ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 11, Issue, 08, pp.6007-6009, August, 2019

DOI: https://doi.org/10.24941/ijcr.36042.08.2019

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

ULTRASONIC BASED DISTANCE MEASUREMENT SYSTEM BY USING PIC MICROCONTROLLER

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ARTICLE INFO

Article History:
Received 14th May, 2019
Received in revised form
29th June, 2019
Accepted 25th July, 2019
Published online 31st August, 2019

Key Words:

PIC Microcontroller,
LCD display,
Ultrasonic sensor.

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ABSTRACT

The Ultrasonic Based Distance Measurement System details the implementation of distance measurement system using the ultrasonic waves. The distance can be measured using pulse echo measurement method. The measurement unit uses the continuous signal in the transmission frequency range of ultrasonic transducers. The signal is transmitted by an ultrasonic transducer, reflected by an obstacle and received by another transducer, reflected by the obstacle and received by another transducer where the signal is detected. The time delay of the transmitted and received signal corresponded to the distance between the system and obstacles.

Citation: Dr. Aye Thida Aung and Dr. Phyu Phyu Mar, **2019.** "Ultrasonic based distance measurement system by using pic microcontroller", *International Journal of Current Research*, 11, (08), 6007-6009.

INTRODUCTION

Today's the developing world shows various adventures in every field. In each field the small requirements are very essential to develop big calculations. By using different sources we can modify it as our requirements and implement in various field. In earlier days the measurements are generally occur through measuring devices. The sources such as sound waves which are known as ultrasonic waves using ultrasonic sensors and convert this sound wave for the measurement of various units such as distance, speed. This technique of distance measurement using ultrasonic in air includes continuous pulse echo method, a burst of pulse is sent for transmission medium and is reflected by an object kept at specific distance. The time taken for the sound wave to propagate from transmitter to receiver is proportional to the distance of the object. In this distance measurement system we had ultrasonic sensor HC-SR04 interfaced with PIC microcontroller 16F887. Programming and hardware part of ultrasonic sensor interfacing with PIC microcontroller 16F887 Block diagram of the Ultrasonic based Distance Measurement System is shown in Fig (1).

Circuit operation

PIC 16F887 is the heart of this circuit V_{DD} and V_{SS} of PIC microcontroller (µC) is connected to +5V and GND respectively which will provide necessary power for its operation. A 4 MHz crystal is connected to OSC1 and OSC2 pins of PIC, to provide clock for its operation. 33 pF capacitors connected along with the crystal will stabilize the oscillations generated by the crystal.16x2 LCD is connected to PORTD which is interfaced using 4-bit mode communication.10 kΩ present is used to adjust the contrast of LCD. A 100Ω resistor is used to limit current through the LCD back-light LED. TRIGGER in of HC-SR04 Ultrasonic sensor is connected to RB0 (pin 33) of PIC which is to be configured as an Output pin (TRIS bit 0) and ECHO pin is connected to RB4 (pin 37) which is to be configured as an Input pin (TRIS bit is 1). The motion of stepper motor is controlled by 16 bit µC PIC 16F887 with frequency of CPU 16 MHz Ultrasonic sensor controls the motor using driver IC ULN 2803.A detail schematic diagram of the Ultrasonic Based Distance measurement system is shown at Fig (2) .A data processing program (firmware) has been developed and down loaded from the personal computer (PC) to the PIC Microcontroller (Hutching, 1995; Penfold, 1997).

Principle of the PIC Based Ultrasonic Distance Measurement System: This Ultrasonic based distance measurement system works on the principle of high frequency sound pulse. When these pulses are sending through the ultrasonic transmitter which is rotating from 0 to 360 degrees through the stepper motor. These pulses are reflected after the collision of unidentified object or obstacle, then these pulses are received by the ultrasonic receiver. After receiving these pulses the ultrasonic module gives the intimation or information signal to the microcontroller. Then the microcontroller check the status of that object or obstacles means it measures the

