ECE 471 – Embedded Systems
Lecture 18

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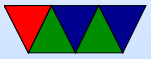
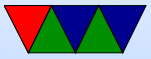
Announcements

- Project ideas! Remember to send them by Friday!
- Any HW#8 Problems? Should I extend the deadline?



HW#7 Review

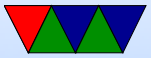
- Code
  - Why cast the tx and rx pointers to long? That's what the kernel interface says to do, not sure why.
  - Be careful when putting multiple things after and if statement, almost always better to use curly brackets
  - Shift and add/or to get proper size
  - Can you assign a large integer overtop of an array? You just can't without crazy casts, but also endianess.



  - memset *before* you assign values.
  - Error Checking: errors, best if exit. Will take points off if it prints invalid temps even if it doesn't crash.
  - Be sure not to leak file descriptors

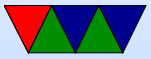
- Realtime Question:
  - Hard – everyone OK
  - Soft and Firm: lots of mixup
    Remember, only firm if data useless after deadline missed

- SPI disadvantage vs i2c – no spec, no errors, more wires,

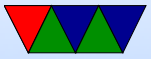


mildly shorter distance, etc

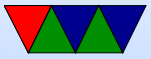
- Long temp probe, phrased it poorly – not spi long, but resistance in line
- /dev/null – throws away the output
- /dev/full – can use to test error handling
- /dev/zero – can be used to make disk images, etc.
- /dev/random – "truly" random. Urandom is pseudo-random



We had a long discussion about why you need random numbers and where they come from (cryptography)

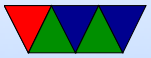


More Busses

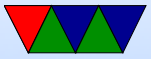


Rasp-pi Headers

- Main header. Has power, ground, gpios, i2c (with pull ups), UART,
- P2 – video card jtag
- p3 – Lan jtag
- p5 – on rev2. Has gpios and another i2c bus
- p6 – reset button

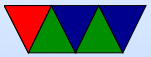


- Other
  - GPIO16 – status LED D5 (SD card access)
  - GPIO28-31 – board ID and resistors R3 to R10 (on Rev1.0 boards)
  - GPIO40 and 45 – used for PWM audio
  - GPIO46 – HDMI hotplug detect
  - GPIO47-53 are – used by the SD card interface GPIO47 is SD card detect

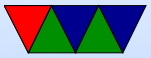


USB Bus

- USB 1.0 – 1996 – 1.5Mbit/s (keyboard, etc), 12Mbit/s (disk)
- USB 1.1 –
- USB 2.0 – 2000 – 470MBit/s
- USB 3.0 – 2008 – 5GBit/s
- 2-5m cables

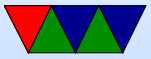


- 4 pins. 5V, GND, D+, D-. Differential signalling (subtractor). More resistant to noise.
- Unit load, 100ma. Can negotiate up to 500ma (more USB 3.0)
- Up to 127 devices (by using hubs)
- Enumeration



USB Protocol

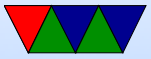
- Each device has endpoint
- isochronous – guaranteed data rate but with some potential data loss (video)
- interrupt – low-latency, like keyboards
- bulk – disk access



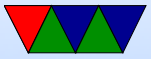
USB Linux

- Linux drivers
  - Device classes – HID, audio, etc. One common driver can handle all devices of a class
  - Specific – device driver is board specific and must have a list of all vendor/device IDs that are supported

- libusb
  Allow direct userspace access to USB interface
  Used by low-level things that might not need driver



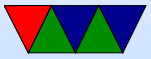
old cameras (not standardized), custom hardware



USB on Rasp-pi

- USB-OTG – on the go. Allows device to act like a host (so can hook up devices as per normal) or as normal USB device. Decides which based on whether A or B cable plugged in, check ID pin (micro/mini have 5th pin)

  The Pi-B does not support running in gadget mode externally (a hub in the way) and the OTG hardware requires more software support than (it is simpler) than regular USB.



- USB 2.0 (sorta). Cannot supply full power (why? Only 1A power supply typical). Also cannot handle high-bandwidth things like audio cards and USB-cameras well.

- USB-host – standard USB port. Cannot provide high current, so use a powered hub if using anything more than keyboard or mouse