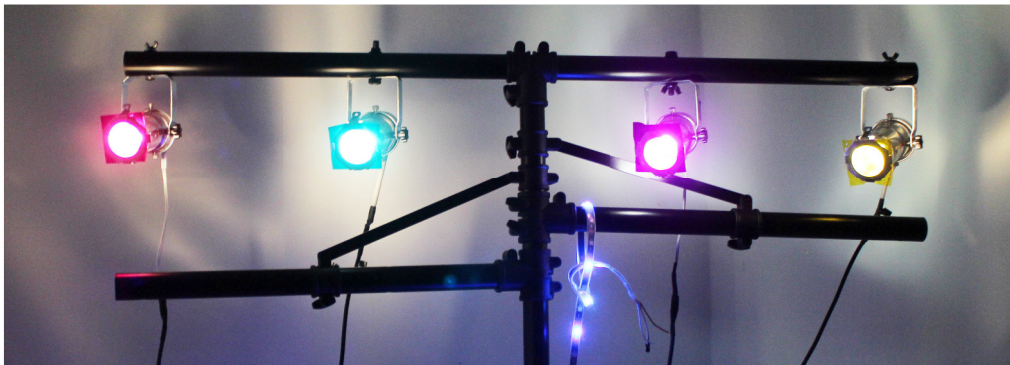


Raspberry Pi Birthday Disco Lights and NeoPixels

Stewart Watkiss



Welcome – Show how to create disco lighting and control multi-coloured NeoPixels using a Raspberry Pi.

When you start learning about physical computing start by turning on an LED – this is taking it to the next step.

Quick introduction with lots to cover, but don't expect to stay sat on your seats – we are going to need some audience participation.

Disco Lights - NeoPixels

- PAR 16 Lights
- MOSFET Switch
- GPIO Zero
- PCB



- NeoPixels
- Python Module
- Pygame Zero



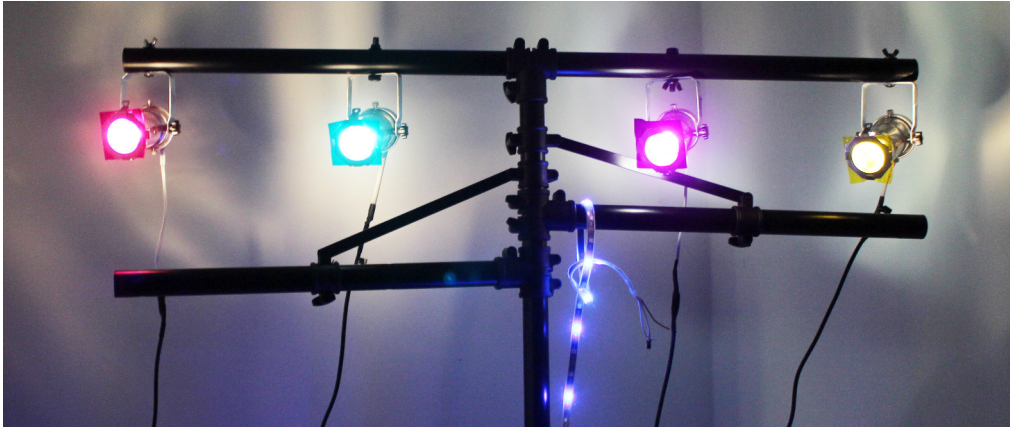
Quick run through of the different aspects we will look at.

Look at the lights, Controlling using GPIO Zero, MOSFET to switch large loads and look at a PCB I designed.

For NeoPixels we will look at the Python module needed to control them as well as the hardware.

If we get time then look at Pygame zero which allows you to create a simple Graphical User Interface to either of these.

Disco / Theatre Lights





PAR 16 Theatre Lights

- Only suitable for 12V MR16 bulbs
- LED low power bulbs
- 12V DC power supply
- 12V to 5V Converter to power the Pi

PAR16

Also available as 230V – but not recommended and won't work with this circuit.

