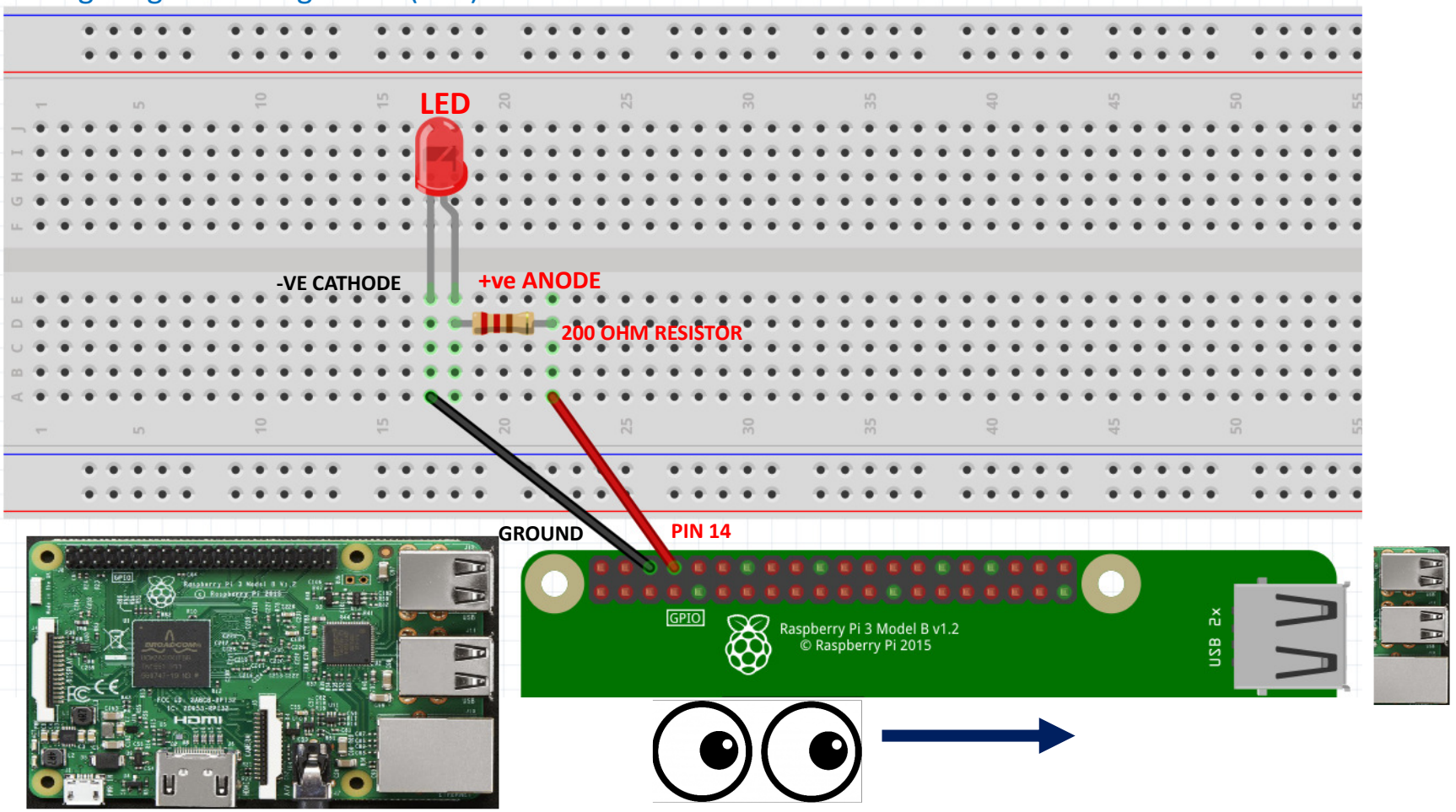
Tampines Regional Library
LearnX Community
Pi Python Introductory Course
Course Material

PLEASE DO NOT WRITE ANYTHING ON THE PAGES
OF THIS BOOKLET. THANK YOU.

Wiring a Light Emitting Diode (LED) EXERCISE #1

WEEK 1



TESTING OUR CIRCUIT USING THONNY SHELL

Ex 1a. Turning our Red LED on

```
>>> from gpiozero import LED
>>> red_led = LED(14)
>>> red_led.on()
```

Ex 1b. Turning it off

```
>>> red_led.off()
```

Ex 1c. Make it blink (1 sec on 1 sec off)

```
>>> red_led.blink()
```

Ex 1d. Make it pulsate a number of times

```
>>> red_led.blink(on_time=.5, off_time=.8, n=5)
```

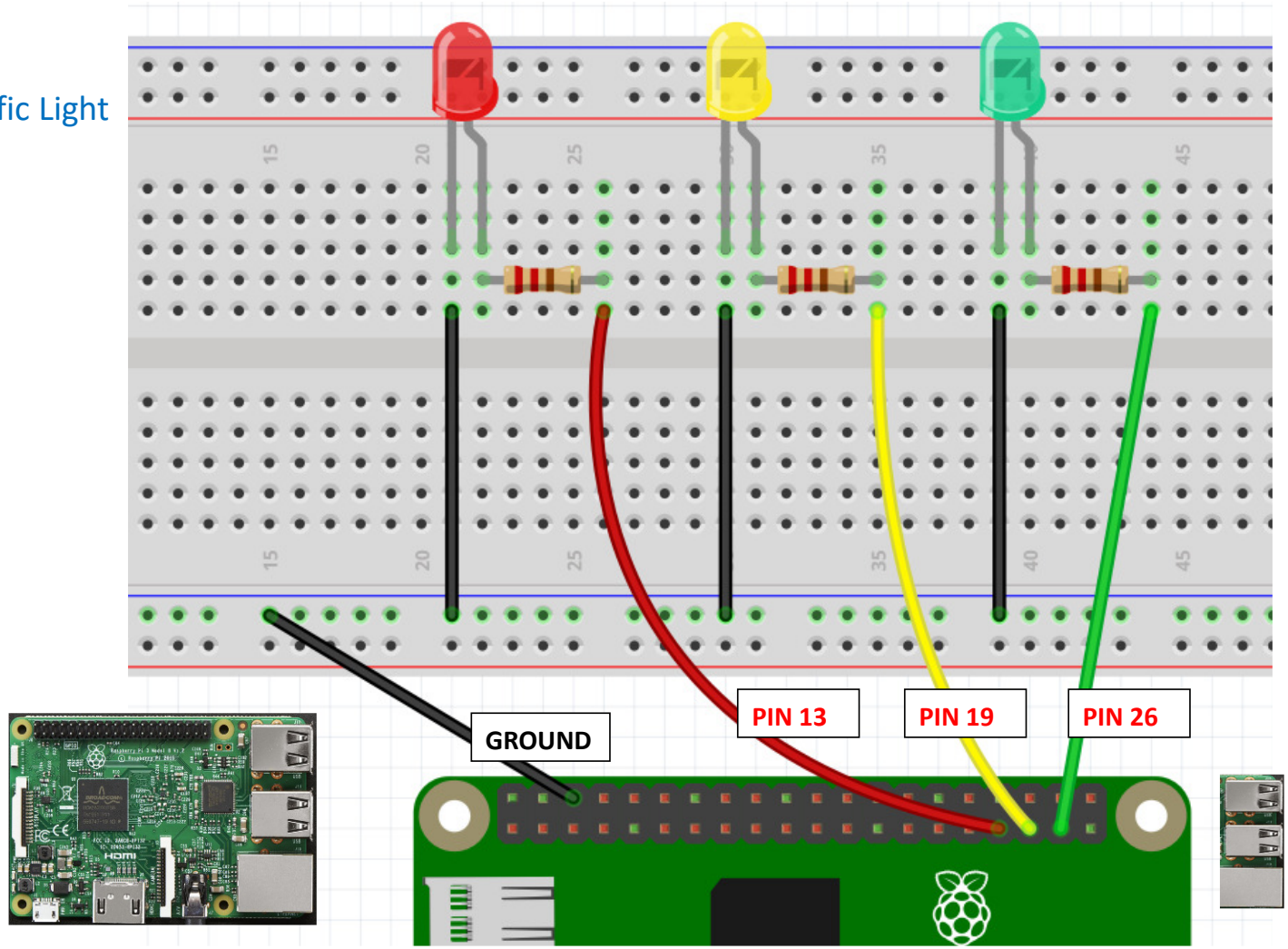
TESTING OUR CIRCUIT USING THE THONNY EDITOR

Ex 1e. Creating our 1st Raspberry Pi Python Program
Click on the green + icon to open a new page
And type these codes into the Editor

```
#Library # in python means – remarks for humans
from gpiozero import LED
from time import sleep
#Setup
tf_red_led = LED(14)
#Algorithm / Logic / Sequence
tf_red_led.on()
sleep(5)     #pause for 5 seconds
tf_red_led.off()
sleep(5)     #pause for 5 seconds
tf_red_led.blink(on_time=.5,off_time=.5,n=5)
sleep(5)     #allow 5 seconds for the blink to complete
```

