

# Single Board Computers

Raspberry Pi, Linux, Alternatives

September 27, 2018

# What is in a computer?

CPU

Memory

I/O controllers

External storage

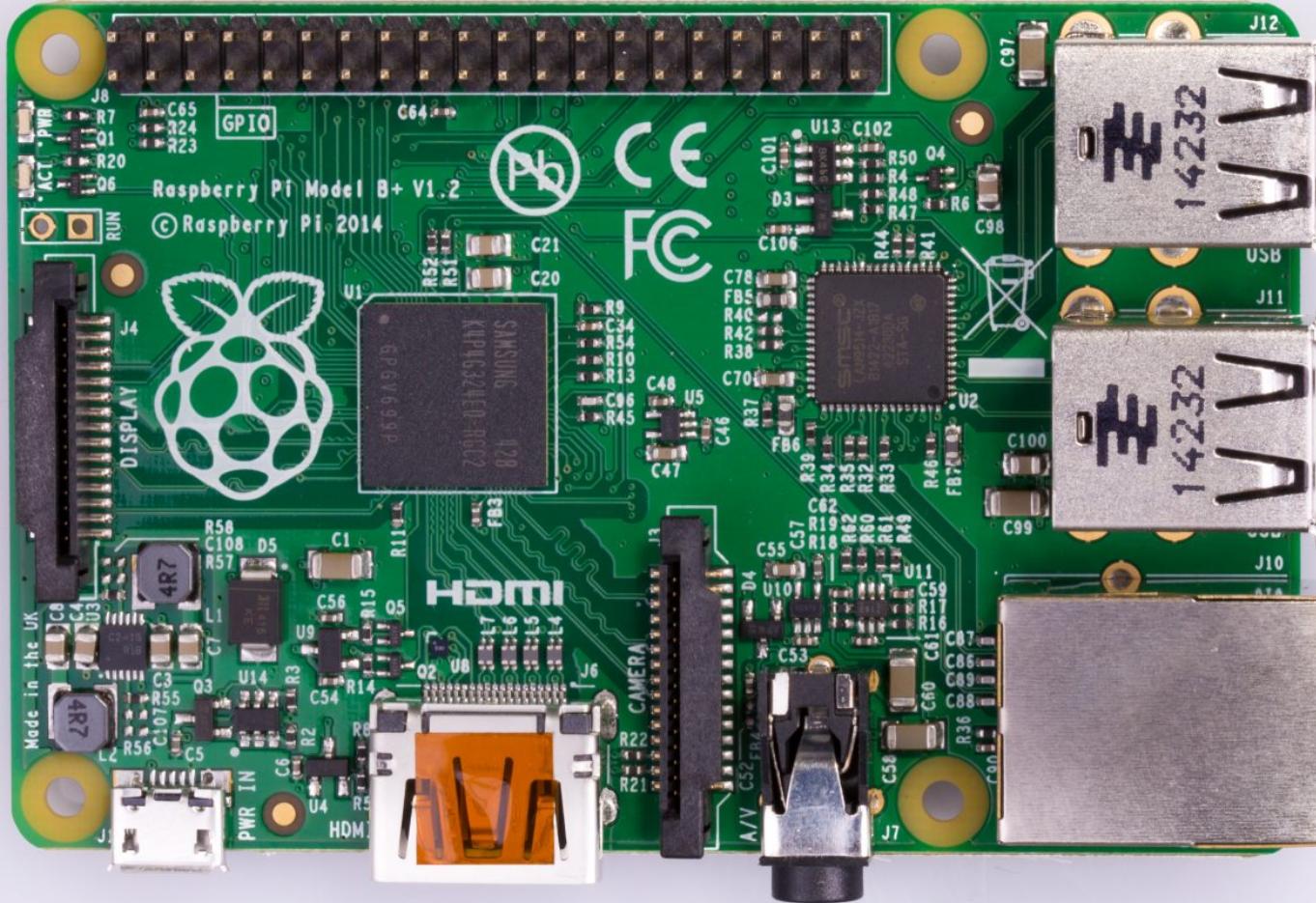


photo from WikiMedia, user Herb fargus

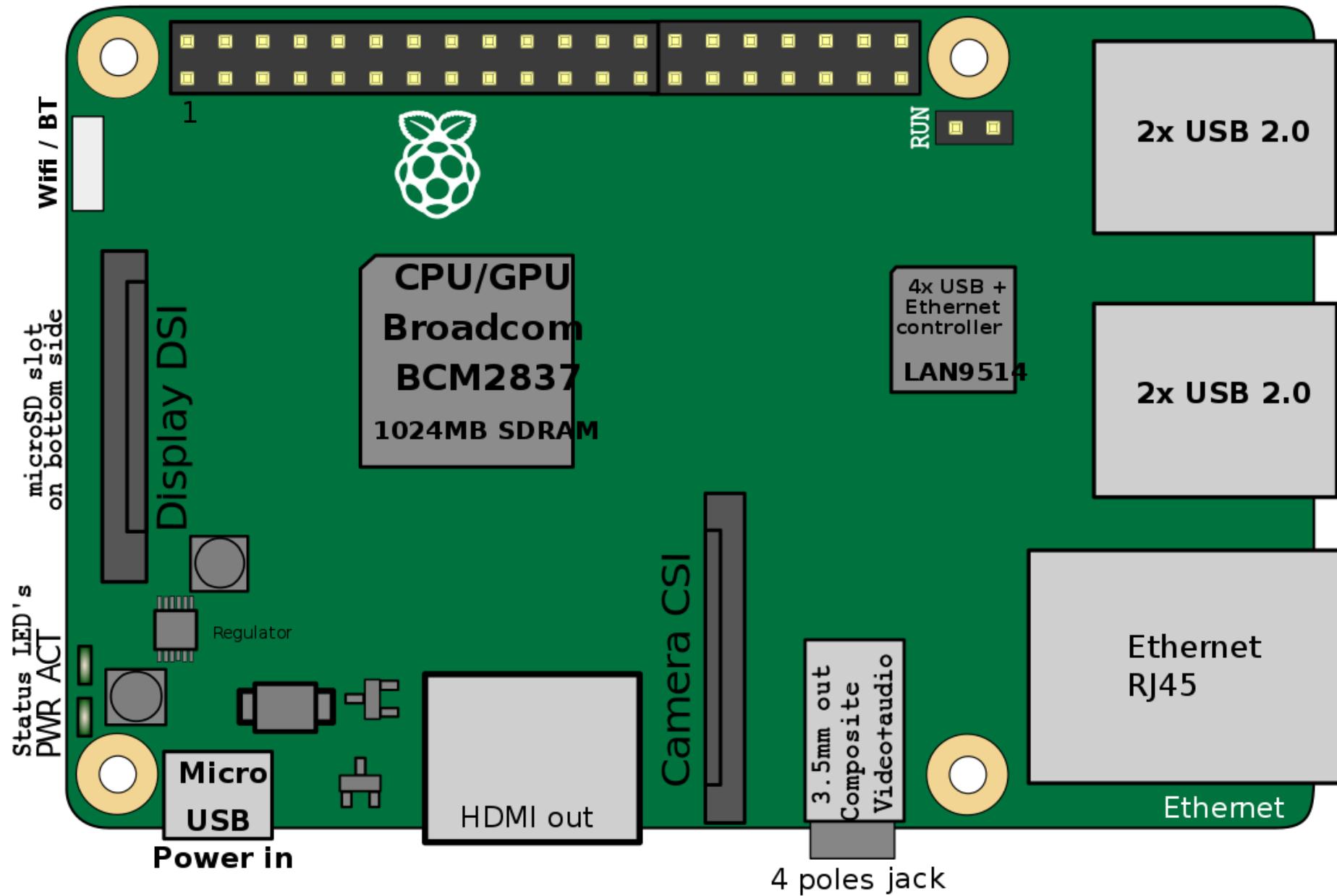


diagram from Wikimedia, user Era

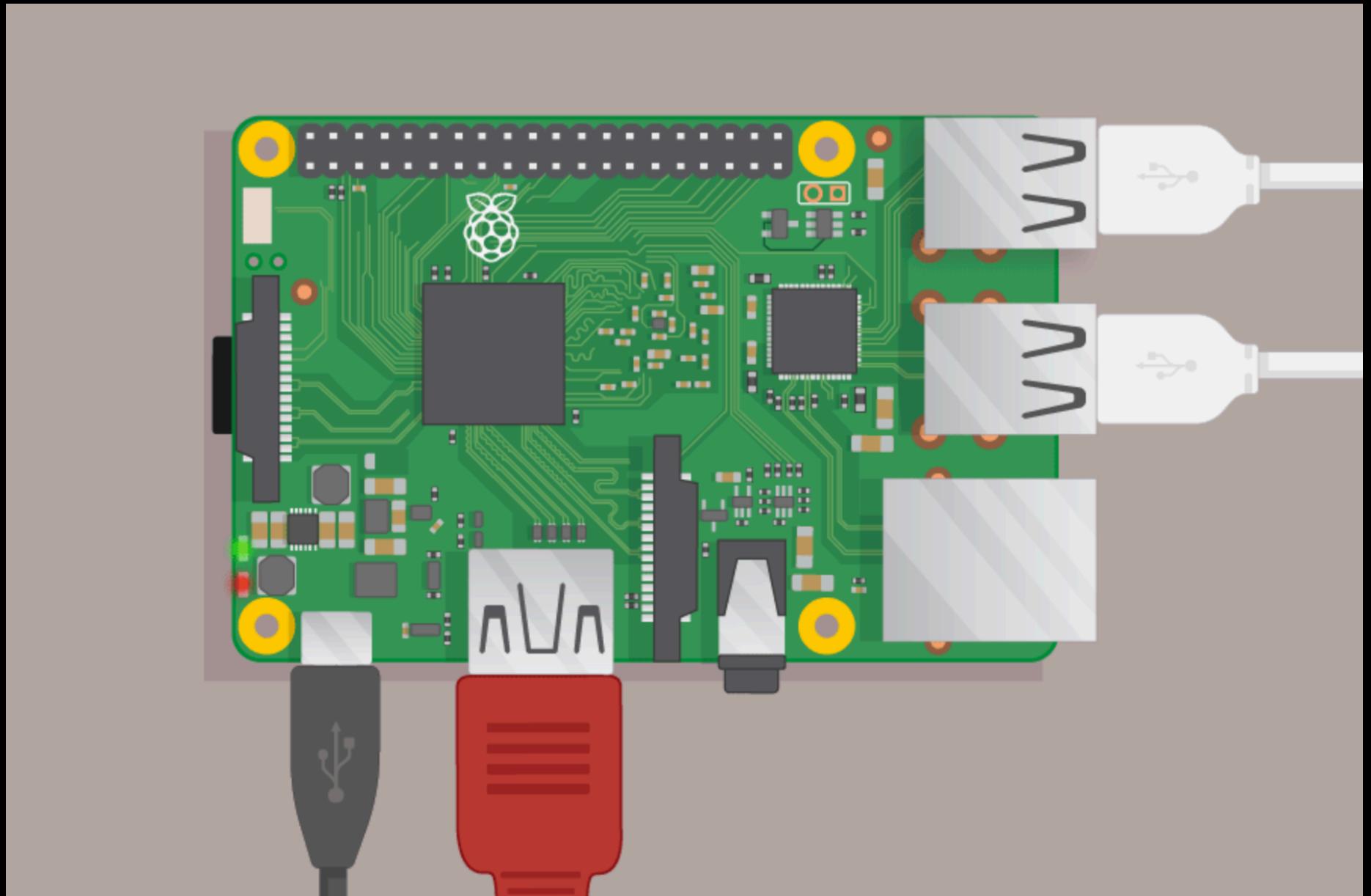


diagram from [RaspberryPi.org](https://www.raspberrypi.org)

# Raspberry Pi

From the UK, specifically for education

15 million sold (as of July 2017) \* Raspberry Pi Foundation,  
