ULTRASONIC DISTANCE DETECTOR

A PROJECT REPORT

JULY 2022

ABSTRACT

A distance measuring device or a LED light sensor which works according to the distance. It is made by using Arduino, an ultrasonic sensor, and connecting wires. 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 human can hear). Arduino is an open-source hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices. The Arduino Programming Language is basically a framework built on top of C++.

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INTRODUCTION

1.1 INTRODUCTION TO ARDUINO

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into anoutput - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments.

1.2 APPLICATIONS OF ARDUINO

1.Home Automation

This application makes use of the Arduino Uno board, Bluetooth interface for connectivity, and smartphones. Software loaded boards are connected to the home devices like lamps, A/C, TV, Refrigerator, and Bluetooth software is interfaced with the board.

2. Public Utility Automation

Applications to manage public utilities like street lighting, Dynamic traffic management systems are being implemented. Street lighting Street lights are fitted with Arduino boards and sensors.

3. IoT

Poka-yoke This system suggests the right component be fitted at any stage in the assembly line. This system senses the product that is being assembled and refers ERP system and finds out the component to be fitted at that stage and accordingly illuminates the light of the compartment of that component.

1.3 INTRODUCTION TO ULTRASONIC SENSOR

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.

There are two main types of Ultrasonic Sensors:

Proximity Detection Ultrasonic Sensors - this type of ultrasonic sensor will alert the user when an object enters an area of detection. The detection is irrespective of the objects size, material reflectivity.

Ranging Measurement Ultrasonic Sensors - this type of ultrasonic sensor can give exact measurements on the distance of an object which is moving to and from the sensor itself. It does this using intermittent sound waves .

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 emission of the sound by the transmitter to its contact with the receiver. The formula for this calculation is $D=(T/2)*V$ (where D is the distance, T is the time, and V is the speed of sound ~ 340 meters/second).

We are using ranging Measurement Ultrasonic Sensor in this project.

1.4 APPLICATIONS OF ULTRASONIC SENSOR

Ultrasonic sensors have been used throughout many applications and industries. They are used within food and beverage to measure liquid level in bottles, they can be used within manufacturing for an automated process and control maximising efficiency on the factory floor. Some of the many ultrasonic sensor applications which use Migatron sensors are:

1.Robotic sensing.
2.Stacking height control
3.Loop control
4.Liquid level control
5.Full detection
6.Counting people/people detection
7.Presence detection
8.Detecting breaks in threads or wires
9.Contouring or profiling
10.Irregular parts detection
11.Tank level detection
12.Distance measurement - regardless of an object's shape, colour or surface texture.

MAIN THEME

2.1 ARDUINO AND ULTRASONIC SENSOR USE

There are many types of Arduino distance sensors, but in this project we have used the HC-SR04 to measure distance in range of 2cm-400cm with an accuracy of 3mm. The sensor module consists of an ultrasonic transmitter, receiver and control circuit. The working principle of ultrasonic sensor is as follows:

1. The module sends eight 40 KHz signals automatically, and then detects whether pulse is received or if the signal is received, then it is through high level.

2.The time of high duration is the time gap between sending and receiving the signal.

Timing Process

The module works on the natural phenomenon of ECHO of sound. A pulse is sent for about 10us to trigger the module. After which the module automatically sends 8 cycles of 40 KHz ultrasound signal and checks its echo. The signal after striking with an obstacle returns back and is captured by the receiver. Thus the distance of the obstacle from the sensor is simply calculated by the formula given as

Distance= (time/2) x speed(340m/s).

Here we have divided the product of speed and time by 2 because the time is the total time it took to reach the obstacle and return back. Thus the time to reach obstacle is just half the total time taken.

