2. Basic Recipes

The following recipes demonstrate some of the capabilities of the GPIO Zero library. Please note that all recipes are written assuming Python 3. Recipes *may* work under Python 2, but no guarantees!

2.1. Importing GPIO Zero

In Python, libraries and functions used in a script must be imported by name at the top of the file, with the exception of the functions built into Python by default.

For example, to use the `Button` interface from GPIO Zero, it should be explicitly imported:

```
from gpiozero import Button
```

Now `Button` is available directly in your script:

```
button = Button(2)
```

Alternatively, the whole GPIO Zero library can be imported:

```
import gpiozero
```

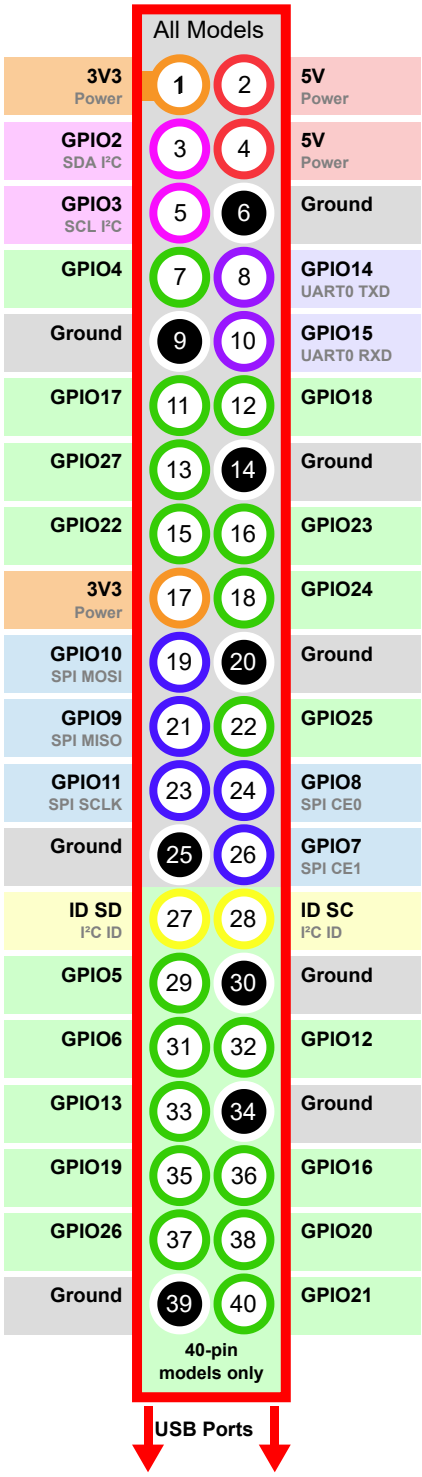
In this case, all references to items within GPIO Zero must be prefixed:

```
button = gpiozero.Button(2)
```

2.2. Pin Numbering

This library uses Broadcom (BCM) pin numbering for the GPIO pins, as opposed to physical (BOARD) numbering. Unlike in the RPi.GPIO library, this is not configurable. However, translation from other schemes can be used by providing prefixes to pin numbers (see below).

Any pin marked “GPIO” in the diagram below can be used as a pin number. For example, if an LED was attached to “GPIO17” you would specify the pin number as 17 rather than 11:



If you wish to use physical (BOARD) numbering you can specify the pin number as “BOARD11”. If you are familiar with the wiringPi pin numbers (another physical layout) you could use “WPI0” instead. Finally, you can specify pins as “header:number”, e.g. “J8:11” meaning physical pin 11 on header J8 (the GPIO header on modern Pis). Hence, the following lines are all equivalent:

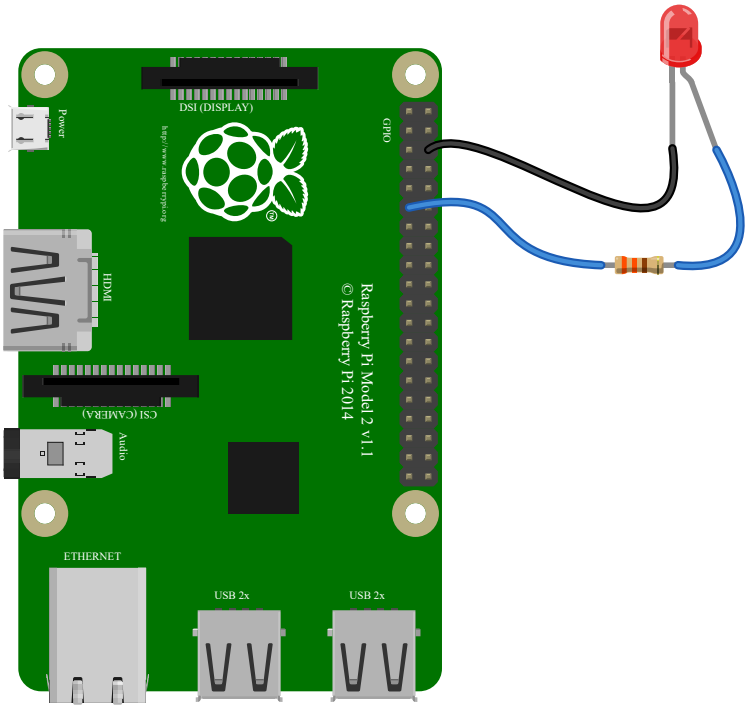
```
>>> led = LED(17)
>>> led = LED("GPIO17")
>>> led = LED("BCM17")
>>> led = LED("BOARD11")
>>> led = LED("WPI0")
>>> led = LED("J8:11")
```

Note that these alternate schemes are merely translations. If you request the state of a device on the command line, the associated pin number will *always* be reported in the Broadcom (BCM) scheme:

```
>>> led = LED("BOARD11")
>>> led
<gpiozero.LED object on pin GPIO17, active_high=True, is_active=False>
```

Throughout this manual we will use the default integer pin numbers, in the Broadcom (BCM) layout shown above.

2.3. LED



Turn an `LED` on and off repeatedly:

```
from gpiozero import LED
from time import sleep

red = LED(17)

while True:
    red.on()
    sleep(1)
    red.off()
    sleep(1)
```

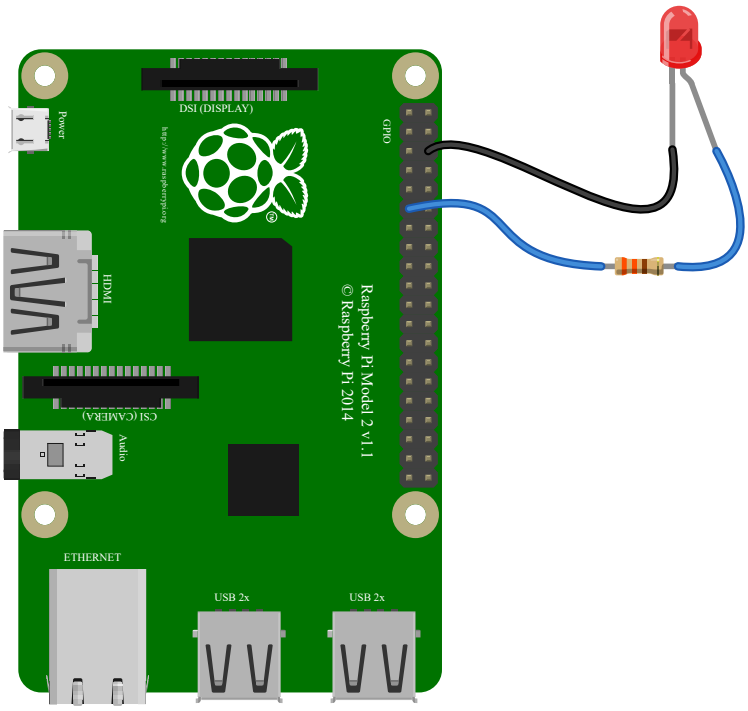
Alternatively:

```
from gpiozero import LED
from signal import pause

red = LED(17)

red.blink()

pause()
```

Note

Reaching the end of a Python script will terminate the process and GPIOs may be reset. Keep your script alive with `signal.pause()`. See How do I keep my script running? for more information.

2.4. LED with variable brightness



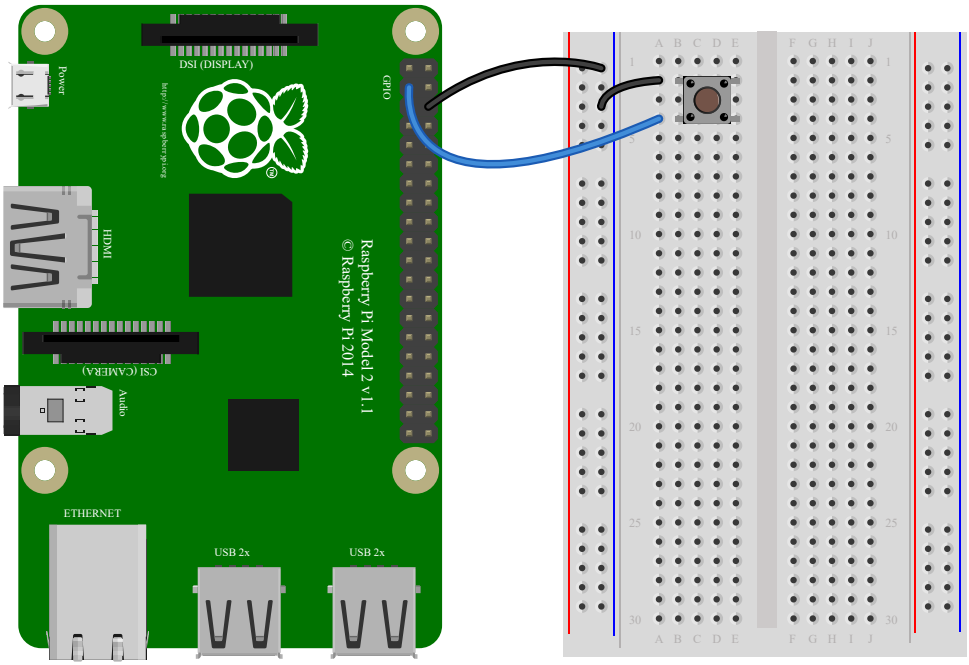
Any regular LED can have its brightness value set using PWM (pulse-width-modulation). In GPIO Zero, this can be achieved using `PWMLED` using values between 0 and 1:

```
from gpiozero import PWMLED
from time import sleep

led = PWMLED(17)

while True:
    led.value = 0  # off
    sleep(1)
    led.value = 0.5  # half brightness
    sleep(1)
    led.value = 1  # full brightness
    sleep(1)
```

