

EID Development Environments & SBCs

Embedded Interface Design

with **Bruce Montgomery**



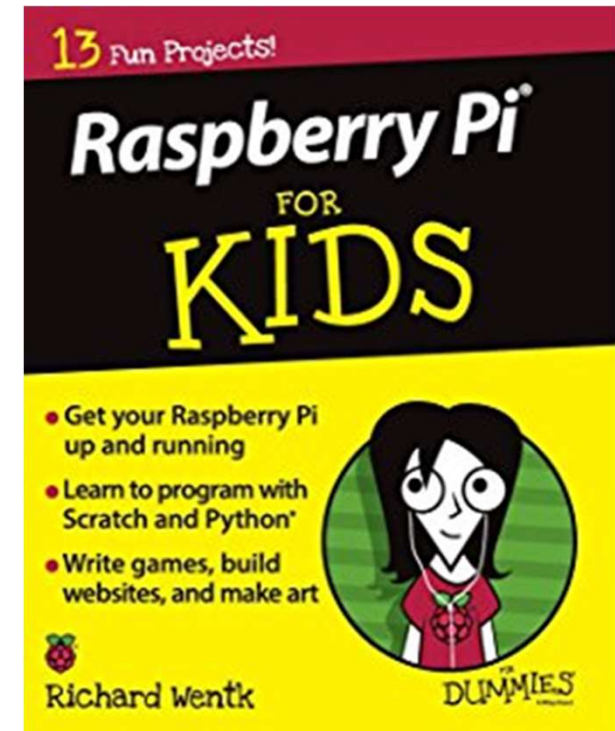
Learning Objectives

- Students will be able to...
 - Understand why Raspberry Pi SBCs are used in EID
 - Learn some approaches to RPi based development



Python? Raspberry Pi's? Those are for kids!

- It is true – Python and RPis are often used in grade school CS education
- So why are we using them for a graduate EE class?