3rd best-selling general purpose computer

# Raspberry Pi B+

Microprocessor: ARM-based CPU, on-chip GPU

Storage: microSD card

Uses normal computer connectors, peripherals

Audio, Video output: 3.5mm headphone, HDMI

Peripheral I/O: 4 USB

Networking: 802.11n, Ethernet, Bluetooth

Target price: \$35

# Linux



Based on UNIX command set

Began in 1991 as personal  
project of Finnish student Linus  
Torvalds to make a free OS  
kernel based on the x86

Free

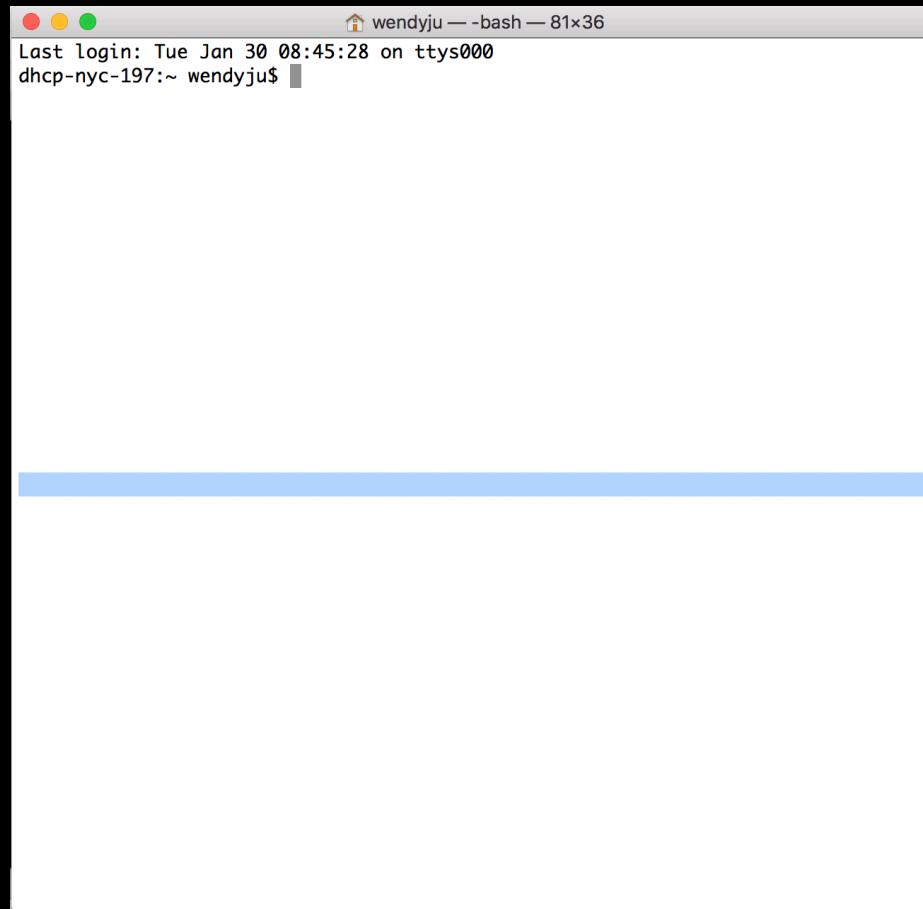
Open source

image: December 2002 issue of Linux Magazine, retrieved from Wikipedia

# Before the dawn of GUI

image: <http://blogs.nobl.k12.in.us/hurstes/files/2014/02/image-281kb6h.jpg>

# Unix/Linux



Demo in Terminal (Window users can use PuTTY)

# Unix Commands

ls

cd

mkdir

cp

mv

rm

cat

# Unix Commands

ssh - secure shell

scp - secure copy

# Operating Systems

Wikipedia:An operating system (OS) is system software that manages computer hardware and software resources and provides common services for computer programs.

