MOBILE ROBOT (LINE FOLLOWING ROBOT)

TENGKU MUSTAQIM BIN TENGKU MUHAMMAD DAUD

OCTOBER 2009

"I hereby declared that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor In Electrical Engineering (Control, Instrumentation and Automation)"

Signature : 

Supervisor's Name : AHMAD AIZAN B. ZULKEFLE

Date : 18/11/09

DESIGN A MOBILE ROBOT
(LINE FOLLOWING ROBOT)

TENGKU MUSTAQIM BIN TENGKU MUHAMMAD DAUD

This Report Is Submitted In Partial of Requirement for
Degree of Bachelor in Electrical Engineering
(Control, Instrumentation and Automation)

Faculty of Electrical Engineering
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OCTOBER 2009

"I hereby that this report is a result of my own work except for the except that have been cited clearly in the references"

Signature : 

Name : TENGKU MUSTAQIM BIN TENGKU MUHAMMAD DAUD

Date : 30 OCTOBER 2009

I dedicate this to my parent, my lovely family, my friend and electrical engineering education.

ACKNOWLEDGEMENT

Thanks God because gives me spirits and confidences in completing the whole project within the correct time. Throughout my project session, I have been guided by my supervisor and my entire colleague.

Here I would like to take this opportunity to express my deepest gratitude to my supervisor En Ahmad Aizan bin Zulkefle for guiding and imparting her knowledge in every sector of my final project.

I also would like to thanks to UTeM especially for Faculty of Electrical Engineering, for giving me changes to be creative and innovative in electrical engineering. With these opportunities, I got clear understanding in electrical concept and learn how to think and build new equipment. Consequently, I would like to thank all individual who make sure this project is success.

ABSTRACT

The main purpose of doing this project is to apply micro technologies to other operational technologies which is can work independently. Mobile robot are autonomous machines that are capable of movement in a given or situation environment, in which can perform in many situation. This robot will move base on a line tracking such as black line to move from point to another point. The main part of this robot is infrared sensor, servo motor and PIC microcontroller. This robot will be program to sense the black line and send the signal to the microcontroller to analyze it. The system will active and the motor will start depend on the signal from microcontroller. The microcontroller will be used as a brain of this robot. Another purpose this mobile robot is designed as a prototype model for educational learning at FKE (Lab Electronic). This robot will be developed in small and portable size.

ABSTRAK

Tujuan utama projek ini adalah untuk mengaplikasi teknologi-teknologi mikro untuk teknologi-teknologi operasi lain yang boleh boleh bekerja secara bebas. Robot mudah alih adalah mesin-mesin berautonomi yang adalah mampu berkerja dalam satu kecenderungan atau keadaan persekitaran, di mana ia boleh membuat pekerjaan yang banyak dalam keadaan yang complex. Robot ini akan bergerak berpandukan satu laluan garis seperti garis hitam untuk bergerak daripada titik ke titik lain. Bahagian utama robot ini adalah penderia inframerah, motor servo dan mikropengawal PIC. Robot ini akan menjadi mengesan garis hitam dan menghantar isyarat untuk mikropengawal bagi menganalisis isyarat yang dihantar oleh penderia inframerah . Sistem itu akan aktif dan motor itu akan bermula bekerja bergantung isyarat daripada mikropengawal. Mikropengawal itu akan digunakan sebagai otak robot ini. Satu lagi tujuan robot mudah alih ini adalah direka sebagai suatu model prototaip untuk pengajian pendidikan di FKE (Makmal Elektronik). Robot ini akan dibangunkan dalam saiz kecil dan mudah alih.

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CHAPTER I

INTRODUCTION

This chapter consists of explanations about the basic things about the project. It will discuss about the project objective, problem statement, scope, and thesis structure in order to complete the project.

1.1 Introduction

Robot is a mechanical or virtual, artificial agent. Usually, it a system because its appearance or the movements, conveys a sense that it has intent or agency of its own. Basically, the word robot can refer to both physical robots and virtual software agents, but the latter are usually referred to as bots to differentiate.

Today, there are still discussions about which machines are qualified as robots. Several typical robot will have even though not necessarily all the properties which is it's not 'natural' because it's artificially created by human. It also can sense its environment, and manipulate, or interact the things in it. Robot also has some ability to make a choices based on the environment where it usually using automatic control or a preprogrammed sequence by using the control software. It's programmable, can moves with one or more axes of rotation or translation, makes dexterous coordinated movements, and appears to have intent or agency.