Similarly to blinking on and off continuously, a PWMLED can pulse (fade in and out continuously):

```
from gpiozero import PWMLED
from signal import pause

led = PWMLED(17)

led.pulse()

pause()
```

2.5. Button



Check if a `Button` is pressed:

```
from gpiozero import Button

button = Button(2)

while True:
    if button.is_pressed:
        print("Button is pressed")
    else:
        print("Button is not pressed")
```

Wait for a button to be pressed before continuing:

```
from gpiozero import Button

button = Button(2)

button.wait_for_press()
print("Button was pressed")
```

Run a function every time the button is pressed:

```
from gpiozero import Button
from signal import pause

def say_hello():
    print("Hello!")

button = Button(2)

button.when_pressed = say_hello

pause()
```

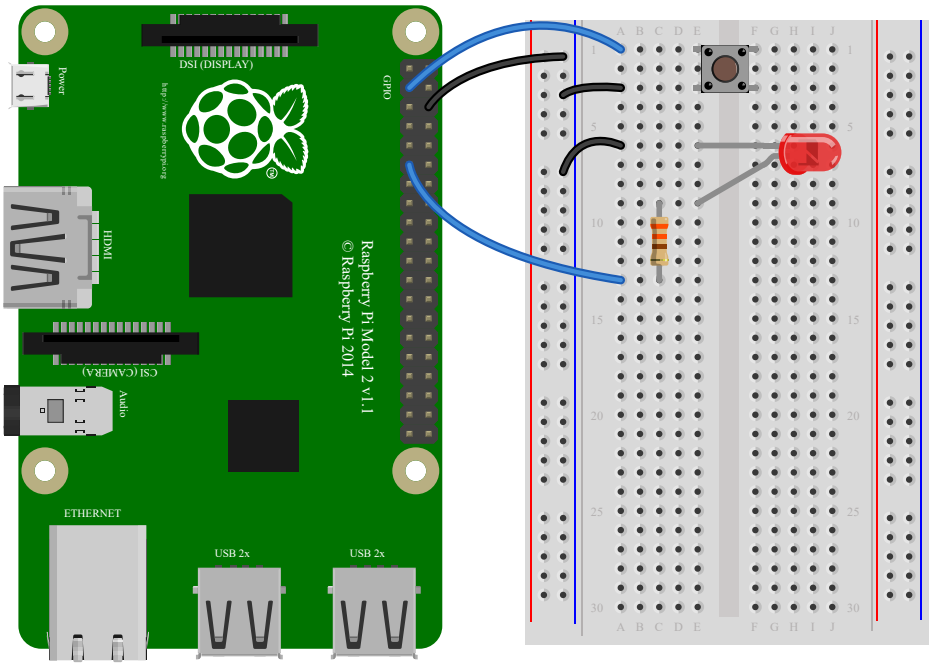
Note

Note that the line `button.when_pressed = say_hello` does not run the function `say_hello`, rather it creates a reference to the function to be called when the button is pressed. Accidental use of `button.when_pressed = say_hello()` would set the `when_pressed` action to `None` (the return value of this function) which would mean nothing happens when the button is pressed.

Similarly, functions can be attached to button releases:

```
from gpiozero import Button
from signal import pause

def say_hello():
    print("Hello!")

def say_goodbye():
    print("Goodbye!")

button = Button(2)

button.when_pressed = say_hello
button.when_released = say_goodbye

pause()
```

2.6. Button controlled LED



Turn on an `LED` when a `Button` is pressed:

```
from gpiozero import LED, Button
from signal import pause

led = LED(17)
button = Button(2)

button.when_pressed = led.on
button.when_released = led.off

pause()
```

Alternatively:

```
from gpiozero import LED, Button
from signal import pause

led = LED(17)
button = Button(2)

led.source = button

pause()
```

2.7. Button controlled camera

Using the button press to trigger `PiCamera` to take a picture using `button.when_pressed = camera.capture` would not work because the `capture()` method requires an `output` parameter. However, this can be achieved using a custom function which requires no parameters:

```
from gpiozero import Button
from picamera import PiCamera
from datetime import datetime
from signal import pause

button = Button(2)
camera = PiCamera()

def capture():
    timestamp = datetime.now().isoformat()
    camera.capture('/home/pi/%s.jpg' % timestamp)

button.when_pressed = capture

pause()
```

Another example could use one button to start and stop the camera preview, and another to capture:

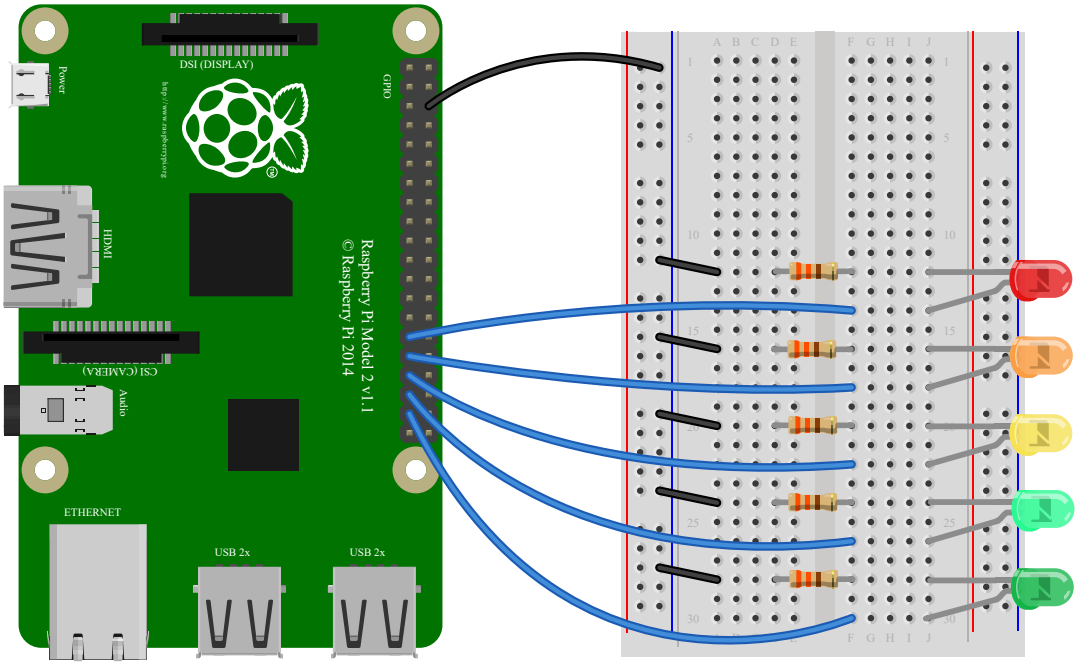
```
from gpiozero import Button
from picamera import PiCamera
from datetime import datetime
from signal import pause

left_button = Button(2)
right_button = Button(3)
camera = PiCamera()

def capture():
    timestamp = datetime.now().isoformat()
    camera.capture('/home/pi/%s.jpg' % timestamp)

left_button.when_pressed = camera.start_preview
left_button.when_released = camera.stop_preview
right_button.when_pressed = capture

pause()
```

2.8. Shutdown button

The `Button` class also provides the ability to run a function when the button has been held for a given length of time. This example will shut down the Raspberry Pi when the button is held for 2 seconds:

```
from gpiozero import Button
from subprocess import check_call
from signal import pause

def shutdown():
    check_call(['sudo', 'poweroff'])

shutdown_btn = Button(17, hold_time=2)
shutdown_btn.when_held = shutdown

pause()
```

2.9. LEDBoard



A collection of LEDs can be accessed using `LEDBoard`:

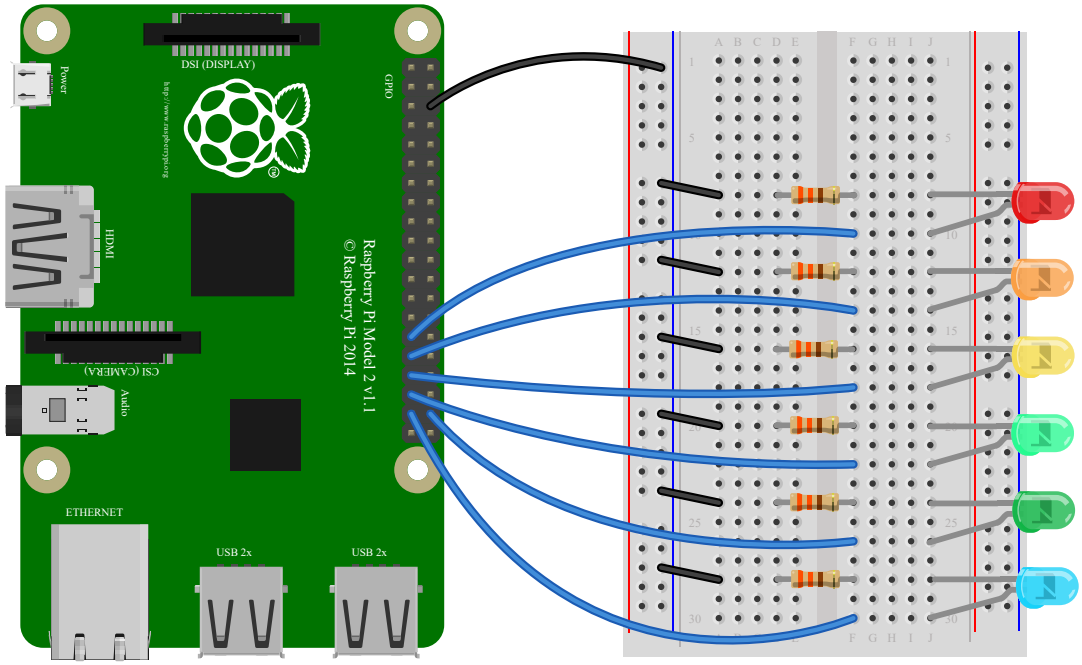
```
from gpiozero import LEDBoard
from time import sleep
from signal import pause

leds = LEDBoard(5, 6, 13, 19, 26)

leds.on()
sleep(1)
leds.off()
sleep(1)
leds.value = (1, 0, 1, 0, 1)
sleep(1)
leds.blink()

pause()
```

Using `LEDBoard` with `pwm=True` allows each LED's brightness to be controlled:

```
from gpiozero import LEDBoard
from signal import pause

leds = LEDBoard(5, 6, 13, 19, 26, pwm=True)

leds.value = (0.2, 0.4, 0.6, 0.8, 1.0)

pause()
```

See more `LEDBoard` examples in the advanced LEDBoard recipes.

