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Distance Measurement Using Ultrasonic Sensor and Arduino

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Abstract **:** *The paper is designed to develop distance measurement system using ultrasonic waves and interfaced with arduino. We know that human audible range is 20hz to 20khz. We can utilize these frequency range waves through ultrasonic sensor HC-SR04.The advantages of this sensor when interfaced with arduino which is a control and sensing system, a pro per distance measurement can be made with new techniques. As large amounts are spent for hundreds of inflexible circuit boards, the arduino will allow business to bring many more unique devices. This distance measurement system can be widely used as range meters and as proximity detectors in industries. The hardware part of ultrasonic sensor is interfaced with arduino. This method of measurement is efficient way to measure small distances precisely. The distance of an obstacle from the sensor is measured through ultrasonic sensor. After knowing the speed of sound the distance can be calculated. Designed to develop distance measurement system using ultrasonic waves and interfaced with arduino. We know that human audible range is 20hz to 20khz. We can utilize these frequency range waves through ultrasonic sensor HC-SR04.The advantages of this sensor when interfaced with arduino which is a control and sensing system, a pro per distance measurement can be made with new techniques. As large amounts are spent for hundreds of inflexible circuit boards, the arduino will allow business to bring many more unique devices. This distance measurement system can be widely used as range meters and as proximity detectors in industries. The hardware part of ultrasonic sensor is interfaced with arduino. This method of measurement is efficient way to measure small distances precisely. The distance of an obstacle from the sensor is measured through ultrasonic sensor. After knowing the speed of sound the distance can be calculated.*

Keywords*: Ultrasonic Waves,Arduino , Control And Sensing System.*

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Distance Measurement Using Ultrasonic Sensor and Arduino

1.INTRODUCTION

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

In order to calculate the distance between the sensor and the object, the sensor measures the time it takes between the emissions of the sound by the transmitter to its contact with the receiver. The formula for this calculation is D = ½ T x C (where D is the distance, T is the time, and C is the speed of sound ~ 343 meters/second). For example, if a scientist set up an ultrasonic sensor aimed at a box and it took 0.025 seconds for the sound to bounce back, the distance between the ultrasonic sensor and the box would be.

D = 0.5 x 0.025 x 343 or about 4.2875 meters.

An ultrasonic sensor emits sound waves toward an object and determines its distance by detecting reflected waves Ultrasonic sensor diagram.(Robo Galaxy)Ultrasonic sensors are used primarily as proximity sensors. They can be found in automobile self-parking technology and anti-collision safety systems. Ultrasonic sensors are also used in robotic obstacle detection systems, as well as manufacturing technology. In comparison to infrared (IR) sensors in proximity sensing applications, ultrasonic sensors are not as susceptible to interference of smoke, gas, and other airborne particles (though the physical components are still affected by variables such as heat).

Ultrasonic sensors are also used as level sensors to detect, monitor, and regulate liquid levels in closed containers (such as vats in chemical factories). Most notably, ultrasonic technology has enabled the medical industry to produce images of internal organs, identify tumors, and ensure the health of babies.So where can we use these sensors? Robot navigation comes to mind, as well as factory automation. Water-level sensing is another good use, and can be accomplished by positioning one sensor above a water surface. Another aquatic application is to use these sensors to "see" the bottom of a body of water, traveling through the water, but reflecting off the bottom surface below.

Though it might not be immediately obvious, if configured correctly ultrasonic sensors can even measure fluid flow rates. In the simplest case, an emitter and a receiver (separate in this configuration) are aligned with the flow of a fluid. Since sound is traveling through a moving medium, the speed of sound relative to these elements will be increased or decreased by the velocity of the fluid. This can be applied to flow inside pipes by aligning these two elements at an angle to each other, calculating the effective velocity increase based on the trigonometric relations between the two.Flowrate accuracy can be increased by using data from multiple ultrasonic elements giving results accurate to within a fraction.

Distance Measurement using Ultrasonic Sensor and Arduino

Distance Measurement using Arduino & Ultrasonic Sensor They are great tools to measure distance and detect objects without any actual contact with the physical world. It is used in several applications like in measuring liquid level checking proximity and even more popularly in automobiles to assist in self-parking or anti-collision systems. Previously we have also build many Ultrasonic Sensor projects like water level detecting, Ultrasonic Radar etc. This is an efficient way to measure small distances precisely. In this project we have used the HC-SR04 Ultrasonic Sensor with Arduino to determine the distance of an obstacle from the sensor.The basic principle of ultrasonic distance measurement is based on ECHO.When sound waves are transmitted in the environment then waves return back to the origin as ECHO after striking on the obstacle. So we only need to calculate the traveling time of both sounds means outgoing time and returning time to origin after striking on the obstacle.

2. PROPOSED SYSTEM

Ultrasonic distance measurement principle

Ultrasonic transmitter emitted an ultrasonic wave in one direction, and started timing when it launched. Ultrasonic spread in the air, and would return immediately when it encountered obstacles on the way. At last, the ultrasonic receiver would stop timing when it received the reflected wave. As Ultrasonic spread velocity is 340m / s in the air, based on the timer record t, we can calculate the distance (s) between the obstacle and transmitter, namely:

s = 340t / 2, which is so- called time difference distance measurement principle

The principle of ultrasonic distance measurement used the already-known air spreading velocity, measuring the time from launch to reflection when it encountered obstacle, and then calculate the distance between the transmitter and the obstacle according to the time and the velocity. Thus, the principle of ultrasonic distance measurement is the same with radar.
Distance Measurement formula is expressed as: L = C X T
In the formula, L is the measured distance, and C is the ultrasonic spreading velocity in air, also, T represents time (T is half the time value from transmitting to receiving).

