

# **oueees-201606**

## **Part 1: IoT**

### **device**

# **technologies**

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14-JUN-2016

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# Lecture notes on GitHub

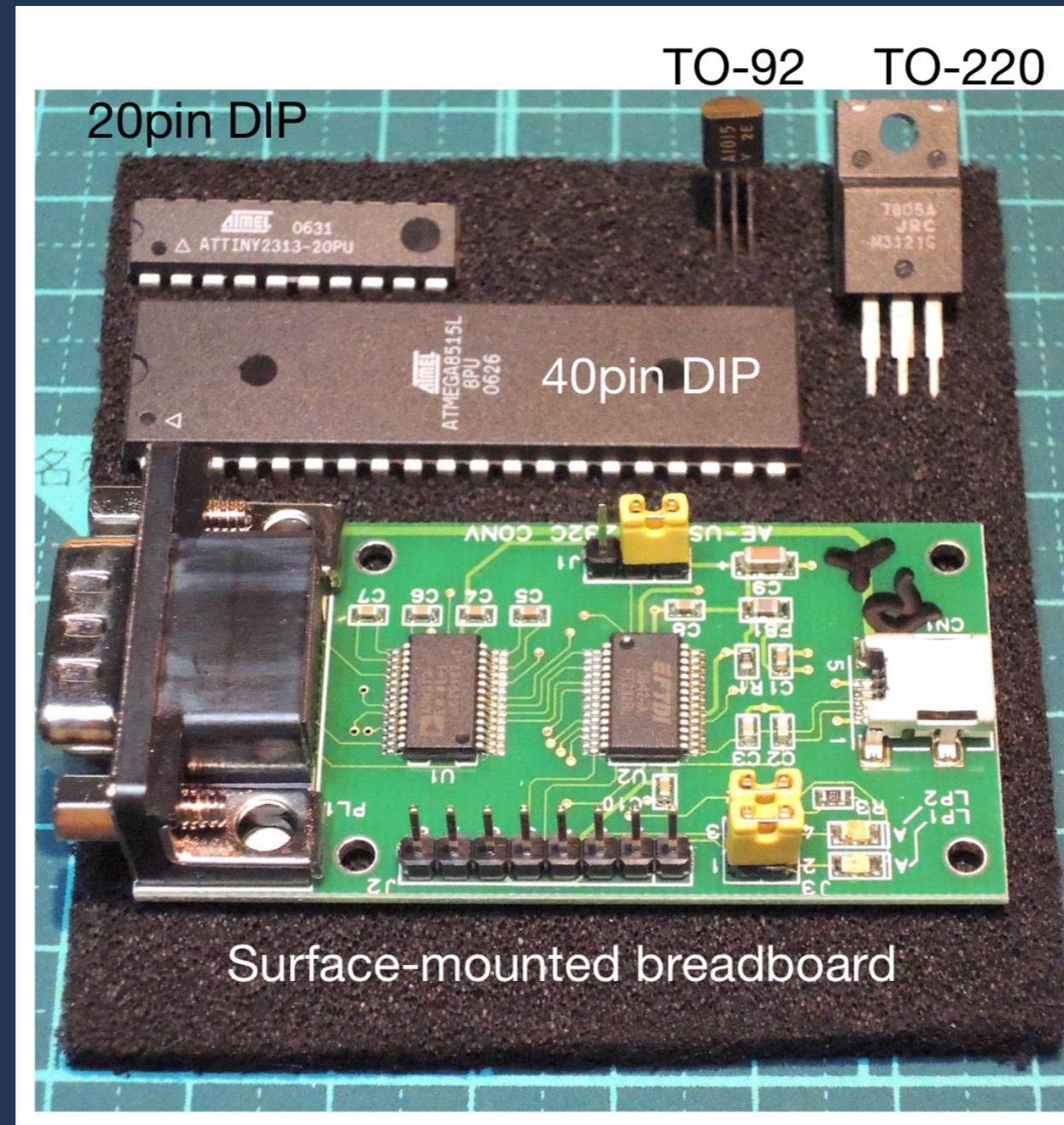
- <https://github.com/jj1bdx/ouees-201606-public/>
- Don't forget to *check out the issues!*