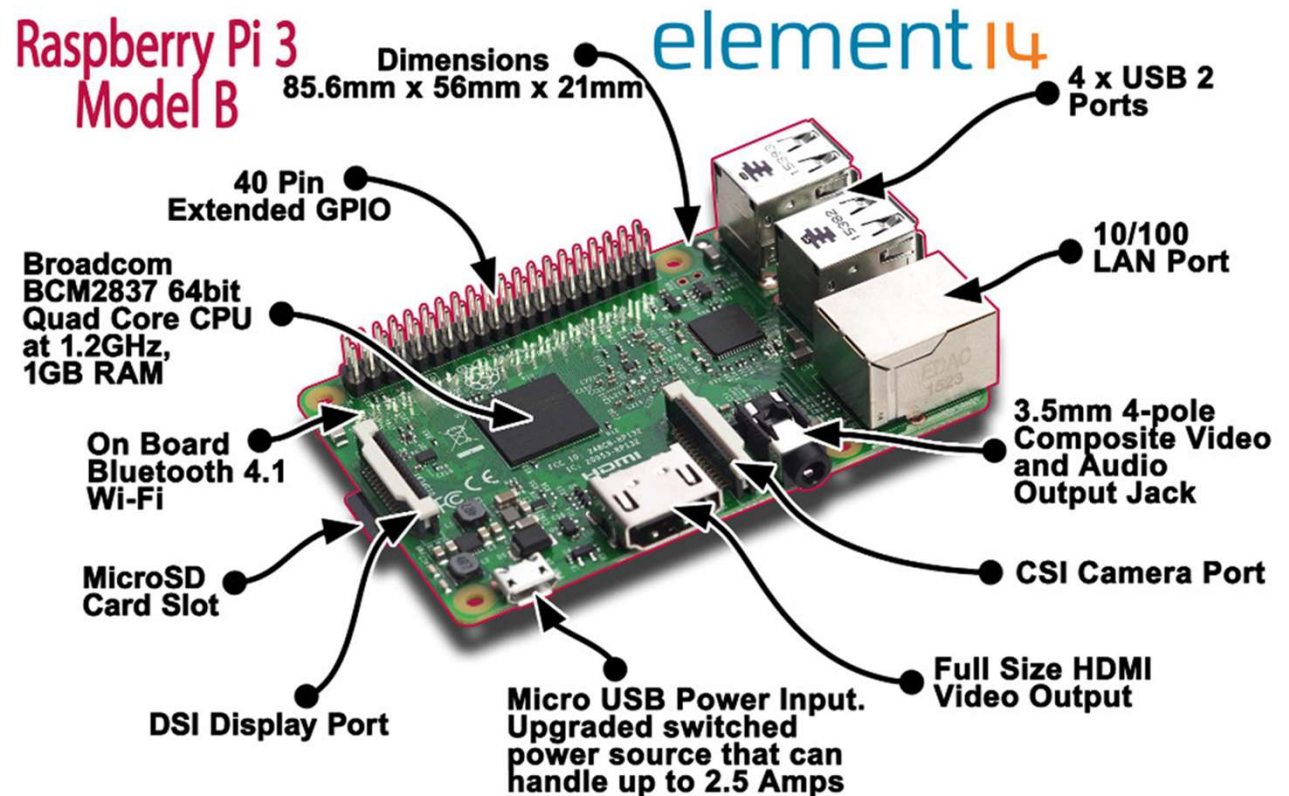
Raspberry Pi family

- Newest – Raspberry Pi 4 – Choice of 1, 2, or 5 GB – 2 micro 4K HDMI ports
- Raspberry Pi 3 A+ – Smaller footprint, single USB port
- Raspberry Pi 3 B+ – 1.4 GHz 64 bit quad core, Gigabit ethernet
- Raspberry Pi 3 B – 1.2 Ghz (in production through Jan 2026)
- Raspberry Pi Compute Module 3+
- Raspberry Pi Zero W
- Raspberry Pi Zero



Raspberry Pi 3 Single-Board Computer (SBC)

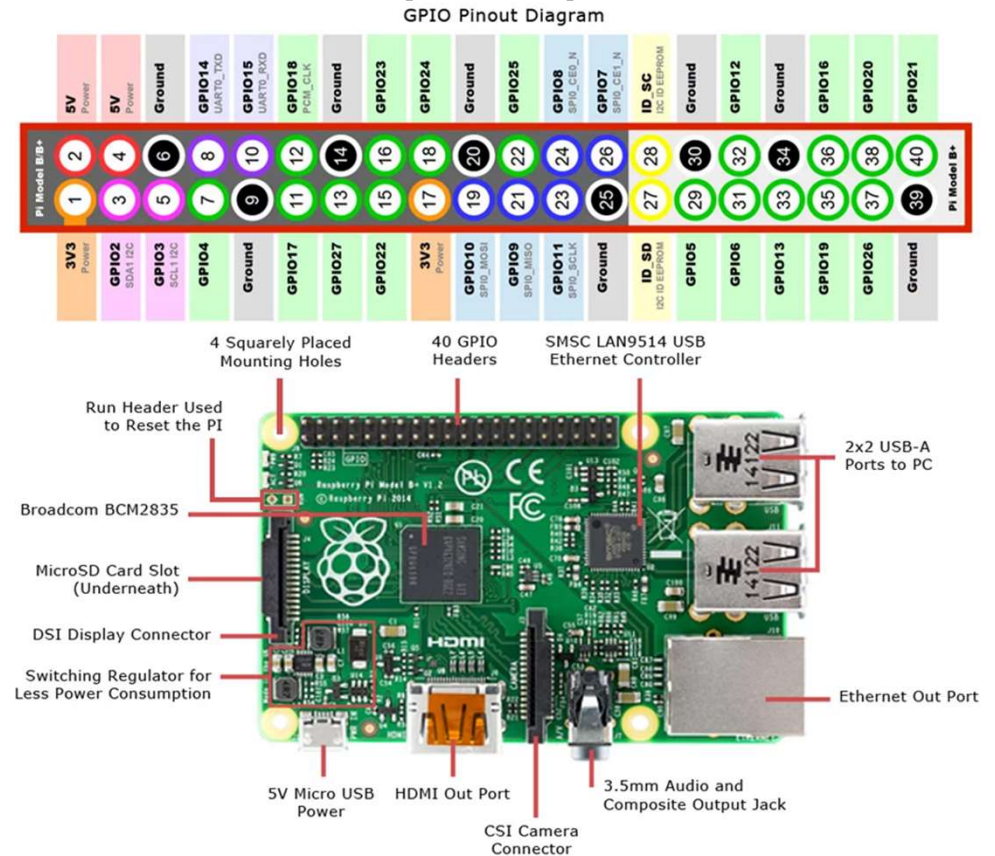
- For a Linux-based SBC, the Raspberry Pi 3 has many advantages
- Features for price (~\$35)
 - BLE 4.1, WiFi, HDMI, 4xUSB, 10/100 LAN Port
- Easy to obtain
- Many add-on elements available, easy to add sensors
- Well-supported by vendor and community
- Many o/s choices available
 - We'll use Raspbian Linux



