ULTRASONIC RANGE FINDER

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ABSTRACT

This project is to build a device that can find range between two objects by using ultrasonic sound wave. Ultrasonic sound wave is cyclic sound pressure with a frequency greater than the upper limit of human hearing. Ultrasonic wave will control and generated by PIC 16F88 microcontroller. It will send through the transmitter and the pulse reflects off an object and is received by receiver. The time from transmission to reflect sound reception lets calculate the distance from the object. Transducer were use to convert sound signal wave from digital to analog signal and vice versa. The result of distance will display on the Liquid Crystal Display (LCD). This device can find range up to 3 meter using 40 KHz transducer and 4 MHz internal oscillator frequency. Normally, distance can be found by used standard device like ruler and meter tape but sometimes this device is not relevant in some situations like to find range between two cars while this car is moving. Main objectives of this project is to build a device (using PIC 16F88) that can measure the distance between two objects by using ultrasonic sound wave and display result of distance on LCD display. With high frequency ultrasonic sound wave that been used, it's should be no problem to get result of distance up to 3 meter. Accuracy of this device is ± 3 cm. This accuracy depend to the error that will be faced from the others sound wave noise of the environment while using this devices. The software mikroC and Proteus Virtual System Modeling (VSM) was used to make programming and circuit for simulation. The Ultrasonic Range Finder device is developed and validated, it can measure distance up to 3 meter by using ultrasonic sound wave and display the result on the LCD panel.

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ABBREVIATION

LCD	-	Liquid Crystal Display
PCB	-	Printed Circuit Board
MCU	-	Microcontroller Unit
TTL	-	Transistor-transistor logic
PIC	-	Programmable Integrated Circuit
IDE	-	Integrated Development Environment
CCP	-	Capture/Compare/PWM Peripherals

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CHAPTER I

INTRODUCTION

1.1 Introduction

This chapter wills representation about the whole major part of the project. That's included the synopsis, analysis, problem statement, scope of work, methodology and expected result of the project.

1.2 Project Synopsis

Ultrasonic range finder is a new digital range measurement device that can be published at the future to replace old measurement devices like ruler and meter tape. It's capable of allowing the user to determine his or her distance from an object or wall. Ultrasonic range finder work by transmitting a short pulse of sound at a frequency inaudible to the ear (ultrasonic). Afterwards the microcontroller listens for an echo. The time from transmission to echo receptions lets to calculate the distance from the object. A range finder can be used in various applications such as a measuring device or an obstacle detection device.

1.3 Project Objectives

1. To build a device that can find range by using ultrasonic sound wave and show the result on the LCD.
2. To design programming circuits that can calculate the distance by using PIC16F88 microcontroller.

1.4 Problem Statement

Today, majority of devices especially measurements devices are available in the digital form but not for the measurements range devices. Normally people will use standard device like ruler or meter tape to measure range. But, for the certain condition such as in the case of a blackout where a person needs to find his way through a dark building and cannot see where the walls are, this is not a good device to measure range. We need something that can be use to find range from our standing point without going to point that we want to measure. This project developed to replace all the old measurement devices with the new era of digital range measurement devices and also can help people in certain situation like blackout and hard situation to measure the distance.

1.5 Scope of Works

The scopes of this project are:

1. To develop a device that can help people to find range up to 3 metre by using ultrasonic sound.
2. To build a ultrasonic transmitter and receiver with have a transducer 40 KHz types to each other.
3. Determine the distance from the reflection of ultrasonic sound wave to the wall or objects which not specific at any surface.
4. Develop a program that determine the distance from the reflect of ultrasonic sound wave at the objects and display the result on the LCD Display.

1.6 Methodology

Methodology is one of the most important elements to be considered to make sure that the development of the project is smooth and get the expected result. The methodology for this project is divided into five phase:

Phase I: Literature review

i. Case study

Phase II: Software specification

i. Write programming/software for PIC microcontroller.
ii. Design hardware through the software
iii. Test programming and hardware

Phase III: Design and develop the hardware.

i. Make the circuit at PCB like design in software.

ii. Test the circuit

Phase IV: Integrate both software and hardware to test whether the system meet the objectives specification of the project.

