

ENGR 4421: Robotics II

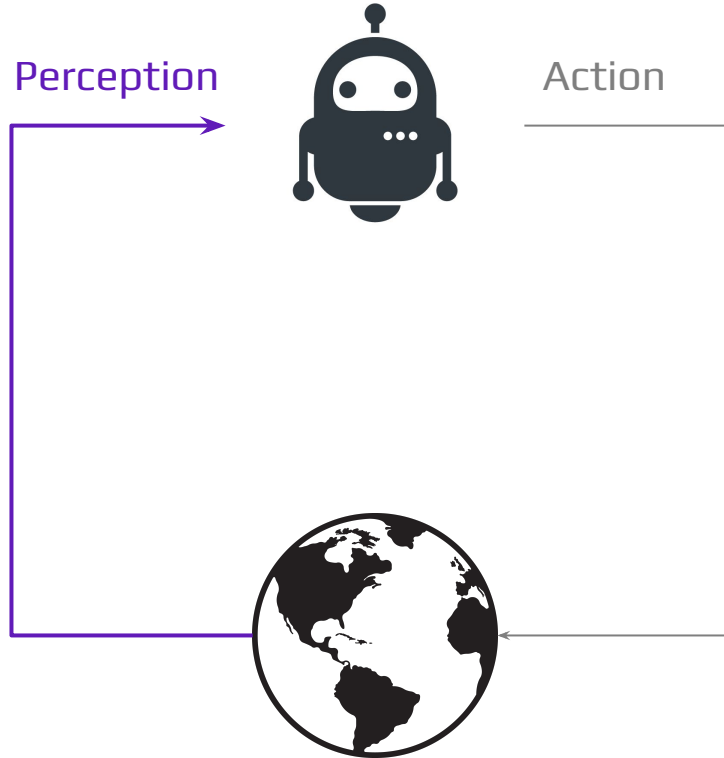
Ultrasonic Distance Sensor

09/19/2023

Outline

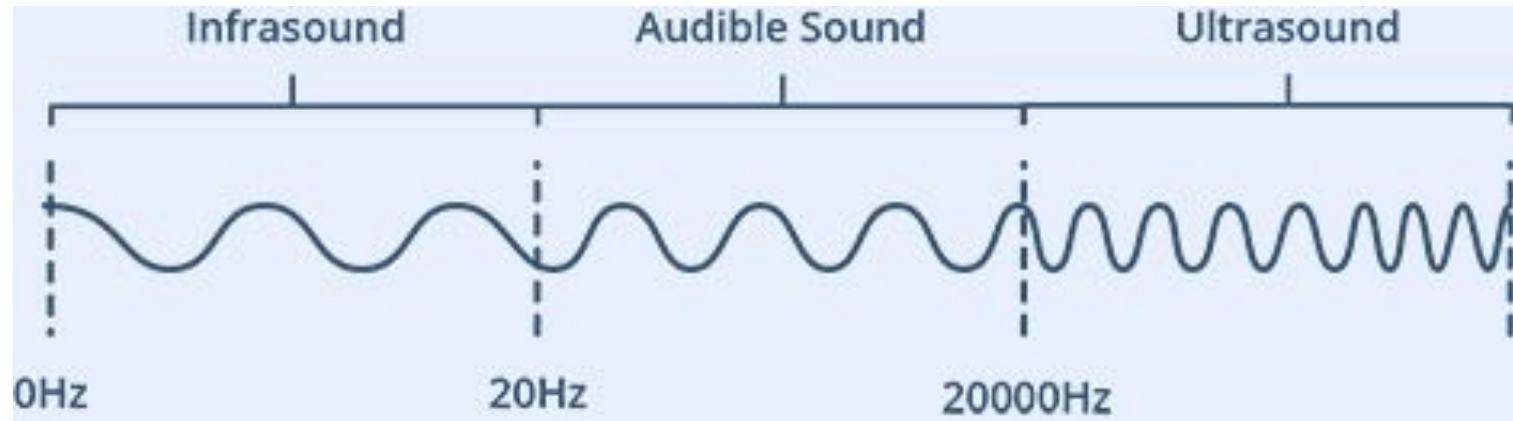
- Ultrasound
- HC-SR04

A Robot Needs to Feel

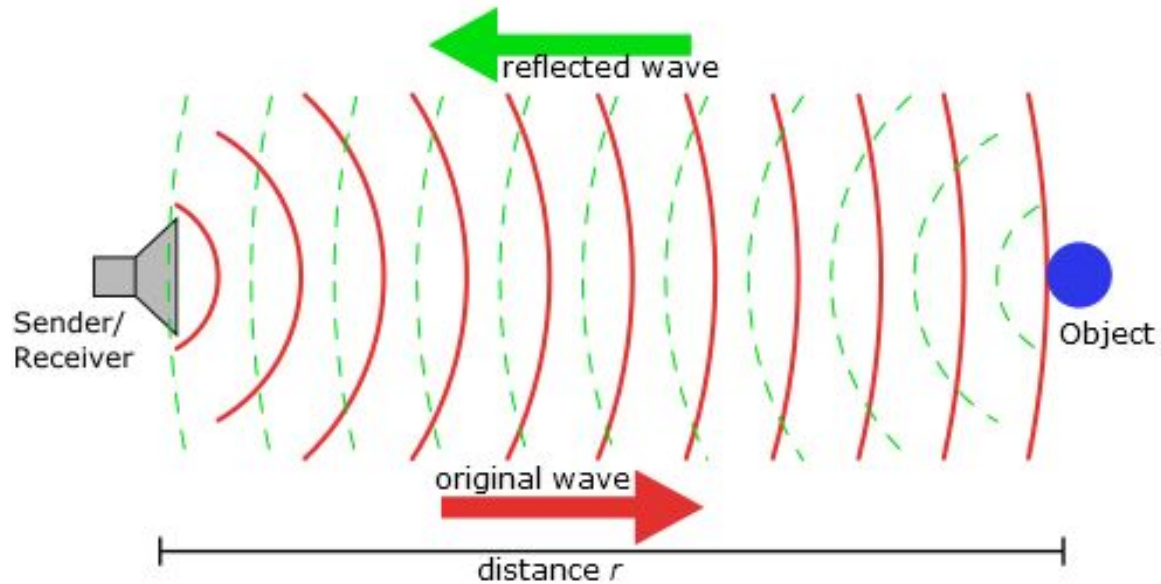


Ultrasound

Ultrasound is high-pitched sound waves with frequencies higher than the audible limit of human hearing.



Ultrasound Distance Sensing