User Interface

3rd party software availability

Ability to integrate peripherals

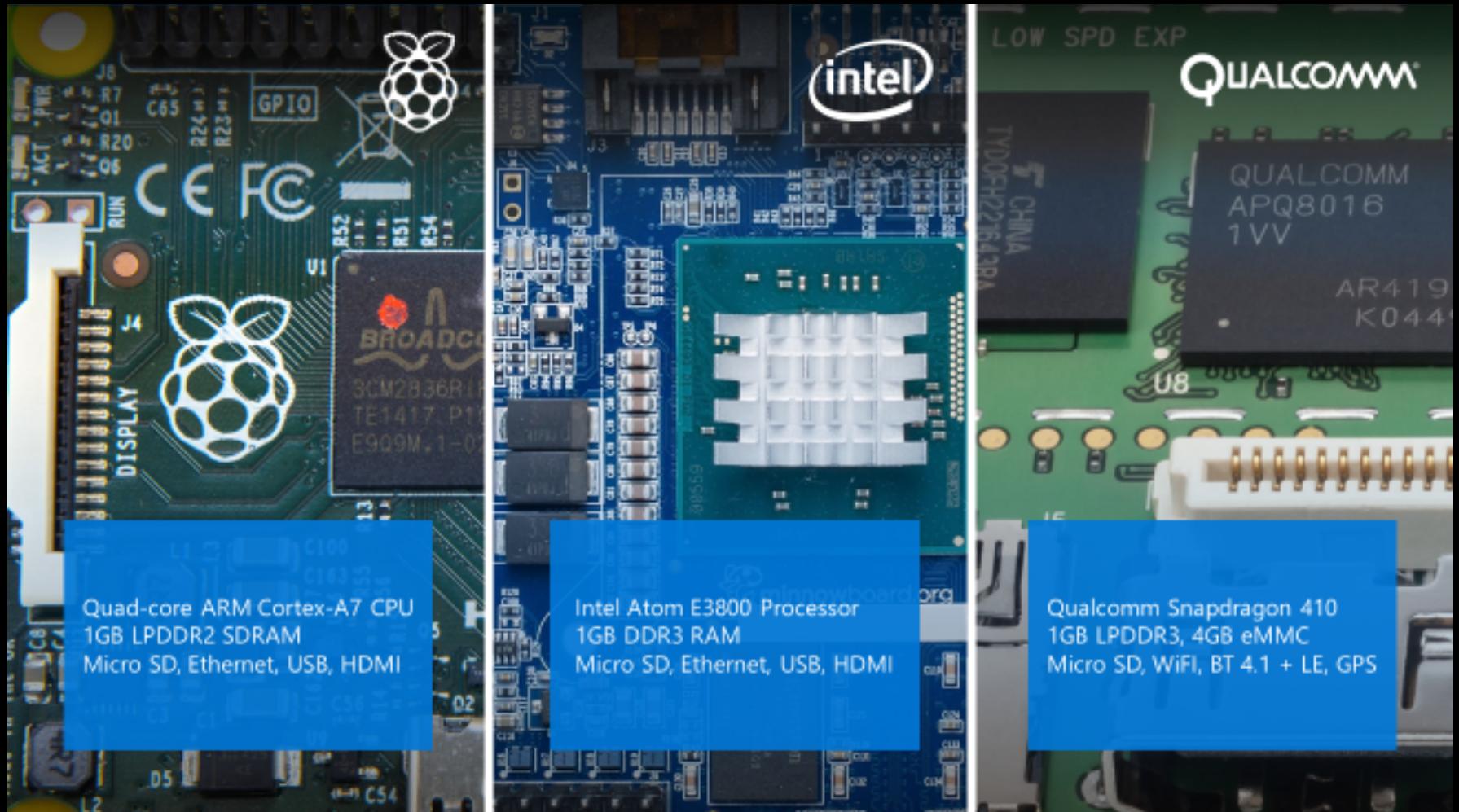
# Android



“Linux makes up the core part of Android, but Google hasn’t added all the typical software and libraries you’d find on a Linux distribution like Ubuntu. This makes all the difference.”

Android allows central vetting of applications.

