UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BARRIER PROBLEM SOLVING IN LINE FOLLOWER VEHICLE USING ULTRASONIC SENSORS

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Computer Engineering Technology (Computer Systems) (Hons.)

by

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TAJUK: **Barrier Problem Solving in Line Follower Vehicle Using Ultrasonic Sensors.**

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I hereby, declared this report entitled "Barrier Problem Solving in Line Follower Vehicle using Ultrasonic Sensors" is the results of my own research except as cited in references.

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Date   : 14 JANUARY 2015

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor's Degree in Computer Engineering Technology (Computer Systems) (Hons.). The member of the supervisory is as follow:

…………………………

Dr Abd Kadir

ABSTRAK

Perkembangan komputer moden dan alatan yang berkaitan adalah berkait rapat daripada ciptaan transistor. Kemunculan transistor terutamanya merevolusikan alatan kejuruteraan dengan mengurangkan saiz cip dan meningkatkan kecekapan. Sekarang , kita sedang dikerumuni dengan kehadiran yang banyak alat komputer yang canggih dan alat-alat perhubungan , menggabungkan idea-idea yang bijak dan keadaan reka bentuk seni. Apabila sejarah dunia akan pasti direkod pada masa sekarang adalah zaman sains dan teknologi. Keajaiban sains dan teknologi bukan sahaja merunsingkan minda manusia tetapi juga membawa kemudahan dan kualiti kepada kehidupan harian manusia. Projek akan terus menerus menggunakan kaedah saintifik. Projek ini berdasarkan kenderaan yang mengikuti garis laluan. Kekurangan yang ada pada projek ini adalah had penggunaan dan akan membebankan. Projek ini juga boleh mengesan halangan yang ada. Robot yang bergerak sendiri untuk mencari jalan dan mengelak halangan adalah kenderaan yang akan mengikut laluannya dengan dua cara, iaitu:

1. Mengikut garis laluan – Ia adalah kenderaan yang digunakan untuk mengikuti garisan yang dipantulkan dilukis di atas lantai. Ia mengesan kedudukan garisan dengan sensor IR. Sensor akan dipasang pada hadapan robot menghadap bawah.

2. Pengawalan halangan – Apabila terdapat halangan yang muncul di atas garisan, kenderaan akan mengesannya dengan menggunakan sensor ultrasonic.

ABSTRACT

The modern growth of computer and its related hardware is consequence of the invention of the transistor. The advent of transistor principally revolutionized the hardware engineering by reducing the hardware size and increasing the efficiency. Now, we are swarmed in with the influx of sophisticated computer gadgets and communication devices, combining ingenious ideas and state of the art designs. When the history of world would be written surely out contemporary age would be called the age of science and technology. The marvels of science and technology has not only bewildered human minds but also brought convenience and quality to human life. The project is continuation of this tradition of science. The project is based on line follower vehicle. It has limitless possibilities of usage and it would certainly become a future workhorse. It can be used to detect the barrier. Autonomous robot for path finding and barrier evasion is a vehicle, which follows the path in two different ways, which are:

    i.   Line Follower – It is a vehicle, which is used to follow the reflecting line drawn on the floor. It captures line position with IR sensors. The sensors will be mounted at front end of the robot.

   ii.   Barrier Handling – When a barrier is appeared on the following line vehicle will detect through the ultrasonic sensor.

DEDICATION

Special dedication to my beloved father and mom, my entire sibling, my fiance, Nur Izzati and my kind hearted supervisor Dr. Abd Kadir and support by En. NurulHalim and my all dearest friends.

ACKNOWLEDGEMENT

First of all, I express my deepest thanks and gratitude's to Allah S.W.T who give me the spirit and the soul throughout the duration of my final year project. Endless appreciation and gratitude to my supervisor, Dr. Abd Kadir and my co-supervised En. NurulHalim who tolerated from the beginning of the report to the completion. However, special thanks to my mother, family, who over the duration has been neglected even ignored, during my deepest concentrations.

It is therefore difficult to name all the people who have directly or indirectly helped me in this effort, an idea here and there may have the appeared insignificant at the time but may have appeared insignificant at the time but may have a significant causal effect. The special thanks to Nur Izzati binti Muhamad Zin for always help me to complete my project.