Save this program
File -> Save [provide a programme name. E.g. Excercise1.py then click OK
Click Run or the play icon to run the program

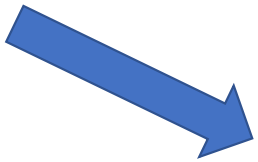
EXERCISE #2
Wiring for a Traffic Light



Ex. 2a – Using our knowledge from Exercise 1a-d, we create a traffic light system.
Save program as Exercise2a.py

ALGORITHM FOR A TRAFFIC LIGHT SYSTEM

STARTS WITH GREEN
AFTER 10 SECONDS
GREEN GOES OFF
AMBER COMES ON
AFTER 5 SECONDS
AMBER GOES OFF
RED COMES ON
AFTER 10 SECONDS
RED GOES OFF
GREEN COMES ON

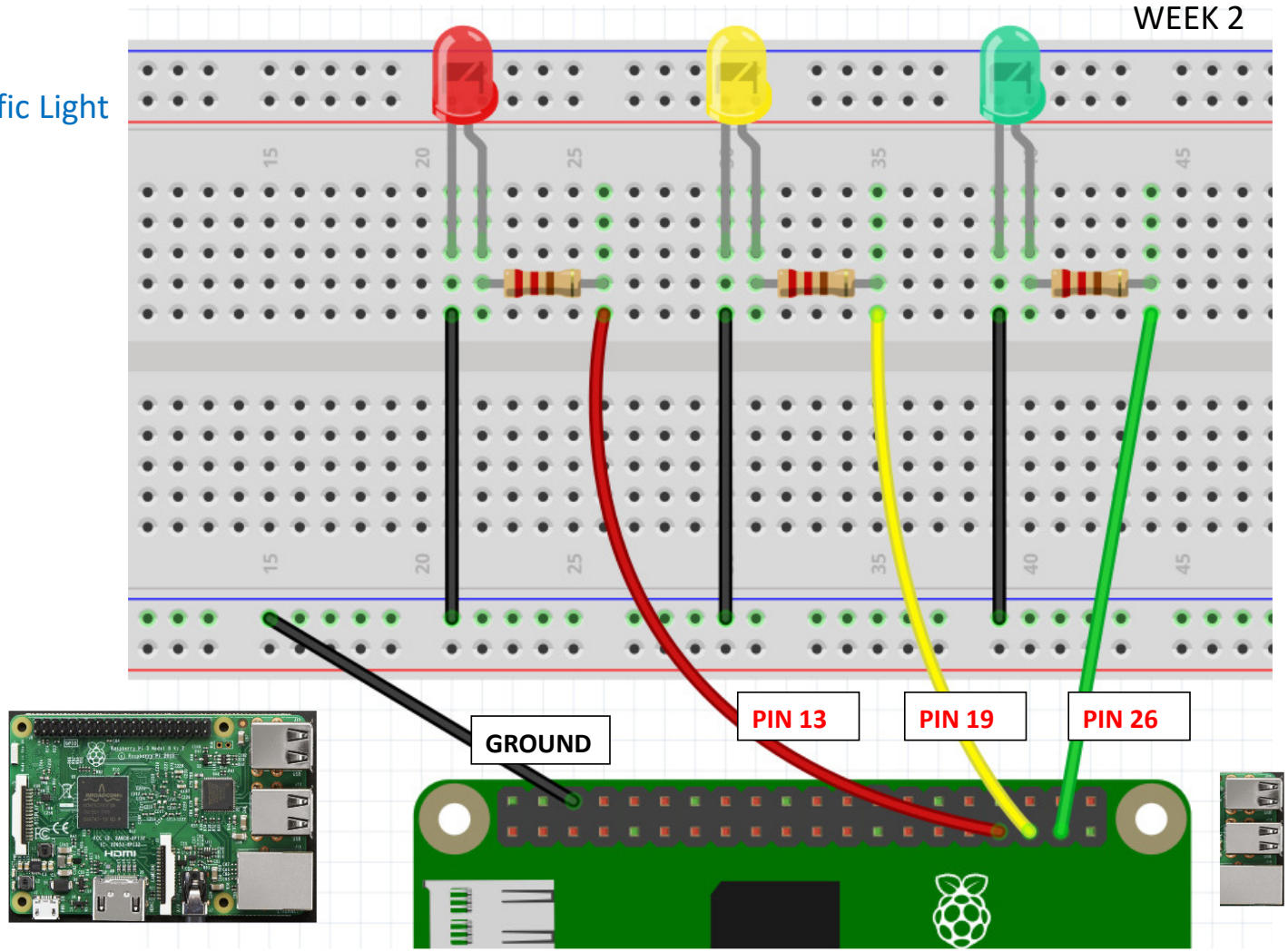


Exercise2a.py

```
1  #Library
2  from gpiozero import LED
3  from time import sleep
4
5  #Setup Components / Variables
6  tf_red_led = LED(13)
7  tf_amber_led=LED(19)
8  tf_green_led = LED(26)
9
10 #Algorithm
11
12 #initialize the LEDs
13 tf_red_led.off()
14 tf_amber_led.off()
15 tf_green_led.off()
16
17
18 tf_green_led.on()
19 sleep(10)
20 tf_green_led.off()
21 tf_amber_led.on()
22 sleep(5)
23 tf_amber_led.off()
24 tf_red_led.on()
25 sleep(10)
26 tf_red_led.off()
27 tf_green_led.on()
28
```

EXERCISE #2

Wiring for a Traffic Light



Ex. 2b Traffic Light in a Loop (Exercise2b.py)

Exercise2b.py

```
#Library
from gpiozero import LED
from time import sleep

#Setup Components / Variables
tf_red_led = LED(13)
tf_amber_led=LED(19)
tf_green_led = LED(26)

#Algorithm

#initialize the LEDs
tf_red_led.off()
tf_amber_led.off()
tf_green_led.off()


while True:
    tf_green_led.on()
    sleep(10)
    tf_green_led.off()
    tf_amber_led.on()
    sleep(5)
    tf_amber_led.off()
    tf_red_led.on()
    sleep(10)
    tf_red_led.off()
```