2.10. LEDBarGraph



A collection of LEDs can be treated like a bar graph using `LEDBarGraph`:

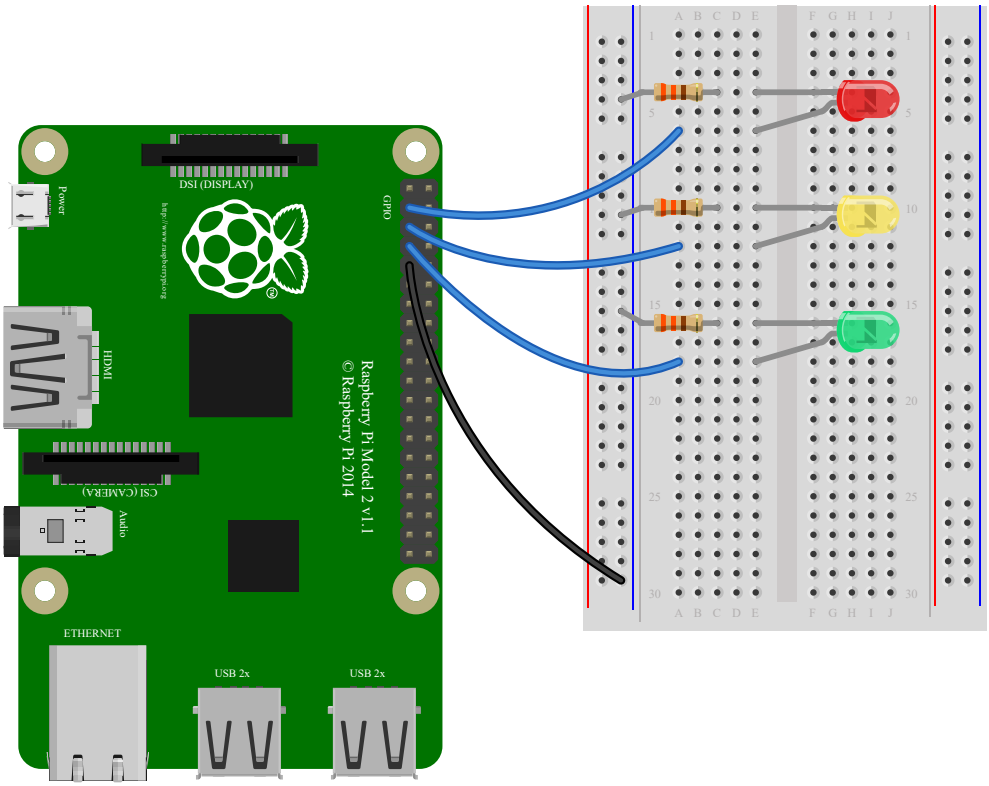
```
from gpiozero import LEDBarGraph
from time import sleep
from __future__ import division  # required for python 2

graph = LEDBarGraph(5, 6, 13, 19, 26, 20)

graph.value = 1  # (1, 1, 1, 1, 1, 1)
sleep(1)
graph.value = 1/2  # (1, 1, 1, 0, 0, 0)
sleep(1)
graph.value = -1/2  # (0, 0, 0, 1, 1, 1)
sleep(1)
graph.value = 1/4  # (1, 0, 0, 0, 0, 0)
sleep(1)
graph.value = -1  # (1, 1, 1, 1, 1, 1)
sleep(1)
```

Note values are essentially rounded to account for the fact LEDs can only be on or off when `pwm=False` (the default).

However, using `LEDBarGraph` with `pwm=True` allows more precise values using LED brightness:

```
from gpiozero import LEDBarGraph
from time import sleep
from __future__ import division  # required for python 2

graph = LEDBarGraph(5, 6, 13, 19, 26, pwm=True)

graph.value = 1/10  # (0.5, 0, 0, 0, 0)
sleep(1)
graph.value = 3/10  # (1, 0.5, 0, 0, 0)
sleep(1)
graph.value = -3/10  # (0, 0, 0, 0.5, 1)
sleep(1)
graph.value = 9/10  # (1, 1, 1, 1, 0.5)
sleep(1)
graph.value = 95/100  # (1, 1, 1, 1, 0.75)
sleep(1)
```

2.11. Traffic Lights



A full traffic lights system.

Using a `TrafficLights` kit like Pi-Stop:

```
from gpiozero import TrafficLights
from time import sleep

lights = TrafficLights(2, 3, 4)

lights.green.on()

while True:
    sleep(10)
    lights.green.off()
    lights.amber.on()
    sleep(1)
    lights.amber.off()
    lights.red.on()
    sleep(10)
    lights.amber.on()
    sleep(1)
    lights.green.on()
    lights.amber.off()
    lights.red.off()
```

Alternatively:

```
from gpiozero import TrafficLights
from time import sleep
from signal import pause

lights = TrafficLights(2, 3, 4)

def traffic_light_sequence():
    while True:
        yield (0, 0, 1) # green
        sleep(10)
        yield (0, 1, 0) # amber
        sleep(1)
        yield (1, 0, 0) # red
        sleep(10)
        yield (1, 1, 0) # red+amber
        sleep(1)

lights.source = traffic_light_sequence()

pause()
```

Using `LED` components:

```
from gpiozero import LED
from time import sleep

red = LED(2)
amber = LED(3)
green = LED(4)

green.on()
amber.off()
red.off()

while True:
    sleep(10)
    green.off()
    amber.on()
    sleep(1)
    amber.off()
    red.on()
    sleep(10)
    amber.on()
    sleep(1)
    green.on()
    amber.off()
    red.off()
```

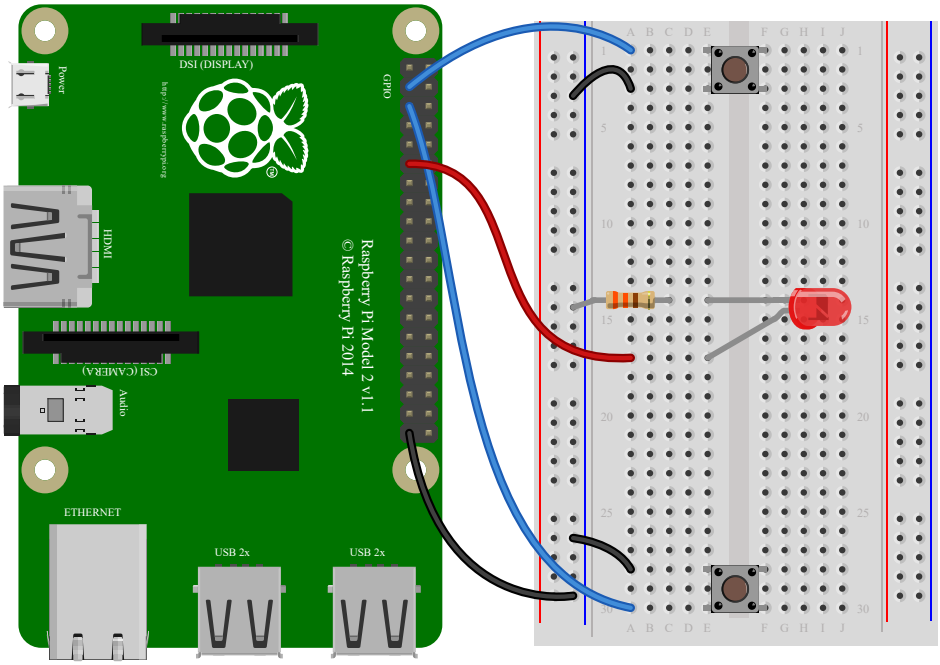
2.12. Push button stop motion

Capture a picture with the camera module every time a button is pressed:

```
from gpiozero import Button
from picamera import PiCamera

button = Button(2)
camera = PiCamera()

camera.start_preview()
frame = 1
while True:
    button.wait_for_press()
    camera.capture('/home/pi/frame%03d.jpg' % frame)
    frame += 1
```

See Push Button Stop Motion for a full resource.

