SOCCER ROBOT: ROBOT DEVELOPMENT

SUPARDI BIN DAWING

This Report Is Submitted In Partial Fulfillment of Requirements for the Bachelor of Electronic Engineering (Industrial Electronics) with honours.

Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka

April 2007

UNIVERSTI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek	:	Soccer Robot
Sesi Pengajian	:	2006-2007

Saya SUPARDI BIN DAWING

mengaku membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (√) :

☐	**SULIT***	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	**TERHAD***	(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑	**TIDAK TERHAD**	

Disahkan oleh:

(TANDATANGAN PENULIS)

Alamat Tetap: 46 2 3 Sri Ayu Apartment, jln 14/55
Taman Setiawangsa 54300, Kuala Lumpur.

(COP DAN TANDATANGAN PENYELIA)

NURULFAJAR B ABD MANAP
Pensyarah
Fakulti Kej Elektronik dan Kej Komputer (FKEKK)
Universiti Teknikal Malaysia Melaka (UTeM),
Karung Berkunci 1200,
Ayer Keroh, 75450 Melaka

Tarikh: 4/5/07

Tarikh: 4/05/07

"I hereby declare that this report is the result of my own work except for quotes as cited in the references."

Signature : .....

Author Name : SUPARDI BIN DAWING

Date : 04 MAY 2007

"I hereby declare that I have read this report and in my opinion this report is sufficient in terms of scope and quality for the award of Bachelor of Electronic Engineering (Industrial Electronics) with honours."

Signature : .....

Supervisor's Name : En. NURUL FAJAR B.

Date : 4/05/07

I dedicated this to both of my parents, my family, friends and electronic engineering education. Thanks for everything. Your deed will be remembered till my last breath.

ACKNOWLEDGEMENT

Special thanks to my supervisor, En. Nurulfajar Bin Abdul Manap for his support, idea, knowledge and sharing his experience to fulfill the objective of this final year project. With his support I gain knowledge from this project. I have learned a lot of project management skill which include the time and cost effective to realize the project.

Also thanks to my project group members, for spending times helping me to realize the project.

Also thanks to my friend for spending their time teaching me about the programming, which seems to be very difficult for me to understand before. Million thanks to all of my friends that giving me so much supports to accomplished this project.

Thank you.

ABSTRACT

This project was purposed to develop a set of soccer robot consisting of two players for each two teams. The robots are controlled by wireless controller through radio frequency (RF). The robots can moved forward, backward, left, right and 360-degree turns. Each robot is equipped with RF receiver so that the movements can be controlled from the wireless controller that equipped with RF transmitter. The robot system is built from PIC as the controller for the whole system. In order to accomplish the project, several methods have been taken starting from gathering all information about the mobile robot, designed and tested the hardware and software for the robot, develop the software and hardware and combining both software and hardware. The software for the project consists of developing a programming to control the movements of the robot. The hardware part consists of the motor driver circuit and robot body. By the end of the project, a set of robot to play soccer is developed. The robots movements system is controlled by PIC.

ABSTRAK

Projek ini adalah bertujuan untuk membangunkan satu set robot untuk bermain bola sepak yang mengandungi dua robot pemain untuk setiap dua pasukan. Robot-robot ini dikawal dengan pengawal tanpa wayar melalui radio frekuensi (RF). Robot- robot ini boleh bergerak ke hadapan, ke kiri, ke kanan dan membuat pusingan 360 darjah. Setiap robot dilengkapi dengan penerima RF supaya pergerakan robot dapat dikawal melalui pengawal tanpa wayar yang dilengkapi dengan pemancar RF. Keseluruhan sistem robot ini dikawal melalui PIC. Untuk melaksanakan projek ini, beberapa cara dan pendekatan telah diambil bermula dengan mengumpul semua maklumat yang berkaitan dengan robot mobil, mereka serta menguji bahagian struktur mekanikal dan perisian, seterusnya membangunkan bahagian-bahagian tersebut. Bahagian perisian melibatkan pembinaan program untuk mengawal pergerakan robot. Bahagian struktur mekanikal melibatkan pembinaan litar kawalan motor dan bahagian badan robot. Di akhir projek ini, satu set robot untuk bermain bola sepak dibangunkan di mana system pergerakan robot akan dikawal melalui PIC.

TABLE OF CONTENTS

TABLE LIST

FIGURE LIST

APPENDICES LIST

CHAPTER I

INTRODUCTION

1.1 Project Background

A robot is comprised of mechanical, electronic, electrical and sensory system [1]. The mechanical system of a robot incorporates mechanisms for locomotion and physical support structure. Motors and drive train composed of gears, shaft and hubs provides support for all system components [2]. An electronic system is implemented to control the mechanical system and the motion of the robot [3].

