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OBSTACLE AVOIDANCE ROBOT ALGORITHM

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"I hereby declared that this thesis is the result of my own effort except as clearly stated its references"

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Dedicated to my beloved family especially my mother, father, brother and sisters.
Also to all my friends.

ACKNOWLEDGEMENT

First of all, I would like to take this opportunity to thank God for his blessing. He gave me physical and mental strength to carry on my final year project up to completion.

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ABSTRACT

Obstacle avoidance is one of the most critical factors in the design of autonomous vehicles such as mobile robots. One of the major challenges in designing intelligent vehicles capable of autonomous travel on highways is reliable obstacle avoidance system. Obstacle avoidance system may be divided into two parts, obstacle detection (mechanism, hardware, sensors) and avoidance control (algorithm, software, code). Vector field histogram (VHF), vector field histogram with look ahead verification (VHF*) and virtual force field (VFF) are a few methods currently used in obstacle avoidance algorithm. This project aims to improve the current obstacle avoidance system using combinational of VHF* and coordination method. The algorithm is programmed into PIC 16F84A and tested on a prototype. The prototype is build using infra red sensor with comparator circuit and DC motor. The project has been tested on several parameters; target distance obstacle distance and size of an obstacle. The result shows that the prototype works at 60% of successful rate.

ABSTRAK

Sistem pengelak halangan adalah bahagian yang amat penting di dalam rekabentuk sesebuah robot bergerak. Bahgian yang agak mencabar di dalam rekabentuk robot bergerak adalah adalah bagaimana memastikan keblehpercayaan sesebuah sistem pengelak halangan. Sistem pengelak halangan yang ingin diangunkan did alam projek ini boleh dibahagikan kepada dua bahagian penting. Bahagian pertama adalah perkakasan iaitu perkara berkenaan motor, pemproses mikro dan pengesan halangan. Bahagian kedua pula adalah berkaitan perisian iaitu pengaturcaraan untuk sistem pengelak halangan. Jenis pengesan yang biasa digunakan untuk mengesan halangan ialah pengesan gelombang buyi, pengesan infra merah dan pengesan sonar. Manakala jenis jenis algoritma yang telah digunakan utuk sistem pengelak halangan ialah VHF, VHF* dan VFF. Projek ini bertujuan untuk memperbaiki sistem yang sedia ada. Prototaip yang dibina untuk projek ini menggunakan PIC16F84A, motor arus terus dan pengesan infra merah. Prototaip yang dibina telah diuji dalam beberapa keadaan. Didapati kebolehan prototaip ini untuk sampai ke kawasan sasaran adalah 60%.

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CHAPTER I

INTRODUCTION

1.1 INTRODUCTION

The project is about the development an obstacle avoidance algorithm. There are two main parts in this project which are hardware and software development. Hardware consists of micro controller, motor controller, sensor, and motor circuits. While the software development part involves of algorithm programming and microcontroller programming.

Many types of controller that can be used such as Intel 8085 microprocessor, Motorola 68k microprocessor, Atmel microcontroller, Peripheral Interface Controller (PIC) microcontroller and Programmable Logic Controller (PLC). Controller that has been chose for this project is PIC 16F84A microcontroller. This PIC is manufactured by Microchip Technology.

The most suitable motor for this project is stepper motor. But due to budget constrain, dc motor is been chosen for this project. Timer and delay concept is applied in the controller program to control motor movement.

1.2 OBJECTIVE

The objectives of this project are:

- Develop a prototype for obstacle avoidance robot.
- This obstacle avoidance robot should be able to find their original track after avoiding an obstacle.
- The prototype should not have any line tracking sensor in order to achieve the second objective.

1.3 PROBLEM STATEMENT

Nowadays there is a lot of obstacle avoidance robot has been developed. After avoiding an obstacle, these robots cannot find their original direction. Therefore, this project's main objective is to overcome this problem.

For example, if the robot is to reach a target at 10 meter to the north, but there is an obstacle between the robot and the target; a normal obstacle avoidance robot will

never reach the target. This is because when the robot detects an obstacle, the robot will change their direction but does not return to its original track. This example can be illustrated as shown in Figure 1.1 below.