2.2 WORKING AND CIRCUIT DIAGRAM

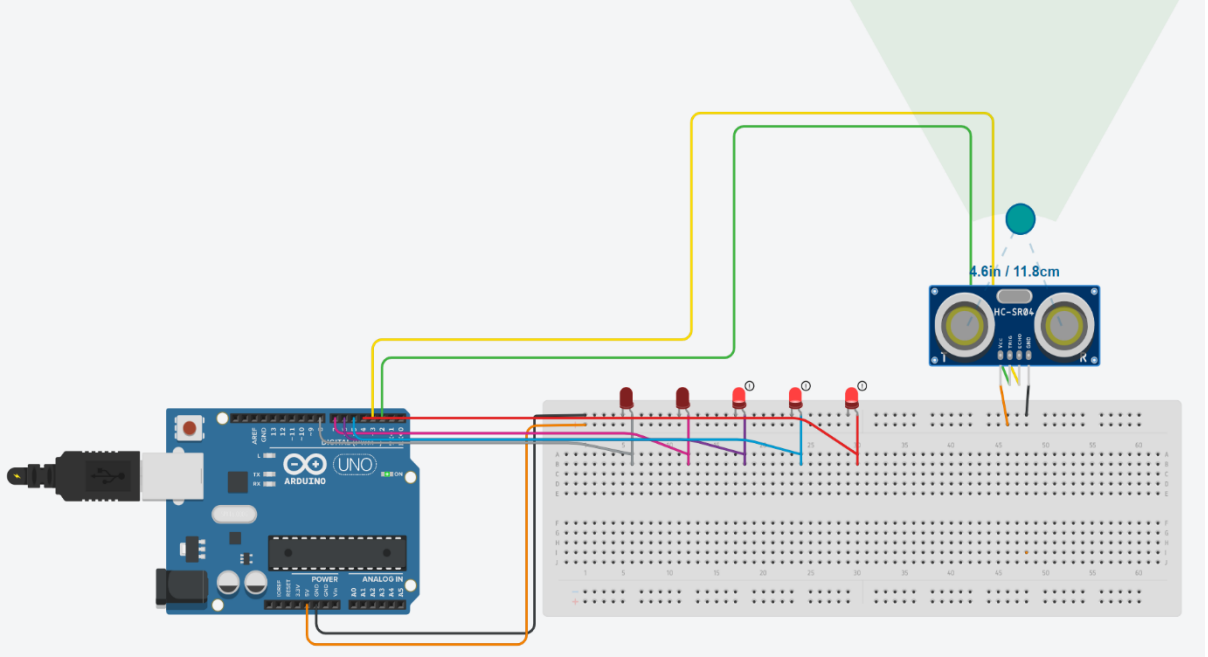


FIG.2.2.1

The module works on the natural phenomenon of ECHO of sound. A pulse is sent for about 10us to trigger the module. After which the module automatically sends 8 cycles of 40 KHz ultrasound signal and checks its echo. The signal after striking with an obstacle returns back and is captured by the receiver. The reflected waves are converted into the electrical energy thus lighting the LED'S. The LED'S will light up to 25cm and range of ultrasonic sensor is 400cm. The distance is shown on the screen with the help of the formula Distance= (time/2) x speed(340m/s).

2.3 ARDUINO CODE

```
const int trig = 2;
const int echo = 3;
const int LED1 = 8;
const int LED2 = 7;
const int LED3 = 6;
const int LED4 = 5;
const int LED5 = 4;
int duration = 0;
int distance = 0;
void setup()
{
  pinMode(trig , OUTPUT);
  pinMode(echo , INPUT);
  pinMode(LED1 , OUTPUT);
  pinMode(LED2 , OUTPUT);
  pinMode(LED3 , OUTPUT);
  pinMode(LED4 , OUTPUT);
  pinMode(LED5 , OUTPUT);
  Serial.begin(9600);
}
void loop()
{
  digitalWrite(trig , HIGH);
  delayMicroseconds(1000);
  digitalWrite(trig , LOW);
 duration = pulseIn(echo , HIGH);
 distance = (0.034*duration)/2 ;
 Serial.println(distance);
  if ( distance <= 5 )
   {
```