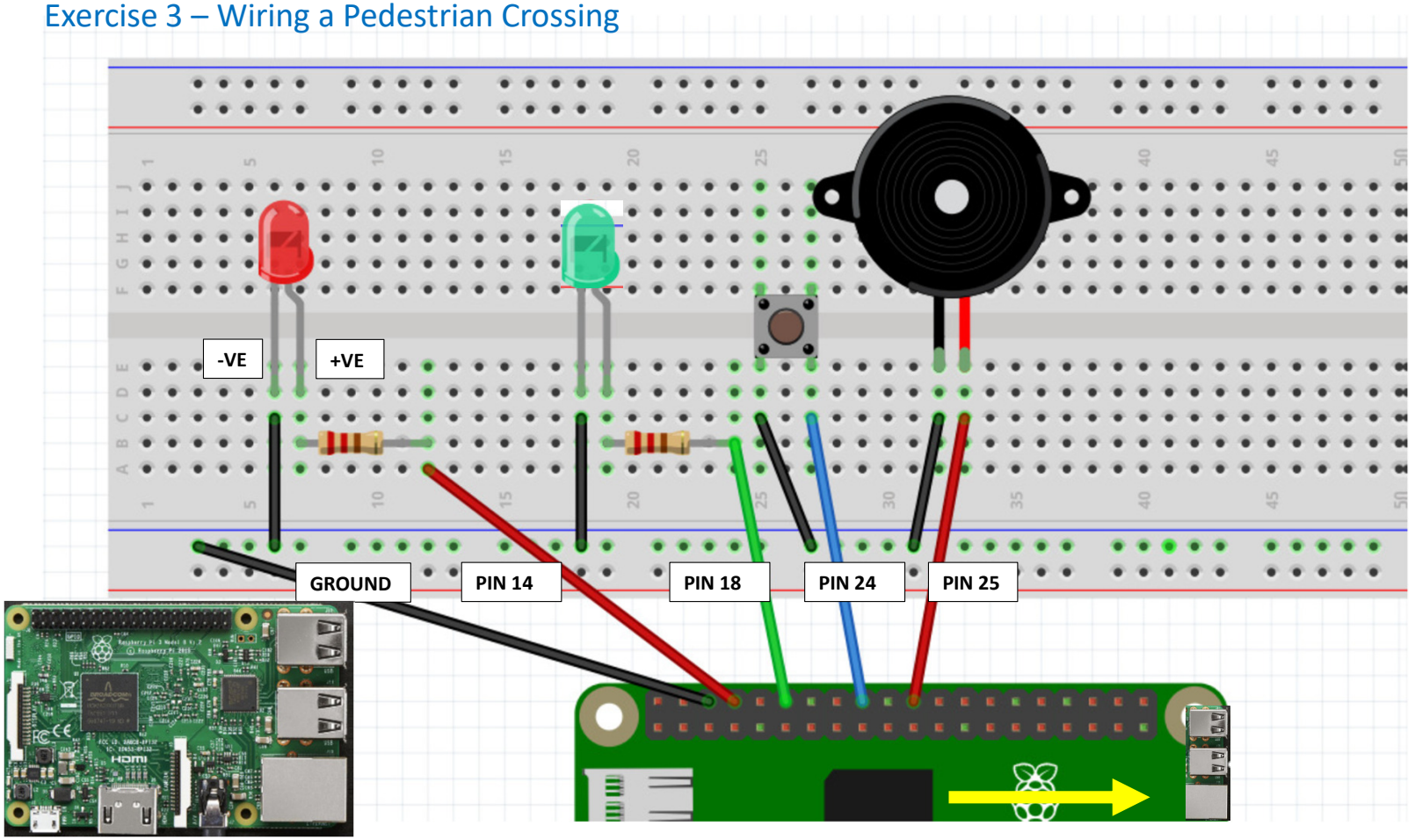
Functionalize

Ex. 2c Traffic Light as a Function (Exercise2c.py)

Exercise2c.py

```
#Library
from gpiozero import LED
from time import sleep

#Setup Components / Variables
tf_red_led = LED(13)
tf_amber_led=LED(19)
tf_green_led = LED(26)
#Algorithm
#initialize the LEDs
tf_red_led.off()
tf_amber_led.off()
tf_green_led.off()

#Function
def trafficLight():
    tf_green_led.on()
    sleep(10)
    tf_green_led.off()
    tf_amber_led.on()
    sleep(5)
    tf_amber_led.off()
    tf_red_led.on()
    sleep(10)
    tf_red_led.off()


while True:
    trafficLight()
```

Exercise 3 – Wiring a Pedestrian Crossing



TESTING OUR CIRCUIT USING THONNY SHELL

Ex 3a. Turning our Buzzer on

```
>>> from gpiozero import Buzzer
>>> buzz= Buzzer(25)
>>> buzz.on()
```

Ex 3b. Turning it off

```
>>> buzz.off()
```

Ex 3c. Make it blink – 1 sec on 1 sec off

```
>>> buzz.blink()
```

Ex 3d. Make it pulsate a number of times

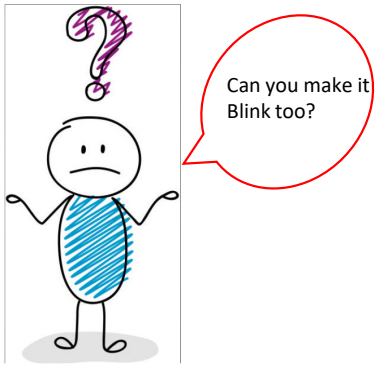
```
>>> buzz.blink(on_time=.5, off_time=.8, n=5)
```

TESTING OUR CIRCUIT USING THONNY SHELL

Ex 3e. Button Activating/Deactivating Buzzer

```
Python 3.9.2 (/usr/bin/python3)
>>> from gpiozero import Buzzer, LED, Button
>>> from signal import pause
>>> buzz = Buzzer(25)
>>> button=Button(24)
>>> button.when_pressed = buzz.on
>>> button.when_released = buzz.off
>>> pause()
```

Ex 3f. Button Activating / Deactivating Red LED (Pin 14)



Ex. 3g Pedestrian Crossing Program – Version 1
Save program as Exercise3g.py

ALGORITHM FOR A PEDESTRIAN CROSSING

STARTS WITH RED
AFTER 10 SECONDS
RED GOES OFF
GREEN COMES ON
AFTER 10 SECONDS
GREEN BLINKS FIVE TIMES
AFTER 5 SECONDS
GREEN GOES OFF
RED COMES ON

Exercise3g.py *

```
1  #Library
2  from gpiozero import  LED
3  from time import sleep
4  #Component Setup
5  green_led = LED(18)
6  red_led=LED(14)
7
8  #Algorithm
9  red_led.on()
10 sleep(10)
11 red_led.off()
12 green_led.on()
13 sleep(10)
14 green_led.blink(on_time=.5,off_time=.5,n=5)
15 sleep(5)
16 green_led.off()
17 red_led.on()
18
```

Ex. 3h Pedestrian Crossing Program – Version 2 – With Buzzer
Save program as Exercise3h.py

ALGORITHM FOR A PEDESTRIAN CROSSING

STARTS WITH RED
AFTER 10 SECONDS
RED GOES OFF
GREEN COMES ON
AFTER 10 SECONDS
GREEN BLINKS FIVE TIMES
BUZZER BLINKS FIVE TIMES
AFTER 5 SECONDS
GREEN GOES OFF
RED COMES ON

Exercise3h.py

```
1  #Library
2  from gpiozero import  LED, Buzzer
3  from time import sleep
4  #Component Setup
5  green_led = LED(18)
6  red_led=LED(14)
7  buzz=Buzzer(25)
8
9  #Algorithm
10 red_led.on()
11 sleep(10)
12 red_led.off()
13 green_led.on()
14 sleep(10)
15 green_led.blink(on_time=.5,off_time=.5,n=5)
16 buzz.blink(on_time=.5, off_time=.5, n=5)
17 sleep(5)
18 green_led.off()
19 red_led.on()
20
21
```

Ex. 3j Pedestrian Crossing Program – Version 3 – Introducing a Function
Save program as Exercise3j.py

ALGORITHM FOR A PEDESTRIAN CROSSING

STARTS WITH RED
AFTER 10 SECONDS
RED GOES OFF
GREEN COMES ON
AFTER 10 SECONDS
GREEN BLINKS FIVE TIMES
BUZZER BLINKS FIVE TIMES
AFTER 5 SECONDS
GREEN GOES OFF
RED COMES ON

Exercise3j.py

```
1  #Library
2  from gpiozero import  LED, Buzzer
3  from time import sleep
4  #Component Setup
5  green_led = LED(18)
6  red_led=LED(14)
7  buzz=Buzzer(25)
8
9  #Function
10 def greenman():
11     red_led.on()
12     sleep(10)
13     red_led.off()
14     green_led.on()
15     sleep(10)
16     green_led.blink(on_time=.5,off_time=.5,n=5)
17     buzz.blink(on_time=.5, off_time=.5, n=5)
18     sleep(5)
19     green_led.off()
20     red_led.on()
21
22 #Algorithm
23 while True:
24     greenman()
```

Ex. 3k Pedestrian Crossing Program – Version 4 – Add a Button
Save program as Exercise3k.py