# Windows 10 IoT



<https://blogs.windows.com/windowsexperience/2015/03/18/windows-10-iot-powering-the-internet-of-things/>

windows-10-iot-powering-the-internet-of-things/

# Windows 10 IoT

Not open source

More peripherals likely to work

Allows you to program in Visual

Studio and run code on Pi

Not a lot of community support

# Pi Alternatives

# BeagleBone Black Wireless

Based on ARM Cortex A8

\$75 MSRP

Less connectivity, more GPIO

Low power consumption

*Intended to be integrated into  
products*

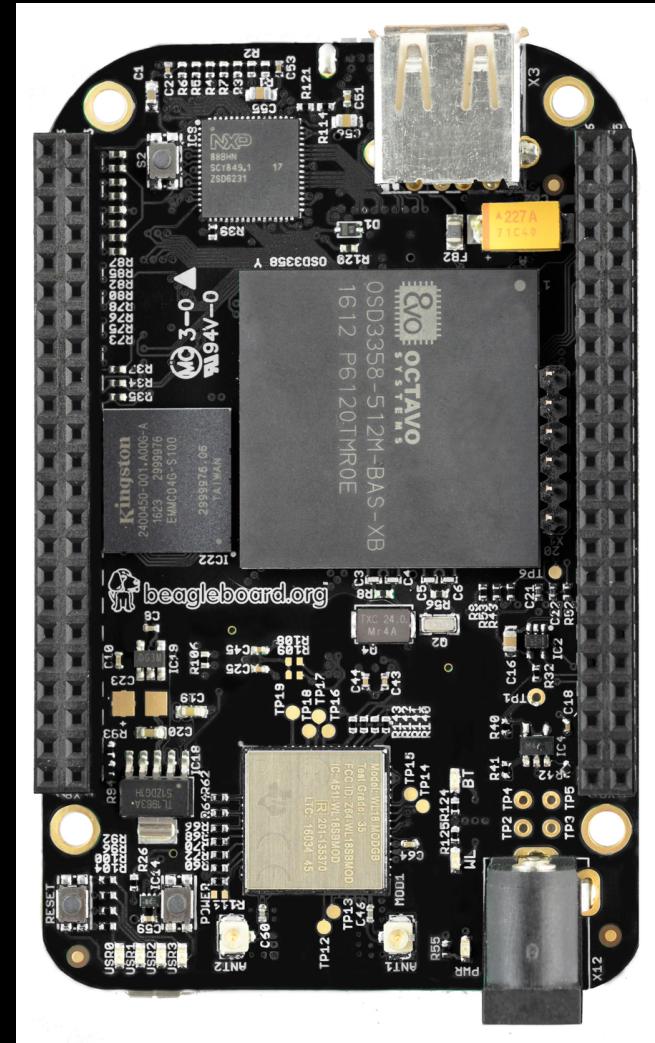


image: <https://beagleboard.org/black-wireless>

# ODROID-XU4

Based on ARM Cortex

~\$60 MSRP

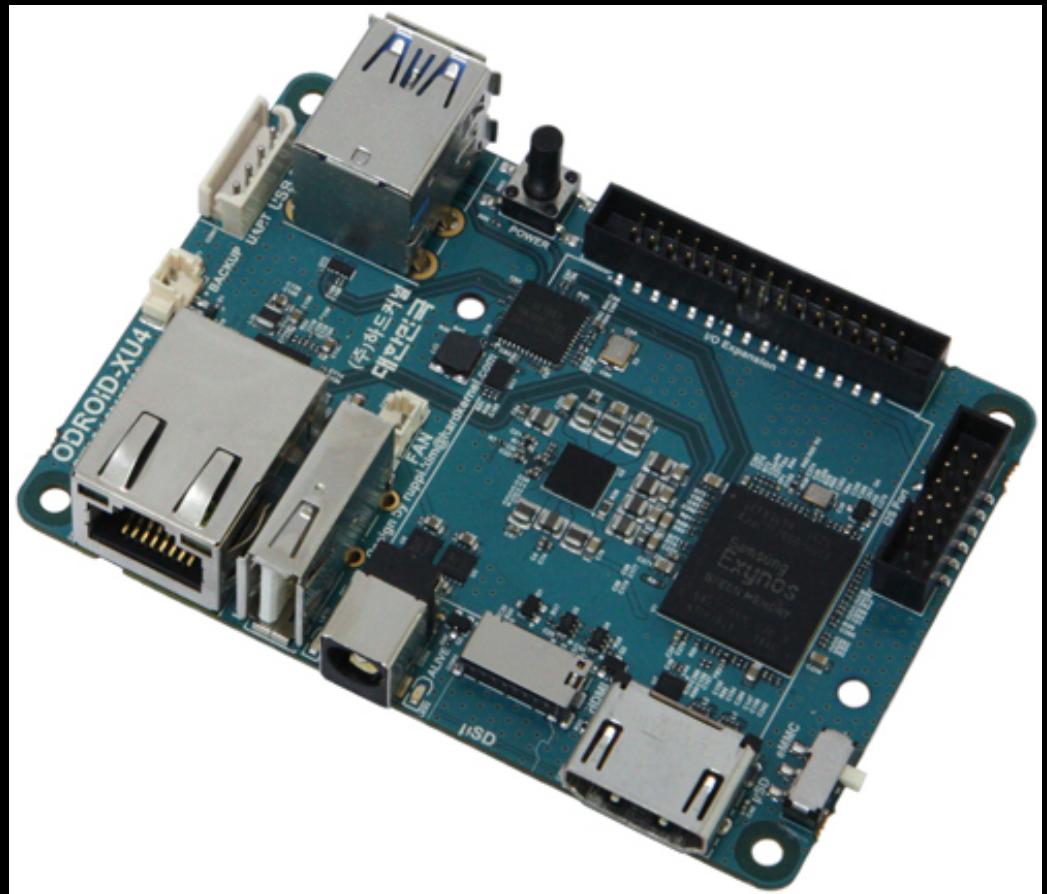
More powerful than Pi

Open hardware

Less community support

Supports Linux, Android

2 USB, no Wifi or BT built in



*Intended to promote Samsung, Android on IoT*

image: <http://www.hardkernel.com/main>

# LattePanda

Runs Windows 10, Linux

~\$89 MSRP

Has an Arduino  
integrated

Normal PC peripheral  
drivers will work

*Intended to promote*

*Windows Infrastructure*



image: <https://www.lattepanda.com>

# Raspberry Pi (RPi) Zero

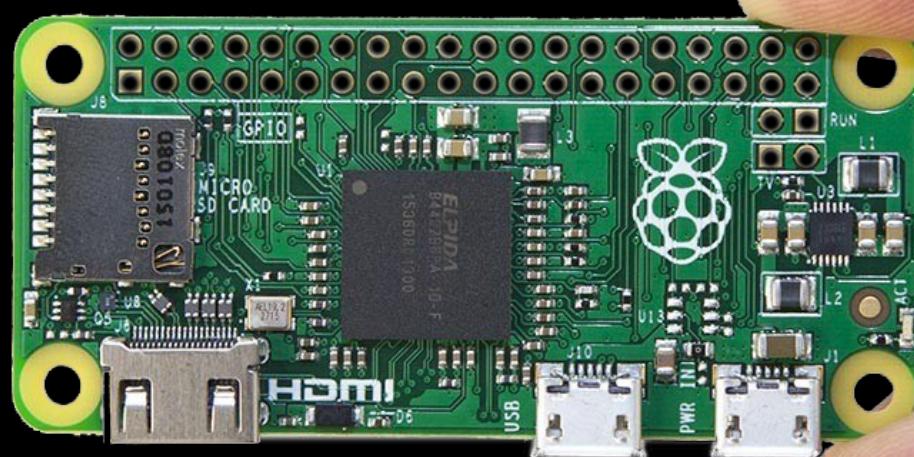
Smaller

MicroSD card slot

MiniHDMI

2 micro USB ports

\$5



Also: Pi Zero W has Wifi- \$10

image: [Pi Supply](#)



## Raspberry PI alternatives

Products &gt; High-Tech

Last update 2018 Aug 2 02:25:54



2

Compare boards which could replace a Raspberry Pi

Compatible Raspberry PI HAT (Hardware Attached on Top): Have the same GPIO layout

You might also be interested by: <http://socialcompare.com/en/comparison/arm-boards> or <http://socialcompare.com/en/comparison/raspberrypi-models-comparison>

- Livres
- Livres en anglais
- Musique
- DVD
- Vidéo
- Logiciels et CD-Rom
- Jeux vidéo

Achetez en toute sécurité



Cliquez ici !

