Lab 02 - Ultrasound distance sensor using Tinker CAD Arduino

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Performance of Experiment	Journal Submission	Total Marks	Remarks	Instructor Sign

Aim: To Interface following sensors such as Temperature or Ultrasonic or Gas sensors with Raspberry-Pi/Beagle board/ TinkerCAD Arduino etc. and display readings on console.

Journal content- Theory and frequently asked questions and experiment

- List and state various sensors used in IoT systems
- What are the other types distance measurement sensors?
- Describe the details of HC-SR04 distance sensor
- Prepare Tinker CAD sketch and explain it
- Write an arduino program to measeure distance using HCSR04 sensor
- Conclusions

List and state various sensors used in IoT systems

- Temperature Sensor
- Pressure Sensor
- Proximity Sensor
- Accelerometer and Gyroscope Sensor
- IR Sensor
- Optical Sensor
- Gas Sensor
- Smoke Sensor

1. **Temperature Sensor :-** A Temperature Sensor senses and measures the temperature and converts it into an electrical signal. They have a major role in Environment, Agriculture and Industries. For example, these sensors can detect the temperature of the soil, which is more helpful in the production of crops.
2. **Pressure Sensor :-** A pressure sensor senses the pressure applied ie, force per unit area, and it converts into an electrical signal. It has high importance in weather forecasting. There are various Pressure sensors available in the market for many purposes. For example, if there are any water leaks in the residential or commercial areas, a pressure sensor needs to be installed to check if there are any leaks and measures the pressure.
3. **Proximity Sensor :-** A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact. A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation and looks for changes in the field or return signal. A most common application of this sensor is used in cars. While you are taking the reverse, it detects the objects or obstacles and you will be alarmed. Also, it is used in retails, museums, parking in airports, malls, etc.
4. **Accelerometer and Gyroscope Sensor :-** The difference between Accelerometer and the gyroscope is **accelerometer measures linear acceleration** based on vibration whereas, the **gyroscope is intended to determine an angular position** based on the principle of the rigidity of space. Accelerometers in mobile phones are used to detect the orientation of the phone. The gyroscope, adds an additional dimension to the information supplied by the accelerometer by tracking rotation or twist. A 3D gyroscope has three gyroscopic sensors mounted orthogonally. Accelerometers and gyroscopes are the sensors of choice for acquiring acceleration and rotational information in drones, cell phones, automobiles, airplanes, and mobile IoT devices.
5. **IR Sensor :-** An Infrared Sensor is an electronic device, which senses certain characteristics of its surroundings by emitting Infrared radiation. It has the ability to measure the heat being emitted by an object and also measures the distance. It has been implemented in various applications. It is used in Radiation thermometers depend on the material of the object.

6. **Optical Sensor :-** The Optical Sensors convert light rays into an electronic signal, it measures a physical quantity of light and transforms into a form which is readable, maybe digital form. It detects the electromagnetic energy and sends the results to the units. It involves no optical fibers. It is a great boon to the cameras on mobile phones. Also, it is used in mining, chemical factories, refineries, etc. LASER and LED are the two different types of light source. Optical sensors are integral parts of many common devices, including computers, copy machines (Xerox) and light fixtures that turn on automatically in the dark. And some of the common applications include alarm systems, synchros for photographic flashes and systems that can detect the presence of objects.
7. **Gas Sensor :-** A Gas Sensor or a Gas detector is a device that detects the gas in an area, which is very helpful in safety systems. It usually detects a gas leak in an area, that results are sent to a control system or a microcontroller, that finally shuts down. it can detect combustible, flammable and toxic gases.
   There are several different sensors that can be installed to detect hazardous gases in a residence. Carbon monoxide is very dangerous, but odorless, colorless gas, making it difficult for humans to detect. Carbon monoxide detectors can be purchased for around US$20–60.
8. **Smoke Sensor :-** A smoke sensor detects smoke and its level of attainment. Nowadays, the manufacturers of the sensor implement it with a voice alarm through ALEXA, also notifies in our smartphones. The smoke sensor if of two types, Optical smoke sensor, and the ionization smoke sensor. The optical smoke sensor also called photoelectric smoke alarms works using the light scattering principle.
   The **alarm** contains a pulsed Infrared LED which pulses a beam of light into the sensor chamber every 10seconds to check for **smoke** particles.

