INTELLIGENT AUTONOMOUS VEHICLE FOR MAIL TRANSPORTATION (MAIL BOTS)

LEE KYEN ROON

This report is submitted in partial fulfillment of the requirements for the awards of Bachelor of Electronic Engineering (Industrial Electronics) With Honors

Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka

APRIL 2009

UNIVERSTI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek	:	**INTELLIGENT AUTONOMOUS VEHICLE FOR MAIL TRANSPORTATION (MAIL BOTS)**
Sesi Pengajian	:	2008/2009

Saya
LEE KYEN ROON 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: 33, Lorong Kledang 3,
Taman Kledang Sentosa, 31450, Menglembu,
Ipoh, Perak

(COP DAN TANDATANGAN PENYELIA)
NORIHAN BT ABDUL HAMID
Pensyarah
Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka (UTeM)
Karung Berkunci No 1752
Pejabat Pos Durian Tunggal
76109 Durian Tunggal, Melaka

Tarikh: .....30th APRIL 2009.....

Tarikh:....30th APRIL 2009...

DECLARATION

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

Signature : .....

Author : LEE KYEN ROON

Date : 30th APRIL 2009

DECLARATION

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

Signature : .....

Supervisor's Name : Mdm. Norihan Bt. Abdul Hamid

Date : 30th APRIL 2009

Dedicated to:

My beloved parents and friends for giving me unconditional love and care.....

ACKNOWLEDGEMENT

I would like to take this opportunity to express my most sincere gratitude to my project supervisor, Mdm. Norihan Bt. Abdul Hamid for accepting me as her project student and providing me excellent guidance, concern and informative support and editorial advice in preparation of this project. In fact, she gave me guidance when obstacles arise throughout this period of time. Once again, thanks to her for his tolerance and endeavors.

Also not forgetting, my grateful thanks to my beloved family members for providing me love, support and patience and at last my friends who give me support and opinion to make my studies possible. Finally to all the people who involve directly or indirectly in my way along to accomplish this task.

ACKNOWLEGEMENT

I wish to express sincerity of appreciation to Universiti Teknikal Malaysia Melaka (UTeM) for giving me a chance to further my study on Bachelor of Degree in Industrial Electronics in Faculty of Electronics and Computer Engineering (FKEKK).

Despite of that, I would take this opportunity to express my profoundest gratitude and deepest regards to all those who gave me the possibility to successfully complete this PSM. I am deeply indebted to my Project Supervisor Puan Norihan Bt. Abdul Hamid and I wish to express a gratitude thanks for her exemplary guidance, monitoring and constant encouragement throughout the development of the project.

I would like to express my gratitude and appreciation to the following people for their essential helps, guidance and supports in making my PSM's project more successful. They are Mr. Sani Irwan, Mr. Wong Wei Yeap, Mr. Poovendran A/L Villiam and to all my lecturers, panels, technicians, course mates and friends who are directly or indirectly involved in my PSM's project.

ABSTRACT

This project entitled us to build a mobility robot to deliver mails within office or hall compound.

This system is designed with AGV characteristics which can deliver certain standard size of letters or documents to designated rooms. Having this project to be presented in prototype, using microcontroller chip 16F877, it synchronizes usage such as alarms, light detection, monitoring applications and ideal for Interchangeable Controller for Real-Time system.

In order to deliver accordingly to each room, this system will detect light sources indication by the LDR; it will stop and signals recipient to collect their respective documents. Moving on to search other rooms ahead where this process is set to pre-determined sequential order which means that letters/documents must be arranged and sorted in proper compartment to the sequence of each location where Mail Bot will drop by.

ABSTRAK

Projek ini bertujuan untuk membina robot menhantar surat dan dokumen disekitar ruang kerja pejabat.

Sistem ini adalah direka dengan ciri-ciri AGV dimana ia boleh menghantar saiz surat yang ditetapkan ke ruang halaman yang tertentu. Dengan adanya projek ini dibentangkan dengan cara prototaip, penggunaan microchip kawalan PIC16F877, menggabungkan fungsi seperti loceng penggera, pengesanan cahaya, pengawasan applikasi and sesuai untuk “Interchangeable Controller” untuk “Real-Time System”.