In industry, there are 90% of all robots used and can be found in factories and they are known as industrial robots. These robots are very useful to industry and factory because of a variety of reasons. Installing robots is often way business owners can be more competitive, because robots can do a job or tasks more efficiently than human. The reasons are:

- Robots never get sick and never need to rest
- Can work 24 hours a day and 7 days a week
- Can do a dangerous task that human cannot do because of the risk
- Robot do not get bored
- It work repetitive
- Unrewarding

Mobile robot is another type of robot that we can see today and it's different to industrial robot. Mobile robots have the capability to move around in their environment and are not fixed to one physical location. Different with industrial robots, where it usually consist of a jointed arm which is multi-linked manipulator and gripper assembly or end effectors that are attached to a fixed surface.

The purpose of mobile robots is the focus of a great deal of current research. Now, almost every major university has one or more labs that focus on mobile robot research. Mobile robots are also can be found in industry, military and security environments. They also appear as consumer products, for entertainment or to perform certain tasks like vacuum. It will make our life easier and help the people who busy with their work everyday.

Introduction to the project

This project is about to develop a mobile robot which is the line following. It has four pair's infrared sensors to move and use the servomotor to control the wheel movement and PIC16F877A for its brain. Beside that, this robot also will use LCD to show the description of the robot when it start 'on'.

For the basic movement, this robot will move forward first and it will follow the black line. Infrared sensor will sense and send the signal to the PIC. The PIC automatically will change the signals and send it to servomotor in order to change the robot directions and movement.

1.2 Project Overview

This project will apply the micro technologies to another operational technology. This project overview also is to develop an autonomous robot which can perform any tasks in unstructured environment without continuous human guide.

This project is about to design and develop a power circuit, motor controller circuit (PIC circuit) for the robot movement, and sensor circuit. This robot will use a infrared led as a sensor or antenna in order to sense any the black line. Firstly, this robot will move base of line tracking with the infra red sensor (reflective sensor) which will detect black line on the white floor.

In this project, it will use PIC16F877A as the robot brain. It will control all the movement, behaviors, and make a decision where the robots need to move. This PIC will receive any signal from the sensors and will operate to change the signal before it sends it back to the servomotor.

MikroC software will be use in order to build and to program this robot. After that, this Hex Code will be burned to the PIC and this PIC will be assembled with the control circuit. This programmed will use the high level language which is C language. Before that, we will run the simulation for this circuit by using the Proteus 7 Professional in order to make sure the circuit function with perfectly.

1.3 Problem Statement

Today, there are many type of mobile robot that can be found in the market. But the current prices are too expensive for the user to buy it especially for the students which have limited money. This is because current robots use too many servomotors in order to move. For example, in order to create the movement which is required the Degree of Freedom (DOF) for one leg, it necessary to use two servomotors. Therefore, this robot will use 12 or more servomotor and the price for this servomotor is not cheap. The programming will be more difficult and hard because there are 12 or more servomotors that must be control by the PIC. Beside that, current mobile robots are move too fast and hard to control it. It will be hard to troubleshoot or to read the sequence of the robot movement. This robot also moves randomly without any specific directions.

1.4 Project Objective

There are many objective of doing this project. In order to determine the purpose and the direction of this project, there are only one objective which is the main objective that needs to be accomplished in order to develop a small mobile robot which can change it direction automatically by using PIC16F877A as its brain and servomotor for its movement.

This project also aims to achieve the following objectives:

- To study PIC microcontroller
- To design a mobile robot
- To design power circuit and control circuit
- To design a prototype mobile robot for faculty lab

1.5 Scope of Project

The purpose of the scope project is as a guideline in order to achieve the objective. Therefore there are several scopes of project that we need to focus on:

- To construct a mobile robot which can move specific direction
- To construct a robot that can change it direction automatically(turn path)
- To construct small and cheap robot
- To study how the robot programming operates
- PIC16F877A as the robot brain

1.6 Thesis Structure

Chapter 1

- Introduction on robotic and line following mobile robot. It explained the problem statement, objectives, and scope of the project

Chapter 2

- Chapter 2 covered project's literature reviews based on the research conducted towards the development of this project.
- Different system and robots have been introduced which is some are using different type of PIC, more servomotors, and different sensors type.

Chapter 3

- Chapter 3 covered project's methodology in order to make sure the project follow the way had been plan.
- This chapter explains about general approach, literature review, software design, hardware design, and finalizing.