ALGORITHM FOR A PEDESTRIAN CROSSING

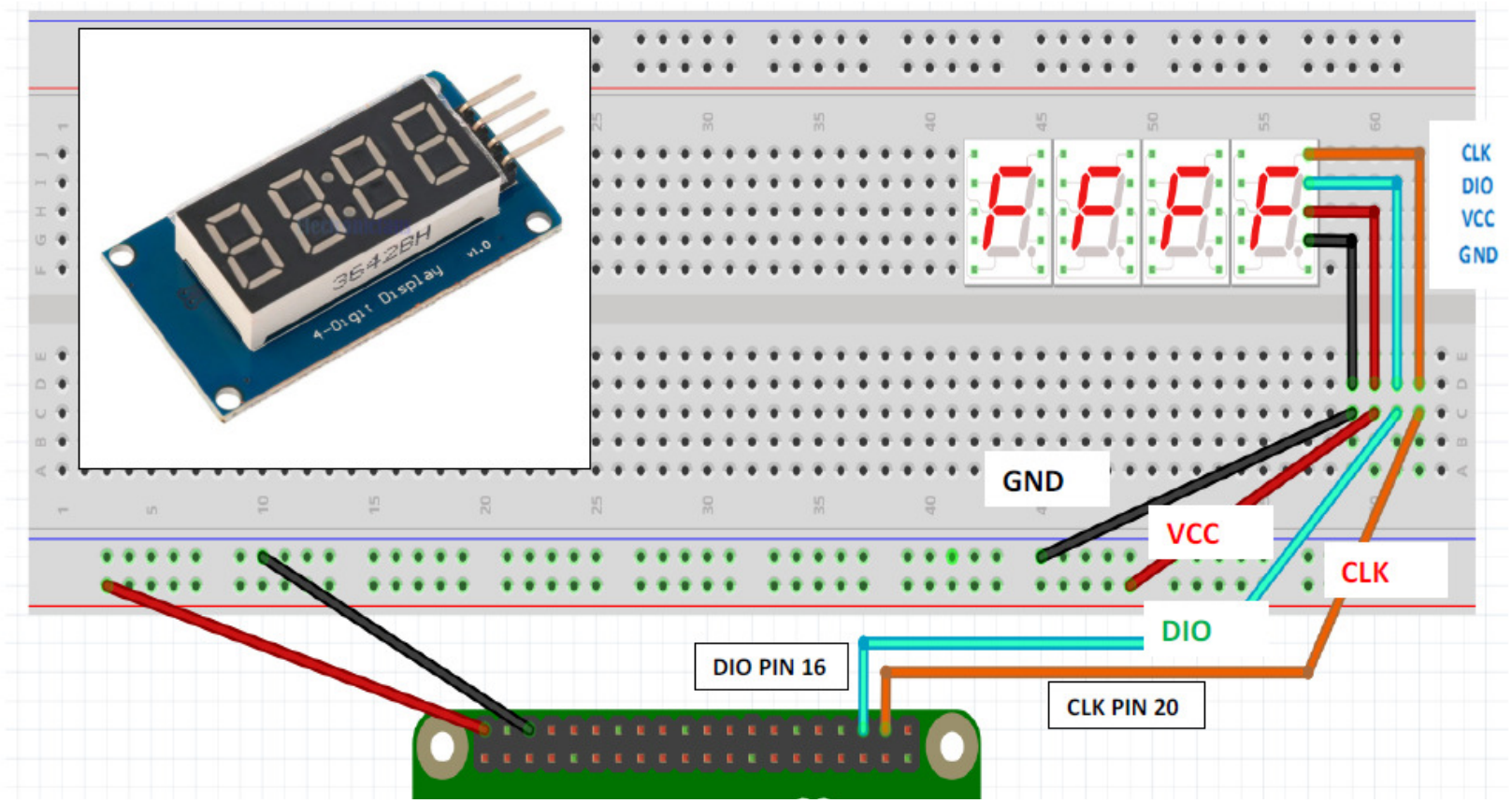
STARTS WITH RED ON
WHEN BUTTON IS PRESSED
ACTIVATE Function greenman()

Exercise3k.py *

```
#Library
from gpiozero import  LED, Buzzer, Button
from time import sleep
from signal import pause
#Component Setup
green_led = LED(18)
red_led=LED(14)
buzz=Buzzer(25)
button=Button(24)

#Function
def greenman():
    print('Button was pressed')
    sleep(10)
    red_led.off()
    green_led.on()
    sleep(10)
    green_led.blink(on_time=.5,off_time=.5,n=5)
    buzz.blink(on_time=.5, off_time=.5, n=5)
    sleep(5)
    green_led.off()
    red_led.on()
    print('waiting for Next Button Press')

#Algorithm
red_led.on()
print('Program Started')
print('waiting for Button to be Pressed')
button.when_pressed = greenman
pause()
```

Exercise 4 – Wiring and Testing Count Down Display

TM1637 7-SEGMENT DISPLAY



TESTING OUR CIRCUIT USING THONNY SHELL

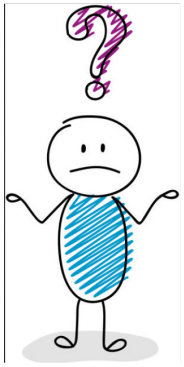
Ex 4a

```
>>> import tm1637
>>> display = tm1637.TM1637(20, 16)
>>> #20=CLK  16=DIO
>>> display.clear()
>>> display.set_values([' ', ' ', ' ', '7'])
```

Ex 4b

```
>>> display.clear()
>>> display.set_values([' ', ' ', '8 ', '7'])
```

Ex 4c



How do you display 1234

Making the 7 Segment Display Library takes the display Data as a List

```
[ '', '', '', '9']
[ '', '', '', '8']
[ '', '', '', '7']
[ '', '', '', '6']
[ '', '', '', '5']
[ '', '', '', '4']
[ '', '', '', '3']
[ '', '', '', '2']
[ '', '', '', '1']
[ '', '', '', '0']
```

counter.py *

```
1  import tm1637
2  from time import sleep
3  display = tm1637.TM1637(20, 16)
4  display.set_values([' ',' ',' ','9'])
5  sleep(1)
6  display.set_values([' ',' ',' ','8'])
7  sleep(1)
8  display.set_values([' ',' ',' ','7'])
9  sleep(1)
10 display.set_values([' ',' ',' ','6'])
11 sleep(1)
12 display.set_values([' ',' ',' ','5'])
13 sleep(1)
14 display.set_values([' ',' ',' ','4'])
15 sleep(1)
16 display.set_values([' ',' ',' ','3'])
17 sleep(1)
18 display.set_values([' ',' ',' ','2'])
19 sleep(1)
20 display.set_values([' ',' ',' ','1'])
21 sleep(1)
22 display.set_values([' ',' ',' ','0'])
23 sleep(1)
24
```

The data to be displayed is sent to the function in the library display.set_values

At 1 seconds intervals in this case

Introduction to the Python For Loop

counter.py *

```
1  import tm1637
2  from time import sleep
3  display = tm1637.TM1637(20, 16)
4  display.set_values([' ',' ',' ','9'])
5  sleep(1)
6  display.set_values([' ',' ',' ','8'])
7  sleep(1)
8  display.set_values([' ',' ',' ','7'])
9  sleep(1)
10 display.set_values([' ',' ',' ','6'])
11 sleep(1)
12 display.set_values([' ',' ',' ','5'])
13 sleep(1)
14 display.set_values([' ',' ',' ',
15 sleep(1)
16 display.set_values([' ',' ',' ','3'])
17 sleep(1)
18 display.set_values([' ',' ',' ','2'])
19 sleep(1)
20 display.set_values([' ',' ',' ','1'])
21 sleep(1)
22 display.set_values([' ',' ',' ','0'])
23 sleep(1)
24
```