Untuk mengendali tugas penghantaran surat ke destinasi tertentu, sistem akan mengesan isyarat cahaya dari LED oleh LDR dan seterusnya berhenti dan loceng penggera akan berbunyi. Selepas dokumen diterima oleh penerima, robot akan meneruskan penghantaran ke lokasi yang lain. Dokumen akan disusun mengikut kedudukan masing-masing supaya setiap dokumen yang diambil adalah dalam susunan lokasi perjalanan robot tersebut.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	TITLE OF PROJECT	**i**
	BORANG PENGESAHAN STATUS LAPORAN	**ii**
	DECLARATION	**iii**
	SUPERVISOR DECLARATION	**v**
	DEDICATION	**vii**
	ACKNOWLEDGEMENT	**viii**
	ABSTRACT	**ix**
	ABSTRAK	**x**
	TABLE OF CONTENTS	**xi**
	LIST OF FIGURES	**xiv**
	LIST OF APPENDIX	**xvi**
I	**INTRODUCTION**	**1**
	1.1 INTRODUCTION	1
	1.1.1 Robot History	1
	1.1.2 Definition of A Robot	2
	1.1.3 Modern Application on Robots	2
	1.2 PROBLEM STATEMENT	4
	1.3 OBJECTIVES	5
	1.4 SCOPE OF WORKS	5

II	**LITERATURE REVIEW**	**6**
	2.1 INTRODUCTION	6
	2.2 AUTONOMOUS ROBOT	6
	2.2.1 Automatic Guided Vehicles (AGV)	7
	2.2.2 Warehouse Robot	7
	2.3 WHAT IS MICROCONTROLLER	8
	2.4 WHY USE A MICROCONTROLLER	9
	2.4.1 Microchip PIC Technology	10
	2.4.2 Atmel Microcontroller	11
	2.4.3 IntelMicrocontroller	11
	2.4.4 STMicroelectronic Microcontroller	12
	2.4.4.1 8-bit Microcontroller	12
	2.4.4.2 16-bit Microcontroller	13
	2.5 DRIVE SYSTEM	14
	2.5.1 DC Motor	14
	2.5.2 Servo Motor	16
	2.5.3 Stepper Motor	18
	2.6 SENSOR	20
	2.6.1 LDR Sensor	20
	2.6.1.3 Steady light source	23
	2.6.1.4 Modulated light source	23

III	**PROJECT METHODOLOGY**		**24**
	3.1	INTRODUCTION	24
	3.2	BLOCK DIAGRAM	25
	3.3	PIC16F877 MICROCONTROLLER	28
		3.3.1 Memory	31
		3.3.1.1 Data RAM	31
		3.3.1.2 Flash ProgramMemory	31
		3.3.2 I/O Ports	32
		3.3.3 Timer	32
		3.3.4 Capture / Compare / PWM Module	32
		3.3.5 Power Supply and Clock Oscillator	33
	3.4	WHY CHOOSE PIC16F877	39
IV	**RESULT (EXPECTED RESULTS)**		**40**
	4.1	INTRODUCTION	40
	4.2	EXPECTED PRELIMINARY RESULT	41
	4.3	PROBLEM ANALYSIS	43
V	**CONCLUSION**		**44**
	5.1	OVERALL VIEW	44
	5.2	RECOMMENDATION	45
REFERANCES			**46**

LIST OF FIGURES

NO	TITLE	PAGE
1.0	Current Mail Robot	4
1.1	A MailBot model in Germany company	5
2.1	Examples of warehosue robot	8
2.2	Microcontroller-based system	9
2.3	Flash microcontroller (left), OTP microcntroller (center) and ROM microcontroller (right)	12
2.4	Various type of DC motor	15
2.5	A simple DC motor	16
2.6	A simple DC motor	16
2.7	A simple DC motor	17
2.11	Stepper Motor	17
2.12	Operation of a Stepper Motor	18
2.13	Operation of a Stepper Motor	18
2.14	Operation of a Stepper Motor	19
2.15	Operation of a Stepper Motor	20
2.16	Current Passing Through LDR	22
2.17	LDR Sensor Circuit	22
2.18	LDR Component	23

3.1	Block Diagram	24
3.2	Pin Diagram of PIC16F877	26
3.3	PIC16F877 Block Diagram	28
3.4	PIC16F877 with Power Supply and Clock Oscillator	34
3.5	MD10A Motor Driver	35
3.6	Flow Chart of Line Following Routine	36
3.7	Circuit Diagram	37
3.8	Top View of the Designated Robot Base	38
3.9	Side View of the Designated Robot Base	38
4.0	GP 9V Rechargeable Battery	39
4.1	GP 12V Rechargeable Lead Acid Battery	39
4.2	Robot Operation	41
4.3	Microcontroller Board	42
4.4	Mail delivery robot at a company in San Francisco	45

LIST OF APPENDIX

NO	TITLE	PAGE
A	PIC16F87X DATA SHEET	47

CHAPTER I

INTRODUCTION

1.1 Introduction

This chapter will discuss on the robot history, robot definition, modern uses of robots, autonomous robot, automatic guided vehicle and warehouse robot. The problem statement, objectives of the project, scope of work and report structure will also be presented.