A propos de cet espace

[Raspberry Pi 3 B+](#)[Raspberry Pi Zero](#)[CHIP](#)[Banana Pi](#)[BeagleBONE BLACK](#)[BeagleBone](#)[A20-OLinuXino-LIME](#)

Image	<a href="#">Raspberry Pi 3 B+</a>	<a href="#">Raspberry Pi Zero</a>	<a href="#">CHIP</a>	<a href="#">Banana Pi</a>	<a href="#">BeagleBONE BLACK</a>	<a href="#">BeagleBone</a>	<a href="#">A20-OLinuXino-LIME</a>
							
<b>HAT compatible</b>	✓	✓					
<b>Height</b>	3.37 in (85.6 mm)	1.18 in (30 mm)	1.57 in (40 mm)	2.36 in (60 mm)	2.15 in	2.15 in	84 mn
<b>Width</b>	2.22 in (56.5 mm)	2.55 in (65 mm)	2.36 in (60 mm)	3.62 in (92 mm)	3.4 in	3.4 in	60 mn
<b>Weight</b>	1.58 oz (45 g)	0.31746 oz (9 g)		1.69 oz (48 g)	1.4 oz	1.4 oz	
<b>Price</b>	US\$35.00	US\$5.00	US\$9.00		US\$45.00	US\$89.00 (Digikey)	€33.00

### Technical details

<b>CPU</b>	1.4GHz 64-bit quad-core ARMv8	1 GHz Low Power ARM1176JZ-F	1 GHz Allwinner A13 Compatible SoC	1 GHz ARM Cortex-A7 dual-core			Allwinner A20 dual core Cortex-A7 processor (1 GHz)
<b>GPU</b>	VideoCore IV	Dual Core VideoCore IV® Multimedia Co-Processor	ARM Mali-400	ARM Mali-400 MP2 GPU dual-core			dual-core Mali 400 GPU
<b>RAM</b>	1 GB	512 MB	512 MB (DDR3)	1 GB	512 MB	256 MB	512 MB (DDR3)
<b>4K compatible</b>	✗	✗	✗	✗			
<b>Onboard storage</b>			4 GB EMMC				
<b>Flash storage types</b>							
<b>Ethernet (LAN, RJ45)</b>	✓ 10/100/1000	✗ via USB	✗	✓ 10/100/1000			✓
<b>USB</b>	✓ 4x USB2.0	✓ micro + micro OTG	✓ 1x USB2.0 + micro OTG	✓ 2x USB2.0 + micro OTG			✓ 2 USB (High-speed host with power control and current limiter)
<b>SATA Ports</b>	✗	✗	✗	✓	✗	✓	✓ SATA connector with 5V SATA power jack
<b>HDMI port</b>	✓ 1	✓ mini	✗ via adapter	✓	✓ micro	✓ DVI-D	✓ + LCD connector compatible with 4.3", 7.0", 10.1" LCD modules from Olimex
<b>Wi-Fi</b>	✓ 2.4GHz and 5GHz 802.11 b/g/n/ac		✓ 802.11 b/g/n	✗	✗	✗	✗
<b>Bluetooth®</b>	✓ 4.2. BLE		✓ 4.0	✗	✗	✗	✗