**IoT = electronics**

# Trends in IoT devices

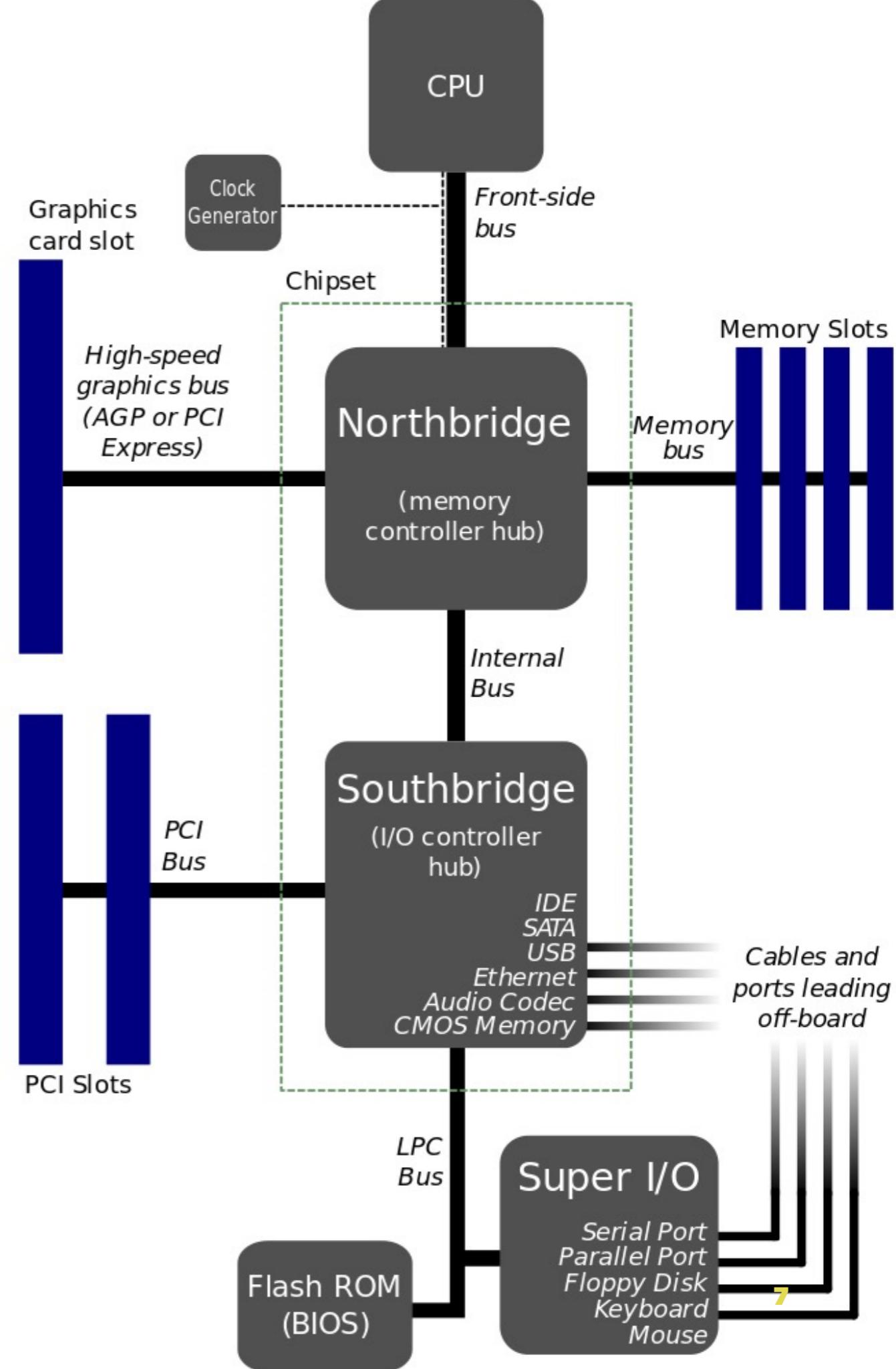
- They are *computers*
- Small, less physical constraints
- Less power, voltage, and heat
- Driven by *software*

