ULTRASONIC PARKING RANGE METER

MOHD FIRDAUS BIN ROSLAN

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DR. YOSZA DASRIL
Pensyarah
Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka
Karung Berkunci No. 1752
Pejabat Pos Durian Tunggal
76109 Durian Tunggal, Melaka

Alamat Tetap: A1-T11-U08

JALAN P16J, PRECINT 16,

62150 PUTRAJAYA

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Author : MOHD FIRDAUS BIN ROSLAN

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Signature : .....

Supervisor's Name : DR. YOSZA BIN DASRIL

Date : 05/05/09

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ABSTRACT

This project is about designing an ultrasonic parking range meter using programmable interface controller (PIC) microcontroller system, sensor and several other devices. Ultrasonic parking range meter is a device that measuring the range between vehicle and wall when the vehicle is reversing. Ordinary device only using sensor and produce bleeping sound when the vehicle is too near to the wall. This project is created to improve this ordinary device to ensure people are not mistaken in judging their vehicle and the wall range to avoid crashes. This project is using an ultrasonic receiver and transmitter while the range is shown by seven-segment LED display in centimeter unit. The receiver and transmitter are situated at the backside of the vehicle's bumper and its function is detecting if there's any object (wall) when reverse gear in place. Transmitter will produce ultrasonic to the wall, ultrasonic will turn back to receiver when it reaches the wall and ultrasonic receiver will send the data to PIC microcontroller to calculate the distance. The objective of this project is to avoid car crashes when backing up (parking). It is also an improvement for already used device which is bleeping sound when the vehicle is too near to the wall. Even tough sensor has many disadvantages to vehicles, but the advantages of using it is cheap, easy to manage, it allows meaningful conclusions to be drawn up about a person's lifestyle and how the system can benefit this. Tools can be developed to predict something undesirable before it actually happens.

ABSTRAK

Projek ini bertujuan membina sebuah sistem pengesan objek di belakang kenderaan dengan mengunakan pengesan ultrasonik di mana jaraknya akan dipamerkan melalui paparan tujuh segmen. Pada masa kini, pengesan objek di belakang kenderaan hanya mengeluarkan bunyi sebagai tanda amaran bahawa kenderaan sudah terlalu hampir dengan dinding di belakang semasa mengundur kenderaan. Maka projek ini direka untuk menambah baik sistem yang sedia ada supaya kemalangan semasa mengundur kenderaan dapat dielakkan. Secara umumnya, sistem pengesan ini menggunakan penghantar dan penerima gelombang ultrasonik dan paparan tujuh segmen yang akan memaparkan jarak dalam unit sentimeter. Penghantar dan penerima gelombang ultrasonik akan diletakkan pada bahagian belakang kenderaan dan akan berfungsi apabila gear mengundur dihidupkan. Penghantar gelombang akan mengeluarkan gelombang ultrasonik kepada objek di belakang kenderaan dan gelombang tersebut akan dipantulkan semula oleh objek tadi dan diterima oleh penerima gelombang ultrasonik. Gelombang ini akan ditafsir oleh pengawal mikro dan diterjemahkan ke paparan tujuh segmen. Walaupun penggunaan pengesan terdapat banyak kekurangan, tetapi kelebihannya adalah ia lebih murah dan senang dijaga. Ia banyak digunakan untuk menjangkakan perkara-perkara yang tidak diingini dari berlaku.

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AD	-	Analog Digital
A/D	-	Analog / Digital
ADCTL	-	Analog to Digital Control Register
ADPU	-	Analog to Digital Disable Bit
BB	-	Big Beat
BDLC	-	Byte Data Link Communication
BDM	-	Background Debug Mode
CCW	-	Counter Clockwise
CPU	-	Central Processing Unit
CW	-	Clockwise
DC	-	Direct Current
DDRA	-	Data Direction Register A
DDRB	-	Data Direction Register B
DDRP	-	Data Direction Register P
DDRS	-	Data Direction Register S
DDRT	-	Data Direction Register T
EEPROM	-	Electrically Erasable Programmable Read Only Memory
IC	-	Integrated Circuit
I/O	-	Input / Output
LED	-	Light Emitting Diode