# Other considerations

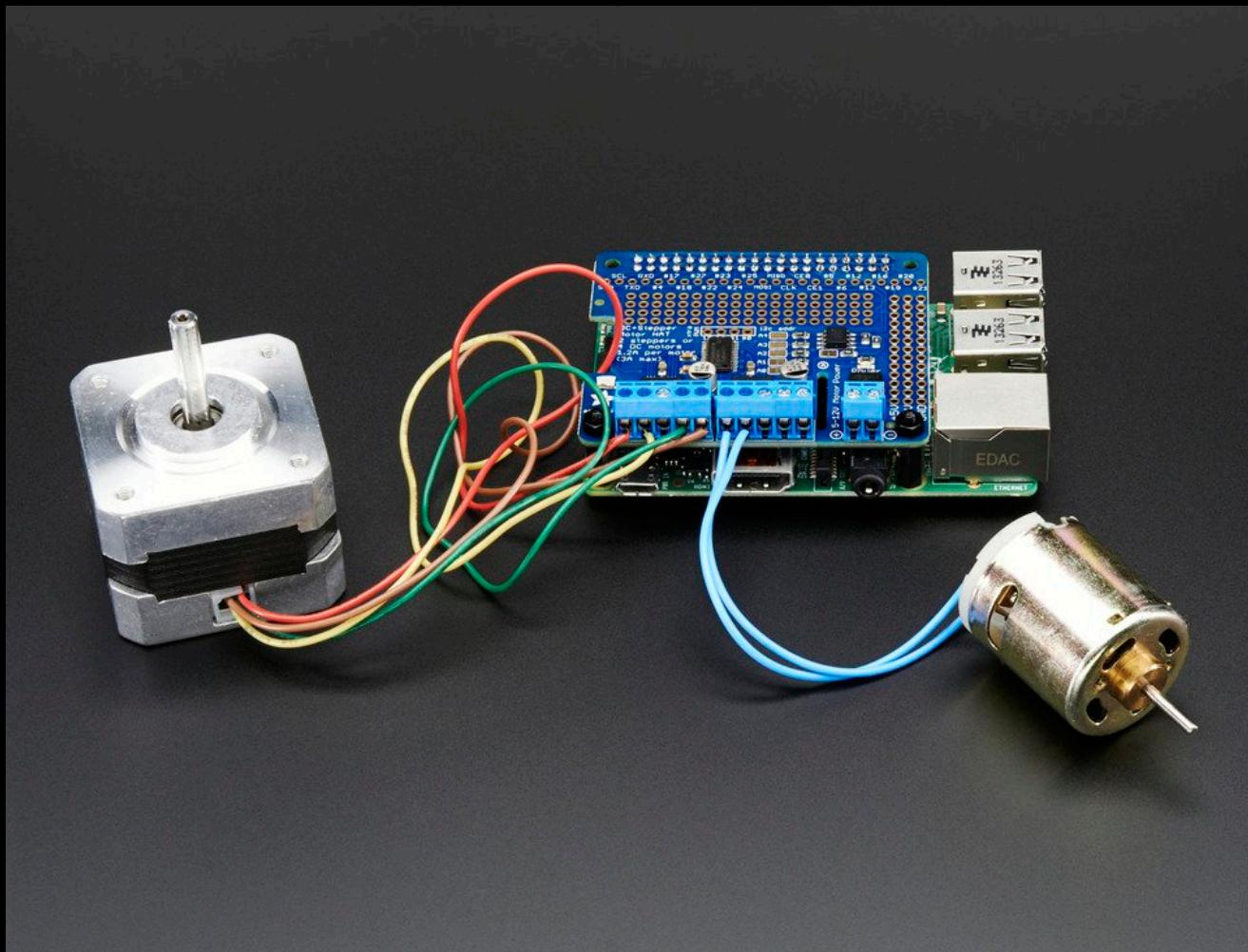
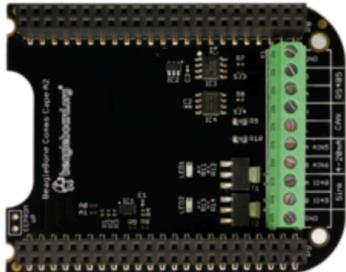


image: [Pi Supply](#)

# Other considerations

## BeagleBoard.org® Capes



### BeagleBoard.org Comms Cape

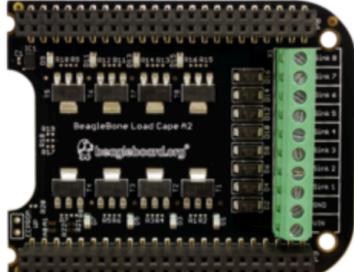
For industrial communication applications. Provides an array of communication protocols including one RS485, one CAN, two analog 4–20 mA current loops, and two 3A 50V interfaces allowing the control of high current loads.