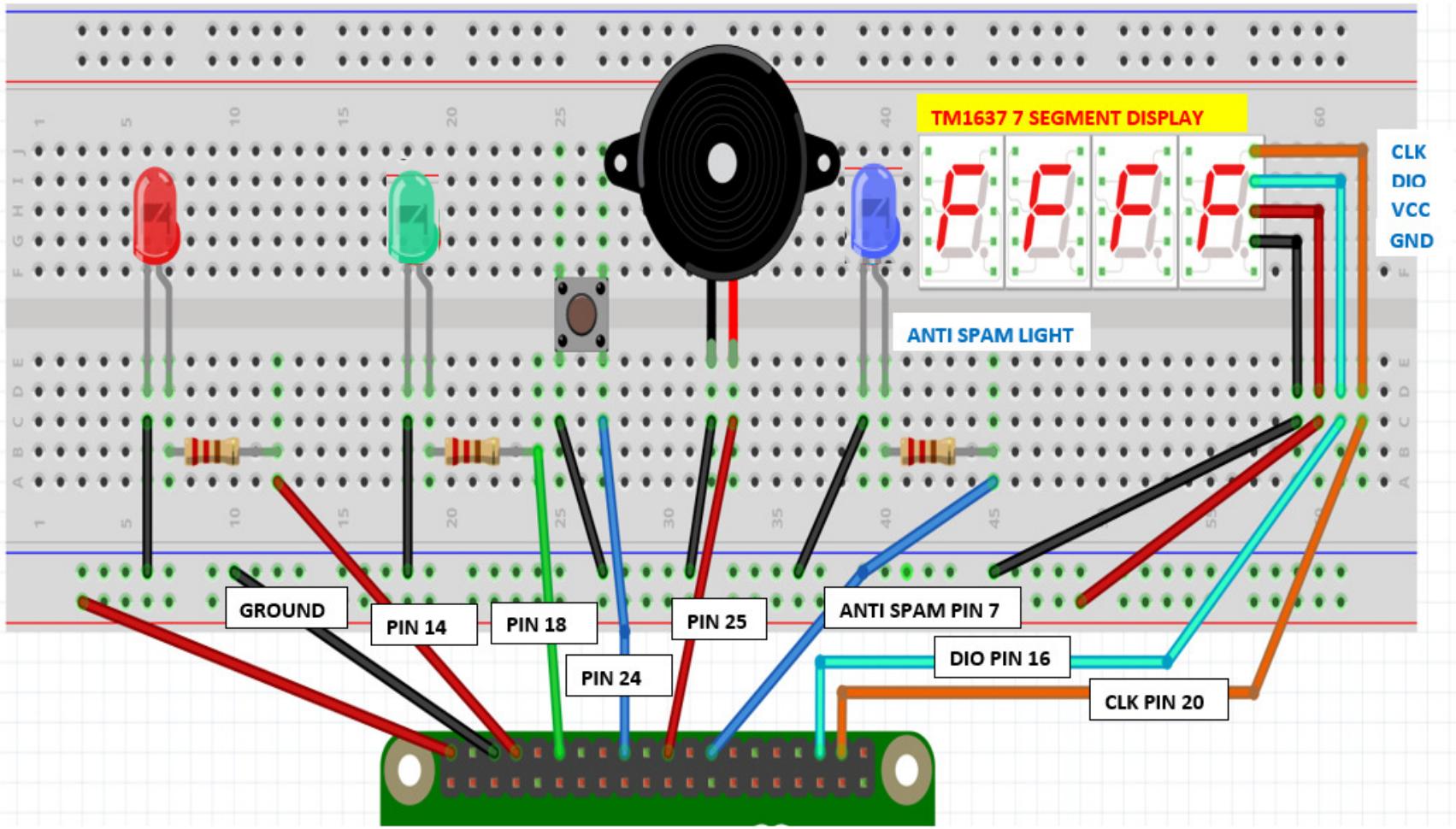
This value is changing from 9 to 0
Create a variable
to represent this value

Give it a name counter and run it in a for loop

counter.py *

```
1  #Library
2  import tm1637
3  from time import sleep
4  #Setup
5  display = tm1637.TM1637(20, 16)
6  #Algorithm
7  for counter in range(9,-1,-1):
8      display.set_values([' ',' ',' ',counter])
9      sleep(1)
10
```

Exercise 5 – Wiring Pedestrian Crossing with Anti Spam LED and Count Down Display



Putting everything we have learned together into a full fledged pedestrian crossing

Recap our Algorithm and Code for earlier version

ALGORITHM FOR A PEDESTRIAN CROSSING

STARTS WITH RED ON

WHEN BUTTON IS PRESSED

ACTIVATE Function greenman()

Exercise3k.py *

```
#Library
from gpiozero import  LED, Buzzer, Button
from time import sleep
from signal import pause
#Component Setup
green_led = LED(18)
red_led=LED(14)
buzz=Buzzer(25)
button=Button(24)

#Function
def greenman():
    print('Button was pressed')
    sleep(10)
    red_led.off()
    green_led.on()
    sleep(10)
    green_led.blink(on_time=.5,off_time=.5,n=5)
    buzz.blink(on_time=.5, off_time=.5, n=5)
    sleep(5)
    green_led.off()
    red_led.on()
    print('waiting for Next Button Press')

#Algorithm
red_led.on()
print('Program Started')
print('waiting for Button to be Pressed')
button.when_pressed = greenman
pause()
```

Now we want to add the Countdown here as well

Injecting codes for countdown display

Exercise3k.py *

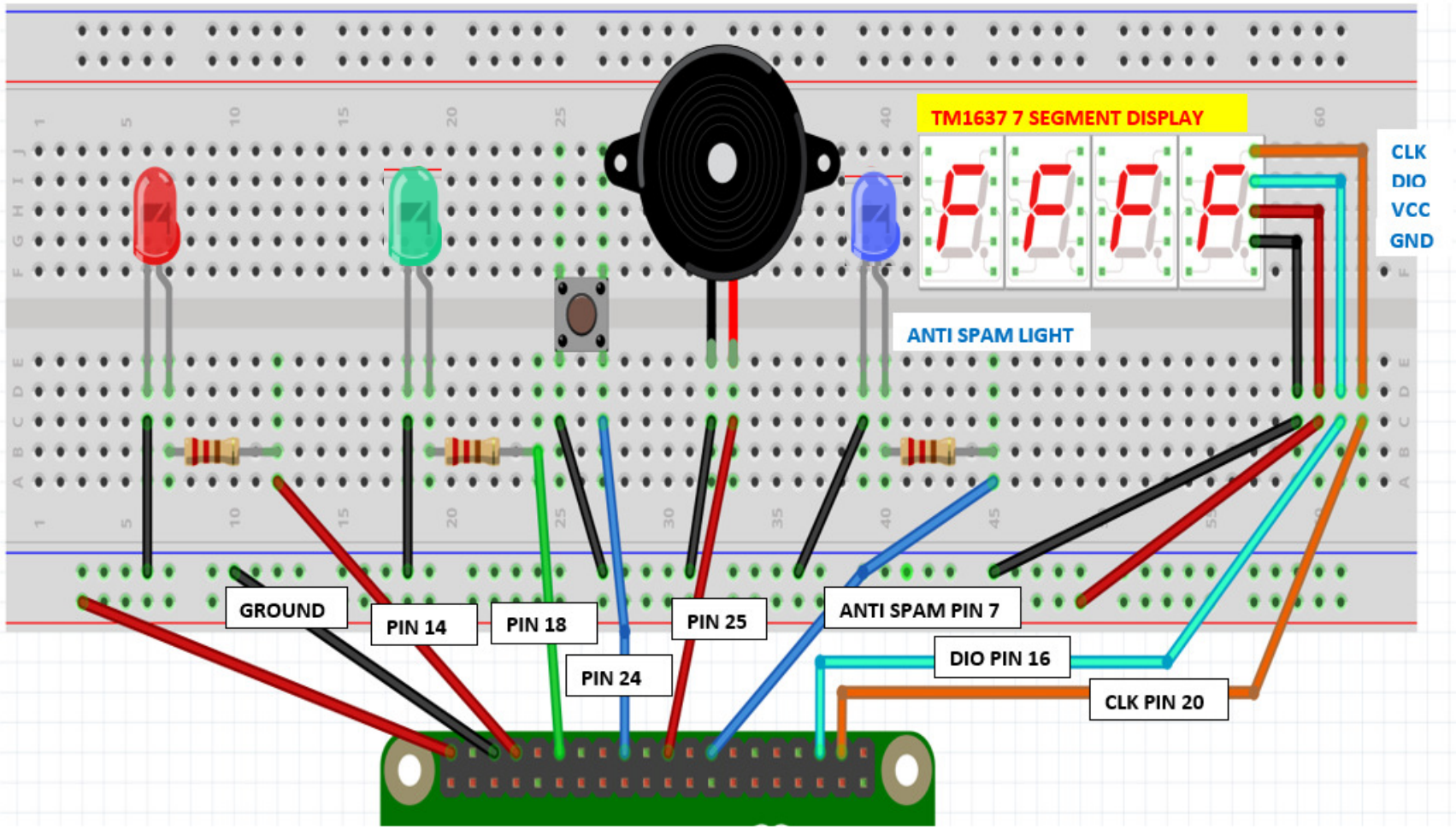
```
#Library
from gpiozero import  LED, Buzzer, Button
from time import sleep
from signal import pause
#Component Setup
green_led = LED(18)
red_led=LED(14)
buzz=Buzzer(25)
button=Button(24)

#Function
def greenman():
    print('Button was pressed')
    sleep(10)
    red_led.off()
    green_led.on()
    sleep(10)
    green_led.blink(on_time=.5,off_time=.5,n=5)
    buzz.blink(on_time=.5, off_time=.5, n=5)
    sleep(5)
    green_led.off()
    red_led.on()
    print('waiting for Next Button Press')

#Algorithm
red_led.on()
print('Program Started')
print('waiting for Button to be Pressed')
button.when_pressed = greenman
pause()
```