# Legacy parts

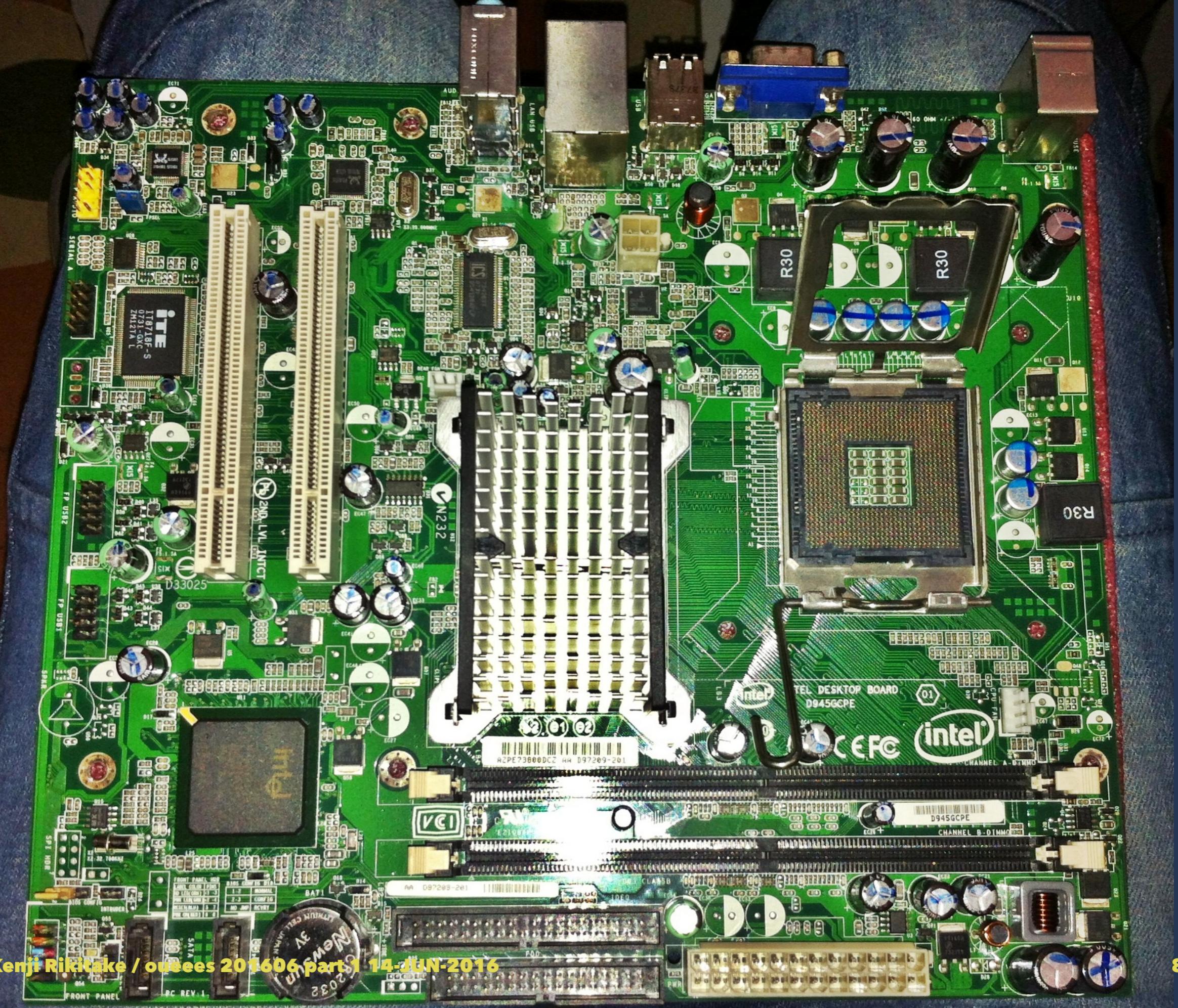


# Traditional PC

- Motherboard<sup>1</sup>
- CPU
- Memory
- "Peripherals"
- Video
- Extension bus



<sup>1</sup> Diagram by Moxfyre, CC BY-SA-3.0



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# Computers for IoT: microcontrollers