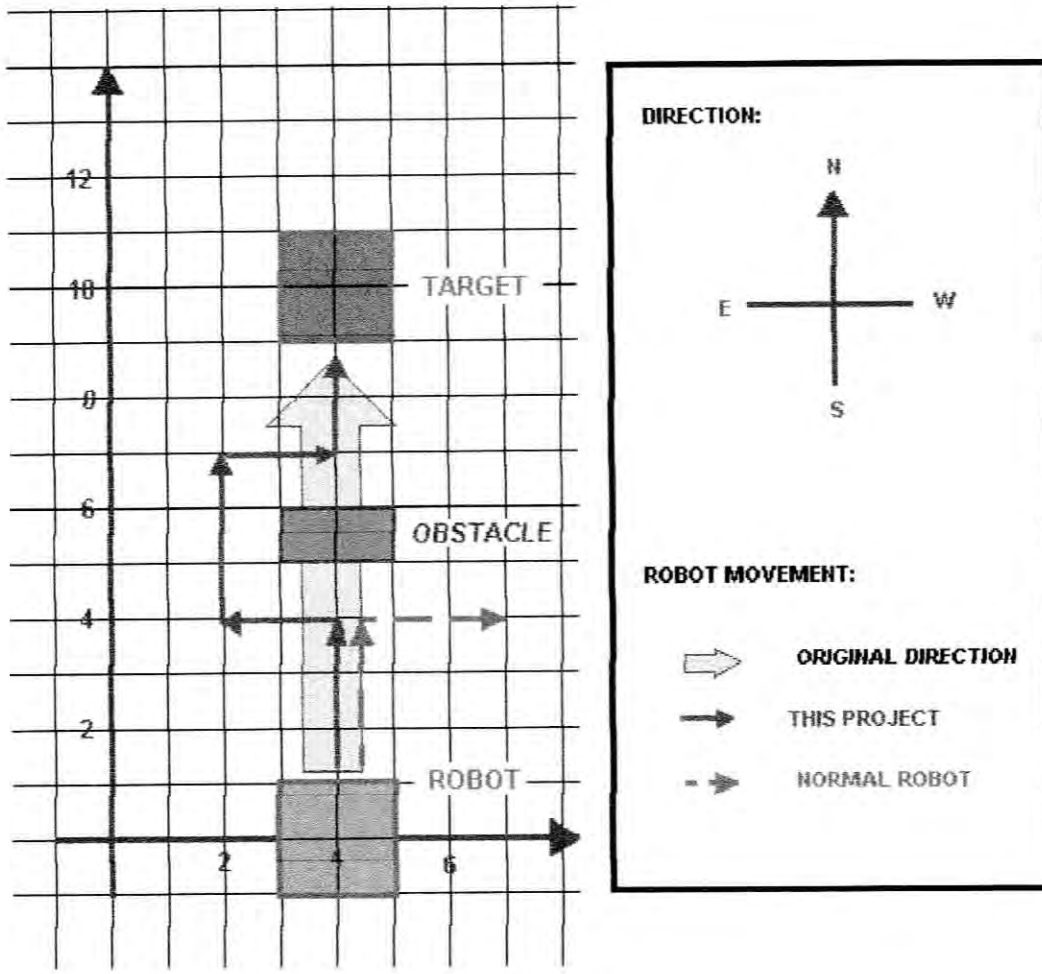

Figure 1.1: Robot movement

1.4 LIMITATIONS:

Obstacle that can be detected by the sensor:

Distance (max):		100 cm
High (min)	:	8 cm
Wide (min)	:	2 cm
Type	:	any material that can reflect wave like paper, glass and metal
Shape	:	any shape that can make the reflected wave reach IR detector

1.5 SCOPE OF WORK

This project covers:

- Suitable devices that can be used in this project.
- Development of a suitable algorithm for the robot in order to fulfill the objective of this project.
- PIC programming
- Circuit developments
- Build a prototype for obstacle avoidance robot.

1.6 REPORT STRUCTURE.

Chapter I is introduction of this project. It explains the objective of this project, problem statement, limitations and scope of work.

Chapter II is about the literature review. Literature review is important in order to understand previous work done in the same field. Literature review covers previous algorithm, microcontroller PIC16F84A, motor controller L293D, power supply and rechargeable battery.

Chapter III is about the project methodology. This chapter explains the procedures that have made in order to complete this project. It is include circuit design and construct the prototype.

Chapter IV is about result and discussion for this project. Prototypes that have been constructed at the previous chapter used to figure out the result of this project.

Chapter V is about summary and future recommendation. Summary have been made due to overall project. Future recommendation is upgrade that can be made to this project to make it more reliable.

CHAPTER II

LITERATURE REVIEW

2.1 INTRODUCTION

There are many types of devices and components can be use for constructing an obstacle avoidance robot. This chapter will explain briefly about the device and component that have been used in this project. The devices that have been chose for this project is main controller, obstacle avoidance sensor, motor controller and power source.

