CamJam EduKit Robotics - Line Detection

Project Line Detection

Description You will learn how to connect the line follower module to your Raspberry Pi, via the Motor Controller Board's breakout header.

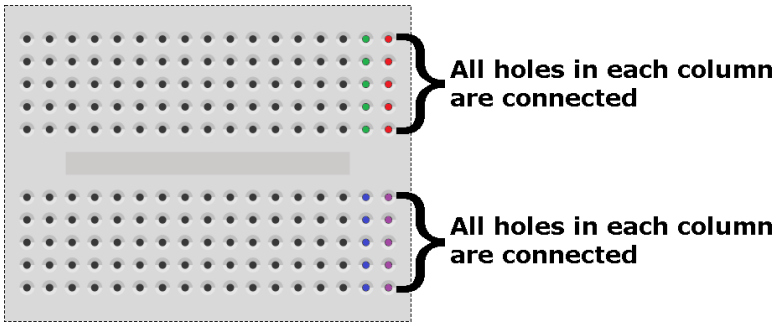
Equipment Required

For this worksheet you will require:

- Your robot
- The line follower sensor
- The mini breadboard
- Jumper leads (3 Male-Female, 1 Male-Male)
- A piece of paper with a 1cm wide black line down the middle; you can print out *CamJam EduKit 3 - Robotics - Test Line.pdf*, which is supplied with these worksheets.

In this first circuit, you will be connecting the line follower to the GPIO header of your Raspberry Pi and using Python to read the output of the line follower, which detects how much light is reflected from the surface underneath it. Before you build the circuit, look at the parts you are going to use.

Breadboard

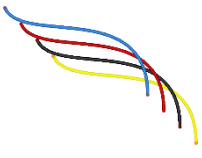


The breadboard is a way of connecting electronic components to each other without having to solder them together. They are often used to test a circuit design before creating a Printed Circuit Board (PCB).

The holes on the breadboard are connected in a pattern.

With the breadboard in the CamJam EduKit Robotics, the columns of wires are connected together with a break in the middle. For example, all the red holes marked are connected together, but they are not connected to the purple holes, nor the green or blue ones. Therefore, any wire you poke into the red holes will be connected to other wires poked into the other red holes.

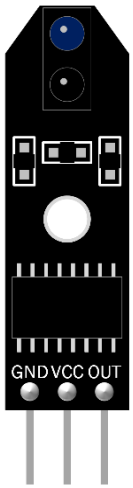
Jumper Wires



Jumper wires are used on breadboards to 'jump' from one connection to another. The ones you will be using in this circuit have different connectors on each end. The end with the 'pin' will go into the breadboard or the controller board; this is known as 'male'. The end with the piece of plastic with a hole in it will go onto the Raspberry Pi's GPIO pins or the line follower sensor; this is known as 'female'.

Note: The jumper wire colours supplied in the EduKit will vary, and are unlikely to match the colours used in the diagrams.

Line Follower Sensor



The 'line follower sensor' used in this kit, and represented by the diagram on the left, has two main working parts – a light emitter, and a light detector. The emitter sends out light of known frequency (colour) and the detector measures how much comes back. If the light is shining on a black surface, very little light will be reflected back. If it is shining on a white surface, then more light will be reflected back.