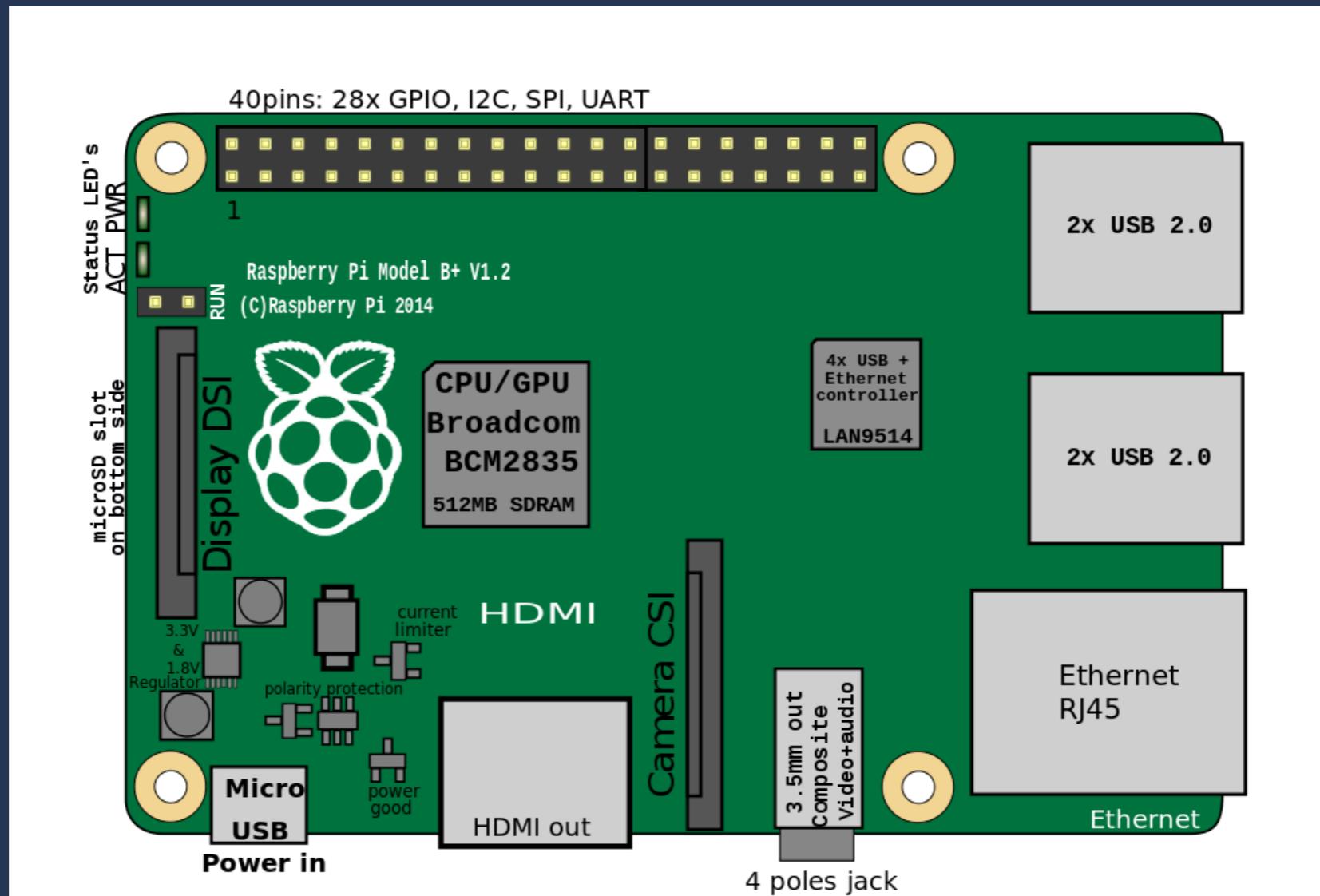
- All in one board or chip
- CPU + ROM + RAM
- GPIO (Digital I/O)
- Analog interface (A/D, D/A)
- Communications (USB, Serial, SPI, I2C)
- Ethernet / WiFi / Bluetooth

