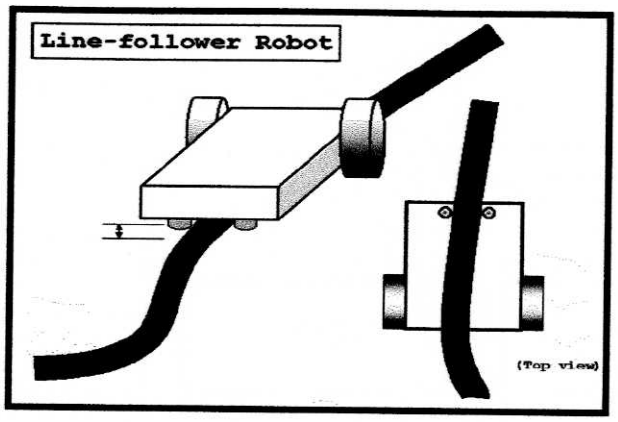

Figure 1.1: Method Use for A Line-follower Robot

The control is done in such a way that when a sensor senses a black line, the motor slows down or stops. Then the difference of rotation speed makes it possible to make turns depends on the situation. For instance, in the Figure 1.1, if the sensor somehow senses a black line, the wheel on the corresponding side slows down and makes a right turn.

1.3 Robot Details

The reactive robot that was designed is a ping pong ball collector robot. This project investigates an existing robot with the aim of designing and creating a robot that will be able to collect the ping pong balls. The aiming for the robot designing is to make a robot that able to perform object detection, obstacle avoidance, object location and object collection.

Designing the robot is one of the difficult things that appear in this project. Implementation of this project began with understanding the need of project requirement and searching related materials from books, journals and internet. Referring to the Figure 1.2, it shows the basic block diagram that was used to design the robot. The main part of the system consists of the input, controller and output.

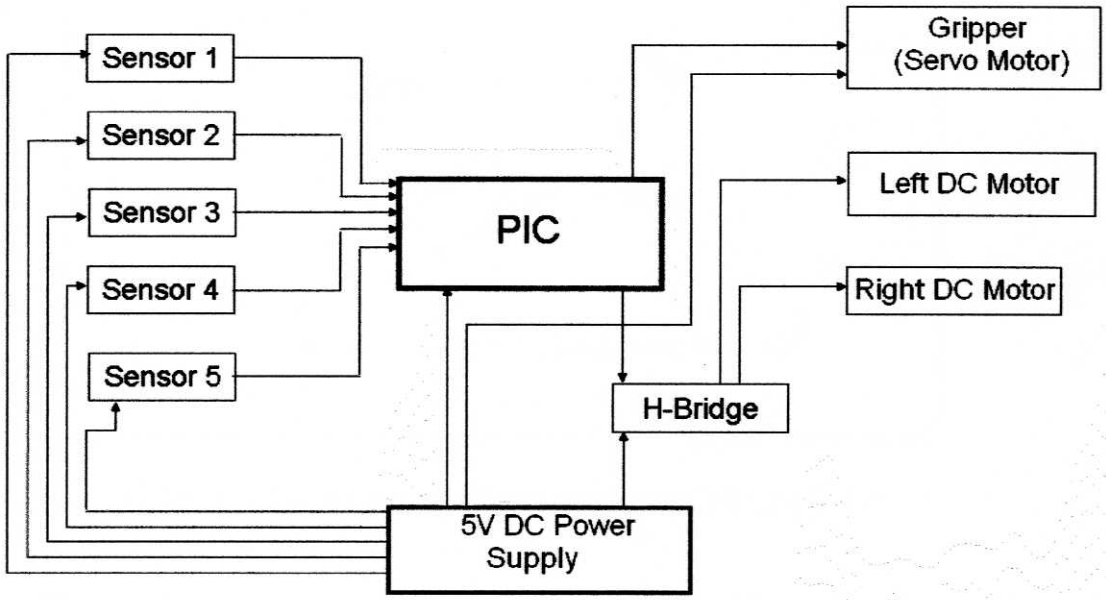

Figure 1.2: Block Diagram of Ping -Pong Ball Collector Robot

The most important thing is the robot need sensors, which act as the input. The main controller of this robot is the PIC 16F877A microcontroller, which can be programmed over a serial link. The PIC microcontroller is used to control the entire robot's system such the control of the robot motion, obstacle avoidance, ball collection and many more. In order to perform object collection, gripper is placed in front of the robot to make the collection process easier.

