DEVELOPMENT OF PING-PONG BALL COLLECTOR ROBOT (HARDWARE)

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This report is submitted in partial fulfillment of requirements for the award of Bachelor of Electronic Engineering (Industrial Electronics) with honours

Fakulti Kejuruteraan Elektronik & Kejuruteraan Komputer
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ABSTRACT

This project proposes to develop a ping pong ball collector robot. It is classified as autonomous robot because the robot works independently without needing any controlling or navigation. It depends on the programming that has been set in the microcontroller that used for the robot. The development of software and hardware for the robot is the important part in constructing the robot. This project required the use of PIC, infra red sensor, DC motor and servo motor as it basic hardware. The ping pong ball collector robot used PIC16F877 microcontroller that act as the brain for the robot. The servo motor is used to generate gripper movement while DC motor used for the wheels. The infra red sensor is used for detecting objects and ping pong ball. The software for this project is the use of C language programming. Both of the software and hardware is combined and perform its function depends to each other in completing the task. This kind of project which is barely developed by higher institution is not so popular yet in Malaysia compare to other developed country which their people take it as their hobby.

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ABSTRAK

Projek ini bertujuan membangunkan robot pemungut bola ping pong. Ia dikelaskan sebagai robot autonomous kerana robot ini berfungsi secara sendiri tanpa memerlukan pengawalan dari sesiapa. Ia hanya bergantung kepada pengaturcaraan yang telah ditetapkan di dalam mikrokawalan yang digunakan untuk robot tersebut. Pembangunan bagi perisian dan juga perkakasan adalah bahagian yang penting untuk menghasilkan robot tersebut. Projek ini menggunakan PIC, pengesan infra merah, motor DC dan motor servo sebagai perkakasan asas. Robot pemungut bola ping pong ini menggunakan pengawalmikro PIC16F877 yang berfungsi sebagai 'otak' untuk robot tersebut. Motor servo digunakan untuk menjana pergerakan pengepit manakala motor DC digunakan untuk menggerakkan roda. Pengesan infra merah pula digunakan untuk mengesan objek dan juga bola ping pong. Sementara itu pula, bahagian penting yang terdapat didalam bahagian perisian ialah penggunaan pengaturcaraan C untuk robot tersebut. Kedua-dua perisian dan perkakasan ini digabungkan dan berfungsi, bergantung antara satu sama lain untuk melaksanakan tugasan yang diberikan. Projek seumpama ini jarang dibangunkan di institusi pengajian tinggi di Malaysia kerana bidang ini 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.

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LIST OF ABBREVIATIONS

PIC	-	Peripheral Interface Controller
PWM	-	Pulse Width Modulation
PCB	-	Printed Circuit Board
LED	-	Light Emitting Diode
DC	-	Direct Current
RC	-	Remote Control
MOSFET	-	Metal-Oxide Semiconductor Field Effect Transistor
MCU	-	Micro Controller Unit
SLA	-	Sealed Lead Acid
NiCad	-	Nickel Cadmium
NiMH	-	Nickel Metal Hydride

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CHAPTER I

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.

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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.

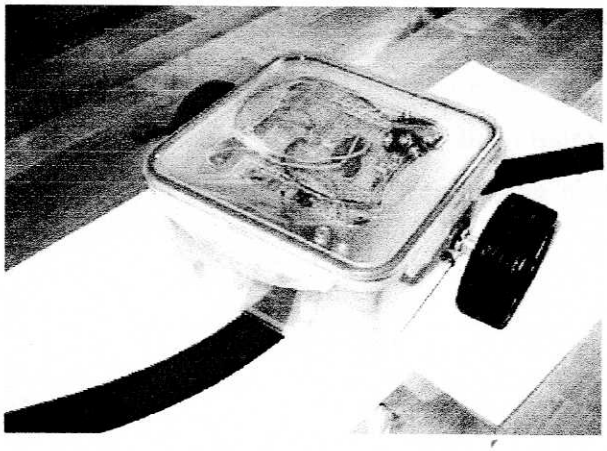

Figure 1.0: A Line-follower Robot

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.