Now we want to add the Countdown here as well

Exercise3l.py

```
#Library
from gpiozero import  LED, Buzzer, Button
from time import sleep
from signal import pause
import tm1637
#Component Setup
green_led = LED(18)
red_led=LED(14)
buzz=Buzzer(25)
button=Button(24)
display=tm1637.TM1637(20,16)
#Function
def greenman():
    print('Button was pressed')
    sleep(10)
    red_led.off()
    green_led.on()
    sleep(10)
    for counter in range(5,-1,-1):
        green_led.blink(on_time=.5,off_time=.5,n=1)
        buzz.blink(on_time=.5, off_time=.5, n=1)
        display.set_values([' ',' ',' ',counter])
        sleep(1)
    green_led.off()
    red_led.on()
    display.clear()
    print('waiting for Button to be Pressed')
#Algorithm
red_led.on()
display.clear()
print('waiting for Button to be Pressed')
button.when_pressed = greenman
pause()
```

Exercise 5 – Wiring Pedestrian Crossing with Anti Spam LED and Count Down Display



Adding Check for Anti Spamming

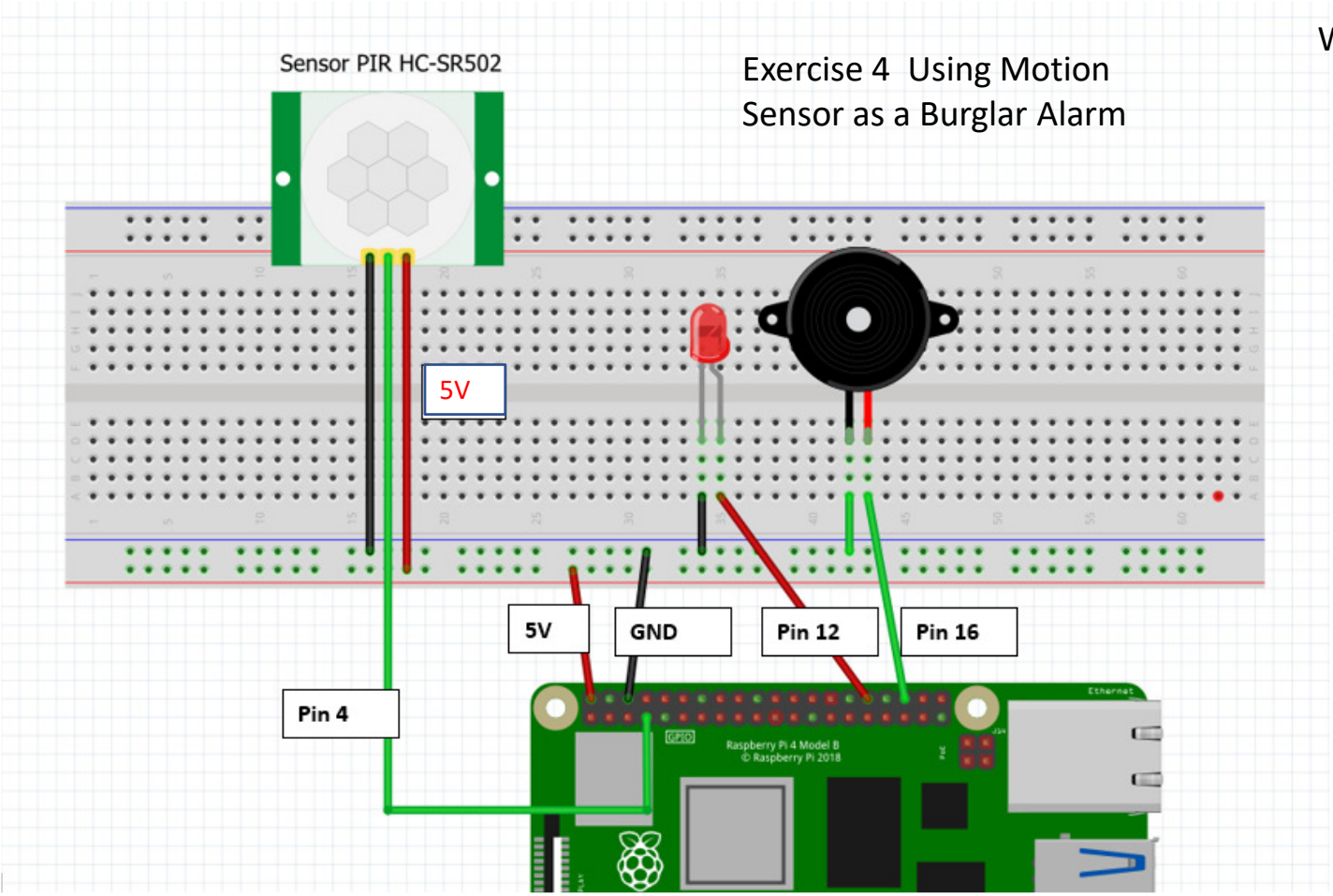
Exercise3m.py

```
#Library
from gpiozero import  LED, Buzzer, Button
from time import sleep
from signal import pause
import tm1637
#Component Setup
green_led = LED(18)
red_led=LED(14)
anti_spam_led = LED(7)
buzz=Buzzer(25)
button=Button(24)
display=tm1637.TM1637(20,16)
#Function
def activate():
    if anti_spam_led.value == 1:
        pass
    else:
        anti_spam_led.on()
        greenman()
```

```
def greenman():
    print('Button was pressed')
    sleep(10)
    red_led.off()
    green_led.on()
    sleep(10)
    for counter in range(5,-1,-1):
        green_led.blink(on_time=.5,off_time=.5,n=1)
        buzz.blink(on_time=.5, off_time=.5, n=1)
        display.set_values([' ',' ',' ',counter])
        sleep(1)
    green_led.off()
    red_led.on()
    anti_spam_led.off()
    display.clear()
```

```
#Algorithm
red_led.on()
anti_spam_led.off()
display.clear()
print('waiting for Button to be Pressed')
button.when_pressed=activate
pause()
```

Exercise 4 Using Motion Sensor as a Burglar Alarm



Ex 4a. Motion Sensor – LED Test

Save this as Exercise4a.py

```
#Libraries
from gpiozero import MotionSensor, LED, Buzzer
from signal import pause
from time import sleep

#Setup Variables for Components
motion_detector = MotionSensor(4)
red_led = LED(12)
buzz = Buzzer(16)
buzz.off()

#Algorithm
motion_detector.when_motion= red_led.on
motion_detector.when_no_motion = red_led.off
pause()
```

