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Date : 28 February 2005

WALL FOLLOWING MOBILE ROBOT

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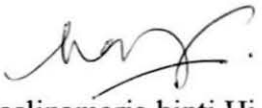
Signature : 

Author : Roslinamaria binti Hj Abdul Rahman

Date : 28 February 2005

To my late father Hj Abdul Rahman bin Roslan,

My mum, Hjh. Rosnah binti Bakrin,

My brother and family, Rosely bin Hj. Abdul Rahman,

My sister and family, Roslinawati binti Hj. Abdul Rahman

and

My love Mohamad Zaihan bin Borhan

APPRECIATION

Nobody gets anywhere without help from many different people along the way. I am no exception to this. I would like to take this opportunity to thank my family especially to my late father Hj Abdul Rahman bin Roslan ***(28 November 2004, 15 Syawal 1425)*** who been my inspiration, my mother Hjh. Rosnah binti Bakrin to be supportive women, my fiancée Mohamad Zaihan Borhan to encourage me.

I would like to thank Mr. Soo Yew Guan for all his support. He was able to use the right words that sparked the wall following mobile robot inside me. He has been, and he always is my adviser in this project.

I would like to thank to all my friends that has been very helpful in providing information and support.

ABSTRACT

Robot is a machine that works automatically and can do some task that human can do. Mobile robot is especially design to operate in environment such as automated assembly halls, factories or warehouse. Mobile robot an intelligent machine that developed to think and function according to the instruction. In this project, a wall-following mobile robot has been designed. The wall-following control problem is characterized by moving the robot along a wall in a desired direction while maintaining a constant distance to the wall. There are several reasons why autonomous mobile robots must be able to follow walls or in a more general sense, to follow the contours of an object. This depends of course on the type of mobile robot and its application. Robots operating in an unknown, unstructured environment (usually outdoors) use their sensors to perceive the surrounding and replan their motions or trajectories accordingly. (Perspective information is very important in unstructured environment and for vision system. Random navigation does not seem like a very elegant way to master a wall so the choice is wall-following mobile robot).

ABSTRAK

Robot adalah satu mesin dimana ia boleh berkerja secara automatik dan boleh melakukan tugas yang mana manusia boleh lakukan dimana keistimewaan robot direkabentuk dengan atau mengikuti suasana seperti mengautomasikan pemasangan ruang depan, kilang atau gudang. Robot mudah alih adalah mesin yang bijak yang dibangunkan untuk berfikir dan berfungsi mengikut arahan. Di dalam projek ini, robot mudah alih mengikut dinding telah dicipta. Masalah pergerakan mengikut dinding boleh disifatkan sebagai robot yang bergerak menyusuri dinding mengikut kehendak arahan serta mengawal jarak dengan dinding. Terdapat pelbagai sebab mengapa robot ini dicipta. Ini bergantung kepada jenis dan aplikasinya. Robot beroperasi di dalam suasana tidak diketahui menggunakan sensor untuk mencapai maklumat keadaan sekeliling. (Perspektif informasi adalah amat penting di dalam suasana yang tidak distrukturkan dan untuk sistem penglihatan. Pergerakan secara rambang tidak beberapa kelihatan menarik untuk menguasai dinding maka pilihan yang baik ialah *wall-following mobile robot*. Cara yang paling mudah untuk menjelaskan penciptaan projek ini ialah dengan membayangkan manusia berjalan dengan keadaan mata yang tertutup ataupun buta. Dengan meletakkan sebelah tangan kepada dinding dan terus menyusuri dinding tersebut hingga mencapai arah tuju.

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LIST OF SHORT FORMS

PIC	-	Programmable Integrated Circuit
IR	-	Infrared
LED	-	Light Emitter Diode
k	-	kilo
m	-	mili
Hz	-	Hertz
PC	-	Printed circuit
V	-	Volts
Amp	-	Ampere
Op-amp	-	Operational Amplifier
Ω	-	ohm
μ	-	micro
A/D	-	Analog to Digital
DC	-	Direct current
AC	-	Alternate current
I/O	-	Input / Output
KUTKM	-	Kolej Universiti Teknikal Kebangsaan Malaysia
EEPROM	-	Electronic Erasable Programmable Read of Memory
TTL	-	Transistor-transistor Logic
CMOS	-	Complementary Metal-Oxide Semiconductor

CHAPTER 1

INTRODUCTION

For this surveillance robot, the main purpose is only to stroll follows the wall, in order to detect intruders, using reflects an Infrared (IR) or movement following behavior. It is not desired to have the robot following walls too closely or having all the space covered, since the main purpose is just to look around for motion or Infrared sources, keeping as far as possible from all walls.

