Raspberry Pi

GPIO and Camera

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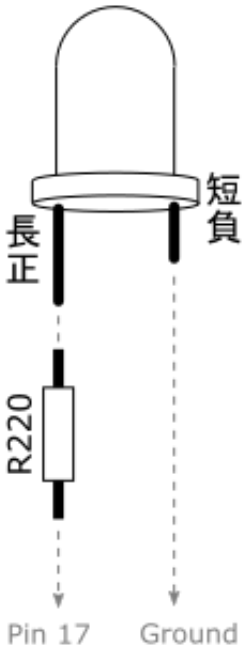
```
$ python3

>>> 1 + 3
>>> 9 - 7
>>> 6 * 3
>>> 3 / 2
>>> 3 // 2
>>> 7 % 3
>>> 4 + 2 * 3
>>> (4 + 2) * 3
>>> 2 ** 3

>>> type(3)
>>> type(3.0)
>>> type('3')

>>> 3.0 == 3
>>> '3' == 3

>>> # comment

>>> x = 1
>>> y = 2
>>> x + y
>>> x * y

>>> import time
>>> time.time()

>>> x = 25
>>> 'I am {} years old'.format(x)

>>> street = 'Nathan Road'
>>> area = 'Mongkok'
>>> 'I live on {} {}, {}'.format(x, street, area)

>>> humidity, temperature = 50.00001, 22.34567
>>> 'Today is {}% {:.2f} degree'.format(humidity, temperature)
```

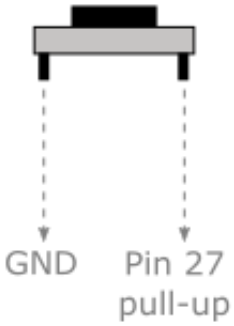
LED

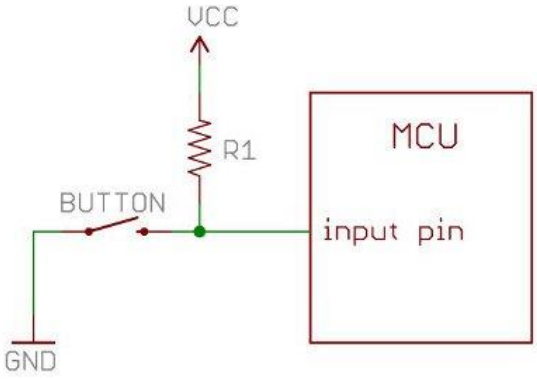


gpiozero basic recipes

- LED
- LED with variable brightness
- Traffic Lights

Button





gpiozero basic recipes

- Button

Quick reaction game

Now that you know how to handle LED and push button, let's check how quick your reaction is. Make a reaction timer as follows:

1. Turn on LED
2. User presses button to "start the clock". LED is turned off.
3. After a random number of seconds (say, 2-10 seconds), LED is turned back on!
4. User has to press button as soon as he can. Print out his reaction time.

reaction.py

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

led = LED(26)
button = Button(12)

