

INTRODUCTION TO THE RASPBERRY PIE

Ralph Iden – WB9ICF



INTRODUCTION TO THE RASPBERRY PIE

Ralph Iden – WB9ICF



INTRODUCTION TO THE RASPBERRY PIE

Ralph Iden – WB9ICF



INTRODUCTION TO THE RASPBERRY PIE

Ralph Iden – WB9ICF



INTRODUCTION TO THE RASPBERRY PI

Ralph Iden – WB9ICF



What is going to be covered

- Introduction to the Raspberry Pi
- Technical overview of Raspberry Pi models
- Comparing the Raspberry Pi with other devices – e.g., Arduino
- How do I get started?
- Examples
- Resources
- Q & A

Introducing the Raspberry Pi

The Raspberry Pi is part of a family of low-cost, high-performance computers that people use to learn, solve problems, and have fun.

The UK-based charity, the Raspberry Pi Foundation, is the organization that is responsible for the Pi. They work “to put the power of digital making into the hands of people all over the world, so they are capable of understanding and shaping our increasingly digital world.”

Introducing the Raspberry Pi

The first Pi, the Model 1 B, was released in April of 2012 and the most recent one, the Model 3 B+, was released on March 14, 2018 (Pi Day 2018). Some models (e.g., Model 2) have been omitted for space.

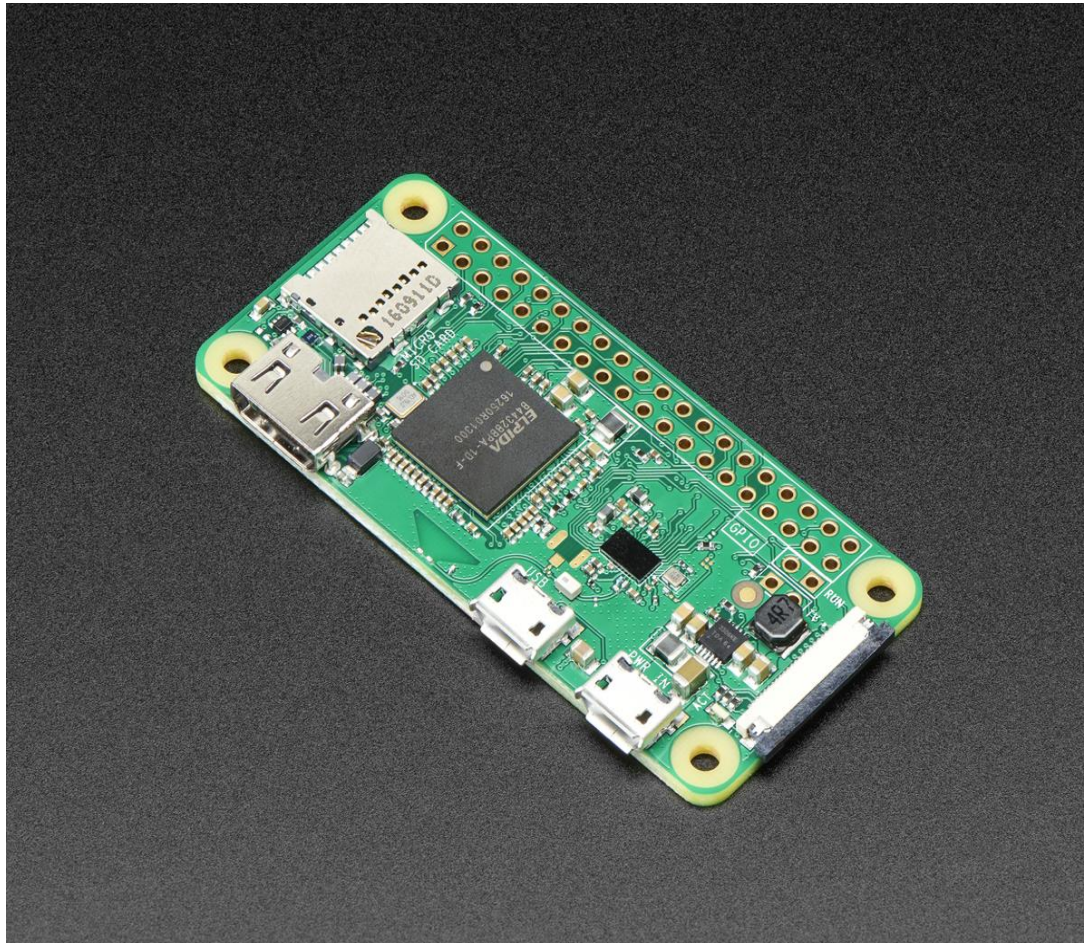
Model	Released	CPU Speed	Memory	Cost (USD)
Pi Model 1 B	Apr 2012	700 MHz	256 MB	\$25
Pi Model 1A	Feb 2013	700 MHz	256/512 MB	\$25/\$20
Pi Zero	Nov 2015	1 GHz	512 MB	\$5
Model 3 B	Feb 2016	1.2 GHz	1 GB	\$35
Pi Zero W	Feb 2017	1 GHz	512 MB	\$10
Pi Zero WH	Jan 2018	1 GHz	512 MB	\$14
Model 3 B+	Mar 2018	1.4 GHz	1 GB	\$25

Raspberry Pi 3 Model B+ - \$35-\$40



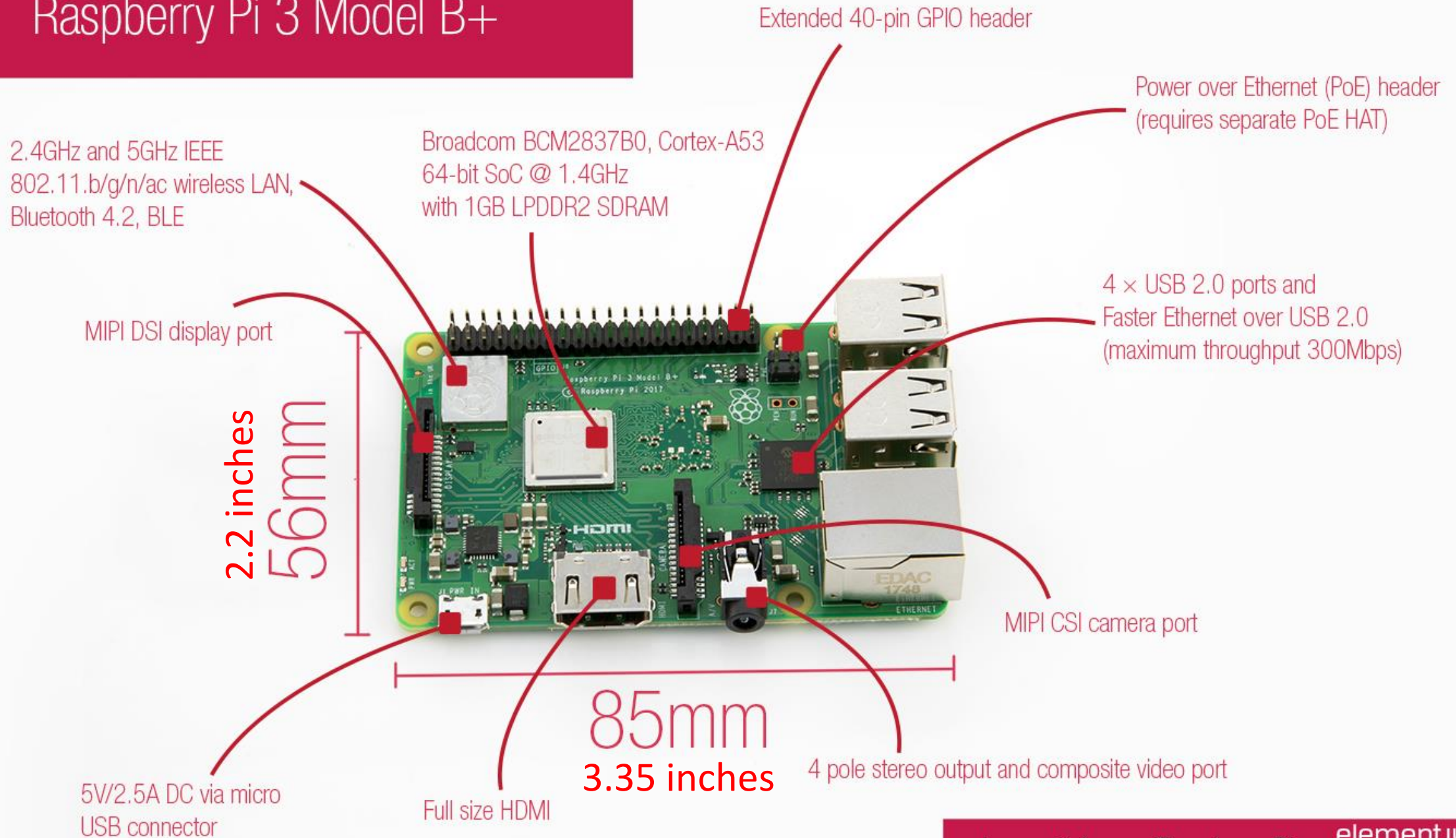
- 1.4 GHz, 64 bit, quad-core CPU
- 1 GB RAM
- Ethernet with POE option
- 802.11 b/g/n/ac wireless 2.4/5 GHz
- Bluetooth 4.2
- Bluetooth Low Energy (BLE)
- Full size HDMI
- 4 USB 2.0 ports
- HAT-compatible 40-pin header
- Composite video and audio out
- Camera and display port connectors