element14

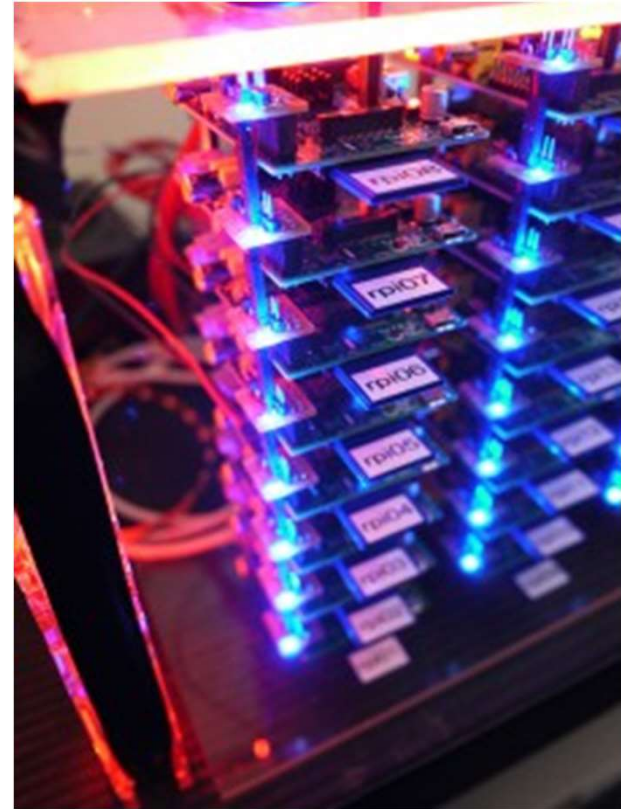
Raspberry Pi 3 Single-Board Computer (SBC)

- 2018 Linux Gizmos survey had RPi at #1, 4, 5, and 9 in Top 10 boards (along with Udoo X86, Odroids, BeagleBones) [1]
- There's a good SBC for every application, the RPi is simply more general purpose, and lets us get to the prototyping quicker
- Good breakdown of RPi3 features [2]
- Nice list of all common SBCs [3]
- RPi3B Pinout [4]



Not a kid's job: Rapid Prototype Development

- We want to focus on the design of
 - User Interfaces, User Experience, Sensor Interfaces, Communication Protocols
- We want to iterate on prototype designs as fast as we can
- We understand the difference between proof-of-concepts, prototypes, and actual products
- Go fast, make mistakes, go again – iterate!
- At my company (and many others) Raspberry Pis (along with other SBCs and development kits) are used regularly to prototype device and systems or to create test systems
- Neat adjacent example – Boise State Pi-based Beowulf Parallel Computing Cluster [5]



If you haven't used a Raspberry Pi 3...