The robot keeps itself faraway from walls by having the capability of adapting its behaviors, in order to be able to enter and explore narrow spaces and to adapt easily to differently reflective environments. In surveillance robots, result expected is to get an overall behavior, which permits an efficient coverage and exploration of the entire space where it should wander about, without the problems of getting indefinitely stuck in particular confusing situations that may occur seldom. Wall-following mobile robot is a small three-wheel robot that follows the walls, which it senses with its active infrared sensors. Each rear wheel has its own motor where the single front wheel is not powered. The robot steers like a tank by rotating the rear wheels in opposite direction.

The sensors are built with infrared LED's, which are running at 36kHz and two 36kHz remote control receiver modules. When an object reflects the 36kHz IR lights from the LEDs, one of the receiver modules will be triggered, and the

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PIC16F84A micro controller will steer the robot by reversing one of the motors and turn to the right if the front sensor detect. If left front sensor robot will go forward.

1.1 Project Objectives And Scope Of Work

The objectives of the robot are to study and investigate the ranging sensor and the integration technique using IR sensor for the wall-following mobile robot and to implement about simple wall-following algorithm then after implement simple wall-following algorithm, designing on wall-following mobile robot on micro controller PIC Basic.

The progress to design wall-following mobile robot it is divide to three major processes and there are designing on micro controller, design the circuit and lastly develop the platform to produce the prototype of wall-following mobile robot.

Firstly the process is design micro controller referred to the planning of movement the wall-following mobile robot after design the micro controller then the simple algorithm will implement to the micro controller using PIC Basic by assembler language.

The next process is designing on the circuitry of the robot. In this process there are get on develop the prototype of the robot, which is from designing on circuitry, and develop the platform. On designing the circuit for wall following after design the circuit it will test on PROTEUS simulator to look after the problem on designing that circuit. If the design nothing problem on the design circuit, the design circuit will transferred to printed-circuit (PC) boards. In this progress started the planning and layout must create to transfer circuit into PC board. Then component assembly and PC board soldering is the next process. Develop the platform is the final construction to produce the prototype of wall-following mobile robot.