1.1.1 Robot History

The word "Robot" comes from the 1921 play "R.U.R." (Rossum's Universal Robots) by the Czech writer Karel Capek. The word "robotics" also comes from science fiction. It first appeared in the short story "Runaround" (1942) by Isaac [1]
Asimov. Three Laws of Robotics as shown below:

Law Zero:A robot may not injure humanity, or, though inaction, allow humanity to come to harm.

Law One: A robot may not injure a human being, or, through inaction, allow a human being to come to harm, unless this would violate a higher order law.

Law Two A robot must obey orders given it by human beings, except where such orders would conflict with a higher order law.

Law Three: A robot must protect its own existence as long as such protection does not conflict with a higher order law.

1.1.2 Definition of A Robot

According to The Robot Institute of America (1979) : "A reprogrammable, multifunctional manipulator designed to move materials, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks." According to the Webster dictionary: "An automatic device that performs functions normally ascribed to humans or a machine in the form of a human (Webster, 1993)." [3]

1.1.3 Modern use of Robots

Robots can be used for exploration when people are interested in places that are sometimes full of danger, like outer space, or the deep ocean. But when they cannot go there themselves, they make robots that can go there. The robots are able to carry cameras and other instruments so that they can collect information and send it back to their human operators. Robots are useful in industry. When doing a job, robots can do many things faster than humans. Robots do not need to be paid, eat, drink, or go to the bathroom like people. They can do repetitive work that is absolutely boring to people and they will not stop, slow down, or fall to sleep like a human.

When making medicines, robots can do the job much faster and more accurately than a human can. Also, a robot can be more delicate than a human. Some doctors and engineers are also developing prosthetic (bionic) limbs that use robotic mechanisms. Dr. David Gow, of the Prosthetics Research and Development Team at Princess Margaret Rose Orthopaedic Hospital, made the first bionic arm called the Edinburgh Modular Arm System (EMAS) in 1998.

Robots also can be used in military and police. Police need certain types of robots for bomb-disposal and for bringing video cameras and microphones into dangerous areas, where a human policeman might get hurt or killed. The military also uses robots for locating and destroying mines on land and in water, entering enemy bases to gather information, spying on enemy troops. [4]

At first, robots where just for entertainment, but as better technology became available, real robots were created. Many robots are still seen on T.V. (Star Trek - The Next Generation) and in the movies (The Day the Earth Stood Still, Forbidden Planet, Lost in Space, Blade Runner, Star Wars). These imaginary robots do a lot of things that the real ones cannot do. Some robots in movies are made to attack people, but in real life they cannot really hurt people at all because they are not in control of themselves.

1.2 Problem Statement

A MailBot is very well used in Western countries nevertheless developed ASIA countries such as China, Japan and Korea. Why would this device necessary for them rather than an office person deliver mails or documents, assigned one just given this task to do and get paid. This may save cost on maintenance and be if to be faster perhaps? Reviewed and studied by referring the video clips (interview session) among office staff. They would say it is very efficient and this is a new breakthrough technology for them to experience such machine roaming around, this is a good approach why human substitute man power to deliver mails rather than machines. Repeatability and operating duration is more consistent compare to office staff to fetch, divide and deliver.

From previous industrial part-time worker, having man power to take this task might lead to inconsistency in scheduled time. Forklift design or mechanical arm is recommended in warehouse for material handling. However, the forklift needs complicated design and source code. This will increase the operation cost and complexity.

Figure 1.0 Current Mail Robot

1.3 Objectives

i. Construct a line following robot.

ii. Function to load and unload pallet in designated area.

1.4 Scopes of Work

The scope of work in this project is stated below:

i. Combination of a line following robot and manipulator robot.

ii. PIC Microcontroller is selected according to the total needs of I/O port.

iii. PICBASIC Pro is used as the programming language for PIC microcontroller.

iv. The maximum weight that can be lifted by the robot is 2kg.

Figure 1.1 A MailBot model in Germany company

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

There are a number of microcontrollers, motors and sensors in the market with vary specification. Therefore, literature review is done in this chapter to make a review between the various types of microcontrollers, motors and sensors. This is very important as a guide line to choose the most suitable of microcontroller, motor and sensor to be used in this project.