led.on()
button.wait_for_press()  ❶

led.off()
sleep(random.uniform(2, 10))  ❷

led.on()
on_time = time()  ❸

button.wait_for_press()  ❹
press_time = time()  ❺

print('{:.3f}'.format(press_time - on_time))
```

❶ Wait for user to get ready

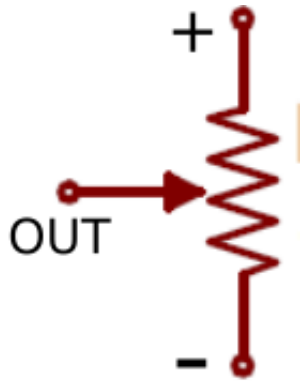
❷ Delay for a random number of seconds (2-10)

❸ Remember the time when LED is turned on

❹ Wait for user to press

❺ Remember the time when user presses the button

Potentiometer
VR, Variable Resistor



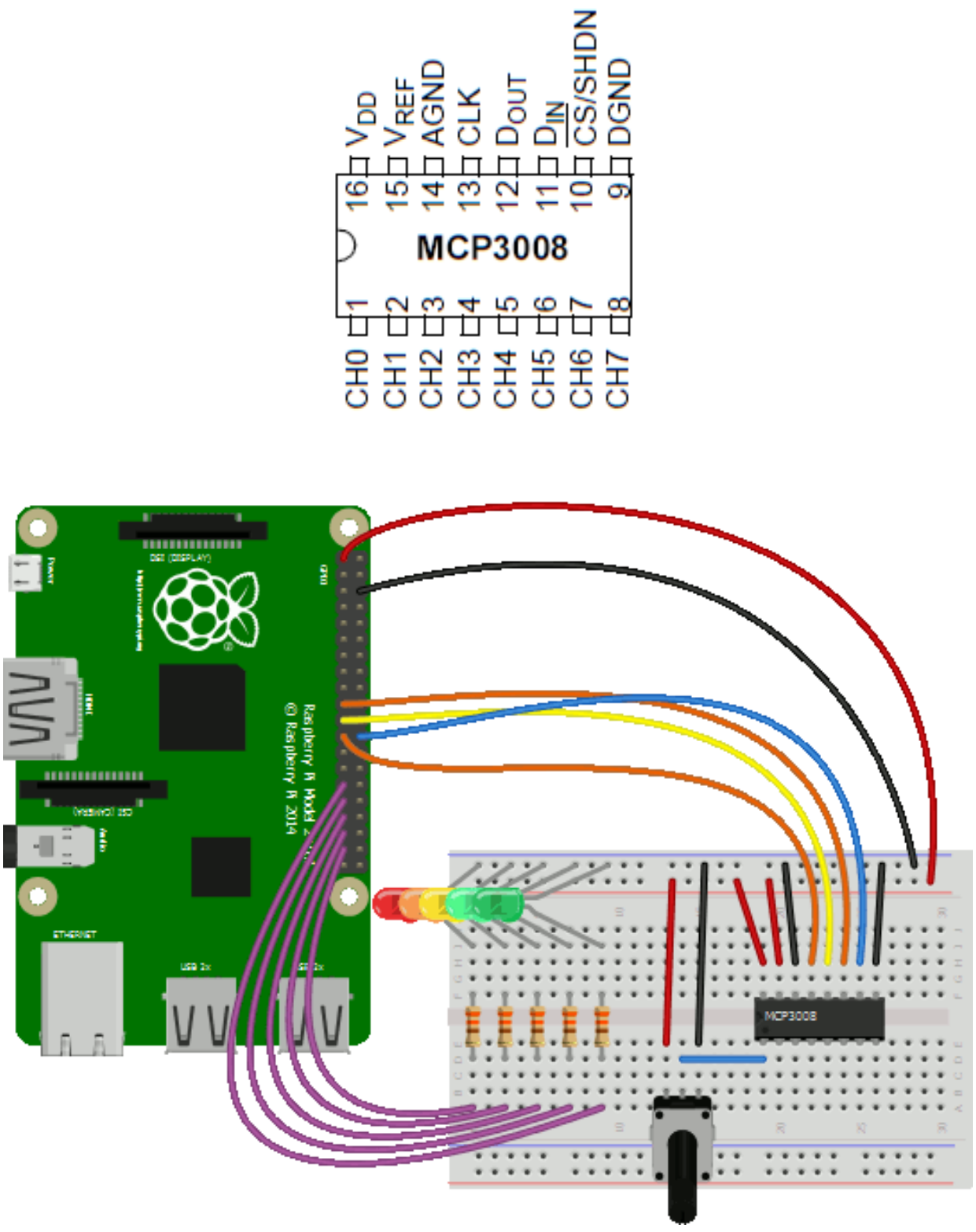
gpiozero basic recipes

- Potentiometer

Problem

- Use a potentiometer to vary an LED's brightness

Joystick 等於兩個 VR，一個 X 軸，一個 Y 軸。


MCP3008
16 VDD
15 VREF
14 AGND
13 CLK
12 DOUT
11 DIN
10 CS/SHDN
9 DGND
1 CH0
2 CH1
3 CH2
4 CH3
5 CH4
6 CH5
7 CH6
8 CH7
MCP3008

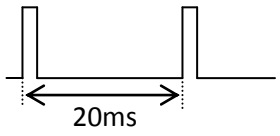
Servo

gpiozero basic recipes:

- Servo

Pulse Width Modulation controlling Servo Motors

Period 20 milliseconds, Frequency 50 Hz

angle	high time	duty cycle	
-90^0	0.5 ms	2.5 %	
-45^0	1 ms	5 %	
0^0	1.5 ms	7.5 %	
$+45^0$	2 ms	10 %	...
$+90^0$	2.5 ms	12.5 %	...

```
from gpiozero import Servo
from time import sleep

servo = Servo(17,
    min_pulse_width=0.5/1000,  ❶
    max_pulse_width=2.5/1000)

while True:
    servo.value = -1   ❷
    sleep(2)
    servo.value = 0   ❸
    sleep(2)
    servo.value = 1   ❹
    sleep(2)
```

❶ 指明最大及最小 pulse width

❷ 停在最小角

❸ 停在中位角

❹ 停在最大角

用 joystick 控制兩個 servo

```
from gpiozero import Servo, MCP3008
from gpiozero.tools import scaled
from signal import pause

h = Servo(17,
    min_pulse_width=0.5/1000,
    max_pulse_width=2.5/1000)

v = Servo(27,
    min_pulse_width=0.5/1000,
    max_pulse_width=2.5/1000)

y = MCP3008(channel=0)   ❶
x = MCP3008(channel=1)

h.source = scaled(x, -1, 1)   ❷
h.source_delay = 0.1
v.source = scaled(y, 1, -1)
v.source_delay = 0.1

pause()
```

❶ X，Y 軸接入 0，1 channel

❷ 0 → 1 map 至 -1 → 1

Camera

Plug in the camera module. Update the system:

```
$ sudo apt-get update
$ sudo apt-get upgrade
$ sudo raspi-config
```

Select **Interfacing Options**, enable **Camera**.

Finish and **reboot**.

raspistill

capture photo

raspistill -o a.jpg	Capture photo to a file.

On LCD, **open the file manager** and double-click on the file to view the photo.

raspistill -o a.jpg -t 1000	Wait 1 second before capturing. Default is 5 seconds.
raspistill -o a.jpg -hf -vf	Flip image horizontally and vertically.
raspistill | less	Display options.

Interesting options:

-t, --timeout
-hf, --hflip
-vf, --vflip
-w, --width
-h, --height
-ss, --shutter
-ifx, --imxfx

raspivid

capture video

raspivid -o b.h264 -t 5000 -fps 25	Record 5 seconds at 25 frames per second.
omxplayer b.h264 --fps 25	View the video on an HDMI display. This will not work on VNC because **omxplayer** makes use of hardware acceleration in the GPU (graphics processing unit), which is only available to HDMI output.
raspivid | less	Display options. Similar to those of **raspistill**.

Convert h264 to mp4

```
$ sudo apt-get install gpac
```

To concatenate many files to a new file (if the destination file exists, its original content will be erased):

```
$ MP4Box -fps 25 -cat a.h264 -cat b.h264 -new c.mp4
```

To concatenate many files to an existing file (if the destination file does not exist, it will be created):

```
$ MP4Box -fps 25 -cat a.h264 -cat b.h264 c.mp4
```

Capturing to a file

```
from time import sleep
from picamera import PiCamera

camera = PiCamera()
camera.resolution = (1024, 768)
sleep(2)  # Camera warm-up time
camera.capture('foo.jpg')
```

Change Camera's Output Orientation

```
camera.hflip = True
camera.vflip = True
camera.rotation = 90
```

The **picamera** package has its own very good documentations. Explore it yourself if you want to know more:

http://picamera.readthedocs.io/

Recording video to a file

```
import picamera

camera = picamera.PiCamera()
camera.resolution = (640, 480)

camera.start_preview()
camera.start_recording('video.h264')

camera.wait_recording(5)

camera.stop_recording()
camera.stop_preview()
```

Overlaying text on the output

The camera includes a rudimentary annotation facility which permits up to 255 characters of ASCII text to be overlaid on all output.

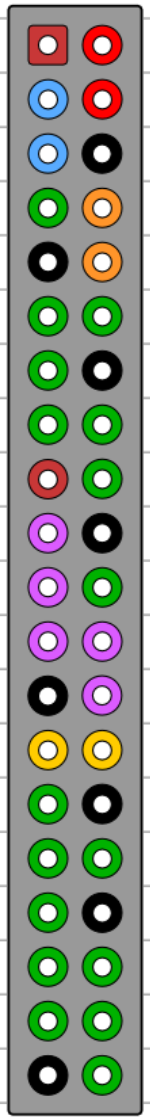
```
import picamera

camera = picamera.PiCamera(resolution=(1280, 720), framerate=24)

camera.annotate_background = picamera.Color('black')
camera.annotate_text = 'Hehehehe'

camera.start_preview()
camera.start_recording('video.h264')
camera.wait_recording(3)
camera.annotate_text = 'Wahahahahaha'
camera.wait_recording(3)
camera.stop_recording()
camera.stop_preview()
```

Camera GUI

https://github.com/Billwilliams1952/PiCameraApp

Raspberry Pi B+ J8 Header

Pin#	NAME		NAME	Pin#
01	3.3v DC Power		DC Power 5v	02
03	GPIO02 (SDA1 , I2C)		DC Power 5v	04
05	GPIO03 (SCL1 , I2C)		Ground	06
07	GPIO04 (GPIO_GCLK)		(TXD0) GPIO14	08
09	Ground		(RXD0) GPIO15	10
11	GPIO17 (GPIO_GEN0)		(GPIO_GEN1) GPIO18	12
13	GPIO27 (GPIO_GEN2)		Ground	14
15	GPIO22 (GPIO_GEN3)		(GPIO_GEN4) GPIO23	16
17	3.3v DC Power		(GPIO_GEN5) GPIO24	18
19	GPIO10 (SPI_MOSI)		Ground	20
21	GPIO09 (SPI_MISO)		(GPIO_GEN6) GPIO25	22
23	GPIO11 (SPI_CLK)		(SPI_CE0_N) GPIO08	24
25	Ground		(SPI_CE1_N) GPIO07	26
27	ID_SD (I2C ID EEPROM)		(I2C ID EEPROM) ID_SC	28
29	GPIO05		Ground	30
31	GPIO06		GPIO12	32
33	GPIO13		Ground	34
35	GPIO19		GPIO16	36
37	GPIO26		GPIO20	38
39	Ground		GPIO21	40



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http://www.element14.com