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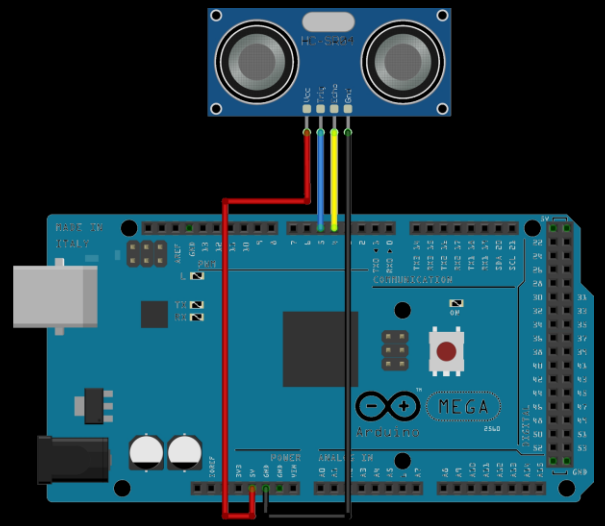
Ultrasonic Sensor



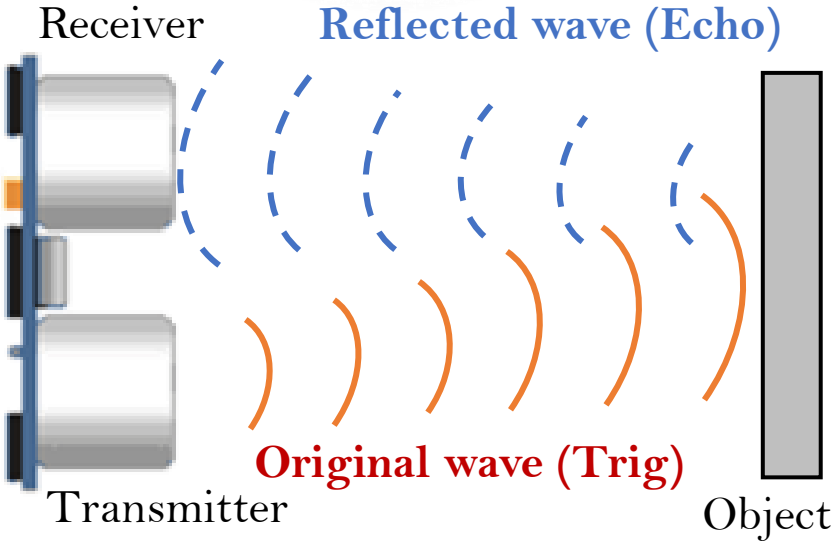
Key Learning Points

After this Lecture, you will be able to:

- Obtain measured distance values from the ultrasonic sensor, and undertake the process of data rejection for 'unwanted' data points

3.1 Introduction

- Required hardware for the exercise:
  - ✓ Supported Arduino Uno board
  - ✓ USB cable
  - ✓ Breadboard
  - ✓ Ultrasonic HC-SR04 sensor
  - ✓ 4 x male-to-male wires



HC-SR04 ultrasonic sensor details:

- Distance measurement of 0.02 to $4.00m$
- Accuracy of $\pm 0.003m$

Calculation for distance measurement:

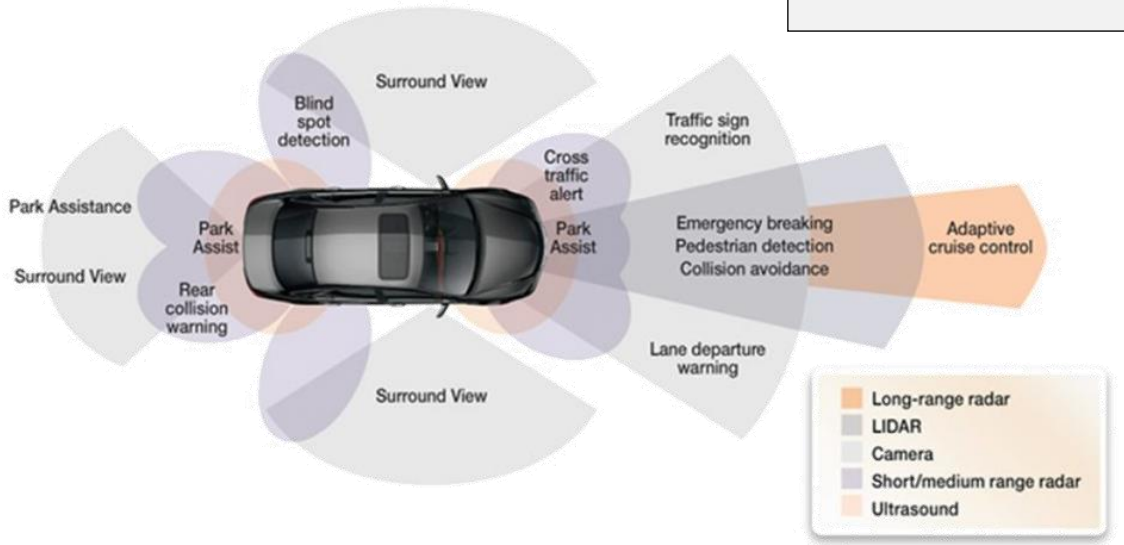
(halved as t is time of Trig and Echo)

Time (between Trig and Echo)

$$d = \frac{1}{2}tc$$

Distance

Speed of sound (approximately $343m/s$)