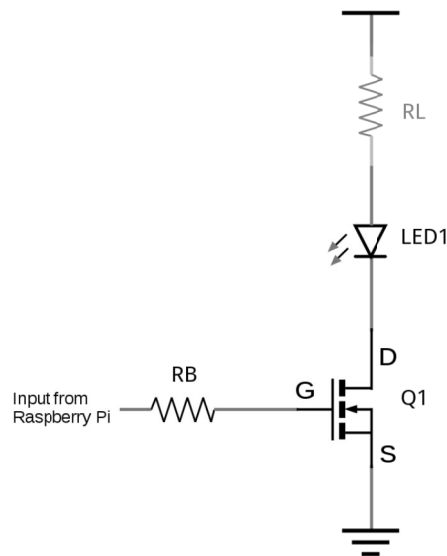
Need to be LED due to the power requirements for the power supply and other components need to be upgraded.

Although normally designed for 12V AC most LED bulbs appear to be OK for DC as well.

12V power supply used for the LEDs, if you would like to use that to power the Pi as well then easiest to use a cheap converter.



MOSFET Switch



Simple MOSFET Circuit.

Is anyone familiar with a MOSFET?

What about a standard transistor?

Like a transistor, but based on switching voltages rather than amplifying current.

In this case consider it as though it's a push switch, but instead of using a finger – use a signal from the Raspberry Pi GPIO – 3.3V = On, 0V = off.

This would be the same with any kind of load – note that R_L is not required for 12V LEDs (effectively built-in), but is often important for other LEDs.

R_B is due to the initial current into the MOSFET



GPIO Zero

```
from gpiozero import LED
import time

LED_PIN = 22

led = LED(LED_PIN)

while True:
    led.on()
    time.sleep(1)
    led.off()
    time.sleep(1)
```

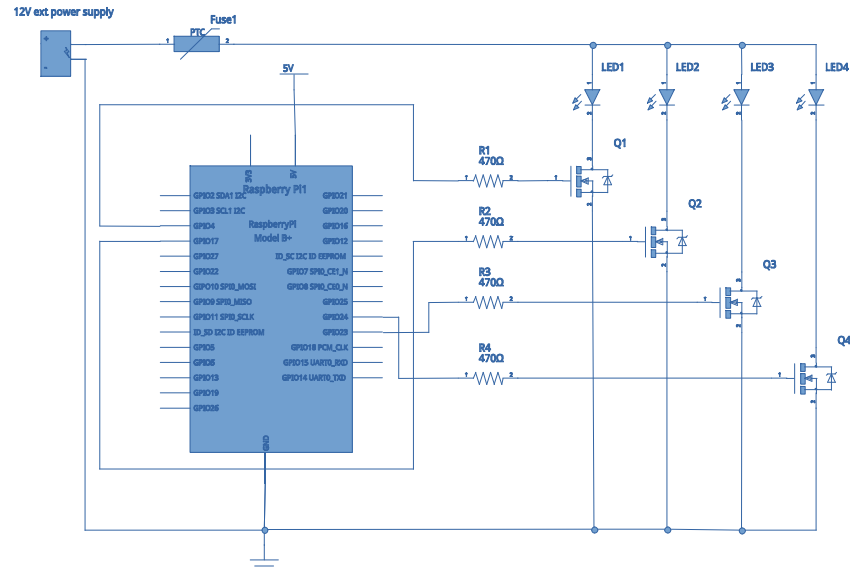
This will turn one LED on and off in Python.

Very simple.

To control more then we just create functions that make a call to each of the LEDs in turn.



PCB Design



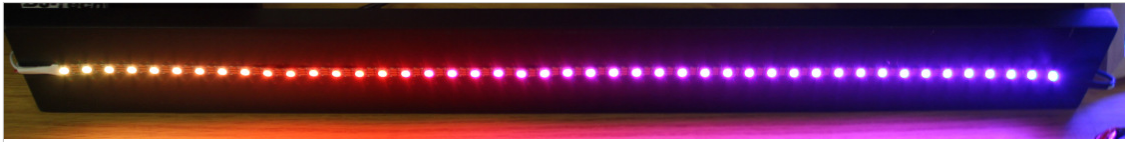
Here is the complete circuit diagram.

