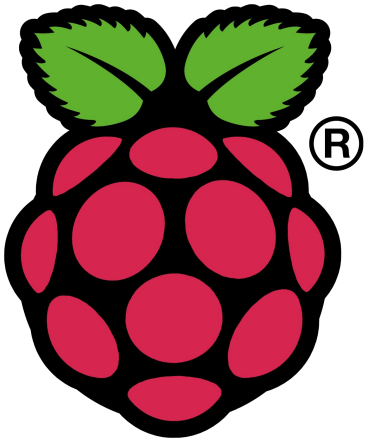
PubNub®



Internet of Things 101: Building IoT Prototype with Raspberry Pi

Feb 9 and 11, 2016 at Forward 4 Conf

PubNub

Tomomi
(@girlie_mac)

Bhavana
(@bhavanaIII0)

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#ForwardJS

While you are waiting...

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Connect Wi-Fi

Wi-Fi Network: NewCircle Student

Password: opensource99

* This requires you to sign in from a captive portal

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https://github.com/pubnub/workshop-raspberrypi

You should have:

- Raspberry Pi 2
- Micro SD card (preloaded w/ Raspbian)
- Mini Wi-Fi adapter
- Micro USB power supply
- HDMI Cable
- Wires
- Breadboard
- LED
- Resistors
- PIR sensor
- DHT22 sensor

What You Will Learn Today

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1. How to start up Raspberry Pi & start Raspbian OS
2. How to connect the Pi remotely from your laptop
3. How to send & receive data with PubNub using Python
4. How to wire a LED & resistor to Pi using breadboard
5. How to program Pi to blink the LED
6. The First IoT : Remote-controlled LED from web interface
7. Projects: Using sensors (Work on your own)

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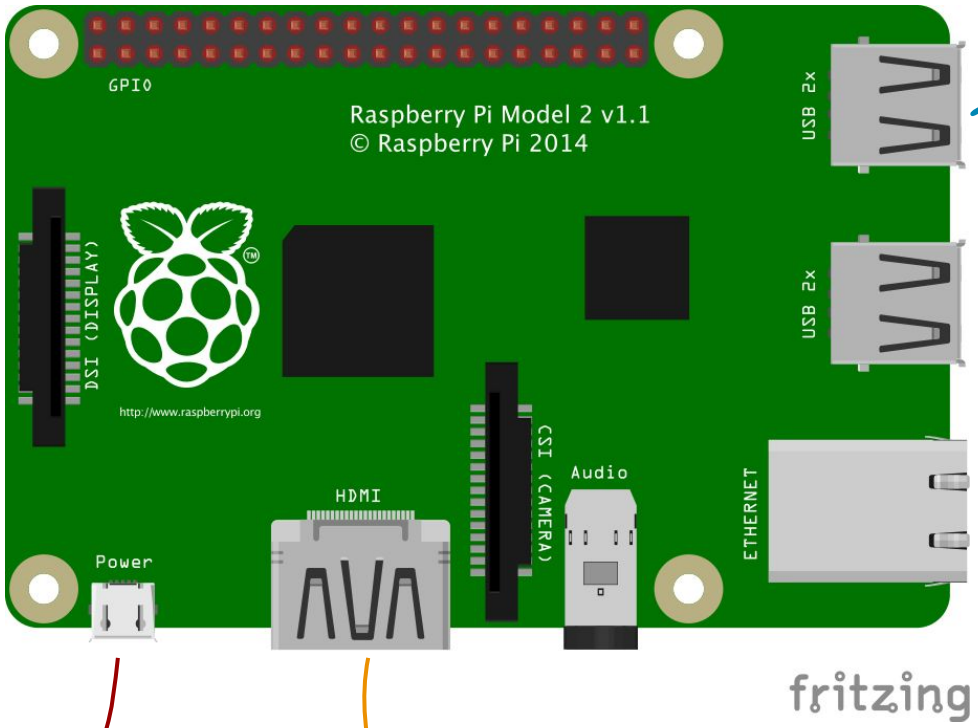
1. Powering the Raspberry Pi

Setting up Your Pi

PubNub

1. SD CARD



2. WI-FI ADAPTER

3. TO KEYBOARD

4. TO MOUSE

5. TO MONITOR

6. USB TO POWER SOURCE

Starting Raspbian

Username: pi

Password: raspberry


```
pi@raspberrypi ~$ startx
```

(Don’t worry about the error dialog. Just dismiss it!)

Wi-Fi Configuration

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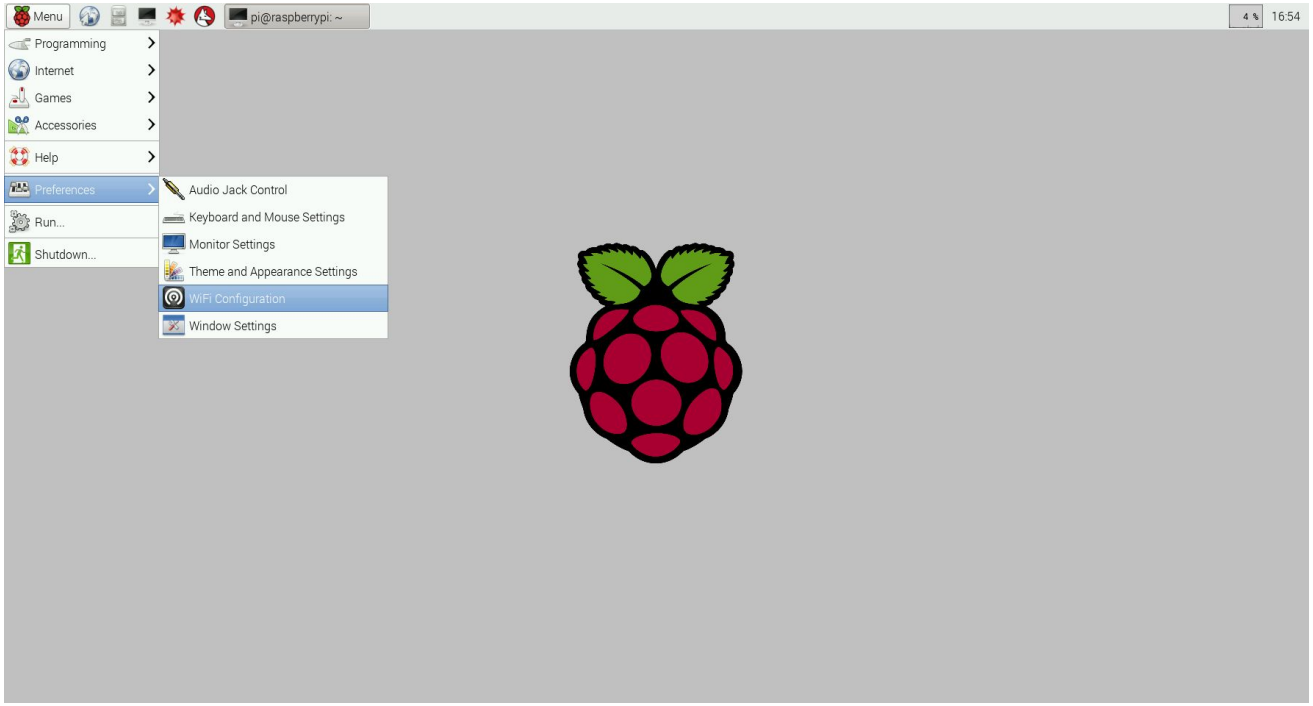
Menu > Preference > WiFi Configuration



Wi-Fi Network: NewCircle Student Password (PSK): opensource99

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2. Remote Connect the Pi

https://github.com/pubnub/workshop-raspberrypi/blob/master/remote-vnc.md

Remote Connect Pi

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Getting your Pi's IP address

```
pi@raspberrypi ~$ hostname -I
```

You'll need the IP address when you connect the Pi from your computer!!!

Remote Connect Pi

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You can choose from the followings:

- SSH to your Pi from terminal, and keep working on the terminal
- SSH with a client, e.g. Cyberduck, and use your usual IDE
- Use VNC (Virtual Network Computing), and work on the virtual GUI

SSH into your Rasp Pi

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SSH to Pi from your laptop

(Terminal on Mac/Linux, PuTTY on Windows):

Your Pi's username

```
me@MyMac ~$ ssh pi@10.96.70.1
```

Use your Pi's IP!

If SSH-ing fails, try:
$ sudo raspi-config
on your Pi

Remote Access w/ VNC

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Remote-access to Raspberry Pi's graphical interface.

1 . On your laptop:

- Install VNC Viewer (Client)

http://www.realvnc.com/download/viewer/

2. On your Pi (Either by SSH, or directly):

- Install VNC server

Remote Access w/ VNC

PubNub®

Install **Tight VNC Server**

```
pi@raspberrypi
  ~$ sudo apt-get install tightvncserver
```

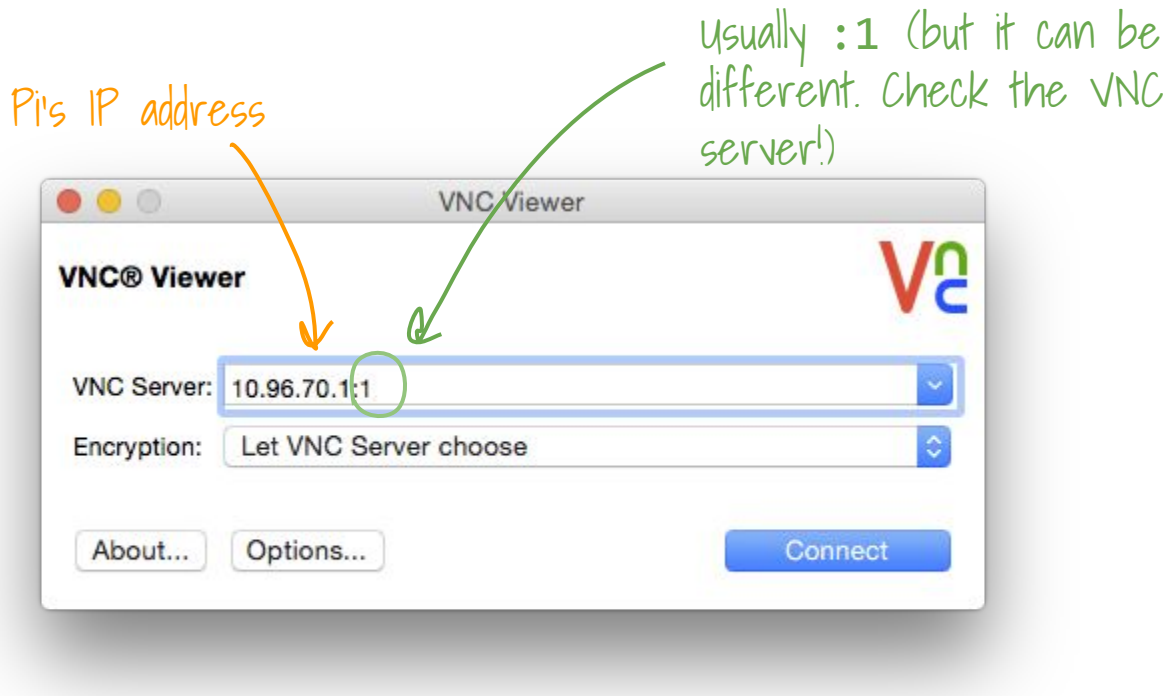
Run the server

```
pi@raspberrypi ~$ tightvncserver
```