CHAPTER II

LITERATURE REVIEW

This chapter consists of explanations and reviews of the past projects and the robots in market that had been done before. It is consists of the products in the market today. Besides that, this chapter also consists about the theory of main components, equipments, and programming languages that will be use in this project.

2.1 First Review: Rollie

Rollie's primary mission is to move forward and avoid obstacles, find people and move toward them. A blue LED flashes and a beeper sounds at different times to alert people of its presence. If Rollie cannot find obstacles, people or the IR beacon, the robot will power down to "watch dog mode" and wait for stimulus. ROLLIE has only two wheels to roll on; each wheel is a pair of CD discs with a foam center. The foam center conforms to the surface and helps provide traction with the floor. The robot's battery pack is toward the bottom and lowers its center of balance. Rollie can move forward, backward, stop and turn upon its center. A 16F84 PIC microcontroller from Microchip, running at 20 Mhz is the brain for the robot. Programming can be downloaded "in circuit" using a serial link with a PC. Rollie is programmed in Basic using Pic Basic Pro(c) from MicroEngineering Labs. Each wheel is driven by a servo modified for continuous rotation. The servos can be completely powered down using a Mosfet as a

switch under software control. This conserves considerable power. IR emitting LEDs are pulsed at 38kc and integrated circuit receiver modules tuned to this frequency, are used to detect and avoid obstacles with very little interference from other light sources. A separate 38kc receiver is used to receive command instructions and detect an IR beacon for location purposes. To prevent interference from the IR emitting LEDs, the 38kc receiver is read between avoidance routines. A heat sensing PIR (Passive InfraRed) motion sensor is used to detect people or hot objects. Four "AA" alkaline (Rayovactm) rechargeable cells provide power for about 2 hours before recharging is necessary. Rollie's autonomous behavior can be interrupted using a specially made IR remote control to help guide the robot out of dangerous situations. An on-board mode switch can cycle the robot through different behaviors.

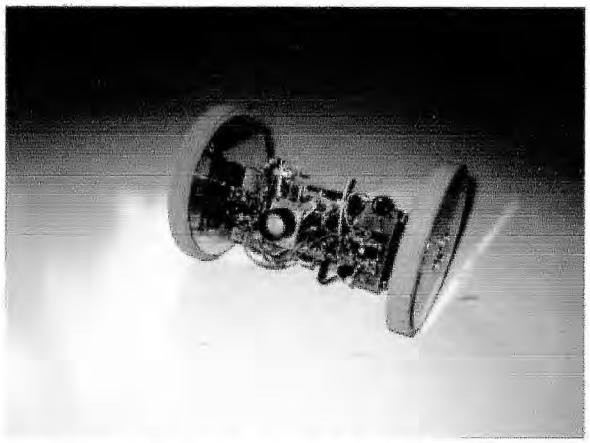

Figure 2.1(a): Overall View of Rollie

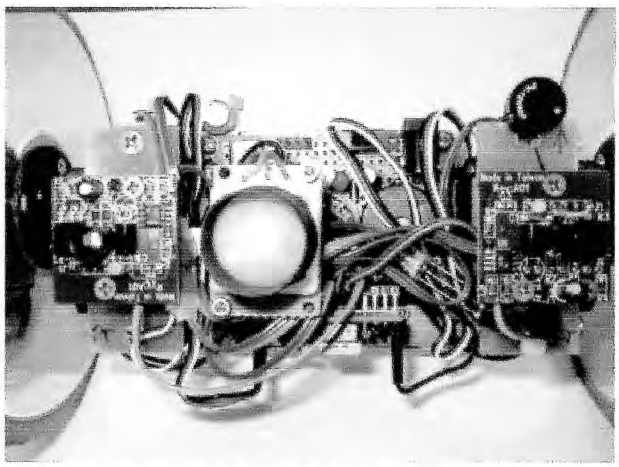

Figure 2.1(b): Front View showing Heat Sensor, IR avoidance module and Beeper

2.2 Second Review: JavaBot1

The JavaBot1 is a small line following robot designed to follow a black line drawn on a dry erase board. It is designed to follow very tight curves. The JavaBot1 uses 2 Cirrus CS-70 servos that have been modified for full rotation and have had their controller boards removed to convert them from servos to gear motors. Servos are a common motive power for small robots due to their low cost, ready availability, standardized sizes and the fact that it only requires 1 bit on your processor to control the motor. The servo controller boards were then removed and the wires soldered to the motor terminals and case ground. The motors were then controlled by an H-bridge circuit to allow direction and speed control with only 2 processor bits per motor. This is implemented as one bit for direction and another bit for power/speed control per motor.