Raspberry Pi Zero/W/WH - \$5, \$10, \$14



- 1 GHz, single-core CPU
- 512 MB RAM
- 802.11 b/g/n wireless 2.4 GHz only
- Bluetooth 4.1
- Bluetooth Low Energy (BLE)
- Mini HDMI
- 1 USB (On-The-Go compatible port)
- Micro USB power
- HAT-compatible 40-pin header
- Composite video and reset headers
- CSI camera connector

Raspberry Pi 3 Model B+



General Purpose Input/Output (GPIO) Header

Raspberry Pi 3 GPIO Header			
Pin#	NAME		NAME Pin#
01	3.3v DC Power	Red	DC Power 5v 02
03	GPIO02 (SDA1 , I ² C)	Blue	DC Power 5v 04
05	GPIO03 (SCL1 , I ² C)	Blue	Ground 06
07	GPIO04 (GPIO_GCLK)	Green	(TXD0) GPIO14 08
09	Ground	Black	(RXD0) GPIO15 10
11	GPIO17 (GPIO_GEN0)	Green	(GPIO_GEN1) GPIO18 12
13	GPIO27 (GPIO_GEN2)	Green	Ground 14
15	GPIO22 (GPIO_GEN3)	Green	(GPIO_GEN4) GPIO23 16
17	3.3v DC Power	Red	(GPIO_GEN5) GPIO24 18
19	GPIO10 (SPI_MOSI)	Purple	Ground 20
21	GPIO09 (SPI_MISO)	Purple	(GPIO_GEN6) GPIO25 22
23	GPIO11 (SPI_CLK)	Purple	(SPI_CE0_N) GPIO08 24
25	Ground	Black	(SPI_CE1_N) GPIO07 26
27	ID_SD (I ² C ID EEPROM)	Yellow	(I ² C ID EEPROM) ID_SC 28
29	GPIO05	Green	Ground 30
31	GPIO06	Green	GPIO12 32
33	GPIO13	Green	Ground 34
35	GPIO19	Green	GPIO16 36
37	GPIO26	Green	GPIO20 38
39	Ground	Black	GPIO21 40

Rev. 2
29/02/2016

www.element14.com/RaspberryPi

Besides the USB ports, the GPIO header is another way that external devices can be interfaced with the Raspberry Pi.

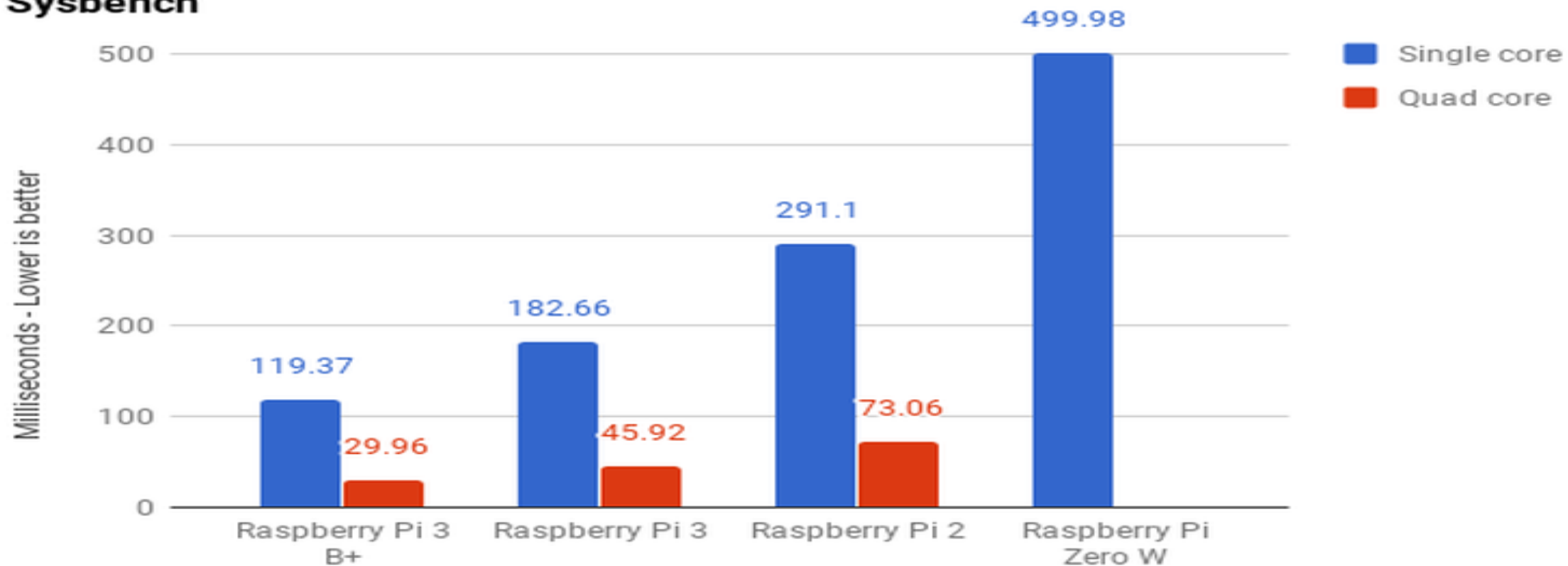
GPIO pins can be configured to be digital inputs or digital outputs. No analog input, but other strategies can be used to read input voltage.

Hardware serial TX/RX, I2C, and SPI.

Limited drive (sink/source) capacity (8 ma per pin on power up, 16 ma maximum).

Important: The Raspberry Pi is a 3V device. Do not apply more than 3.3 volts or less than 0 volts to the GPIO pins.

Sysbench



<https://www.techrepublic.com/article/raspberry-pi-3-model-b-review-hands-on-with-the-new-board/>

Power Consumption and Software

- Power consumption varies by model, but is approximately 1.5 watts when idle and a maximum of 6 watts under stress (aka doing things like SDR). The B+ has the highest power profile, which was a bit surprising at first glance.
- Free operating systems (OS) are available, nearly all Linux based.
 - Graphical user interface (e.g., desktops)
 - Command line/shell only distributions as well
 - Most are bundled with productivity applications (OpenOffice, etc.)
 - Screen readers are supported as well (although not JAWS)

Software

- The current “default” OS is Raspbian, based on Debian Stretch and paired with the PIXEL desktop. Other Linux distros available include CentOS, Ubuntu, and a handful of others.
- Custom distros are also available that are designed for out-of-the-box, plug-and-play applications
 - Home Assistant (home automation)
 - OpenHAB (home automation)
 - SDRPlay (software defined radio)
- Lots of ways to be productive right from the start.

But I want to run Windows

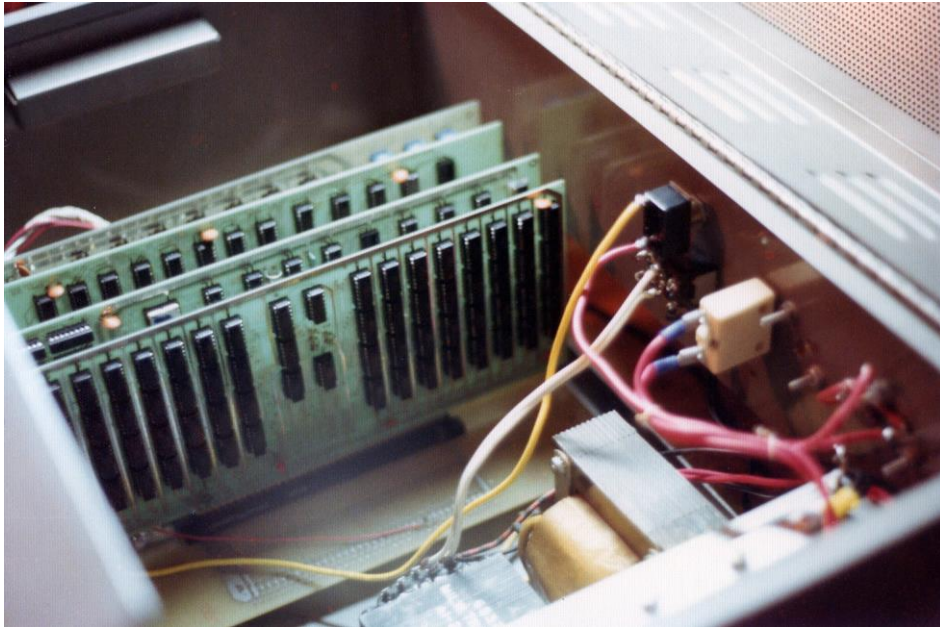
Well, you can, kind-of

- Windows 10 IoT (Internet of Things) Core is available
- Windows 10 for ARM (Advanced Reduced-instruction set computer Machine)
- Mixed reviews, I haven't been impressed with Core and ARM not yet ready

WINE?