Last but not least, I take this opportunity to dedicate this report for all computer system of engineering students. All suggestions for further improvement of this report are welcome and will be gratefully acknowledged. This work is reliant on those mentioned in the references and upon the people mentioned above. Without these giants, this work would be mere supposition and I thank them for the solidity their shoulders have granted me.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

A/D	-	Analog to Digital
CPU	-	Central Processing Unit
EEPROM	-	Electrical Erasable Programmable Read-Only Memory
D/A	-	Digital to Analog
DC	-	Direct Current
I/O	-	Input and Output
IR	-	Infrared Sensor
LED	-	Light Emitting Diodes
PIC	-	Peripheral Interface Controller
PWM	-	Pulse Width Modulation
RAM	-	Random-Access Memory
ROM	-	Read-Only Memory
RISC	-	Reduced Instruction Set Computer
>	-	More than
<	-	Less than

CHAPTER 1

INTRODUCTION

1.1   Background

The word "vehicle" or "vehiculum" in Latin language is a mobile machine that transports passengers or cargo. Nowadays, the world of the vehicle grows up fast. Vehicles are becoming more and more widely used in land, sea and air, also with the technology without the driver that called "autonomous vehicle" or "mobile robot". A mobile robot is an automatic machine that is capable of movement in any given environment and instructions. Mobile robots have the capability to move around in their environment and are not fixed to one physical location. Mobile robots are also found in industry, military and security environment.

Today, industries are highly automated for various applications. Automated guided vehicles are now widely used in many industries due to high level of performance and reliability. All guided vehicles feature some kind of barrier avoidance. The functions of guided vehicles is to carry a material and deliver products from one manufacturing point to another; where rail, conveyer and gantry systems are not a suitable option. Designing autonomous vehicle requires the integration of many sensors and actuators according to their task.

1

Barrier detection is primary requirement for any autonomous vehicle. The vehicle acquires the information from the outside environment and process it according to the sensor mounted over it. Various types of sensors are used for the barrier detection which is laser sensor, bump sensor, camera, infrared sensor and ultrasonic sensor among these entire sensors, ultrasonic sensor is most suitable because of its easy to detect hardness object and long range detection. This project consists of ultrasonic sensors and a microcontroller, the sensors are mounted on the vehicle to acquire the information from its surrounding.

Ultrasonic sensors also known as transceivers when they both send and receive but more generally called transducers that work on a principle similar to radar or sonar which evaluate attributes of a target or barrier by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by sensor. Sensor calculates the time interval between sending the signal and receiving the echo to determine the distance to an object.

1.2   Problem Statement

Autonomous vehicle is machine that very important in the world today. Human sometimes cannot do some of works by their own. The created of the autonomous vehicle help human to do these of the work. For example work that will waste human's time and harm the human like transfer product, out of space, underground work or many more. This vehicle is very sensitive and everything in the vehicle must be perfect to do the task that we want. Nowadays most of the delivery jobs such as deliver loads are problem to human in industry because the heavy weight or repeat delivers always. At the same time, it will reduce time and human power. It also will increase the efficiency of the delivery job because human normally affected by pressure and problems. So, this line follower vehicle will be alternative way to solve this problem. However, sometimes an object blocks the pathway of the line following vehicle. It will make the vehicle cannot move. In order to make the vehicle find the path, an algorithm to overcome the problem must be developed.

1.3 Project Objective

The main objective of this project was to make the designed and development a line following vehicle for multipurpose application with a suitable body and wheel. In order to make this project successful, the objective had been declared these objectives must be achieved in completing this project.

There were other objectives of this project:

a) Designed and implemented a system that allows the vehicle recognize barriers in its pathway and avoids the barrier.

b) To develop an approach to find the alternative way in the next pathway, the vehicle can continue moving.