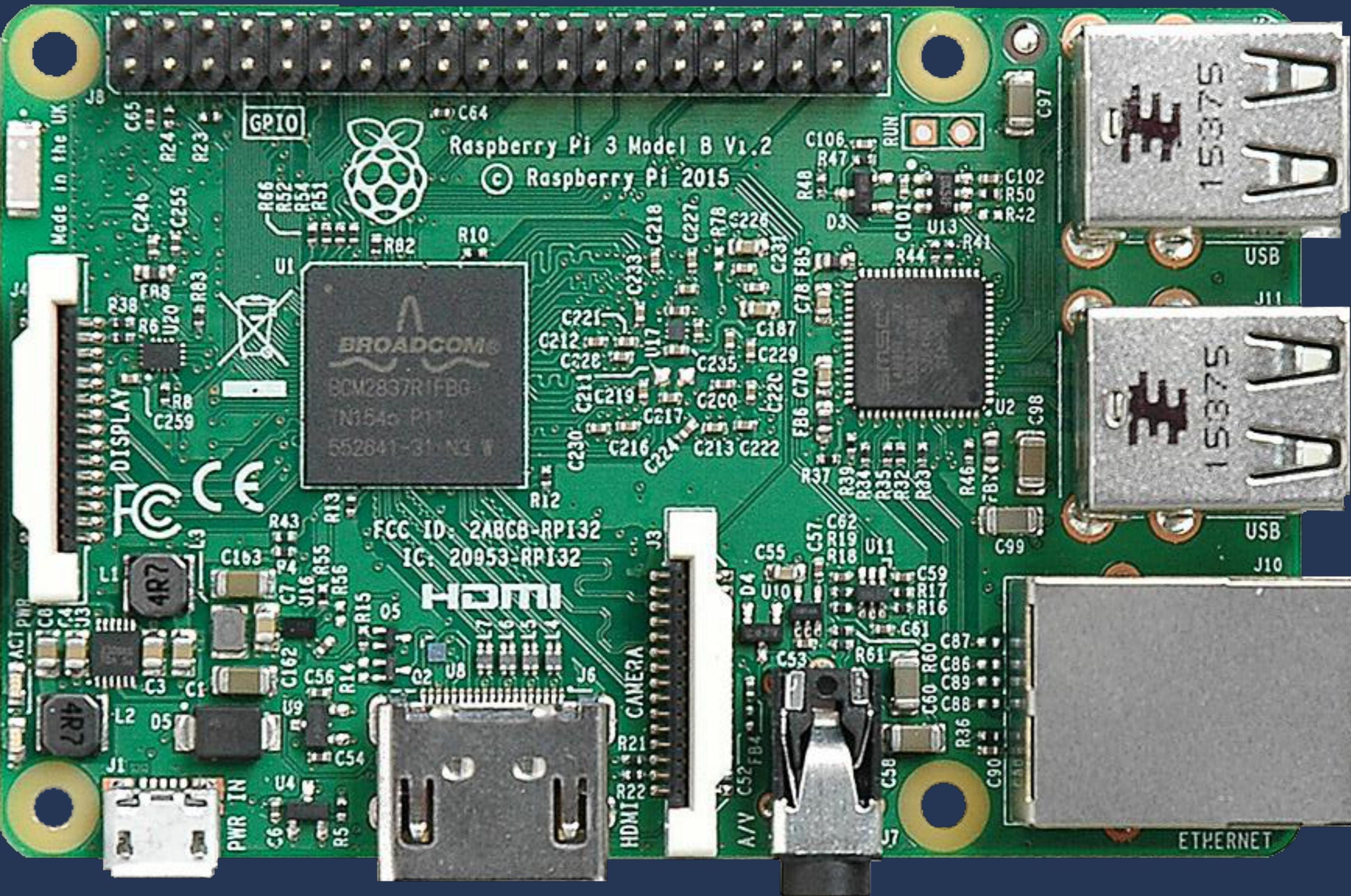
# Legacy CPUs .vs. microcontrollers

- Power consumption/management
- Built-in I/O interfaces
- Virtualization and memory protection
- Operating environment
- *Microcontrollers are catching up very fast*