We have 4 lots of the circuit previously mentioned, but also add a fuse to protect the power supply if someone connects a halogen bulb etc.

Show PCB made using Fritzing.

NeoPixels / RGB LEDs





NeoPixels / RGB LEDs

- WS2811 / WS2812
- Available in strips, matrix or shapes
- Individually addressable
- Uses PWM for timing
- Needs voltage step-up for signal

Now look at NeoPixels – also known as addressable RGB LEDs or by the part code WS2811 / WS2812

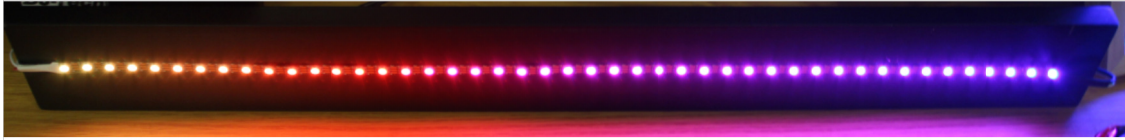
The LEDs include a built-in controller.

Create a list of LED codes using the individual colour from each LED.

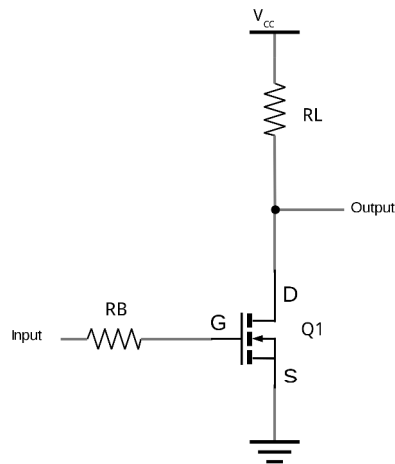
Needs volunteers

Create a stack of colour card and pass along the line – taking own colour off first.

Don't know how many other LEDs so create pause between series of LEDs. If processor was busy drawing a different Window – controlling Minecraft etc. then it would see the next request as being a new one.



Voltage level shift

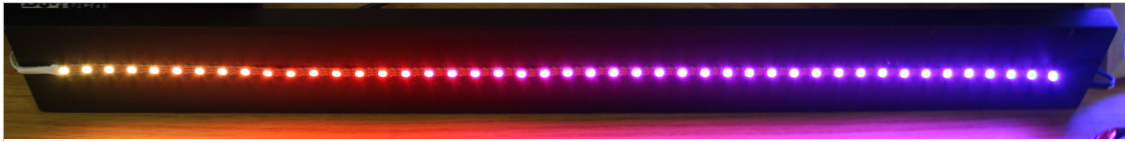


Here's how we increase from 3.3V from the GPIO to 5V for the NeoPixels.

Note that this is inverting so needs appropriate setting in software to invert the signal – could just use an IC which is non-inverting such 74HCT125

When 0V from Raspberry Pi then MOSFET is off and so the output is just connected through RL so output is 5V

When 3.3V from Raspberry Pi then MOSFET is on and so pulls down to 0V



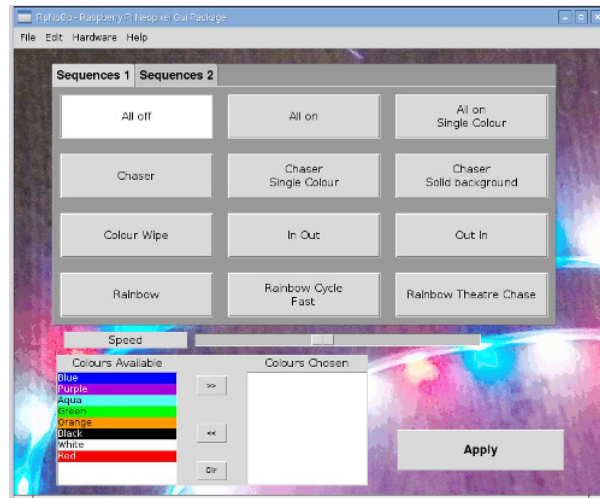
Python Module

- Originally created by Adafruit
- Updated by Jeremy Garff and community
- Works with all models of Raspberry Pi including Raspberry Pi 3
- https://github.com/jgarff/rpi_ws281x