1.4 Project Scope

The systems of the project are the combination of ultrasonic sensor and Arduino microcontroller. Ultrasonic sensor emits a sound pulse that reflects off of objects entering the wave field. The reflected sound or echo is then received by sensor. Detection of the sound generates an output signal for use by microcontroller. The output signal can be analog or digital. Ultrasonic sensor are capable of detecting most objects that are from metal or nonmetal, clear or opaque, liquid, solid, or granular with has sufficient reflectivity. The capabilities of ultrasonic sensors are that are less by condensing moisture than photoelectric sensors. Ultrasonic sensors with digital (ON/OFF) outputs have excellent repeat sensing accuracy. It is possible to ignore immediate background objects even at long sensing distance because switching hysteresis is relatively low. The response of analog ultrasonic sensor is linear with distance. This makes ultrasonic sensors ideal for level monitoring. There are many features that are common to all Arduino boards that make them very versatile. All the boards are based around the ATMEGA AVR series microcontrollers from ATMEL which feature both analog and digital pins.

1.5 Project Limitation

The limitations of this project are:

a) The line must be white but the objects that block the pathway must be not white.
b) The soft object wills hard to detect must be followed by the sensor.

1.6 Thesis Outline

Line follower vehicle for avoid barrier using ultrasonic sensors and Arduino's final thesis is a combination of five chapters overall that contains and elaborates specific topics like introduction, literature reviews, methodology, result and analysis, and conclusion.

a) **Chapter 1:** Introduction

This chapter will simply introduce about the project. This chapter contains introduction, objectives, scope of project, project limitation and problem statement.

b) **Chapter 2:** Literature Reviews

This chapter shows about the studies and research that relevant to the project.

c) **Chapter 3:** Research Methodology

This part will show the canvass about the research methodology used in this project.

d) **Chapter 4:** Result, Discussion and Analysis

This part will state out the result that be obtained, discussion and analysis of the result.

e) **Chapter 5:** Conclusion and Recommendation

This chapter will talk about conclusion and recommendation of the project.

CHAPTER 2

LITERATURE REVIEW

Literature review has been done to gain some ideas before conducting this project. In this chapter, there will some discussion about the previews work done by other researcher. Technical paper series and thesis from other research are referred. Furthermore, the various types of microcontroller and sensors is done as a guideline to choose for the most suitable components to be used in this project

2.1   Line Follower Vehicle

Creating autonomous mobile robots is the first step toward the creation of artificial intelligence robots such as the ones from science to fiction. Robots are like animals, require continuous input to correctly and dynamically understand what they are doing and what they should do next. It is same to line follower vehicle that must avoid the barrier and find their own pathway to deliver the items. Autonomous vehicle have been designed and implemented to perform a wide variety of tasks, from delivering medical sample in a hospital to sweep and to clear unexploded ordnance from a mine-field. One way to simplify this is to define a task based on a simple environmental stimulus, in this project a white line surrounded by black paper. The primary goal is to create sensors and logic hardware to control a line follower vehicle to follow a white line and stop on a field of white. The line follower vehicle also avoids the barriers that are not white color.

Khaled and Samial (2013) proposed a new approach on to differentiate between human and other obstacle and accidental situation send location. The passive Infrared sensor is mainly used to detect human or animal. Atmega8 microcontroller is used in this project.

Jaseung Ku (2005) has been designed a line follower robot to be able to follow a black line on the ground without getting off the line too much. The robot has two sensors installed underneath the front part of the body, and two DC motors drive wheels moving forward. A circuit inside takes the input signal from two sensors and controls the speed of wheels' rotation. The control is done in such a way that when a sensor senses a black line, the motor slows own or even stops.

Erik Albert (2000) had been implemented the line follower robot on every programming environment that currently use. The robot follows a dark line on a light surface. It's been calibrated that >50 is the surface, and <40 is the line on a scale of 0-100. The robot has been implemented two different ways, one as a treaded vehicle and one as tricycle type design. Structurally they are basically the same, two motors in the back to drive, and a light sensor in the front that controls them. If the sensor is over the line, the robot will turn so that it is not over the line, if the sensor is over the surrounding area, the robot will turn until it is over the line.

Now, that is the block diagram for the process in this project as shown in Figure 2.1.
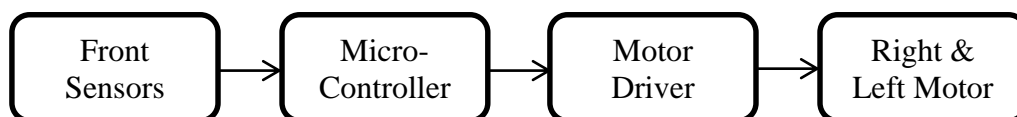

Figure 2.1: Block diagram of project

2.2 Microcontroller

A microcontroller is a computer-on-a-chip. It is an inexpensive single-chip computer and sometimes referred to as one-chip microcomputers, used to control a wide range of electrical and mechanical appliances. The microcontroller existing on the encapsulated silver of silicon has features and similarities to our standard personal computer. The microcontroller is capable of storing and running a program and it is most important feature.