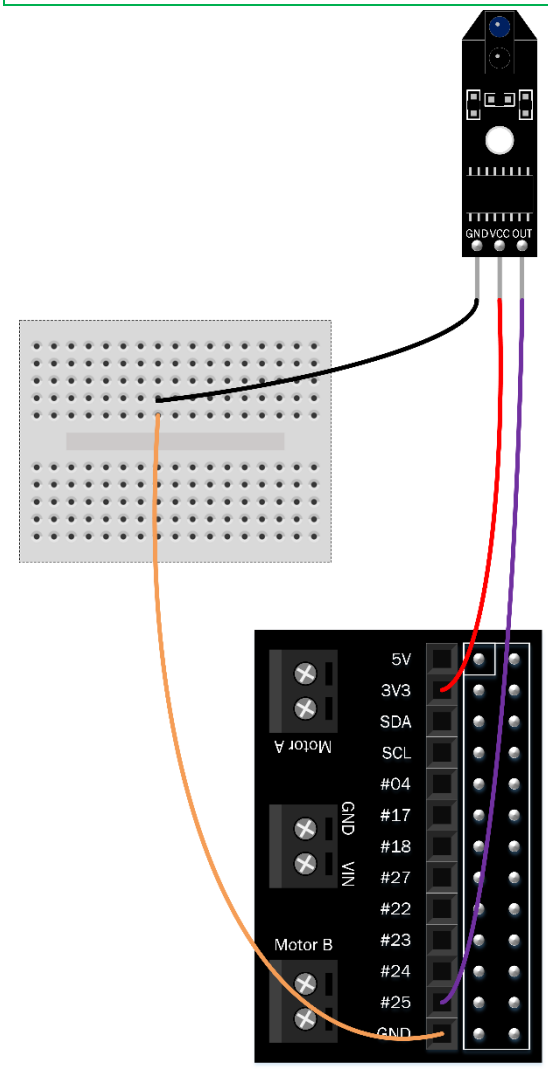
You can use this property to detect whether a robot is over a black line or over a white surface, and therefore create a line following robot.

The GND (ground) must be connected to a ground pin of the Pi, the VCC (Voltage) to a 3.3 volt power pin, and the OUT to one of the GPIO pins. This pin will be read 'HIGH' if the detector is over a black, non-reflective surface, and read 'LOW' if it is over a white, reflective surface.

Robots can use one, two or three of these sensors. With one sensor, the robot will have to seek for the line, and if it goes off the line, will have to search for the line again by moving right and left. This is what you have in the EduKit.

Building the Circuit

Note: Please be very careful when you connect up your line sensor as connecting it up incorrectly can damage the sensor.



Use the three female-male jumper wires for all of the connections between the line follower and the motor controller board and breadboard. The male-male jumper connects between the ground of the controller board and the breadboard.

Connect the 'GND' (meaning ground) pin of the line sensor to the breadboard, and the breadboard to the ground of the EduKit Controller Board.

Connect the 'VCC' (meaning voltage+) pin on the line sensor to 3V3 (3.3 volts) on the EduKit Controller Board.

Lastly, connect the 'OUT' pin of the line sensor to GPIO pin 25. This pin will be used as an input pin and will get a reading from the line follower.

Code

In a terminal window, change to the EduKitRobotics directory using:

```
cd ~/EduKitRobotics/
```

Create a new text file "5-line.py" by typing the following:

```
nano 5-line.py
```

Type in the following code:

```
# CamJam EduKit 3 - Robotics
# Worksheet 5 – Line Detection

import RPi.GPIO as GPIO # Import the GPIO Library
import time # Import the Time library

# Set the GPIO modes
GPIO.setmode(GPIO.BCM)
GPIO.setwarnings(False)

# Set variables for the GPIO pins
pinLineFollower = 25

# Set pin 25 as an input so its value can be read
GPIO.setup(pinLineFollower, GPIO.IN)

try:
    # Repeat the next indented block forever
    while True:
        # If the sensor is Low (=0), it's above the black line
        if GPIO.input(pinLineFollower)==0:
            print('The sensor is seeing a black surface')
        # If not (else), print the following
        else:
            print('The sensor is seeing a white surface')
        # Wait, then do the same again
        time.sleep(0.2)

# If you press CTRL+C, cleanup and stop
except KeyboardInterrupt:
    GPIO.cleanup()
```

Once you have typed all the code and checked it, save and exit the text editor with "Ctrl + x" then "y" then "enter".

Running the Code

To start the program, type the following into the terminal window:

```
python3 5-line.py
```

Move the sensor over the paper. The message on the screen will change as the sensor detects the black and the white. You may have to adjust how far above the paper you hold the sensor. Take a note of how high the sensor is when it detects the change in black/white under it.

If the code does not run correctly there may be an error in the code. Re-edit the code by using the nano editor, typing `nano 5-line.py`.

Next Steps

Think about how you would attach the line follower sensor to your robot at the correct height above the floor.