Adapted from: https://www.maxbotix.com/articles/how-ultrasonic-sensors-work.htm
https://trionprojects.org/ultrasonic-sensor-hc-sr04-with-pic-microcontroller/

Module 7 – Working with an Ultrasonic Sensor

For this module you will need:

- ESP32
- Breadboard
- Thin jumper wires
- Ultrasonic sensor

Be sure the ESP32 is unplugged, and the battery pack power switch is OFF.

We will now interface an Ultrasonic Sensor to the ESP32 (a microcontroller).

Doing so will allow us to measure the distance to an obstacle in front of the robot car.

Assemble the diagram shown here:
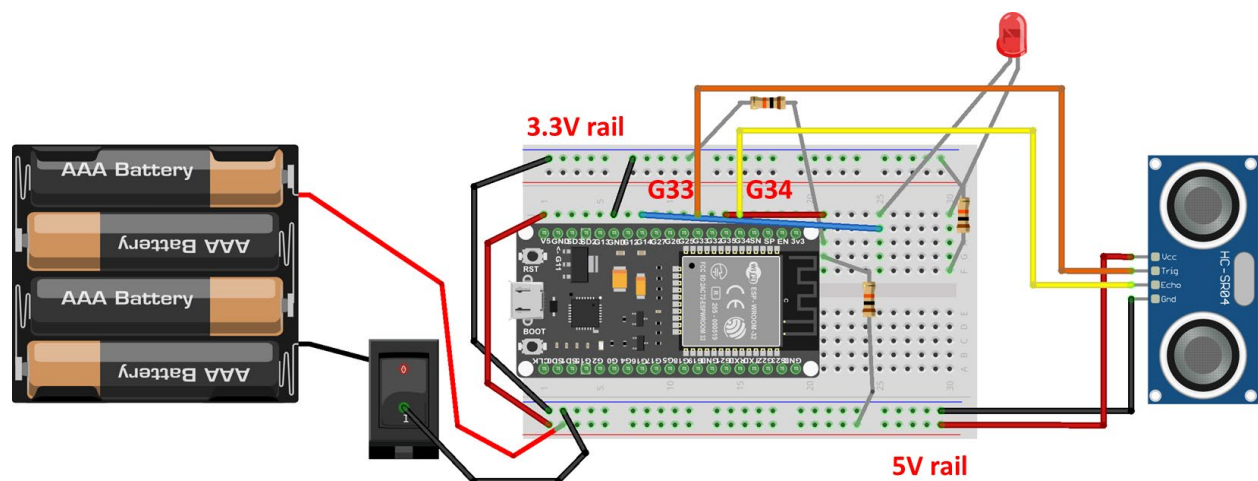
Jumper the two red rails together

Jumper the two blue rails together

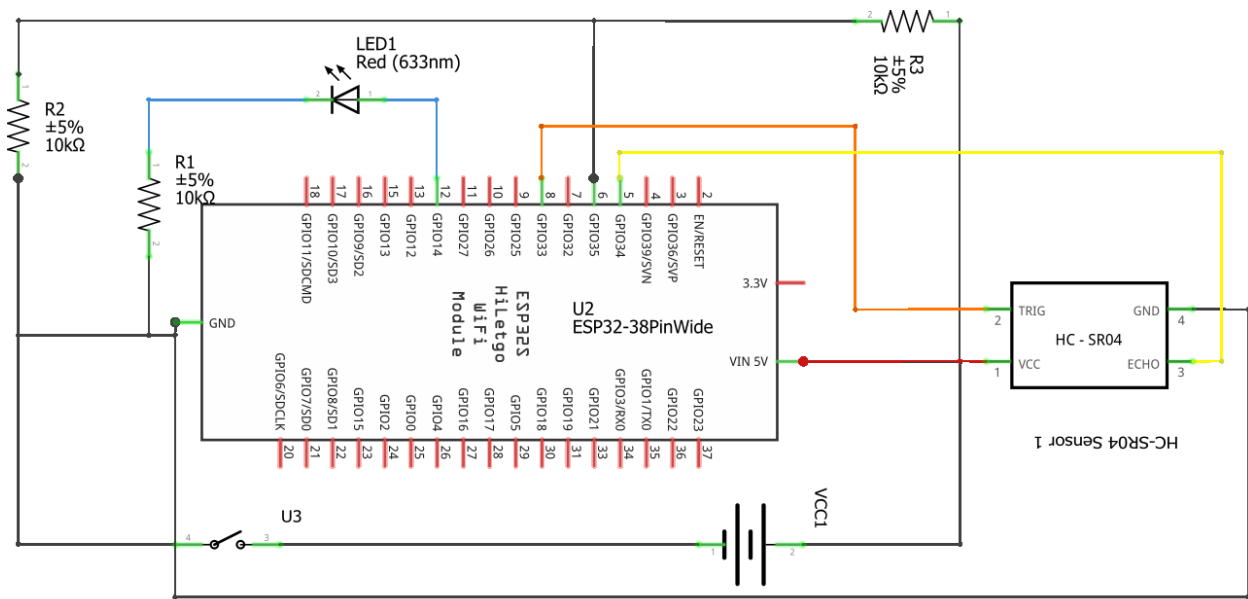Connect the ultrasonic Vcc to **the 5V red rail**