Remote Access w/ VNC

PubNub

Run the client



SSH w/ Cyberduck

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- No virtual GUI, but faster than using VNC
- You can use your fave IDE to edit files
- Mac users can keep using Mac keyboard shortcuts

Download the client at: https://cyberduck.io/

SSH w/ Cyberduck

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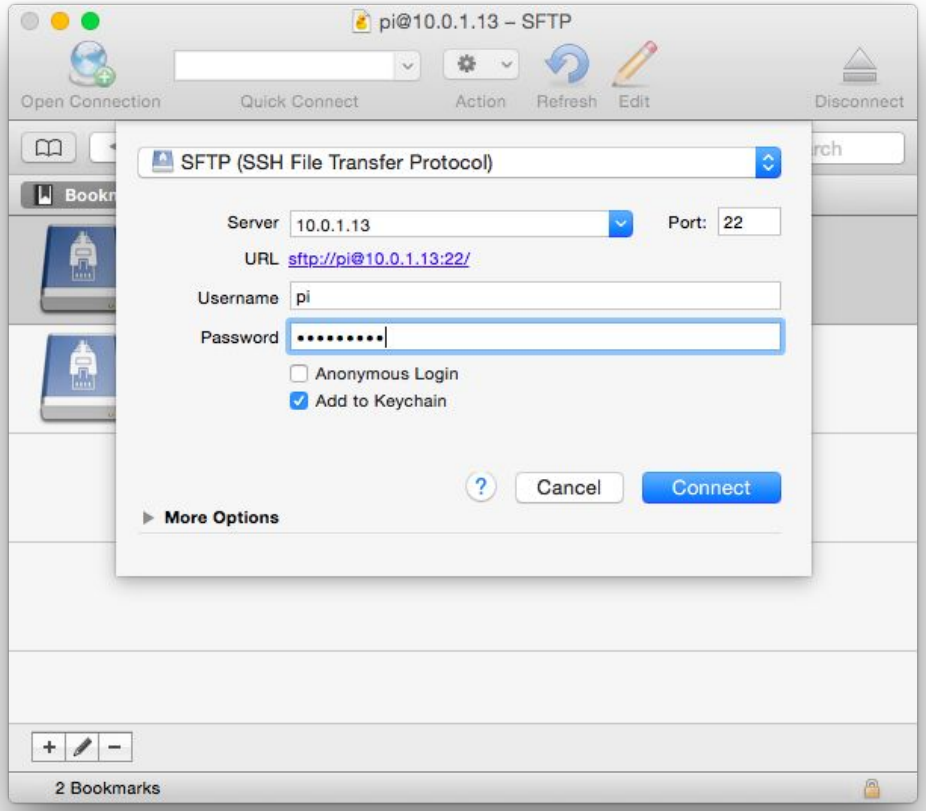

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3. Get Started w/ PubNub Python SDK

Update System First

Update the System's package list

```
~$ sudo apt-get update
```

Upgrade the installed packages to the latest versions

```
~$ sudo apt-get upgrade
```

Get Started w/ Python

Install python and pip

```
~$ sudo apt-get install python-dev
~$ sudo apt-get install python-pip
```

Get Started w/ PubNub

Install pubnub libs

```
~$ sudo pip install pubnub
```

Hello World w/ PubNub

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https://github.com/pubnub/workshop-raspberrypi/tree/master/projects-python/helloworld

Hello World w/ PubNub

Import & init (hello.py)

```
import sys
from pubnub import Pubnub

pubnub = Pubnub(publish_key='pub-c-123...',
subscribe_key='sub-c-456...')
```

Hello World w/ PubNub

PubNub®

Publish (Sending data)

```
channel = 'hello-pi'
data = { 'username': 'SpongeBob',
         'message': 'Hello world from Pi!'}

def callback(m):
   print(m)

pubnub.publish(channel, data, callback=callback,
error=callback)
```

Use your own name & message!

Hello World w/ PubNub

Run your program

```
~$ sudo python hello.py
```

Hello World w/ PubNub

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Subscribing data you are publishing

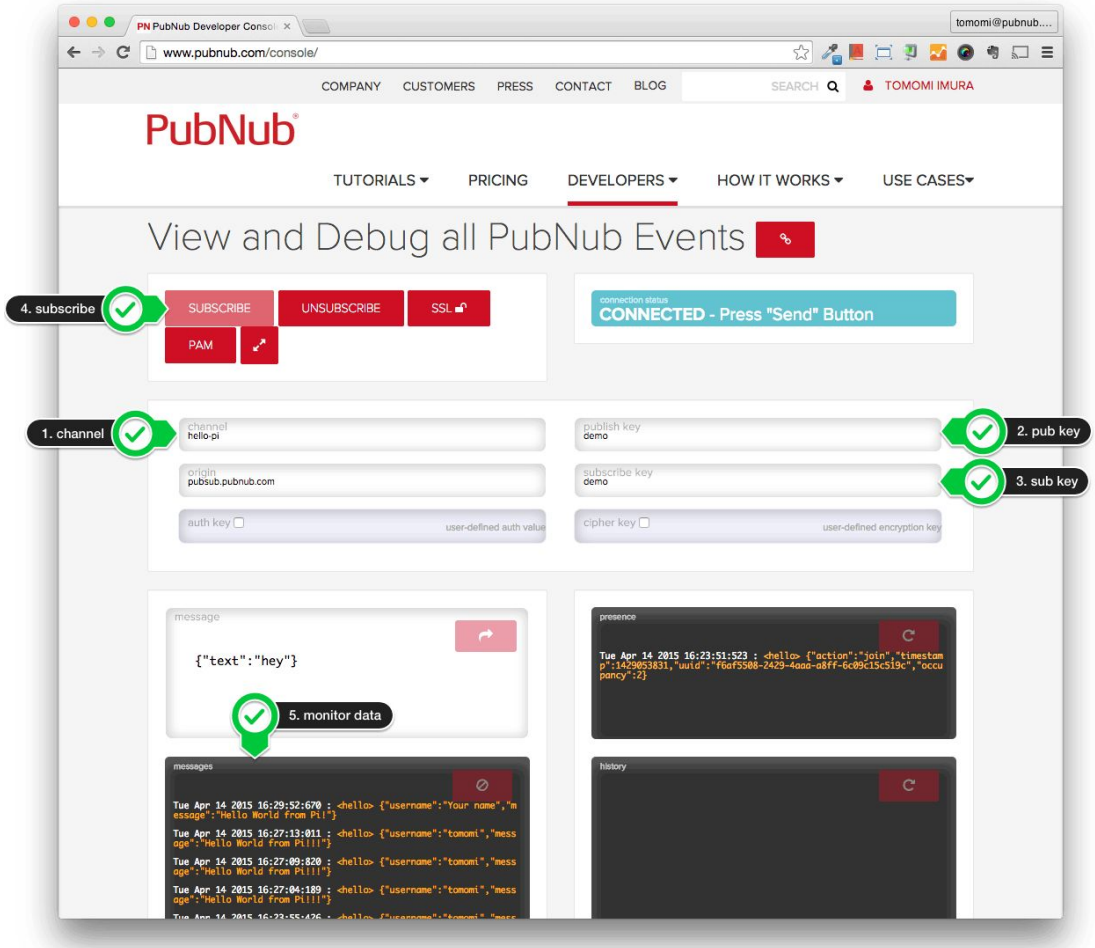
http://pubnub.github.io/workshop-raspberrypi/web/hello.html

PubNub®

3. Using the Debug Console

Debug Console

PubNub®



http://pubnub.com/console/

1. channel: hello-pi
2. pub key: demo
3. sub key: demo

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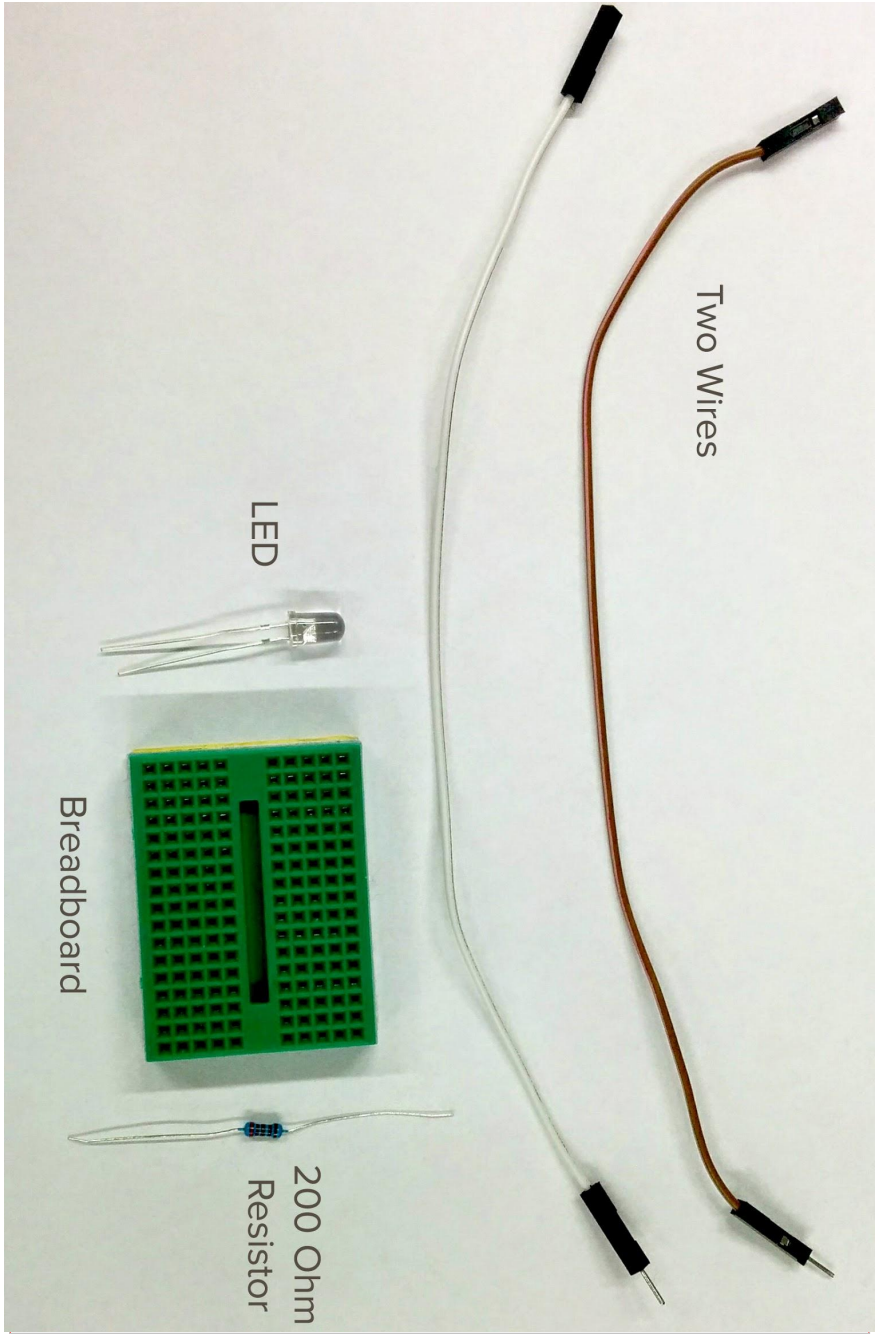
4. Blinking LED