2.13. Reaction Game

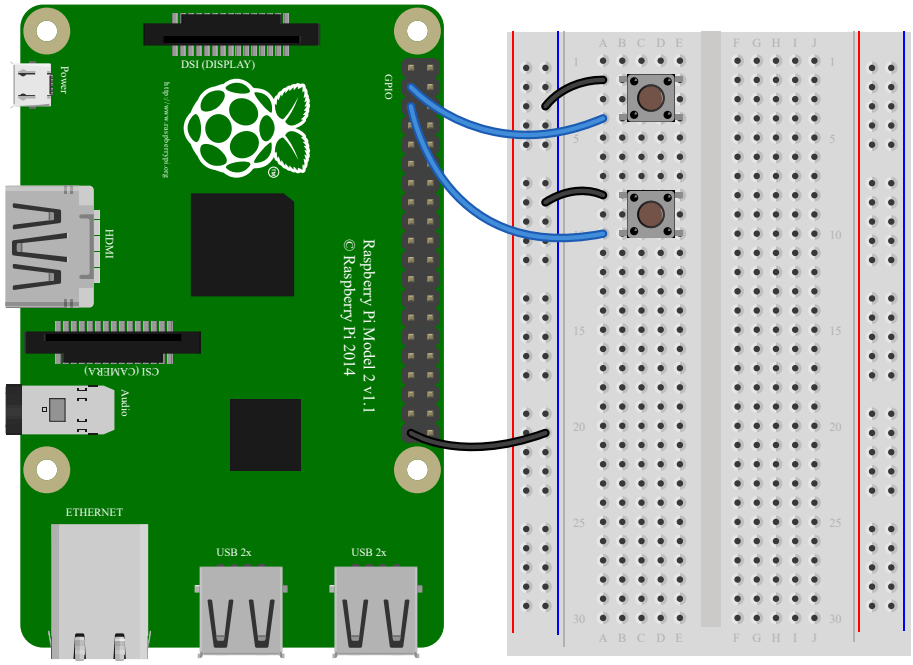


When you see the light come on, the first person to press their button wins!

```
from gpiozero import Button, LED
from time import sleep
import random

led = LED(17)

player_1 = Button(2)
player_2 = Button(3)

time = random.uniform(5, 10)
sleep(time)
led.on()

while True:
    if player_1.is_pressed:
        print("Player 1 wins!")
        break
    if player_2.is_pressed:
        print("Player 2 wins!")
        break

led.off()
```

See Quick Reaction Game for a full resource.

2.14. GPIO Music Box



Each button plays a different sound!

```
from gpiozero import Button
import pygame.mixer
from pygame.mixer import Sound
from signal import pause

pygame.mixer.init()

button_sounds = {
    Button(2): Sound("samples/drum_tom_mid_hard.wav"),
    Button(3): Sound("samples/drum_cymbal_open.wav"),
}

for button, sound in button_sounds.items():
    button.when_pressed = sound.play

pause()
```

See GPIO Music Box for a full resource.

2.15. All on when pressed

While the button is pressed down, the buzzer and all the lights come on.

`FishDish`:

```
from gpiozero import FishDish
from signal import pause

fish = FishDish()

fish.button.when_pressed = fish.on
fish.button.when_released = fish.off

pause()
```

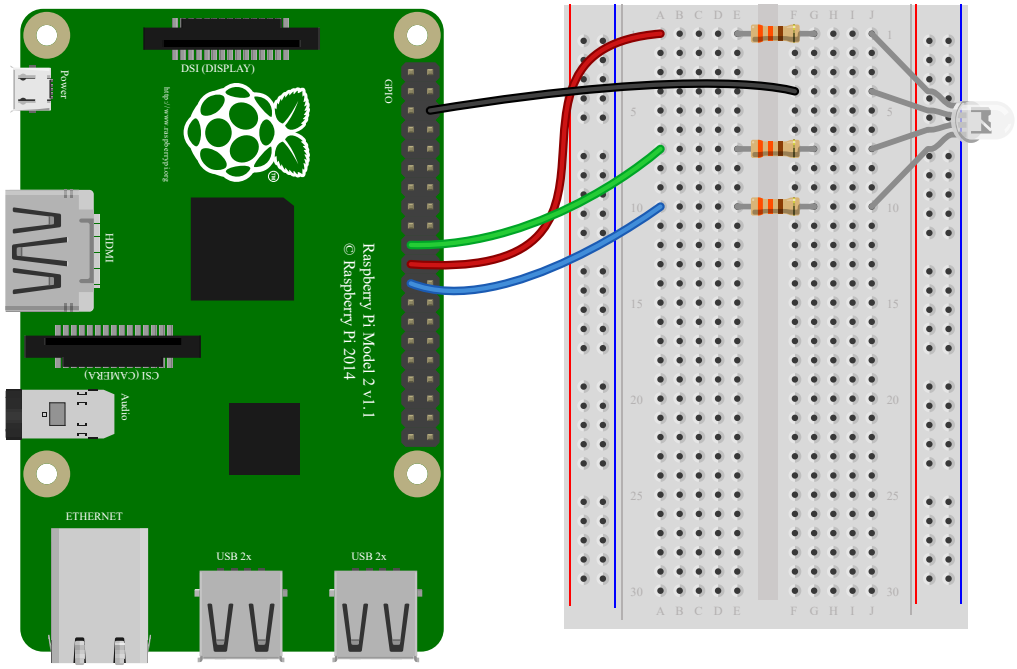
Ryanteck `TrafficHat`:

```
from gpiozero import TrafficHat
from signal import pause

th = TrafficHat()

th.button.when_pressed = th.on
th.button.when_released = th.off

pause()
```

Using `LED`, `Buzzer`, and `Button` components:

```
from gpiozero import LED, Buzzer, Button
from signal import pause

button = Button(2)
buzzer = Buzzer(3)
red = LED(4)
amber = LED(5)
green = LED(6)

things = [red, amber, green, buzzer]

def things_on():
    for thing in things:
        thing.on()

def things_off():
    for thing in things:
        thing.off()

button.when_pressed = things_on
button.when_released = things_off

pause()
```

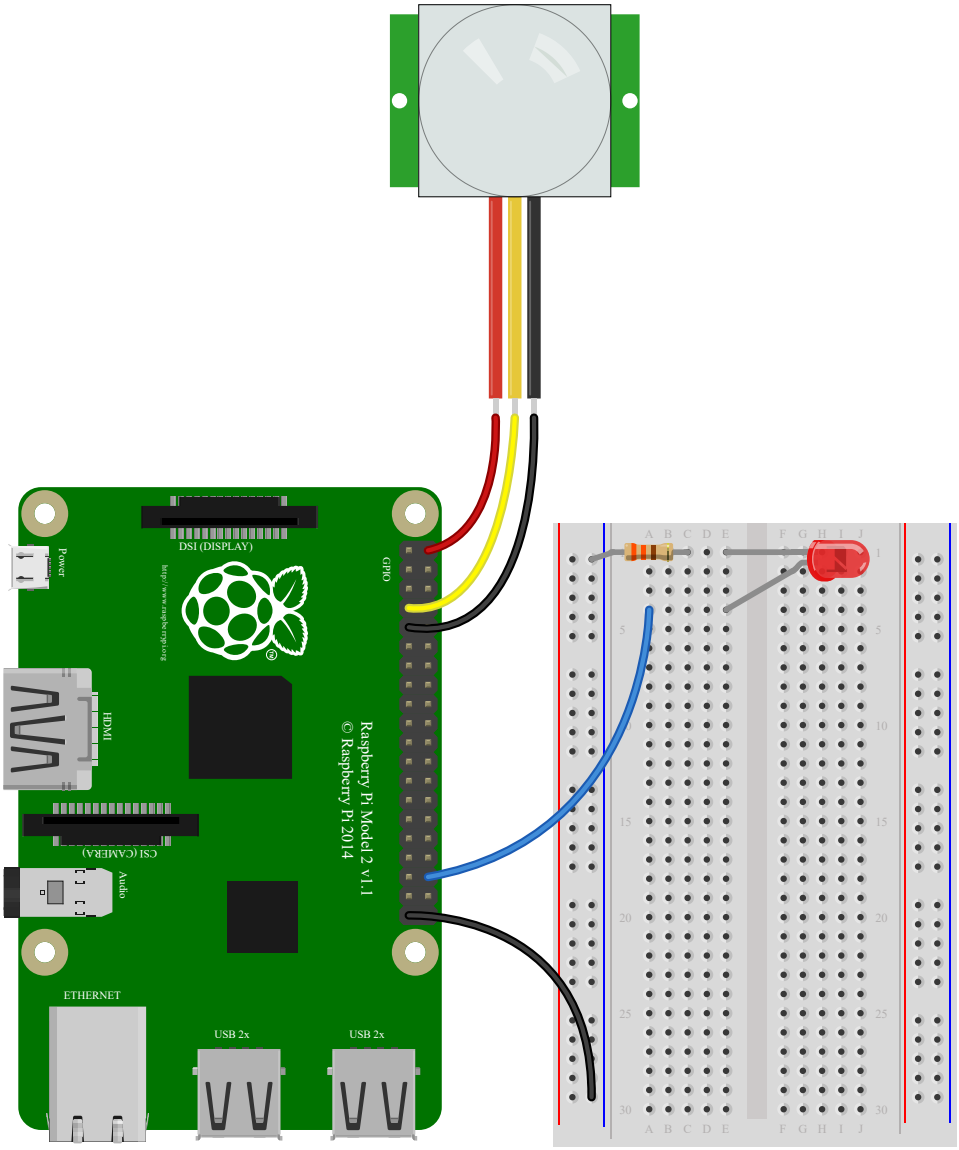
2.16. Full color LED



Making colours with an `RGBLED`:

```
from gpiozero import RGBLED
from time import sleep
from __future__ import division  # required for python 2

led = RGBLED(red=9, green=10, blue=11)

led.red = 1  # full red
sleep(1)
led.red = 0.5  # half red
sleep(1)

led.color = (0, 1, 0)  # full green
sleep(1)
led.color = (1, 0, 1)  # magenta
sleep(1)
led.color = (1, 1, 0)  # yellow
sleep(1)
led.color = (0, 1, 1)  # cyan
sleep(1)
led.color = (1, 1, 1)  # white
sleep(1)

led.color = (0, 0, 0)  # off
sleep(1)

# slowly increase intensity of blue
for n in range(100):
    led.blue = n/100
    sleep(0.1)
```