Connect the ultrasonic Gnd to a blue rail

Connect the ultrasonic Echo to G34

Connect the ultrasonic Trig to G33

Adapted from: https://www.maxbotix.com/articles/how-ultrasonic-sensors-work.htm
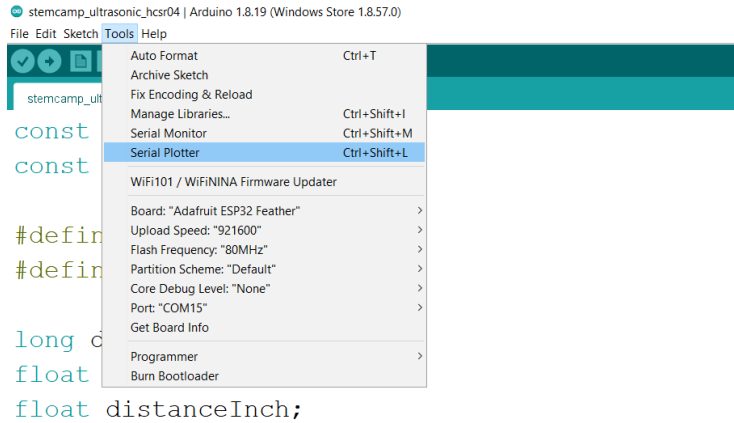https://trionprojects.org/ultrasonic-sensor-hc-sr04-with-pic-microcontroller/

With the jumper cables connected to the ultrasonic sensor, bend the pins back as picture below and insert into the ultrasonic sensor holder.
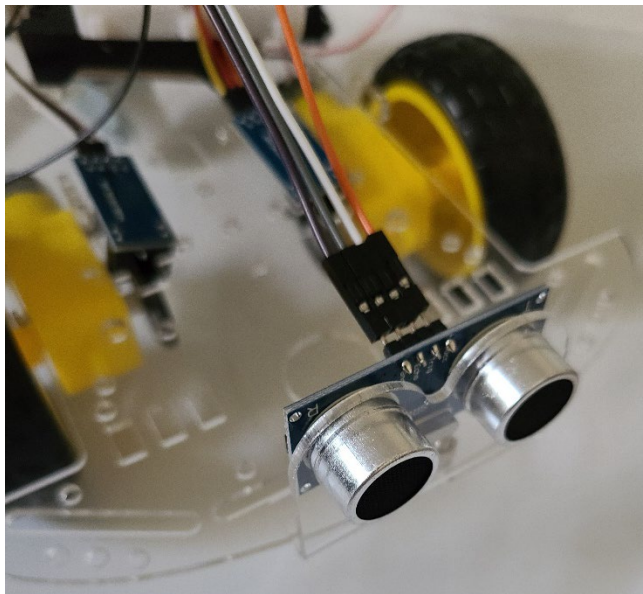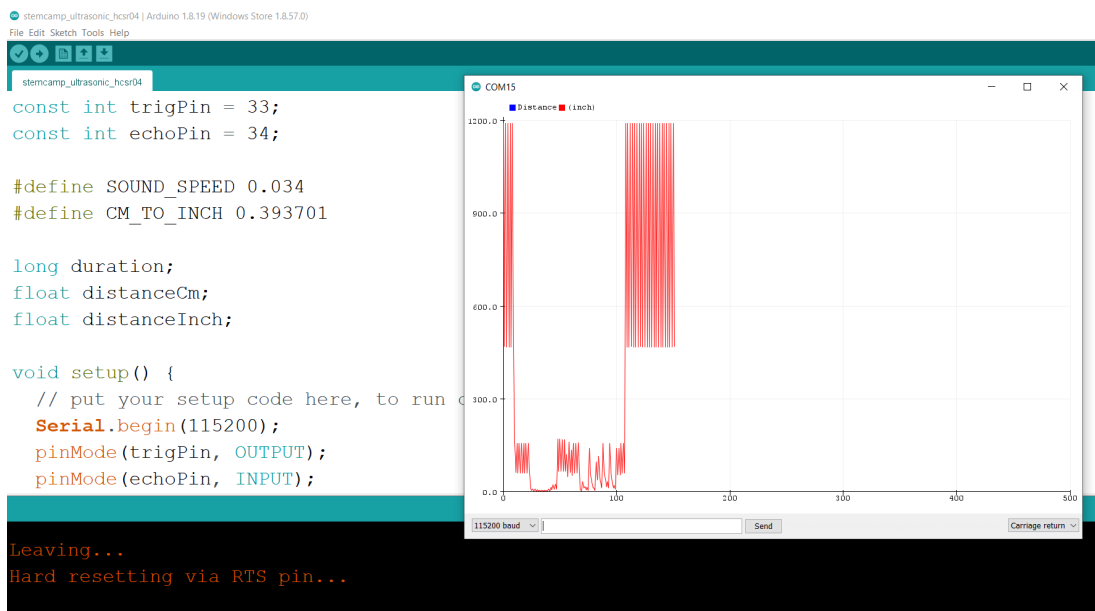
Adapted from:

In the Arduino IDE, open the file **stem_camp_ultrasonic.ino**

Go to ***Tools->Serial Plotter***

You will see the distance that the ultrasonic sensor detects in the serial monitor.

See if you can work with your team to turn the LED on and off depending on a certain distance.

What is an ultrasonic sensor?

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves.

An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity.

High-frequency sound waves reflect from boundaries to produce distinct echo patterns.

How Ultrasonic Sensors Work.

Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor acts as a microphone to receive and send the ultrasonic sound. Our ultrasonic sensors, like many others, use a single transducer to send a pulse and to receive the echo. The sensor determines the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse.

The working principle of this module is simple. It sends an ultrasonic pulse out at 40kHz which travels through the air and if there is an obstacle or object, it will bounce back to the sensor. By calculating the travel time and the speed of sound, the distance can be calculated.

Ultrasonic sensors are a great solution for the detection of clear objects. For liquid level measurement, applications that use infrared sensors, for instance, struggle with this particular use case because of target translucence.

For presence detection, ultrasonic sensors detect objects regardless of the color, surface, or material (unless the material is very soft like wool, as it would absorb sound.)

To detect transparent and other items where optical technologies may fail, ultrasonic sensors are a reliable choice.