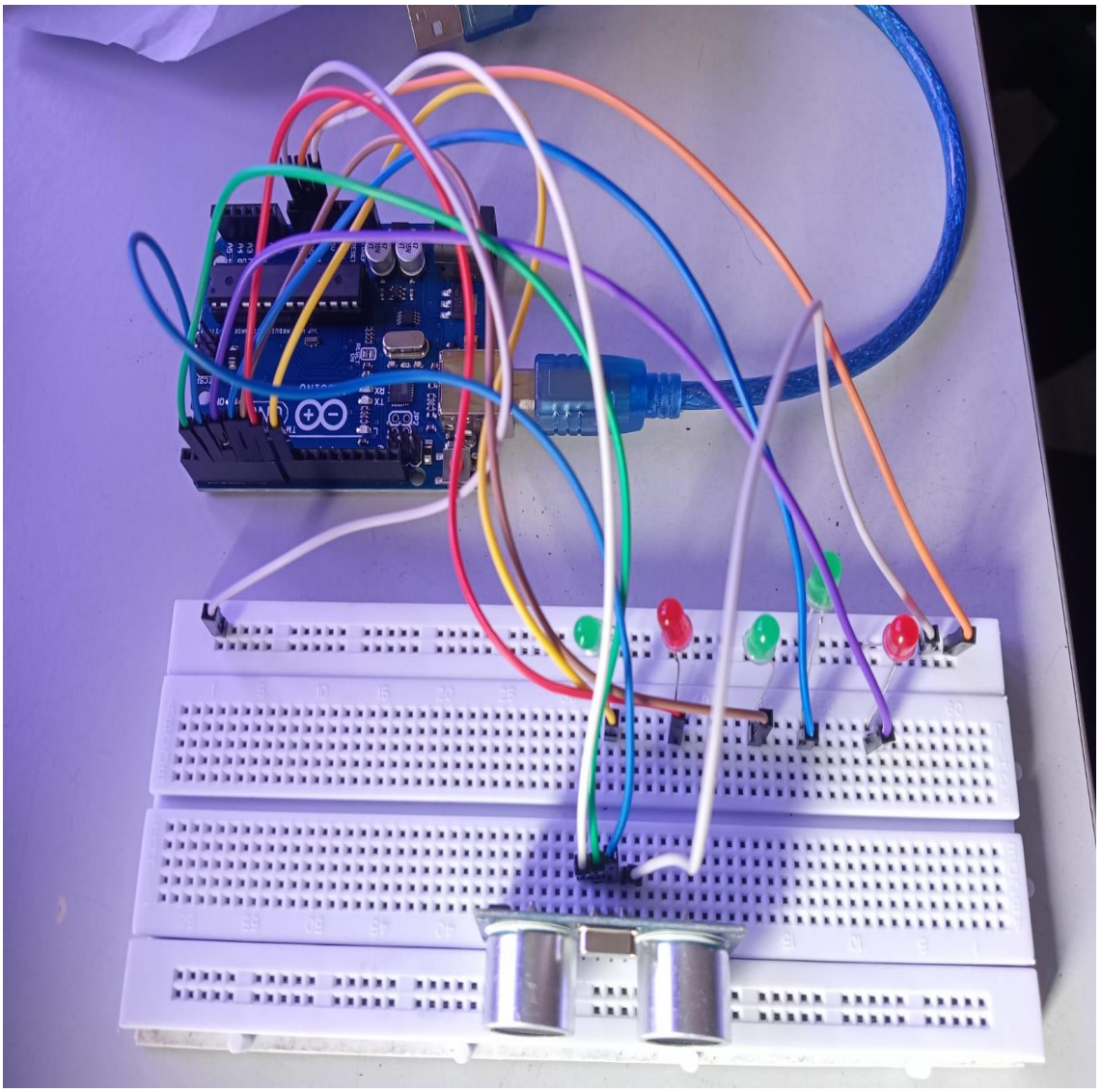
```
  digitalWrite(LED1, HIGH);
}

else
{
  digitalWrite(LED1, LOW);
}
if ( distance <= 10 )
{
  digitalWrite(LED2, HIGH);
}
else
{
  digitalWrite(LED2, LOW);
}
if ( distance <= 15 )
{
  digitalWrite(LED3, HIGH);
}
else
{
  digitalWrite(LED3, LOW);
}
if ( distance <= 20 )
{
  digitalWrite(LED4, HIGH);
}
else
{
  digitalWrite(LED4, LOW);
}
if ( distance <= 25 )
```

```
  {
    digitalWrite(LED5, HIGH);

  }
  else
  {
    digitalWrite(LED5, LOW);
  }
  delay(100);
}
```

Arduino Practical Video



Conclusion

3.1 Applications:

1. Car parking Back View-This device can be used to notify the user how much distance the car is away from the wall thus helping the user to park his car safely.
2. Object Detection-Any object in the range of 400 cm can be detected and LED will light up to 25cm.

3. Distance Measurement-Distance can be calculated of the object with the help of this.

3.2 Merits:

The technology used by ultrasonic sensors is non-contacting, this gives the sensors most of the advantages they have. Ultrasonic sensor advantages include;
1. Wear Free – Ultrasonic sensors have no moving parts; this makes them completely wear-free and gives them a longer life than contacting alternatives.