What are the other types distance measurement sensors?

1. Ultrasonic Sensor :-

Arguably the most common type of distance measuring sensor is the Ultrasonic Sensor. Also known as the Sonar sensor, it detects the distance to objects by emitting high-frequency ultrasonic waves.

1. The ultrasonic sensor emits high-frequency sound waves towards the target object
2. Target object picks up the sound waves

3. Sound waves are then bounced off and reflected back towards the ultrasonic sensor
4. The time it took for the sound wave to return is used as the measurement of the distance between

2. IR Distance Sensors :-

IR distance sensors, in short for infrared. Most commonly associated with the Sharp GP2Y0A21YK0F, it does distance or proximity sensing through emitting IR beam and calculating angle of reflection.

IR sensors come with two lenses:

- An IR LED emitter lens that emits a light beam
- A position-sensible photodetector (PSD) where the reflected beam will fall onto

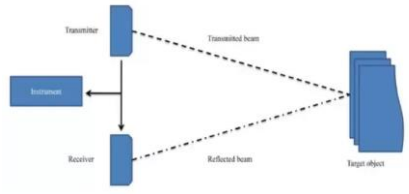
IR distance sensors work through the principle of triangulation; measuring distance based on the angle of the reflected beam.

1. Infrared light is emitted from the IR LED emitter
2. The beam of light hits the object (P1) and is reflected off a certain angle
3. The reflected light will reach the PSD (U1)
4. The sensor in the PSD will then determine the position/distance of the reflective object.

3. LIDAR Sensors :-

LiDAR, in short for Light Detection and Ranging, can be considered as a laser distance sensor. It measures the range of targets through light waves from a laser instead of radio or sound waves.

There are various ways where you could explain how LIDAR works (E.g. Triangulation, pulse base, etc.) but the following way is the easiest:



1. The transmitter on the LiDAR device emits laser light at the target object
2. The pulse of the laser is then picked up by the target and reflected back
3. Distance is then calculated by using the relationship between constant speed of light in air and the time between sending/receiving of the signal.

Describe the details of HC-SR04 distance sensor

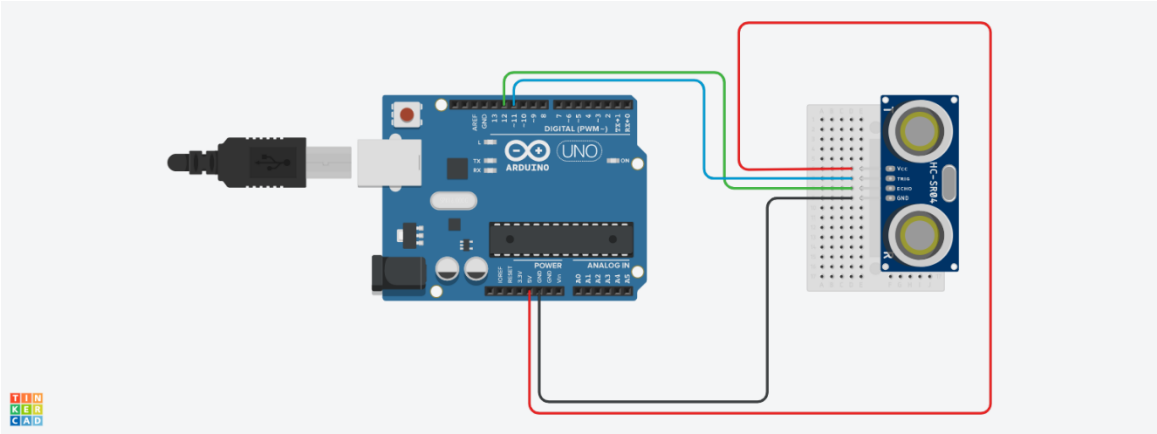
The HC-SR04 Ultrasonic Distance Sensor is a sensor used for detecting the distance to an object using sonar. It's ideal for any robotics projects your have which require you to avoid objects, by detecting how close they are you can steer away from them!