In order to follow the line I/R reflective sensors were used to detect if a line was present or not. The sensors chosen are the QRB1114 from QT Optoelectronics and have a focal point of about 1/4 inch. An array of seven sensors arranged in an "inverted V " pattern are bolted under the front of the robot The sensors are wired with all the receivers connected in parallel and fed to an LM311 comparator to set the threshold trigger level with it's output fed to a processor bit. The transmitter LEDs are connected to a 74HCT138 with a current limiting resistor to VCC. This allows the entire array to use 4 bits for the sensors.

The PIC16F84 was chosen for its small size, easy reprogram ability and interrupts (the fact that we manufacture a PIC processor emulator also helped in this decision). It is clocked at 4 MHZ by a ceramic resonator and is powered by 4 AA rechargeable batteries.

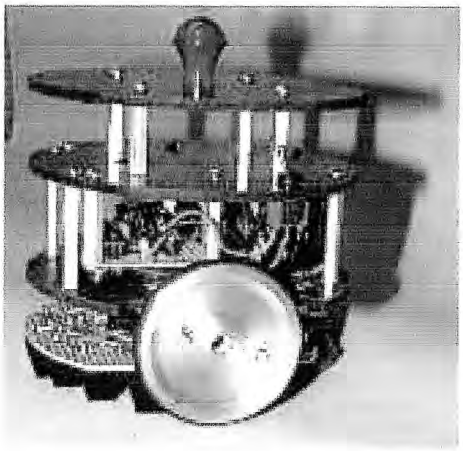

Figure 2.2: JavaBot1

2.3 Third Review: Robot 877

The other review is about the Futurlec Robot 877 which has is an exciting, easy to use and fully programmable robot. Based on the very popular PIC16F877 microcontroller from Microchip, this robot can be programmed to perform a number of instructions. A series of micro switches are used for collision detection, together with a couple of dc motors to control robot movement. A row of optical sensors are mounted on the base for tracking operations.

The board is provision for a DS1307 Real Time Clock, EEPROM's, and low voltage circuit cut-out. The robot is completely mobile with an on-board large rechargeable battery included for long life. The robot is based on a solid anodized aluminums base, designed for strength and light weight. This reduces power drain on the battery and ensures the robot can withstand tough knocks combined with collisions.

With the port connections and analog input connections, brought out to standardized polarized connectors. Add a voice, distance measuring, infrared sensing to your robot, the possibilities are endless. Robot 877 is an ideal learning tool for robotics combined with microcontroller programming. The robot is ideal to use as a teaching tool

in schools, colleges and universities, together with providing endless hours of fun in the home.

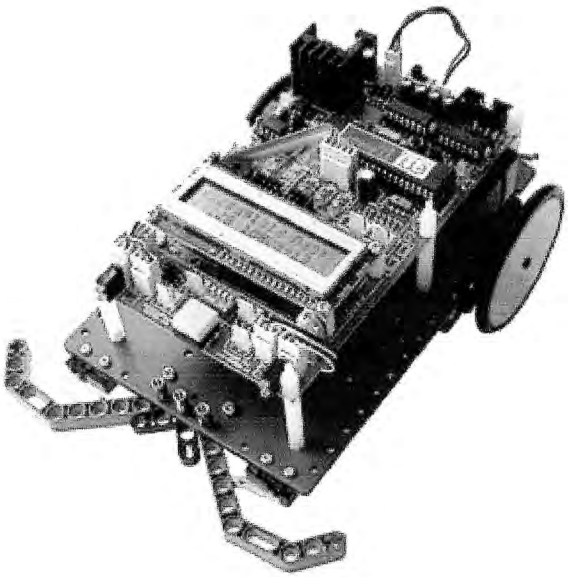

Figure 2.3: Robot 877

2.4 Fourth Review: BADlam (Line Following Robot without Microcontroller).

This robot design is to use a comparator circuit and IR reflective sensors. It use power a pair of AA batteries, so everything had to work with only 3 volts of power. The overall size of the bot is 5" wide including wheels and 5" long. This line follower only works with white lines on a dark background. The circuit could easily be modified to allow selecting between white or black lines. The "gear eyes" actually serve a purpose; they are counter balance for the batteries on the back. The weight of batteries made the front end too light. It works with polystyrene plastic. It's light, strong, easy to cut and easy to join.

The drive train was taken from a mechanical wall-following mouse. It uses a worm drive that minimizes the number of gears needed. The mouse used a single C cell