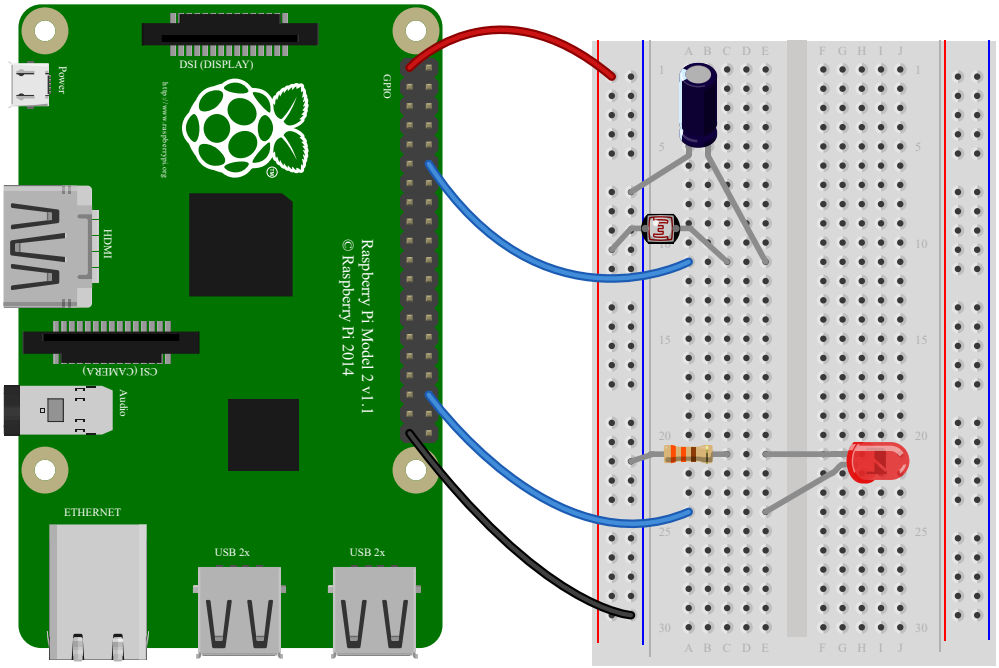
2.17. Motion sensor



Light an `LED` when a `MotionSensor` detects motion:

```
from gpiozero import MotionSensor, LED
from signal import pause

pir = MotionSensor(4)
led = LED(16)

pir.when_motion = led.on
pir.when_no_motion = led.off

pause()
```

2.18. Light sensor



Have a `LightSensor` detect light and dark:

```
from gpiozero import LightSensor

sensor = LightSensor(18)

while True:
    sensor.wait_for_light()
    print("It's light! :)")
    sensor.wait_for_dark()
    print("It's dark :(")
```

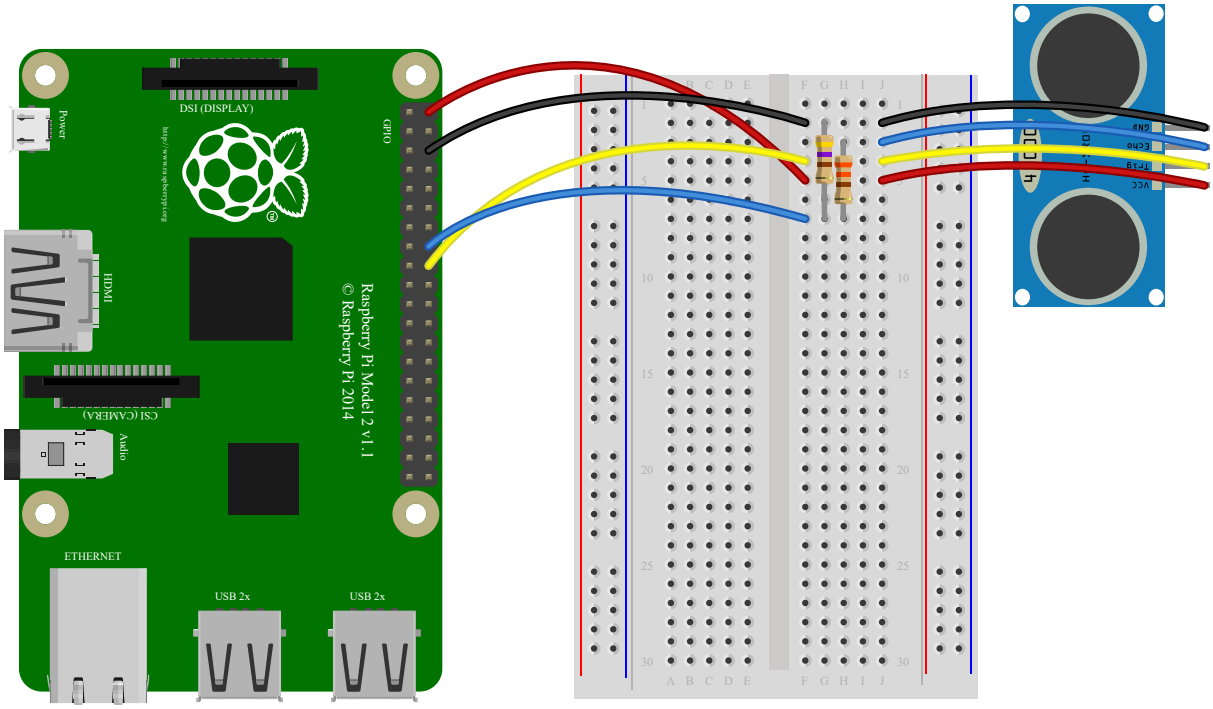
Run a function when the light changes:

```
from gpiozero import LightSensor, LED
from signal import pause

sensor = LightSensor(18)
led = LED(16)

sensor.when_dark = led.on
sensor.when_light = led.off

pause()
```

Or make a `PWMLED` change brightness according to the detected light level:

```
from gpiozero import LightSensor, PWMLED
from signal import pause

sensor = LightSensor(18)
led = PWMLED(16)

led.source = sensor

pause()
```

2.19. Distance sensor



Note

In the diagram above, the wires leading from the sensor to the breadboard can be omitted; simply plug the sensor directly into the breadboard facing the edge (unfortunately this is difficult to illustrate in the diagram without the sensor's diagram obscuring most of the breadboard!)

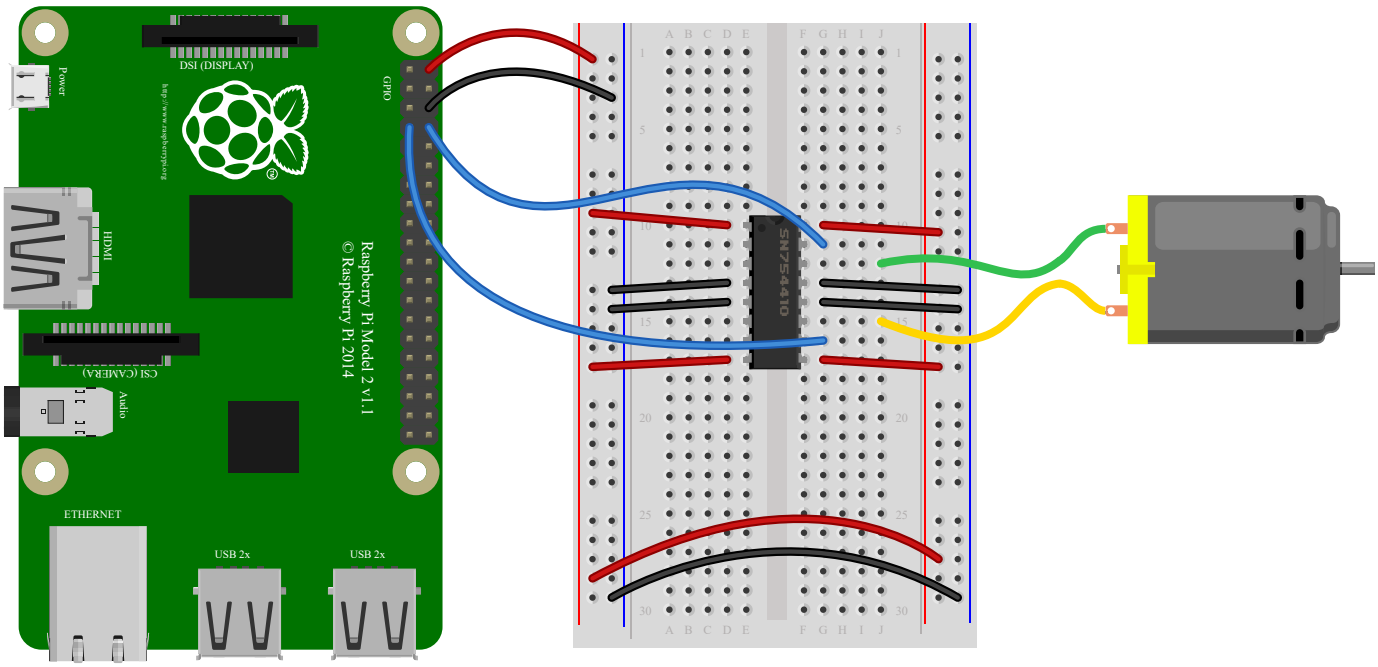
Have a `DistanceSensor` detect the distance to the nearest object:

```
from gpiozero import DistanceSensor
from time import sleep

sensor = DistanceSensor(23, 24)

while True:
    print('Distance to nearest object is', sensor.distance, 'm')
    sleep(1)
```

Run a function when something gets near the sensor:

```
from gpiozero import DistanceSensor, LED
from signal import pause

sensor = DistanceSensor(23, 24, max_distance=1, threshold_distance=0.2)
led = LED(16)

sensor.when_in_range = led.on
sensor.when_out_of_range = led.off

pause()
```