https://github.com/pubnub/workshop-raspberrypi/tree/master/projects-python/led

Blinking LED

- Raspberry Pi 2
- 1 LED (1.9 - 3.2V)
- 1 Resistor (200Ω)
- 1 Breadboard
- 2 M-to-F jumper wires, 2 colors



OMG Physics!

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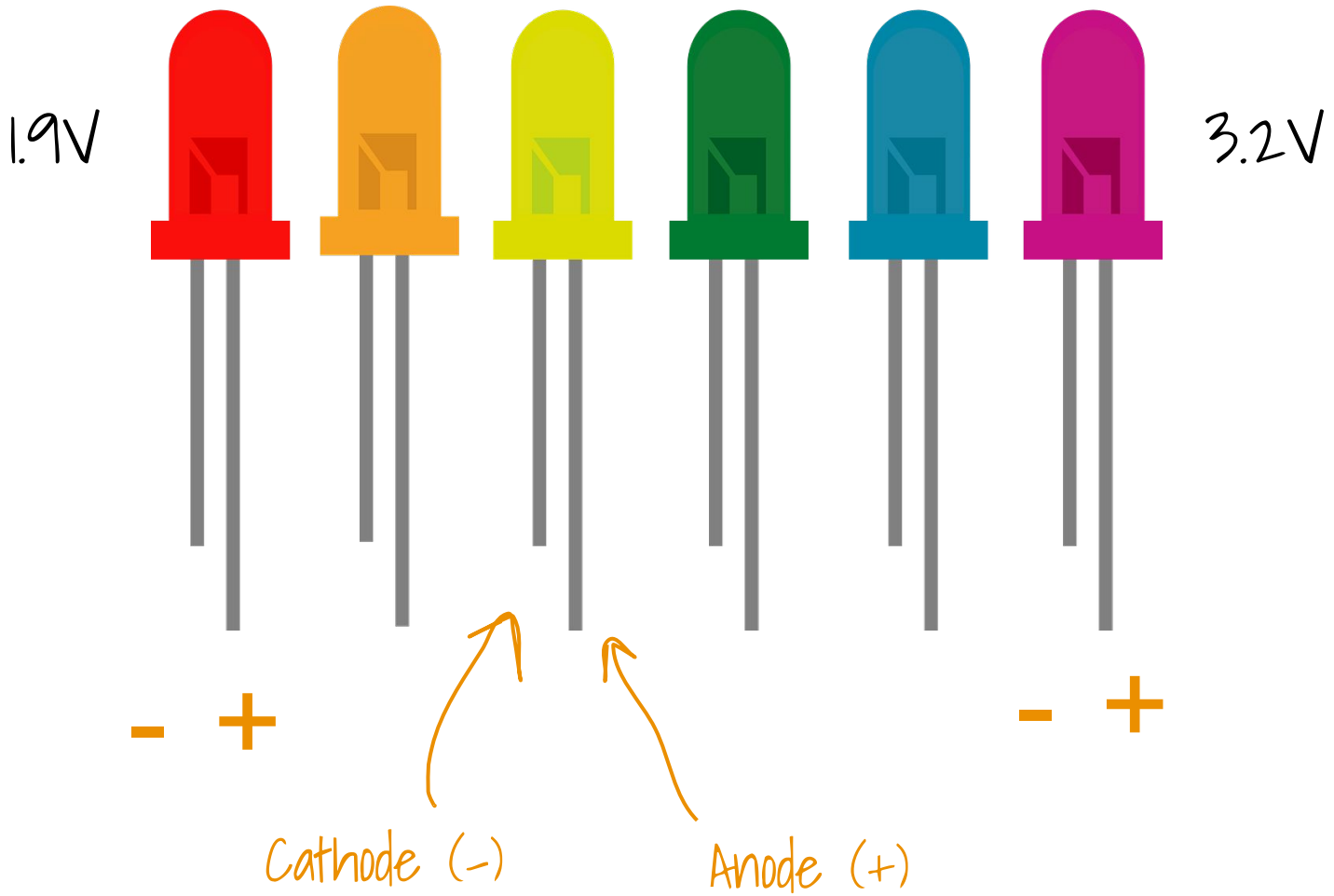


OMG Physics!

PubNub

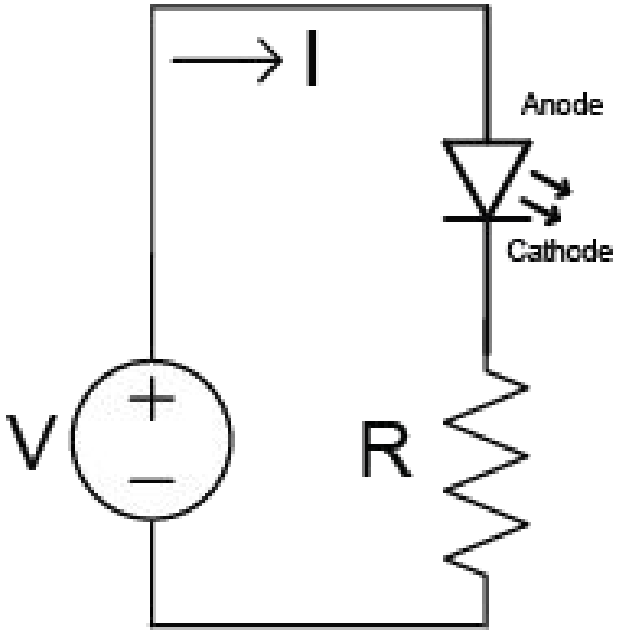
source voltage (V)

forward voltage (V)
(LED voltage drop)

$$R = \frac{V_s - V_f}{I}$$

resistance (Ω)

current thru
the LED (A)



OMG Physics!

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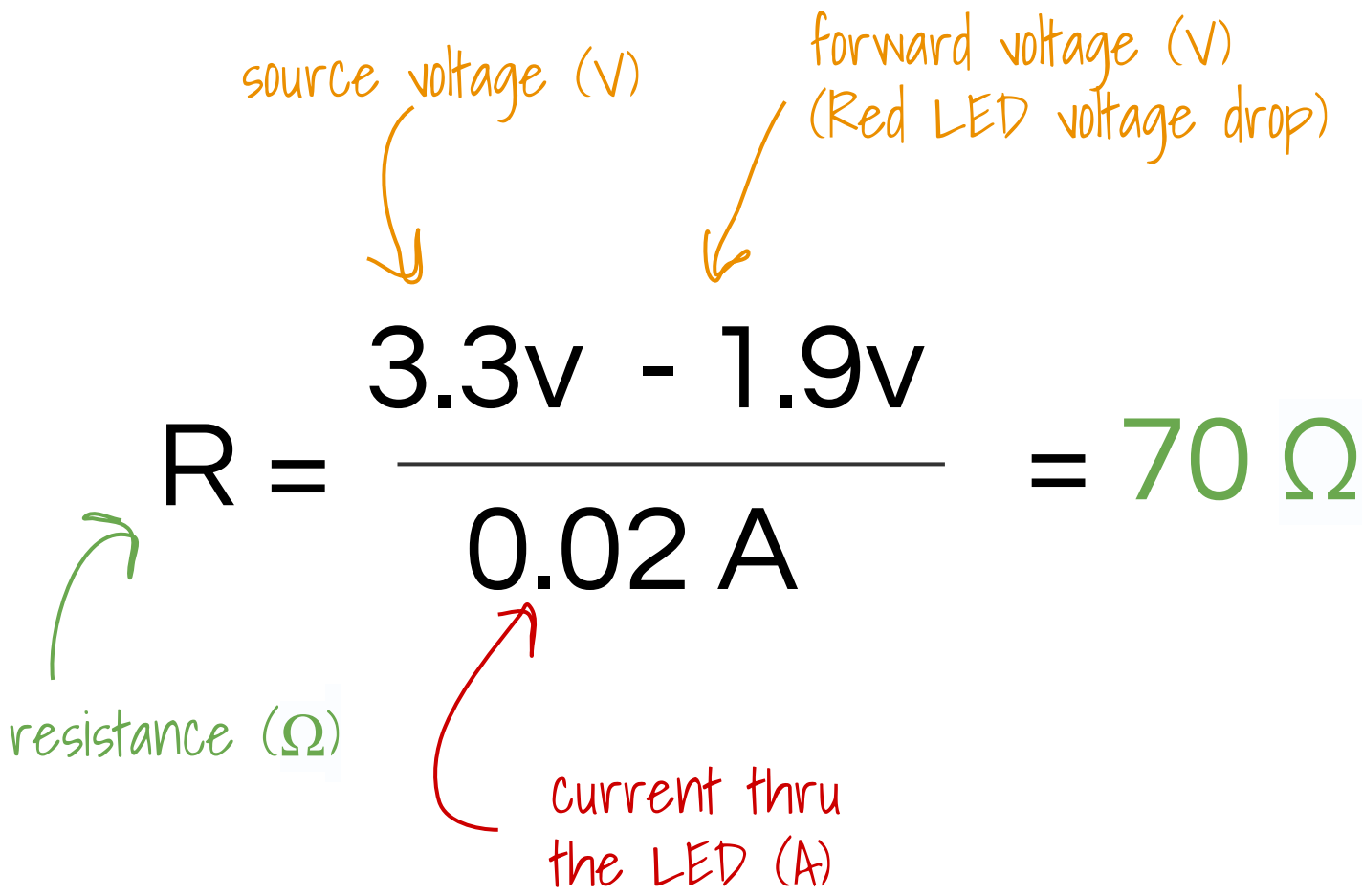

