CORPORATION ROBOTS

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DEDICATION

To my beloved parents, sisters, brother, friends and lecturers, without your fully support, guidance and advice I might not had this kind of achievement.

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ABSTRACT

Nowadays, various robots are built to perform multiple tasks. Multiple robots working together to perform a single task becomes important. One of the key elements for multiple robots to work together is the robot need to able to follow another robot. This project is mainly concerned on the design and construction of the robots that can follow line. In this project, focuses on building line following robots leader and slave. Both of these robots will follow the line and carry load. A Single robot has a limitation on handle load capacity such as cannot handle heavy load and cannot handle long size load. To overcome this limitation an easier way is to have a groups of mobile robots working together to accomplish an aim that no single robot can do alone.

ABSTRAK

Saat ini, pelbagai robot dibuat untuk menjalankan banyak tugas. Beberapa robot bekerja sama untuk melakukan satu tugas menjadi penting. Salah satu elemen kunci untuk robot ganda untuk bekerja sama adalah keperluan robot untuk bisa mengikuti robot lain. Projek ini terutama berkaitan pada reka bentuk dan pembinaan robot yang dapat mengikuti garis. Dalam projek ini, menumpukan pada pembangunan baris berikut pemimpin robot dan budak. Kedua-dua robot akan mengikuti garis dan membawa beban. Sebuah robot tunggal mempunyai had-had dalam menangani kapasiti beban seperti tidak dapat menangani beban berat dan tidak boleh menangani beban saiz panjang. Untuk mengatasi keterbatasan ini cara yang lebih mudah adalah memiliki kumpulan robot mobile bekerja sama untuk mencapai suatu tujuan bahawa tidak ada satu robot boleh melakukannya sendiri.

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LIST OF SYMBOLS

V	-	Voltage
+	-	Positive
-	-	Negative
I	-	Input
O	-	Output
ICP	-	In-circuit debugger
CCP	-	Capture - compare
PWM	-	Pulse – width modulation
PSP	-	Parallel slave port
RPM	-	Rotation per minute
IR	-	Infra red

LIST OF APPENDIXS

CHAPTER 1

1.1 Introduction

Mobile robots are becoming more heavily used in environments where human involvement is limited, impossible, or dangerous. These robots perform some of the more dangerous and laborious human tasks on Earth and throughout the solar system, many times with greater efficiency and accuracy, saving both time and resources. There exists a Nomad robot used to do all mission in Mars. This mobile robot is a nice application for having new knowledge in the space, but the inversion it is very expense and very complex in design: It requires several capabilities to operate in many environments. The cost was over 1.6 million dollars. If it has problem or fail, all the work will stop. An easier and cheaper way, is to have a groups of mobile robots working together to accomplish an aim that no simple robot can do alone. An ideal application for groups of heterogeneous robots working together, like a society of insect, can accomplish the same mission that one robot. Using simpler mobile robots doing specific task, is less expensive, more reliable and it can reach the same aims of one robots. Some examples of applications are in manufacturing, medicine, space exploration and home. The nature of work environments requires the robotic systems be fully autonomously in achieving human supplied goals. One approach to designing these autonomous systems is to develop a single robot that can accomplish particular goals in a given environment. The complexity of many environments or works may require a mixture of robotic capabilities that is too expensive to design into a single robot. Additionally, time constraints may require the use of multiple robots working simultaneously on different aspects of the mission in order to successfully accomplish the objective. In cases, it may be easier and cheaper to design cooperative teams of robots to perform the same tasks than it would be to use a single robot. Then, it is possible to build teams of heterogeneous robots that can work together to accomplish a mission, where each robot has different architecture performing different task in a collaborative manner. Any of this group of robots needs reliable communication among them, in such way that the robots will be able to accomplish their mission even when no robot failures occur. The multi robot system required some knowledge of capabilities of its team-mates, before the start of the mission. The team of robots can be model observing the natural behavior of insects. They form colonies with individuals that perform different roles in function of the needing of the community. Using this model, it is possible to have colony of robots with some robots in charge of some responsibilities to work with others in a cooperative way to do same tasks, in a collaborative way, to communicate each other to be more efficient or to take decisions in a collective way, etc. in the same form as natural insects. This colony has to have "nest" where the some robot assigns to others what to do, and other robot that receive orders from human and communicate him the results. It is necessary to formulate, describe, decompose, and allocate problems among a group of intelligent agents; to communicate and interact; to act coherently in actions; and to recognize and reconcile conflicts. In this presentation is focusing in colony of robots. This implies to merge several disciplines such as mobile robotics, intelligent agents, ontologisms, semantics, as well as automatic control, models of communities, communication, and others ones, to have control of a society of robots working together in a collaborative and cooperative way in a non structured environments [1] . Design and construction of Mobile Robot requires a broad range of engineering skills such as electronics design, mechanical design, program design and how the student approach complex engineering problem. To build this project we need know how to build the sensor circuit, comparator circuit, controller circuit and motor driver circuit then we connect them together as showing in Figure 1.1