1. How Ultrasonic Sensors Work
2. HCSR04 Specifications
3. Timing chart, Pin explanations and Taking Distance Measurements
4. Wiring HCSR04 with a microcontroller
5. Errors and Bad Readings

How Ultrasonic Sensors Work

Ultrasonic sensors use sound to determine the distance between the sensor and the closest object in its path. How do ultrasonic sensors do this? Ultrasonic sensors are essentially sound sensors, but they operate at a frequency above human hearing. The sensor sends out a sound wave at a specific frequency. It then listens for that specific sound wave to bounce off of an object and come back (Figure 1). The sensor keeps track of the time between sending the sound wave and the sound wave returning. If you know how fast something is going and how long it is traveling you can find the distance traveled with equation 1.

Equation 1. $d = v \times t$

The speed of sound can be calculated based on the a variety of atmospheric conditions, including temperature, humidity and pressure.
It should be noted that ultrasonic sensors have a cone of detection, the angle of this cone varies with distance, Figure 2 show this relation. The ability of a sensor todetect an object also depends on the objects orientation to the sensor. If an object doesn't present a flat surface to the sensor then it is possible the sound wave will bounce off the object in a way that it does not return to the sensor.

HCSR04 Specifications

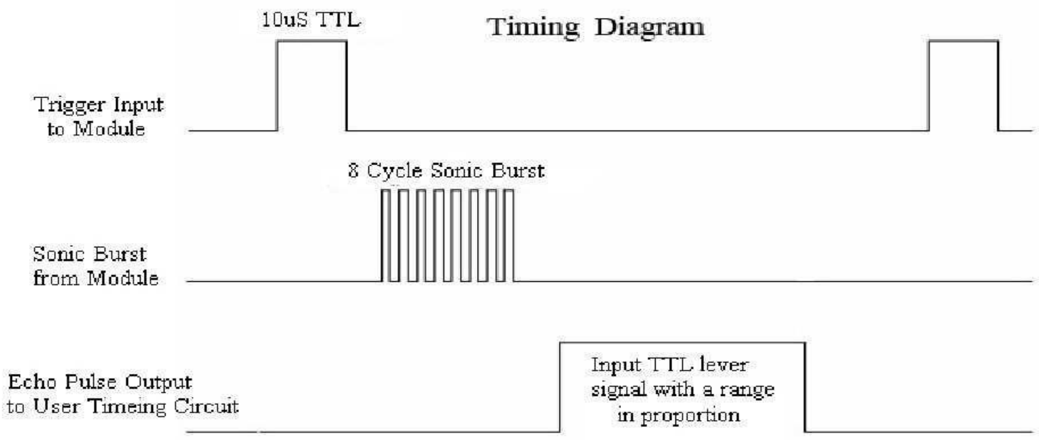
The sensor chosen for the Firefighting Drone Project was the HCSR04. This section contains the specifications and why they are important to the sensor module. The sensor modules requirements are as follows.

- Cost
- Weight
- Community of hobbyists and support
- Accuracy of object detection
- Probability of working in a smoky environment
- Ease of use

The HCSR04 Specifications are listed below. These specifications are from the Cytron Technologies HCSR04

Timing diagram

You only need to supply a short 10uS pulse to the trigger input to start the ranging, and then the module will send out an 8 cycle burst of ultrasound at 40 kHz and raise its echo. The Echo is a distance object that is pulse width and the range in proportion .You can calculate the range through the time interval between sending trigger signal and receiving echo signal. Formula: uS / 58 = centimeters or uS / 148 =inch; or: the range = high level time * velocity (340M/S) / 2; we suggest to use over 60ms measurement cycle, in order to prevent trigger signal to the echo signal.



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Attention:

The module is not suggested to connect directly to electric, if connected electric, the GND terminal should be connected the module first, otherwise, it will affect the normal work of the module.When tested objects, the range of area is not less than 0.5 square meters and the plane requests as smooth as possible, otherwise ,it will affect the results of measuring.

Product features:

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit.
The basic principle of work:

(1) Using IO trigger for at least 10us high level signal,

(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.

(3) IF the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning.

Test distance = (high level time×velocity of sound (340M/S) / 2,

Wire connecting direct as following:

5V Supply
Trigger Pulse Input
Echo Pulse Output
0V Ground

Electric Parameter

Working Voltage	DC 5 V
Working Current	15mA
Working Frequency	40Hz
Max Range	4m
Min Range	2cm
MeasuringAngle	15 degree
Trigger Input Signal	10uS TTL pulse
Echo Output Signal	Input TTL lever signal and the range in proportion
Dimension	45*20*15mm

Fig: Vcc Trig Echo GND

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3. CONCLUSIONS & FUTURE SCOPE

Distance measurement using ultrasonic sensor and arduino consist of a transmitter part of ultrasonic module units ultrasonic high frequency waves in the form of polices after collision of these wares with any object, these wares detected by microphone time taken by these wares from transmitter and receiver is used to measure distance from any object. We had used a ultrasonic sensor module of HC-SR04, because this ultrasonic module is initiated with pulse of 10us The distance from any object is calculated from. Distance =speed*time The human audible range can be converted measure the distance precisely manner.
New prototyping hardware & capatibility & interfacing with other consumer elatrone/tv/smartphones & flooding of shields. Mining equepments may require where entail. Acready compatible with many major simulation software like MATLAB & lab view, we may see even move flexible programming environment & development option. Using temp. Compensation, it can be used over wide temp range. Height meausrment, agriculture velide, collision /protection can be other application

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