Detecting Object Location by Array of Ultrasonic Sensors

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***Abstract*— The goal is to develop a dependable, low-cost object recognition system using a horizontal array of ultrasonic sensors. The benefit of using an ultrasonic sensor is distance measurement of immediate objects becoming easy without intensive processing. Recognition methods with an ultrasonic sensor are often utilized in situations where optical sensors cannot be used or in objects which are hard to be identified by the approach based on the light. In comparison to other technologies, ultrasonic sensors are also inexpensive. As a result, using an ultrasound sensor to find and identify objects seems to be a good solution. In the paper, a new approach is proposed in which the response of ultrasonic sensors from rough surface objects is used for object recognition. When the object surface has roughness of specific degree, incident ultrasonic waves scatter more and part of ultrasonic may return to the sensor receiver. Thus, recognition of objects having critical orientation with respect to ultrasonic sensor arrays or rough surfaces has become possible.**

***Keywords*— Arduino UNO, Ultrasonic sensor, LED, Buzzer**

Introduction

The basic concept used in this project is to detect the presence of an object and target its position. Targeting mechanism is automated as it uses ultrasonic sensors for detecting the object and its range. Ultrasonic sensor spreads out ultrasonic sound waves (high frequency sound waves) at regular intervals and receives the echo. The echo signals are reflected back to the sensor, when the object is hit. The time that is taken for the ultrasonic waves to spread out and to the distance that is travelled from system to target and back to the system precisely is measured by this structure. The calculation of distance to the target is based upon the time-span between emitting the signal and receiving the echo. From this project we could also get the adequate information about Arduino, MATLAB Simulink for Arduino.

Implementation

Components used:

- Ultrasonic sensor (HC- SR04)
- Arduino UNO
- Buzzer

Hardware Description

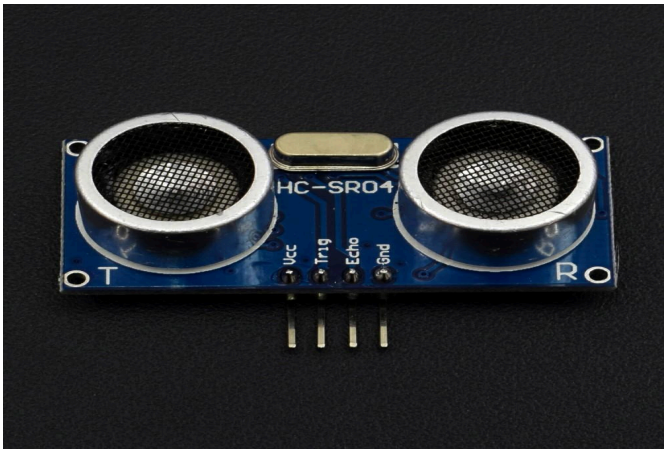
Ultrasonic sensor

The ultrasonic sensor we are using is the HC-SR04 ultrasonic distance sensor. This economical sensor provides 2cm to 400cm of non-contact measurement functionality with a ranging accuracy that can reach up to 3mm. Each HC-SR04 module includes an ultrasonic transmitter, a receiver and a control circuit.

The four pins of the HC-SR04 are described as: VCC (Power), Trig (Trigger), Echo (Receive), and GND (Ground). Ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the echo from the target, which measures the distance to the target by measuring the time between the emission and reception.

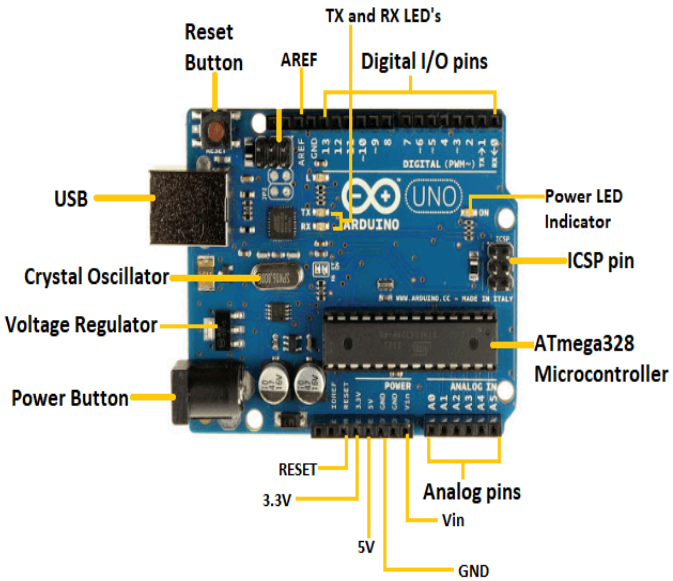
Features:

- Supply Voltage: 5VDC
- Supply Current : 30mA
- Range: 2 cm - 3m (0.8 in to 3.3 yards)
- Size: 22mm H 46mm W x 16mm D(0.84 in x 1.8 in x 0.6 in).



Arduino UNO

ARDUINO UNO is a microcontroller board that is based on the ATmega328P. Arduino has 14 digital input/output pins (out of which PWM output pins are of 6), 6 analog inputs, 16 MHz quartz crystal, a USB connection port, power jack, an ICSP header and a reset button in it. Everything is contained in it WHICH is needed to support the microcontroller and an USB cable can be used to connect the computer to it and to get it started. The Arduino can be powered either by AC to DC adapter or by a battery. "Uno" has the meaning of one in Italian and it was used to represent the release of the first version of Arduino Software (IDE). The Uno board and first version of Arduino Software (IDE) were the reference versions of Arduino, now new releases are evolving.



