

## Taking the BrickPi from human interface control to autonomous control (teacher notes)

### Summary

In this activity, we will:

1. Run the example `car` Scratch script
  - a. correct the controls due to inverted motors
  - b. discuss pros and cons of different approaches; changing just the keys or the broadcasts
2. Run the `ultrasonic sensor` example Scratch script
  - a. understand the data returned by the sensor, and use it to trigger controls to make the robot autonomous
  - b. perform testing to determine the optimal distance for triggering evasive action
  - c. discuss failings of current solution

### Learning objectives

- Use VNC to connect to the graphical Desktop on a networked Raspberry Pi (RPI) robot that runs the Linux operating system.
- Understand the robot's design from a high level.
- Understand how the layers of software and hardware are used to interact with motors and sensors, from the Scratch interface.
- Understand how to modify the Scratch scripts to change how the robot behaves.
- Use new skills to convert the robot from interactive control to autonomous control; relying on sensors to understand the robot's environment.

### Group size

This activity works best with students grouped in pairs or threes, rather than larger groups. With larger groups, there are not enough tasks for all the members to run the workshop as-is. Once they have read the first page of the process document, have students explain, or talk them through the flow of information through from their laptop, right through to the sensors and motors and back.

### Age range for this activity

The students of age 8yrs+ should be able to follow the document and often it helps to redirect any questions that are answered by re-reading the document, back to the instructions first. This reinforces careful reading and following step by step, which will help in gaining a deeper understanding of the process. Any questions not contained in the document are fine to be answered by the

teacher/volunteer trainer.

### Preparation tips

The following tasks should be performed prior to running the workshop. Refer to the 'Connecting to the Raspberry Pi teacher's guide' for details on how to connect and perform these, or have a technical person assist:

- View the Python script <put in the path to it (location) here> and take note of the different sensor names that correspond to the NXT or the EV3 sensors and make sure that they are checked before the activity, so that you already have the correct sensor name in the Ultrasonic example script. Otherwise, the sensor won't return a valid distance when the script is run.
- Label the sensor and motor connections with the same letters as found in the Dexter Industries documentation <http://www.dexterindustries.com/BrickPi/about/design/>. This will make it easier for the students to check that cables are connected correctly, and allow them to add additional motors and sensors later.
- Run through the workshop tasks yourself, to make sure that everything works correctly. This also helps when assisting students to troubleshoot.

Once the students have played with the initial Car script, ask whether anything isn't working correctly, and ask them how it would be fixed. Discuss pros and cons of different solutions, or why a solution wouldn't work.

As the students load the Ultrasonic sensor script, remind them that the sensor can take a few seconds to initialize, and then have them test that it works by placing their hand in front, and observing the value change in Scratch.

Once they understand how the script and sensor work, get them to read the document, which will tell them to merge both the Car and Ultrasonic scripts using the Import command from the File menu. Make sure they remember to save the project under a new name, in the *My Projects* folder on the SD card.

Once they have it working, get them to identify in which cases it doesn't work properly and have them postulate why. Then we can repeat the same steps to get other sensors working, and discuss other ways of adding to their project. They may be curious about the jaws, so have them figure out how they might control those by tracing the cables.