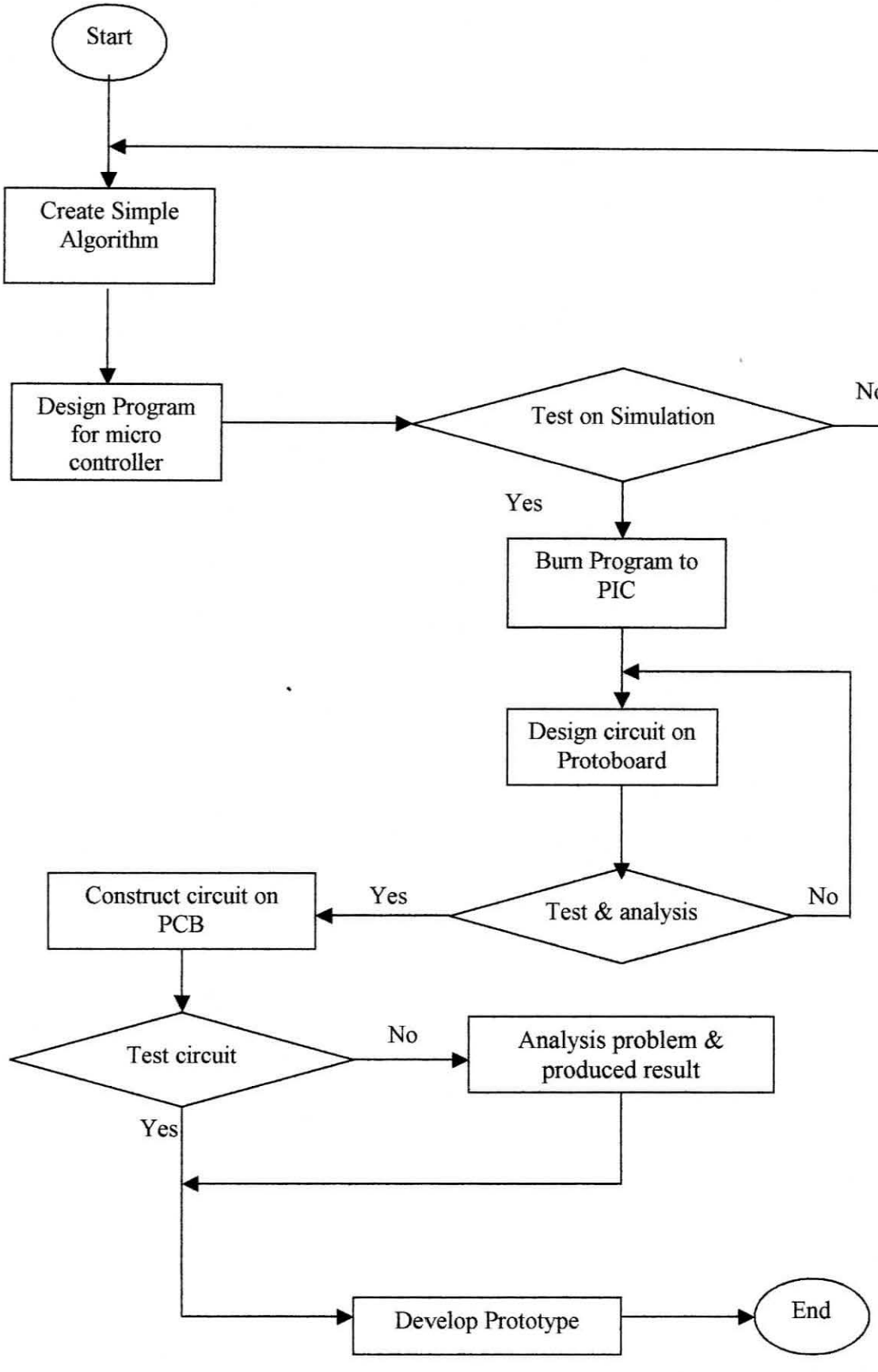

Figure 1.1: Flow Chart Scope of Work

1.2 Problem Statements

The problem in wall-following mobile robot has been study in this project is the movement control target of the robot to sense the wall. The biggest problem facing a robot nowadays is overall system reliability. A robot might face any combination of the following failure modes, firstly mechanical failures, these might range from temporarily jammed movements to wedged gear trains or a serious mechanical breakdown. Secondly is electrically failures, hope it is safe to assume that the computer itself will not fail but loose connections of motors and sensors are a commonly problem. Finally sensor unreliability, sensor will provide noisy data (data that is sometimes accurate, sometimes not) or data that simply incorrect (transmitter fails to detect and trigger motor).

The first two of the above problems can be minimized with careful design, but the final category, sensor unreliability, warrants a closer look. Here is a brief analysis of the sensor problem.

CHAPTER 2

LITERATURE REVIEW

These robots are design by Mike Linnen at April 4, 2002 [5]. This can be accomplished by using the front and rear sensor. The arrangement of sensor positioning at left side on body of robot.

For a mobile robot, wall following is a useful motion in structured environments and can be employed for obstacle avoidance. In many mobile robot ultra sonic range sensor are used for wall following. With these robots, the range from robot to wall is commonly measured by an ultrasonic sensor and used for motion control. However from the point of view of vehicle motion control, the direction angle to the wall is more useful and suitable information to realize wall following. So Mike Linnen [5] set out to build and program a maze robot to follow one wall. He chooses to use a differential drive system on a round body. This would allow him to control the robot rather easily and prevent it from getting hung up on maze walls. Mike Linnen [5] mounted two ultrasonic sensors on a single shaft on top of a servomotor. The sensors were positioned 90^0 apart. The servomotor allowed the robot to look parallel wall at the same time.

In order to tell if the robot was getting closer or further away from a wall a minimum of two sensor readings would have to be taken over a period of time while the robot was moving. Mike Linnen [5] had some difficulty in fine-tuning the reactions needed to prevent the robot from touching the walls. Mike Linnen [5] quickly realized that this sensor arrangement had some shortcomings. He needed to

be able to look at a wall and determine if the robot was parallel to it without moving forward.

