WALL FOLLOWING ROBOT

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DECLARATION

"I admit that the entire article is from my own idea except for summarization each of it that I had explained the source"

Signature : Saul.
Student : Saul Ribai anak Paul
Date : 11/05/06

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Special dedication to my loving dad, Mr. Paul Kilat, my mum, Pn. Bulan anak Jawi, all my siblings, my kind hearted supervisor Pn. Mai Mariam binti Mohamed Aminuddin, and all my dearest friends.

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ABSTRACT

Imagine you are navigating through your house in the dark — you've woken up in the middle of the night, hungry for a snack. You get out of bed, but leave the lights off so you don't wake everyone else. You can't see anything, so you run one hand along the wall as you walk down the hallway. There are small discontinuities in the wall, like the closet door, but you keep walking straight. You feel the wall "end," so you turn the corner and keep going. Perhaps at some point, you leave the wall and walk across a (known obstacle-free) room, holding your hand out in front to detect when you reach the opposite wall. You eventually reach the kitchen without much trouble. This blind navigation is an apt analogy for how a sensing-limited robot "sees" the world. By "sensing-limited," i mean that the robot has sparse and very limited-range information about the world. These limited sensing capabilities result in a restricted view of the world — features of the environment can only be detected by observing a time series of sensor readings. Small robots with limited sensing capabilities are inexpensive, and are therefore ideal in applications where many potentially disposable robots are required to map and explore a building in parallel such as find a parameter in unknown place where human can not reach, robot guidance for blind people for an architect, in search and rescue or urban reconnaissance scenarios. This paper only focuses solely on the problems of exploration, and navigation for a single robot. The problem is for a sensing-limited robot to explore an unknown environment. The resulting paths should be efficient to the extent that safety, limited-range sensing, and errors in sensing, and robot motion. This paper demonstrates that such a robot can complete this task, though there are some limitations based on the size and geometric complexity of the world. We should not expect the same performance from a sensing limited robot as we would from a robot with richer sensing modalities (e.g. a laser scanner). While we permit lesser performance in terms of time and scope, we still expect reasonable accuracy.

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So this is the project to build a Wall Following Robot. This project is purposely to build a robot that run follow a wall. The wall following robot consist sensors, dc motor and limit switch. The IC will be used to control this component to get the desired output. The goals of a wall following robot is to navigate through open spaces until it encounter a wall, and then navigate along the wall at some distance. This robot will follow a wall on its right and when it comes to corner turn to the left and continous right wall following. This robot will be equip with a sensor in front of the robot and a limit switch at the right side to detect or sense the wall and to avoid colision with the wall. This robot also build so that it can make a turn a couple of degrees to left and also to the left when its encounter a corner. This robot are equip with sensors and a whisker to avoid and navigate in open space. So this project is attempt to solve this problems.This project consist of hardware and a software. The part that consist for the hardware is electronic circuit especially in robot controll design. These electronics circuit are combined with micro-controller circuit,PIC. The PIC program is the software part. It play the most important part in this project because it contain the main operation to control the robot movement in real world.

