ENGR 3421: Robotics I

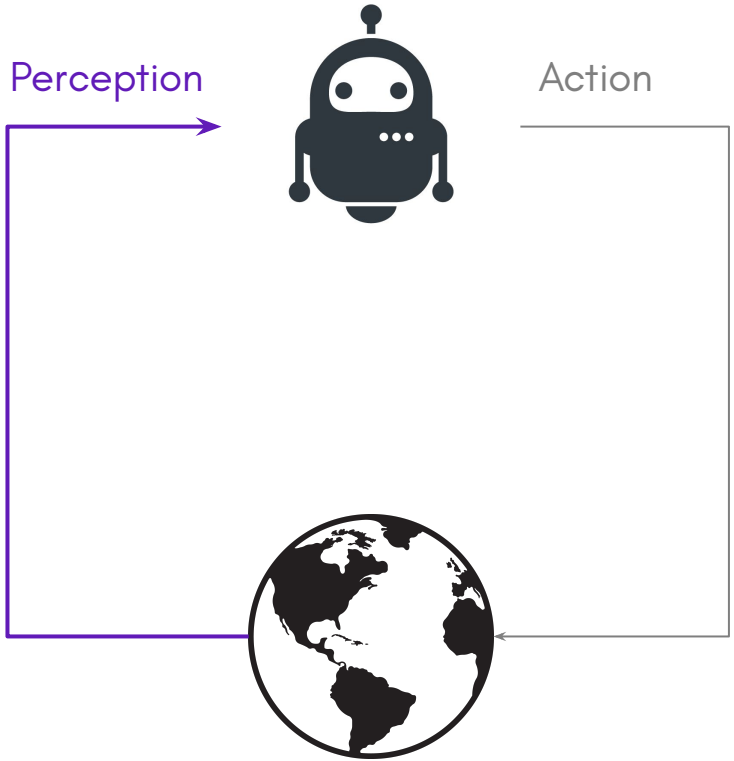
Ultrasonic Distance Sensor

10/08/2024

Outline

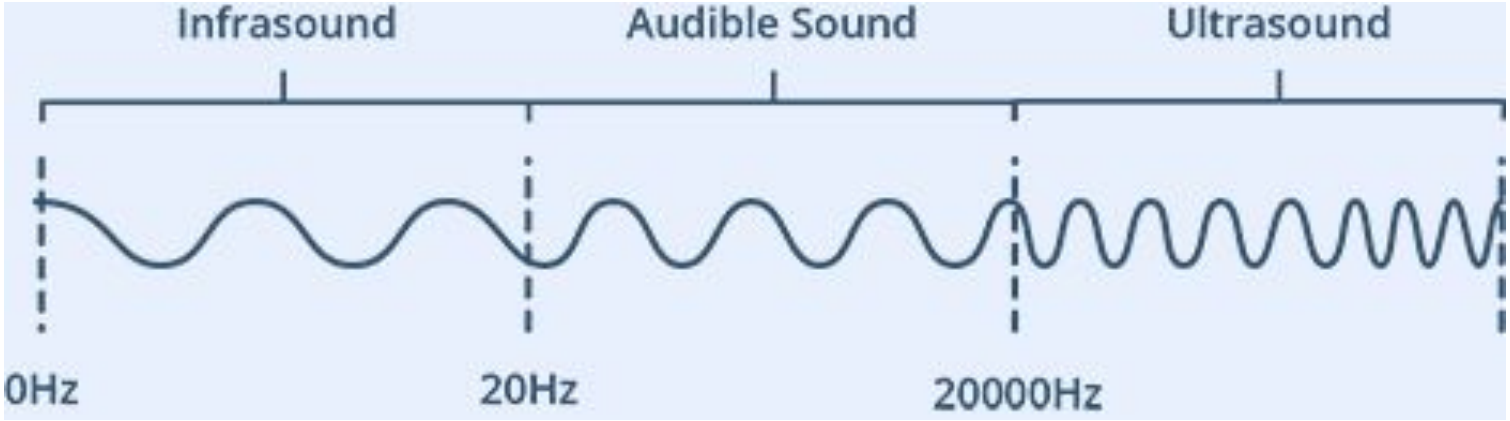
- Ultrasound
- HC-SR04

A Robot Needs to Feel

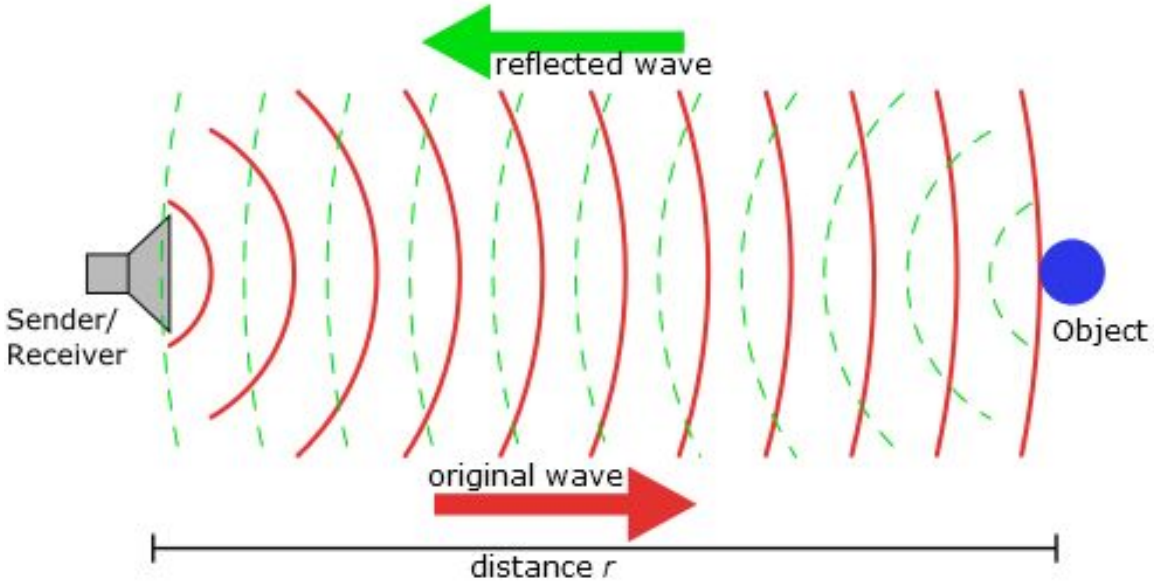


Ultrasound

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



Ultrasound Distance Sensing



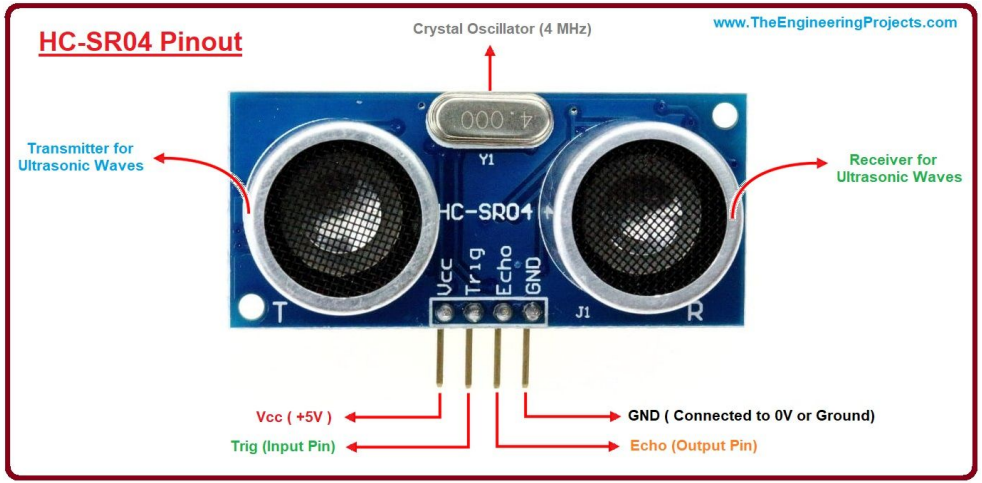
$$\text{distance} = \frac{\text{speed} \times \text{time}}{2}$$

$$r = \frac{v \times t}{2}, \text{in air: } v = 340 m/s$$

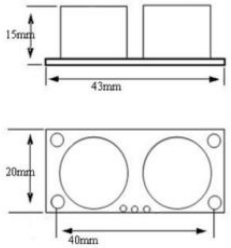
HC-SR04 Ultrasonic Distance Sensor

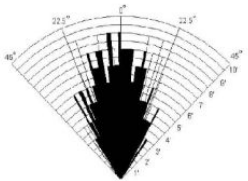
- Consists of a transmitter and a receiver.
- Transmitter broadcasts ultrasound at 40kHz.
- Receiver listens to the transmitted ultrasonic waves.