PIC16F84A is chosen as the main controller, quadruple half H-bridge drive *L293D* as a motor microcontroller, IR transmitter and IR detector as an obstacle avoidance sensor and nickel-metal hydride (NiMH) rechargeable battery as a power source. Motor type that has been used in this project is DC motor.

2.2 MAIN CONTROLLER

There is a lot types of controller that can be use to control a system. Tree main controller type have been commonly used today is programmable logic controller (PLC), microprocessor and microcontroller.

PLC applications are widely used in electrical device control system. PLC usually used in factory as production line control system. This type of controller infrequently used for electronic control system. To implement this PIC for a robotic system is not efficient due to the price of PLC. Currently the price for one unit PLC controller is more then RM500. This price is really high compare to the price of one microprocessor or microcontroller.

Microprocessor is usually implemented in electronic control system. It is widely used in mobile phone, personal digital assistance (PDA), VCD player and robotic control system. One chip microprocessor cannot stand alone. It has to be implemented with memory chip, input output (IO) controller chip, clock and peripheral device. This feature provides flexibility to microprocessor. The memory and IO port can be easily expand by adding additional memory chip or IO controller chip. Example of microprocessor is Intel 8085, Atmel and Motorola 68K.

Microcontroller is a single chip that contains controller processing unit, memory and IO controller. It can operate alone without additional peripheral chip like microprocessor. The advantages of microcontroller compare to microprocessor are cheaper and easy to implement. Disadvantage of microcontroller is lest flexibility due

to integrated memory and IO controller. Microcontroller widely used in digital camera, television, robot, electronic device and vehicle control system.

In this project used PIC Microchip microcontroller as a main controller. This decision has been make due to the low price and simplicity of the microcontroller. Microcontroller is also easier to find in the market compare to microprocessor and PLC.

2.3 OBSTACLE AVOIDANCE SENSOR

There is a lot type of sensor available in the market now a day. In example infra red (IR) sensor, limit switch, LDR, red green blue (RGB) sensor, digital compass, ultra sonic sensor and sonar sensor. A few type of this sensors cannot find easily like sonar sensor and digital compass.

There is a few type of sensor that can be use for obstacle detection. The most common used is ultra sonic sensor, sonar sensor and infra red (IR) sensor. The operation method apply in sonar and ultra sonic sensor is quite same. The difference between sonar and ultra sonic sensor is the sonar sensor can be rotate 360 degree. All of this sensor use wave reflection method to detect an obstacle.

Usually these obstacle avoidance sensors have two parts which is wave generator and wave detector. For ultra sonic, sonar and IR it is used 38 kHz to 40 kHz frequency to be operated.

2.3.1 IR sensor and IR LED

There are two main types of IR sensor. The first one is IR activated transistor. Even the name is transistor, but this sensor only has two pin. This pin represent for emitter and collector. This sensor will activate when there is a IR wave detected. Figure 2.9 shows the symbol of this sensor.

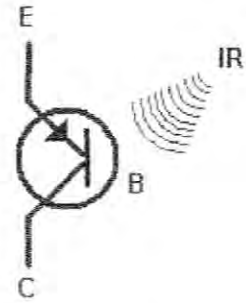

Figure 2.1: IR sensor symbol

The second type of IR sensor is IR sensor that have tree pin. Two pin for supply and the other one pin for output signal. The arrangement of the pin is not the same for all this kind of sensor. Figure 2.10 shows a few type of pin arrangement for IR sensor. Without datasheet, try and error analysis have to use to figure out the pin arrangement.

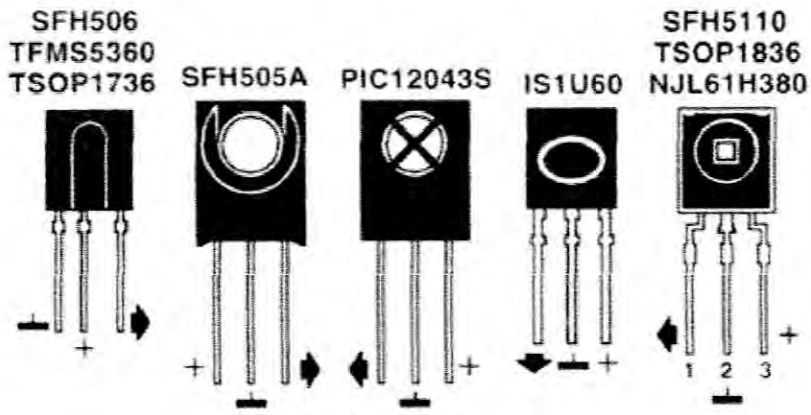

Figure 2.2: Several type of IR sensor.

Source: http:// www.spettel.de/ralf/projekte/avr_rc5/index.shtml