Phase V: Result Analysis

i. Data collection

ii. Data analysis

1.7 Expected Result

At the end of this project, the prototype of the project expected to working by using microcontroller that can be used to find range up to 3 metre by using ultrasonic sound. The distance between object will be show on the Liquid Crystal Display (LCD). This device can be use in various application, but only need to change the final output in order to make its reliable with the application or some situation. For example if want to put at OKU walking stick, LCD display was not reliable with this situation and need to be replaced with others device like something which can give 'bip bip bip' sound depend on the distance of object. LCD display is suitable with application like replace at the car to find range another car in front of or back, or can use in blackout situation where we want to find range between object or wall. It also can use as alternative measure device or replace the device where we are already used like ruler or meter tape to find distance between two object.

1.8 Conclusion

This chapter is presented objectives, problem statement and scope of the project in section 1.3, 1.4, and 1.5 respectively. It will give some idea and general views about this project. And continued with Chapter 2, the detail explanation about the Literature Review of the project would explain there.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

In this chapter, it will be discuss details about the case study and research including the theory and concept of the entire project. This chapter covers about the previous project work, comparison with existing devices technology, and the hardware that will be used in this project.

2.2 Previous Research Work

From the research that have been made, there are two type of similar project with Ultrasonic Range Finder that already exist and done by someone. Table 2.1 shows the differences between these two projects.

Table 2.1: Differences of the project that already exist

Project name	Ultrasonic Rangefinder	PIC Sonar Range Finder
Resource		
Microcontroller Unit (MCU)	Atmel Mega32	PIC 16F88
Type of Transducer	40kHz	40kHz
Output Devices	LCD	7 segment display
Max. Distance	3 meter	~5cm - 300cm
Accuracy	No data	+/-3cm

From this two project, analysis show that the main different of this two project only at the MCU and the output devices. There are so many MCU in the market that can be choose and used. Different MCU got different advantage and disadvantage, but the main function is same in this project, to calculate the distance. Output devices that be used is depend on the application. For the standard views of the normal people, LCD or 7 segment display is suitable devices that can be used.

The concepts of two projects are same; an ultrasonic pulse is transmitted by a transducer and then this pulse reflects off an object and is received by another transducer. Using the known speed of sound (340.29 m/s) and the time between the transmitted pulse and the received pulse, one can simply calculate the distance traveled by the pulse.

2.3 Comparison with existing devices technology

From the research, Ultrasonic Range Finder that will be developed will taken general idea and concepts from the projects that already exist. This is because to study back and try to make the whole project with own idea maybe lead to meet a lot of problem and take a long time for done this project.

The hardware of Ultrasonic Range Finder that will be developed can be broken down into three functional units, the receiving circuit, the transmitting circuit, and the Microcontroller Unit (MCU) circuit. Function of transmitter and receiver is to send short pulse ultrasonic wave and receive for an echo. Table 2.1 shows the main part what Ultrasonic Range Finder will be used.

Table 2.2: Main part of Ultrasonic Range Finder

Microcontroller Unit (MCU)	PIC 16F88
Type of Transducer	40kHz
Output Devices	LCD

The circuit in this project like transmitter and receiver circuit almost similar with the project that already exist. But with the changes of some device that will be used, the circuit also needs to modify with the help from manual data sheet and someone who got experienced with it.

Ultrasonic rangefinder is capable of allowing the user to determine his or her distance from an object or wall. This project considered issues such as safety, user interface, and case of use. Hardware and software to be used will be introduced in this chapter.

2.4 Ultrasonic

Ultrasonic is cyclic range finding with a frequency greater than the upper limit of human hearing. Human hearing is limited to approximately 20 Hz to 20 kHz. Although this limit varies from person to person, this is approximately 20 KHz in healthy, and thus, 20 kHz serves as a useful lower limit in describing ultrasound. Ultrasonic sound is produced by transducer which operates either by the piezoelectric effect or the magnetostrictive effect. The magnetostrictive transducers can be used to produce high intensity ultrasonic sound in the 20-40 kHz range for ultrasonic cleaning and other mechanical applications. Ultrasonic used in many applications like in biomedical, industrial, ultrasonic cleaning, ultrasonic humidifier, ultrasonic identification (USID), ultrasonic disintegration, and also in ultrasonic range finding.

