LESSON PLAN

CUBOT Moodle Year Course
LESSON PLAN

TITLE:	**The Importance of Sensors and the Ultrasonic Sensor**
LESSON:	**9 / 32**
DURATION:	1h
TOPICS INTRODUCED:	The Ultrasonic Sensor, Sensors in Robotics
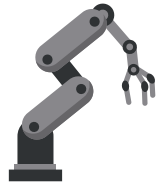
INTRODUCTION:

This lesson touches on sensors and why they're used in robotics. It then introduces the ultrasonic sensor: how it works, and how to use it. The activities include using the ultrasonic sensor to turn on an LED, and a driving activity where the robot will avoid bumping into obstacles.

Note: This lesson requires an active internet connection for Arduino firmware updates.

IN THIS LESSON:

- We will look at how the ultrasonic sensor works.
- The students will learn how to use an ultrasonic sensor.
- We will look at sensors and why they're used in robotics.
- The students will complete some driving activities with the ultrasonic sensor.

Below, there is a *theory overview* that covers the theoretical questions asked in this lesson's presentation. The trainer is required to familiarise themselves with the presentation content before teaching the class.

RESOURCES REQUIRED:

1. CUBOT and Arduino UNO Kit
2. Laptop and USB B – A Cable
3. Ruler
4. Wall or large object that can be placed in front of robot

LESSON STRUCTURE:

1. Presentation | **15 mins**
2. Activity: Driving Activities with the Ultrasonic Sensor | **35 mins**
3. Quiz | **10 mins**

EXTRA RESOURCES:

Watch: A Competing robot uses sensors to solve a challenge

LESSON 9
THEORY OVERVIEW:

- **What is a sensor?**
  A sensor is a device or machine that is used to assist a robot in understanding its environment.

- **Sensors allow robots to be more precise.**
  Can you imagine trying to do an obstacle course if you couldn't see?

  Using sensors in robotics can help robots take real world measurements. This allows them to stop moving, or respond when certain conditions are met.

  - **Can you imagine if your car had two different sized doors?**
    Using sensors, the robot arm that cut your doors was able to know exactly where it was in space, in order to cut the two doors exactly the same.

- **What is an ultrasonic sensor?**
  An ultrasonic sensor is a device that can measure distance. *there are also images in the user manual for this topic.

  It has a usable range of about 3 to 100cm.
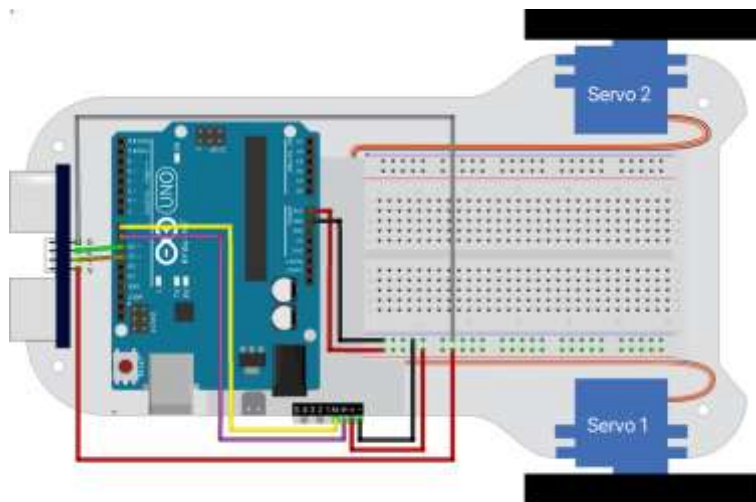
- **How does it work?**
  An ultrasonic sensor measures distance by sending ultrasonic pulses (sound waves) and measuring how long they take to get back to the sensor.