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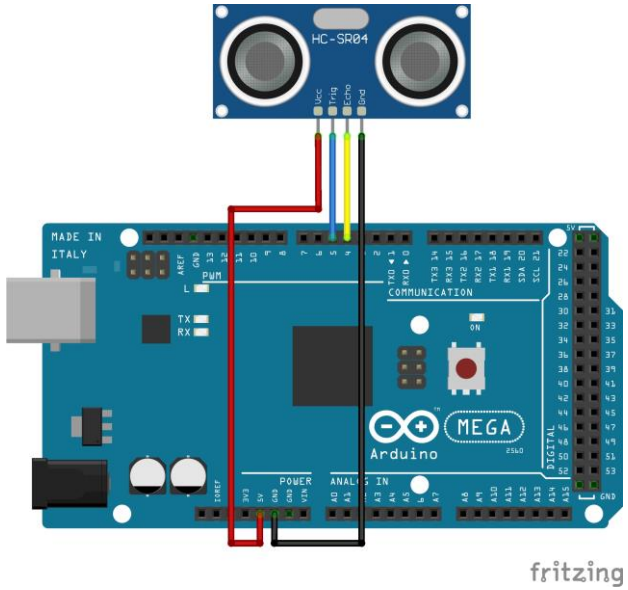
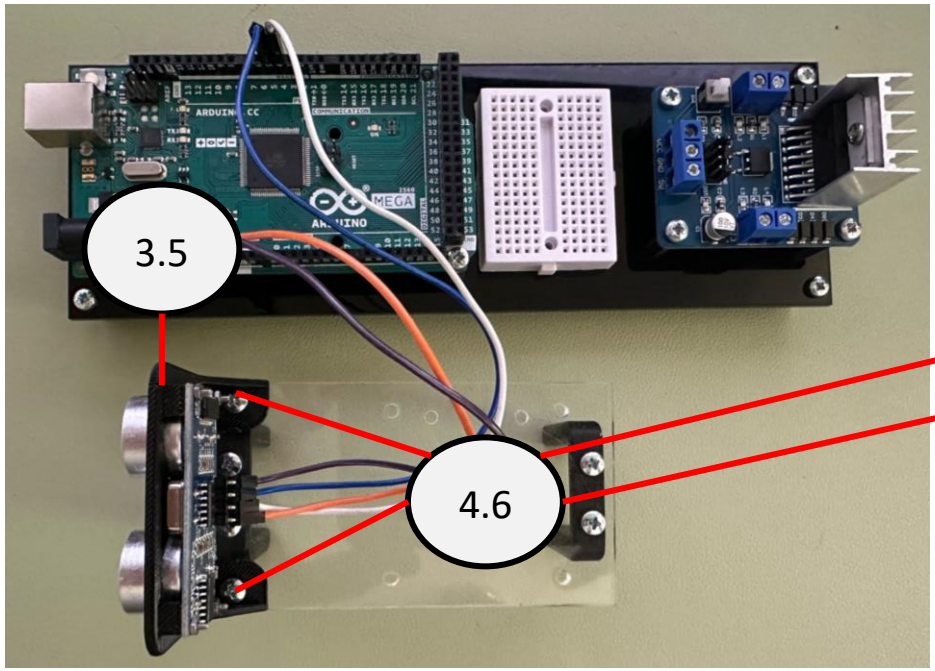
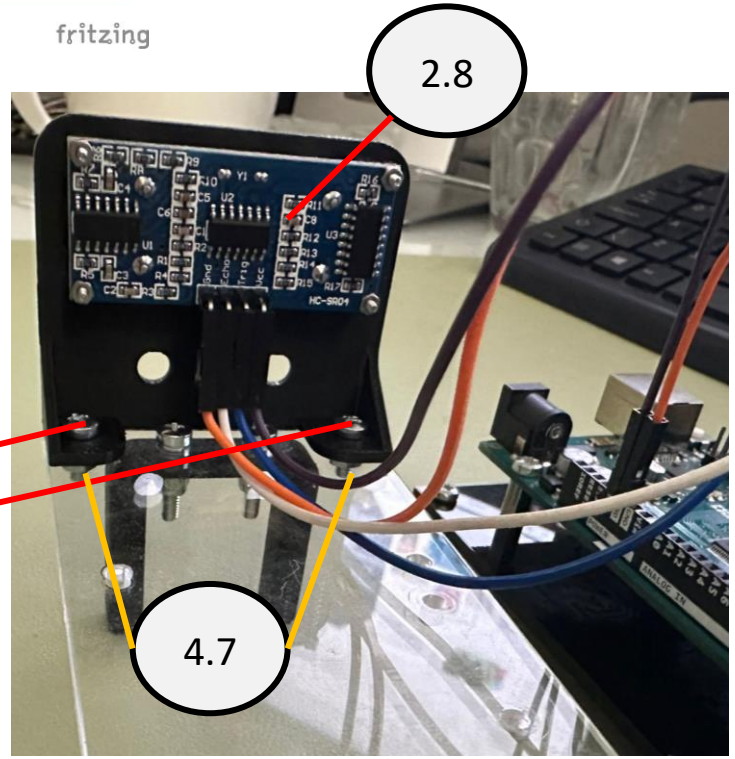
3.2 Hardware

- Required hardware for the exercise:
  - ✓ Supported Arduino Mega 2560 board
  - ✓ USB cable
  - ✓ Breadboard
  - ✓ Ultrasonic HC-SR04 sensor
  - ✓ 4 x male-to-female wires
- Set-up the CLB rig as illustrated to the right, using the following components of importance:
  - 2.8: HC-SR04 ultrasonic sensor
  - 3.5: Ultrasonic sensor and LEDs mount
  - 4.6: 2 x bolt, 16mm, M3
  - 4.7: 2 x nuts, M3







