DESIGN AND DEVELOPMENT OF ULTRASONIC REVERSE SENSOR

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ABSTRACT

This project is about designing and development of ultrasonic reverse sensor using programmable interface controller (PIC) microcontroller system, ultrasonic sensor and several other devices. The main problem of the driver is how to reverse their vehicle safely without any accident. Some of them complained that their vehicles are easily damaged when it's hitted by obstacles that are hardly seen through their rearview and side mirror. The objective of this project is to build a reverse car system that can measure the distance between vehicle and the obstacle behind the vehicle which can warn the driver by using an alarm. It is also an improvement for already used device by using beeping sound when the vehicle near to the obstacle or object or wall. The output of this system can be divided into two parts which are display mode and audio mode. For display mode, liquid crystal display (LCD) is used to display the distance of the vehicle based on condition that have been set. For audio mode, a buzzer is used to warn the driver about the distance of the vehicle with the obstacle behind it. The faster tone of beeping sound means that the vehicle is closer to the obstacle. The ultrasonic sensor is located behind the vehicle in order to detect the obstacle or object behind it. The maximum range ultrasonic sensor can measure is up to 200 cm and minimum range is 2 cm. The microcontroller analyses the signal, sends the command and measure the distance of the object from the vehicle within the specific range of detection. The measured distance is displayed on the LCD display. Advantages of this ultrasonic sensor are low cost, easy to manage and it also provides distance measurement compare to the existing device in the market.

ABSTRAK

Projek ini bertujuan membina sebuah sistem pengesan objek di belakang kenderaan dengan mengunakan sistem pengawal micro (PIC), sensor ultrasonik dan beberapa peranti lain. Masalah utama bagi pemandu adalah ketika mengundurkan kenderaan secara selamat. Ramai pemandu yang mengadu bahawa kenderaan mereka yang berharga rosak akibat daripada terlanggar sesuatu yang susah dilihat melalui cermin sisi ataupun cermin belakang. Objektif projek ini adalah untuk membina satu sistem pengundur kenderaan yang boleh mengukur jarak antara kenderaan dan halangan di belakang yang boleh member amaran kepada pemandu. Ia juga merupakan penaiktaraf bagi peranti yang sedia ada yang hanya mengeluarkan bunyi bip apabila kenderaan terlalu dekat dengan objek atau penghalang. Keluaran bagi projek ini boleh dibahagi kepada dua iaitu melalui bunyi dan paparan. Melalui bunyi loceng isyarat digunakan untuk mengingatkan pemandu tentang jarak kereta dengan sesuatu halangan di belakang kereta. Semakin laju bunyi loceng isyarat semakin dekat jarak kereta dengan sesuatu benda di belakangnya. Manakala melalui paparan pula "Liquid Crystal Display" (LCD) digunakan untuk memaparkan jarak berdasarkan keadaan yang telah ditetapkan. Ultrasonik diletakkan di bahagian belakang kereta untuk mengesan sesuatu halangan. Isyarat daripada ultrasonic akan dihantarkan ke pengawal sistem. Sensor ultrasonik boleh mengukur jarak maksimum pada 200cm dan jarak minimum pada 2cm. Pengawal akan menganalisis isyarat dan menghantar arahan untuk mengura jarak dari kenderaan. LCD akan memaparkan jarak yang dikira melalui pengawal. Antara kelebihan sensor ultrasonik adalah, senang dijaga dan ianya juga menghasilkan pengukuran jarak berbanding dengan yang telah tersedia ada dipasaran pada ketika ini.

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LIST T OF ABBREVIATION

cm	–	centimeter
Hz	–	Hertz
V	–	Volt
LCD	–	liquid crystal display
IO	–	Input/output
PIC	–	Programmable interface controller
E	–	Enable
R/W	–	Read/Write
RS	–	Register select
CRT	–	Cathode ray tube
IDE	–	Integrated development environment
MCU	–	Microchip microcontroller
A/D	–	Analog to digital
DC	–	Direct current
PWM	–	Pulse-width modulation

CHAPTER 1

INTRODUCTION

1.1 Introduction

Presently, laser, radar, infrared ray and ultrasonic have been widely applied at the aspects of safety technique of car collision avoidance and distance measurement. In the aspect of collision avoidance laser, radar and infrared ray are commonly applied to measure the control range between two cars and the range which should be measured behind the car [1]. At the aspect of distance measurement the technique of ultrasonic is applied to measure the detection range when a car change the driveway and to detect the obstruction behind the car when backing up or parking. Because of the expensive price, the distance measurement system of backing up with the technique of laser and radar is only set on the minority of slap-up cars, so the research of the distance measurement system of backing up with high ratio of capability and price for the medium cars and the low-end cars is an important task of auto-electronic industry.