HC-SR04



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

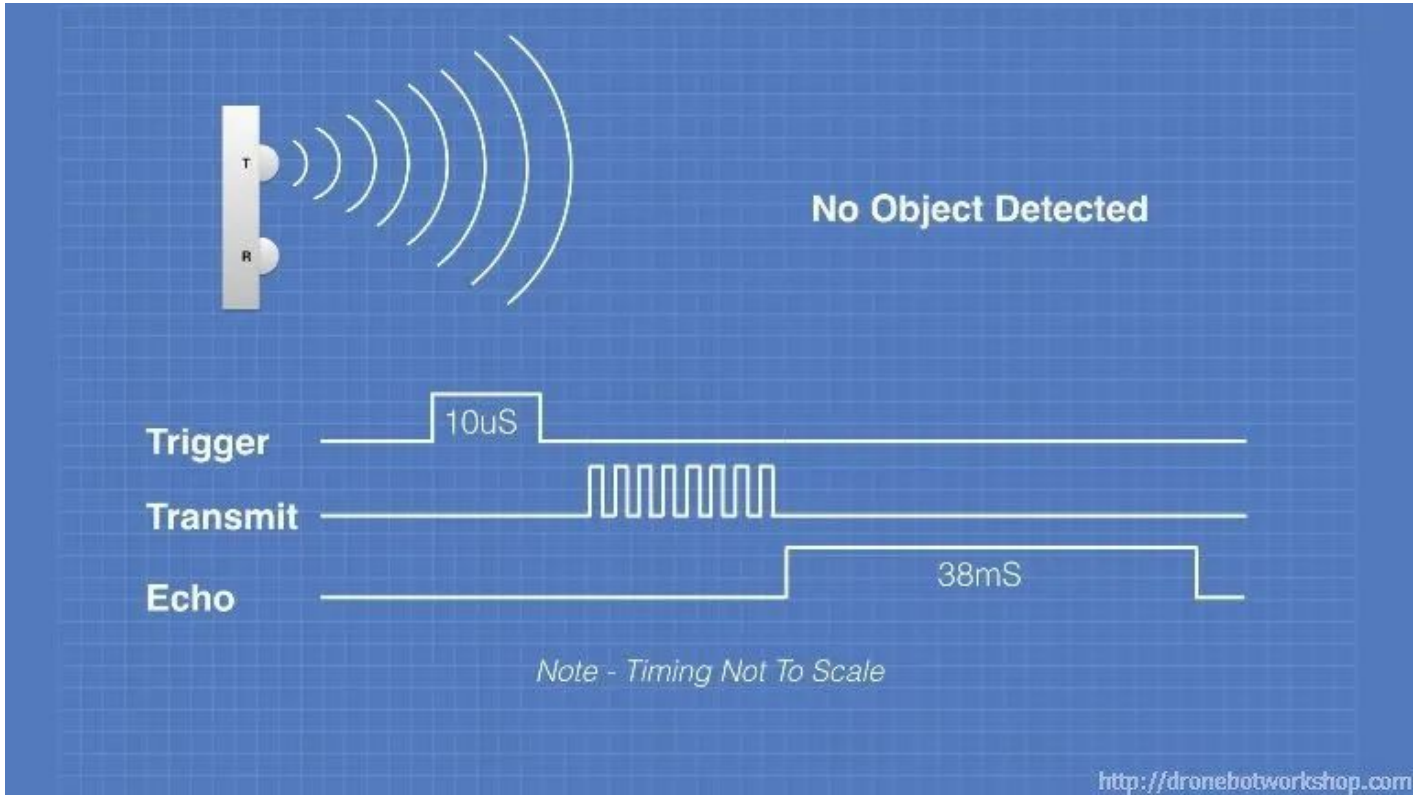