# Raspberry Pi

## Raspberry Pi 3 Model B

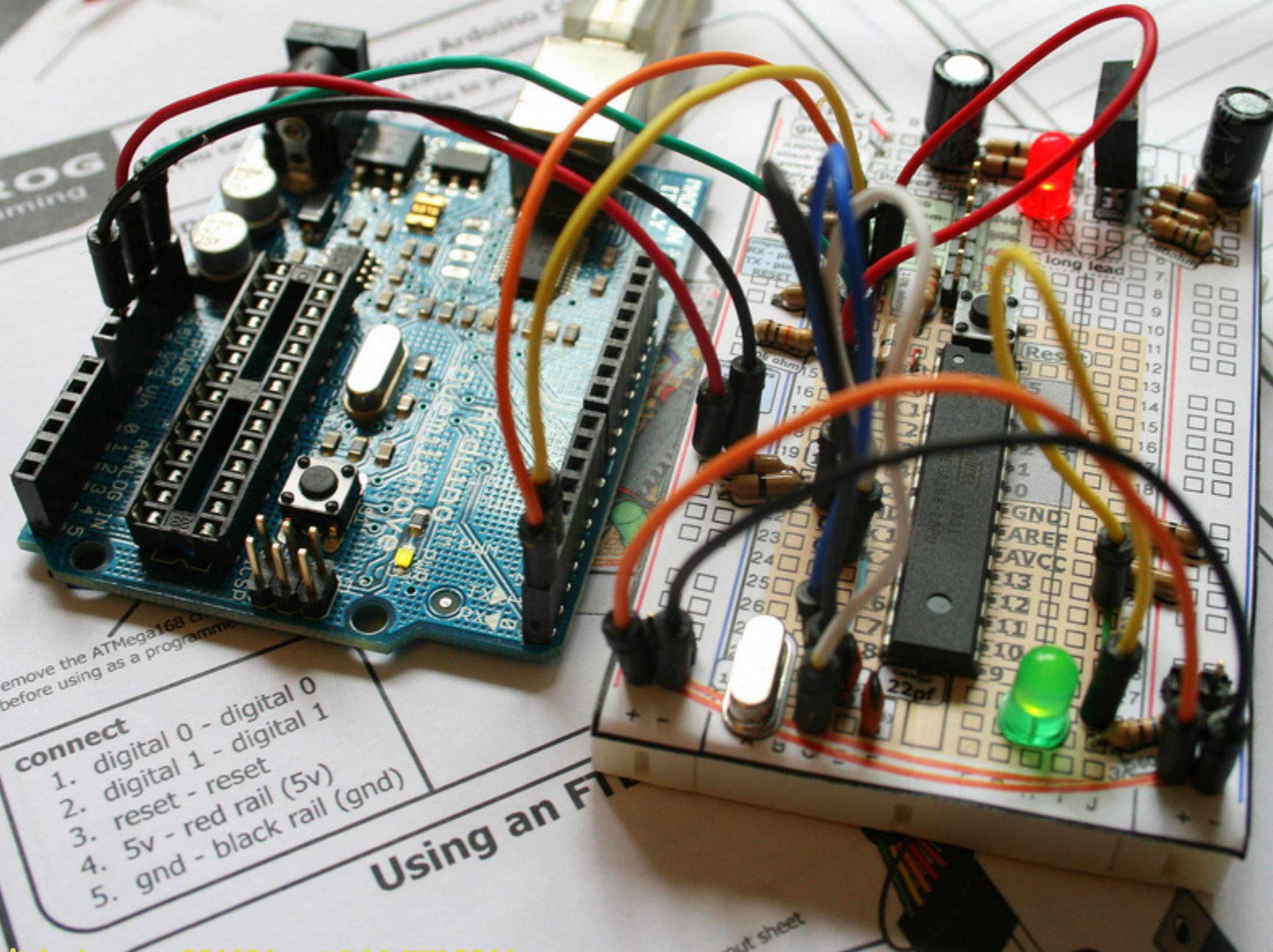




# **Design and implementation of IoT products**

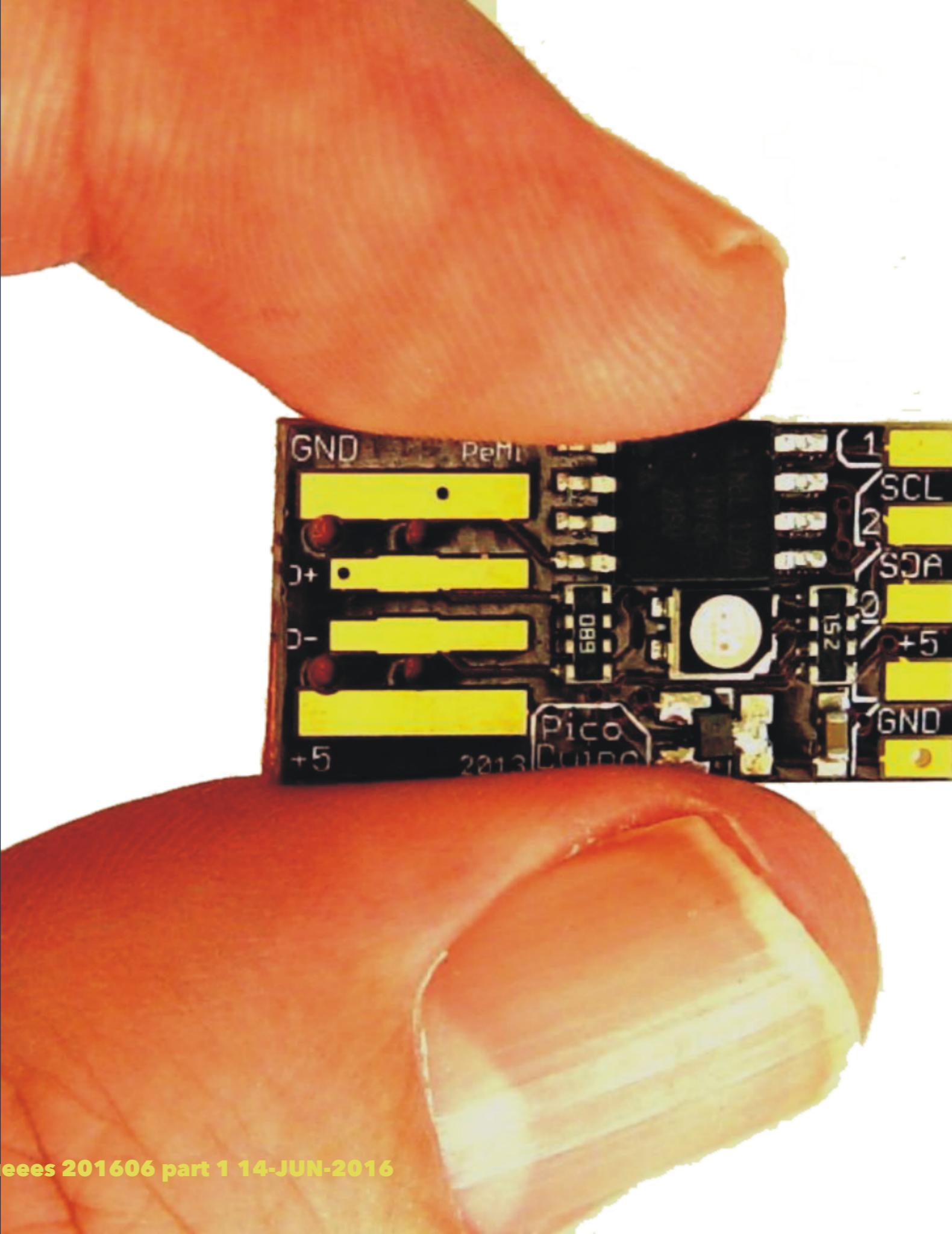
# Prototyping

- Using breadboards
- No-solder wiring
- Easy but *unstable*
- Many startup projects haven't got further than this phase
- *Not* production-ready



# Building actual products

- Soldering surface-mount chips and parts
- Making *small* as possible
- Factory built
- Minimalize the features
- Physically and electronically stable
- Legally approved (FCC/UL, CE, PSE)