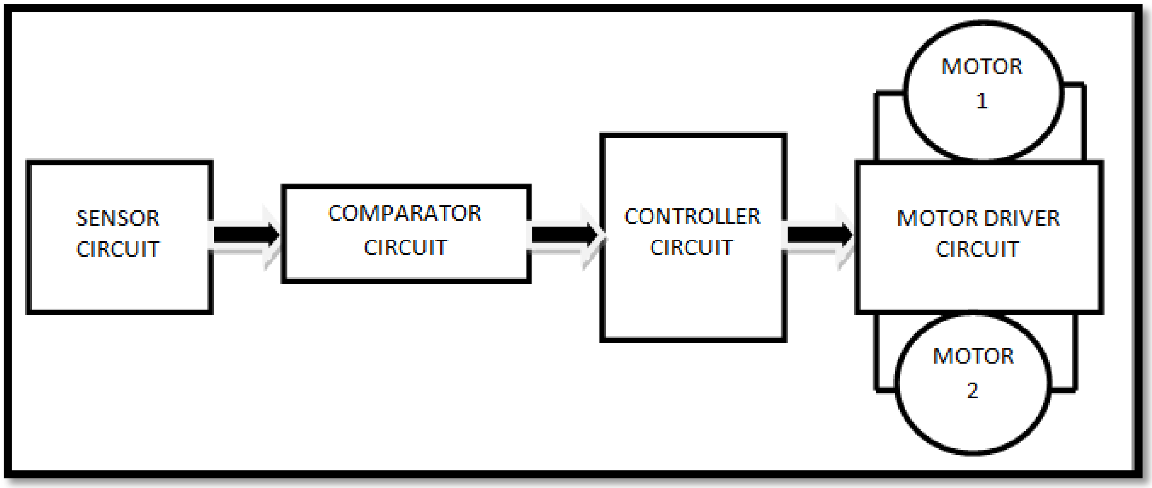

Figure 1.1: Block diagram of mobile robot

A mobile robot is divided into two main parts, namely the software and hardware. For the software, PIC16F877A micro controller will be use for system controller for this robot. While on the hardware side, a circuit will be built and connected to sensors and motors. For this project a better of reflective sensor is to use Infrared Light (IR) and NPN transistor, as less much interferences. The control has 6 modes of operation, turn left/right, forward/reverse, and stop. The actual action is caused by controlling the direction/speed of the two motors (the two back wheels), thus causing. Two motors as an output will control by motor driver that connected to the PIC16F877A

1.2 Problem statement

A Single robot has a limitation on handle load capacity such as cannot handle heavy load and cannot handle long size load. To overcome this limitation an easier way is to have a groups of mobile robots working together to accomplish an aim that no single robot can do alone. The problem statement of this project is how to develop corporation robots.

1.3 Objectives

In this master project the objectives divided into:

1- To design single line following robot as leader.
2- To design second line following robot as slave robot.
3- To develop a programming code suitable for both robots to follow the line.

1.4 Scope of project

Scope of this project proposal is:

1- Develop two following line robots. In which the first robot as leader and the second robot as slave.
2- The robots controller developed by using PIC16F877A microcontroller that is program with assembly language.
3- Use DC motors as actuators with suitable motor driver.

1.5 Organization of project

Chapter one: Discuses the introduction (problem statement, Objectives, Scope of project and Organization of project)

Chapter two: Discuses the literature Review

Chapter three: Discuses the methodology

Chapter four: Concluding the results and Discussion

Chapter five: Conclusion and recommendations

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews some of previous work on development of single and corporation robots.

2.2 Development of road vehicle convoy system

A final year project entitled “Development of a road vehicle model for road vehicle convoy system” [2] was conducted at Faculty Electrical Engineering (FKE), University Technology Malaysia in 2007. In this project, two small scale car-like robots were developed. One is the leading vehicle and another is the following vehicle. The following vehicle could follow the leading vehicle in straight line.

Both vehicles in this project utilize PIC 18F454 microcontroller (MCU) as the “brain” for both vehicles. The following vehicle utilizes ultrasonic sensor (R40-16 & T40-16) to detect and measure the distance between the leading and the following vehicle. When the ultrasonic sensor sends a wave with certain frequency and received it back through reflection after hit the obstacle, the information was sent to the PIC microcontroller. The Microcontroller then perform calculation to obtain the distance between the vehicles and follow the vehicle. The C programming language was used for the programming part in this project. The MPLAB IDE version 7.43 with C18 compiler support C language programming.