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ABSTRAK

Bayangkan anda berjalan di dalam keadaan yang gelap di dalam rumah anda, anda terbangun di tengah malam, kelaparan dan ingin mengisi perut kosong anda. Anda bangun dari katil anda, tetapi tidak membuka lampu supaya anda tidak mengejutkan orang lain yang sedang tidur. Anda tidak boleh melihat apa-apa pun di dalam yang amat gelap sekali dan anda berjalan dengan berpandukan sentuhan tangan anda di dinding di dalam perjalanan anda ke dapur untuk mendapatkan makanan. Di situ terdapat ruang seperti tempat menyimpan almari tetapi anda meneruskan perjalanan anda seperti biasa menuju ke ruang dapur. Ada masanya anda terpaksa meninggalkan dinding tersebut untuk menyentuh sebelah lagi dinding dengan menganjurkan tangan anda ke hadapan sehingga anda menemui dinding yang lain. Selang beberapa saat kemudian anda terasa seperti sampai di satu hujung dinding, dan anda terus membelok mengikut bentuk dinding tersebut dan berjalan seperti biasa. Anda biasanya tidak akan mempunyai banyak masalah untuk ke ruang dapur. Pemanduan dalam keadaan gelap ini adalah salah satu cara bagaimana robot mengesan sesuatu ruang ataupun untuk bergerak dalam ruang yang tidak diketahui oleh robot tersebut. Dengan maksud mengesan ini, robot mempunyai batasan untuk bergerak dalam ruang dunia tidak seperti kita manusia walaupun dilengkapi dengan pengesan. Batasan ini merangkumi ruang- ruang ataupun benda yang tidak dapat di kesan oleh robot dalam dunia nyata. Robot kecil yang mempunyai batasan yang terhad yang banyak adalah murah dan senang dibina dan amat sesuai untuk aplikasi dimana kebanyakan robot diguna untuk pelbagai kegunaan seperti mengenal pasti ruang yang tidak dapat dimasuki oleh kita sebagai manusia, robot untuk kegunaan orang buta untuk berjalan, untuk pencarian dan penyelamatan dalam keadaan yang membahayakan nyawa manusia. Tesis ini hanya memfokuskan untuk menyelesaikan masalah yang berkaitan dengan cara bagaimana robot bergerak dalam ruang yang tidak diketahui dan bagaimana untuk mengawal pergerakan robot. Jalan yang dipilih

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mestilah selamat, batasan pengesan yang terhad, masalah pengesan, dan pergerakan robot. Projek ini akan menunjukkan bagaimana robot ini menyelesaikan masalah-masalah yang telah dinyatakan sebelum ini dan batasan-batasan yang terdapat pada robot dan batasan – batasan yang lain seperti bentuk geometri dalam alam nyata. Kita tidak mengharapkan robot kita akan beroperasi seperti robot yang lebih mahal dan mempunyai batasan yang sedikit. Walaubagaimana dengan masa dan skop yang terhad, projek ini mengutamakan ketepatan dalam robot ini. Robot pengikut dinding ini dibuat khas untuk mengikut parameter dinding. Robot ini dilengkapi dengan pengesan, motor arus terus dan suis. IC akan digunakan untuk mengawal segala pergerakan atau tingkahlaku robot. Tujuan utama robot ini adalah untuk bergerak dalam ruang yang tidak diketahui dan akan terus bergerak sehingga menemui dinding. Apabila robot telah mengesan dinding, robot ini akan cuba untuk bergerak mengikut parameter dinding ini dan akan bergerak selari dengan jarak yang selamat untuk mengelakkan pelanggaran dengan dinding tersebut. Apabila robot sampai di hujung dinding atau sudut dinding, robot ini akan membelok dan akan terus mengekalkan jarak dengan dinding dan terus akan bergerak ke hadapan. Robot ini hanya berupaya mengikut dinding di tepi sebelah kanannya. Robot ini dilengkapi dengan pengesan untuk berinteraksi dengan dunia nyata dan untuk mengelakkan pelanggaran dengan dinding. Jadi matlamat robot ini adalah untuk menyelesaikan semua masalah yang di atas. Projek ini dibahagikan kepada pembinaan bahagian robot dan juga aturcara. Bahagian ini akan digabungkan dan akan membentuk sebuah robot yang dapat berinteraksi dengan alam sekeliling. PIC pula adalah program yang sangat penting di mana semua tingkahlaku robot akan dikawal dengan program ini.