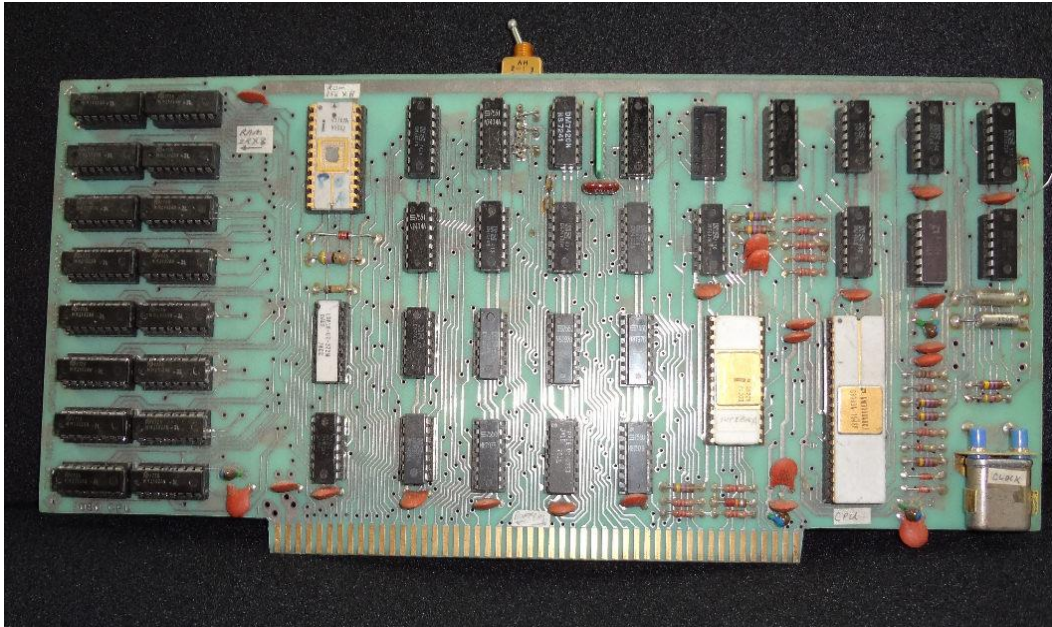
- Wine Is Not an Emulator!
- Designed to run Windows binaries under Linux
- Windows binaries tend to be X86/i586 not ARM, so these processors need to be emulated before passing along to WINE.

Performance comparison



My first computer that I built, circa 1975 – Digital Group 8080/Z80 designed by Dr. Robert Suding, W0LMD/SK

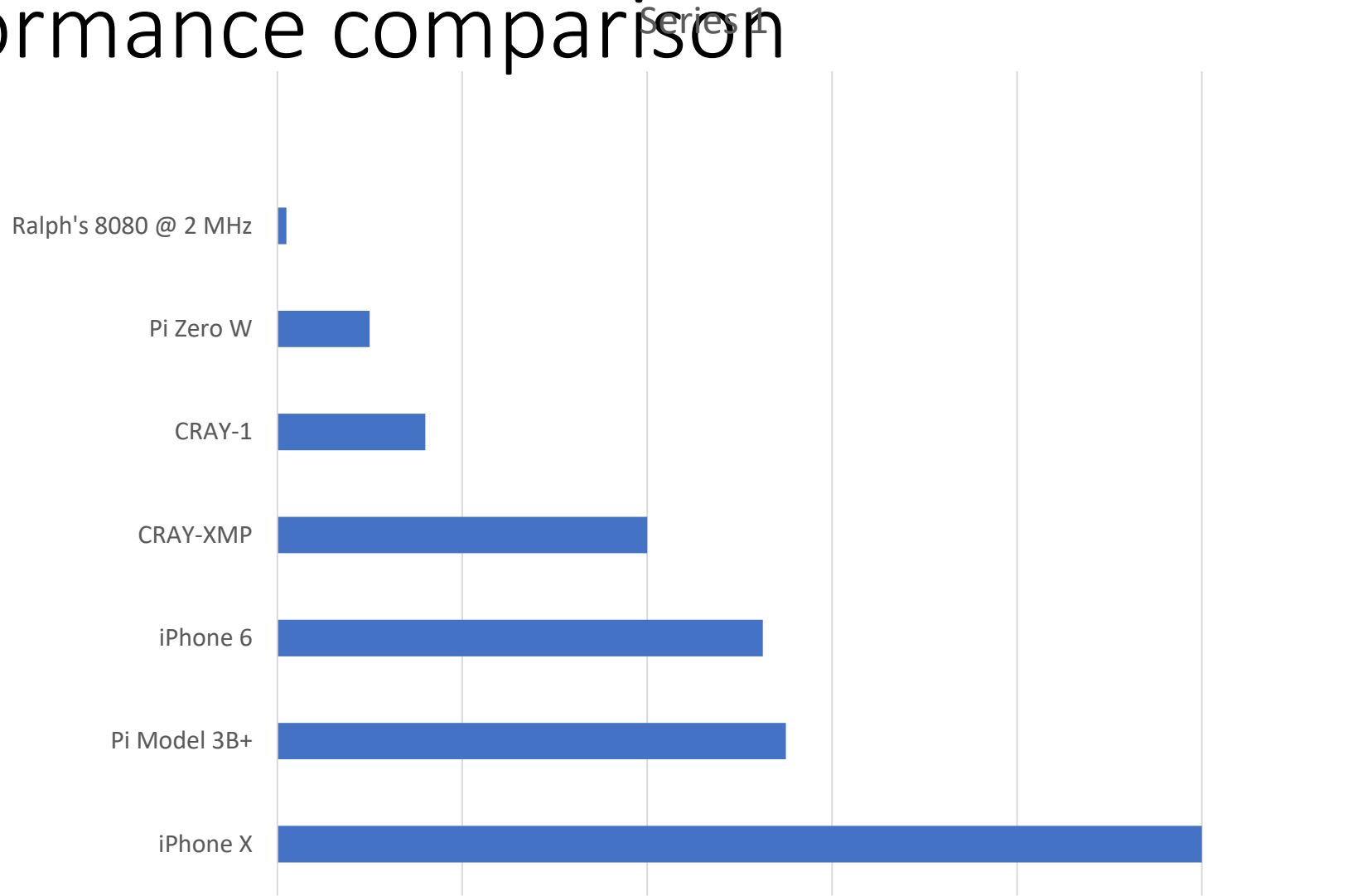
Performance comparison



VS



Performance comparison



Raspberry Pi vs “Arduino”

- Arduino is a micro-controller
- Raspberry Pi, a general purpose micro-computer
- Each has its strengths, depending on the purpose
- Overlap in functionality
- Often work together in a symbiotic relationship
 - Arduino as a data gatherer and pre-processor
 - Pi for the analytics, presentation, or data archiving

Raspberry Pi vs “Arduino”

Which is best for a starter system?

Not as easy to answer.

How Do I Get Started?

Getting Started – The essentials

Raspberry Pi 3 , Pi Zero W, or Pi Zero WH (with header).

MicroSD card – 4 GB or larger. Class 10 recommended.

5V supply capable of delivering 2.5 amps; average draw much less than 1A.

My switchers have been pretty quiet.



USB Keyboard and mouse – wireless dongles work, Bluetooth as well.

HDMI cable (Mini-HDMI for Pi Zero)

Case. Highly recommended and large variety available.

A means to transfer software image to MicroSD card.

Getting Started – The extras

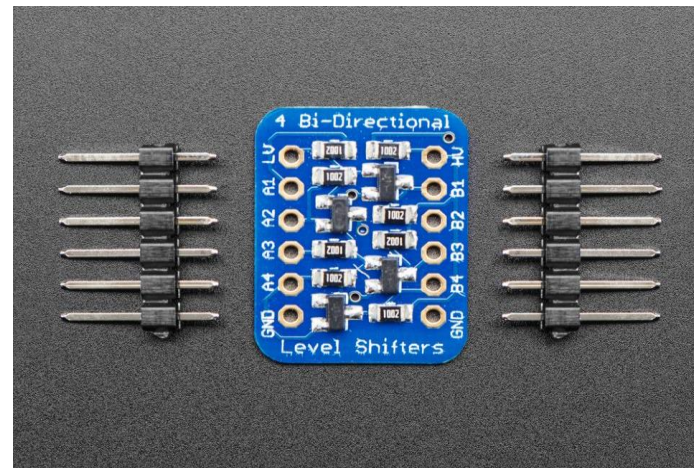
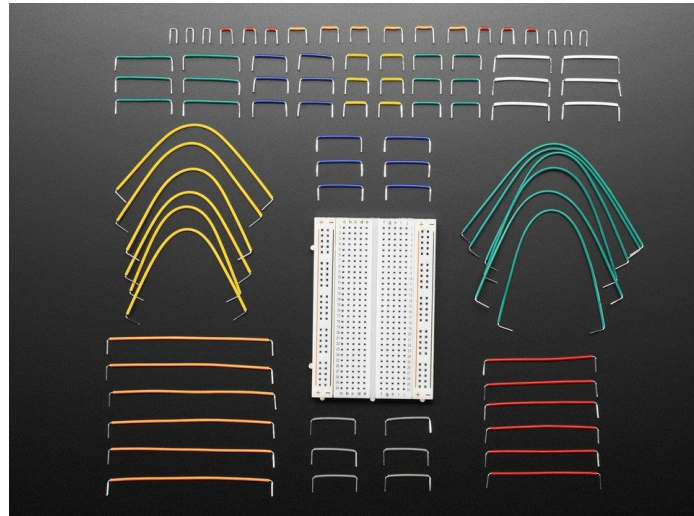
Breadboard

Wire jumpers for breadboard

Jumper assortment (MF, FF, and MM)

Bi-directional level converter from 5V logic level to 3V

MicroSD card reader, if not built in to your computer.