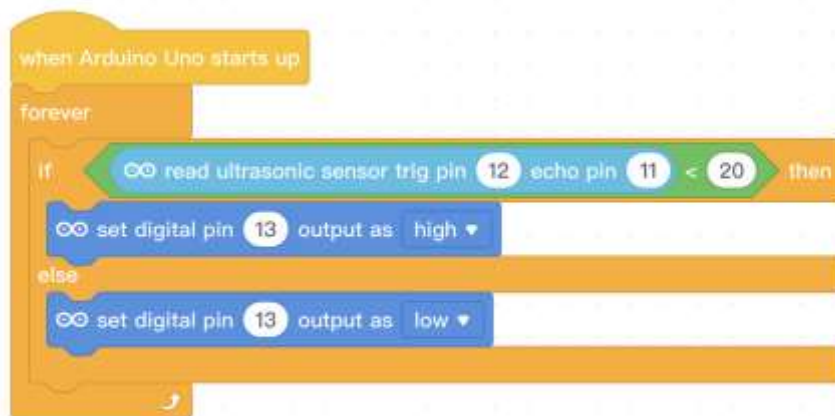 Ultrasonic waves are sound waves that are too high pitched for a human to hear.

- **Let's experiment with the ultrasonic sensor!**

- **Connect the lead wires to your robot as shown below:**

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- **Upload the following code to your robot: (Arduino code in folder)**

Outcome: When your hand is about 20cm away from the sensor, the LED turns on.

Here is where you would define the distance in cm in your code. (circle 20 in the green block) Experiment with this value.

- **Activity Guide**

Activity 1: Stop 30 cm from a wall

For this activity, you will need a wall or object that you can place in front of the robot.

You will need to modify the code above so that your robot:
   o   Drives forward
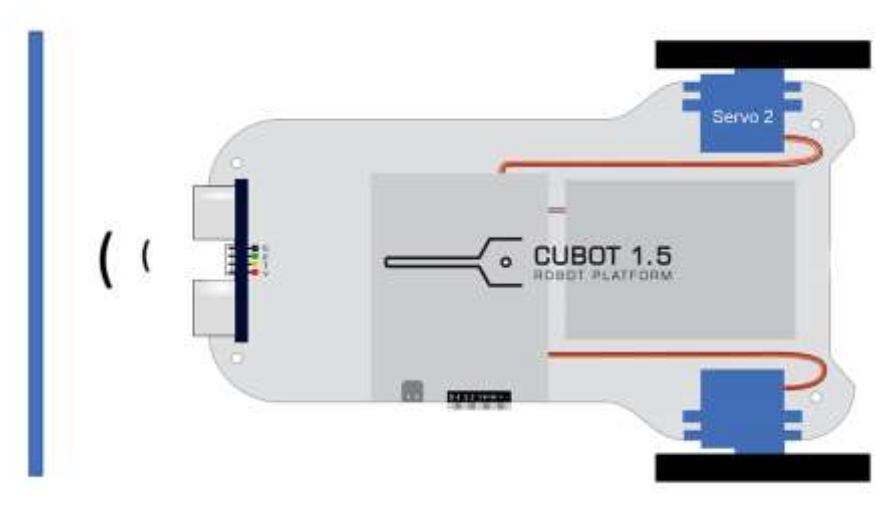
o   Stops exactly 30cm from a wall.

Note: 30cm in the code will probably not translate to 30cm in real life.
Use a ruler to measure your robot and adjust the number accordingly.

Here is some pseudocode that might help you:

"Loop the below forever:
If the ultrasonic sensor measures a value greater than 30cm, drive forward (70, 110).
Else, stop the motors from turning (90, 90)"

Activity 2: Object Avoidance

In this challenge, your are to modify the code that you have created so that your robot drives forward. If an object is detected (ultrasonic sensor detects something less than 20cm):

o   Your robot should stop for half a second
o   Your robot should reverse
o   Your robot should turn
o   Your robot should start driving forward again

Pseudocode:
"Loop the below forever:
If the ultrasonic sensor measures a value greater than 30cm, drive forward (70, 110).
Else,
*   Set the motors to (110, 70)*
*   wait 0.5*
*   Set the motors to (90, 90)*
*   wait 0.5*

Set the motors to (110, 90)
wait 1"

- o Troubleshooting
  - Sometimes you will get an upload error. You may need to:
  - Disconnect and reconnect the Arduino.
  - Select a different port from the programming environment.
  - Try a different USB port.