- You should understand basic computer architectures before taking this course...
- We will hand out RPi3s, SD cards, Power Supplies, and Temp/Hum sensors soon
 - You must return all that at the end of the term
- We will give you some basic instruction in setting up your Pi and sensors
- We will want all the class RPi3s set-up the same to allow for testing projects
- We are not going to provide displays for the RPi3— instead you'll use VNC or a Remote Desktop from your laptop as your Pi GUI
- The RPi3 is a very friendly embedded device with an ever improving GUI Linux development environment
- And it's fun!



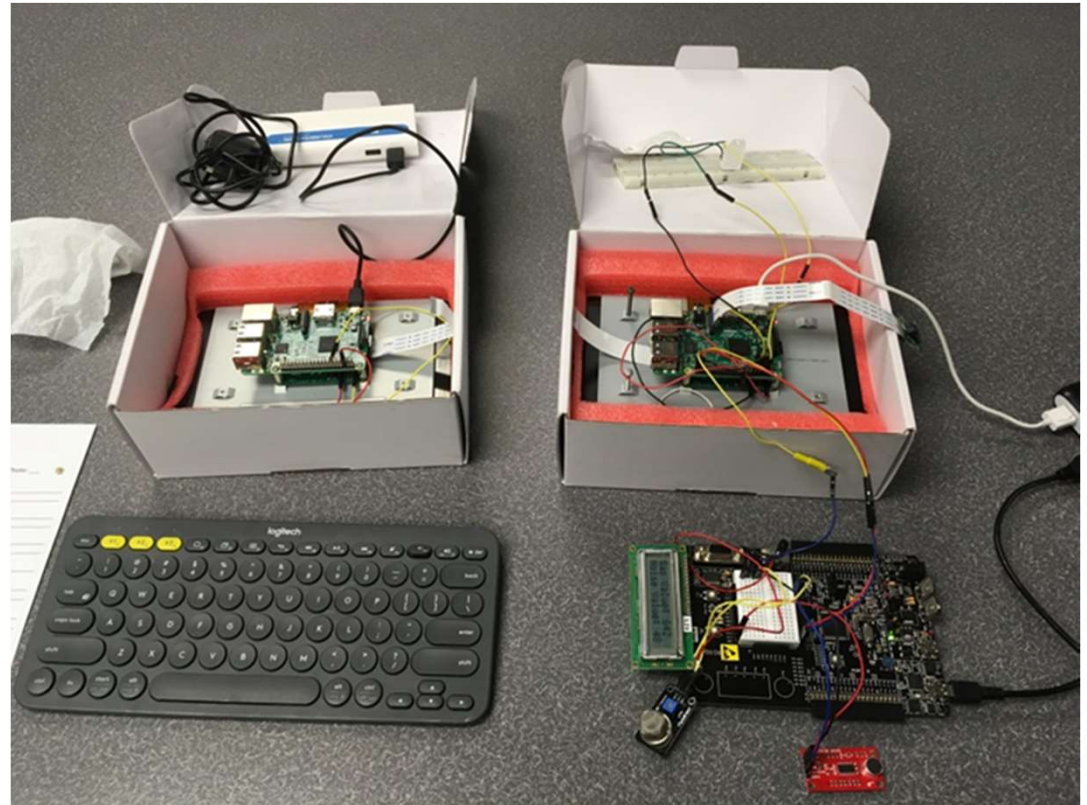
Alternative development environments

- To work directly on a Pi, you'll need an HDMI monitor, a USB or BLE keyboard and a mouse
- The IDLE3 and Geany IDEs on the Pi aren't bad, you can look at others
- The RPi Raspbian Linux distribution can be run in a Virtual Box VM on your laptop – it's like having a RPi with you all the time – you can work on the virtual Pi and transfer files to the actual Pi later for final tweaking
 - Loading Raspbian into a Virtual Box VM directions [6]
- You will likely run a RPi3 Remote Desktop or VNC on your PC or Mac
 - I've done this on my Windows PC using xrdp on the Pi and RDC on the PC, where it worked really well [7]
 - TightVNC is recommended for Macs [8]