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ABBREVIATIONS AND ACRONYMS

RAM	-	Read Access Memory
IC	-	Integrated Circuit
PROM	-	Programmable Read Only Memory
EPROM	-	Electrically Programmable Read Only Memory
MCLR	-	Memory Clear
PIC	-	Programmable Integrated Circuit
PWM	-	Pulse Width Modulation
DC	-	Direct Current
IR	-	Infrared
CMOS	-	Complementary Metal-Oxide Semiconductor
NMOS	-	Negative-Channel Metal-Oxide Semiconductor
I/O	-	Input/Output
NZR	-	Nonreturn Zero
ADC	-	Analog-To-Digital Converter
ISCP	-	In-Circuit Serial Programming
EEPROM	-	Electrically Erasable Programmable Read Only Memory
UV	-	Ultraviolet
AC	-	Alternating Current
ROM	-	Read Only Memory

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CHAPTER I

INTRODUCTION

This chapter will give an overall description of Wall Following Robot. This chapter includes the project overview, project objectives, project scopes, methods of analysis and thesis summary. Roughly, the flow of work from the beginning until the fulfillment of this project will be described in this chapter.

1.1 PROJECT OVERVIEW

The wall following robot is a microcontroller robot programming. The microcontroller usually used as a brain for the robot. Sensors are acts as a hand for the robot and dc motor to run the robot in open space.

This project is to design a robot that capable to follow a wall. This project will focus on how to control this robot movement and how to navigate in open space before it encounter a wall and also to avoid from hit a wall. Hence, provide the solution to overcome the problems. In the next chapter, the problems encounter by the robot in navigation will be described and project's methodology is highlighted.

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1.2 PROBLEM STATEMENT

When build a robot that using micro-controller, the most common kind of robot failure is not mechanical or electronic failure but rather failure of the software that controls the robot. For example, if a robot were to run into a wall, and its front touch sensor did not trigger, the robot would become stuck (unless the robot is a tank), trying to drive through the wall. This robot is not physically stuck, but it is "mentally stuck": its control program does not account for this situation and does not provide a way for the robot to get free. Many robots fail in this way. This project will solve some of the problems typically encountered when using robot sensors, and present a framework for thinking about control that may assist in preventing control failure of robots. The hardware will design to include two sensor and IC (a brain). Since each wheel in the rear had its own motor, a system had to be developed to activate either both wheels forward, or one wheel backward to make a turn.

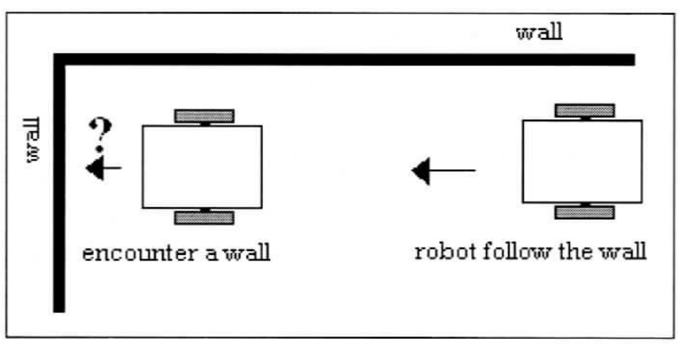

Figure 1.1: Follow And Encounter A Wall

1.3 PROJECT OBJECTIVES

Imagine a robot with a distance sensor on its right side and two motors, with each motor driving wheel on opposite sides of the robot. The robot can move forward by turning both motors on. It can turn left by turning the left motor off and

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right motor on. It can turn right by turning the right motor off and the left motor on. Now suppose the robot must follow a wall to its right. Here are some solutions to make the robot follow a wall:

a) Measure distance to wall
b) If the wall is too close, turn left (away from wall)
c) If the wall is acceptably close, keep going forward and
d) If the wall is too far away, turn right.

The robot will be build base on all of these objectives. The robot is limited in their sensing abilities (and maybe their computational abilities as well) so we have to choose the appropriate sensor and ICs. We also have to learn and doing research at different sensor and IC because they have differences function. For choosing DC motor, there is no two dc motor having exactly the same speed . So here the speed of the dc motor have to be same so that the robot can move forward in a straight line and also parallel with the wall. To controlling the speed of DC motor (usually have high speed), Pulse Width Modulation (PWM) will be use. The PWM will controll the motor speed by driving the motor with short pulses. The longer the pulses, the faster the motor turns, and vice versa.