Buzzer (Piezo-electric buzzer)

Features:

- Voltage : 9 - 12VDC
- Maximum current : 30mA/12VDC
- Size: 10mm
- Decibel : > 85db/10cm
- Resonant frequency : 2500 Hz (+/- 300 HZ)

WORKING PROCEDURE

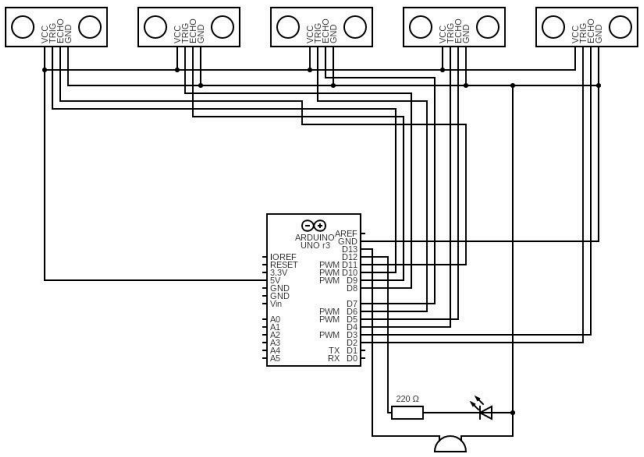
We connected an array of five Ultrasonic Sensors to the Arduino so that when the sensor senses any object, the signal from the sensor is sent to the Arduino. The Ultrasonic sensor emits high frequency sound waves at regular time intervals as the velocity of sound in air. The waves fall on the object and get reflected back to the receiver. The sensor emits waves of frequency about 40KHz and it can cover up to a range of 2m. The transmitter that is present in the sensor converts the electrical signal into ultrasounds whereas the receiver converts the ultrasounds into electrical signals. As soon as an object comes under the range of the sensors each sensor measures the time duration by transmitting and receiving the ultrasonic waves. By using the formula s=(t/2)*(speed of sound) the distance is calculated, where speed of sound in non-humid air at 20 degrees Celsius is about 343 metres per second. Similarly, distances from each sensor is calculated and then average distance is taken. Also, when the object gets too close to the

base i.e. distance<=15 cm the LED starts glowing and the buzzer beeps simultaneously

The precision and range are increased when a horizontal array of five ultrasonic sensors is used. If we use one sensor and one servo motor we would get very inaccurate for distance measurement with low range. An array of sensors give no delay to measure positional distance of a huge area in front of the array. Also having extra mechanical complexity like a servo will make the hardware more prone to failure.

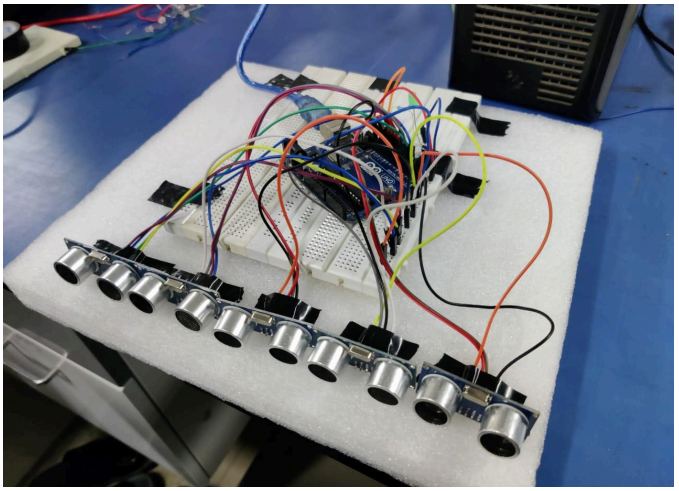
Then, the Arduino integrated development environment (IDE), which is being used here, is a cross platform application developed in java. It is planned in such a way that it introduces the basic ideas of programming and knowledge to new users and beginners who have no knowledge on software development. It embraces a code editor which has salient features which has highlighting of the syntax, matching of braces, and indentation process that is automatic, and it has the capability to compile and upload programs to the board that is connected using only a click in it. Either in C or C++ language, the Arduino programs are being written. Once the code is embedded to the IDE the system works as per the embedded code

Result



This proposed model locates an object and provides us its distance. In the given circuit Arduino uses the ultrasonic sensors. The sensor consists of 4 pins Vcc, Trig, Echo and Gnd which are connected to the Arduino UNO pins 5V, 2,3 and Gnd respectively. Similarly, four other sensors are connected. The sensor measures the time duration and sends it to the Arduino then the distance is calculated through the formula used in the code embedded. Also, when the object is within the range of 15 cm, the LED (connected to pin 12) and the buzzer (connected to pin 13) connected to the circuit start responding.The active sensing range is increased from 25 cm to 200 cm by using an array of 5 ultrasonic sensors.

Conclusion



This project can be used in vehicles as driving assistance to detect other vehicles in front of them and other bumpers on the road to avoid accidents.The project has been successfully designed and tested, and the desire of the project is accomplished without any discrepancy. Since this project has many security values, the future scope for this project is high. For many applications, this can be used as the base material. It can also be technologically advanced or reformed according to the increasing necessities and future demands.

References

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