2.5 Transmitter and receiver

Transmitter use to transmit ultrasonic signal and reflection of signal from the object will be received on receiver. The receiver and transmitter circuits can work independently of the micro controller unit (MCU). At the heart of the transmitter and receiver circuit is one of the ultrasonic transducers. In this project, ultrasonic range finder will use 40 KHz ultrasound transducer. At 40 kHz, the human user would not be able to hear the pulse (human hearing is limited to approximately 20 Hz to 20 kHz) so irritancy is not an issue. The transducer converts an incoming sound wave and converts it into a voltage signal. This signal needs to be cleaned of noise, amplified, and turned into transistor-transistor logic (TTL-type) signal for the MCU. The signal from the transducer is fed through a capacitor to filter out noise and then through a voltage divider to center the signal. From here, the signal needs to be amplified to guarantee true

TTL levels. Transmitter circuit used to transmit 40 KHz ultrasound and receiver circuit will detect an echo from the ultrasonic reflection.

2.6 Transducer

The transducer converts an incoming sound wave and converts it into a voltage signal. This signal needs to be cleaned of noise, amplified, and turned into a TTL-type (transistor-transistor logic) signal for the MCU. Ultrasonic transducers optimized for 25 kHz, 32 kHz, 40 kHz or wide bandwidth transducers. These projects use a 40 kHz transducer but it will still work with the others if a simple change is made to the software (where it generates the 40kz signal). The receiver and generator circuits will work as they are.

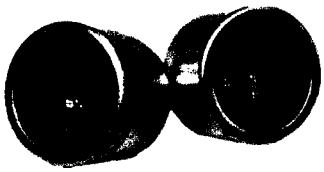

Figure 2.1: Pair of Ultrasonic Transducer

2.7 PIC 16F88 Microcontroller

PIC 16F88 is one of the powerful PIC that can execute 200 nanosecond instruction, it also easy–to-program with only 35 single word instructions. This PIC has CMOS Flash-based 8-bit microcontroller into an 18-pin package and is upwards compatible with the PIC16C7x, PIC16C62xA, PIC16C5X and PIC12CXXX devices. The PIC16F88 features includes 8 MHz internal oscillator, 256 bytes of EEPROM data memory, a capture/compare/PWM, an Addressable USART, a synchronous serial port that can be configured as either 3-wire Serial Peripheral Interface (SPI) or the 2-wire Inter-Integrated Circuit bus, 7 channels of 10-bit Analog-to-Digital (A/D) converter and 2 Comparators that make it ideal for advantage analog / integrated level applications in automotive, industrial, appliances and consumer applications [7].

PIC 16f88 is use as the brain of rangefinder. Since the basic principle of a rangefinder is rather straight forward send pulse, receive pulse, and calculate distance based on time difference, PIC 16F88 MCU can support all of it. This MCU can easily handle the software needed for the rangefinder and there was no reason not to use it. Using a different MCU would require learning all the intricacies associated with it and was not practical. PIC will be programmed to calculate the distance between object from the time delay between transmitting and receiving ultrasonic pulse. This PIC also used to display the distance to the user on the LCD.

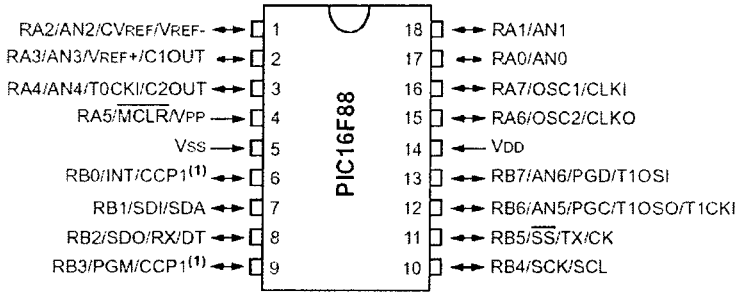

Figure 2.2: PIC 16F88 with Port Pin List