GPS, Sensors, Relays, HATs, Oh My

GPS board (Did I hear you say, APRS?)

Weather sensors – Temperature, humidity, and barometric pressure

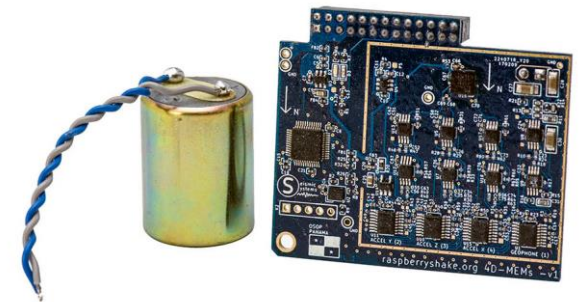
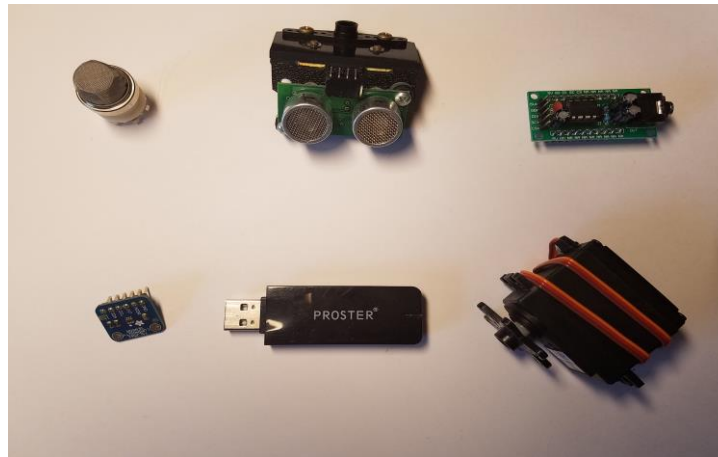
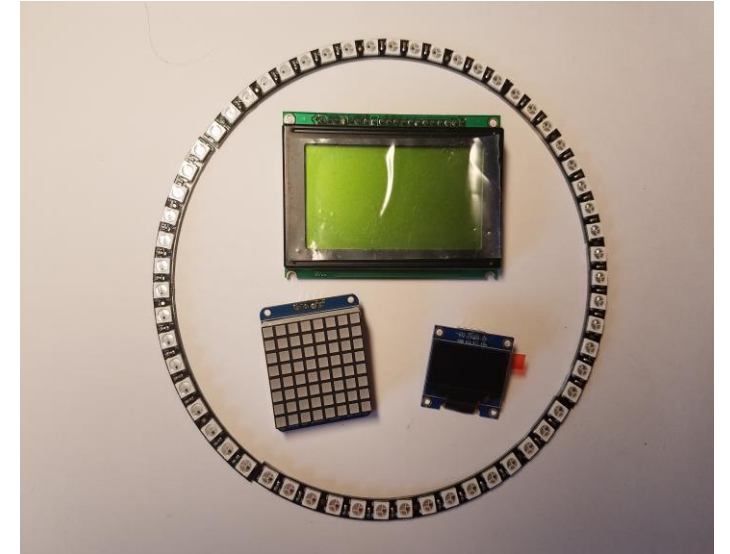
Motion and proximity sensors, range finders (laser TOF, IR, and ultrasonic), sound and noise detectors.

Relay boards to isolate Pi from mains.

Video and still cameras

Daughter boards (Hardware Attached on Top or HAT)

And much, much more.



Let's Get Started – Step by Step

The Raspberry Pi site (<https://www.raspberrypi.org>) has a wealth of information about setting up and using your Raspberry Pi.

There is a page on installing an operating system on the Pi, which can be seen here:

<https://www.raspberrypi.org/documentation/installation/installing-images/>

The next few slides will summarize the process.

Let's Get Started – Step by Step

1. Obtain a software image
 - a. <https://www.raspberrypi.org/downloads/>
 - b. http://www.sdrplay.com/software/SDRplay_RPi3_V0.3.img.7z
 - c. <https://www.microsoft.com/en-us/software-download/windows10IoTCore>
2. Download and move the image to the Micro SD card
 - a. Download the Raspberry Pi image to your local computer.
 - b. Insert a MicroSD card into your computer's card reader or external adapter.
 - c. Using a disk image utility, such as Etcher (<https://etcher.io> Windows, Mac, or Linux), transfer the image to the MicroSD card.
3. Plug the MicroSD card into the Pi, contacts side up.

Let's Get Started – Step by Step

4. Attach a monitor to the Pi using the HDMI, Mini-HDMI, or Composite video port.
5. Plug in a USB keyboard and mouse (or dongle for USB kb and mouse).
6. Attach 5V power supply (2.0-2.5 amps) and apply power.
7. If all goes well, you will see four Raspberry Pi images and the operating system will begin to boot.
8. The desktop will display after a minute or so (or the login prompt if you are not using the desktop).

Let's Get Started – Step by Step

9. Configure the WiFi settings, if you want the Pi to be on the network.
10. Under the Configuration menu, set the time zone, keyboard language, and WiFi country.
11. Optionally, turn on SSH (secure shell) and the VNC (Virtual Network Computing) server. This will allow access to the Pi from other computers. **USE WITH CAUTION AND CHANGE THE DEFAULT PASSWORD!**

What can I do with this thing?

Home Automation

Home Assistant <https://www.home-assistant.io/>

OpenHAB <https://www.openhab.org/>

- Raspberry Pi “ready-to-flash” images available
- Highly customizable
- Alexa and Google Home supported
- Custom integrations such as homebrew controllers and radio control are easily incorporated and controlled locally (e.g., not in the cloud)

Home Assistant

Overview

Map

Logbook

History

Hass.io

Configuration

Log out

Developer tools

Home Assistant

HOME DOWNSTAIRS UPSTAIRS GARAGE ENVIRONMENT

Climate

Living Room Cool 68 °F
Currently: 71 °F

Temperature 82.6 °F

Servers

creativewidgetworks.com On

donationmaster.com On

downstairs_lights_overview

Dining Room

Floor light

Table Light 1

Table Light 2

Christmas Tree Lights

Weather Underground

High Temperature Record (2005) 90 °F

High Temperature Today 93 °F

Temperature 82.6 °F

Low Temperature Today 72 °F

Low Temperature Record (2000) 52 °F

Precipitation Probability Today 0 %

Precipitation Intensity Today 0 mm

Wind Speed 0 kph

Mjpeg Camera(Image not available)

Switch

Aeotec ZW111 Nano Dimmer Switch

Aeotec ZW130 WallMote Quad Switch

ESwitch 1

fan low

Z-Wave

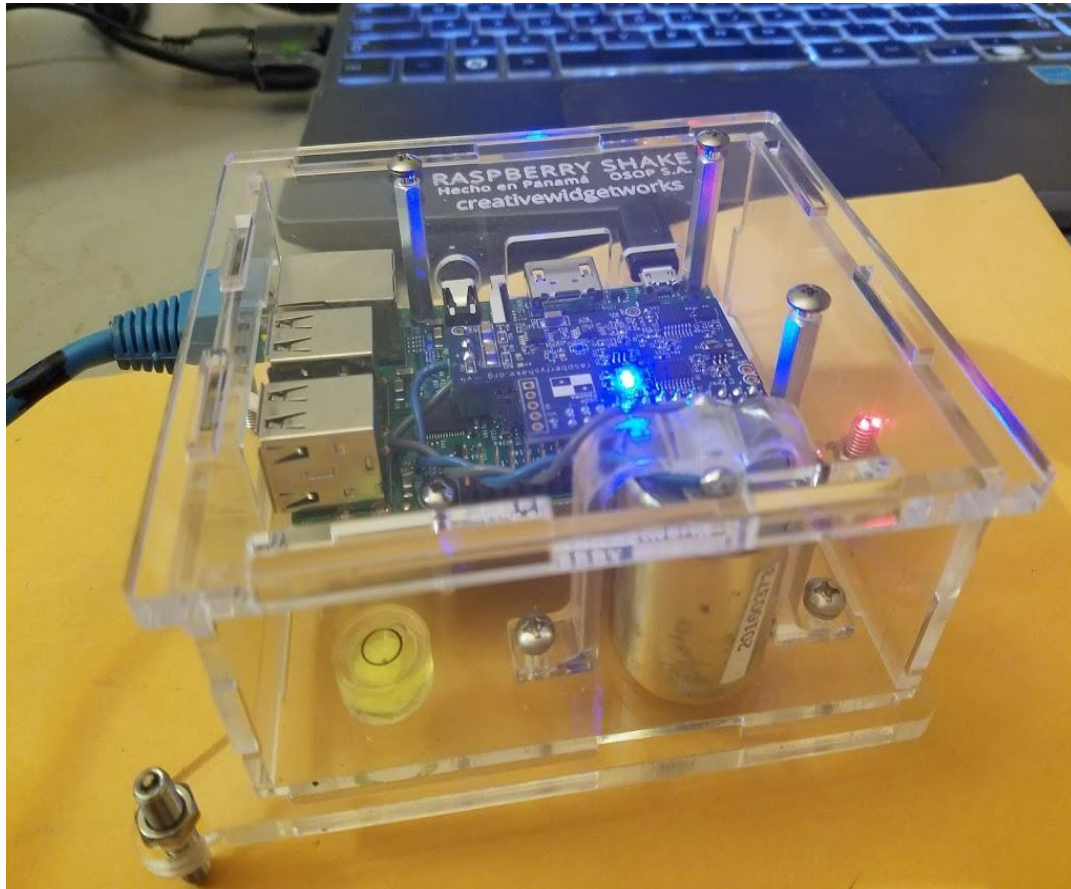
Aeotec ZW111 Nano Dimmer Ready

Light

Linear LB60Z-1 Dimmable LED Light Bulb Lev...