The other objectives of build this wall following robot because it is very useful to many applications such as in applications where many potentially disposable robots are required to map and explore a building in parallel such as find a parameter in unknown place where human can not reach, robot guidance for blind people for an architect, in search and rescue or urban reconnaissance scenarios.

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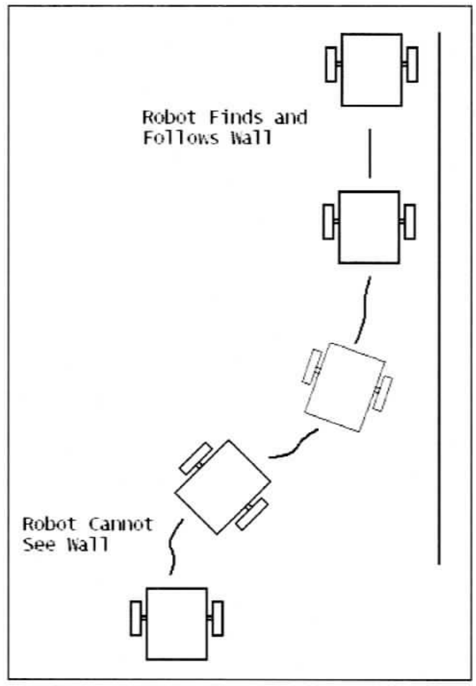

Figure 1.2: Navigate In Open Space Until Find A Wall

1.4 PROJECT SCOPES

The scopes of this project are;

i. Specially design for programming robot controller.
ii. To control and navigate the robot in open space.
iii. To build a wall following robot that can navigate along the wall.

This project is to build a robot consist a microcontroller, sensor and dc motor. In other word this project is built especially for wall following robot. The navigation of the robot circuit that consists of electronic circuit that combined with micro-controller to navigate the robot. Eventually, this project will produce a robot that can run along the wall.

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CHAPTER II

LITERATURE REVIEW AND PROJECT BACKGROUND

This chapter will described about the background of this project and literature review which includes the previous related project and the development of the technologies.

2.1 PROJECT BACKGROUND

This paper describes a method for a wall following with a mobile robot. It discusses how to build the robot. This project goal is to be able to run the robot in an open space and it try to find a wall and then follow the wall contour as long there is a wall. While many wall have a corner, my software is implemented to handled this corner or solve a simple maze by a wall following solution. This software written for the project is in MPLab IDE software. This wall following robot is using the dc motors and motor drivers. The primary sensor used by this robot is IR Sensor. The dc motor will drive the robot forward to find a wall. While exploring, the infrared obstacle avoidance is on alert to prevent this robot from colliding with obstacles or a wall.

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2.2 LITERATURE REVIEW

This section include all literature review that had been done while doing this project which helps to understand more about a robot.

2.2.1 Robot

The field of robotics is very interesting to anyone curious about how organisms (including people) interact with the "real world". A true robot kit allows you to get a closer understanding of how human and animal senses work, and how many memory (programming can be used for specific tasks. Some do both, and others only one of these thing, but either is sufficient to separate a real robotics kit from a toy.

It's unfortunate that the market of robots is crowed with toy models with no robotic functions, sometimes residing with real robots in the same manufacturer's line. For example, LEGO has two advanced kits that fit the definition of a programmable robot, but they also sell a Technic Giant Robot Set that only a model of a robot, with no independent functions or programming capabilities. Robotix sells several "robots" kits that have direct control through a wired remote, but the kits only become a real robots when you add an additional programmable control unit. A robot can be seen as a machine with three characteristics;

- Input (sensors or stored in information)
- Intelligent (interpretation, brains – effected by the presence of a central processing unit)
- Actuators (controlled motion systems or other output devices)

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A robot reacts to input by judging its state with its intelligence, and passes commands to its actuators. For example, a robot can judge where a wall is touching it with a sensor; the input is recorded when the sensor is tripped by the obstacle, and passed to the robot's intelligent processing system, which decides that hitting a wall is a bad idea, and moves the robot by passing a command to the actuators.