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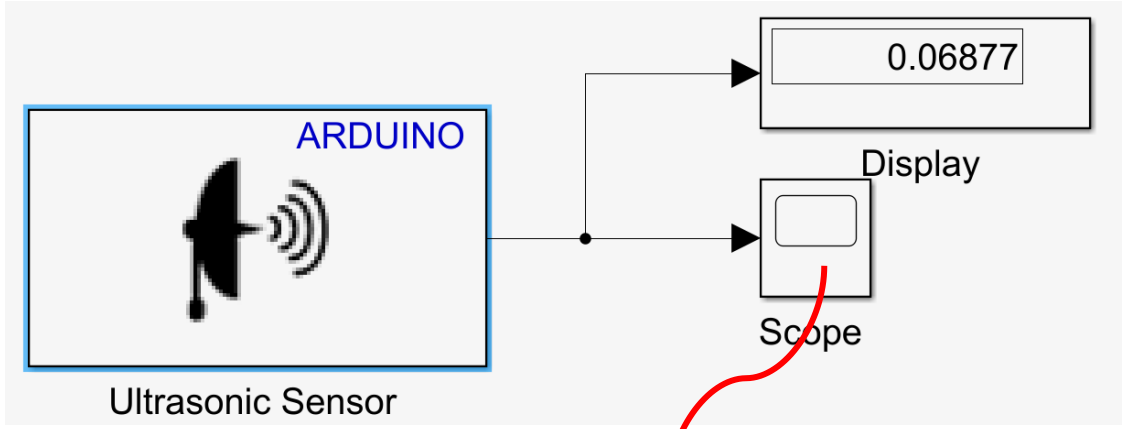
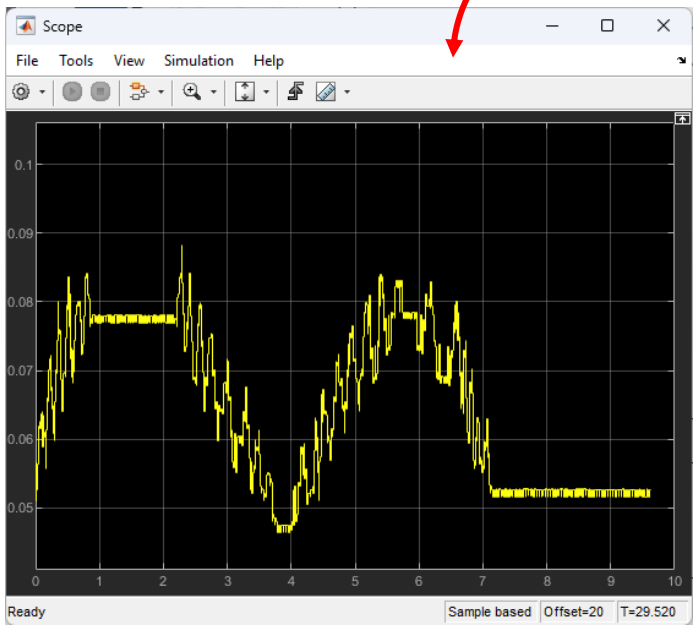
3.3 Algorithm Design

- ‘Ultrasonic Sensor’ block is found under the ‘Sensors’ tab in ‘Simulink Support Package for Arduino Hardware’
- ‘Display’ and ‘Scope’ are both found under the ‘Sinks’ tab in ‘Simulink’

- **Undertake the following three steps:**
  i. Double click on ‘Ultrasonic Sensor’ then set the number of signal pins to ‘2’
  ii. The trigger pin should be defined as ‘4’ and the echo pin as ‘5’
  iii. Select a sampling time/interval, T_s (e.g., 0.01 seconds – you should investigate different values)





Move an object Infront of the ultrasonic sensor to measure the distance.