The robot follower in [2] has a numbers of limitations. Firstly, the following vehicle cannot follow the leading vehicle when the leading vehicle turn left or right from the straight line. Besides, the following vehicle could not avoid any obstacle or collision. The following vehicle also could not vary its speed in accordance to the distance between the vehicles. It can travel at a constant speed only.

2.3 Low Cost Sensing for Autonomous Car Driving on Road

Figure 2.1 HANS Vehicle

According to [3], a car-like robot equipped with a system called HANS, is able to navigate in an autonomous and safe manner, performing trajectories similar to the ones carried out by human drivers. The system was successfully tested in both simulations and in a laboratory environment using a mobile robot to emulate the carlike vehicle. As a result, this autonomous car can follow the front vehicle in curve road. Besides, this mobile robot also can follow the road, keeping the car in the right lane, maintaining safe distances between vehicles, and avoiding collision. For this mobile robot, it is assumed that there are no cars driving faster than the HANS vehicle which means that no cars will appear from behind.

HANS in [3] uses a low resolution web camera located in the centre of the vehicle behind the rear-view mirror and a set of sixteen sonar sensor. The key role of the camera is to act as a vision system. It is used to detect the side lines that bound the traffic lanes, the position and orientation of the robot relative to these lines, and the vehicles driving ahead and determining their lane and distance to the robot.

The sixteen sonar sensor was arranged to build up a occupancy grid as shown in figure 2.2. This strategy is to reduce the influence of sonar reflections. Each sonar sensor will form up one cone and each cone is divided into zones. The distance of each zone is defined from the robot. Obstacles lying over a region of the occupancy grid contribute to the voting of the cells. The zone with the highest number of measurements (votes in a sense) is considered as being occupied by obstacle. Sonar sensors are also used to detect emergency stopping conditions. With combinational of camera and sonar sensor, the perception of environment also can be mapped for the robot making autonomous decision.

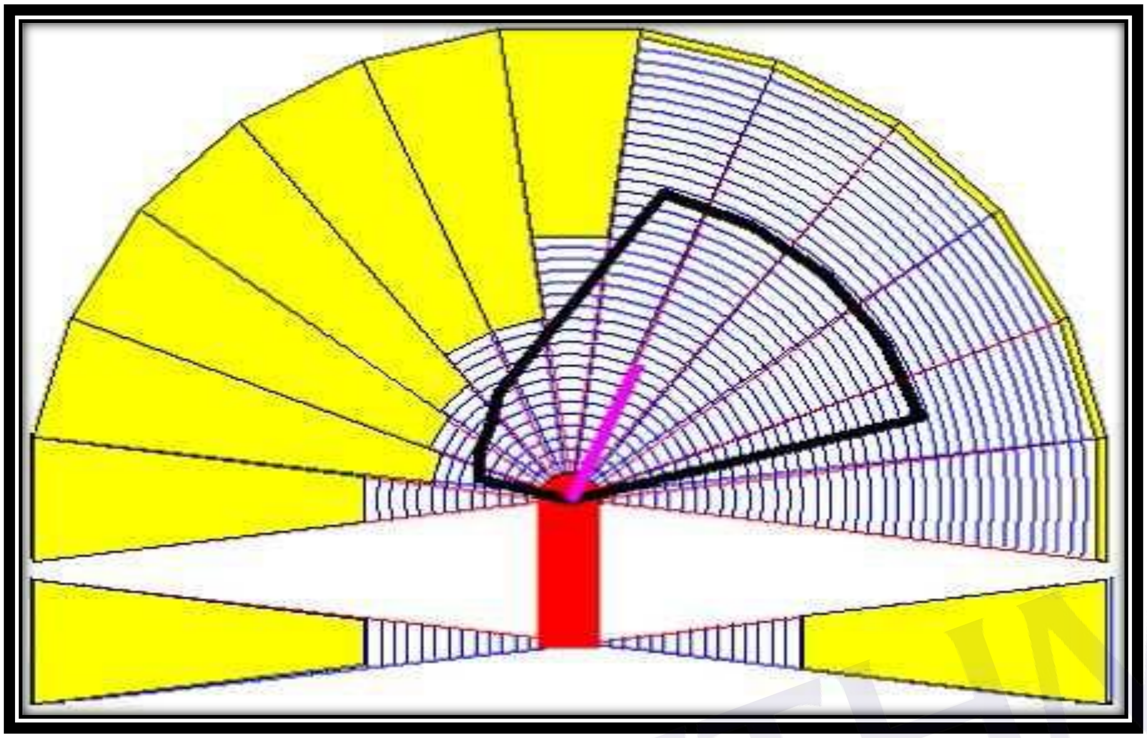

Figure 2.2**:** Occupancy Grid

2.4 Leader/Follower Behavior using ultrasonic transmitter and receiver

Figure 2.3 shows two robots that are performing the leader and follower behavior. The robot is called Maxelbot [4]. In figure 2.3, one of the robots acts as the leader and another robot act as follower in the following behavior. The leader uses the ultrasonic transmitter to transmit a signal through the parabolic cone. The purpose of the parabolic cone is to transmit the signal at 360 degree to the surrounding. The three receivers of the following car will catch the signal transmitted from the transmitter. Then the following car will perform mathematical calculation based on the distance of three receivers from the transmitter. Base on the calculation result, the follower predicts the distance and angle of leader relative to the follower.