The project purposed was to develop a set of soccer robot consisting of two players for each two teams. The robots are controlled by wireless controller through radio frequency (RF). Each robot is equipped with a receiver and it will receive signal from the transmitter at the controller. Two controllers are used to control the robots. One controller controlled a team which means each controller controls two robots but only one robot at a time. The robots are controlled to move forward, left, right and 360-degree turn. The robots' motor drive system is controlled by PIC. The signal will be transmitted from the controller transmitter to the receiver of the robot. The receiver is connected to the PIC. The PIC is programmed to respond to the signal that is received

from the transmitter. The microcontroller programming determine the robot movements by referring to the signal that is received at the receiver.

1.2 Objectives

Project Objectives:

1. To develop and design a set of robot to play soccer by using PIC.
2. To develop and design robots that can move forward, backward, left, right and 360-degree turn.

1.3 Scopes of Project

The scope of this project is concentrated on the material (hardware and programming) decision and specification including designing method such as circuit, programming and robot chassis for the locomotion hardware and control. In this project, four units' soccer robots will be developed and it will be separated into two teams. Each controller can control two units of robot, but it can only control one robot at a time.

The project scope covers the selection of suitable motors by gathering their information, concept and principle. For this project, DC motor has been chosen as the drive train for the robot movement. The DC motors will connect to the microcontroller which is PIC16F84A. Then a program is developed for each direction that has been decided by using language application software.

1.4 Problem Statements

Most of the soccer robot is autonomous or semi-autonomous [4]. It is less fun because it moves by itself. Besides that, certain soccer robots are using more than two wheels. This causes the robot to take a long time in doing rotation movements. Problems often occur in wired robot due to broken wires, difficulties in system placement and movement poor adaptation [5].

Wired remote control or tethered control can be the right way to interface a computer with a stationary robot [6]. For mobile robots, the cable can become a burden to the robot. Furthermore, the electric signal transferred over a wire loses energy because of the wire's resistances. The result is that the amplitude of the signal decreases as distance increases.

Reflection also can be a problem when the data rate is high. This means a previous signal doesn't disappear before the next is transmitted. This is why transmission lives are 'terminated' with a resistor to ground.

Mechanical issues with cables also become problems to wired robot. Cables have fixed number of wires in them, so if we need more cables, we have to replace the whole cable, which can be very time consuming. Cables also have certain stiffness. The thicker the cable, the more force we need to apply to bend the cable. Another problem with wired robot is the cables have weight. This makes it hard for smaller robots to drag around. A part from that, the cable can get in the way of the robot. So, this project proposes a wireless system soccer robot where all wires and cables can be eliminated.

1.5 CHAPTER SUMMARY

CHAPTER I will describe the definition of this project will be explained in this chapter. Also in this chapter there will be summary the project progress.

CHAPTER II will discuss about research and information which are related to this project. Every fact and information are gained from different references will be discussed so that the best technique and method can be implemented on this project.

CHAPTER III will be describing how this project is separated to small partition. The elements which are used to build each circuit are described by concept and theory. Plus, figures are provided to ensure the understanding.

CHAPTER IV is describing about the project result and outcome discovery. The project outcome discovery will be presented from the many data analysis results.

The final chapter, CHAPTER V will be explaining about the conclusion of the whole project which includes project finding, achievement analysis and conclusion about the research implementation which have been used. The project suggestion for enhancement also discussed.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

The literature review of this project consists of the theory and application of the basic components that are used to meet the objective of this project. There have been many investigations in the field of robotics of the concept that were used in building mobile robot locomotion. These includes the DC motor concept, mobile robot locomotion and the wheel positioning encoding, microcontroller, C programming, and language application software. All these aspects, components, specifications, technical data, theory and their functions need to be understood thoroughly as guidance in designing and developing the soccer robot's locomotion hardware and the control.

2.2 Basic Mobile Robot Development Concept

The review is based on what is usually needed when developing a mobile robot. Firstly, the physical design of the robot always focuses on how many wheels that is

needed. Next is focusing on what objective is required by the mobile robot. Then, a block diagram of the whole system can be sketched out to plan the whole robot system. Therefore, how many input and output system of the robot will be used can be known from the plan. Next is to determine how each input and output will interact with each other by using microcontroller or programmable PIC. Then, the component that will be used such as DC motor, transmitter, receiver and PIC circuit are defined.

Most of the article review on the drive system of the robots states that most robots come from many categories such as two wheeled, four wheeled and others. From this review, it helps to choose the suitable drive trains for the robots.

2.3 Microcontroller

A microcontroller is essentially an inexpensive single-chip computer [6]. Single chip means the entire computer system lies within the confines of a silver 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 [6].

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.

