I/O

CPE380, Spring 2025

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`http://aggregate.org/hankd/`

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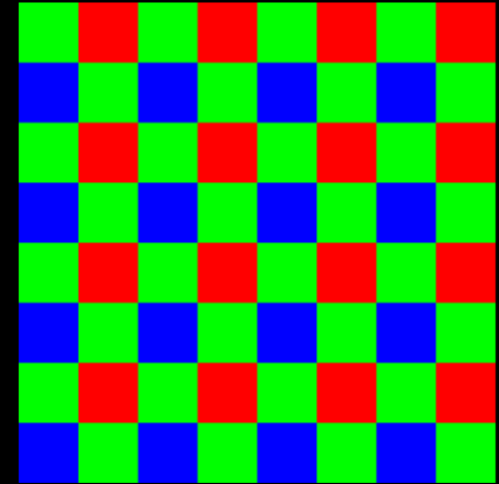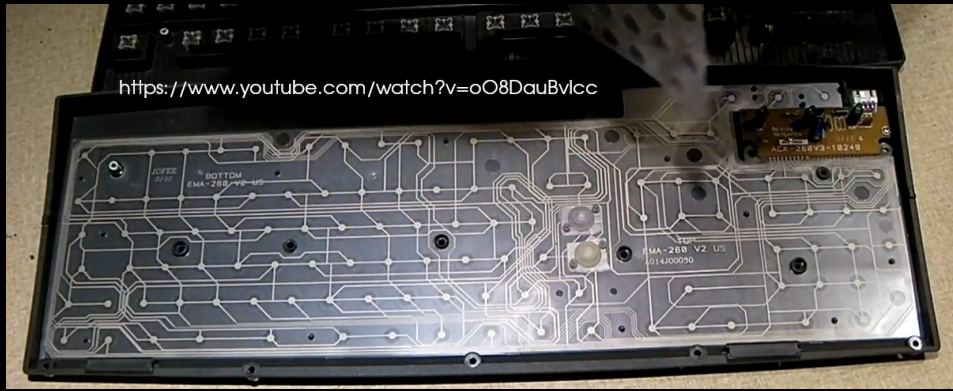
Network Terminology

- **SAN, LAN, MAN, WAN** – Area Network; System/Storage, Local, Metropolitan, Wide
- **Ethernet, DSL** (Digital Subscriber Line)
- **USB, FireWire**
- **Hub, Switch, Router**
- **WiFi, Bluetooth, NFC**
- **Bandwidth, Latency**
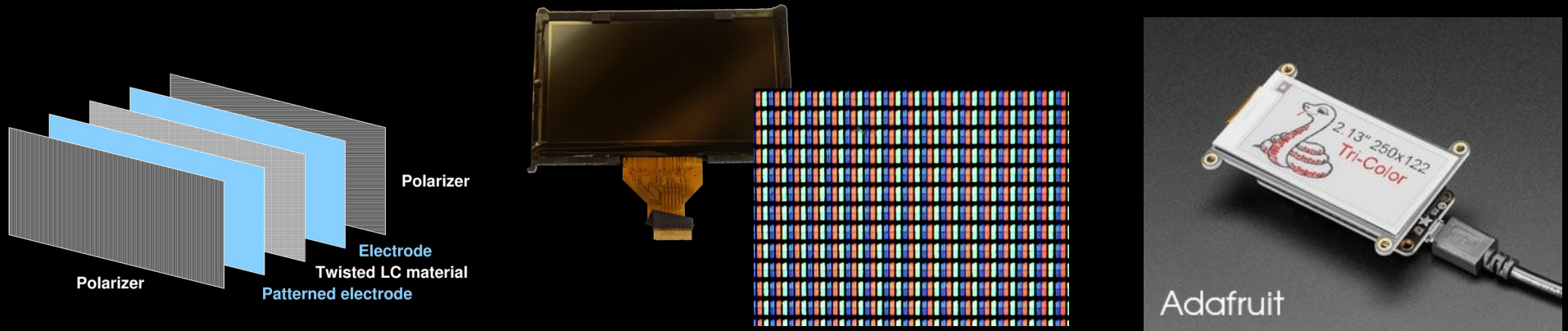
Other I/O Terminology

https://www.youtube.com/watch?v=oO8DauBvIcc
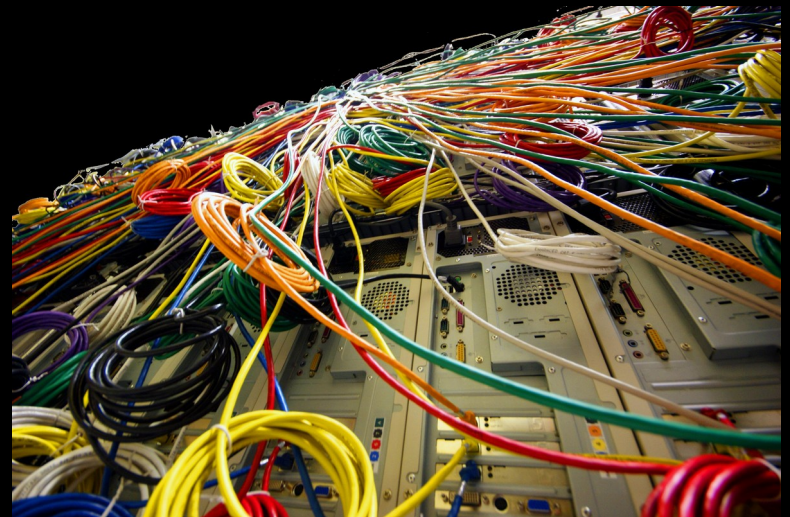
- Keyboard
- Mouse, Trackball, Touchscreen, Lightpen, Touchpad, etc.
- Pixel – Picture Element
- Camera: Charge-Coupled Device, CMOS, BackSide Illuminated, Stacked

Other I/O Terminology

- Display: Cathode Ray Tube, Plasma, Liquid Crystal Display, Digital Micromirror Device aka Digital Light Processor, Organic Light Emitting Diode, eInk

Input / Output

- We've discussed interfaces & device types… here are some external interface connectors:

- What's left is just two universal concepts:
  - How to name I/O device registers
  - How to interact with them

Naming I/O Device Registers

- Memory-mapped I/O
  - Most processors implement this
  - Some physical memory addresses are I/O; use load/store to access, even from HLLs
  - Protection via page table

- Separate I/O address space
  - Implemented on x86 family processors
  - Special port input/output instructions
  - Separate I/O path and protection (`ioperm`)

Interacting With I/O Devices

- Polling
  - Processor loops looking at device registers to see when things have happened
  - Fast, but keeps processor busy

- Interrupts, for infrequent things
  - Device signals processor when ready
  - Poll to discover "who rang" and why

- DMA (Direct Memory Access)
  - Cheap secondary processor moves data
  - Signals done using an interrupt