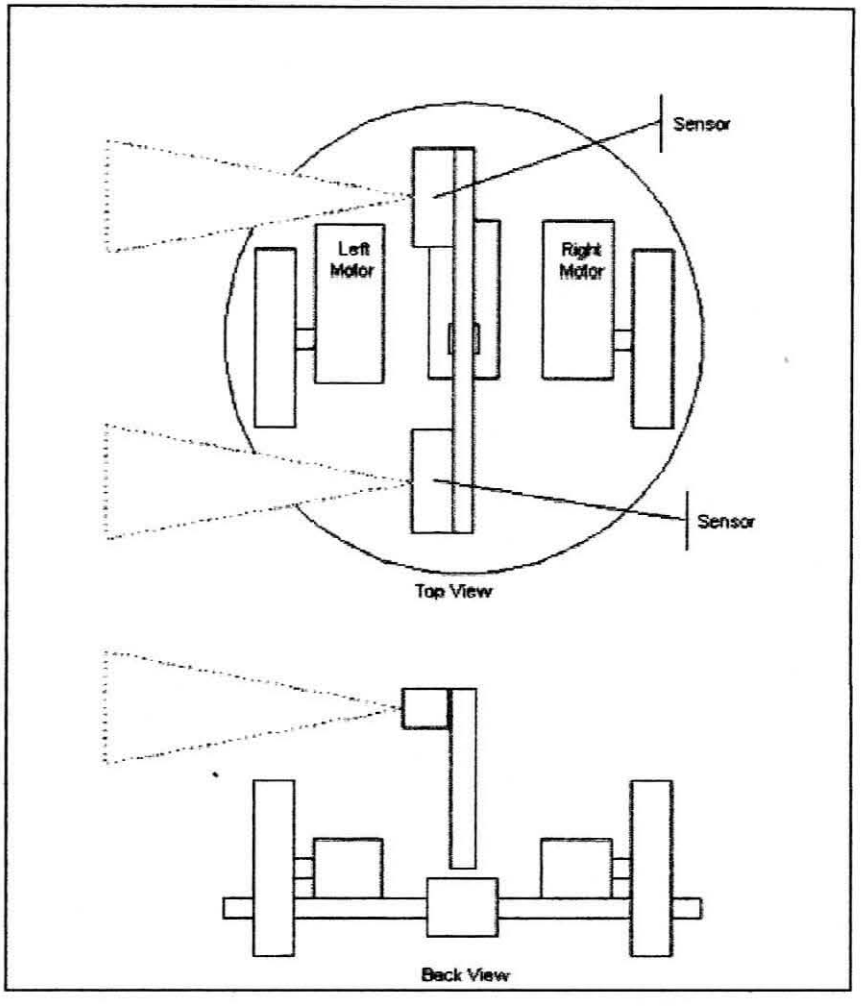

Figure 2.1: DR X Prototype

Mike Linnen [5] found out some other advantages of this sensor arrangement. While the robot was following a wall and it approached a doorway of the maze the first sensor would detect the opening (doorway) very easily. Once the second sensor detected the doorway he knew the robot was directly in front of the entranceway. A 90^0 turn towards the entranceway would position the robot perfectly for passage through the door. Passage through the door would also be easily detected. As the robot moved forward, both sensors could detect the door jam. The robot could successfully determine when a door was found and navigate through the door rather easily.

The following drawings show the robot navigating through a doorway.