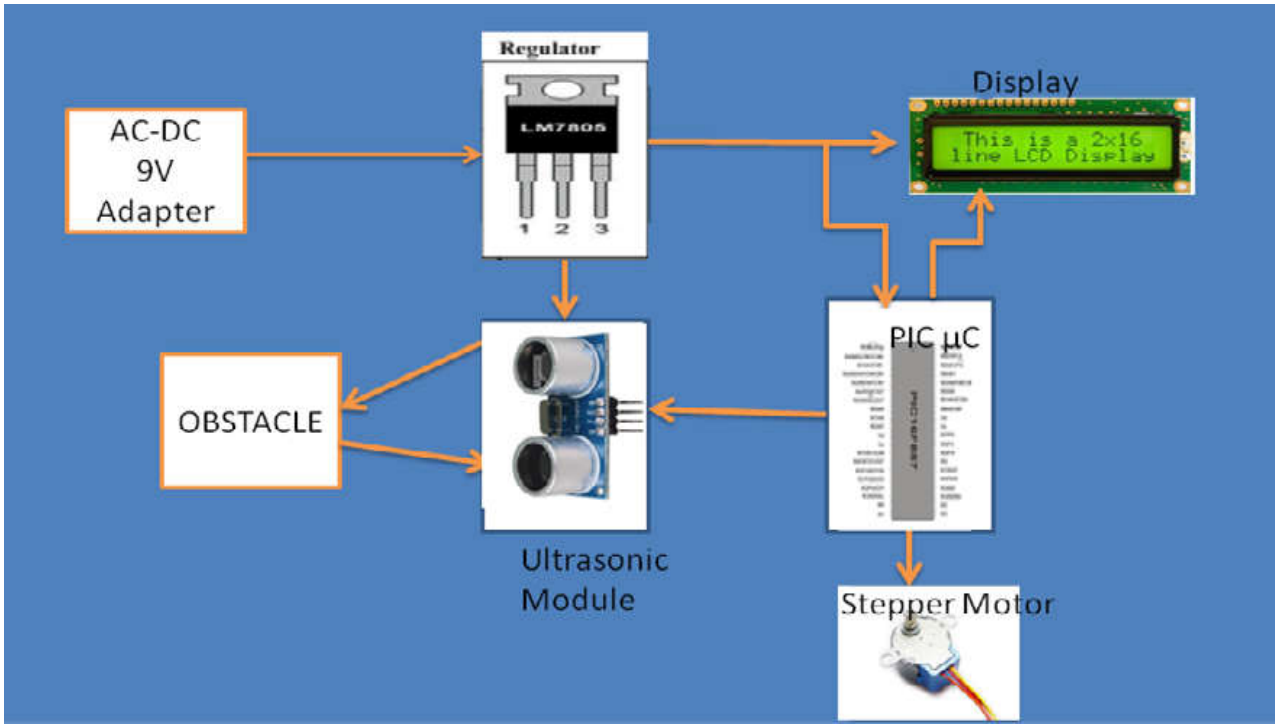

Fig. 1. Ultrasonic based Distance Measurement System

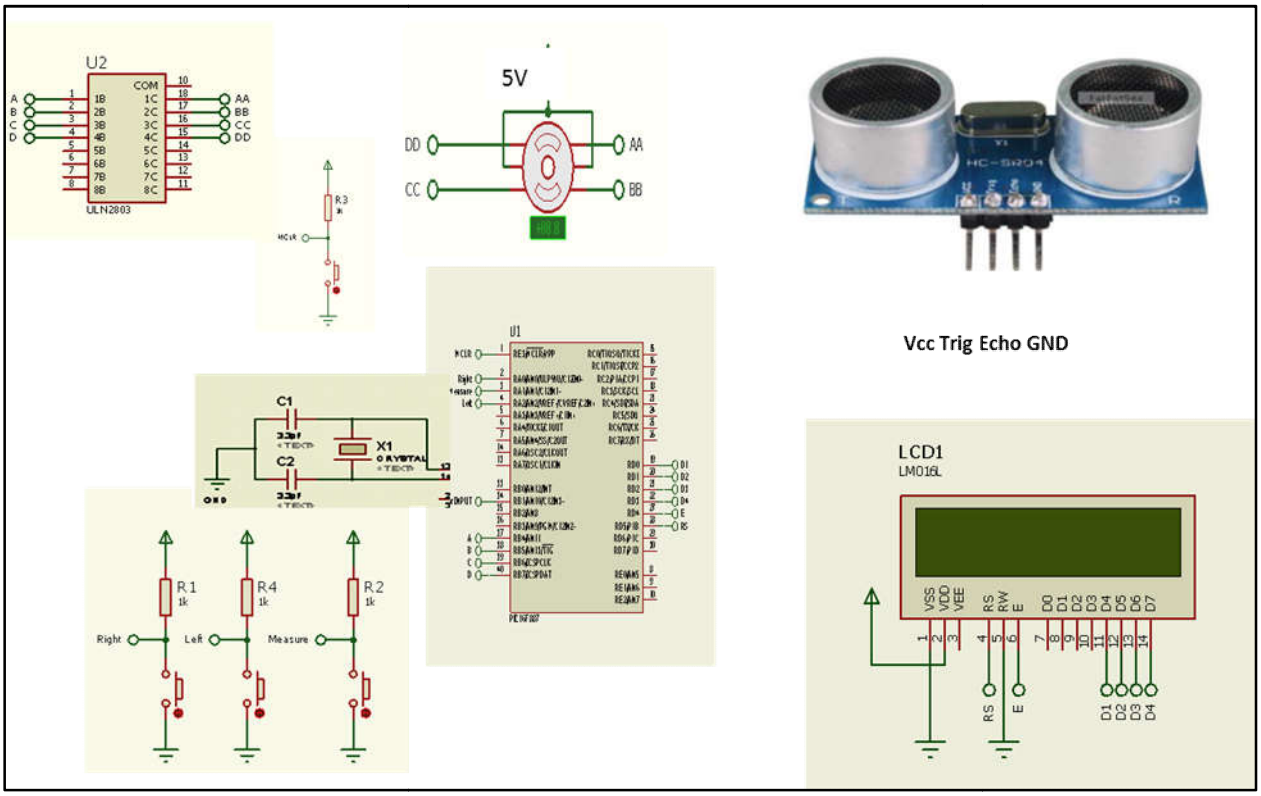

Fig. 2. Ultrasonic Based Distance Measurement System

distance of that one. After checking the distance it gives the intimation signal to the LCD display which shows the distance of that object or obstacles. For the demonstration purposes, we can check this system by placing anything in front ultrasonic module when it is moving through the stepper motor. Here are the components lists with short detail of this system. The PIC 16F887 microcontroller generates starting pulse for transmitter, measures reflected pulse's width which comes to receiver shown in Fig [3].

RESULTS AND DISCUSSION

This study employs an ultrasonic ranging module- HC - SR04 to provide a 2cm - 220cm non-contact measurement function with a ranging accuracy up to 3mm. This module includes an ultrasonic transmitter, receiver and control circuit . HC-SR04 ultrasonic sensor has 4 pins: Vcc (Voltage in), Trig (Trigger), Echo, and GND (Ground). The Vcc pin requires 5V DC and the GND pin needs to be properly grounded.

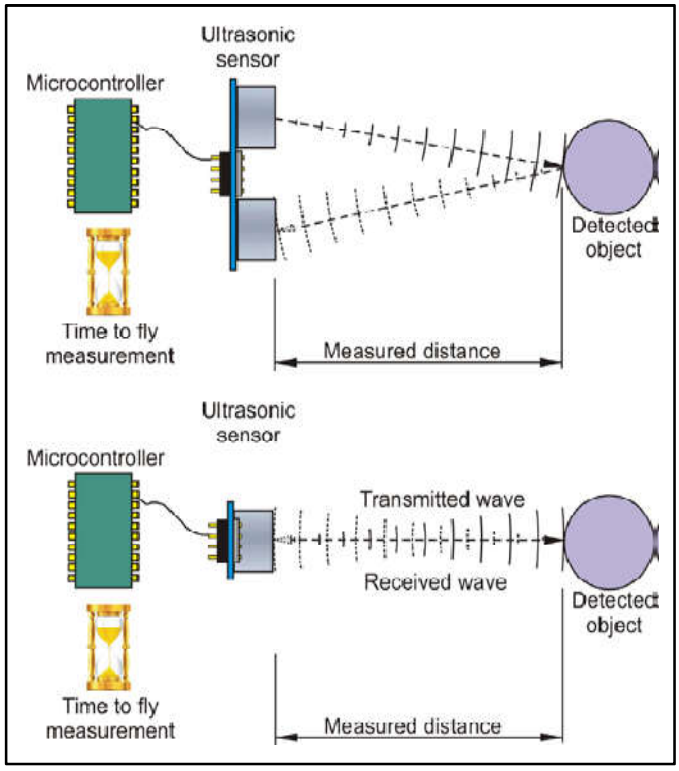

Fig. 3. Ultrasonic sensor working principle

The Trig pin receives a pulse to start ranging and sends out a burst of ultrasound. The Echo pin receives the signal and calculates the time between sending a signal and receiving it. The formulas in Equations 1 and 2 show how the distance to an object is calculated, where Equations 1 and 2 show the distance calculation, and Equation 3 show the range of sensor (Koniar *et al.,* 2011).