nsec	-	nano second
NPN	-	Negative-Positive-Negative
PACTL	-	Pulse Accumulator A Control Register
PAD	-	General Purpose Input Pin
PAEN	-	Pulse Accumulator A System Enable Bit
PC	-	Personal Computer
PORTAD	-	Port AD Data Register
PORTP	-	Port P Data Register
PORTS	-	Port S Data Register
PORTT	-	Port T Data Register
PNP	-	Positive-Negative-Positive
PWEN	-	Pulse Width Enable Register
PWM	-	Pulse Width Modulation
RAM	-	Random Access Memory
RS	-	Recommended Standard
SCI	-	Serial Communication Interface
SPI	-	Serial Peripheral Interface
TEN	-	Timer Enable Register
TSCR	-	Timer System Control Register
TTL	-	Transistor-Transistor Logic

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CHAPTER 1

INTRODUCTION

1.1 Background of Project

Nowadays the application of microcontroller is widely used for consumer. A microcontroller is a functional computer system on a chip. It contains a processor core, memory and programmable input and output peripheral. It emphasizes high integration, unlike a microprocessor which only contains a CPU. Adding up to the usual arithmetic and logic elements of a microprocessor, microcontrollers include an integrated CPU, memory (a small amount of RAM, program memory, or both) and peripherals capable of input and output.

Microcontrollers often operate at relatively very low speed compared to microprocessors, but this is sufficient for typical applications. Microcontroller consumes relatively little power and will generally have the ability to maintain functionality while waiting for a process such as a button press or interrupt. Power consumption while inactive may be just nanowatts, making microcontroller ideal for low power and long lasting battery applications. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, remote controls, office machines, appliances, power tools, and toys [2].

By reducing the size, cost, and power consumption compared to a design using a separate microprocessor, memory, and input and output devices,

microcontrollers make it economical to electronically control many more processes. Operations of a microcontroller are difficult to be demonstrated without an application. Most of applications available are in big and bulky automatic machine. In commercial applications, sensors are often hidden to improve appearance of the whole unit. Operation of sensors observation cannot be done thoroughly.

One of the best solutions is by developing an application that is easy to use and have easily understandable operations. Selected application is an ultrasonic parking range meter. This type of sensor will replacing the current sensor used on vehicles that doesn't used any microcontroller in its sensor circuit but only adjusting their sensitivity. By replacing this ordinary sensor, driver will be more confident and car crash during reversing can be avoided.

There are several ways to measure distance without contact. One way is to use ultrasonic waves at 40 kHz for distance measurement. Ultrasonic transducers measure the amount of time taken for a pulse of sound to travel to a particular surface and return as the reflected echo. The circuit calculates the distance based on the speed of sound at 25°C ambient temperature and shows it on a seven segment display. By using this kind of circuit, distance up to 2.5 meters can be measured.

For this particular application, the required components are AT89C2051 microcontroller, two 40 kHz ultrasonic transducers, current buffer, operational amplifier, inverter, four seven segment displays, five transistors and some discreet components.

In this project, the ultrasonic transmitter unit will excite with a 40 kHz pulse burst and expect an echo from the object whose distance that want to be measured. The transmitted burst will travels to the object in the air and the echo signal is picked up by another ultrasonic transducer unit (receiver), also a 40 kHz pre-tuned unit. The received signal, which is very weak, is amplified several times in the receiver circuit.

1.2 Objectives of Project

The aims of doing this project are stated below;

1. To design an ultrasonic parking range meter by using microcontroller circuit.
2. To allow full study on function of microcontroller.
3. To demonstrate application module for purpose of education easily.
4. To allow thorough observation on sensors function and operation.
5. To avoid car crashes when backing up (parking)

1.3 Problems Statement

The objective of this project is to avoid car crashes when backing up (parking). It is also an improvement for already used device which is bleeping sound when the vehicle is too near to the wall. This ordinary device was only using normal integrated circuit (IC) and many disadvantages were found when using bleeping sound. The problem for using bleeping sound is people sometimes didn't realize if they were too close to the wall because of the bleeping sound was too slow because the battery had gone low. In other problem, some people felt annoyed by the bleeping sound. Practically, when reverse gear in place, bleeping sound will be produce automatically because it was set by the manufacturer. This kind of output was use either to ensure driver to be careful or reminding the driver that the reverse gear is in place. This project recommends an output that shows the distance between vehicle and the object behind it.