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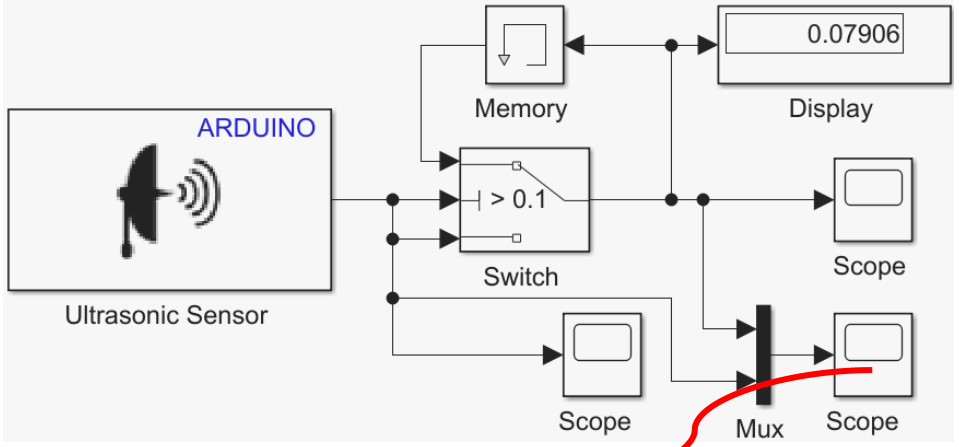
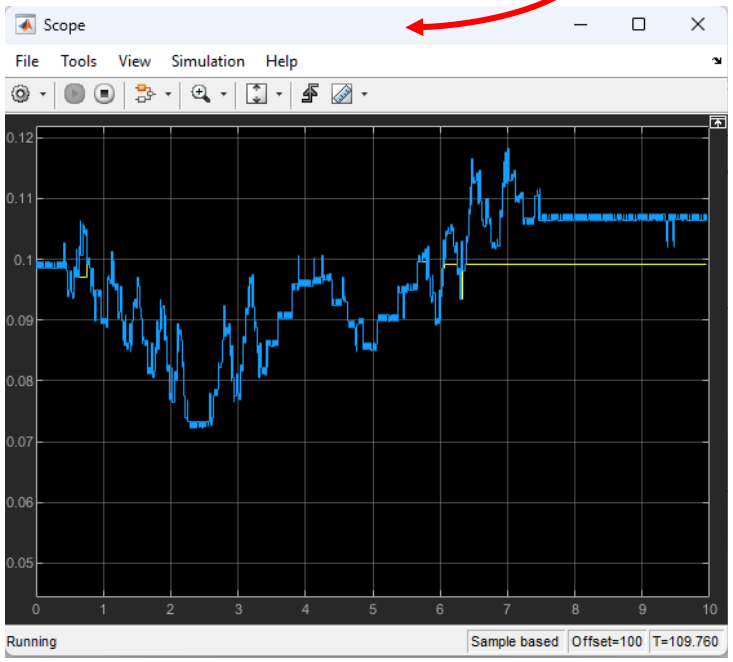
3.4 Algorithm Design – Data Rejection

- This could be set-up for use within the operational requirenents of the sensor, i.e., 0.02 to 4.00m
- 'Switch' block is found in 'Signal Routing' of 'Switch'
- 'Memory' block is found in 'Discrete' of 'Simulink'

- **Undertake the following step:**
  i. Double click on the 'Switch' and change the 'Threshold' to 0.1 (how this set-up works: if the ultrasonic sensor output value is above 0.1 meters, then the last known stored value in the memory below 0.1 meters will be the output)





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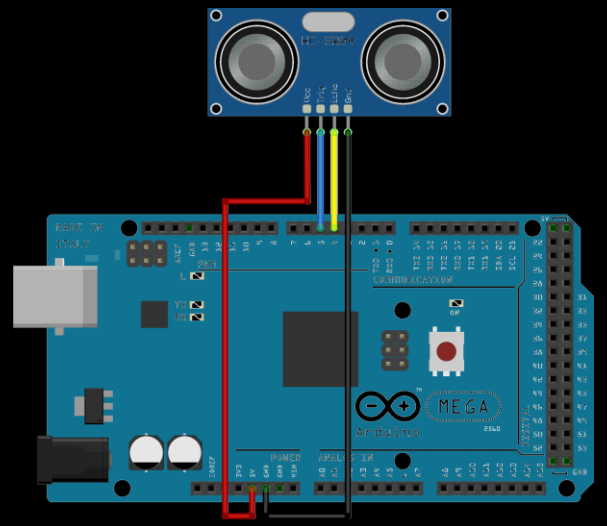
Ultrasonic Sensor



3.5 Summary

- An ultrasonic distance measuring sensor has been used with an Arduino Uno
- Simulink has then been used to develop a data rejection algorithm to reject 'unwanted' data points