4-band Resistor Color Code

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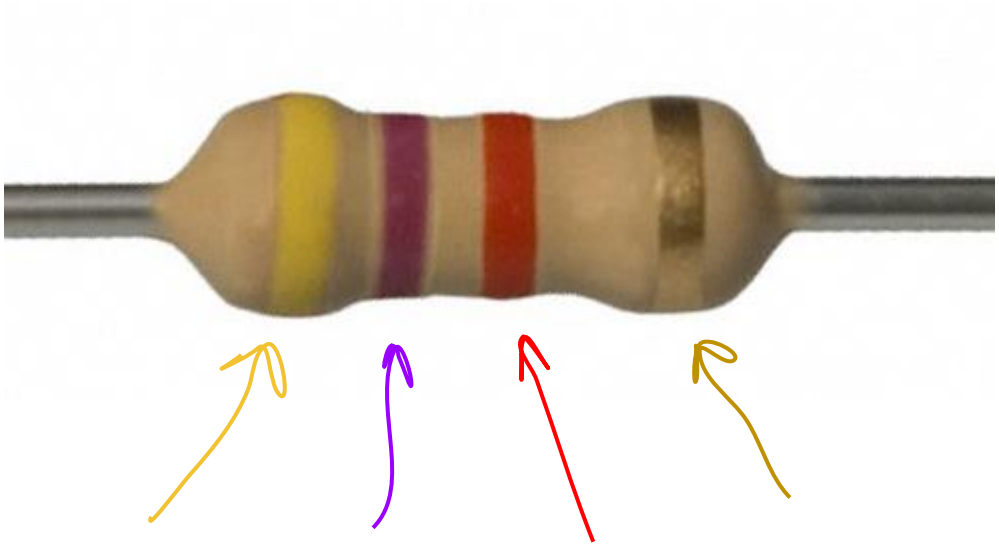


Learn more at: https://learn.adafruit.com/multimeters/resistance

5-band Resistor Color Code

PubNub®

2 0 0 10^0 +/- 1%

multiplier

tolerance

200 X 1 =

200 Ohms

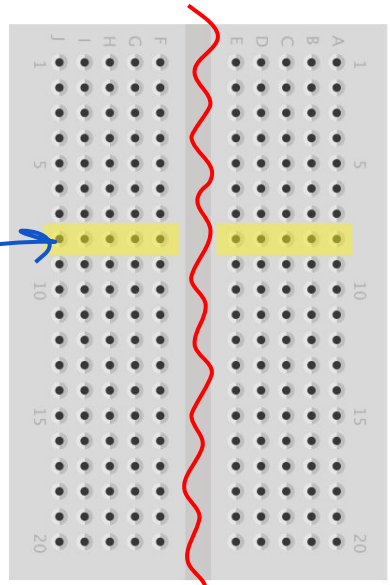
Learn more at: https://learn.adafruit.com/multimeters/resistance

Breadboard

PubNub

An electronics breadboard is a fundamental tool to build circuits. It is solderless, and great tool for prototyping.

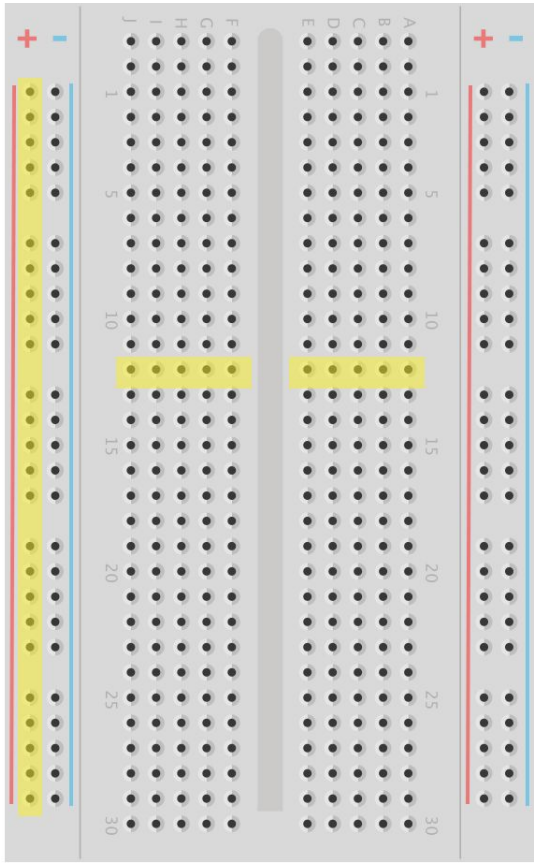
We are using this kind today!



Connected! conductive metal strips goes horizontally

not connected !

Mini



You may find this type of breadboard when googling circuits. They have power rails that goes vertical!

400-pin

Turning LED on

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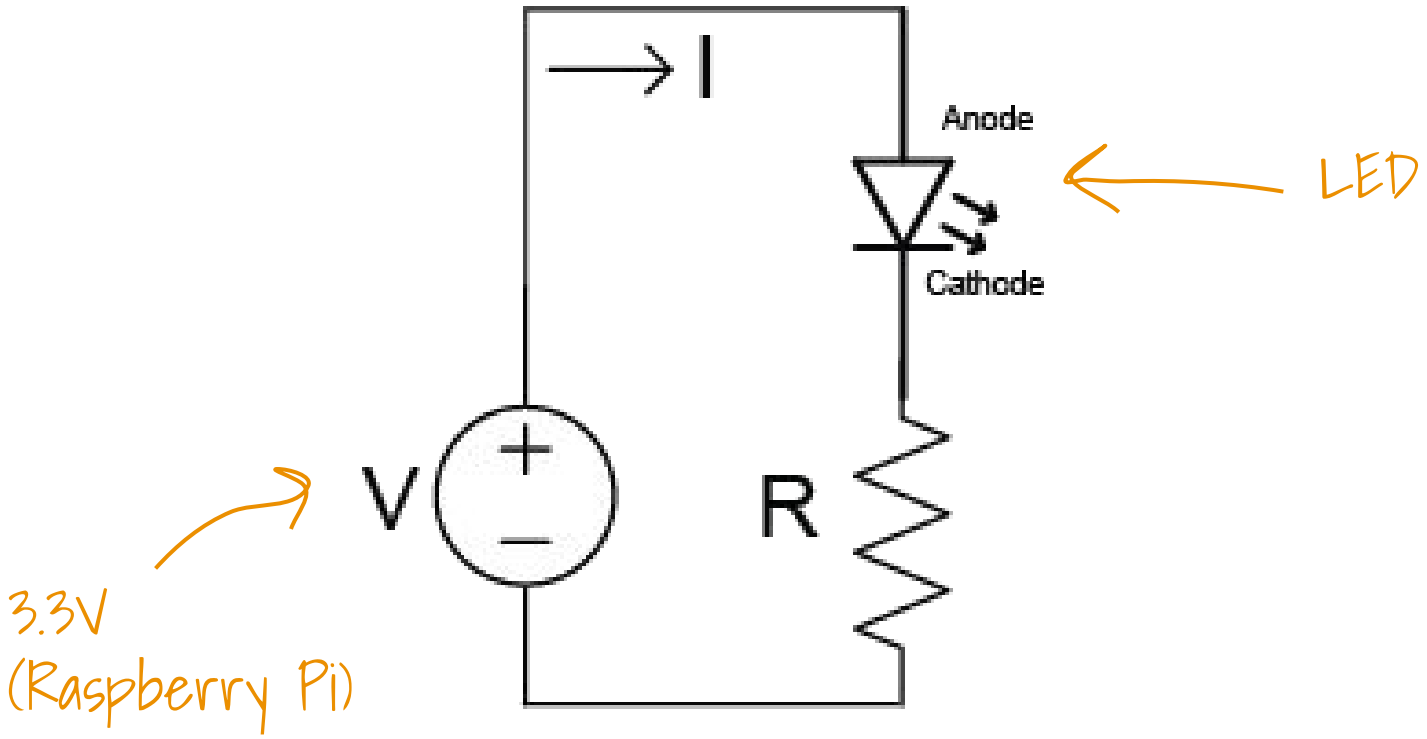
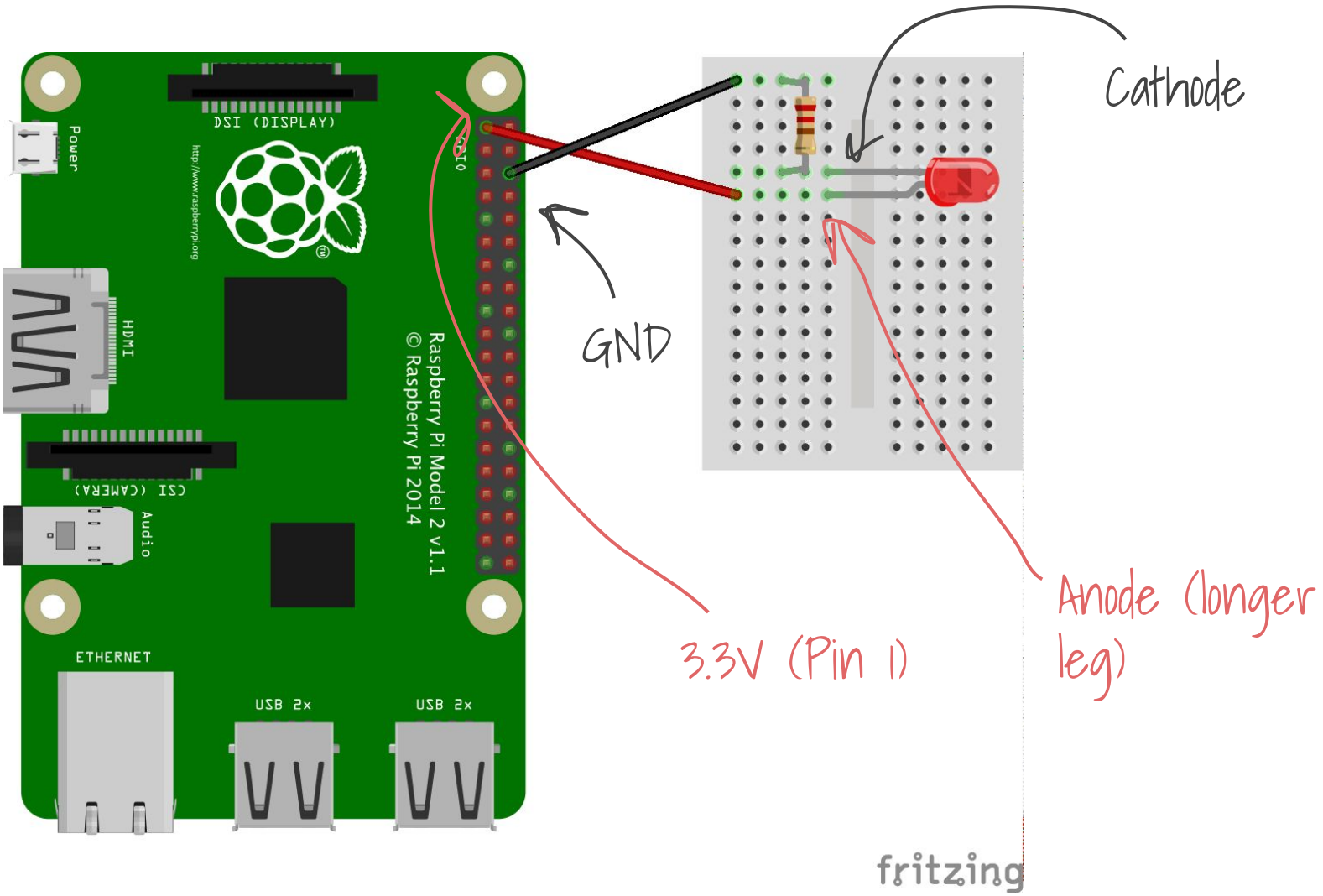