There are several microcontrollers that exist nowadays. The STAMP microcontroller only has a single byte PORT. It has eight pins which may be reconfigured to be outputs or inputs. By changing the number of visible pins, any combination of input and output pins can be obtained, up to a maximum of eight. Generic microcontroller does not exist in reality but demonstrates the theory and practice of microcontrollers. It has eight digital input pins, eight analog input pins and sixteen digital output pins. PIC microcontroller is a family of Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division.

PIC are popular with developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability.

2.4 PIC16F84A

The PIC16F84A is a high-performance, low-cost, CMOS, fully-static 8-bit microcontroller with 1K x 14 EEPROM program memory and 64 bytes of EEPROM data memory. It is the second member of an enhanced family of PIC16CXX microcontrollers.

Its high performance is due to instructions that are all in single word (14-bit wide), which execute in single cycle (400 ns at 10MHz clock) except for program-branches which take tow cycles (800ns). The PIC16C84 has four interrupt sources and an eight level hardware stack. The peripherals include an 8-bit timer/counter with an 8- bit prescaler (effectively a 16 bit timer) and 13 bi- directional I/O pins. The high current drive (25 mA max. sink, 20 mA max source) of the I/O pins help reduce external drivers and therefore, system cost. The PIC16C84 product is supported by an assembler, an in-circuit emulator and a production quality programmer. These tools are supported on the IBM PC and compatible machines.

2.4.1 Peripheral Features

- 13 I/O pins with individual direction control
- High current sink/source for direct LED drive 25 mA sink max. per pin
- 20 mA source max. per pin
- 8-bit real time clock/counter (RTCC) with 8-bit programmable prescaler
- Special Microcontroller Features
  - Power-on reset
  - Power up timer
  - Oscillator start-up timer
  - Watchdog timer (WDT) with its own on-chip RC oscillator for reliable operation
  - Security EPROM fuse for code-protection
  - Power saving SLEEP mode
  - User selectable oscillator options:
    - RC oscillator: RC
    - Crystal/resonator: XT
    - High speed crystal/resonator: HS
    - Power saving low frequency crystal: LP
  - Serial, In-System Programming (ISP) of EPROM program memory using only two pins

2.4.2 Pin Diagram of PIC16F84A

The 18-pin 16F84 chip devotes 13 of its pins to I/O. Each pin may be independently programmed as an input or output. The pin's status (I/O direction control) may also be changed on the fly via programming. Other features include power on reset, power-saving sleep mode, power-up timer and code protection. Figure 2.1 shows the pin diagram of PIC 16F84A

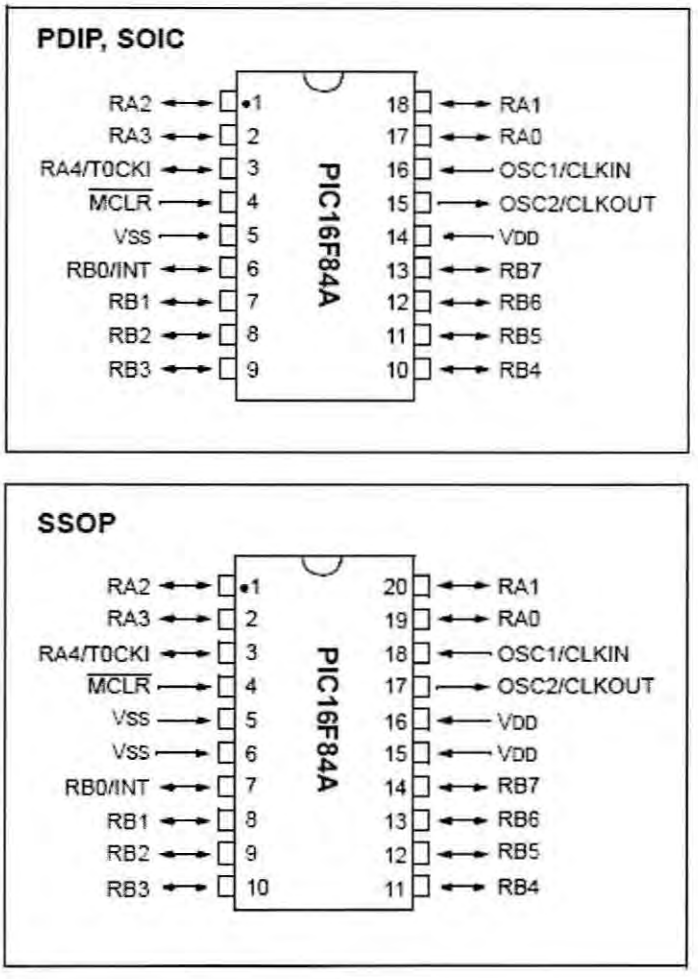

Figure 2.1: Pin Diagram of PIC16F84A

The PIC16F84A belongs to the mid-range family of the microcontroller devices. A block diagram of the device is shown in Figure 2.2.