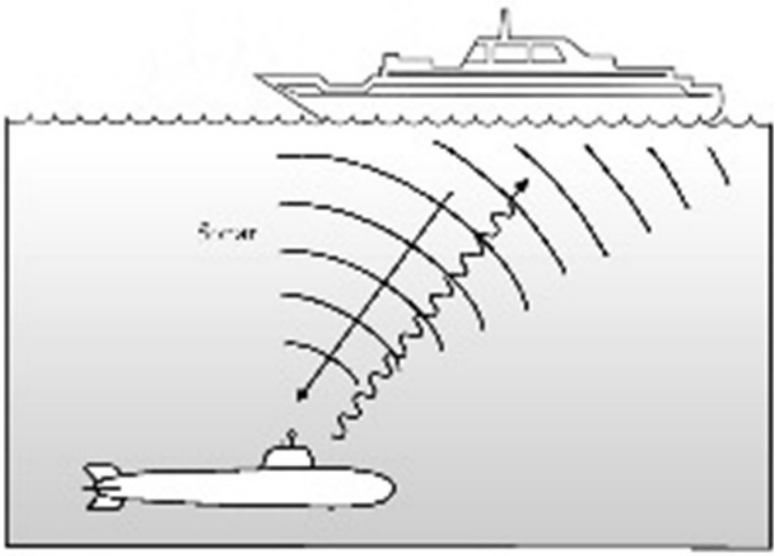
Make an ultrasonic Santa detector

You will build a detector that spots if a beam of ultrasound is broken and sets off an alarm. Along the way you will learn how to connect an ultrasonic-distance sensor to the Raspberry Pi, and how to control the flow of your Scratch program by responding to the input from the sensor.

Introduction: what is an ultrasonic distance sensor?

An ultrasonic distance sensor is a sensor that uses very high pitch sound to detect the distance objects are from the sensor.

It works by sending out an ultrasonic "blip". We then count how long it takes for that blip to bounce back. We then need to do a little bit of maths to work out the distance.



The other name for this technology is Sonar. Sonar is famously used to find submarines.

We will be using the extremely popular HC-SR04 module. It is able to detect flat objects as far as 2 metres away or slightly curved objects as far as 1 metre away.

We can set the sensor up pointing at a wall or other flat object then wait until the distance changes. When it changes, we know the beam has been broken!

Step 1: Building the circuit

We can't just plug the sensor directly into the Raspberry Pi. We must first build a small circuit with 3 resistors on a breadboard.

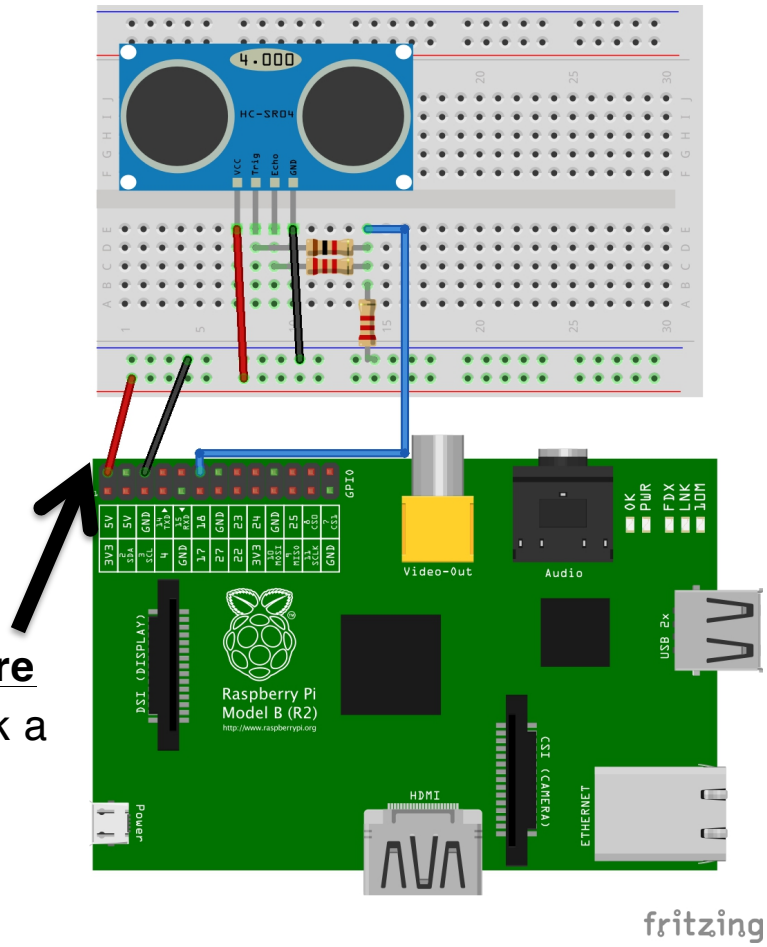
The reason for this circuit is to lower the voltage of the signal coming from sensor. It usually will return a signal at 5 volts, but the Raspberry Pi only supports up to 3.3 volts. Providing it with 5 volts could blow the Raspberry Pi, so we must reduce it!

By Andrew Mulholland. Based off Raspberry Pi Foundation HoC resources
Northern Ireland Raspberry Jam

You will need

- An HC-SR04 ultrasonic sensor
- A breadboard
- 3 Male to Female jumper cables
- 2 Male to Male jumper cables
- 2 2.2K resistors
- 1 1k resistor

Set up your circuit like the diagram to the right. **Before connecting this wire**, ask a mentor to check it!