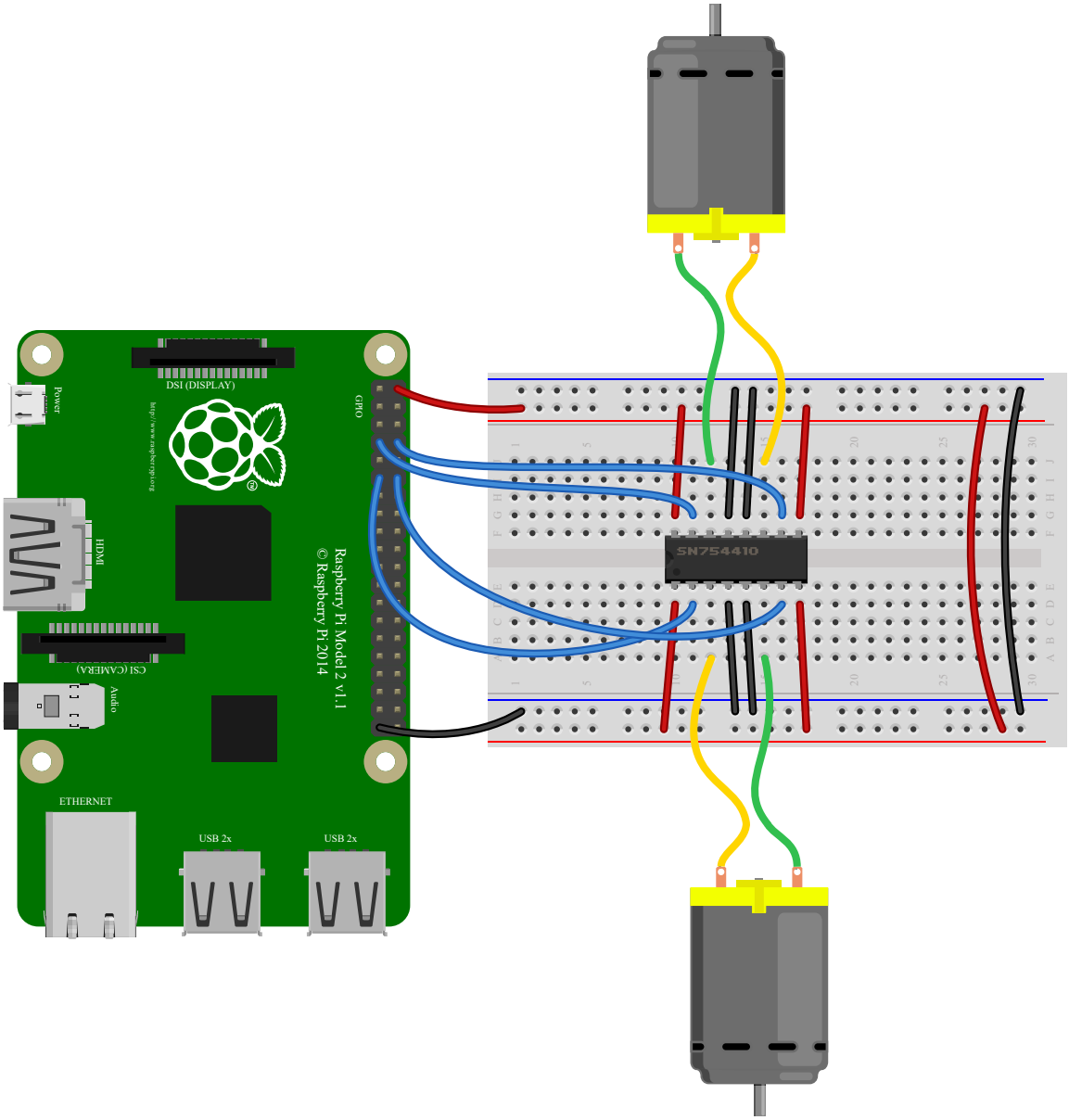
2.20. Motors



Spin a `Motor` around forwards and backwards:

```
from gpiozero import Motor
from time import sleep

motor = Motor(forward=4, backward=14)

while True:
    motor.forward()
    sleep(5)
    motor.backward()
    sleep(5)
```

2.21. Robot



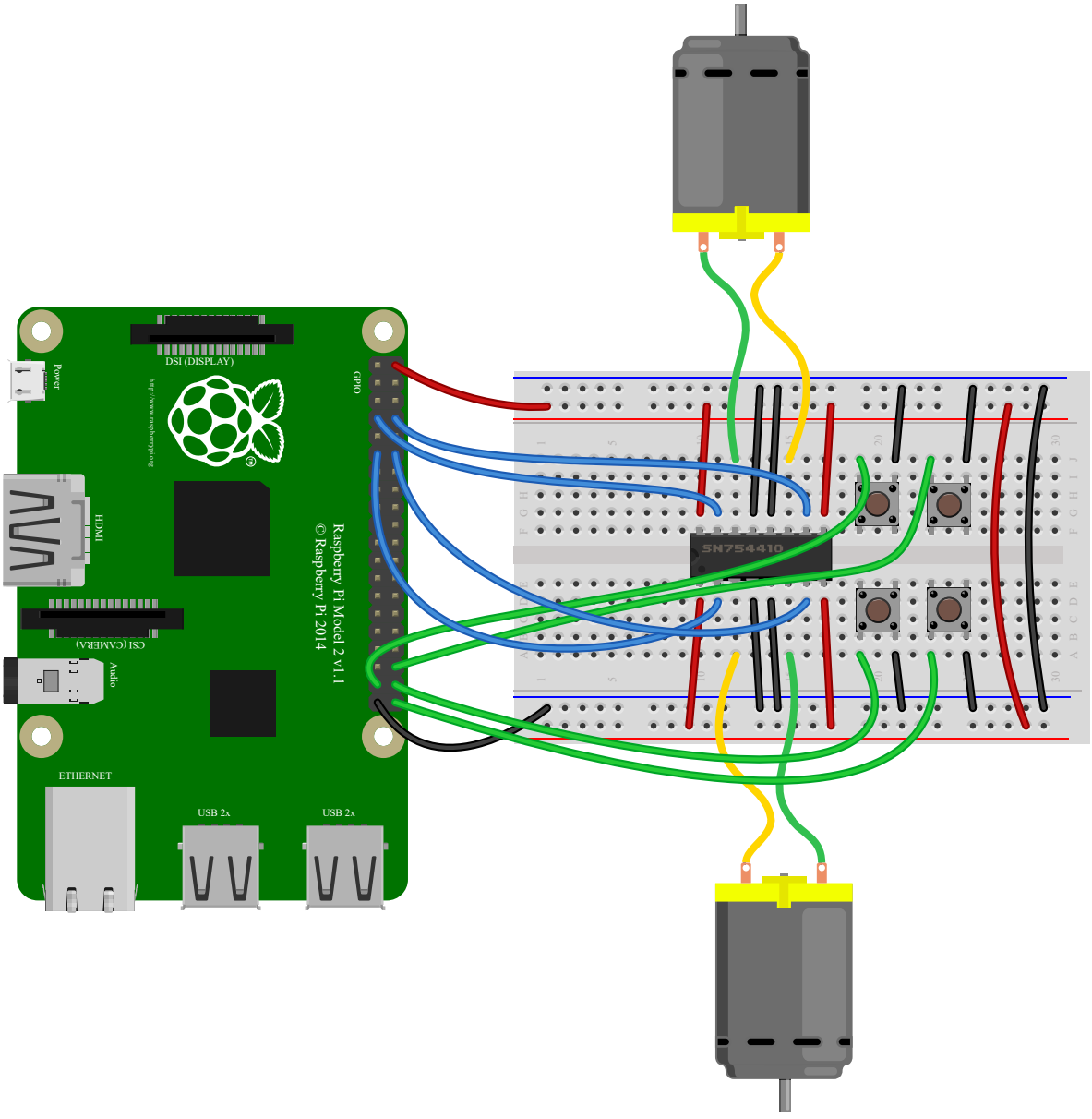
Make a `Robot` drive around in (roughly) a square:

```
from gpiozero import Robot
from time import sleep

robot = Robot(left=(4, 14), right=(17, 18))

for i in range(4):
    robot.forward()
    sleep(10)
    robot.right()
    sleep(1)
```

Make a robot with a distance sensor that runs away when things get within 20cm of it:

```
from gpiozero import Robot, DistanceSensor
from signal import pause

sensor = DistanceSensor(23, 24, max_distance=1, threshold_distance=0.2)
robot = Robot(left=(4, 14), right=(17, 18))

sensor.when_in_range = robot.backward
sensor.when_out_of_range = robot.stop
pause()
```