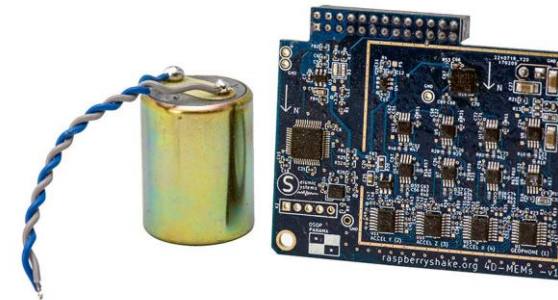
Linear LB60Z-1 Dimmable LED Light Bulb Lev...

Monitor Earthquakes

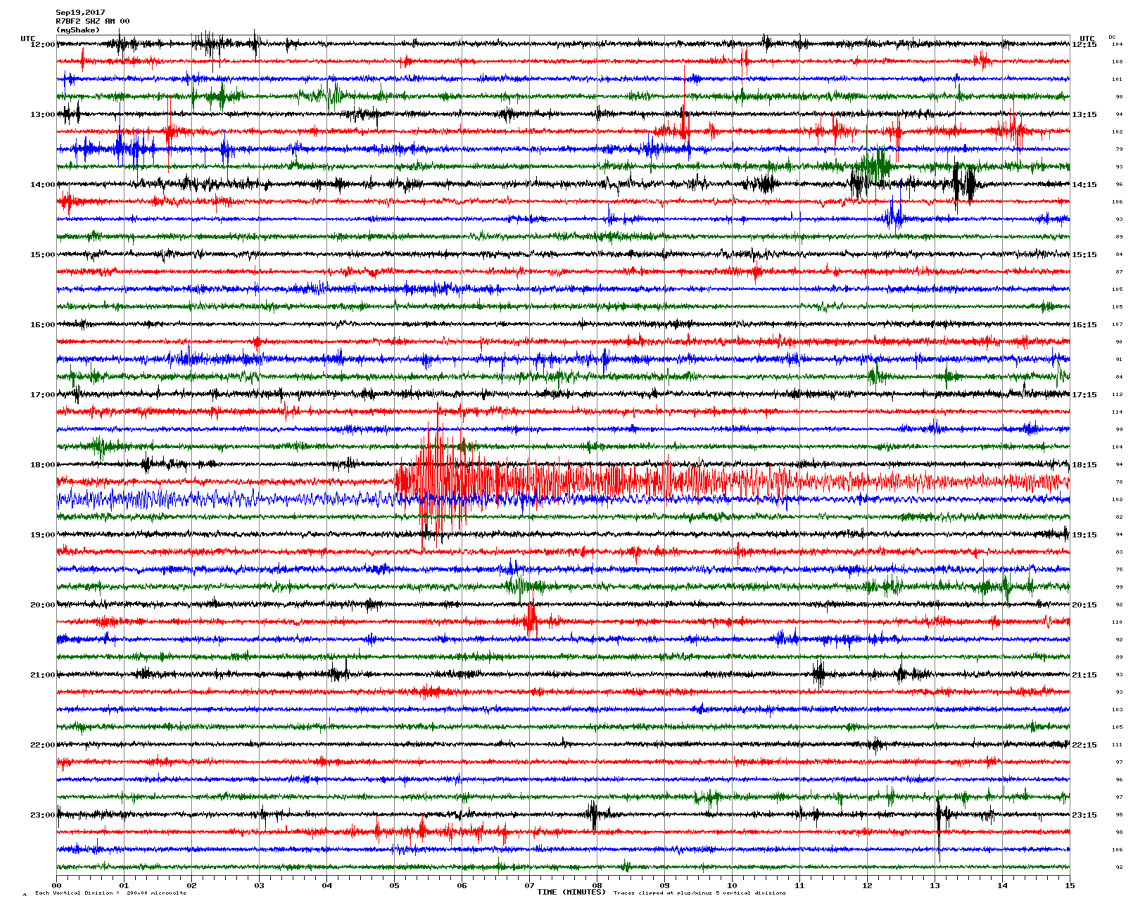
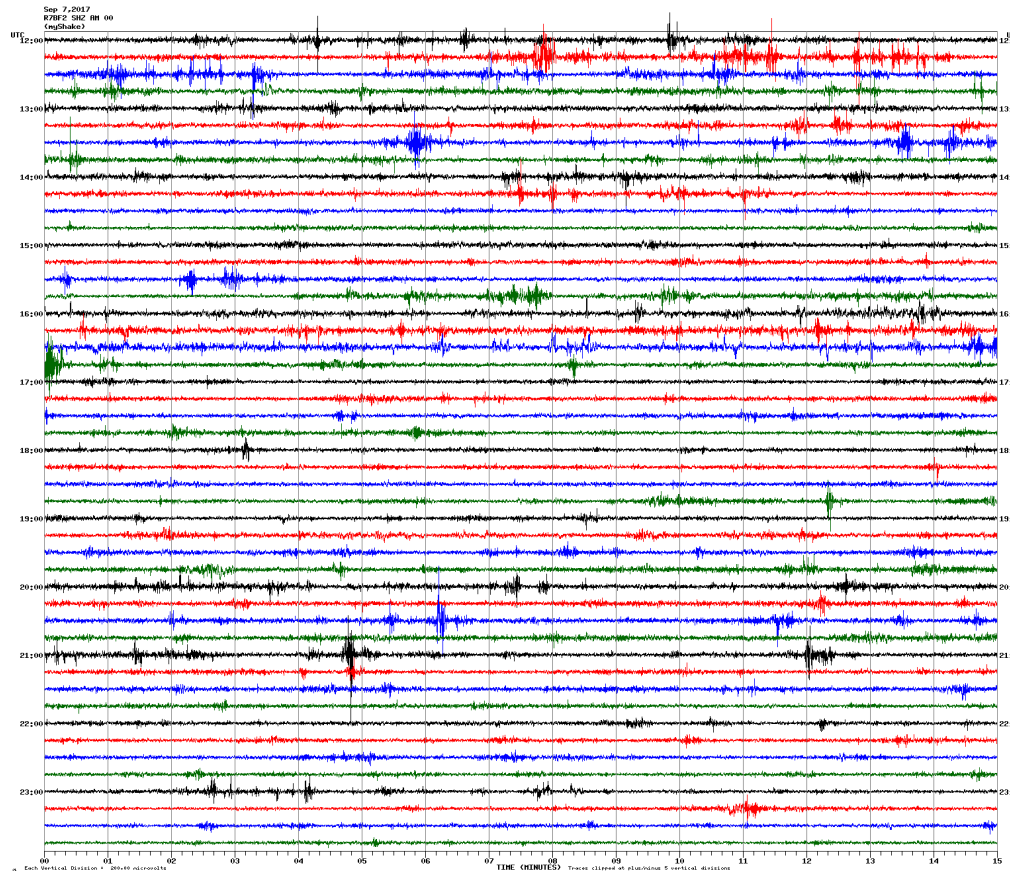


A world-wide network of sensors operated by citizen scientists.