Usually, an ultrasonic sensor consists of one ultrasonic transducer, it able to convert the electrical energy into sound and vice versa. Ultrasonic sensors have been used in many type of applications such as detecting and identifying solid objects, measuring the shape and orientation of an object, detecting possible collisions between objects to avoid the collisions from happening, room surveillance, flow measurement and determining a type of material by measuring the absorption of sound [1]. An ultrasonic sensor also known as a sonar sensor and it widely used in application

involving range finding and object detection and avoidance. It also known as transducers when they both transmit and receive data detected. An ultrasonic transducer is a device that converts energy into ultrasound or sound waves above the normal range of human hearing [2].

An ultrasonic reverse sensor is an electronic device that detects the physical movement in a given area and transforms motion into an electric signal. The range meter is connected to devices or indicator that will showed the resulting range that detected. Ultrasonic sensors are used in a wide variety of applications and it is mainly used in transportation area. In market, there are many kind of ultrasonic range detector sell, basically this project is to design a parking range meter by using an ultrasonic sensor that use to detect physical movement of human, animal, or anything that move. The design is to improving the existing sensor in detecting range and also to test the reliability and efficiency of the ultrasonic reverse sensor.

The Ultrasonic Reverse Sensor system technically consists of reverse car system that functional to measure the range between the car bumpers to obstacles behind the car is by using ultrasonic sensors. These parking sensors are using a sonar sensor types. The term sonar is an acronym for sound navigation and radar, it is used to calculate the distance of the object from the time it takes for sound waves to travel to the target and bounce back. This device uses ultrasonic range finder sensor as method to measure the distance between the rear bumper and obstacles behind the car.

The sensor will send a signal wave and if there are any barriers behind the car this wave signal will bounce back and this range reflection will be analyzed in the microcontroller. The resulting signal from the sensor is in the form of ultrasonic waves. Ultrasonic wave generated will be amplified and filtered in a suitable form before this wave will be analyzed in a microcontroller. After the analysis done, the distance between the sensors with this last barrier will be displayed on the LCD screen. Alarm system (buzzer) can also be added to give an early warning to the user, that mean the buzzer will sound loud and long when the range of the car and obstacle are closely.

1.2 Problems Statement

There are many cases of accidents occurred because of reverse parking problems. Examples of cases of the problem as follows:

1. Child died accidentally hit by father [3].

   KLUANG 16 Jan. - Seorang kanak-kanak, Nur Faridah Mohd. Affandi, 2 tahun, mati setelah dilanggar secara tidak sengaja oleh bapanya yang memandu kenderaan pacuan empat roda di pekarangan rumahnya di Ladang Bukit Cantik, Kahang.Menurut polis, kejadian tersebut berlaku kira-kira pukul 6 petang ketika bapa kanak-kanak itu, Affandi Isnin, 29, seorang jurutera ladang mengalihkan kenderaan tersebut selepas mencucinya di kawasan lapang berdekatan rumah.Kejadian itu disedari oleh bapa berkenaan sebaik sahaja mengundurkan kenderaannya.``Kanak-kanak itu ditemui terbaring dengan berlumuran darah pada hidung dan telinga berhampiran tayar kanan hadapan," kata polis.Anak tunggal Affandi itu kemudian dikejarkan ke Pusat Kesihatan Kahang dan disahkan telah meninggal dunia sebaik tiba di situ. Timbalan Ketua Polis Daerah Kluang, Deputi Supritendan Mohd. Zam Mohd. Zain mengesahkan polis menerima laporan mengenai kejadian itu daripada bapanya pada pukul 8 malam hari yang sama.Menurut beliau, kes itu disiasat mengikut Seksyen 304A, Kanun Keseksaan kerana kecuaian menyebabkan kematian.

