Lab - 07
Connecting an LED

Problem

You want to know how to connect an LED to the Raspberry Pi.

Solution

Connect an LED to one of the GPIO pins using a 470Ω or 1kΩ series resistor to limit the current. To make this recipe, you will need:

- Breadboard and jumper wires
- 470Ω resistor
- LED

Figure shows how you can wire this LED using a solderless breadboard and male-to-female jumper leads.

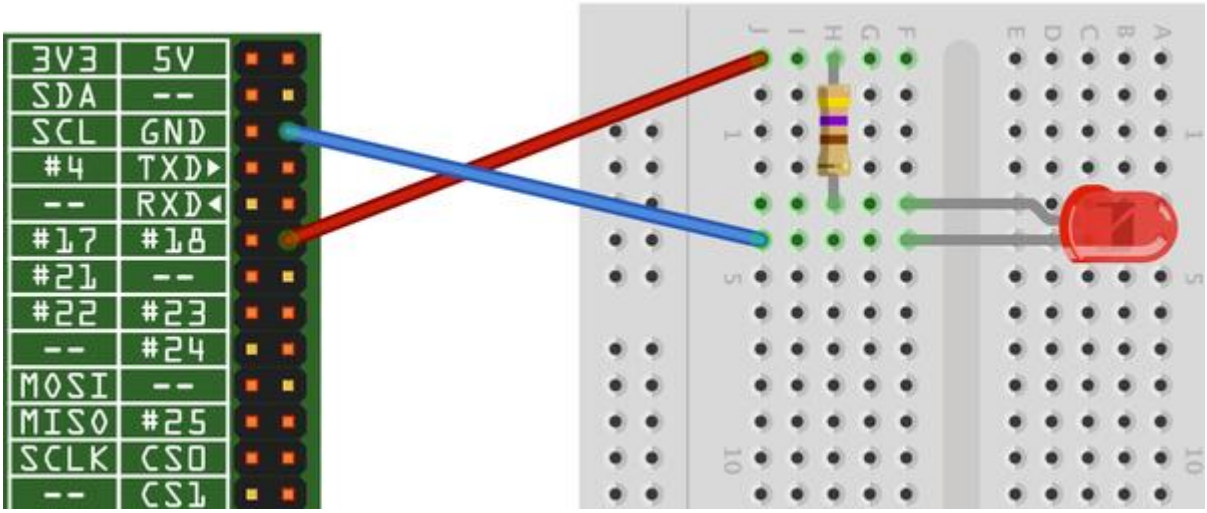

Figure. Connecting an LED to a Raspberry Pi

Having connected the LED, we need to be able to turn it on and off using commands from Python.

Start a Python console from the Terminal with superuser access and enter these commands:

```
pi@raspberrypi  ~ $ sudo python
>>> import RPi.GPIO as GPIO
>>> GPIO.setmode(GPIO.BCM)
>>> GPIO.setup(18, GPIO.OUT)
>>> GPIO.output(18, True)
>>> GPIO.output(18, False)
```

This will turn your LED on and off.

Discussion

LEDs are a very useful, cheap, and efficient way of producing light, but you do have to be careful how you use them. If they are connected directly to a voltage source (such as a GPIO output) that is greater than about 1.7 volts, they will draw a very large current. This can often be enough to destroy the LED or whatever is providing the current—which is not good if your Raspberry Pi is providing the current. You should always use a series resistor with an LED because the series resistor is placed *between* the LED and the voltage source, which limits the amount of current flowing through the LED to a level that is safe for both the LED and the GPIO pin driving it. Raspberry Pi GPIO pins are only guaranteed to provide about 3mA or 16mA of current (depending on the board and number of pins in use). LEDs will generally illuminate with any current greater than 1mA, but will be brighter with more current. Use Table as a guide to selecting a series resistor based on the type of LED; the table also indicates the approximate current that will be drawn from the GPIO pin.

LED type	Resistor	Current (mA)
Red	470Ω	3.5
Red	1kΩ	1.5
Orange, yellow, green	470Ω	2
Orange, yellow, green	1kΩ	1
Blue, white	100Ω	3
Blue, white	270Ω	1

Table. Selecting series resistors for LEDs and a 3.3V GPIO pin

As you can see, in all cases, it is safe to use a 470Ω resistor. If you are using a blue or white LED, you can reduce the value of the series resistor considerably without risk of damaging your Raspberry Pi.

If you want to extend the experiments that you made in the Python console into a program that makes the LED blink on and off repeatedly, you could type the following code into the IDLE or nano editors. Save the file as *led_blink.py*.

```
import RPi.GPIO as GPIO
import time
GPIO.setmode(GPIO.BCM)
GPIO.setup(18, GPIO.OUT)
while (True):
    GPIO.output(18, True)
    time.sleep(0.5)
    GPIO.output(18, False)
    time.sleep(0.5)
```

Remember that to run the program, you must have superuser privileges for the RPi.GPIO library, so you need to use this command:

```
pi@raspberrypi  ~ $ sudo python led_blink.py
```