The HC-SR04 uses non-contact ultrasound sonar to measure the distance to an object, and consists of two ultrasonic transmitters (basically speakers), a receiver, and a control circuit. The transmitters emit a high frequency ultrasonic sound, which bounce off any nearby solid objects, and the reciever listens for any return echo. That echo is then processed by the control circuit to calculate the time difference between the signal being transmitted and received. This time can subsequently be used, along with some clever math, to calculate the distance between the sensor and the reflecting object!

The HC-SR04 Ultrasonic Range Sensor Features:

- Input Voltage: 5V
- Current Draw: 20mA (Max)
- Digital Output: 5V
- Digital Output: 0V (Low)
- Working Temperature: -15°C to 70°C
- Sensing Angle: 30° Cone
- Angle of Effect: 15° Cone
- Ultrasonic Frequency: 40kHz
- Range: 2cm - 400cm
- **Dimensions :-**
    - Length: 43mm
    - Width: 20mm
    - Height (with transmitters): 15mm
    - Centre screw hole distance: 40mm x 15mm
    - Screw hole diameter: 1mm (M1)
    - Transmitter diameter: 8mm

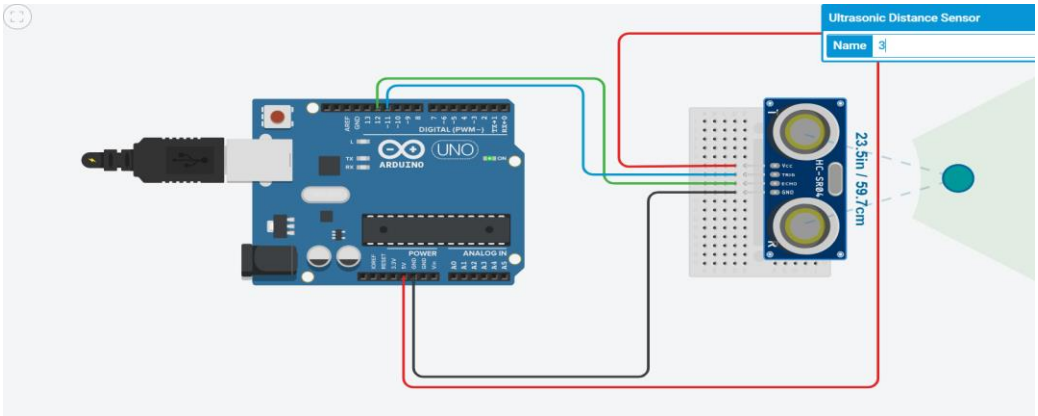
Prepare Tinker CAD sketch and explain it



The Ultrasonic Sensor consists of 4 terminals :- +5V , Trigger ,Echo and GND.

- Connect +5V of sensor to 5v of Arduino board.
- Connect GND of sensor to GND of Arduino board.
- We are connecting trigger of sensor to 11 port of Arduino board.
- We are connecting echo of sensor to 12 port of Arduino board.

We are displaying the distance measured in cm at different locations from sensor.



It is an example that object is at 59.7 sec and every 2 seconds we are taking different readings and calculating the distance.

ULTRASONIC DISTANCE SENSOR WRITTEN BY :- PD 33 Divyang Bagla

```
const int trigger = 11;

const int echo = 12;

float duration , distance;

void setup()

{

  pinMode(trigger, OUTPUT);

  pinMode(echo,INPUT);

  Serial.begin(9600);

}

void loop()

{

  digitalWrite(trigger, LOW);

  delayMicroseconds(2);

  digitalWrite(trigger, HIGH);

  delayMicroseconds(10);

  digitalWrite(trigger, LOW);

  duration = pulseIn(echo,HIGH);

  distance = (duration * 0.000001 * 34000)/2;

  Serial.print("Ditance is :");

  Serial.print(distance);

  Serial.println("cm");

  delay(2000);

}
```

OUTPUT:-

Distance is :78.90cm
Distance is :78.90cm
Distance is :79.10cm
Distance is :79.10cm
Distance is :78.90cm
Distance is :79.10cm
Distance is :79.10cm
Distance is :78.91cm

CONCLUSION:-

Thus implemented the ultrasonic distance sensor using tinker cad and calculated the distance and displayed the value at serial monitor on tinker CAD.