This robot used sensors for various task. The sensor is used to identify the objects; either the objects is the ping pong ball or not, and also to ensure the objects is the obstacle that should being avoid. When the sensor detects the ping pong ball, it will send the signal to the PIC controller to runs the process depends to the programs programmed in PIC. Then the PIC controller will send the signal to the output to move the wheel motor or gripper. A different process is used for the output when the robot detects obstacles.

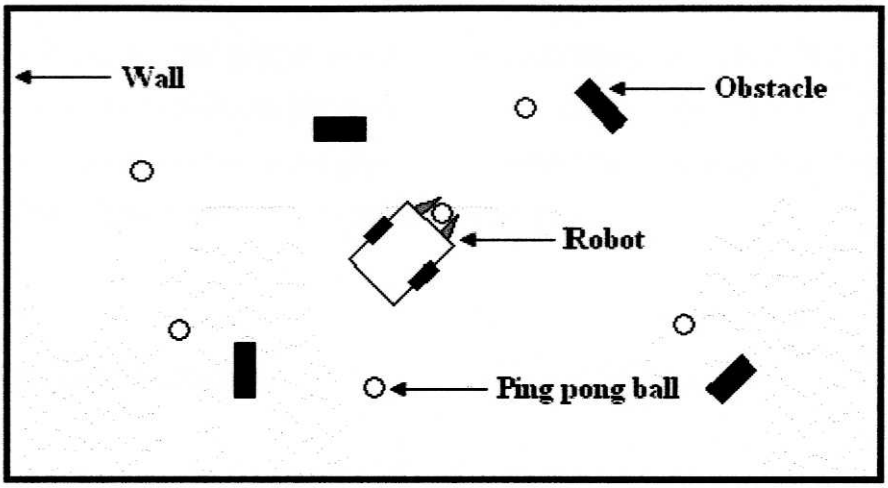

Figure 1.3: The Prototype of Ping-pong Ball Collector Robot

Figure 1.3 shows the drawing of the idea on robot navigator. The robot will be placed in an area that surrounded by wall. A pen is place in the middle of the robot body where the ball collected is stored. The robot will move in the limitation area until the sensor detects the ping pong ball. Then the PIC controller will control the robot and send the signal to DC motor to towards the ball. The gripper will collect the ping pong ball. The collected ball is keep inside the designated pen which is mounted on the robot's body.

1.4 Object Detecting And Object Avoidance

This project considers which possible sensors that can be use to detect ping-pong balls and avoid the obstacle. The sensor that had been chosen should be able to detect the ping pong balls and as the object avoidance. To implement this project, we are planning to use an infra-red distance sensor. Infra-red distance sensors are far more successful to use than others sensors. Therefore, the infra-red sensors will be used to perform the initial detection of the balls. To avoid obstacles and walls, an infra red sensor is used and will be placed at the right, left and front bumper of the robot.

1.5 Object Collection

In this project, the gripper is used to perform object collection. When the sensor detects the ping pong ball, the PIC controller will send the signal to move the motor to go near the ball and then move the gripper thus collect the ping pong ball. The gripper is placed in front of the robot, to make the collection easy.

1.6 Problem Statements

Nowadays, the technology in electronic field is expanding with the existing the variety of robots, which this robot helps to make the work easy for human in the world. So, more types of robot can be placed in UTeM's laboratory as teaching aided, like the Line Follower Robot. Line Follower Robot moves by following the line or track that has been setting.

From our observation and research that have been done on this robot, the main weakness that found is that the robot is unable to detect objects and avoid the obstacle. The robot for this project is designed to be able to detect the object, to collect the object and to avoid the obstacle. The ping pong ball is used as the object set.

1.7 Project Objectives

Based on the problem statements, the project objectives of this project is to design and build a robot that able to identify the object either the object is ping pong ball or not. This robot also should be able to avoid an obstacle and able to collect the ping pong ball. The statement below summarized the objectives of this project;

- To design and build a robot that will be able to recognize objects;
- To design and build a robot that will be able to differentiate between ping

pong ball and other objects

- To design and build a robot that will be able to avoid obstacles;
- To design and build a robot that will be able to collect ping pong ball autonomously.