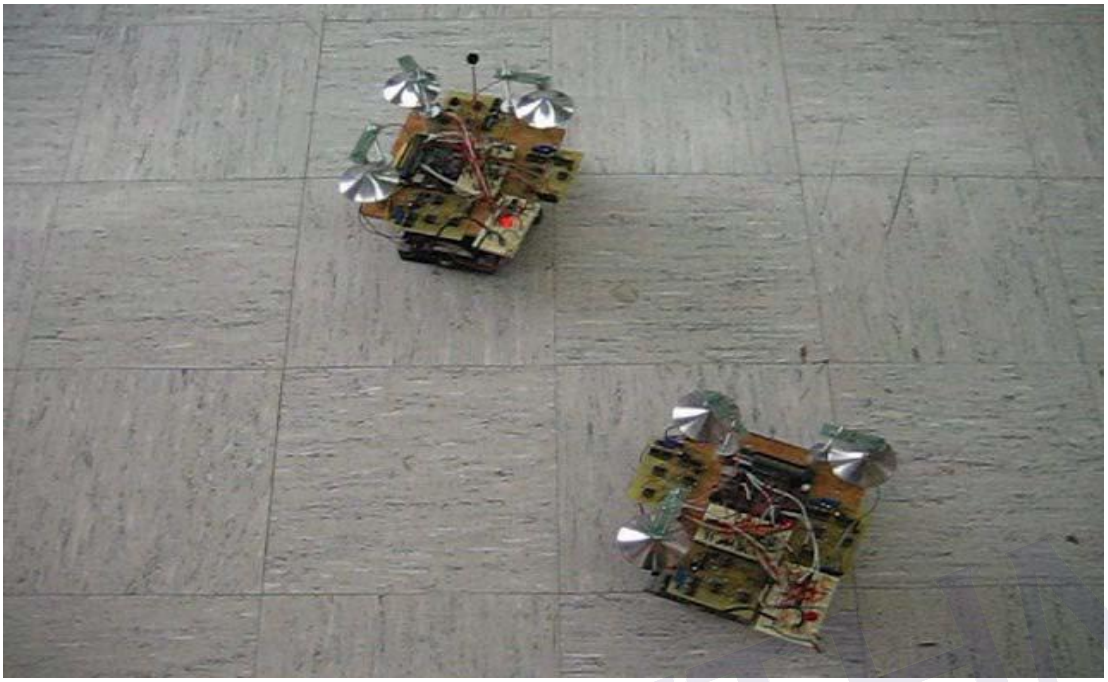

Figure 2.3 : Maxelbot

Limitation of this project is that the effective distance that can be measured by the follower from the leader is about one meter only. Once the distance of the leader is more than 1 meter from the follower, the follower cannot follow the leader.

The advantage of this method is that the cost of the hardware is relatively low when compared to the vision system base method. Beside, the robot is more robust when performing the following task in multiple obstacles environment compared to following system utilizing IR sensors only.

2.5 Scale Invariant Feature Transform (SIFT) algorithm

In [5], a robot was constructed to follow human or another robot using the vision system. The vision system in this project utilized the SIFT algorithm as shown in figure 2.4. In this algorithm, the robot uses the feature extracted from the training image of target to track the target. Firstly, it uses the SIFT algorithm to recognize the target. After the target is recognized, it estimates the position of the target. Then it uses the PID controller to control the motor to maintain the minimum distance between the follower and the target.

Figure 2.4: Robot Follower Using SIFT Algorithm

There are a number of limitations of this method for following behavior. The 3.5 meter effective distance for the recognition system is adequate for a small robots operating indoors, but would not be adequate for larger outdoor platforms. Additionally, direct pursuit of the leader's current position is quite impropriate and does not work well in complex environments. PID control loops were time consuming to properly tune, and the performance of the simple robot platform limits the applicability of the system as implemented to wider applications.

The advantages of this system are: Firstly, the immunity to orientation and occlusion problems made the system easy to use. Object recognition also allows for the implementation of a wide variety of different behaviors based upon a set of different

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