2. Highly accurate – Because of how they work, Ultrasonic sensors are highly accurate and can detect minimal alterations in position. They can also measure the thickness of an object as well as the depth of the parallel surface.
3. Detect a range of materials – Ultrasonic position sensors can detect and measure objects irrespective of their surface or color.
4. Easy to Use – Another advantage of ultrasonic sensors is that they can easily interface with a microcontroller and they are not dangerous to operate.

3.3 Demerits:

The HC-SR04 ultrasonic sensor is really good in terms of accuracy and overall usability especially compared to other low-cost ultrasonic sensors. This does not mean that the HC-SR04 sensor will work all the time. The following pictures show some of the limitations of the HC-SR04:

- The distance between the sensor and the object/obstacle is greater than 13 feet.

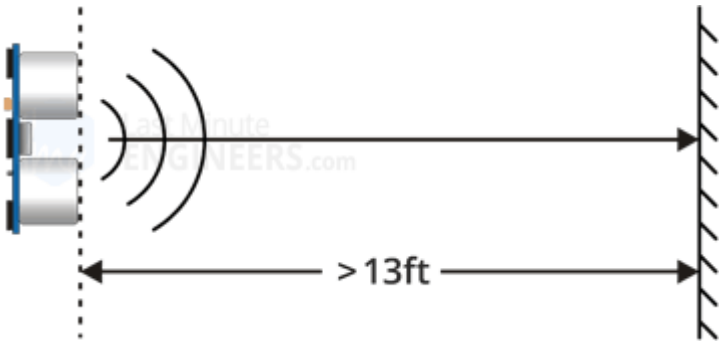


FIG.3.3.1

- The object has its reflective surface at a shallow angle so that the sound is not reflected to the sensor.

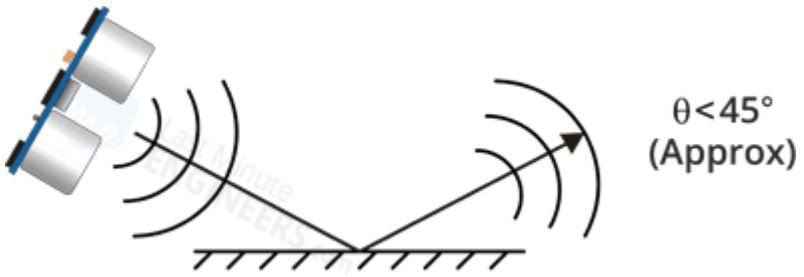


FIG.3.3.2

- The object is too small to reflect enough sound back to the sensor. Also, if your HC-SR04 sensor is mounted low on your device, you are likely to get sound reflecting off the floor.

FIG.3.3.3

- Some objects with soft, irregular surfaces (such as stuffed animals) absorb sound rather than reflect it, so the HC-SR04 sensor may find it difficult to detect such objects.

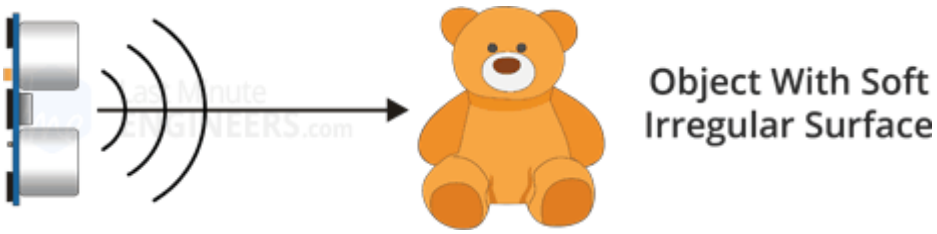


FIG.3.3.4

3.3 Future Scope

1. On a higher upgradation this device can be used in Border/sensitive areas to detect any unusual activity.

2.Moreover we can also calculate the size, velocity and surface of the object.

3.The ultrasonic sensors are broadly used in diverse industries, including food & beverages, chemicals, medical, automotive, agriculture, wastewater management, and more.

4. Owing to an increase in integrating automation into manufacturing and other industries, the use of industry 4.0 is contributing heavily towards the growth of the ultrasonic sensor market.

5. Moreover, the use of sensors in autonomous vehicles and other vehicles with ADAS features to measure the range during parking is giving other opportunities to the automotive industry for growth.

References

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