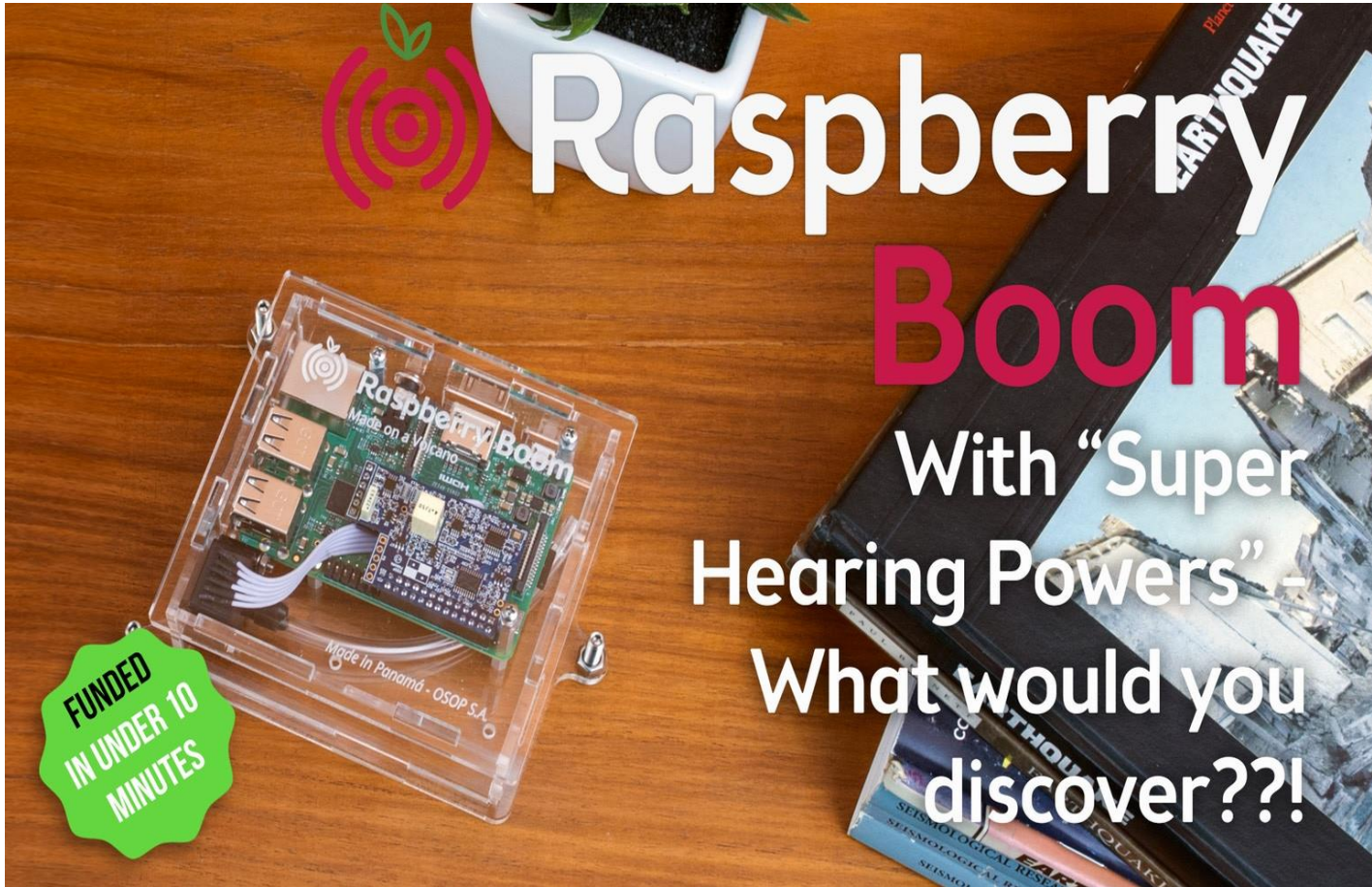
Data is streamed and combined with data from USGS, Gempa, and others to provide an unprecedented view of seismic activity – including rocket launches and underground nuclear tests.



Monitor Earthquakes



Atmospheric Monitor



Building upon the Raspberry Shake's data collection and reporting framework, the Boom is an infrasound monitor.

I will be deploying this unit soon and I am looking forward to seeing what it can detect.

An infrasound monitor is well suited to detect explosions, avalanches, thunder, tornadoes, fireworks, rocket launches, and more.

WSPR Transmitter

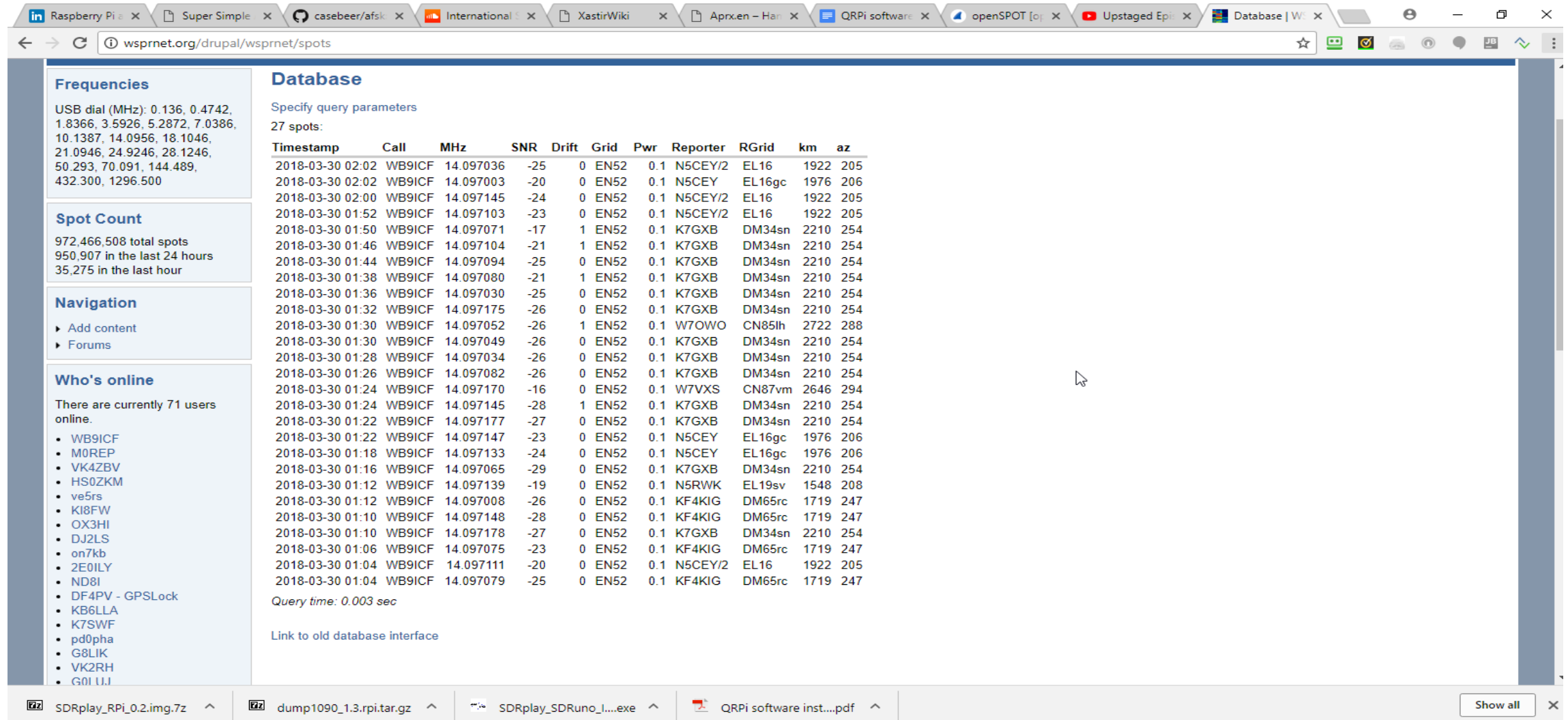


A GPIO pin can be used to generate a wide range of frequencies!

The output is a square wave, so it needs to pass through a low-pass (LP) filter to clean up the waveform.

The LP filter can be homebrewed, but Tucson Amateur Packet Radio has produced a Pi HAT that combines the filter with a buffer to protect the Pi.

WSPR Transmitter – 1691 miles with .1 watt



The screenshot shows a web browser window with the URL `wspnet.org/drupal/wspnet/spots`. The page displays a table of 27 WSPR spots. The left sidebar contains navigation links for Frequencies, Spot Count, Navigation, and Who's online. The main content area is titled 'Database' and shows a list of spots with columns for Timestamp, Call, MHz, SNR, Drift, Grid, Pwr, Reporter, RGrid, km, and az. The bottom of the browser window shows a taskbar with several open applications.

Frequencies

USB dial (MHz): 0.136, 0.4742, 1.8366, 3.5926, 5.2872, 7.0386, 10.1387, 14.0956, 18.1046, 21.0946, 24.9246, 28.1246, 50.293, 70.091, 144.489, 432.300, 1296.500

Spot Count

972,466,508 total spots
950,907 in the last 24 hours
35,275 in the last hour

Navigation

- Add content
- Forums

Who's online

There are currently 71 users online.