Turning LED on

PubNub



Raspberry Pi 2 Pins

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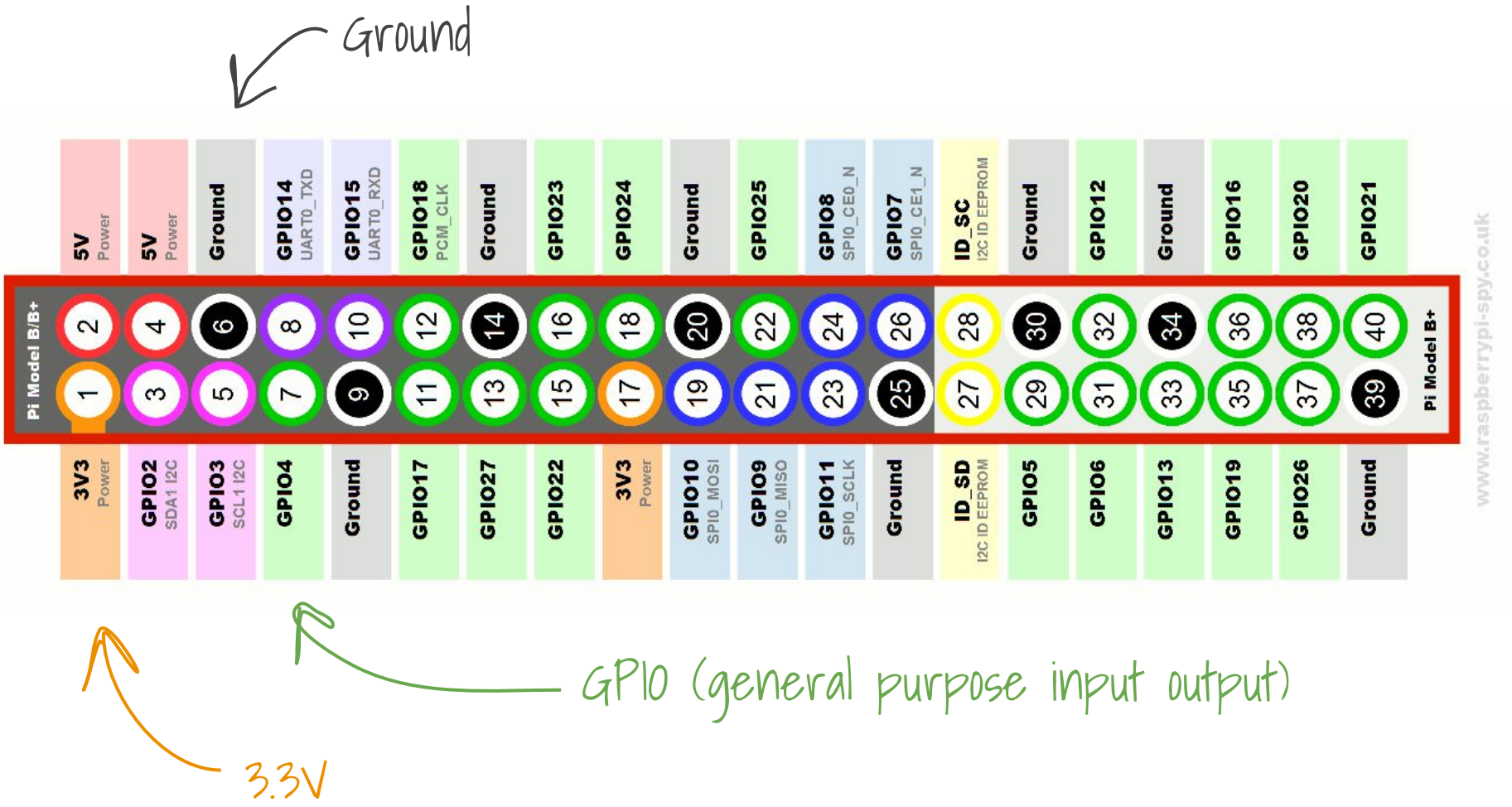

Programming LED

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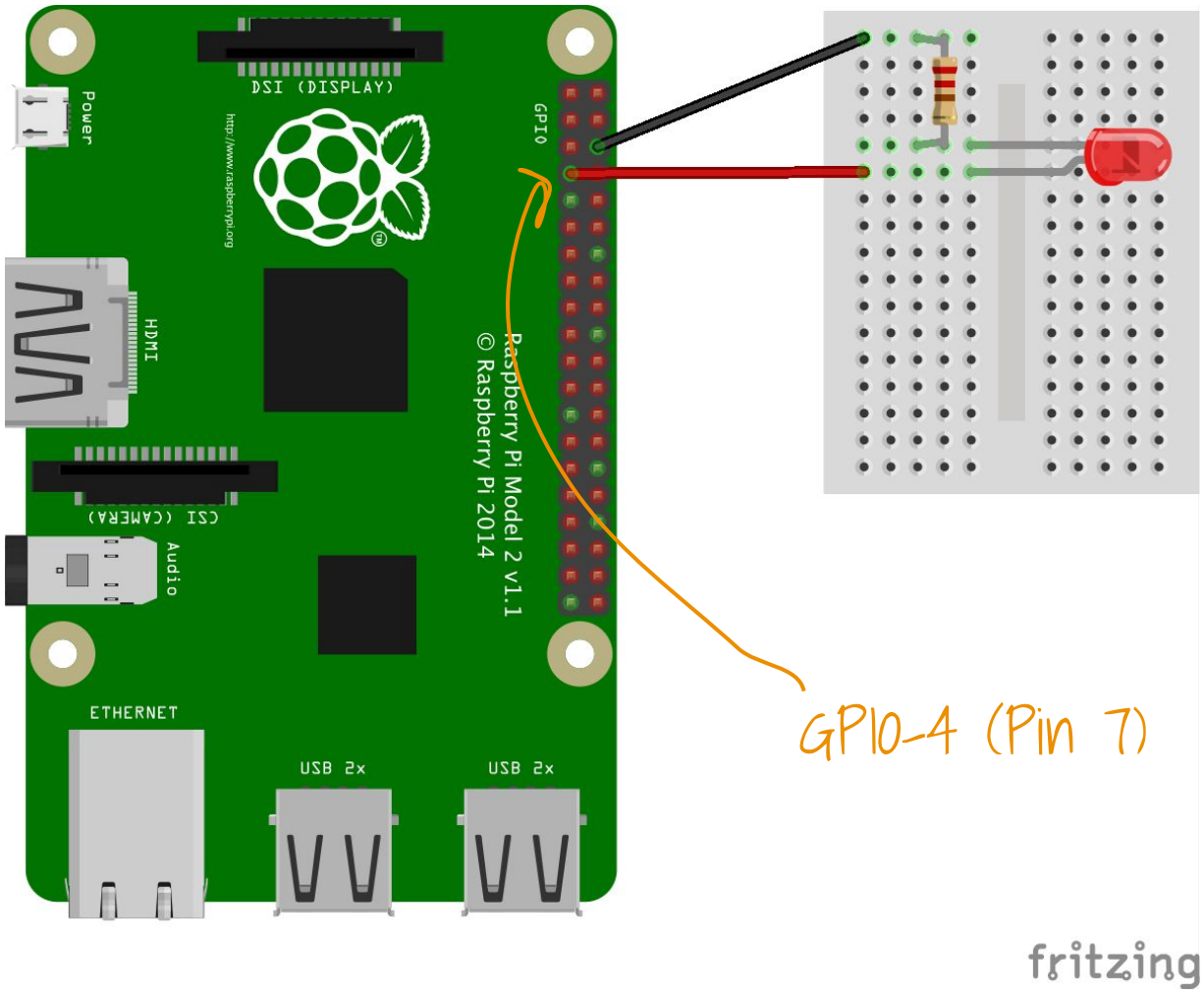

Programming LED

PubNub®

```
import RPi.GPIO as GPIO
import time

GPIO.setmode(GPIO.BCM)
LED = 4
GPIO.setup(LED,GPIO.OUT)

while True:
    GPIO.output(LED,True)
    time.sleep(0.5)
    GPIO.output(LED,False)
    time.sleep(0.5)
```

import RPi.GPIO libs

set pin type. use BCM, not pin number

GPIO 4 pin (Pin 7)

set LED pin as output

toggle light pin signal to low/high to make it blink.