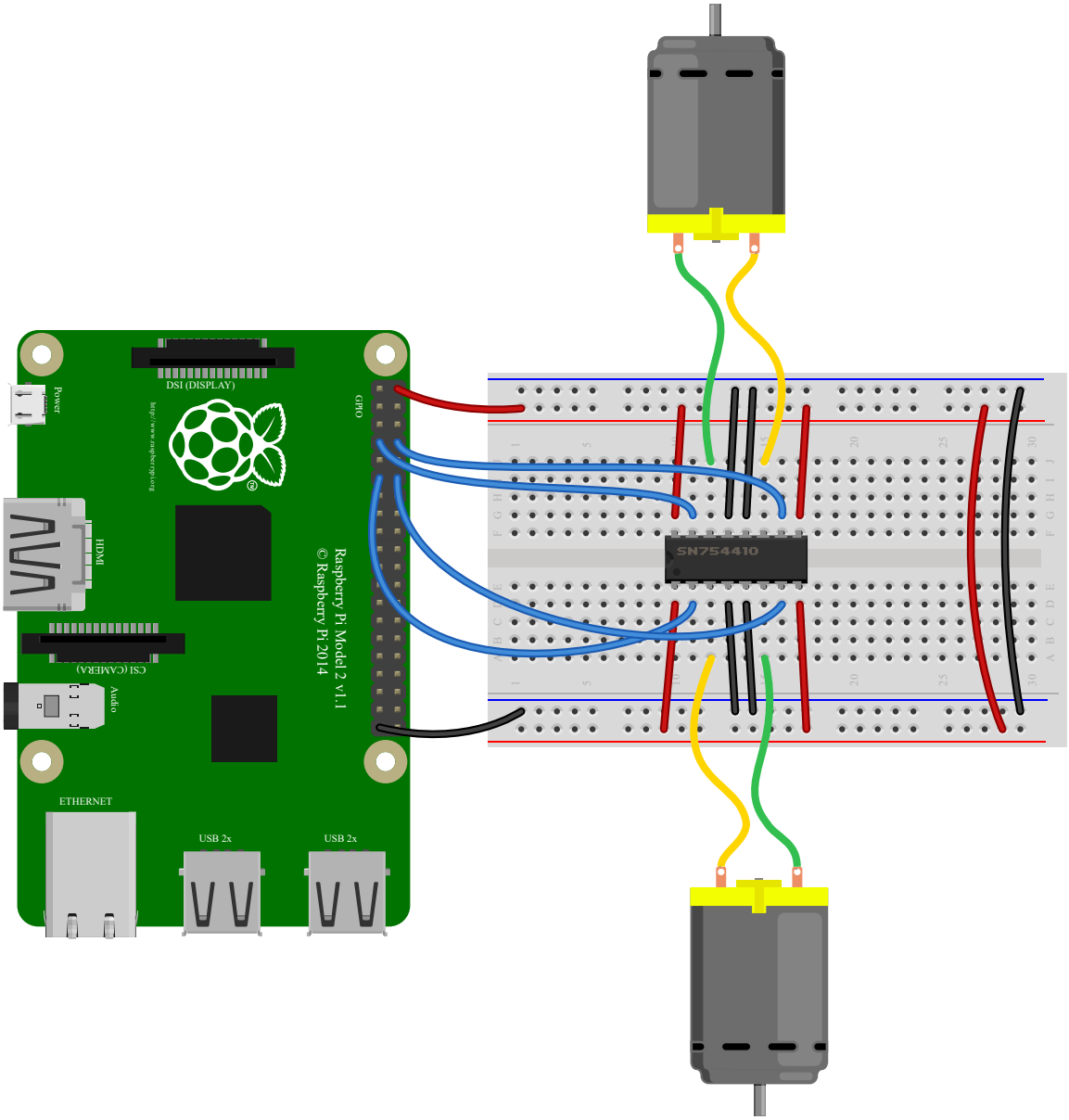
2.22. Button controlled robot



Use four GPIO buttons as forward/back/left/right controls for a robot:

```
from gpiozero import Robot, Button
from signal import pause

robot = Robot(left=(4, 14), right=(17, 18))

left = Button(26)
right = Button(16)
fw = Button(21)
bw = Button(20)

fw.when_pressed = robot.forward
fw.when_released = robot.stop

left.when_pressed = robot.left
left.when_released = robot.stop

right.when_pressed = robot.right
right.when_released = robot.stop

bw.when_pressed = robot.backward
bw.when_released = robot.stop

pause()
```

2.23. Keyboard controlled robot



Use up/down/left/right keys to control a robot:

```
import curses
from gpiozero import Robot

robot = Robot(left=(4, 14), right=(17, 18))

actions = {
    curses.KEY_UP:    robot.forward,
    curses.KEY_DOWN:  robot.backward,
    curses.KEY_LEFT:  robot.left,
    curses.KEY_RIGHT: robot.right,
}

def main(window):
    next_key = None
    while True:
        curses.halfdelay(1)
        if next_key is None:
            key = window.getch()
        else:
            key = next_key
            next_key = None
        if key != -1:
            # KEY PRESSED
            curses.halfdelay(3)
            action = actions.get(key)
            if action is not None:
                action()
            next_key = key
            while next_key == key:
                next_key = window.getch()
            # KEY RELEASED
            robot.stop()

curses.wrapper(main)
```

Note

This recipe uses the standard `curses` module. This module requires that Python is running in a terminal in order to work correctly, hence this recipe will *not* work in environments like IDLE.

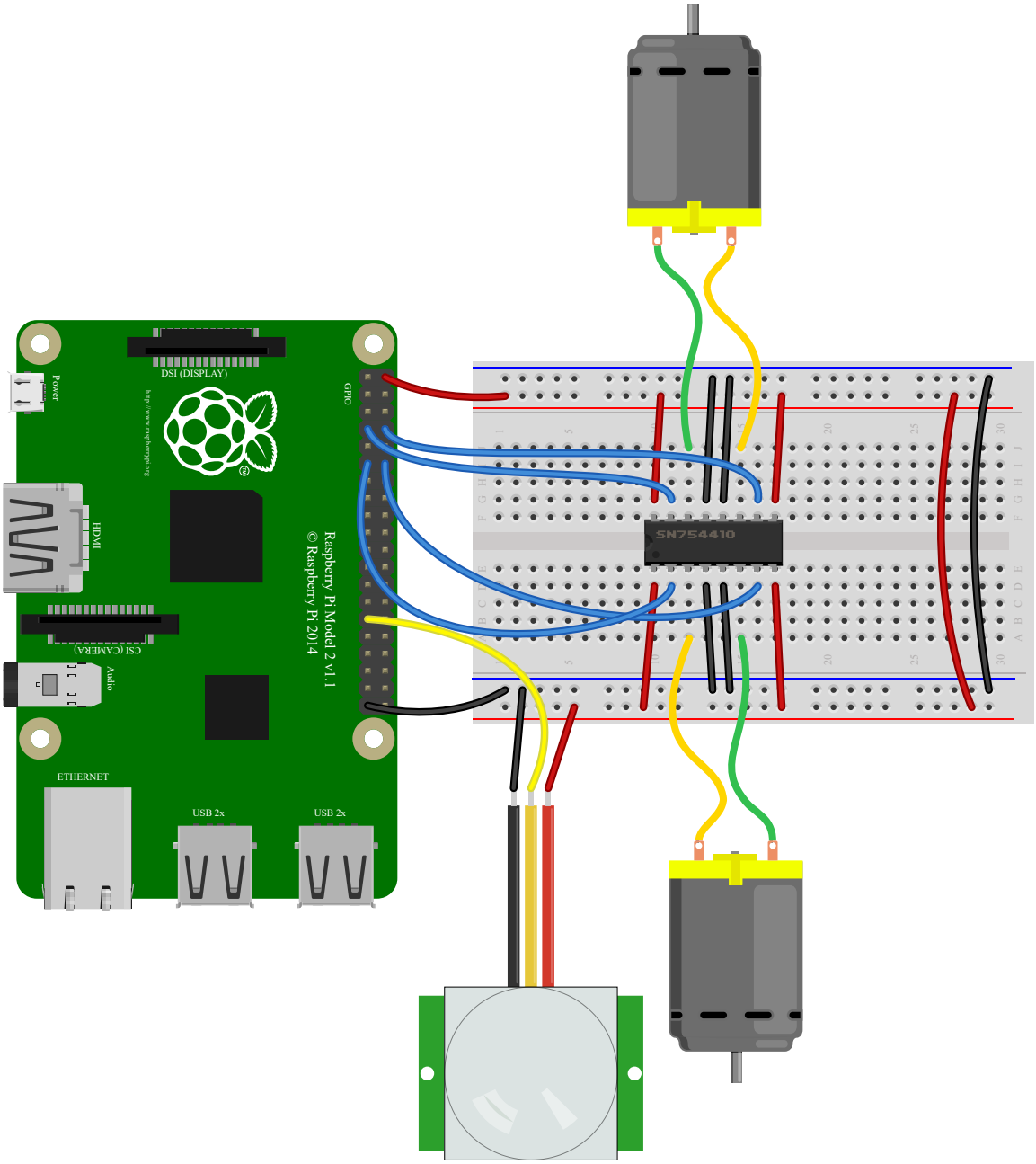
If you prefer a version that works under IDLE, the following recipe should suffice:

```
from gpiozero import Robot
from evdev import InputDevice, list_devices, ecodes

robot = Robot(left=(4, 14), right=(17, 18))

# Get the list of available input devices
devices = [InputDevice(device) for device in list_devices()]
# Filter out everything that's not a keyboard. Keyboards are defined as any
# device which has keys, and which specifically has keys 1..31 (roughly Esc,
# the numeric keys, the first row of QWERTY plus a few more) and which does
# *not* have key 0 (reserved)
must_have = {i for i in range(1, 32)}
must_not_have = {0}
devices = [
    dev
    for dev in devices
    for keys in (set(dev.capabilities().get(ecodes.EV_KEY, [])),)
    if must_have.issubset(keys)
    and must_not_have.isdisjoint(keys)
]
# Pick the first keyboard
keyboard = devices[0]

keypress_actions = {
    ecodes.KEY_UP: robot.forward,
    ecodes.KEY_DOWN: robot.backward,
    ecodes.KEY_LEFT: robot.left,
    ecodes.KEY_RIGHT: robot.right,
}

for event in keyboard.read_loop():
    if event.type == ecodes.EV_KEY and event.code in keypress_actions:
        if event.value == 1:  # key pressed
            keypress_actions[event.code]()
        if event.value == 0:  # key released
            robot.stop()
```

Note

This recipe uses the third-party `evdev` module. Install this library with `sudo pip3 install evdev` first. Be aware that `evdev` will only work with local input devices; this recipe will *not* work over SSH.