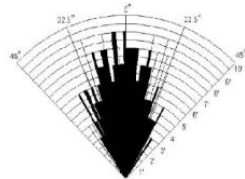
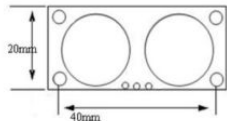
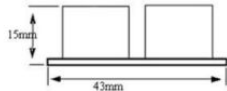
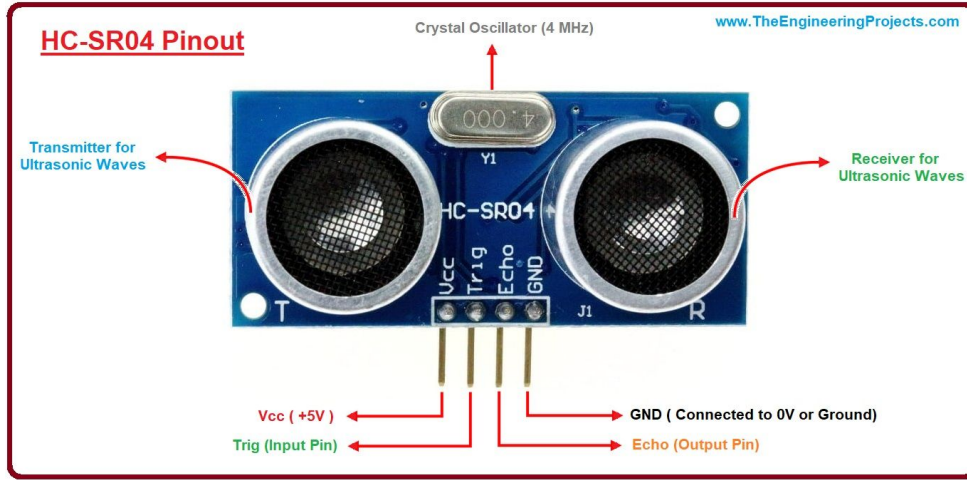


$$\text{distance} = \frac{\text{speed} \times \text{time}}{2}$$

HC-SR04 Ultrasonic Distance Sensor

- Consists of a transmitter and a receiver.
- Transmitter broadcasts ultrasound at 40kHz.
- Receiver listens to the transmitted ultrasonic waves.