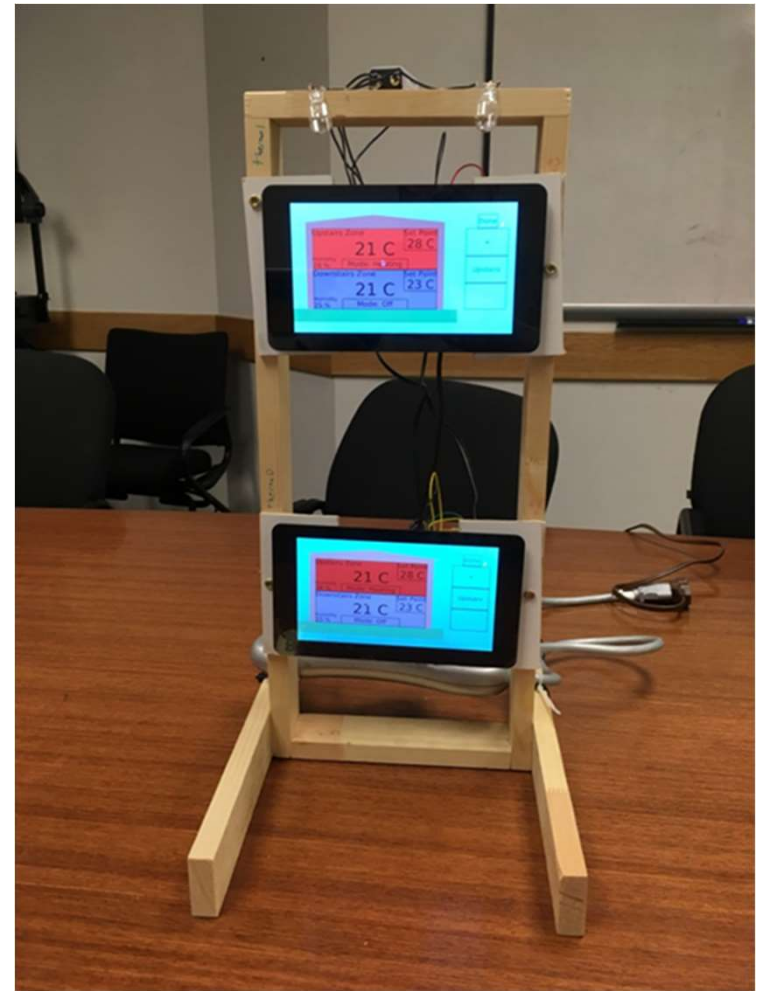
Example SuperProjects from past classes

- Road and Traffic Sensor –
Two RPi3s
w/Touchscreens, Camera,
Audio Sensor, DHT22 –
AWS IoT, Dynamo DB,
EC2, WebSockets, CoAP,
MQTT



Example SuperProjects from past classes

- Networked Thermostats – Two RPi3s w/Touchscreens, DHT22s, Displays, 24V HVAC Interface – AWS IoT, Android, HTTP, Flask