No criticism of Adafruit – shows how Open Source software is so good. If this was proprietary then we would have to wait for the supplier to update – if ever.

Updated for Raspberry Pi 3, within 2 days of the Pi 3 being made available.

Making a graphical application



Who has written a graphical application – in Python or any other language?

What was it like?

Typically – lots and lots of code.
Difficult to understand
Hard to achieve what you want.

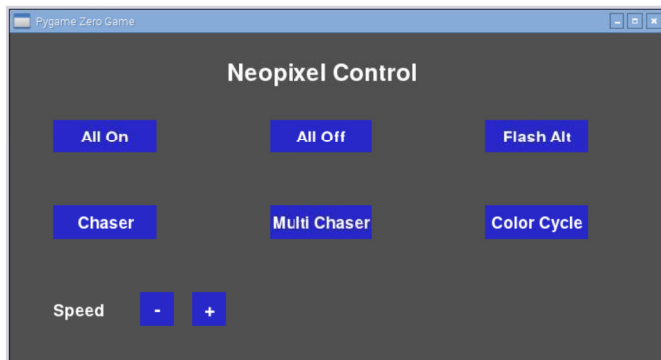
Particularly for those new to programming.

The above example is written in Python tkinter and available at:

<https://github.com/penguintutor/neopixel-gui>

Look at something different...

Pygame Zero



Don't have time to discuss in detail, but Pygame Zero makes creating a GUI much easier than some other Graphical libraries.

Recommend taking a look at:

<https://pygame-zero.readthedocs.org>

By pure co-incidence the previous session in this theatre was on Pygame Zero

Pygame Zero

```
#!/usr/bin/pgzrun

WIDTH = 760
HEIGHT = 380

def draw():
    screen.fill((80,80,80))
    // Code to draw buttons

def on_mouse_down(button, pos):
    // Code to change selected sequence

def update():
    // Code to update Disco Lights / NeoPixels
```

Only quick explanation.

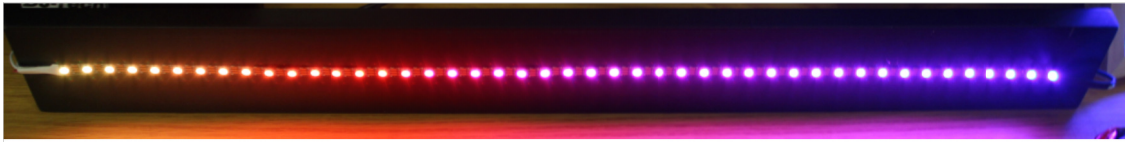
Instead of calling python directly runs pgzrun

The WIDTH and HEIGHT is all you need to create a window

draw() is used to define the screen – setup the buttons (which are rectangles)

on_mouse_down() uses .collidepoint() to see if button has been clicked.

update() is run regularly (60 times per second)
use to call updates to the pixels (or disco lights)



More information



- www.penguintutor.com/piparty
- Slice of Pi Club 22 March 2016
- @stewartwatkiss / @penguintutor
- Coming soon:
 - Learn Electronics with Raspberry Pi, Apress



Hope that was useful.

These notes and other links will be available at
www.penguintutor.com/piparty - check back in a
few days after this (4 March 2016)

If in Midlands

Slice of Pi Club – in Redditch will be giving a practical
session using NeoPixels – joint event with Code
Club.

Twitter personal account / website account

Book available this summer

<https://www.apress.com/index.php/author/author/view/id/17605>