Connecting Devices in Packet Tracer

In this activity you will use Cisco Packet Tracer to connect four sensors to four actuators through a microcontroller. When connected properly, you should see a visible action at an actuator when you make a change at the sensor.

Note: This activity uses Packet Tracer 7. Older versions may not have the same components or may use slightly different names.

Place the Sensors

1. Open Packet Tracer to a new, blank screen.
2. Using the icon-based menus at the bottom of your screen, find the list of **Sensors**. It is a subcategory of the **Components** menu.
3. Find the following 4 sensors then click and drag them to one part of your workspace:
    - Rocker Switch
    - Toggle Push Button
    - Potentiometer
    - Flex Sensor

Reminder: Each device's name becomes visible at the bottom of screen when you hover your mouse cursor above the icon in the menu.

Place the Actuators

1. Another subcategory of the **Components** menu is the **Actuators** menu. Find the following 2 components then click and drag them to group them in a different part of your workspace to the sensors:
    - LED
    - Motor
2. Go to the **End Devices** menu and find the following 2 components in the **Home** subcategory. Click and drag them near your other actuators.
    - Light
    - Siren

Place and Connect the Microcontroller

1. In the **Components** menu is a subcategory called **Boards**. You will find a microcontroller board (MCU Board) which is labelled **MCU-PT**. Click and drag this into your workspace between your group of sensors and your group of actuators.

2. In the **Connections** menu is a subcategory also called **Connections**. From this list of connections, click on the green cable called **IoT Custom Cable**. Now when you move your mouse cursor into the workspace it will change to a symbol that represents a plug on a cable.

3. Click on the microcontroller board (MCU). A list of all available connections will appear. You should see one called USB0, six labelled D0-D5 and four labelled A0-A3. These may be used as either inputs or outputs. Those starting with a "D" are digital and those starting with an "A" are analogue. Any connections that already have cables plugged in will not appear in this list.

4. Click the **USB0** connection. You will see an error message because the IoT Custom Cable cannot be connected to that port.

5. Click the microcontroller again to see the list of connections. This time click the digital port called **D0**.

6. Move your mouse and you will see a green cable extend from the microcontroller.

7. Click the **Rocker Switch** which will be in the group of sensors you placed in the workspace.

8. You will see that there is only one connection option which is also labelled **D0**. Click on this to make the connection between D0 of the microcontroller and D0 of the rocker switch. You will now see a green wire which remains connected even if you move either component.

9. Connect each sensor and actuator to the microcontroller board using the connections listed in the tables below. You will need to click on the menu icon for **IoT Custom Cable** again after each connection. You have already connected the first one on this table:

Microcontroller Port Number	Sensor Name and Port Number
D0	Rocker Switch D0
D1	Toggle Push Button D0
A0	Potentiometer A0
A1	Flex Sensor A0

Microcontroller Port Number	Actuator Name and Port Number
D2	Light D0
D3	LED D0
D4	Siren D0
D5	Motor A0

Program the Microcontroller

The microcontroller needs to be programmed so it knows:

- which of its ports are inputs and which are outputs
- when and how it should read from the sensors
- any processing it should do with that information
- when and how it should write to the actuators

In Course 2 of the IoT MicroMasters (Sensors and Devices) we are not focussing on how to program but you need to understand that the microcontroller needs to be programmed before it can perform the above functions.

Programming will be covered in more detail in Course 4 of the IoT MicroMasters.

Instead you will be copying and pasting a supplied Python script to run in the microcontroller. The following steps show you how to do this:

1. Click on the microcontroller board (MCU). A new window will appear which gives more detail on the device and allows changes and configuration.
2. Click on the tab labelled **Programming**.
3. You will see a screen where programming can be entered but it should be mainly empty. A demonstration program called **Blink (JavaScript)** will be listed. Click on this to select it then press the **Delete** button on the screen (not on your keyboard). Click **Yes** when it asks if you are sure you want to delete it.
4. Next to the **Delete** button is the **New** button. Click **New** to create a new project.
5. In the window that opens it will allow you to rename the new project or leave it as the default name "New Project". Make sure the "Empty **– Python**" template is also selected then click **Create**.
6. In the column on the left will be a function called **name.py**. Double-click this to open the code editor where you will see a cursor flashing which would allow you to type.
7. The Python script (or code) is on an RTF file on the edX page. Highlight the entire script and then copy it. It is important to copy it exactly as it is written, including all spacing.
8. Click back in the code editor window where the code can be entered so that the cursor flashes then click the **Paste** button that you will see above the code editor.
9. Now that the Python script has been written click the **Run** button. If the script was copied with no errors or spacing changes then you will see a message at the bottom of the code window reading "*Starting New Project (Python) …*"
10. If you see any error messages then you may have to click **Stop**, try copying and pasting again, then click **Run** again. Otherwise, continue on to the next steps to test your project.

Test the Sensors

1. If the connections have been made correctly and the microcontroller is running the program then you can minimise or close the microcontroller window so that you can see the main Packet Tracer workspace.
2. Nothing should be happening yet. All sensors can be activated by clicking on them while holding a button on the keyboard. For the Windows version of Packet Tracer this is the **ALT** button. If you are using the Linux version of Packet Tracer you will need to hold **OPTION+SHIFT** or **ALT+SHIFT** buttons depending on your particular keyboard. Holding this button and clicking again will turn something back off if it was already on.
3. Activate the Rocker Switch and you will see it turn on. In response you will see the Light illuminate.
4. Activate the Toggle Push Button and you will see the LED turn on.
5. The Potentiometer is an analogue sensor so it does not have on and off settings but can instead be turned to many different positions. Hold your keyboard button/s to activate while clicking and dragging the mouse left and right on the Potentiometer. You will see that the Siren activates above a set point and deactivates below it.
6. The Flex Sensor is also analogue. Move its position using the same method as in step 5 and watch the Motor respond.
7. If all is working as expected, then you have completed the activity. If not, then go back and check all connections and make sure the Python script was copied correctly.

You should now be familiar with how to make IoT device connections, activate devices and locate programming in Packet Tracer. You have also viewed four examples of both analogue and digital sensors causing actions in devices via a microcontroller.