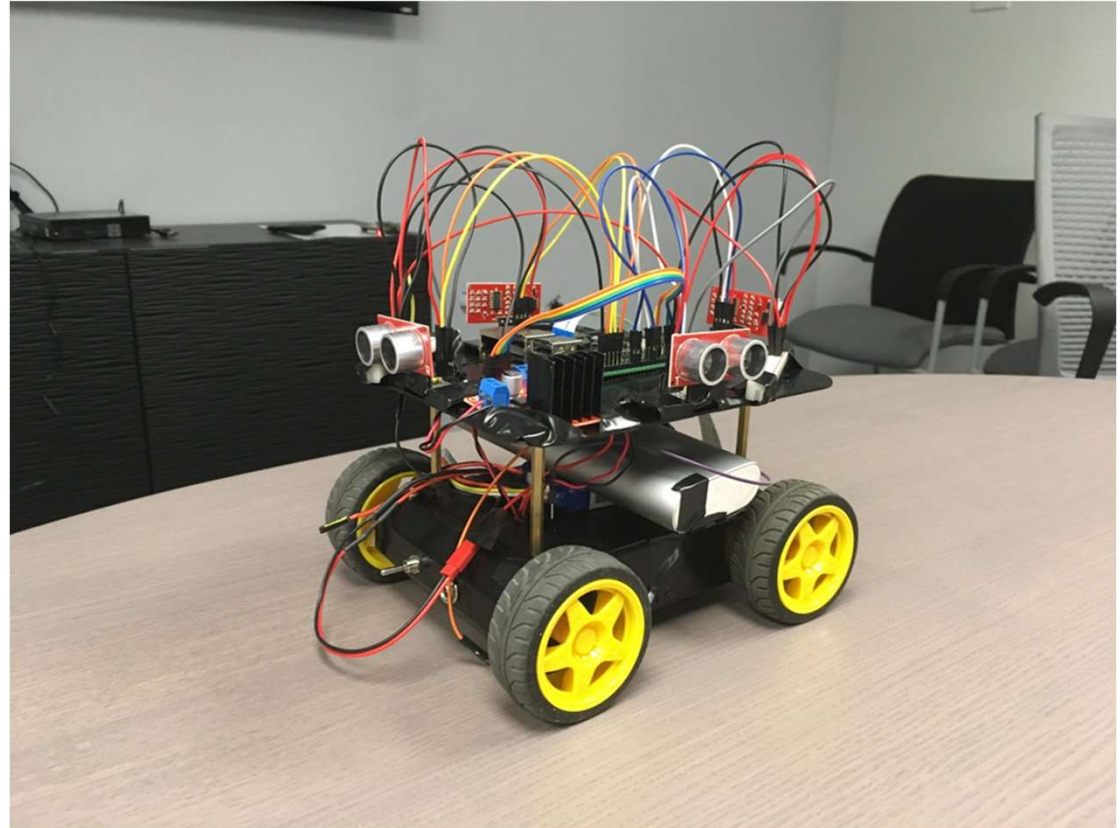
Example SuperProjects from past classes

Gesture-based Security Sensor – Two RPi3s w/Touchscreens, Gesture Sensor – AWS IoT, EC2, SMS, Dynamo DB, MQTT, CoAP, WebSockets, Google Voice Service



Example SuperProjects from past classes

Super Car – Pis, Proximity Sensors,
Cameras, Car Controls, AWS Dynamo
DB and Image Recognition and Voice
Commands



Summary

- The RPi is a great platform for prototyping
- Great arrays of tools and hardware to bring into the mix
- We'll talk more about getting your Pi up and running when we do the first project



References

- [1] <http://linuxgizmos.com/raspberry-pi-3-b-wins-hacker-board-reader-survey/>
- [2] <http://hackaday.com/2016/02/28/introducing-the-raspberry-pi-3/>
- [3] <http://linuxgizmos.com/catalog-of-98-open-spec-hacker-friendly-sbcs/>
- [4] <https://www.jameco.com/Jameco/workshop/circuitnotes/raspberry-pi-circuit-note.html>
- [5] <http://coen.boisestate.edu/ece/research-areas/raspberry-pi/>
- [6] <https://thepi.io/how-to-run-raspberry-pi-desktop-on-windows-or-macos/>
- [7] <http://www.raspberrypiblog.com/2012/10/how-to-setup-remote-desktop-from.html>
- [8] https://smittytone.wordpress.com/2016/03/02/mac_remote_desktop_pi/

