Information for the Workshop Participant:

**Directions:**
Complete the assignment below and then ask your reviewer to use the attached instructions to check your work. You may attempt the project as many times as you would like; remember the purpose is to expand on what you have learned.

**Additional Notes:**
Before attempting this project assignment, we recommend that you

1. Try out the programs shown in the videos for yourself. Make sure that you understand how to write them yourself, and that when you download them to your EV3 it behaves as expected.
2. Try writing the programs shown in the videos again, from scratch, again and again, until you get to the point where you can do so without peeking at the video or at your previous program.
3. Complete the previous assignments – Robot Projects 1 through 3.
4. Complete the following troubleshooting tasks to help you prepare:
   
   **Troubleshooting Task 1:**
   Write a program that uses a switch to do the following:
   i. Play a high note if there is an object within roughly 15 cm of the ultrasonic sensor
   ii. Play a low note otherwise
   
   **Troubleshooting Task 2:**
   Write a program that uses a loop and a switch to do the following for 5 seconds:
   i. Display a smile whenever there is an object within roughly 15 cm of the ultrasonic sensor
   ii. Display a frown otherwise
   
   Note that this means that during the 5 second period the image should switch multiple times between smile and frown as you repeatedly move an object in front of the ultrasonic sensor and then move the object away. This program is actually very similar to the program you will write to solve the actual robot project, but the use of images in place of movement makes it somewhat easier to test.

While we strongly recommend that you complete the above tasks, they are all optional and do not need to be reviewed.
Assignment:
Create a new program called **Project 4**. Your program should cause your robot to do the following for 10 seconds:

- Whenever there is an object that is less than 20 cm from the robot’s ultrasonic sensor, the robot should move backwards, away from the object.
- Otherwise, the robot should move forwards

After 10 seconds have elapsed, your robot should stop moving.

You can view a video of a working example of this program at [http://youtu.be/TQycE0IbSlw](http://youtu.be/TQycE0IbSlw)

Notes and hints:

- If there is nothing in front of the robot, your robot should just drive forward smoothly for 10 seconds. If your robot does not drive smoothly in this situation, that’s probably because you have set a fixed duration (in terms of either time or motor rotations) on your move blocks. Consider whether that is really necessary.
- If there is a wall more than 20 cm in front of your robot, your robot should drive forward smoothly until it is roughly 20 cm away from the wall, and then move jerkily forward and backward – when it recognizes the distance is less than 20 cm it moves forward, but as soon as that is no longer the case it retreats.
- The ultrasonic sensor works best with large flat objects that have a matt surface like a piece of cardboard or a pad of paper.
- You may find it easier to do this task if you reduce the power to the motors on your move blocks.
- During the 10 second period, the robot should never stop moving. It should always be moving either forwards or backwards.
Information for the Project Reviewer

In this project, the participant will have attached an ultrasonic sensor (shown on the right) to the robot. The ultrasonic sensor is used to detect whether there is an object in front of the sensor, and if so, how far away that object is.

This program should run for a total of about 10 seconds. During that time, the robot should move backwards if it detects an object less than roughly 20 cm in front of the ultrasonic sensor, and forwards otherwise. After 10 seconds have elapsed, the robot should stop moving.

Thus:
- If there is nothing in front of the robot's ultrasonic sensor, the robot will simply move forward smoothly for 10 seconds.
- If there is an object within approximately 20 cm of the robot, the robot will move backwards.
- If an object moves in and out of the 20 cm range, the robot will move forwards and backwards appropriately.
- If the robot drives towards a wall, it will move smoothly forwards until the ultrasonic sensor is roughly 20 cm away from the wall, and then will move jerkily backwards and forwards (staying roughly 20 cm away) until time runs out.

The ultrasonic sensor is very good, but by no means perfect, and reacts differently to different surfaces. So driving towards a wall the robot may (or may not) get a bit closer than when it is driving towards a piece of cardboard.

You can view a video of a working example of this program at http://youtu.be/TQycE0lbSlw