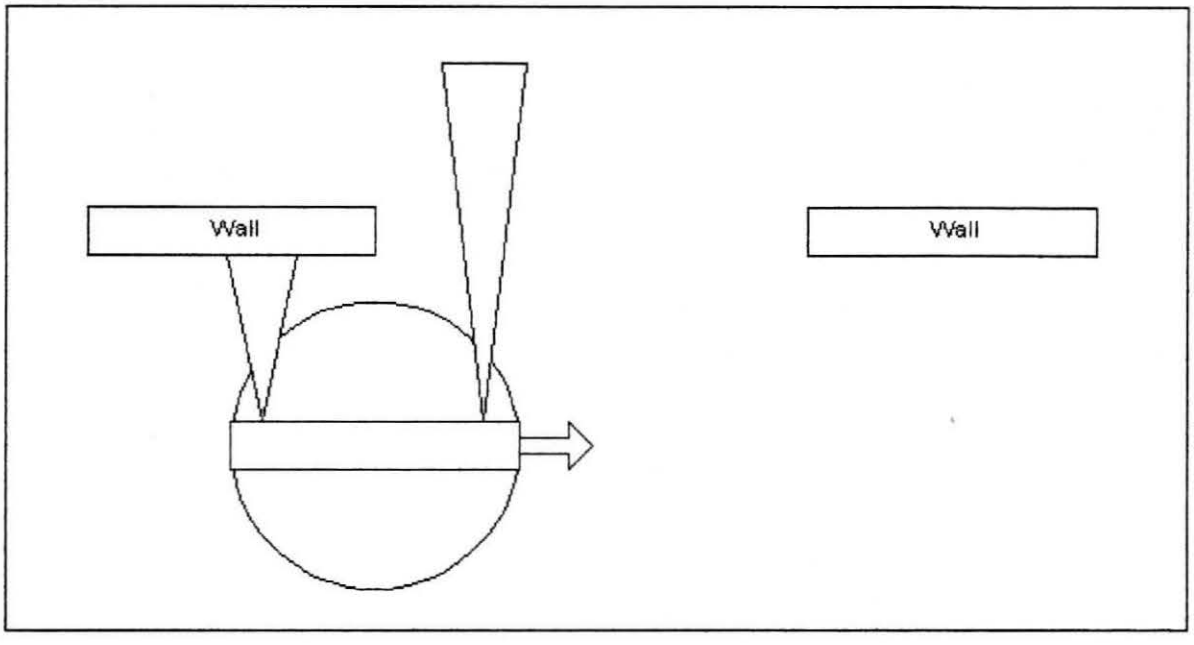

Figure 2.2: The robot approaches the doorway.

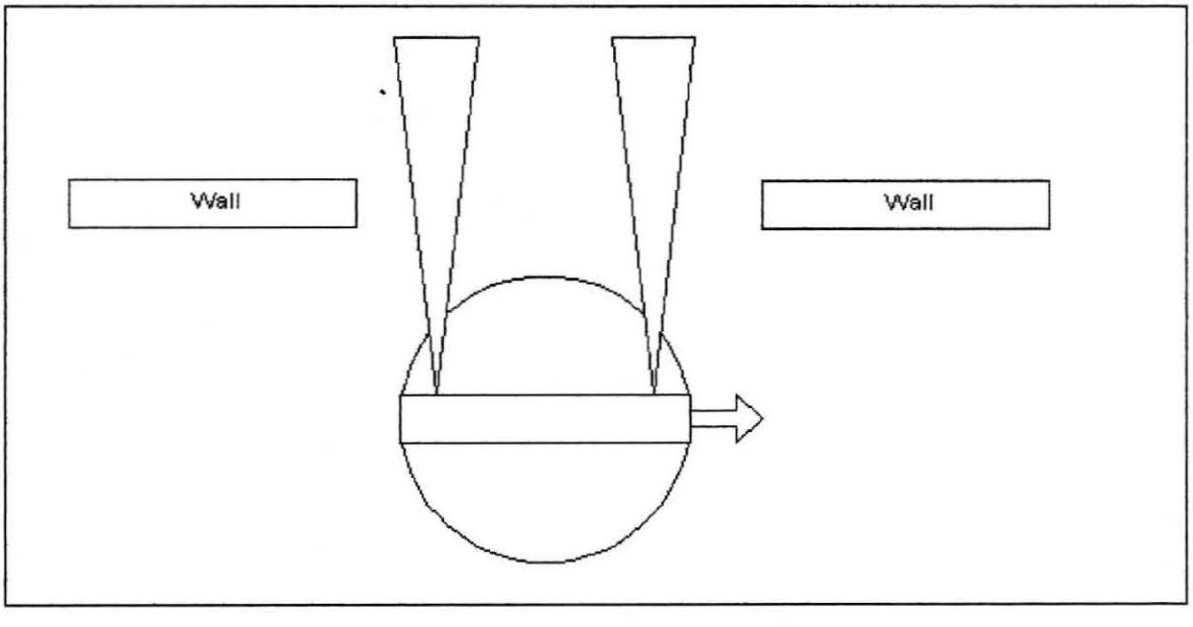

Figure 2.3: The robot passes the doorway.