- WB9ICF
- M0REP
- VK4ZBV
- HS0ZKM
- ve5rs
- KI8FW
- OX3HI
- DJ2LS
- on7kb
- 2E0ILY
- ND8I
- DF4PV - GPSLock
- KB6LLA
- K7SWF
- pd0pha
- G8LIK
- VK2RH
- G0I UJ

Database

Specify query parameters

27 spots:

Timestamp	Call	MHz	SNR	Drift	Grid	Pwr	Reporter	RGrid	km	az
2018-03-30 02:02	WB9ICF	14.097036	-25	0	EN52	0.1	N5CEY/2	EL16	1922	205
2018-03-30 02:02	WB9ICF	14.097003	-20	0	EN52	0.1	N5CEY	EL16gc	1976	206
2018-03-30 02:00	WB9ICF	14.097145	-24	0	EN52	0.1	N5CEY/2	EL16	1922	205
2018-03-30 01:52	WB9ICF	14.097103	-23	0	EN52	0.1	N5CEY/2	EL16	1922	205
2018-03-30 01:50	WB9ICF	14.097071	-17	1	EN52	0.1	K7GXB	DM34sn	2210	254
2018-03-30 01:46	WB9ICF	14.097104	-21	1	EN52	0.1	K7GXB	DM34sn	2210	254
2018-03-30 01:44	WB9ICF	14.097094	-25	0	EN52	0.1	K7GXB	DM34sn	2210	254
2018-03-30 01:38	WB9ICF	14.097080	-21	1	EN52	0.1	K7GXB	DM34sn	2210	254
2018-03-30 01:36	WB9ICF	14.097030	-25	0	EN52	0.1	K7GXB	DM34sn	2210	254
2018-03-30 01:32	WB9ICF	14.097175	-26	0	EN52	0.1	K7GXB	DM34sn	2210	254
2018-03-30 01:30	WB9ICF	14.097052	-26	1	EN52	0.1	W7OWO	CN85lh	2722	288
2018-03-30 01:30	WB9ICF	14.097049	-26	0	EN52	0.1	K7GXB	DM34sn	2210	254
2018-03-30 01:28	WB9ICF	14.097034	-26	0	EN52	0.1	K7GXB	DM34sn	2210	254
2018-03-30 01:26	WB9ICF	14.097082	-26	0	EN52	0.1	K7GXB	DM34sn	2210	254
2018-03-30 01:24	WB9ICF	14.097170	-16	0	EN52	0.1	W7VXS	CN87vm	2646	294
2018-03-30 01:24	WB9ICF	14.097145	-28	1	EN52	0.1	K7GXB	DM34sn	2210	254
2018-03-30 01:22	WB9ICF	14.097177	-27	0	EN52	0.1	K7GXB	DM34sn	2210	254
2018-03-30 01:22	WB9ICF	14.097147	-23	0	EN52	0.1	N5CEY	EL16gc	1976	206
2018-03-30 01:18	WB9ICF	14.097133	-24	0	EN52	0.1	N5CEY	EL16gc	1976	206
2018-03-30 01:16	WB9ICF	14.097065	-29	0	EN52	0.1	K7GXB	DM34sn	2210	254
2018-03-30 01:12	WB9ICF	14.097139	-19	0	EN52	0.1	N5RWW	EL19sv	1548	208
2018-03-30 01:12	WB9ICF	14.097008	-26	0	EN52	0.1	KF4KIG	DM65rc	1719	247
2018-03-30 01:10	WB9ICF	14.097148	-28	0	EN52	0.1	KF4KIG	DM65rc	1719	247
2018-03-30 01:10	WB9ICF	14.097178	-27	0	EN52	0.1	K7GXB	DM34sn	2210	254
2018-03-30 01:06	WB9ICF	14.097075	-23	0	EN52	0.1	KF4KIG	DM65rc	1719	247
2018-03-30 01:04	WB9ICF	14.097111	-20	0	EN52	0.1	N5CEY/2	EL16	1922	205
2018-03-30 01:04	WB9ICF	14.097079	-25	0	EN52	0.1	KF4KIG	DM65rc	1719	247

Query time: 0.003 sec

[Link to old database interface](#)

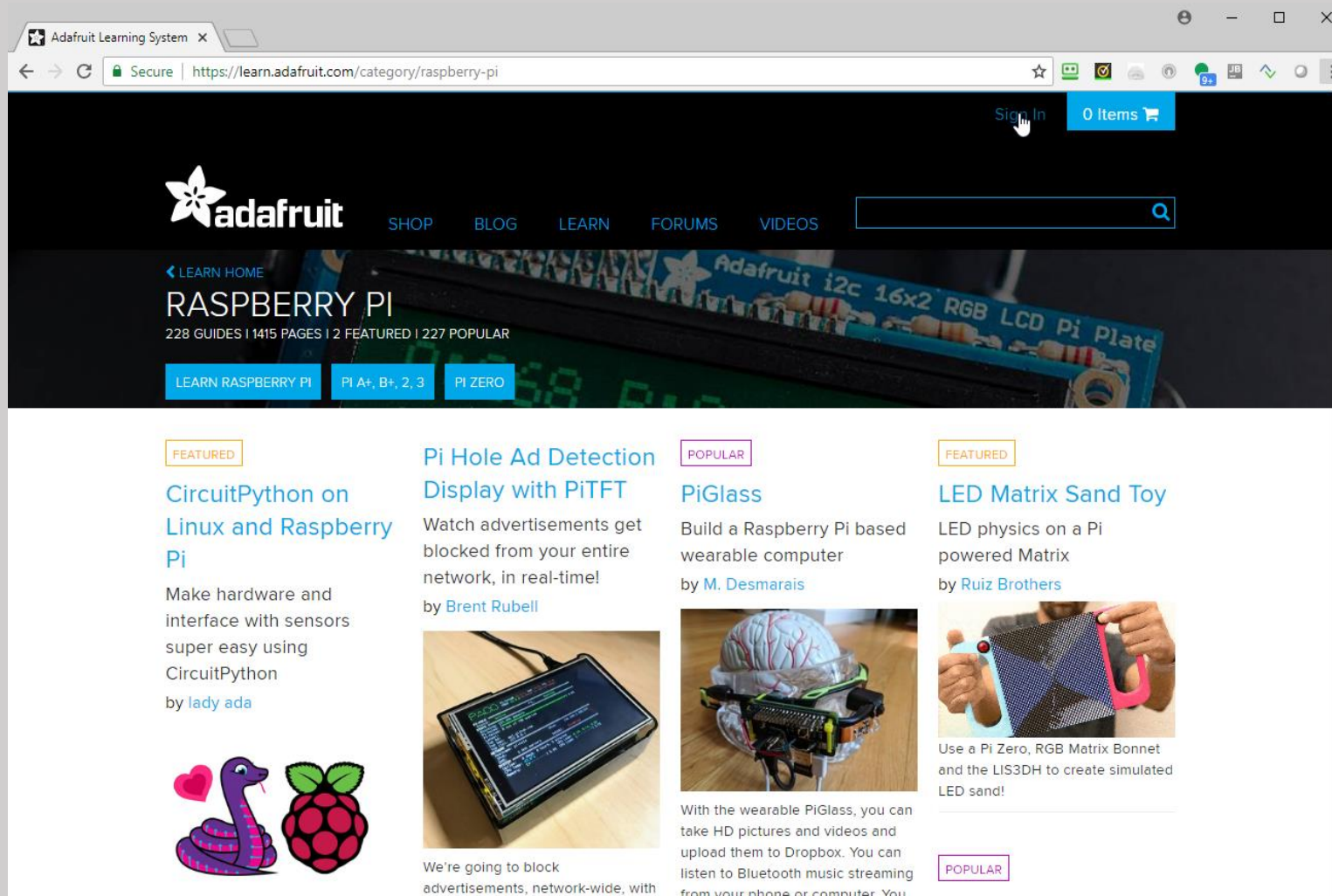
Taskbar: SDRplay_RPi_0.2.img.7z, dump1090_1.3.rpi.tar.gz, SDRplay_SDRUno_1....exe, QRPI software inst....pdf, Show all

Now for some live demos

- Raspberry Pi Desktop walkthrough
- Google Voice Kit
- Raspberry Boom and the earthquake data center
- SDRPlay distro
 - ADS-B (dump1090)
 - CubicSDR
 - SDR-J DAB receiver
 - SoapySDR/SoapySDRPlay
 - SoapyRemote