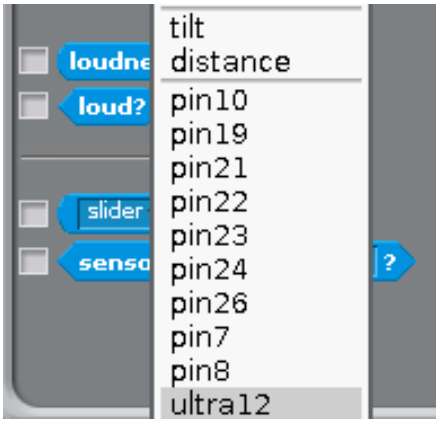
Step 2: Test the sensor

Because we are using the GPIO pins, we need to run a special version of Scratch called 'Scratch GPIO 5'. Double-click this icon on the desktop to run it.

Scratch GPIO has support for our sensor built in and can handle all the complicated maths required for the sensor, automatically!

To check the distance once every second, create a new broadcast with ***ultra12*** as its title like to the right and double click it to run it.

Now check in the ***sensing*** section in Scratch in the ***[slider] sensor value*** block dropdown menu until you find ***ultra12***. Select it.



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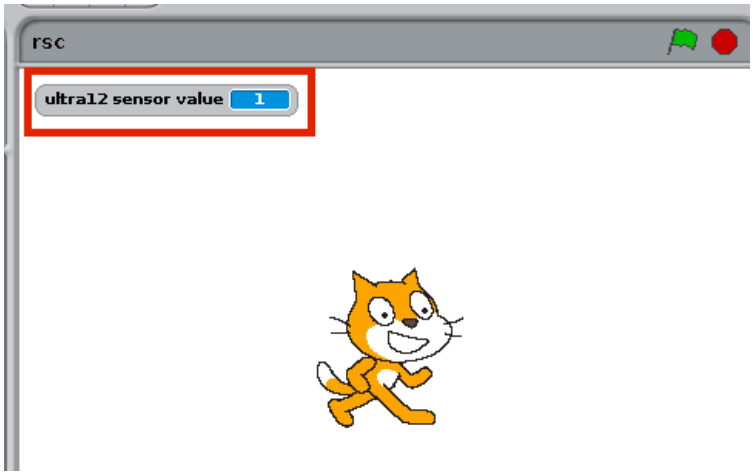
You will now notice the value the sensor is currently reading is shown in the top left corner of the stage.



If it is reading 255, this means the sensor is not receiving anything back. Maybe the object is too far away or not flat enough?

Step 3: Draw a sprite and add sound

Click on the ***Costumes*** tab and draw a Santa sprite. This will be displayed when the ultrasonic distance sensor value drops below a certain value

Click on the ***Sounds*** tab and import a sound from the ***Electronic*** folder. I've used a siren called 'Whoop' here.

Step 4: Program what happens when the detector spots movement

The ***if*** statement continuously checks the ultrasonic sensor on pin 12 distance. When it drops below ***30*** (cm) it does the following:

- Shows the sprite

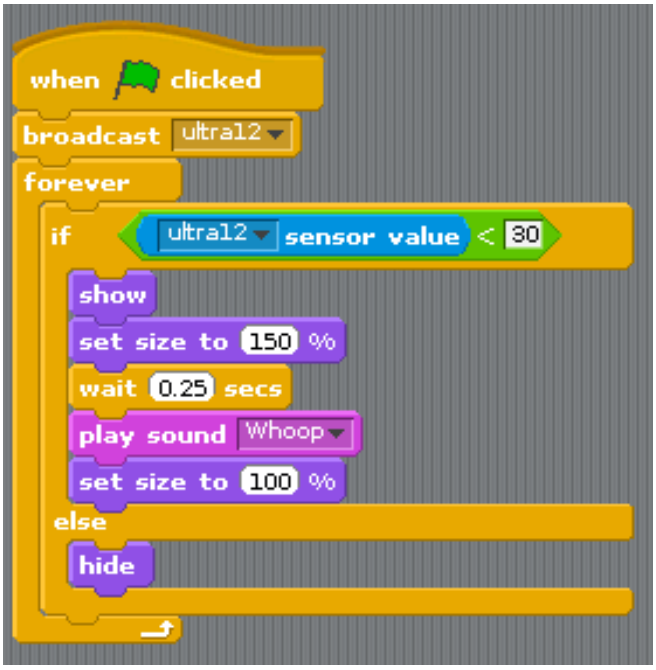
- Makes the sprite bigger

- Waits a bit

- Plays a sound

- Makes the sprite normal size

It keeps doing this as long as the sensor value is below ***30*** (cm) i.e. someone has broken the beam.



The ***else*** statement simply hides the sprite when the sensor reports greater than ***30cm***.

Now what?

Now you can choose what happens when Santa is detected.

Here are a few ideas

- Make the background flash
- Animate the sprite using costumes
- Change the sound (***'Santa Claus is coming to town'*** would be good :))
- Use different graphic effects instead of ***change size***
- Display a message
- Hook up an RGB LED (see adding RGB LED worksheet) and have it flash when Santa is near.