2.24. Motion sensor robot



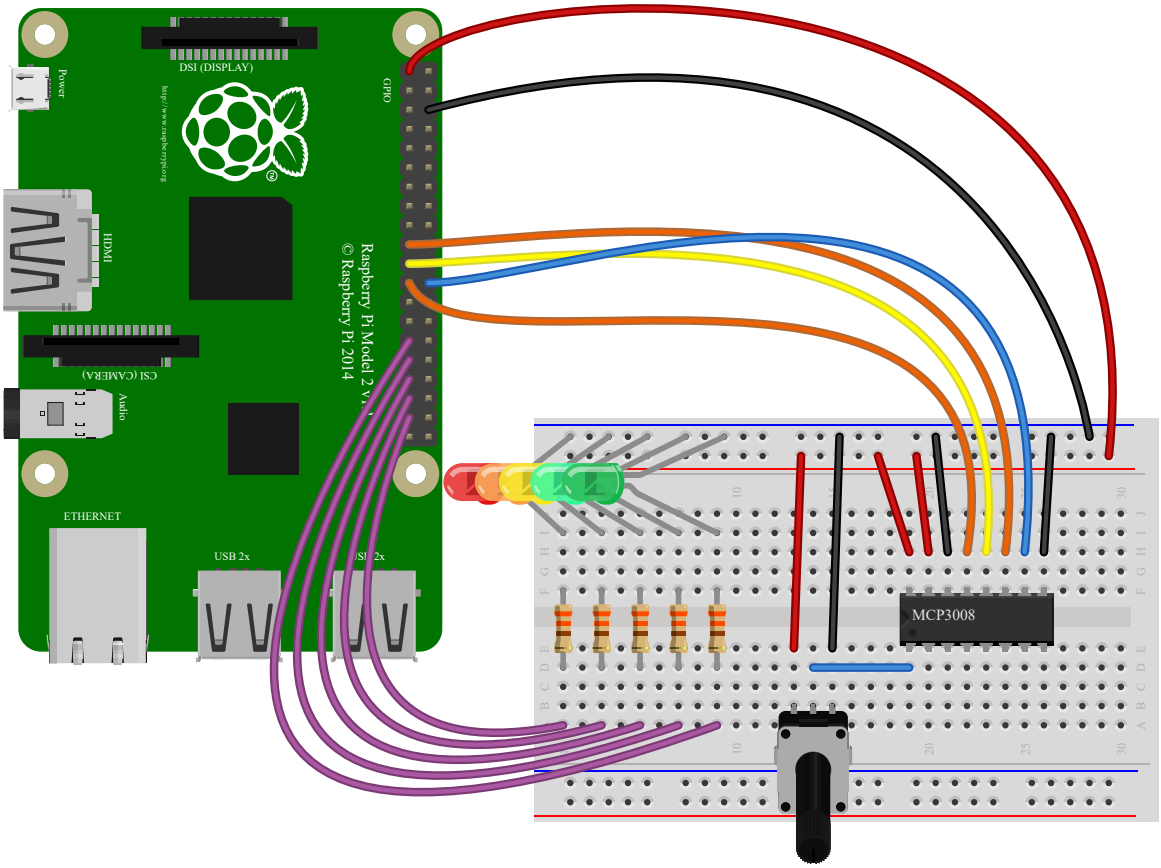
Make a robot drive forward when it detects motion:

```
from gpiozero import Robot, MotionSensor
from signal import pause

robot = Robot(left=(4, 14), right=(17, 18))
pir = MotionSensor(5)

pir.when_motion = robot.forward
pir.when_no_motion = robot.stop

pause()
```

Alternatively:

```
from gpiozero import Robot, MotionSensor
from gpiozero.tools import zip_values
from signal import pause

robot = Robot(left=(4, 14), right=(17, 18))
pir = MotionSensor(5)

robot.source = zip_values(pir, pir)

pause()
```

2.25. Potentiometer



Continually print the value of a potentiometer (values between 0 and 1) connected to a `MCP3008` analog to digital converter:

```
from gpiozero import MCP3008

pot = MCP3008(channel=0)

while True:
    print(pot.value)
```

Present the value of a potentiometer on an LED bar graph using PWM to represent states that won't "fill" an LED:

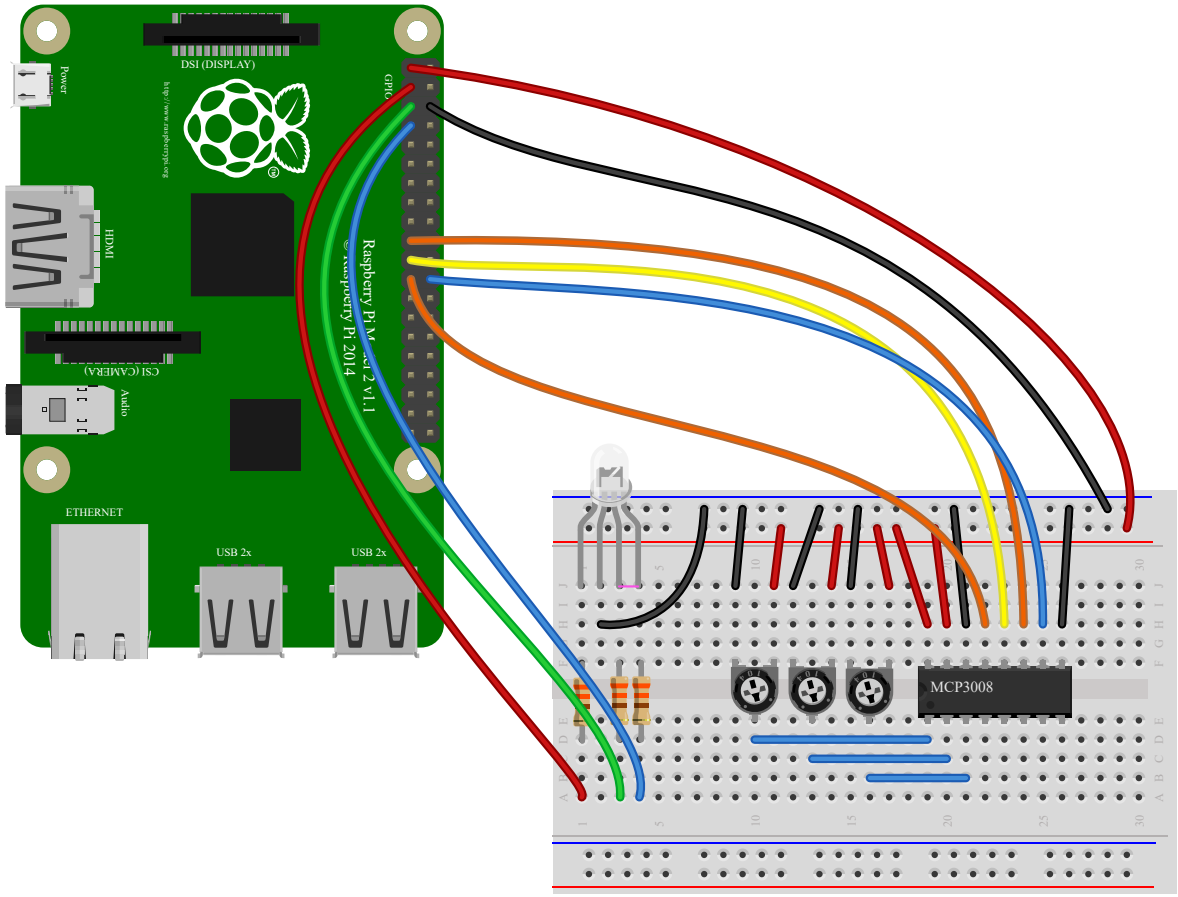
```
from gpiozero import LEDBarGraph, MCP3008
from signal import pause

graph = LEDBarGraph(5, 6, 13, 19, 26, pwm=True)
pot = MCP3008(channel=0)

graph.source = pot

pause()
```

2.26. Measure temperature with an ADC

Wire a TMP36 temperature sensor to the first channel of an `MCP3008` analog to digital converter:

```
from gpiozero import MCP3008
from time import sleep

def convert_temp(gen):
    for value in gen:
        yield (value * 3.3 - 0.5) * 100

adc = MCP3008(channel=0)

for temp in convert_temp(adc.values):
    print('The temperature is', temp, 'C')
    sleep(1)
```

2.27. Full color LED controlled by 3 potentiometers



Wire up three potentiometers (for red, green and blue) and use each of their values to make up the colour of the LED:

```
from gpiozero import RGBLED, MCP3008

led = RGBLED(red=2, green=3, blue=4)
red_pot = MCP3008(channel=0)
green_pot = MCP3008(channel=1)
blue_pot = MCP3008(channel=2)

while True:
    led.red = red_pot.value
    led.green = green_pot.value
    led.blue = blue_pot.value
```

Alternatively, the following example is identical, but uses the `source` property rather than a `while` loop:

```
from gpiozero import RGBLED, MCP3008
from gpiozero.tools import zip_values
from signal import pause

led = RGBLED(2, 3, 4)
red_pot = MCP3008(0)
green_pot = MCP3008(1)
blue_pot = MCP3008(2)

led.source = zip_values(red_pot, green_pot, blue_pot)

pause()
```

2.28. Timed heat lamp

If you have a pet (e.g. a tortoise) which requires a heat lamp to be switched on for a certain amount of time each day, you can use an Energenie Pi-mote to remotely control the lamp, and the `TimeOfDay` class to control the timing:

```
from gpiozero import Energenie, TimeOfDay
from datetime import time
from signal import pause

lamp = Energenie(1)
daytime = TimeOfDay(time(8), time(20))

lamp.source = daytime
lamp.source_delay = 60

pause()
```

2.29. Internet connection status indicator

You can use a pair of green and red LEDs to indicate whether or not your internet connection is working. Simply use the `PingServer` class to identify whether a ping to *google.com* is successful. If successful, the green LED is lit, and if not, the red LED is lit:

```
from gpiozero import LED, PingServer
from gpiozero.tools import negated
from signal import pause

green = LED(17)
red = LED(18)

google = PingServer('google.com')

green.source = google
green.source_delay = 60
red.source = negated(green)

pause()
```

2.30. CPU Temperature Bar Graph

You can read the Raspberry Pi's own CPU temperature using the built-in `CPUTemperature` class, and display this on a "bar graph" of LEDs:

```
from gpiozero import LEDBarGraph, CPUTemperature
from signal import pause

cpu = CPUTemperature(min_temp=50, max_temp=90)
leds = LEDBarGraph(2, 3, 4, 5, 6, 7, 8, pwm=True)

leds.source = cpu

pause()
```

2.31. More recipes

Continue to:

- Advanced Recipes
- Remote GPIO Recipes