1.8 Scope Of Work

To develop this project, the scope of work that have been studied includes the study of the PIC and its applications. A proper way to used the SourceBoost software to write the C language is also been studied. The other scope that is important to study and do the research is about the electronic circuit theory, sensor, servo motor, how to create the prototype of the robot, the idea of planning the motion of robot and design the mechanism to collect the ping pong ball. The study the sensors which to make the sensor to be able to differ the ping pong ball and other objects is also been studied.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature review of this project consist of the theory an application of the basic components that use to meet the objectives of this project. There have been many investigations in the field of robotics of the concept that were use in building mobile robot locomotion. These includes the mobile robot locomotion and the wheel positioning encoding, microcontroller, C programming, and language application software. All these aspects and component need to be understand thoroughly the specifications, technical data, theory and their function so they can be guidance in designing and developing the soccer robot's locomotion hardware and the control. This chapter describes the overall about the project theory and concept. It discuss about the perspective and method used in the past research and to see how far this project can be connected with the theory and experiment nowadays. Besides that, the theories are important to be understood because it is used as a guideline in solving problem and testing the project. Most of the theories are related to the software that is used in the project and others option that can be consider to be used for the project.

2.2 Microcontroller

A microcontroller is essentially inexpensive single-chip computer. Single chip means the entire computer system lies within the confines of a silver of silicon encapsulated inside the plastic housing of an integrated circuit. The microcontroller has features similar to those of standard personal computer. The microcontroller contains CPU (central processing unit), RAM (random access memory), ROM (read-only memory), I/O (input/output) lines, serial and parallel ports, timers and sometimes other built-in peripherals such as analog to digital (A/D) and digital-to-analog (D/A) converters. The key feature however is the microcontroller's capability of uploading, storing and running a program.

Being inexpensive single-chip computers, microcontrollers are easy to embed into larger electronic circuit designs. Their ability to store and run unique programs makes them extremely versatile. For instance, one can program a microcontroller to make decisions and performs functions based on situations (I/O line logic) and events. The math and logic functions allow the microcontroller mimic sophisticated logic and electronic circuits. Programs can also make the microcontroller behave as a neural network and/or fuzzy logic controller. Microcontrollers are incorporated in consumer electronic and are responsible for the intelligence in these smart electronic devices.

2.3 Programming

The general programming method for a robot is to give it an instruction. For example, tell the robot to move it's motors forward for two seconds. A turn for a two-motor robot would be activated by the instruction "left motor forward, right motor backward,' which would turn the robot to the right. In general terms, this is the way most of the robots will be programmed with increasing complexity as add sensors and conditional behaviors to the programs. Another programming method is the Teach mode. This method uses direct control of the robot (like a remote control car), but stores

the steps take in a program file. The robot then repeats the exact steps each time run the program. This is a good way to create a sophisticated movement program without having to figure out the steps and without the necessity of inputting program code.

2.4 Assembly language (ASM)

Assembly language is essentially the native language of the computer. Technically the processor of the machine understands machine code (consisting of ones and zeroes). But in order to write such a machine code program, we first write it in assembly language and then use an assembler to convert it to machine code. However nothing is lost when the assembler does its conversion, since assembly language simply consists of mnemonic codes which are easy to remember (they are similar to words in the English language), which stand for each of the different machine code instructions that the machine is capable of executing.

Assembly language is a human-readable text, and machine language is machine-readable binary code. When we program in assembly language, we are programming on the machine language level. The language closest to the PC hardware is machine language. Assembly language is used to write programs in terms of the basic operations of a processor. The architecture of a computer is a logical description of its components and its basic operations. In pure assembly language one assembly language statement corresponds to one basic operation of the processor. When a programmer writes in assembly language the programmer is asking for the basic operations of the processor. The architecture of the processor is visible in every statement of the program.

The architecture of a processor chip is a description of its basic components and of its basic operations. Each processor family has its own architecture. Assembly language is a programming view of the architecture of a particular processor. Each type of processor has its own assembly language.