Unit 03 Tutorial 3: Sensors: Touch Sensor
Brighton H.S Engineering
By: Matthew Jourden

Robots have a variety of sensors that help the machine sense the world around it. We will be looking at four different types of sensors

a. **Touch Sensor**: uses a pressure switch that is attached to the robot and will carry out a command set when depressed by an obstacle. (I.E Moving robot sensors depresses when a wall to a maze comes in contact with it and the robot will stop)

b. **Ultrasonic Sensor**: uses sound waves to determine what is in front of a robot; similar to radar

c. **Color Sensor**: uses light refraction to sense colors to carry out a series of commands. (I.E having a movable robot follow a path or have a robotic arm sort colored objects)

d. **Acceleration/Tilt Sensor**: Supplies data on how fast a robot is moving or if the robot on an even axis

e. **Gyro**: Compares angles or rate of the sensor

1. Add the Touch Sensor to Lego Base Robot. See Build Manual in the Lego Core Set Kit for details or Build Instructions Touch Sensor File on Website

2. Open Lego Mindstorms Education EV3 programming software > Start a New Program > Save Program > Name Tutorial3 Sensor Touch

3. Typically a looped program will need to be used in order for the program use the sensor multiple times
   a. Drag from the Flow Tab (Orange) > Loop code block and attach to start command

Loop Name: Touch
4. Go to the Sensors Tab (Yellow) > Drag and Drop the **Touch Sensor** inside the loop. We will start with the Touch Sensor before turning on the motors so the machine will not try to move before the sensors has time to work.

**Options for Sensor Display**

- **Measure**: Touch Sensor is Pressed or Released
- **Compare**: Allows user choose between Released, Pressed or Bumped

**Port # on the EV3 Brick. Be sure to that the wire is in the correct port or change the number here to the numbered port on your EV3 Brick**
5. Go to Action Tab (Green) > Drag and Drop Display code block to the right of the Sensor display

6. Change the Display Features as follows and Drag the Logic Statement from the Touch Sensor code block to the Text Option on the Display Code Block.

7. Upload Program to the EV3 Brick > Test Program by pressing on the Touch Sensor. The Screen on the EV3 should display a 0 or 1 (0 not pressed, 1 pressed). Logic statements will only produce numbers so that the data gathered could be used in other mathematical formulas to make your robot do certain things.

8. Note we can check the same data by turning on the robot. Navigate to Port View on the Lego Brick > Select the port the ultrasonic sensor is linked too. You can change the units by pressing the center button to change the units.
Making the Robot Move: Touch Sensor

9. Delete the Touch Sensor and Display from in the Loop (DO NOT DELETE THE LOOP) > Go to Flow Tab (Orange) > Drag the Switch code Block and place it in the loop > Set Switch to Touch Sensor-Compare-State

Switch Code Block is an If/Then or True/False Statement that can be controlled in a number of ways from sensor readings to mathematical data. The top half (Check Mark) is the True side of the statement and the bottom half (X Mark) is the False side of the statement.

Choose how you want the If Statement to read using a variety of options

Set as Touch Sensor > State > 1 (Pressed)

0. Released
1. Pressed
2. Bumped
10. Go to Flow Tab (Orange) > Place in the loop as the first code block > Place the Touch Sensor and Display in the True and False part of the Switch. See Below
   NOTE: This will be the base program for your Programming Assignment

11. Upload and Run the Program. Play with the sensor to see it works. Note this program is in an infinite loop so you will need to manually stop the program by pressing the Grey Button (Top Left Corner) on the EV3 Brick to cancel the program.

12. **Assignment:** Printout before the Touch Value the following word(s). NOTE the value 0 or 1 will come from the sensor. (Hint: use x and y coordinates to move the sensor value up/down or left/right
   a. **Released** = 0
   b. **Pressed** = 1
Stops program
**Variable Creation**

In this section we will create a variable that we will use to exit the loop.

1. Add the following move commands to your program

2. Creating a variable
   a. Click on Data Operations (Red Tab) > Click on Variable Icon (looks like a suitcase)
   b. Select White Box in Top right corner > Click on Add Variable > call it COUNTER > Ok
Variables can either be read or written

**Read:** Allows user to use the value the variable currently equals. Read Icon looks like an open book.

**Write:** Allows the user to assign or overwrite a value to that variable. Write icon looks like a pencil

c. Place Counter Variable in the following locations along with the mathematical formulas
d. Upload program and test settings

- Set Counter to 0
- Reads Counter then adds 1 to Counter and sets Counter to the new value
- Reads Counter compares Counter to see if Counter is $\geq$ to 5. This value gets passed to the end of the loop to see if True or False
  
  **False:** Continues the loop
  
  **True:** Exits the Loop and stops motors

**Turns Off Motors**
3. Notice the program ends immediately after the touch sensor is pressed. Result is the loop is occurring so fast that the adding one to the counter gets to 5 faster than a person could release.

Add the following to get the program to last longer
1. True Side of Switch: After sensor is pressed
   a. Stop the Motor (Currently in the program)
   b. Wait 1 Second
   c. Reverse the motors for .5 second.
   d. Stop the motors
   e. Reset Counter Back to 0 (Zero)
2. False Side:
   a. Add a Wait Statement of .25 seconds after Move Forward Commands

Test the New program and see what happens.