2. The boy died hitted by truck driven by his uncle [4].

   KUALA KANGSAR 3 Mac - Seorang kanak-kanak, Khairul Ikmal Abu Bakar, 2, maut setelah dilanggar oleh lori yang dipandu bapa saudaranya di Kampung Keruh Hilir, Padang Rengas, dekat sini pagi ini.Ketua Polis Daerah Kuala Kangsar, Supritendan Zakaria Pagan berkata, kejadian berlaku ketika bapa saudara mangsa, Mohd. Nor Shadan, 46, sedang mengundurkan lorinya di halaman rumah kira-kira pukul 10 pagi.Katanya, Mohd. Nor terasa lori itu

seolah-olah lori itu tersangkut pada sesuatu dan tidak dapat bergerak.Katanya, sebaik sahaja turun dari lorinya, dia mendapati Khairul Ikmal terperosok di bawah tayar belakang lori. Menurutnya, kanak-kanak tersebut yang tinggal bersamanya, cedera parah di kepala dan dikejarkan ke klinik Padang Rengas tetapi disahkan meninggal dunia.Zakaria memberitahu, mayat Khairul Ikmal dihantar ke Hospital Kuala Kangsar untuk bedah siasat sebelum dituntut oleh keluarganya.

Table 1.1: Accident Statistic [5]

PERANGKAAN KEMALANGAN JALAN RAYA BAGI TAHUN 2002-2011 (JAN-MEI)											
TAHUN		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
JENIS KEMALANGAN INJURI	Kemalangan Maut	5,378	5,634	5,674	5,604	5,711	5,672	5,952	6,218	6,260	2,500
	Kemalangan Parah	6,696	7,163	7,444	7,600	7,375	7,384	7,020	6,978	6,002	2,029
	Kemalangan Ringan	30,259	31,357	33,413	5,928	15,596	3,979	12,893	12,072	10,408	4,121
JUMLAH KEMALANGAN INJURI		**42,333**	**44,154**	**46,531**	**39,132**	**28,682**	**27,035**	**25,865**	**25,268**	**22,670**	**8,650**
JUMLAH KEMALANGAN TANPA INJURI (ROSAK SAHAJA)		237,378	254,499	280,283	289,136	312,550	336,284	347,182	372,062	391,751	170,048
JUMLAH KEMALANGAN		279,711	298,653	326,814	328,268	341,232	363,319	373,047	397,330	414,421	178,698
JENIS INJURI	Mati	5,891	6,286	6,228	6,188	6,287	6,282	6,527	6,745	6,872	2,671
	Cedera Parah	8,425	9,040	9,229	9,397	9,254	9,273	8,866	8,849	7,781	2,581
	Cedera Ringan	35,236	37,415	38,631	31,429	19,884	18,444	16,901	15,823	13,616	5,314
JUMLAH INJURI		**49,552**	**52,741**	**54,088**	**47,014**	**35,425**	**33,999**	**32,294**	**31,417**	**28,269**	**10,566**
INDEKS KEMATIAN JALAN RAYA	Setiap 100 ribu penduduk	**24.10**	**25.10**	**24.30**	**23.70**	**23.60**	**23.10**	**23.60**	**23.80**	**24.20**	**NA**
	Setiap 10 ribu kenderaan berdaftar	**4.88**	**4.88**	**4.51**	**4.18**	**3.98**	**3.73**	**3.63**	**3.55**	**3.40**	**NA**
	Setiap 1 Bilion VKT	**22.71**	**22.77**	**21.1**	**19.58**	**18.69**	**17.6**	**17.2**	**17.28**	**17.28**	**NA**
Sumber : Polis DiRaja Malaysia (PDRM)											
Cawangan Trafik Bukit Aman											

Table 1.1 show the statistic of amount of accident in Malaysia in year 2002 until 2011 (Jan - May). From the research, there are a few factors why the accidents occurred because reverse parking problem happened. Firstly the drivers fail to detect if there any obstacle behind the car. Then, the driver is unable to determine the distance between the car and an obstacle behind it.