Ex 4b. Motion Sensor – Buzzer Test

Save this as Exercise4b.py

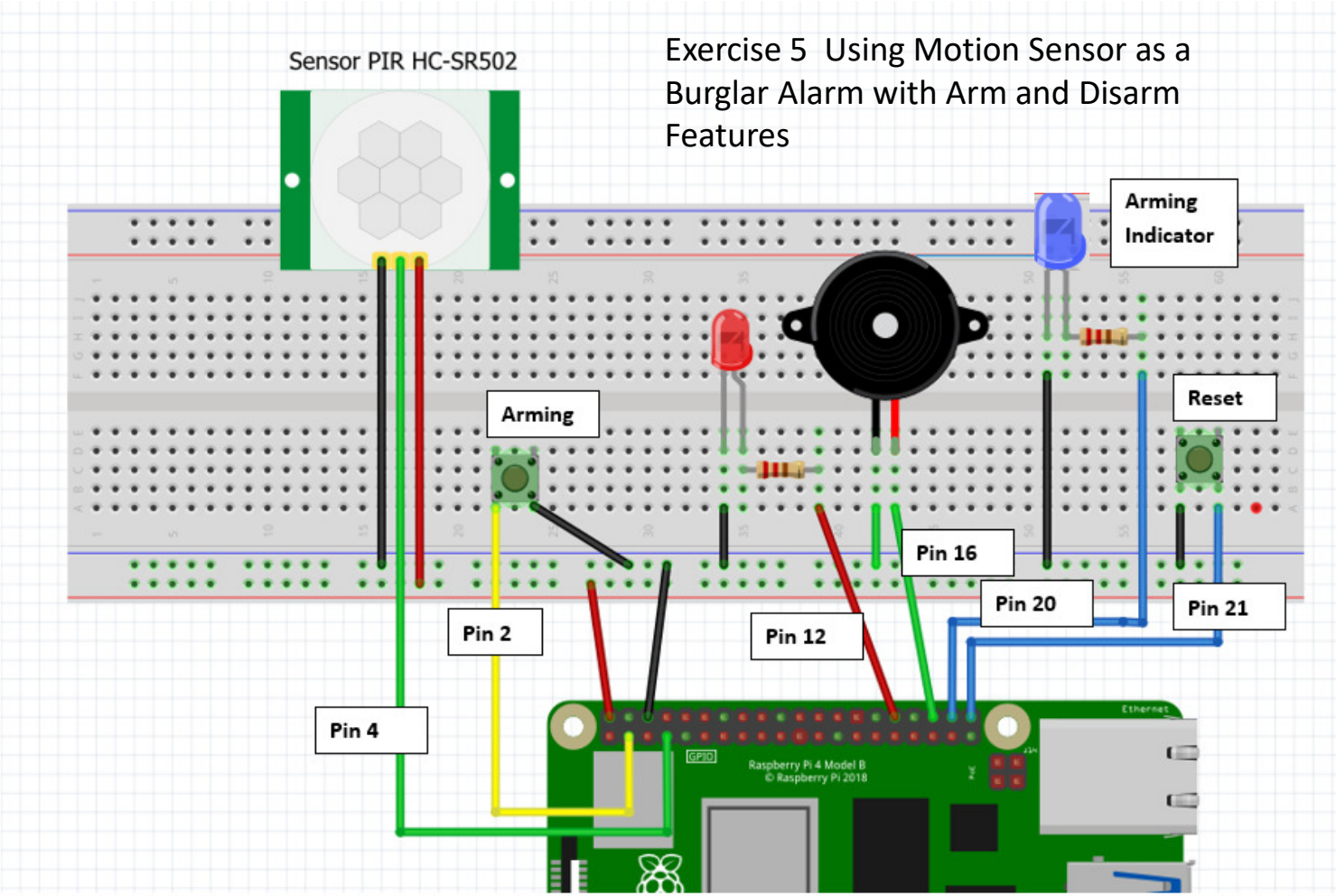
```
#Libraries
from gpiozero import MotionSensor, LED, Buzzer
from signal import pause
from time import sleep


#Setup Variables for Componenst
motion_detector = MotionSensor(4)
red_led = LED(12)
buzz = Buzzer(16)

#Algorithm
buzz.off()
motion_detector.when_motion= buzz.on
motion_detector.when_no_motion = buzz.off
pause()
```

Ex4c Motion Sensor – FLASHING LED AND BUZZER

Save program as Exercise4c.py

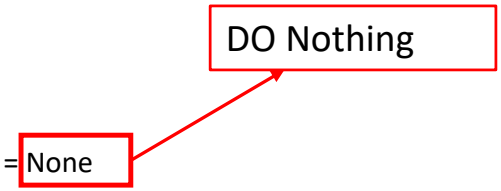
```
#Libraries
from gpiozero import MotionSensor, LED, Buzzer
from signal import pause
from time import sleep

#Setup Components / Variables
motion_detector = MotionSensor(4)
red_led = LED(12)
buzz = Buzzer(16)
buzz.off()

#Functions
def alarm():
   buzz.blink(on_time=.5,off_time=.5,n=5)
   red_led.blink(on_time=.5,off_time=.5,n=5)
   sleep(5)
def alarmOff():
   buzz.off()
   red_led.off()

#Algorithm
motion_detector.when_motion= alarm
motion_detector.when_no_motion = alarmOff
while True:
  pause()
```

Exercise 5 Using Motion Sensor as a Burglar Alarm with Arm and Disarm Features

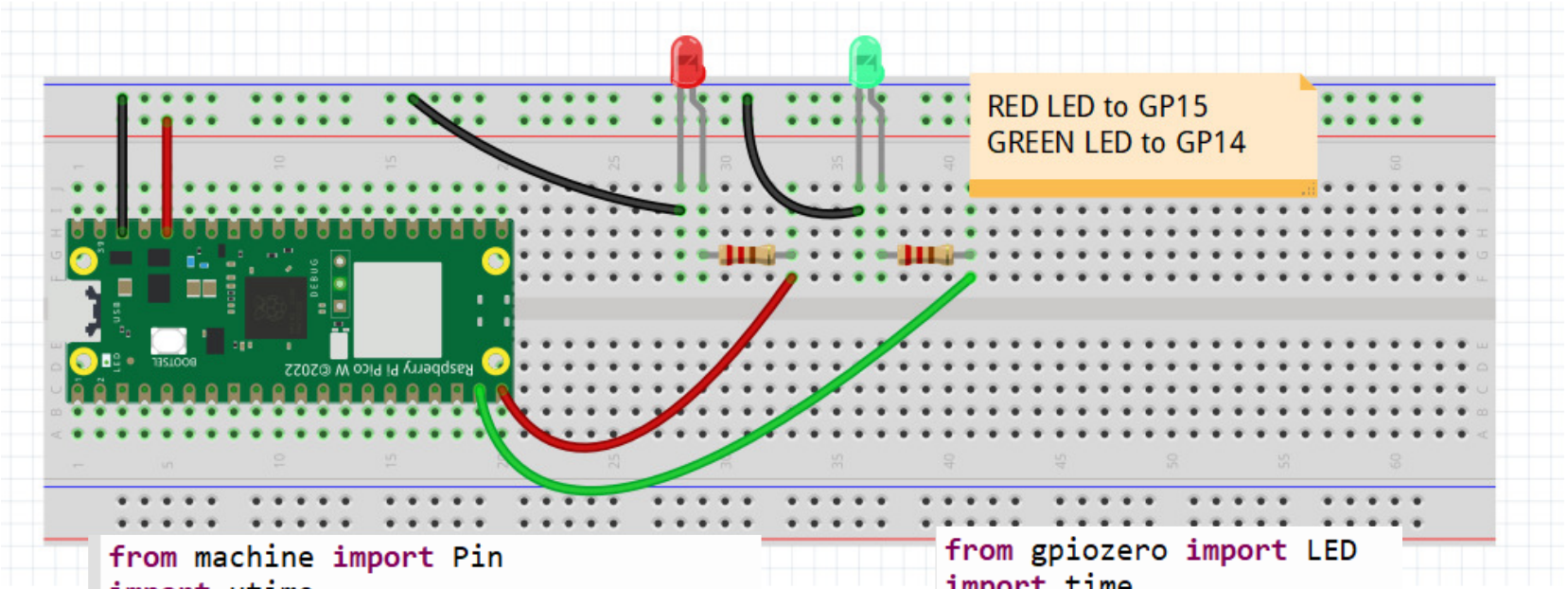


Ex 5. BURGLAR ALARM WITH ARM AND RESET BUTTONS

```
#save this program as Exercise5.py

#Library
from gpiozero import MotionSensor, LED, Buzzer, Button
from signal import pause
from time import sleep

#Variables for Components
password='12345'
motion_detector = MotionSensor(4)
red_led = LED(12)
armed_led=LED(20)
armed_led.off()
arm_button=Button(2)
reset_button=Button(21)
buzz = Buzzer(16)
buzz.off()

#Functions
def alarm():
   red_led.blink(on_time=.5,off_time=.5,n=20)
   buzz.blink(on_time=.5,off_time=.5,n=20)
   sleep(20)

def armAlarm():
   armed_led.on()
   motion_detector.when_motion = alarm

def disarmAlarm():
   pwd=input('Enter Password')
   if pwd != password:
      pass
   else:
      armed_led.off()
      buzz.off()
     red_led.off()
     motion_detector.when_motion = None

#Algorithm
arm_button.when_pressed = armAlarm
reset_button.when_pressed = disarmAlarm

while True:
    pause()
```