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5. Introduction to IoT

Making it IoT: Remote-Controlled LED

PubNub®

https://github.com/pubnub/workshop-raspberrypi/tree/master/projects-python/remote-led

Making it IoT: Remote-Controlled LED

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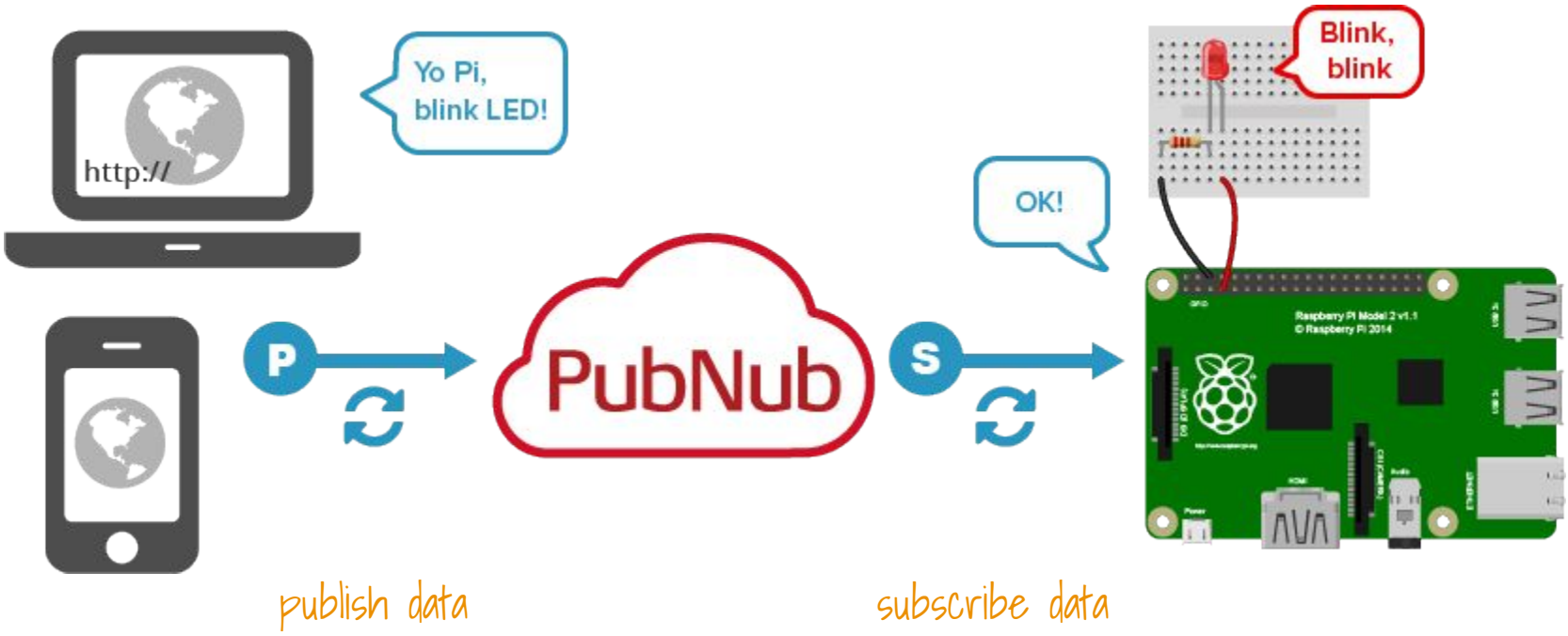


Making it IoT: Remote-Controlled LED

PubNub

Subscribing data from a web client

JS

```
button.addEventListener
('click', publish);
```

When the button is clicked on browser, it publishes data, {'led': 1}

```
pubnub = Pubnub(publish_key='demo', subscribe_key='demo')
channel = 'disco'

def _callback(m, channel):
  if m['led'] == 1:
    for i in range(6):
      GPIO.output(LED_PIN,True)
      time.sleep(0.5)
      GPIO.output(LED_PIN,False)
      time.sleep(0.5)

pubnub.subscribe(channels=channel, callback=_callback, error=_error)
```

Making it IoT: Remote-Controlled LED

PubNub®

Disco!

http://pubnub.github.io/workshop-raspberrypi/web/disco.html

IoT & PubNub
Case Study: Insteon

PubNub®

http://www.insteon.com

PubNub®

6. Go conquer IoT

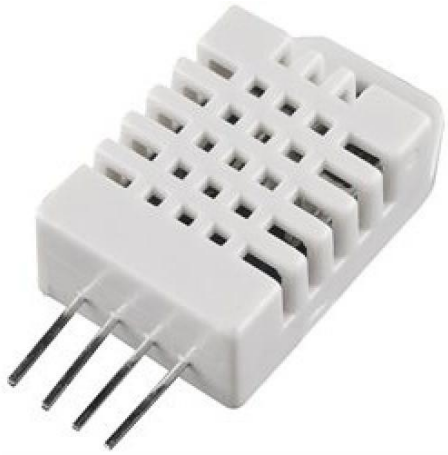
Projects

PubNub

- Pyroelectric IR Motion sensor
- Combinations of sensors and LED
- DHT22 Temperature & Humidity sensor

PIR sensor

DHT22 sensor



PIR Motion Sensor

PubNub

It detects motions by measuring changes in IR radiation when an object moves around it.

https://github.com/pubnub/workshop-raspberrypi/tree/master/projects-python/motion-sensor

http://pubnub.github.io/workshop-raspberrypi/web/motion.html

PIR Motion Sensor

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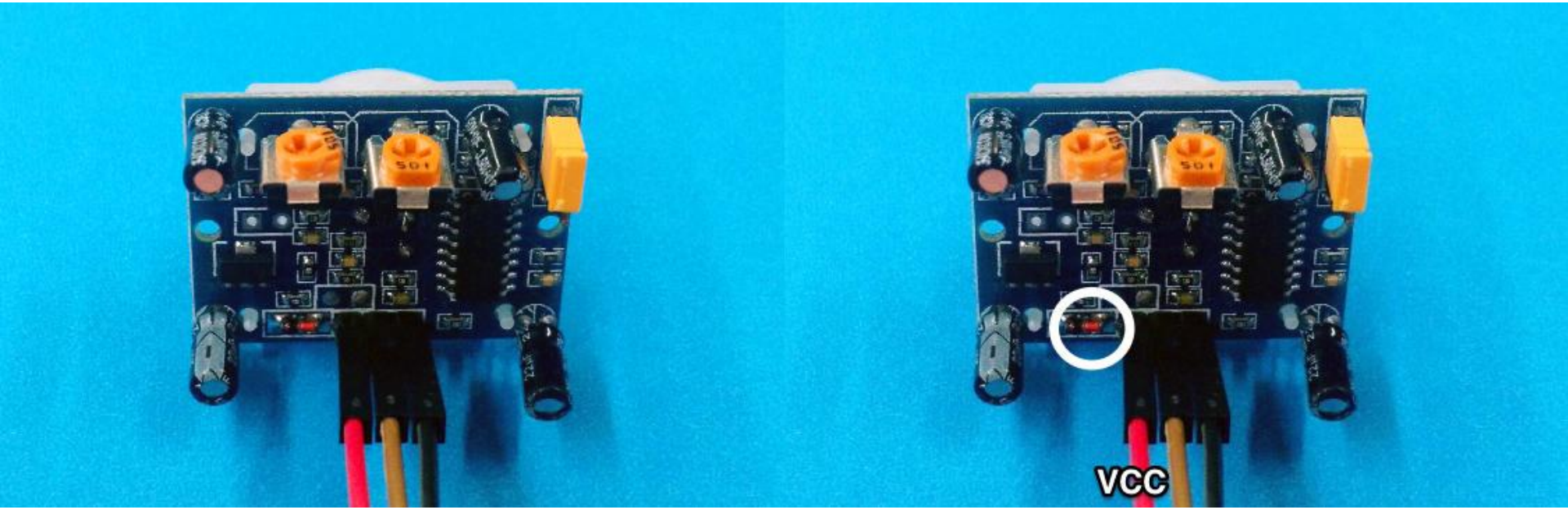
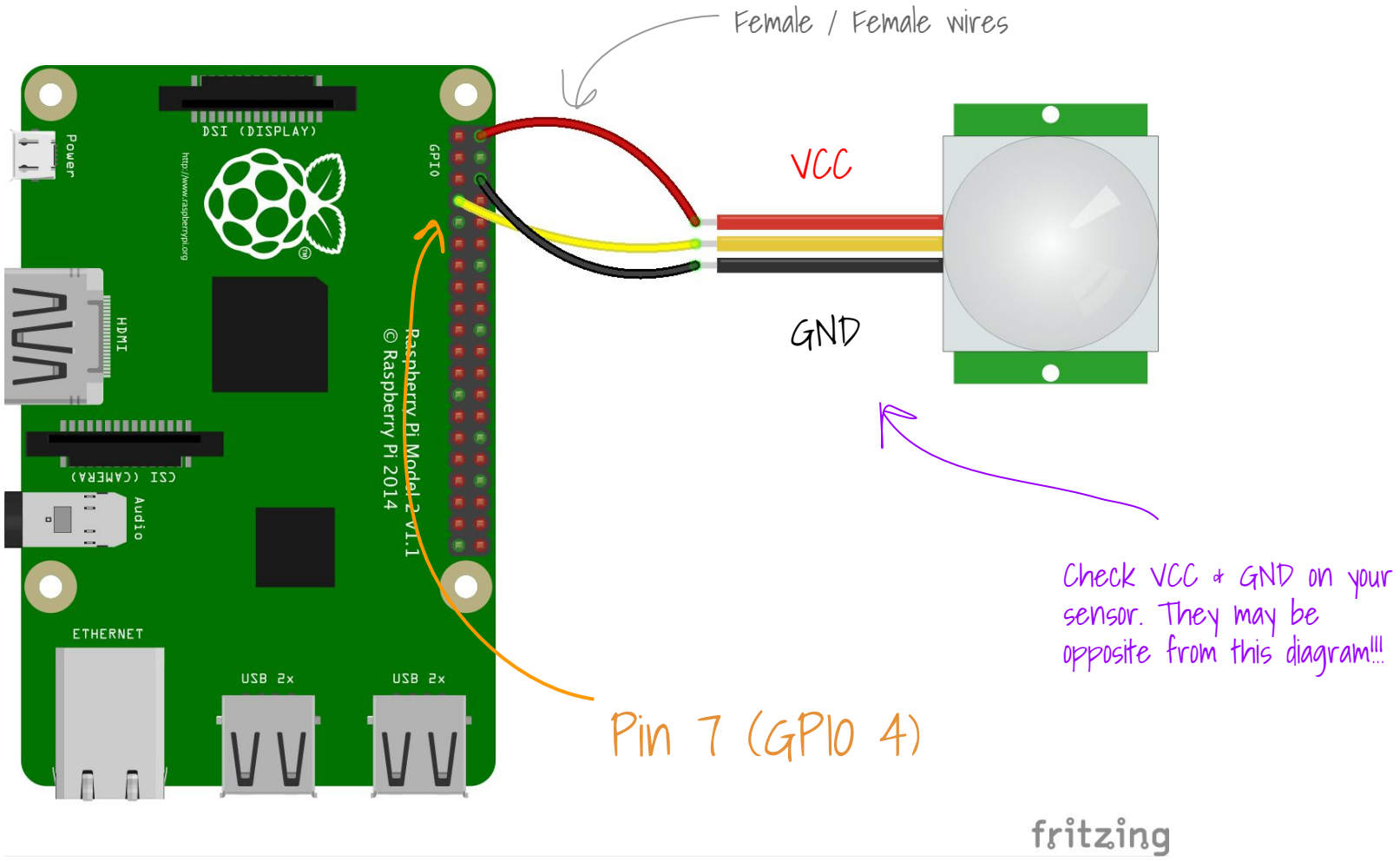