1.4 Scopes of Project

In this project, the scope is based on four main parts. By understanding these elements, the maximum usage of ultrasonic can be obtained to fulfill the requirement. They are:

1. Design an ultrasonic parking range meter for educational purpose.
2. Interface microcontroller with input/output devices using input/output port.

3. Assemble 7 segment display and AT89C2051 in the current sensor circuit.
4. Develop assembly language program to manipulate data from input devices and afterward control output devices.

Programmer develops a program based on desired operation of the ultrasonic parking range meter. Microcontroller executes operation designed in the program. Data from input devices manipulated by microcontroller and then microcontroller will control output devices according to the program. User will only deal with input and output devices.

The scopes of tasks are stated below:

1. Develop program for microcontroller (AT89C2051).
2. Simulate the program.
3. Build a circuit for:
   a) Receiver Circuit.
      Converts a modulated ultrasound signal into useful information
      i. Signal Amplification Circuit
      ii. Detection Circuit
      iii. Signal Detector
      iv. Signal Holding Circuit

   b) Transmitter Circuit
      Transmitting ultrasonic wave to the wall.

   c) 7 segment LED display circuit
      Displaying the distance between the vehicle and wall.

   d) Resonator
      Exhibits resonance or resonant behavior, that is, it naturally oscillates at some frequencies, called its resonance frequencies, with greater amplitude than the others [4].

e) Power supply circuit

Supplying power to the circuit for operating.

4. Hardware assembly and build a unit panel display.

1.5 Methodology

In order to complete this project, there are three stages that need to be completed. The first stage is by understanding the concept of current sensor which is ultrasonic sensor and how does it works. The type of microcontroller had been selected and in order to maximize the full application of this PIC, the datasheet of this microcontroller must be use as reference. This datasheet contains many information about the PIC such as the circuit diagram, the proper power can be applied, every pin construction and its connection usage and further modification. The second stage will be more on researching the current products and how to upgrading it into more useful device. By doing some research, the best way to improve the current sensor can be done and it will avoid any mistake when constructing the circuit. There are some flowcharts that being used to show the relationship between PIC and other components in the circuit. These flowcharts show from the beginning until the end of the circuit process. In other word, it's representing words to describe the processes from power supply to the seven segment display panel which is act as an output. The third stage is about developing the proper assembly language for the PIC microcontroller. This type of coding will ensure the effectiveness of the PIC application into the circuit. It will determine when and what to do when power supply have been applied (switched on). It acts like a brain to the PIC. Finally, the best circuit for the ultrasonic sensor by adding the 7 segment display on a proper place in the circuit is constructed.

1.6 Outline of Thesis

This thesis consists of five chapters. The first chapter explains about background, objective, problems statement, scope and the methodology of this project. Chapter two discuss more on theory and include literature reviews that have been done in order to compare the related products that have in the market with this project development. It also will discuss on components of the hardware and software used in this project. Chapter three discuss on the methodology hardware and software development of this project and also the advantages and disadvantages. Chapter four will discuss about project's testing and results. Finally in chapter five, it will discuss about conclusion and future work proposal for the project.

CHAPTER 2

LITERATURE REVIEW

2.1 Literature Review Overview

This chapter discuss about reviews of existing project created to get an idea about the project design, conception and any information that related to improve the project. With different concept and design, there are other creations and innovations of projects done by other people. Researches related to this project also covered in this chapter.

2.2 Ultrasonic Sensor Having Piezoelectric and Acoustic Matching Member

An ultrasonic sensor having a piezoelectric element mounted on a substrate such as a metallic or resin substrate has been known hitherto. The ultrasonic sensor receives ultrasonic waves transmitted from a transmitter and reflected on an object to be detected. Based on signals outputted from the ultrasonic sensor, a position and/or a distance of the object are detected in a two- or three-dimensional manner.

Some of the ultrasonic sensors include an acoustic matching layer or a member for adjusting acoustic impedance and for improving a receiving efficiency of ultrasonic waves. In this type of the ultrasonic sensor, the piezoelectric element is