INTRODUCTION TO PI PICO

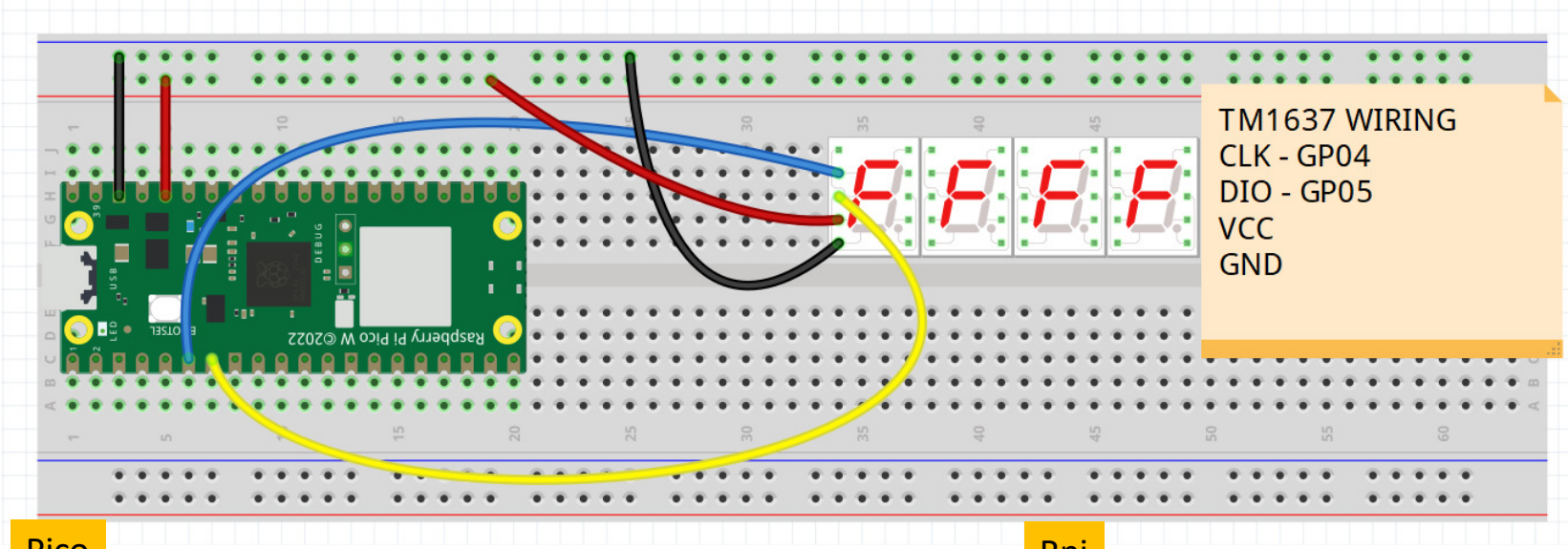


Pico

```
from machine import Pin
import utime
red_led=Pin(15,Pin.OUT)
green_led=Pin(14,Pin.OUT)
#blinking the red and green LEDs 10x
for x in range(1,11,1):
    red_led.on()
    green_led.off()
    utime.sleep(.2)
    red_led.off()
    green_led.on()
    utime.sleep(.2)
```

Rpi

```
from gpiozero import LED
import time
red_led=LED(15)
green_led=LED(14)
for x in range(1,11,1):
    red_led.on()
    green_led.off ()
    time.sleep(.2)
    red_led.off ()
    green_led.on()
    time.sleep(.2)
```



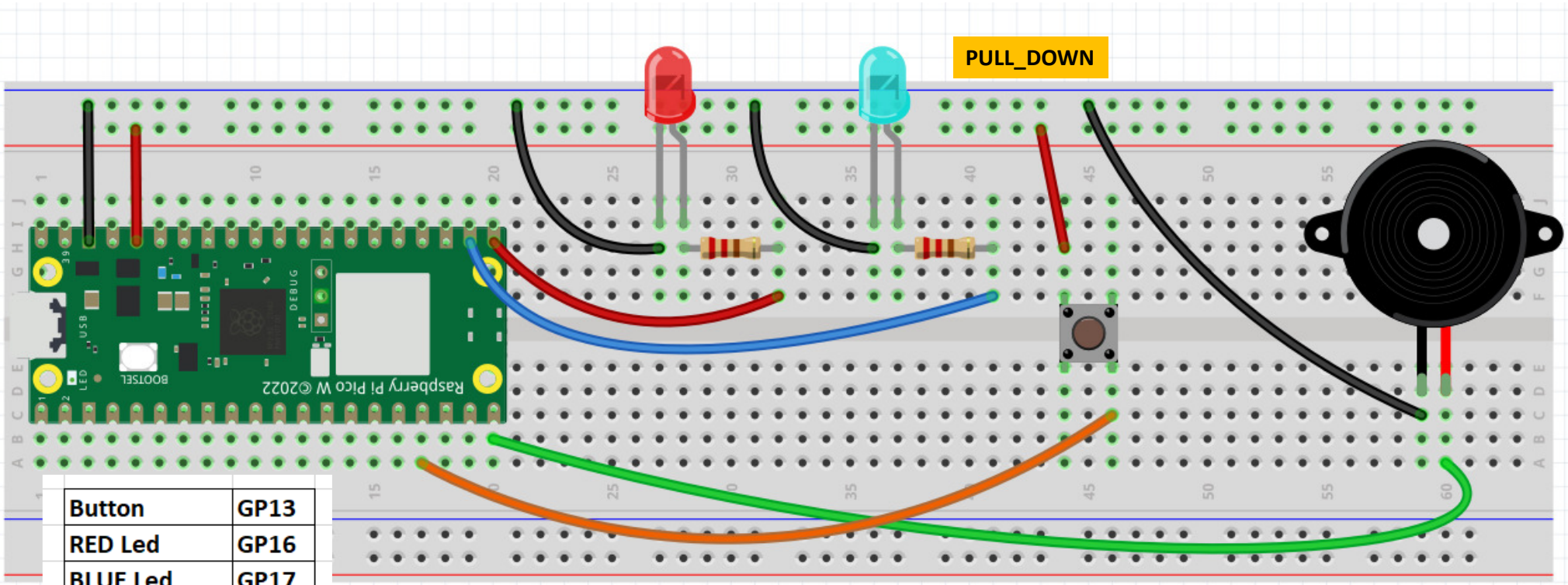
Pico

```
>>> import tm1637
>>> tm = tm1637.TM1637(clk=machine.Pin(4), dio=machine.Pin(5))

>>> tm.show('    ')
>>> tm.show('HELP')
>>> tm.number(1)
>>> tm.number(12)
>>> tm.number(123)
>>> tm.number(1234)
```

Rpi

```
>>> import tm1637
>>> display = tm1637.TM1637(4,5)

>>> display.clear()
>>> display.set_values(['H','E','L','P'])
>>> display.set_values([' ', ' ', ' ','1'])
>>> display.set_values([' ', ' ','1','2'])
>>> display.set_values([' ','1','2','3'])
>>> display.set_values([' 1','2','3','4'])
```

Patrol Car Flashing Lights



Button	GP13
RED Led	GP16
BLUE Led	GP17
Buzzer	GP15

ChatGPT Demo

micropython pico w a program with button on Pin 13, red led on Pin 16, blue led on Pin 17 and a buzzer on Pin 15. When button is pressed, flash red and blue led and buzz. use from machine import Pin