PIR Motion Sensor

PubNub



PIR Motion Sensor w/ LED

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Combination of the PIR motion sensor with a LED as a visual indicator

https://github.com/pubnub/workshop-raspberrypi/tree/master/projects-python/motion-led

http://pubnub.github.io/workshop-raspberrypi/web/motion.html

PIR Motion Sensor w/ LED

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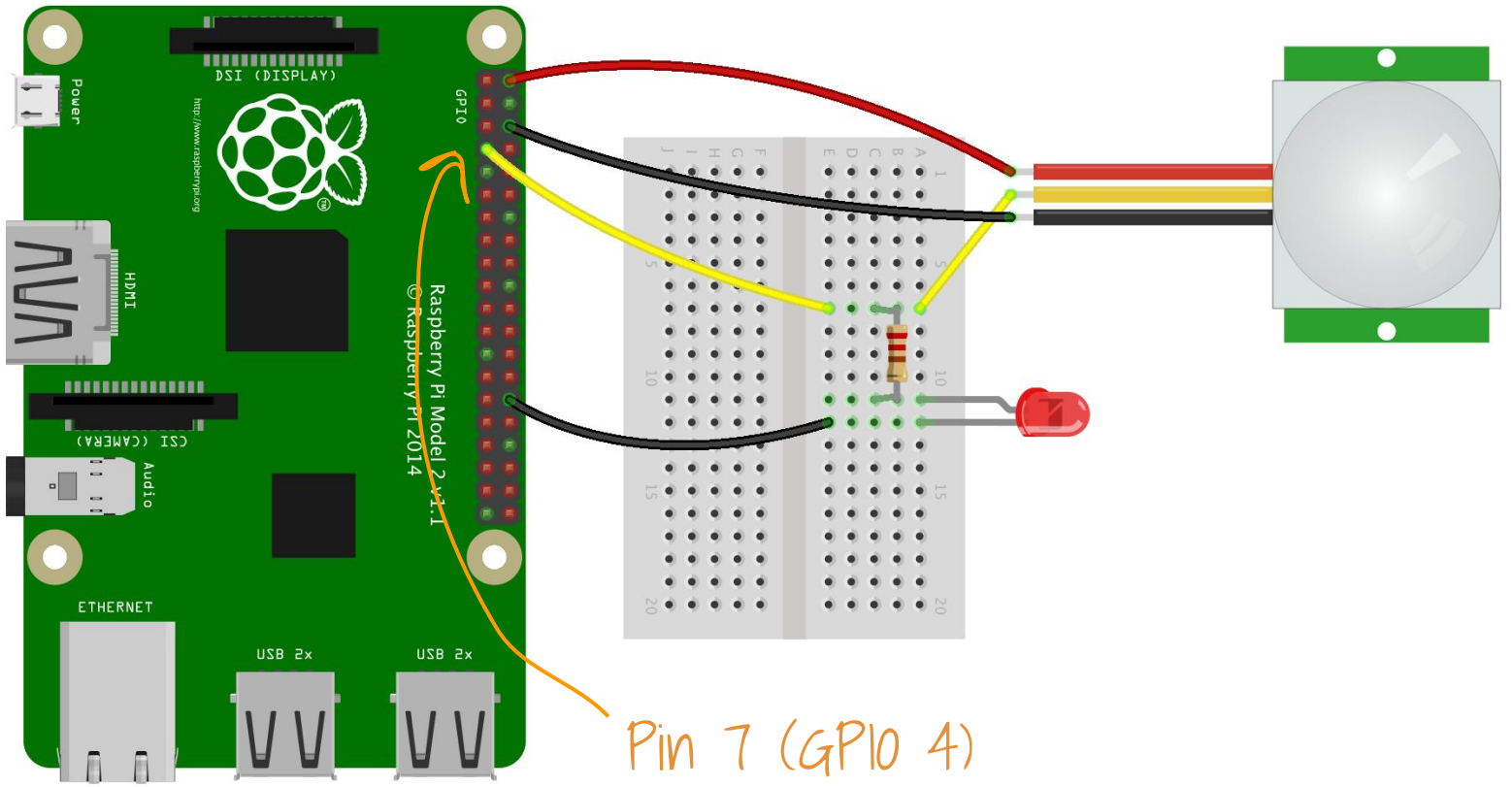

Note: The circuit change only. The code remains the same.

Data Visualization with Temperature Sensor

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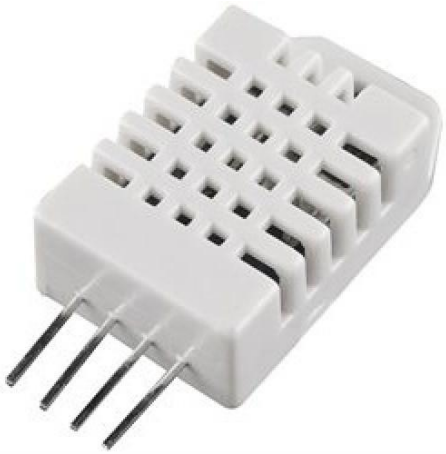
It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin.



https://github.com/pubnub/workshop-raspberrypi/tree/master/projects-python/dht22

http://pubnub.github.io/workshop-raspberrypi/web/temperature.html

DHT22 Sensor

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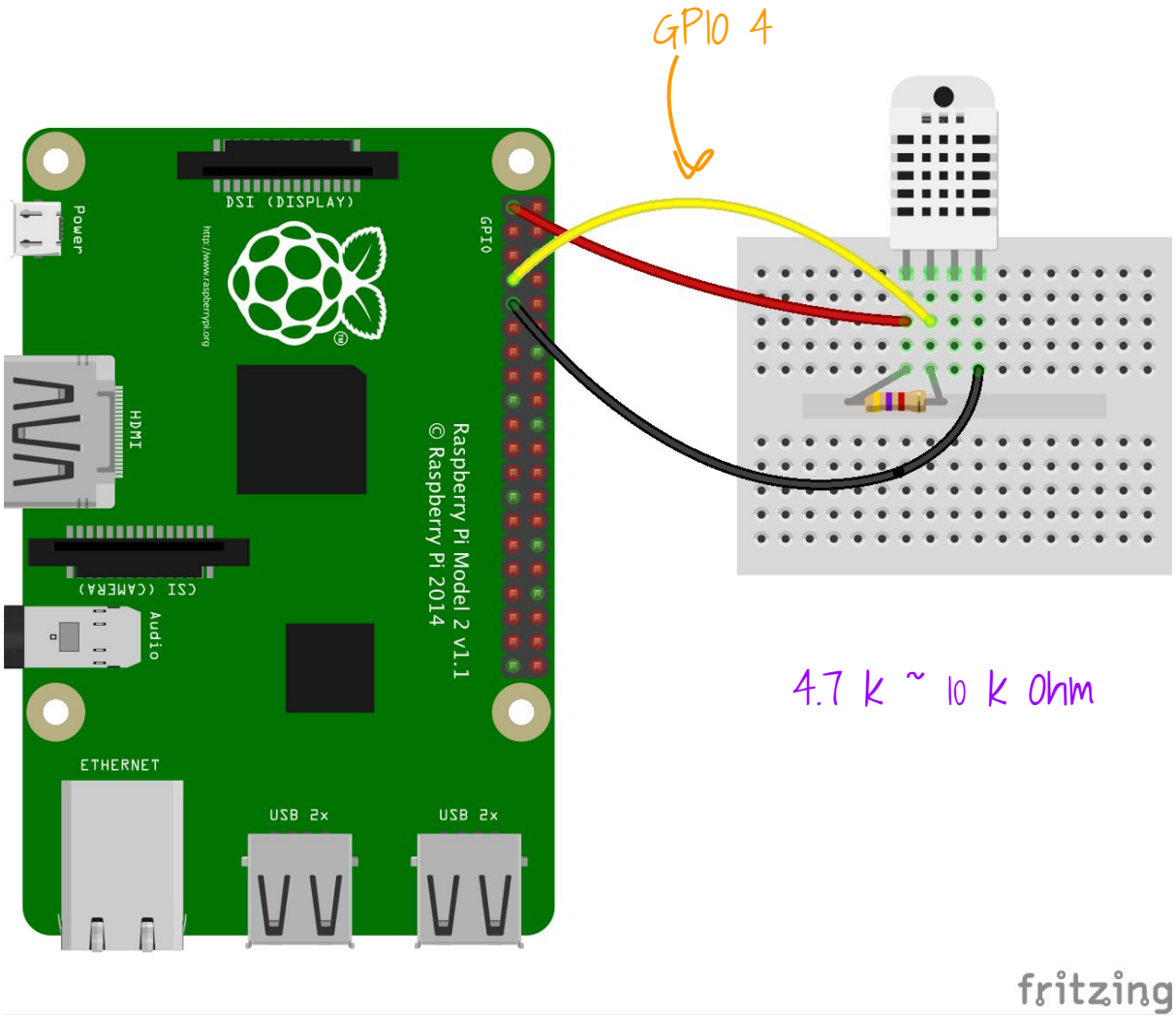

DHT22 Sensor

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Download & Install Adafruit DHT library:

```
~$ git clone https://github.com/adafruit/Adafruit_Python_DHT.git

~$ cd Adafruit_Python_DHT

~$ sudo python setup.py install
```