HC-SR04 Ultrasonic Distance Sensor

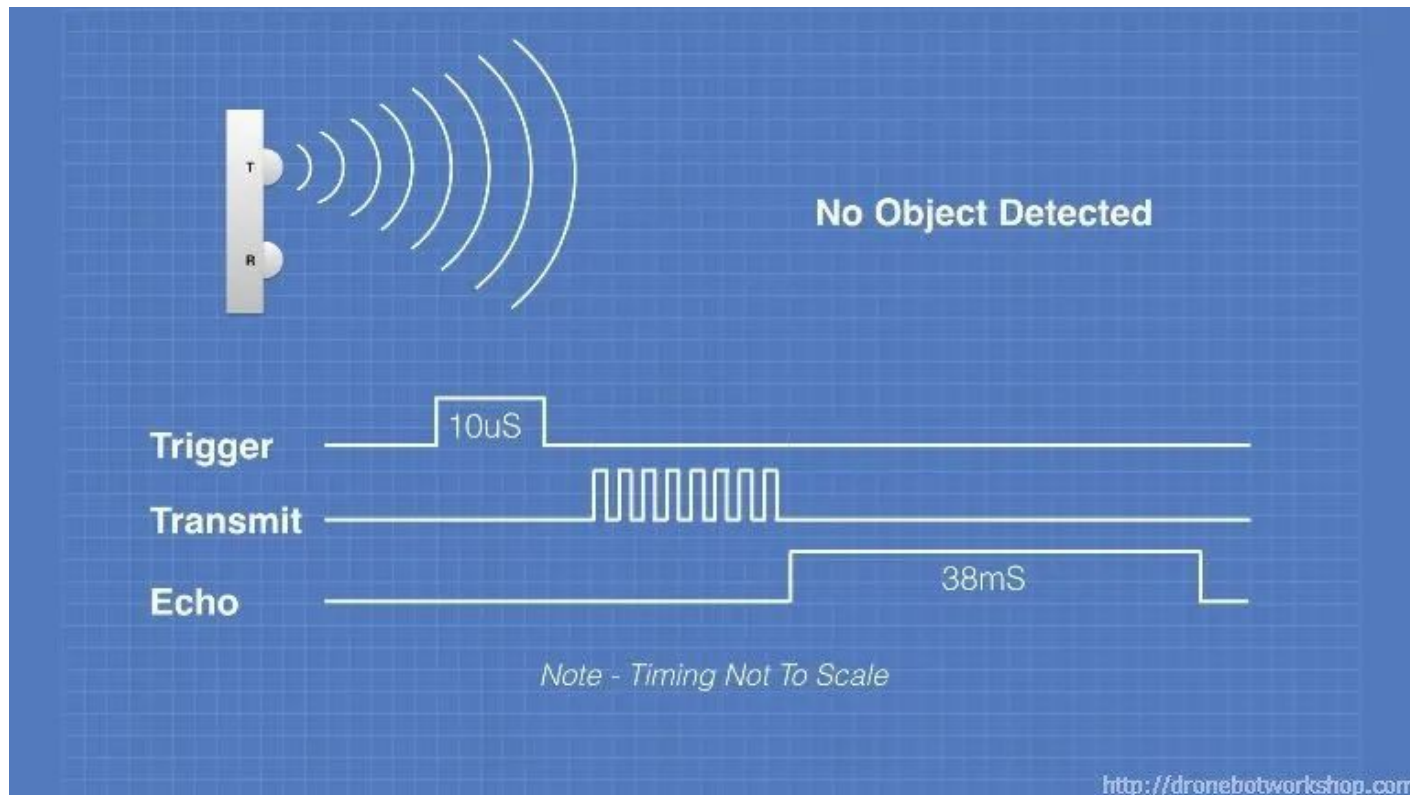


Practical test of performance,
Best in 30 degree angle

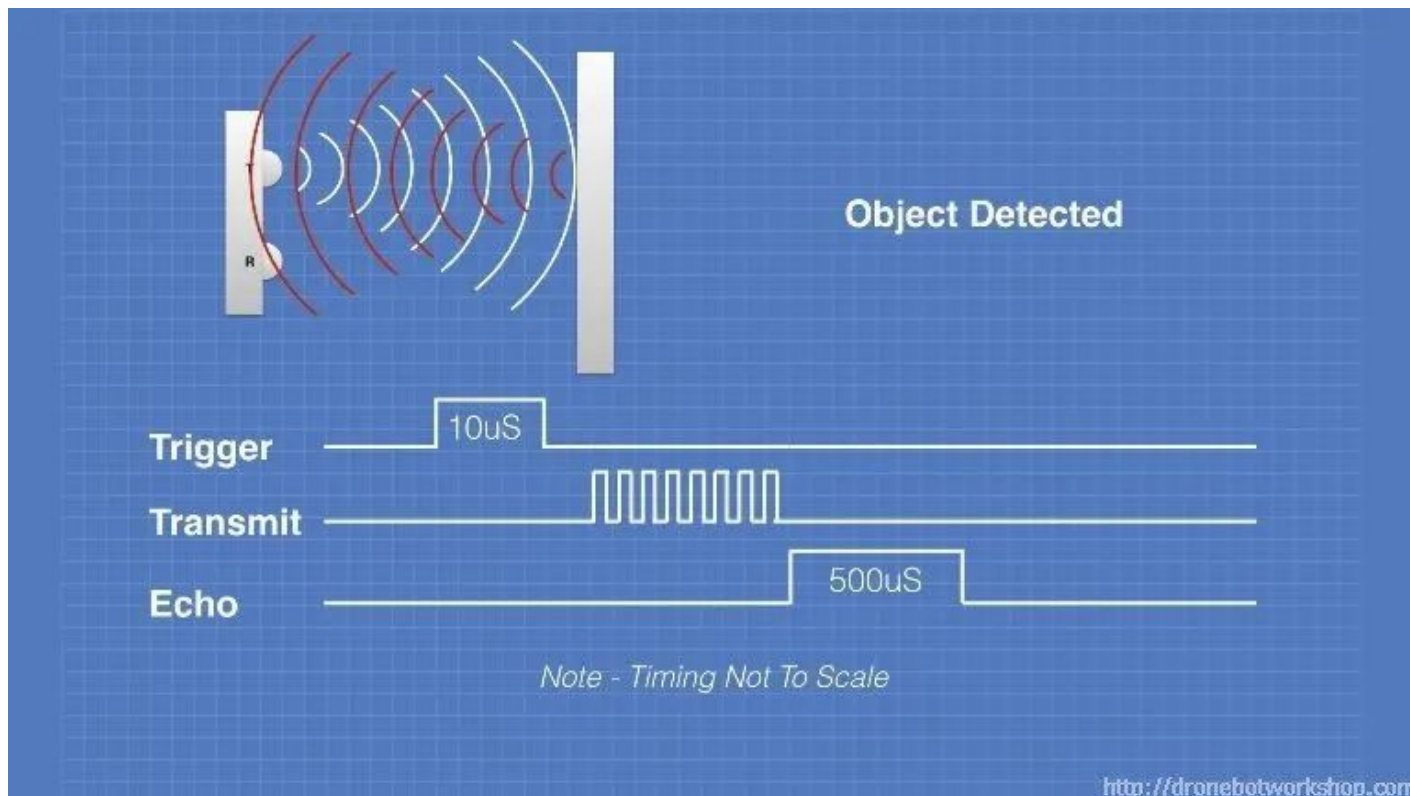
Operating Voltage	5V
Operating Current	15mA
Ultrasound Frequency	40kHz
Max. Linear Range	4 m
Min. Linear Range	0.02 m
Measuring Angle	15 deg
Measuring Accuracy	3 mm