You can separate the use of stored information from interpretation by means of intelligence in some cases. Consider the analogy of using two different methods to walk across a room. You could clear your mind and use your senses to navigate around obstacles. This is an example of sensor-based navigation. Or you could close your eyes and rely on your memory of where thing are in the room to make the same route. This is an example of using a stored program. [11]

2.2.2 The Microchip PICmicro Microcontroller

The advantages of Microchip PICmicro Controller compare to others architecture's such as complementary metal-oxide semiconductor (CMOS) PICmicro Controller and negative-channel metal-oxide semiconductor (NMOS) architecture that this Microchip PICmicro Controller include how easy it is to find the parts from numerous distributors around the world. As well as there being many different places to finds the parts, there are many different part numbers (or versions) of the PICmicro controller available, one of which will probably have all the features that meet your requirements. Every year, Microchip releases up to hundred new part numbers, giving customer new internal features as well as packaging options.

The different features built into different PICmicro MCU part numbers include the following:

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- Changeable operations using configuration fuses that are set during programming
- Different clocking options
- Different reset options
- Different input/output (I/O) pin options including
    - high current I/O
    - Open collector
    - Nonreturn to zero (NZR) serial I/O
    - Synchronous serial I/O
    - Analog inputs with comparators or analog-to-digital converters (ADCs)
    - Bus device emulation
- Flash-based program memory with simple programming for easy and cheap experiment
- Multiple clock/timer/counter options
- Interrupts from multiple source (multiple interrupt vectors in some PICmicro MCUs)

Microchip was one of the first manufacturers that provided their chips with a simple, low-cost, and documented programming methodology. Most PICmicro microcontrollers are designed to have their applications programmed in serially using the In-Circuit Serial Programming (ISCP) protocol. This synchronous serial programming method enables PICmicro MCUs to be programmed very rudimentary parts.

Microchip was also one of the first microcontroller manufacturers that built microcontrollers with flash Electrically Erasable Programmable Read-Only Memory (EEPROM) for program memory instead of using ultraviolet (UV) light Erasable Programmable Read-Only Memory (EPROM). Providing devices wit flash program memory avoided the need for expensive, "windowed" ceramic packaging for the

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chips as well as the need for the experimenter to have a UV eraser. Microchip's ICSP, coupled along with Flash-based microcontroller, enables the experimenter to develop PICmicro MCU applications at a cost that is hundreds of dollars less than what is required for some other microcontroller. [3]

2.2.3 Sensor

Sensor gives a robot the means to perceive its environment. The robot processes the information received from its sensors and reacts in a predetermined manner according to the design of the control system.

To achieves its goal of traveling in the open space, the robot may require the sense of sight and/or touch, depending on the sensor technology (or combination of technologies) used. Sight simulated through pressure sensors. Infrared (IR) sensors are a type of light sensor, ultrasonic or sonar sensors are type of sound sensor, and touch or bump sensors are type of pressure sensor. Light and sound may give either proximity or distance detection. Proximity sensors only detect whether or not an object is within a predetermined range from the robot, while distance sensors determine the actual distance between the object and the robot. Here are general look at each sensor technologies:

- Infrared (IR) sensors – An infrared consists of an infrared transmitter that sends out an invisible beam light into the environment and an infrared receiver that absorbs the beam of light that is reflected back. The angle of the reflected beam indicates the proximity of the infrared receiver to the object that is reflecting the light. The microprocessor of the robot uses the changes in angle to measure the distance of the robot from object ahead.

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