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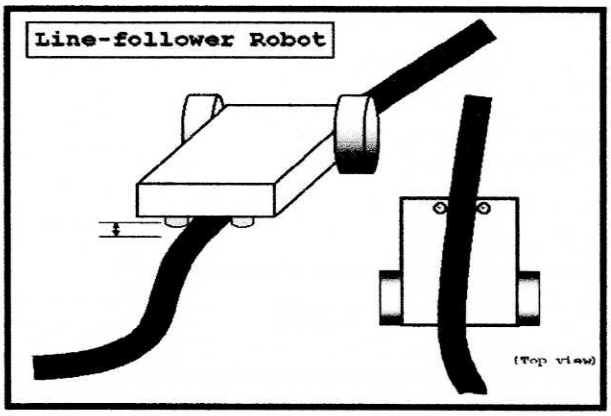

Figure 1.1: Method Use for A Line-follower Robot

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.

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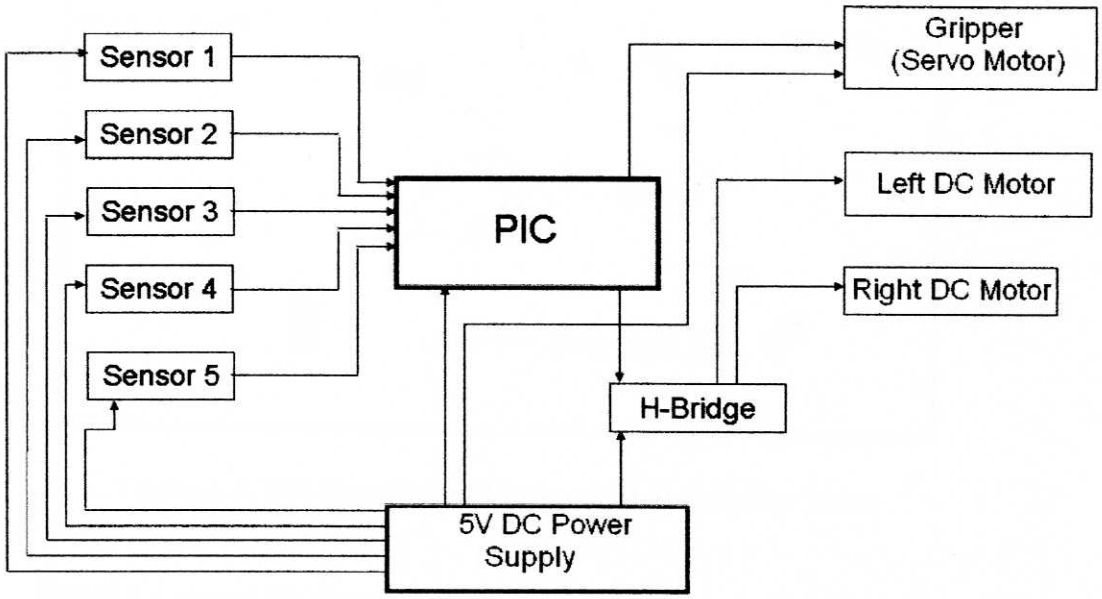

Figure 1.2: Block Diagram of Ping -Pong Ball Collector Robot

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.

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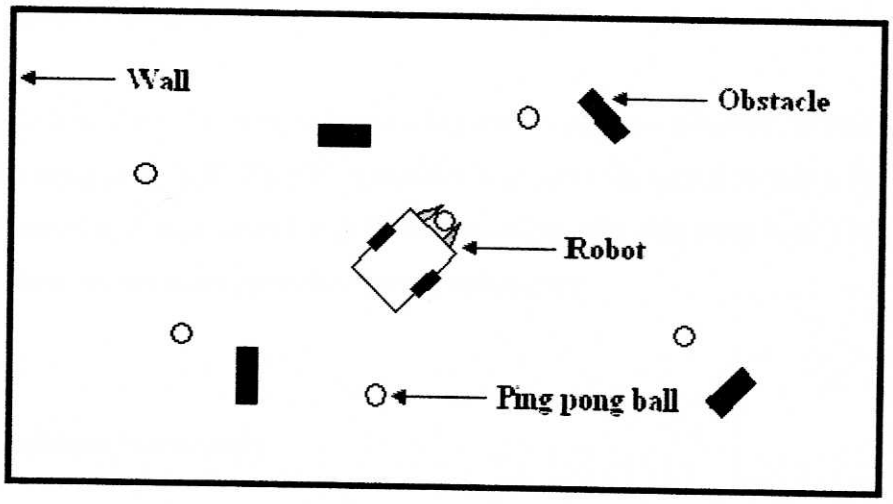

Figure 1.3: The Prototype of Ping-pong Ball Collector Robot

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.

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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.

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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 has 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.

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