Besides, there is a device in market that invented which can detect the range of object but the sound of alarm is to low and hard to heard by the driver. The sound produced by alarm sometimes was annoying and make the driver uncomfortable. Other than that, the sound alarm is usually not really accurate and the drivers cannot determine

the exact range of the obstacles accurately. So, basically when the driver put on the reverse gear, the sound is starting to sound with beeping sound until the gear is change to other. Because of the entire factor above, the ultrasonic parking range meter is used to detect the obstacles or object when car is backing up.

In conclusion, Ultrasonic reverse sensor is a complete system which is needed by each driver to make sure their driving is safe and to prevent accident that caused by parking problem from happened. In addition, this system can help the disabled people who suffer from deafness. The proposed project aims to overcome this problem with upgrade the beep sound with LCD display that this system can measure the actual distance between the vehicle and barrier in behind.

1.3 Objectives of project

The objectives of this project are:

i. To build a car reverse system that can measure the distance between the vehicle and the barrier in behind which can warn the driver.
ii. To develop a program by using microcontroller that can measure the distance through the sound of buzzer and display the distance on LCD screen.
iii. To inform the driver the state of car condition either they are in safe, warning or stop zone through the sound of buzzer and distance measurement on LCD.

1.4 Scope of project

In order to achieve the objective of the project, there are several scope had been outlined. The scope of this project includes ultrasonic sensor, microcontroller, buzzer, and 16x2 LCD modules. The scope of this project flow is stated below:

1. Two ultrasonic sensors placed at the rear bumper of the vehicle, one in the left side and another one on the right side of the vehicle.
2. The limit frequency of ultrasonic sensor that used to travel to the target and bounce back is 40 kHz.
3. The distance that the sensors start detects the obstacles up to 200 cm away.
4. Short beep will start warn when the distance of vehicle at 200 cm and the sound will be longer when vehicle is getting closer to obstacles between 40 cm.
5. Microcontroller will be used in this project to develop the program and C programming is used in the program.
6. Distance measurement will be display on LCD (16x2) and measurement unit in centimeter.

1.5 Significant of project

There have a few significant of this project where students able to build a car reverse system that give a benefit to user vehicles. User know the distance between the vehicle and the barrier in behind according to distance on LCD Display while warn the driver by using a buzzer. Students also able to develop a program by using microcontroller where student have been learn more about microcontroller and programming mechanism. This form of thinking and engineering will be prevalent in the modern world and beyond as new applications are found which will test the limits of current technologies. Moreover this study will be helpful to the student to prepare for future work environment.

1.6 Chapter organization

This report consists of five chapters. Chapter 1 is about the problems statement, objectives of project, scopes of project, significant of project and chapter organization.

Chapter 2 will discuss more on theory and literature review about the component that used in this project. This section also contains the previous researches that have been collected from different sources for the development of the project.

Chapter 3 is about the design and methodology of the project. It will explain the methods in details such as the connection of the circuit and the device in order to complete the circuit.

Chapter 4 is about the result and discussion of this project. It will show the student observation in this project.

Chapter 5 will discuss the conclusions and recommendations for the further research when the others students want to upgrading the system in the future.

CHAPTER 2

LITERATURE REVIEW

2.1 Literature review overview

In completing this project, some literature reviews have been done on several resources. The theory and description plus details about the project have taken as guidance in completing this project. By this chapter, an overview of some application that similar to the project and related project design is present.

2.2 Previous Design and Development of Ultrasonic Reverse Sensor

Example of Design and Development of Ultrasonic Reverse Sensor is created by International Journal of Computer Theory and Engineering. Distance measurement of an object in front or by the side of a moving entity is required in a large number of devices. These devices may be small or large and also quite simple or complicated. Such distance measurement systems are available. These use various kinds of sensors and systems. Low cost and accuracy as well as speed is important in most of the applications. In this paper, we describe such a measurement system which uses ultrasonic transmitter and receiver units mounted at a small distance between them. A correlation is applied to minimize the error in the measured distance. Ultrasound sensors are very versatile in distance measurement. They are also providing the cheapest solutions. Ultrasound waves are useful for both the air and underwater. Ultrasonic sensors are also quite fast for most of the common applications. In simpler system a low cost version of 8- bit