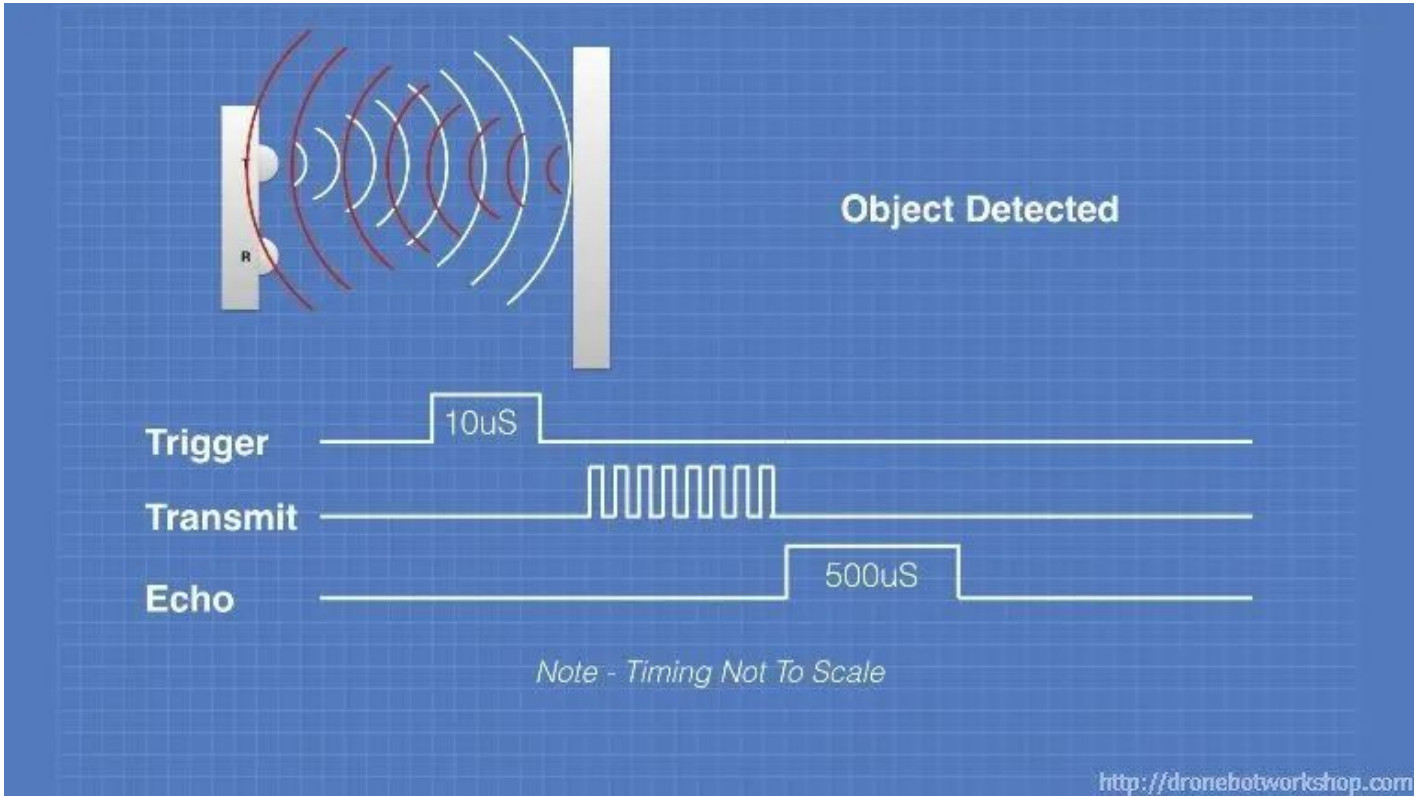
Practical test of performance, Best in 30 degree angle