Purchase Link: <https://www.amazon.com/dp/B07YXX52SC/>

HC-SR04 Detection



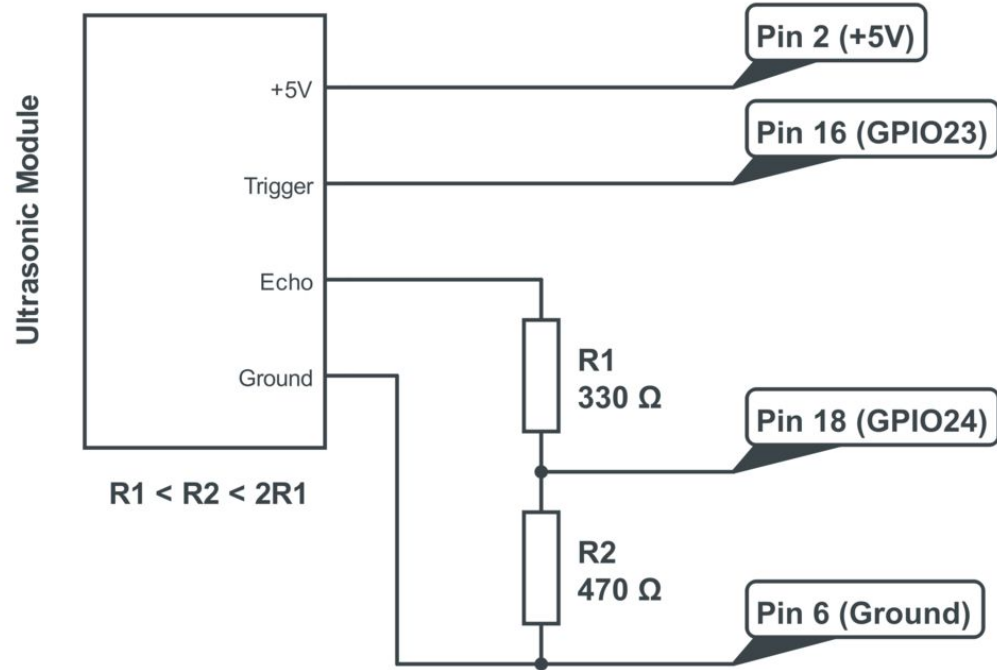
HC-SR04 Detection



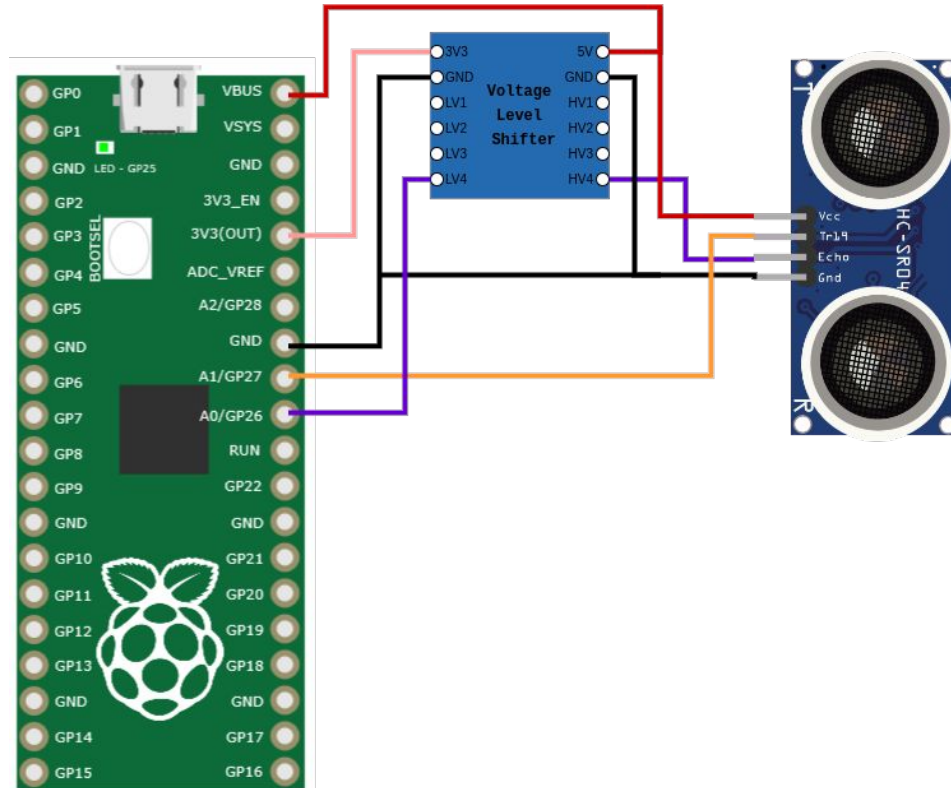
HC-SR04 Workflow

1. Send a **10 microseconds pulse at 5 volt** to the “Trigger” pin.
2. The transmitter bursts of **8 pulses at 40 KHz**. This 8-pulse pattern makes the “ultrasonic signature” from the device unique, allowing the receiver to discriminate between the transmitted pattern and the ultrasonic background noise.
3. As soon as the 8-pulse ultrasonic wave is transmitted, the **“Echo” pin goes high**.
4. If the receiver DOES NOT hear the 8-pulse signal. The **“Echo” pin goes low after 38 milliseconds**.
5. If the 8-pulse signal is received before the Echo signal timed out, the **“Echo” pin goes low immediately**. This produces a pulse whose width varies **between 150 uS to 25 mS**.
6. The width of the received pulse is used to calculate the distance to the reflected object.

Voltage Divider



HC-SR04 Wiring



picozero Examples

```
from picozero import DistanceSensor
```

```
from time import sleep
```

```
ds = DistanceSensor(echo=2, trigger=3)
```

```
while True:
```

```
    print(ds.distance)
```

```
    sleep(0.1)
```