[Additional details](#)

- RS485
- CAN
- 2x 4–20mA current loop inputs
- 2x 3A 50V sinks for high-current loads
- I<sup>2</sup>C EEPROM

Purchase

Select a distributor to buy



### BeagleBoard.org Load Cape

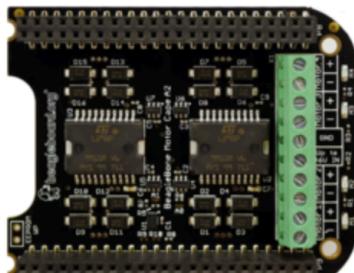
Drive high-current loads like relays, motors, solenoids, and high current LEDs.

- 8x 3A 50V sinks for high-current loads
- I<sup>2</sup>C EEPROM

[Additional details](#)

Purchase

Select a distributor to buy



### BeagleBoard.org Motor Cape

Drive DC motors with direction and PWM control.

- 4x 3A motor outputs up to 46V
- I<sup>2</sup>C EEPROM

[Additional details](#)

Purchase

Select a distributor to buy

## BeagleBoard.org Power Cape

[Beagleboard Capes](#)

# Alternatives

Criteria for selection:

Price

Power consumption

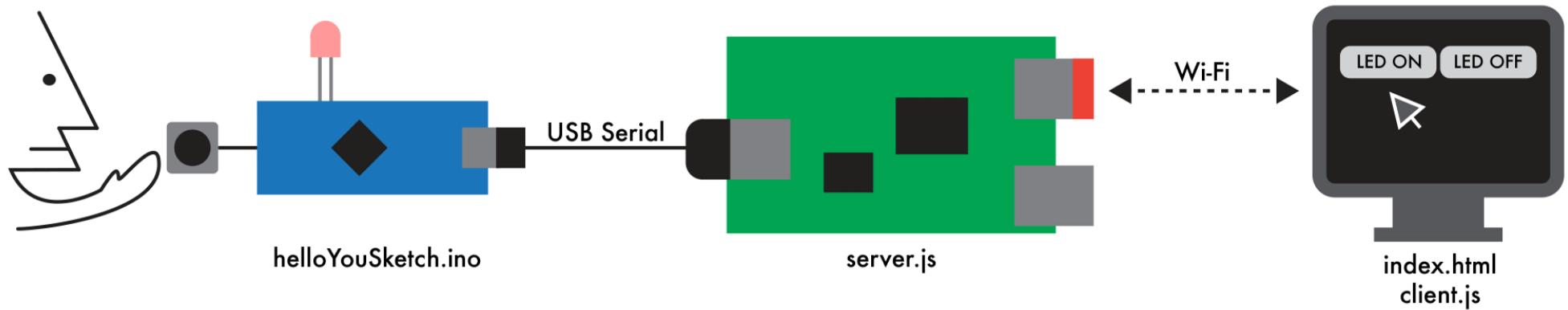
Availability

Product roadmap

Community

Software support

# Interaction Engine



The Interaction Engine is a framework for prototyping web-connected hardware. We use a set of widely supported tools to create a system to help interaction designers quickly realize new, multimodal interactive experiences.

# Node.js

Node.js is a JavaScript run-time environment which can make interactive websites through server-side scripting. It uses an event-driven, non-blocking I/O model that makes it lightweight and efficient.

# npm

Packages people 'npm install' a lot



## browserify

browser-side require() the node way

16.1.0 published 3 weeks ago by [goto-bus-stop](#)



## gulp

The streaming build system

3.9.1 published 2 years ago by [phated](#)



## npm

a package manager for JavaScript

5.7.1 published a week ago by [zkat](#)



## grunt-cli

The grunt command line interface

1.2.0 published 2 years ago by [vladikoff](#)



## grunt

The JavaScript Task Runner

1.0.2 published 4 weeks ago by [vladikoff](#)



## cordova

Cordova command line interface tool

8.0.0 published 2 months ago by [stevegill](#)



## bower

The browser package manager

1.8.2 published 6 months ago by [sheerun](#)

express

## express

Fast, unopinionated, minimalist web framework

4.16.2 published 5 months ago by [dougwilson](#)



## forever

A simple CLI tool for ensuring that a given node script runs continuously (i.e. forever)

0.15.3 published a year ago by [indexzero](#)

Node.js' package ecosystem, [npm](#), is the largest ecosystem of open source libraries in the world. (<https://www.npmjs.com>)

# Software Best Practices

## Start early

- bugs are best resolved with time rather than intensity
- time enables collaboration

## Make a plan, keep the plan updated

- a plan will help you when you get lost
- a plan will help you remember what you did
- a plan helps others see where you went wrong

# Software Best Practices

## Don't code alone

- do not beat your head on problem for more than 1 hour
- see if anyone else has had your problem
- use Discord to get help

## Documentation

- write down your sources
- when you hit an error and resolve it, write it down YOU WILL SEE IT AGAIN