Resources

Adafruit



<https://learn.adafruit.com/category/raspberry-pi>

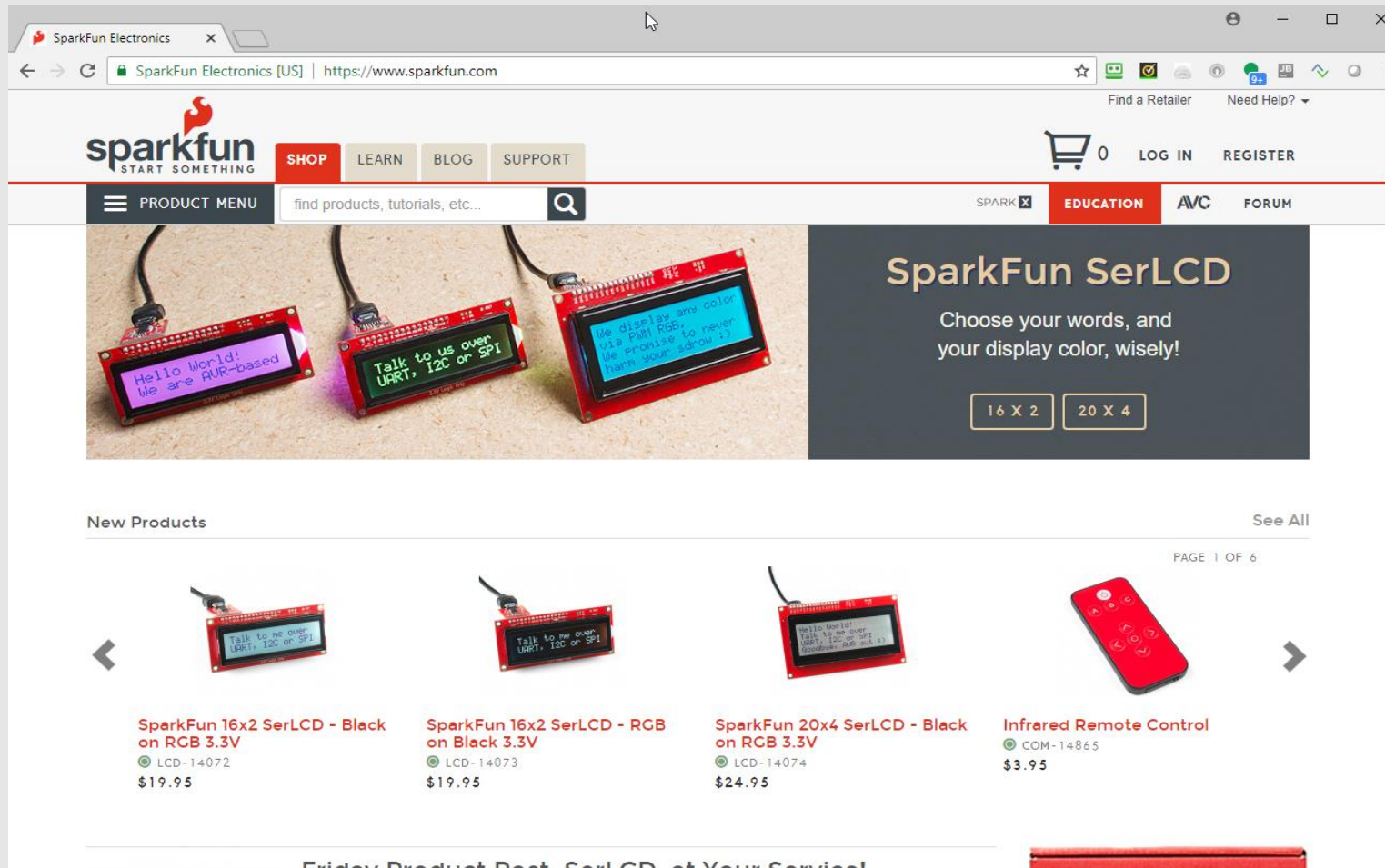
Limor Fried, AC2SN, founder

Diverse product lineup including Raspberry Pi, Arduino, components, and their own products engineered and built by Adafruit.

Hundreds of projects and tutorials complete with WORKING software.

Adafruit products are also available from DigiKey and Mouser.

Sparkfun



<https://sparkfun.com>

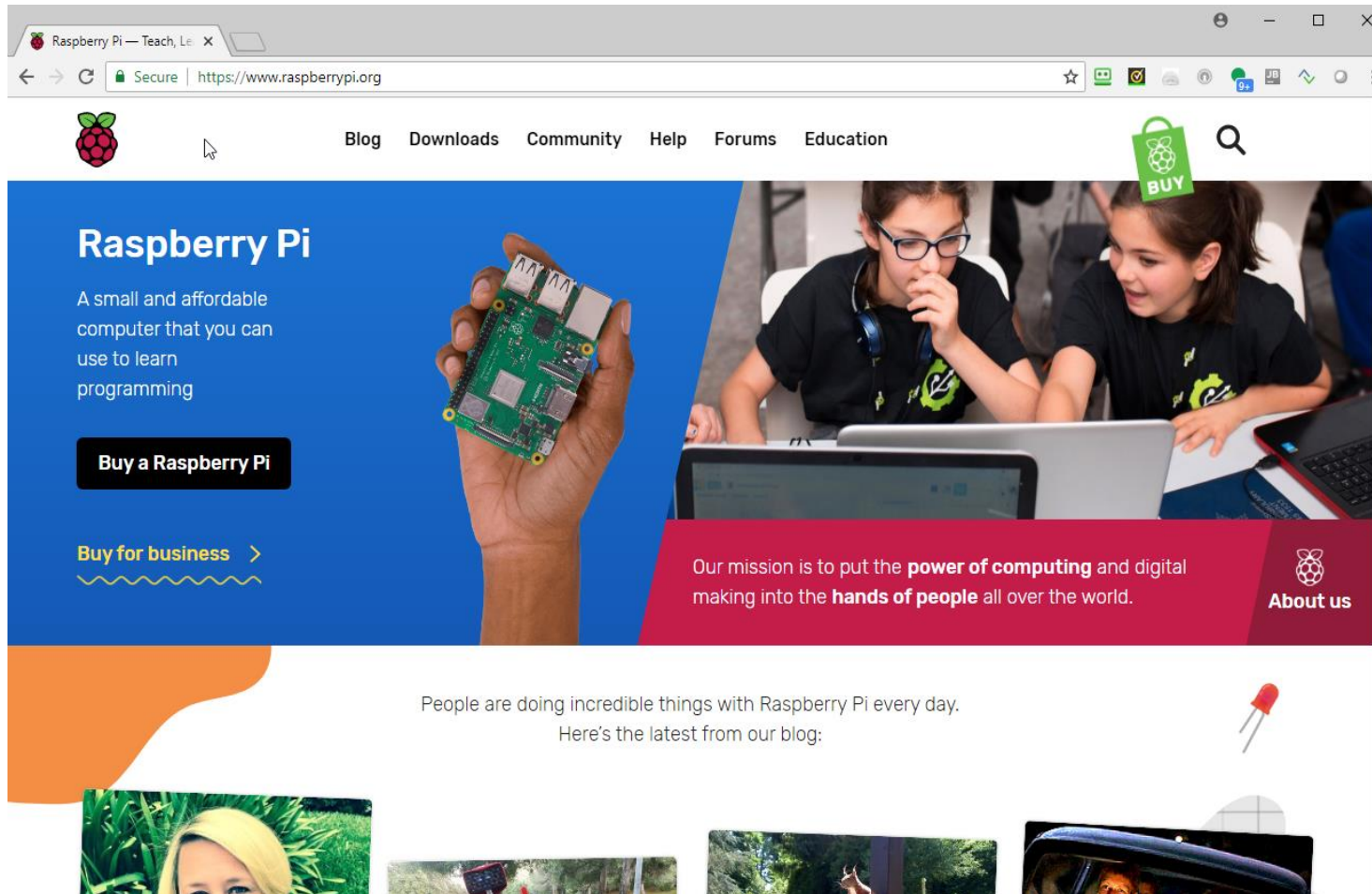
Founded In 2003, by Colorado University student Nate Seidle. Sparkfun has grown into a multi-million enterprise.

Carries a wide variety of products including ones created by Sparkfun.

Engineering quality is generally excellent, although sometimes there are minor issues with the custom board design or software drivers. Still, an excellent resource.

Forum with thousands of topics.

Raspberry Pi Foundaton/MagPi



The official source for all things Pi.

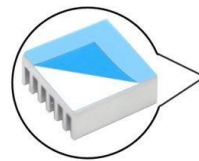
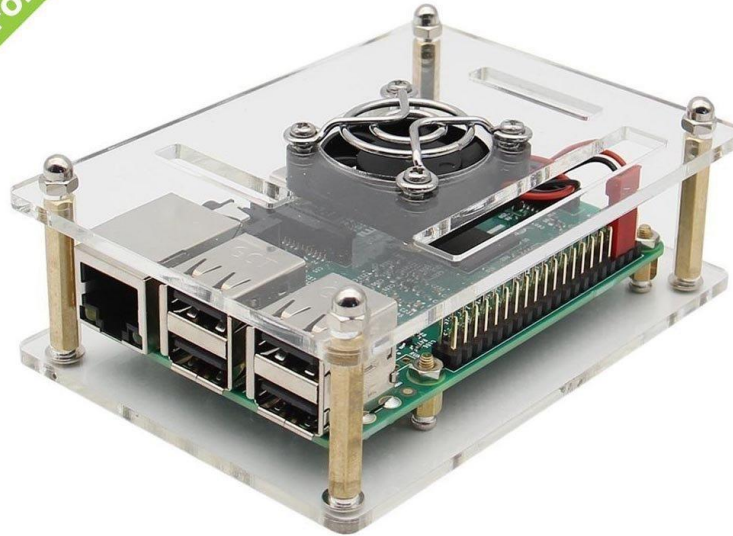
RaspberryPi.org publishes MagPi , the official magazine for the Raspberry Pi.

Features a vibrant community of users and a forum with hints, How-Tos, and more.

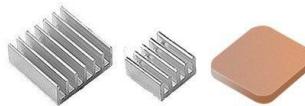
<https://www.raspberrypi.org> <https://www.raspberrypi.org/magpi/>

Raspberry Pi 3 B+ case with fan - \$8.95

<https://www.amazon.com/gp/product/B01LXSMY1N>



Thermal Tape



Google Voice Kit Version 1 - \$9.95

https://www.amazon.com/gp/product/B075SFLWKX/ref=oh_aui_detailpage_o02_s00?ie=UTF8&psc=1



Where to go from here?

- Introduction to “Arduino”/ESP-8266?
- Club project for a Raspberry Pi or Arduino project?
- Enough of this stuff, let’s eat some real raspberry pie.

Questions?

<http://creativewidgetworks.com>

riden@creativewidgetworks.com