Realtime Data Graphs & Charts

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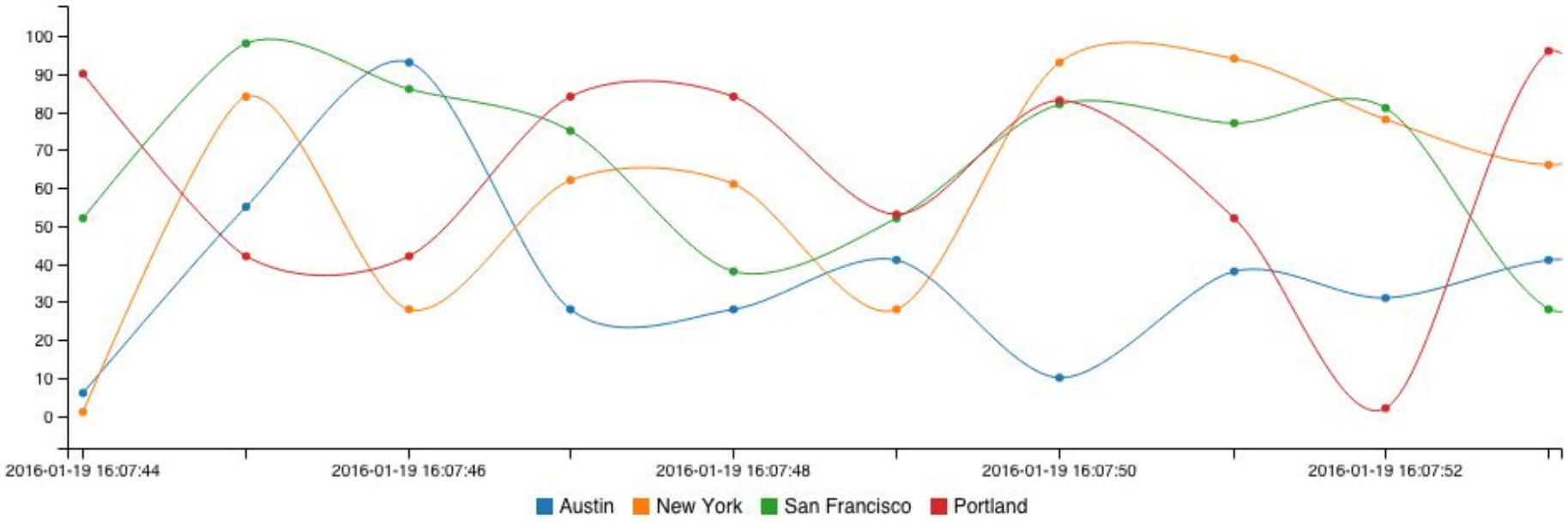

https://github.com/pubnub/eon-chart

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You've got some extra time for one more project?

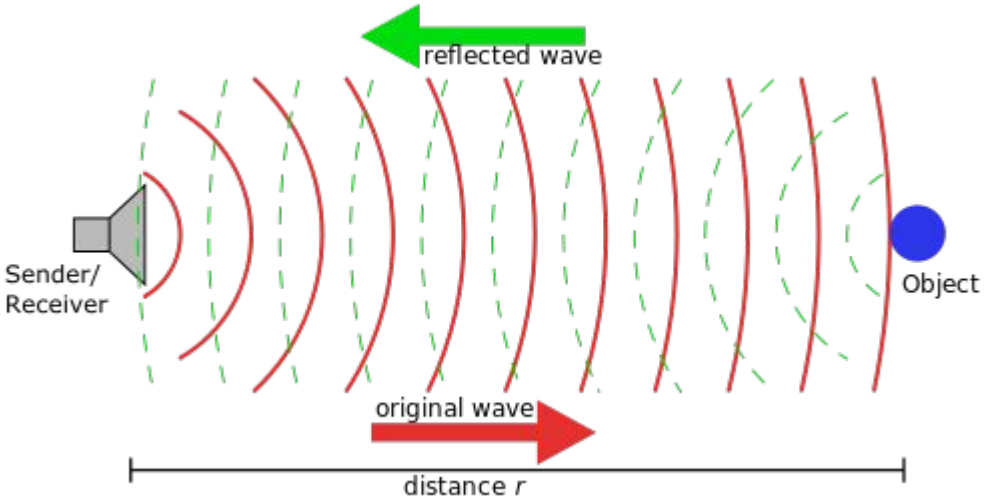
Come to front to pick up:

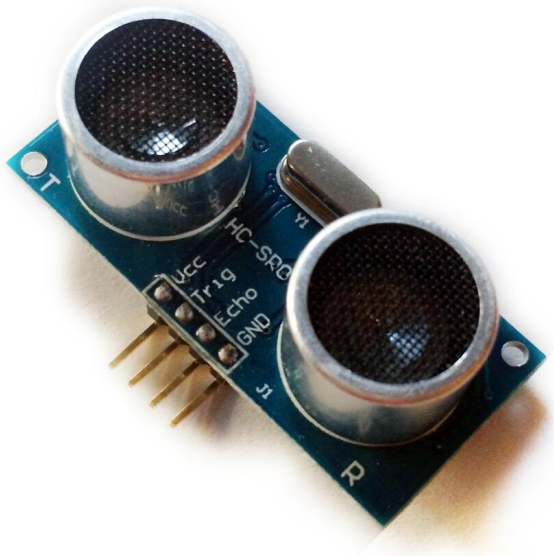
- HC-SR04 Ultrasonic sensor
- resistors (1k Ohm & 2.2k Ohm)
- extra wires

Ultrasonic RangeFinder

PubNub

The HC-SR04 ultrasonic sensor uses sonar signals to determine distance to an object





Ultrasonic RangeFinder

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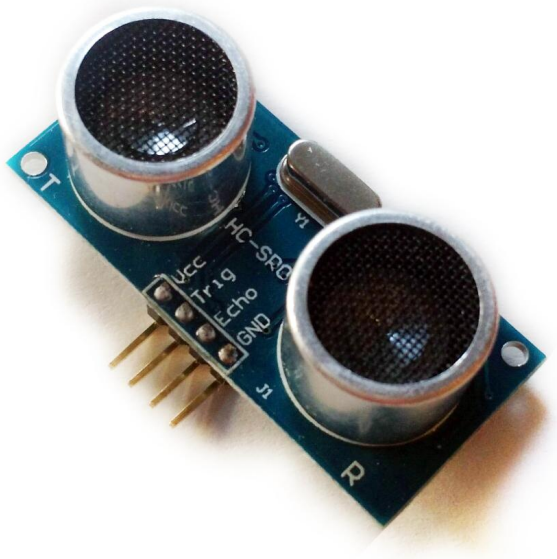
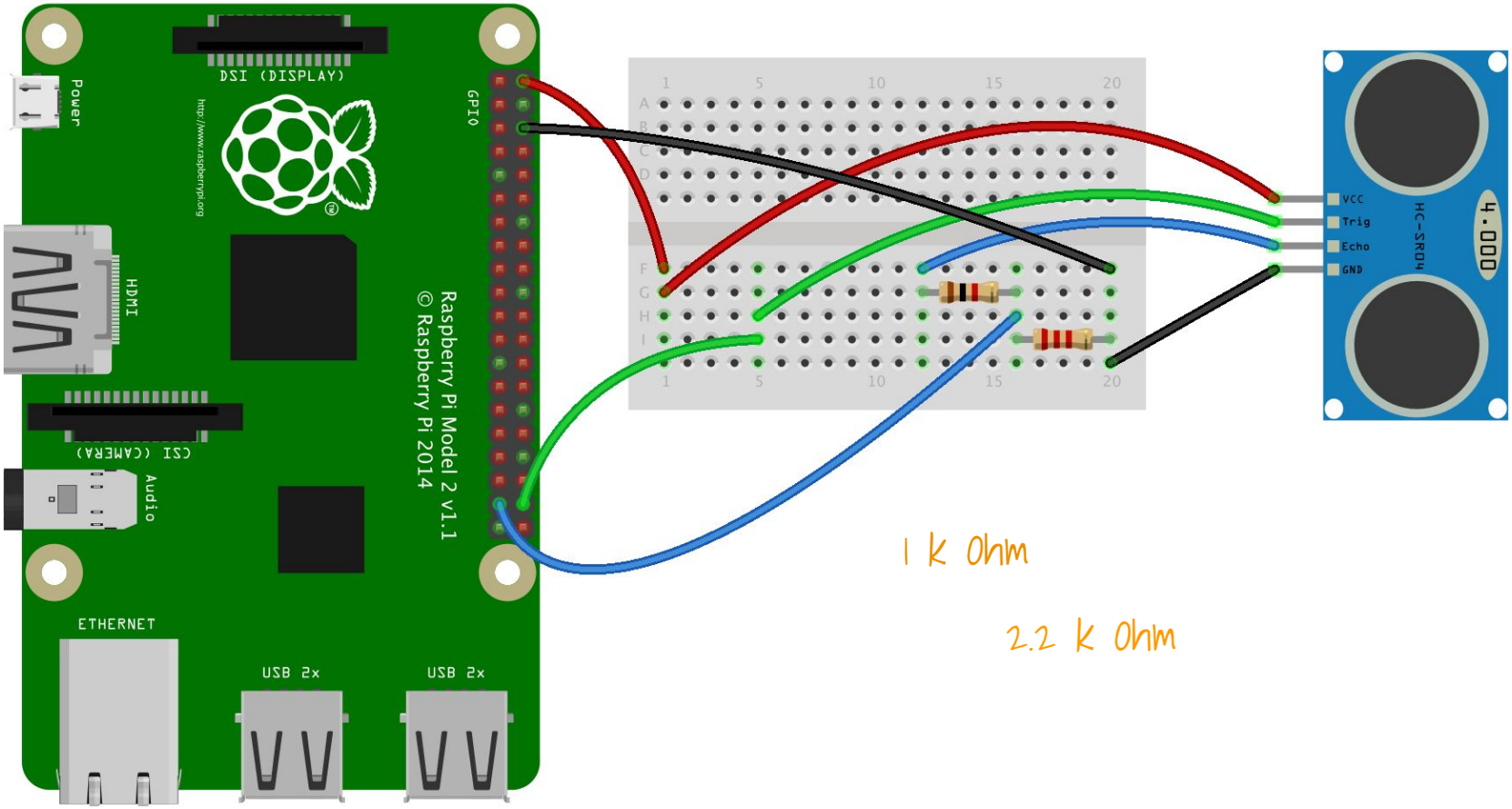
https://github.com/pubnub/workshop-raspberrypi/blob/master/projects-python/range-finder/

http://pubnub.github.io/workshop-raspberrypi/web/range.html



Ultrasonic RangeFinder

PubNub®



fritzing

Thank you :-)

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- PIR Sensor: Wikimedia / Oomlout
- Ultrasonic: Wikimedia / Georg Wiora (Dr. Schorsch)
- GPIO Pins: RaspberryPi-Spy.co.uk

Also, great public domain images from Pixabay!

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Please give us feedback at:

https://goo.gl/0WeZQb