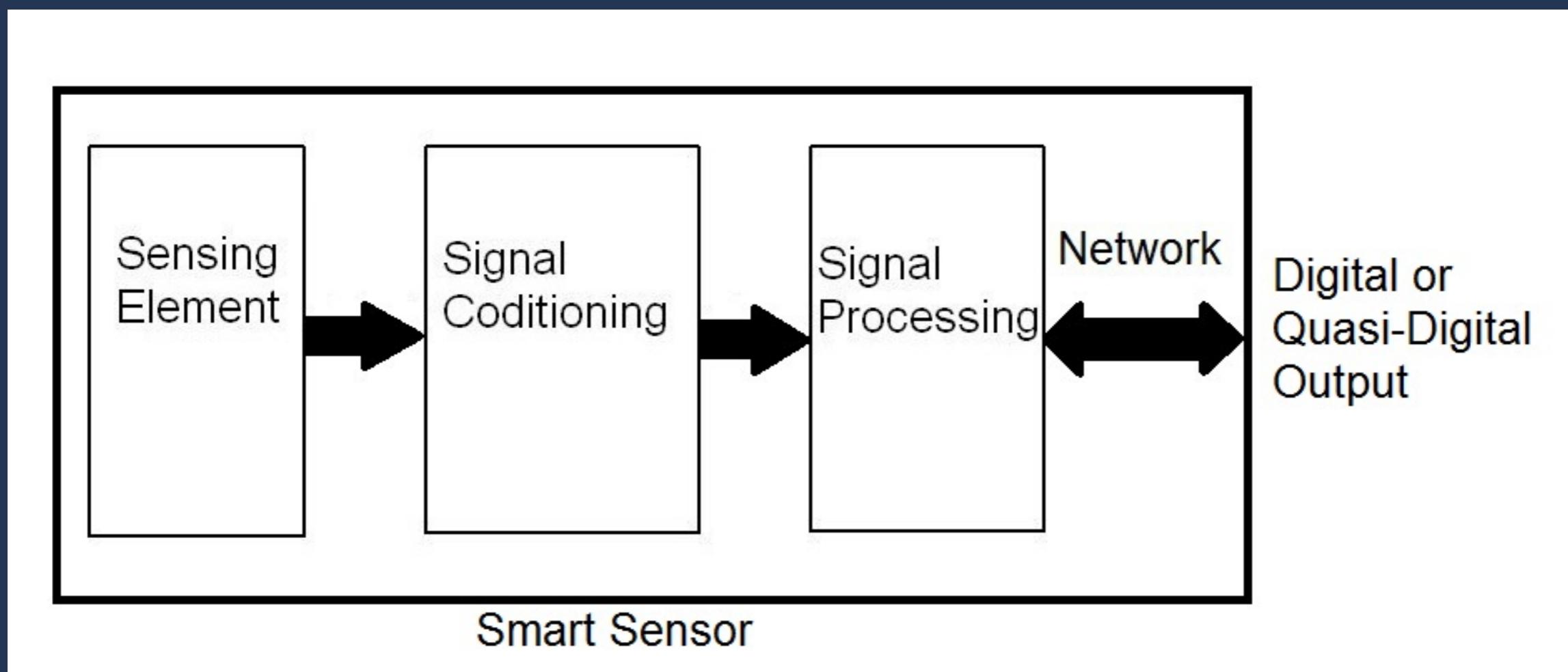
# Other issues

- Mechanical alignment and stability
- Long-term reliability
- Product life cycle determination
- Vulnerability assessment
- Security and privacy
- Legal liability

# Real-world interface: sensors

# What are sensors?

Converting environmental changes into information output



# Example: mechanical sensors

- Mechanical switches
- Piezoresistivity
- Piezoelectricity
- Capacitive change
- Inductive change

# Application of mechanical sensors

- Accelerometer
- Anemometer (wind speed)
- Gyroscope
- Pressure sensor
- Strain gauge

# Non-contact sensors

- Antenna (electromagnetic / radiowave)
- Geiger-Müller tube (radioactivity)
- Microphone (sound / vibration)
- Photodiode (CCD/CMOS image sensors)
- Thermistor (temperature)

# Passive or active

- Passive sensors
  - stealth
  - taking energy from the object
- Active sensors
  - detectable
  - dynamic measurement methods

# How microcontrollers help sensors

- Digital signal processing
  - Calibration
  - Measurement accuracy
  - Noise reduction
- Failure detection
- Storage

# Role of sensors on IoT technology: collectivity

Extracting hidden characteristics from the massively collected data

- Correlation analysis
- Geographically different points
- Multiple types of information
- Time series analysis

# **Question: what kind of new sensor devices will emerge?**

Think about the following aspects:

- Collective nature of IoT
- Microcontrollers and sensors
- Anything can be a sensor device

# Appendix: Wikimedia Commons credits for photos

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