

## Lego Mindstorms EV3 Lesson Plan

**Getting Started:** Locate the touch sensor, colour sensor and infrared sensor and the cables to attach them to the robot. Start by connecting the touch sensor to the robot.

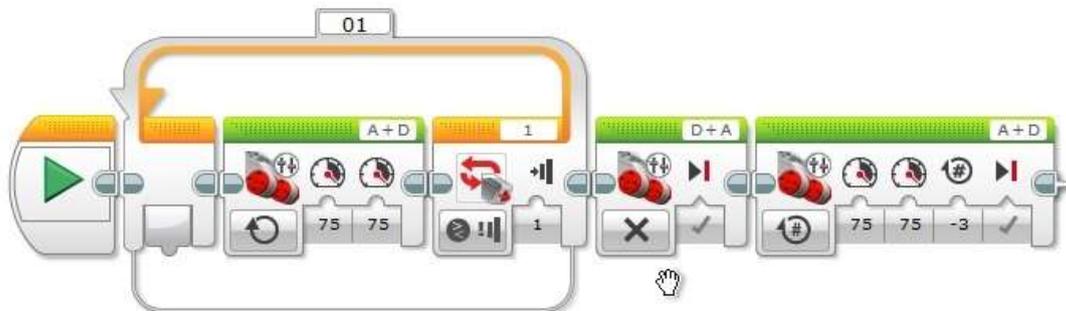
**Learning about the EV3 sensors:**

**Touch Sensor:**



When the button is pressed on the touch sensor, an electrical signal is sent to the microprocessor. This signal can then be used by the program to follow a specific set of instructions. For example, use the program in Fig 2 below to instruct the robot to move forward until the touch sensor is pressed, stop and move backwards 3 rotations.

**Fig 1: Touch Sensor**



**Fig 2: Touch Sensor Program**

The instruction to move forward is enclosed in a **loop**. **Loops** are used in programming to make an instruction continue indefinitely until the condition at the end of the loop is satisfied. In this program, the robot will continue to move forward until the button on the touch sensor is pressed. The loop then stops and the program moves onto the next instruction on the list.

**Activity:**

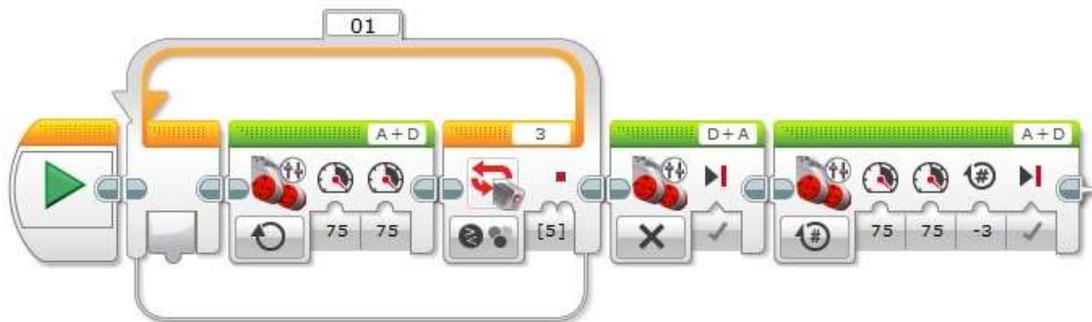
1. Can you program the robot to react when the touch sensor button is pushed *and* released?

**Colour Sensor:**



The colour sensor can detect the colours Black, White, Red, Blue, Yellow and Green. It does this by measuring the brightness/intensity of the light reflected from surfaces. The measurements are on the scale 0 (very dark/black) to 100 (very light/white). This measurement is what is sent to the microprocessor for use in the program. Connect the colour sensor to port 3 and use the program in Fig 4 to instruct the robot to move forward until the colour sensor detects red, stop and move backwards 3 rotations.

**Fig 3: Colour Sensor**



**Fig 4: Colour Sensor Program**

**Activity:**

1. Make your robot react to all the different colours available.
2. Note that each colour has a reference number in the program. Go into the third menu option on the Lego Brick and select Port View. The colour sensor can be found under the port that the sensor is currently using. In this menu, you can point the sensor to a variety of different colours and see what each colour measures on the 0-100 scale and also what colour reference number it generates. Do this for as many colours as you can find. How does the sensor deal with different shades of the same colour?

**Infrared Sensor:**

All objects which have a temperature greater than absolute zero (0 Kelvin) possess thermal energy and are sources of infrared radiation as a result. This infrared energy takes the form of lightwaves that are beyond the visible spectrum (i.e. they are present but we cannot see them). The infrared sensor uses special LEDs to detect and measure this radiation. These measurements are used by the robot to “see” objects in front of it and determine how far away those objects are.

**Fig 5: IR Sensor**

**Activity:**

1. Plug your IR sensor into port 4 and write a program to make the robot move forward until it detects an object within 5cm. Make the robot change direction to avoid the object.
2. Did the robot reach exactly 5cm? Perform some sensitivity tests at different distances (i.e. 10cm, 15 cm, 2cm) to examine how accurately the sensor behaves.