https://www.amazon.com/dp/B07YXX52SC/

HC-SR04 Detection



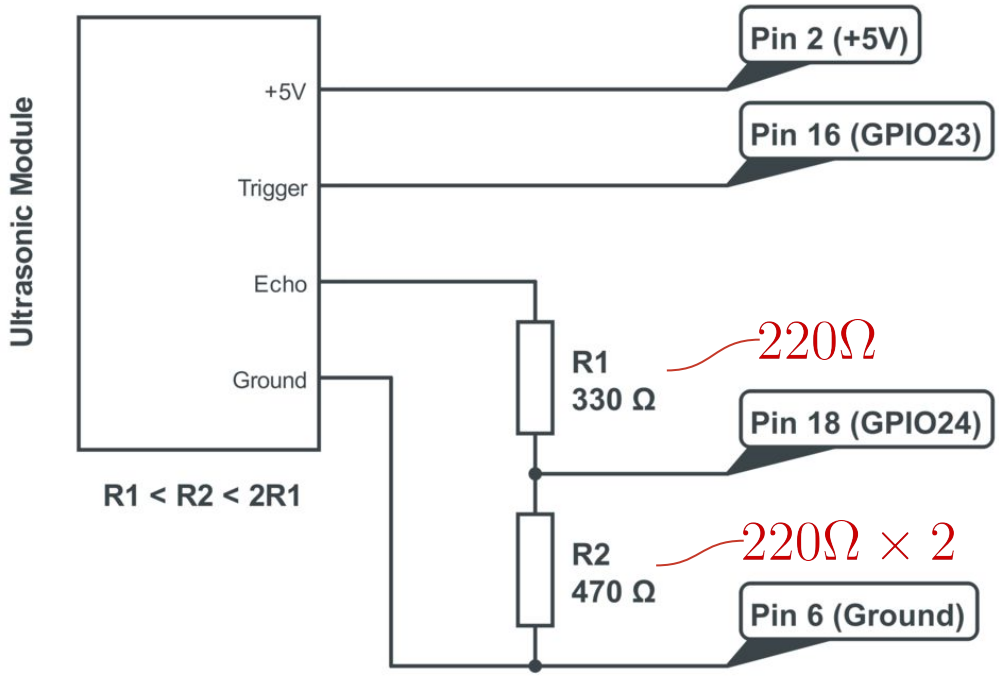
HC-SR04 Detection



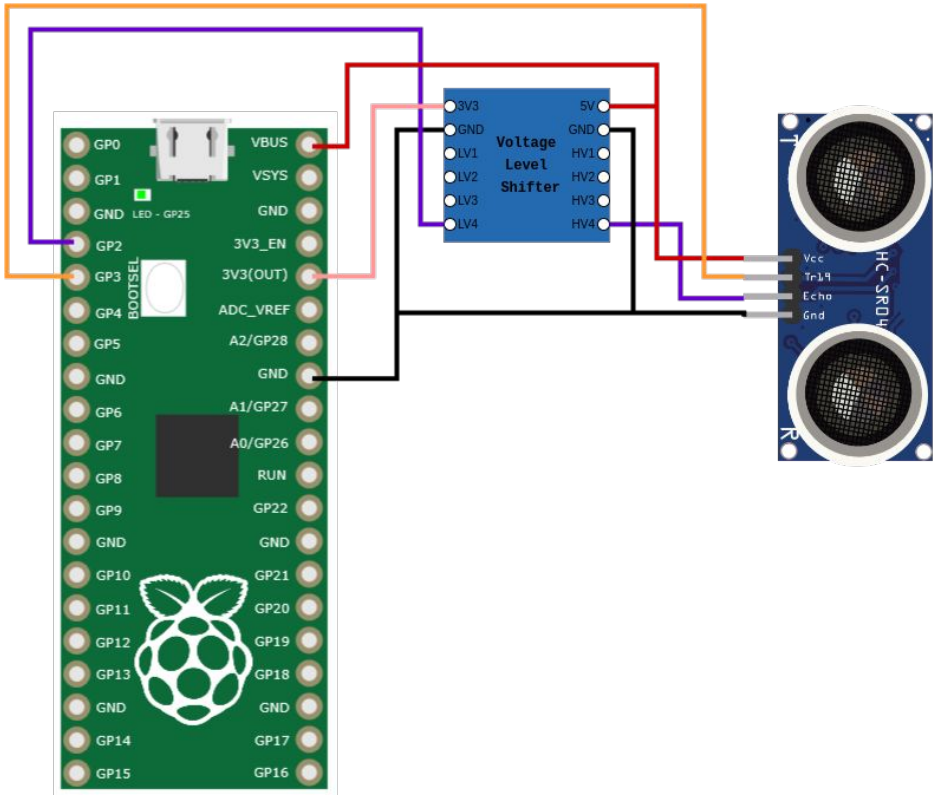
HC-SR04 Workflow

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)
```