$$\text{Distance (cm)} = \frac{\text{Time } (\mu s)}{58} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\text{Distance (Inch)} = \frac{\text{Time } (\mu s)}{148} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\text{Range} = \frac{(\text{High Signal Time})(\text{Speed of Sound})}{2} \quad \ldots\ldots\ldots\ldots (3)$$

Application of Distance Measurement System: In applications, basic concept of electronic distance measure system is adopted in many areas like aviation, navigation and many more. In aviation, direct feedback system is required for linear positioning and motion control application. One of the good examples for distance measurement in navigation is GPS system using satellites. So there is no doubt about the usefulness of distance measurement technology in our environment.

Conclusion

The results show that the results for measured distance are satisfying for use in the sewer inspection system being developed. It can also be used for other devices requiring distance measurement of object or obstacle. As shown, the system is implementable in the robotic sewer blockage direction system. The distance of the blockage from a specified entry point in the sewer pipeline can be calculated by adding travelled distance by the robotic vehicle. The accuracy of distance of blockage will be sufficient for normal practical uses. The system can be easily implemented in other devices and systems requiring the measurement of distance of an object or an obstacle from stationary or moving observation point where the ultrasonic sensor will be location. Distance measurement is the activity of obtaining and comparing in our real world. It is one of the important functions in science, engineering and astronomy to business activities.

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