A microcontroller is different from a microprocessor in many ways. The microcontroller is design to be all in one. It is a general-purpose chip that is used to create a multi-function computer or device and requires multiple chips to handle various tasks. No other external components are needed for its application because all necessary peripherals are already built into it. In order for a microprocessor to be used, other components such as memory or components for receiving and sending data must be added to it.

The great advantage of microcontrollers compare to use large microprocessor is that the part-count and design costs of the item being controlled can be kept to a minimum. They are typically designed using complementary metal oxide semiconductor CMOS technology that is an efficient fabrication technique uses less power and more immune to power spikes than other techniques. The microcontroller is capable of storing and running a program the most important feature.

The microcontroller contains a central processing unit (CPU), random-access memory (RAM), read-only memory (ROM, electrical erasable programmable read-only memory (EEPROM), input and output (I/O) lines, serial and parallel ports, timers, and other built-in peripherals such as analog to digital (A/D) and digital to analog (D/A) converters. Figure 2.2 shows for the microcontroller based system.
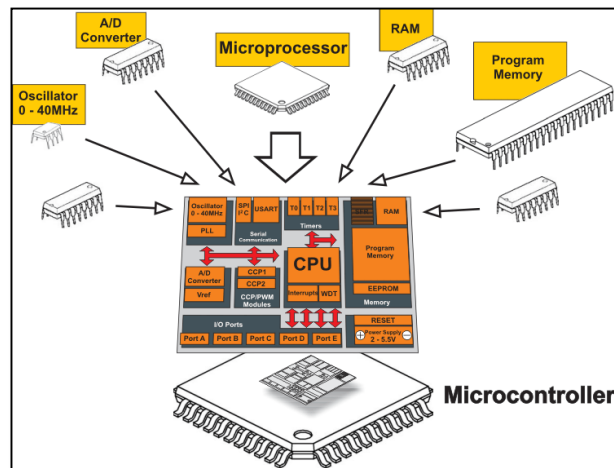

Figure 2.2: Microcontroller based-system (Verle, 2010)

2.2.1 Central Processing Unit (CPU)

The CPU is the internal core of the microcontroller that used to accept the input data, execute the programs, and output the results. In general, the CPU will add data, move and compare data, execute loops, read and store data, read and modify internal status registers, and increment counters. Figure 2.3 shows for simplified central processing unit with control unit and registers.
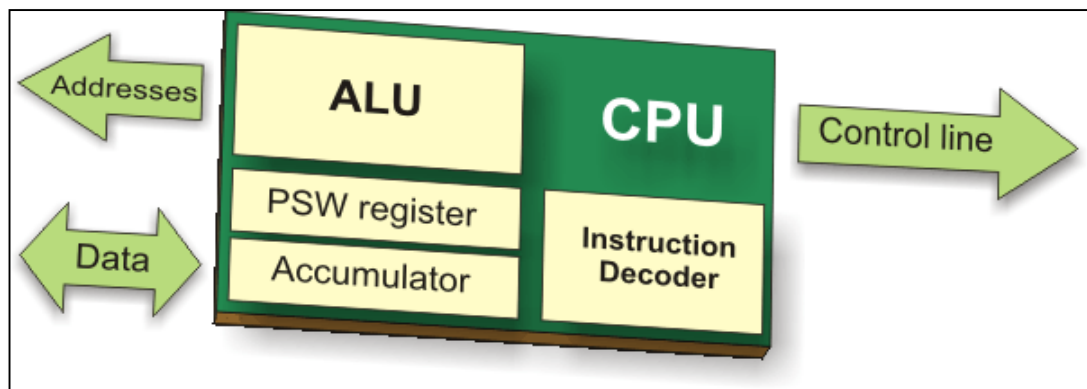

Figure 2.3: Simplified central processing unit with register (Verle, 2010)