2.2 Autonomous Robot

Autonomous robots are robots which can perform desired tasks in unstructured environments without continuous human guidance. Autonomous vehicles have been designed and implemented to perform a wide variety of tasks, from delivering medical sample in a hospital to sweeping and clearing unexploded ordnance from a mine-field. One of the most practical and popular applications for autonomous vehicles has been in the area of material handling. The use of autonomous material handling vehicles is now common in the high volume production facilities of many industries. [4]

2.2.1 Automatic Guided Vehicles (AGV)

Automatic Guided Vehicles (AGV) has been in existence since the 1950's. AGVs are driver-less industrial trucks, usually powered by electric motors and batteries. AGVs range in size from carrying small loads of a few kilograms up to loads over 100 tons. The working environment may vary from offices with carpet floor to harbor dockside areas. Automatic load handling is used in many AGVsystems. The AGV can pick up and drop off pallets or transfer loads automatically using fork attachments, conveyors, lift tops etc. depending on the type and size of the load units to handle. Modern AGVs are computer-controlled vehicles with onboard microprocessors and can be equipped with robot arms and grippers to perform robotic handling functions. Several methods of guidance and navigation can be implemented. The early AGVs were tracking an inductive guide wire or an optical visible line, painted or made with tape on the floor. The inductive guide wire is still the most used guiding system for AGVs running on concrete floors. In later years AGV guiding and navigation systems with laser scanners, microwave transponders, inertia gyros, ultrasonic sensors, embedded magnet and camera vision systems have been launched. [4]

2.2.2 Warehouse Robot

Forklift type Automatic Guided Vehicles (AGV) are relatively new guided vehicles which have the ability to service palletized loads or rolls both at the floor level and on stands. In some cases these vehicles can also stack loads in racks. This kind of vehicle is very useful in a warehouse to do the loading and unloading process. Therefore, it also can be called as warehouse robot. [4]

Figure 1.1 shows some examples of warehouse robot which are done by other PSM students:

Figure 2.1: Examples of warehouse robot

2.3 What is A Microcontroller

A microcontroller is an integrated chip that is often part of an embedded system. They are designed to execute only a single specific task to control a single system and are much smaller and simplified so that they can include all the functions required on a single chip. Single-chip means that the entire system is lies within the confines of the integrated circuit.

A microcontroller differs from a microprocessor, which is a general-purpose chip that is used to create a multi-function computer or device and requires multiple chips to handle various tasks. A microcontroller is meant to be more self-contained and independent, and functions as a tiny, dedicated computer

The great advantage of microcontrollers, as opposed to using larger Microprocessors, is that the parts-count and design costs of the item being controlled can be kept to a minimum. They are typically designed using CMOS (complementary metal oxide semiconductor) technology, an efficient fabrication technique that uses less power and is more immune to power spikes than other Techniques.

Primarily, the microcontroller is capable of storing and running a program, its most important feature.9 The microcontroller contains a central processing unit (CPU), random-access memory (RAM), read-only memory (ROM), electrically erasable programmable read-only memory (EEPROM), input/output (I/O) lines, serial and parallel port, timers, and other built-in peripherals, such as analog-to-digital (A/D) and digital-to-analog (D/A) converters. [6]

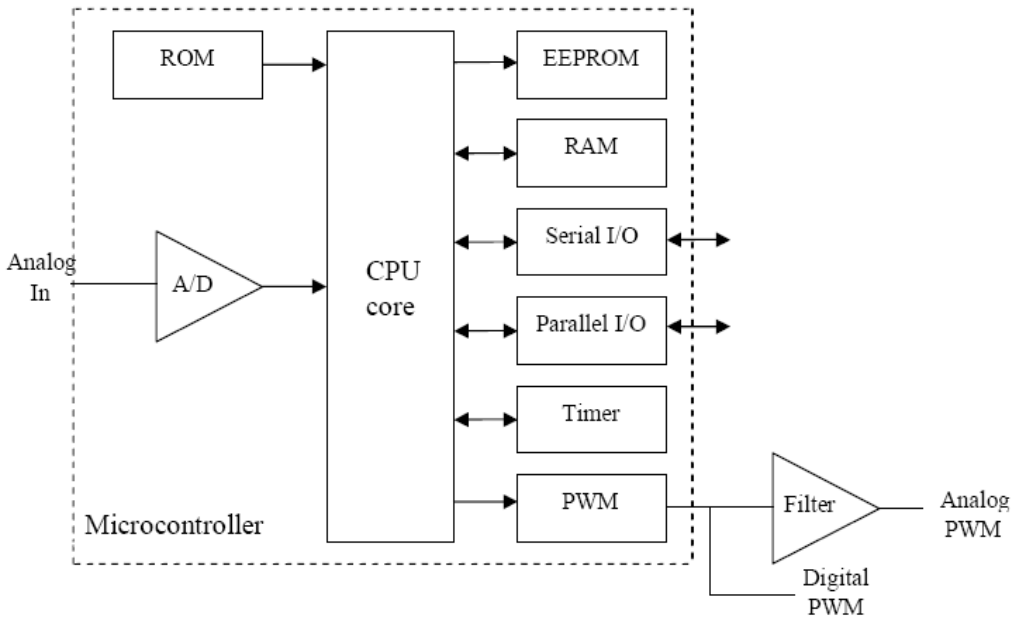

Figure 2.2: Microcontroller-based system