Web Applications on embedded systems

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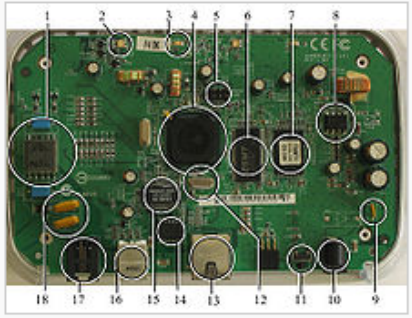
What is an embedded system?

Embedded system

From Wikipedia, the free encyclopedia

An **embedded system** is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints.[1][2] It is *embedded* as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today.[3] Ninety-eight percent of all microprocessors are manufactured as components of embedded systems.[4]



Picture of the internals of an ADSL modem/router, a modern example of an embedded system. Labelled parts include a microprocessor (4), RAM (6), and flash memory (7).

Examples of properties of typically embedded computers when compared with general-purpose counterparts are low power consumption, small size, rugged operating ranges, and low per-unit cost. This comes at the price of limited processing resources, which make them significantly more difficult to program and to interact with. However, by building intelligence mechanisms on top of the hardware, taking advantage of possible existing sensors and the existence of a network of embedded units, one can both optimally manage available resources at the unit and network levels as well as provide augmented functions, well beyond those available.[5] For example, intelligent techniques can be designed to manage power consumption of embedded systems.[6]

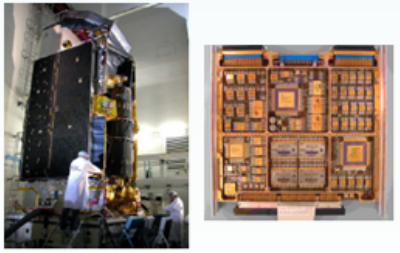
We live surrounded by embedded systems

Networking & Telecom

Home devices

Automotive

Industrial automation



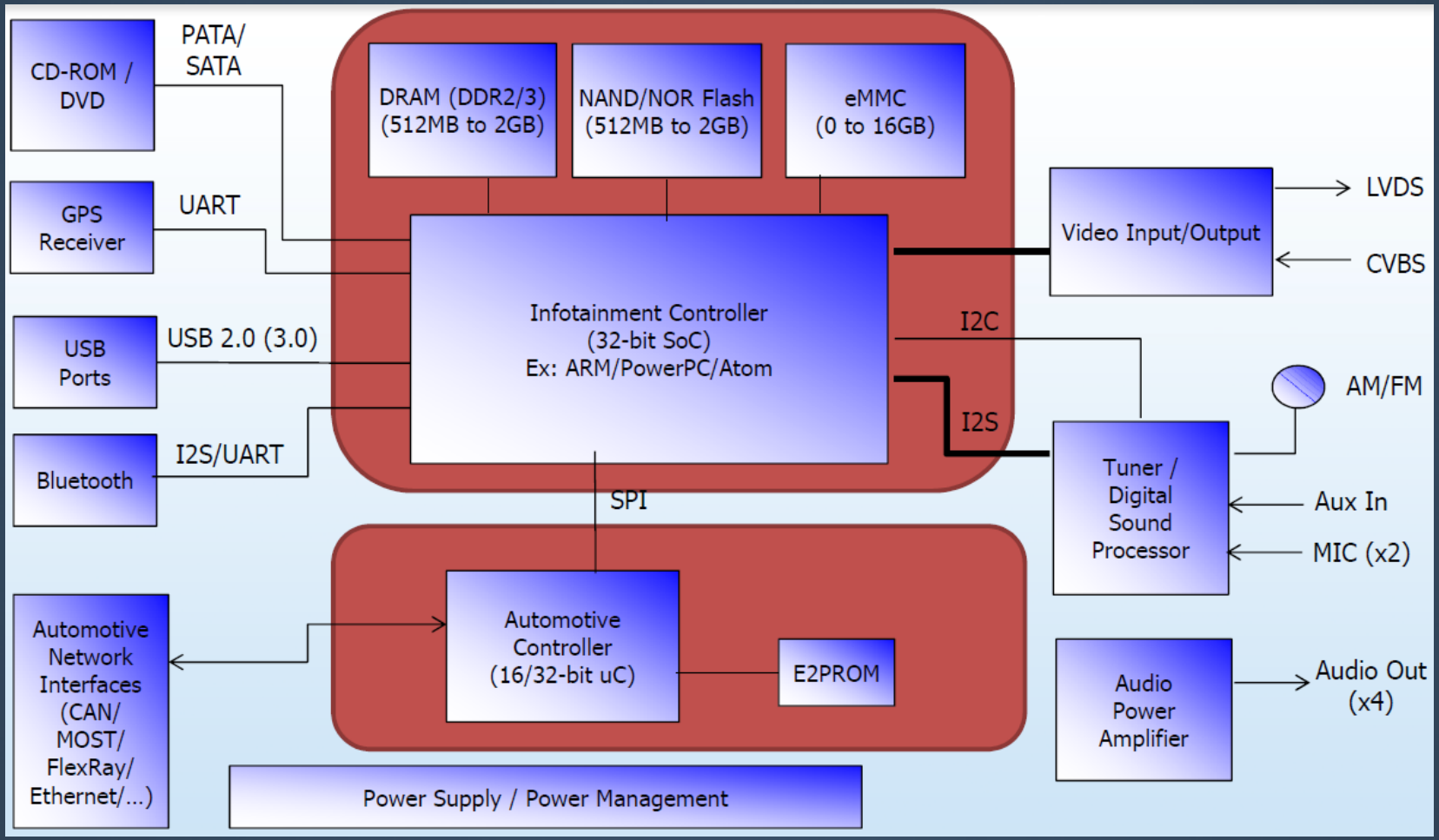
Space and defense

Typical characteristics of an embedded system

Embedded systems often have one or more of the following features:

1. Reduced power consumption
2. Reduced size
3. Low cost per unit
4. High Reliability
5. Reduced (zero) need of maintenance

Example: In-Vehicle Infotainment



Hardware commoditization

- Thanks to Moore's law, embedded systems have now enough computing power to allow adaptation and reuse of complex software originally developed for servers and desktops
  - Networking stacks and protocols
  - User Interface frameworks
  - Open Source software
- With the economy of scale achieved by smartphones and other consumer devices, complex computer architectures have become affordable also for embedded systems
- On the other hand, developing dedicated, custom hardware and porting standard platform software requires a huge investment and becomes justified only for high volume productions

Example: GENIVI Demo Platform

```
$ sloccount gdp_ivi9_beta/workspace

Totals grouped by language (dominant language first):

ansic:      46260693 (69.83%)
cpp:         9910207 (14.96%)
asm:         2006557 (3.03%)
sh:          1575972 (2.38%)
perl:        1276566 (1.93%)
python:      1163866 (1.76%)
xml:         1054193 (1.59%)

...

Total Physical Source Lines of Code (SLOC) = 66,247,653
```

Example: Android 5.1.1

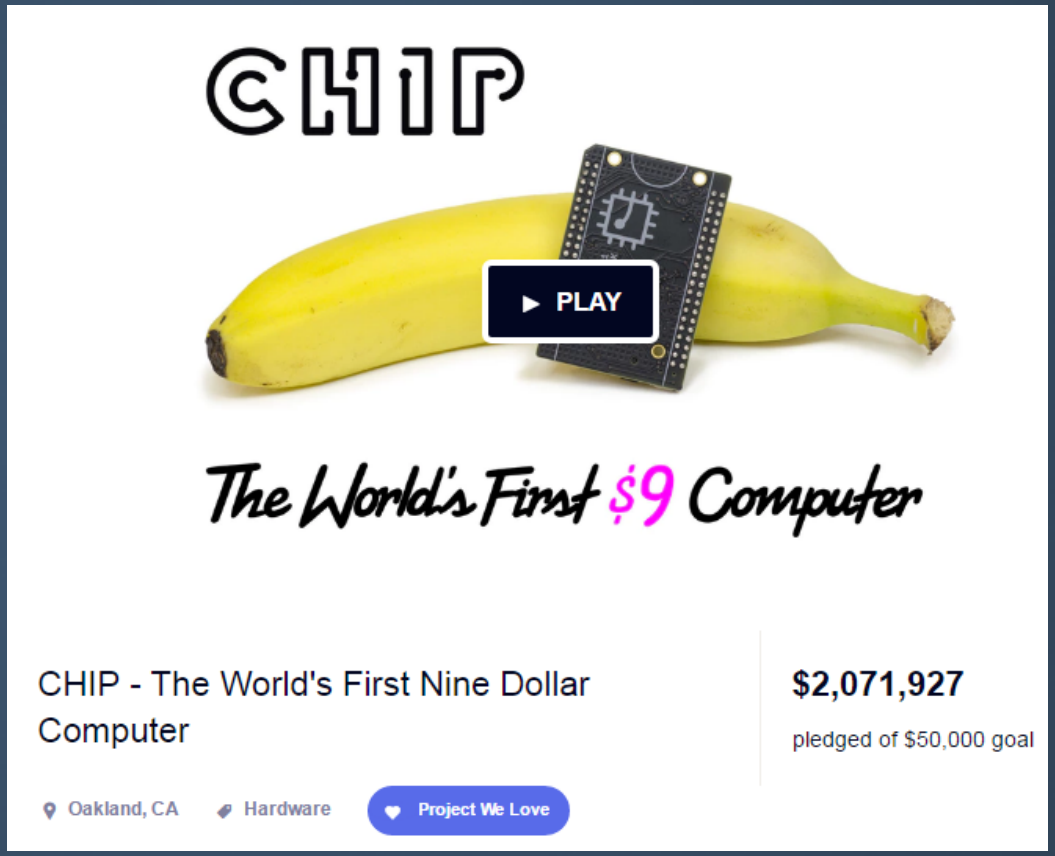
```
$ sloccount build_android_udooneo/workspace

Totals grouped by language (dominant language first):
ansic:      28909496 (48.66%)
cpp:        14820059 (24.95%)
xml:         6894345 (11.61%)
java:        5651249 (9.51%)
asm:         1105027 (1.86%)
python:      1061272 (1.79%)
sh:           434135 (0.73%)
perl:         197439 (0.33%)

...

Total Physical Source Lines of Code (SLOC) = 59,405,160
```

Standard HW/SW Platforms are becoming mainstream

- Low-cost building blocks to prototype embedded systems
- Complete with a ready-to-go Open Source software stack
- Widely used hardware interfaces
- Available for PoC and low-volume production
- Can speed up and reduce risk in embedded system design

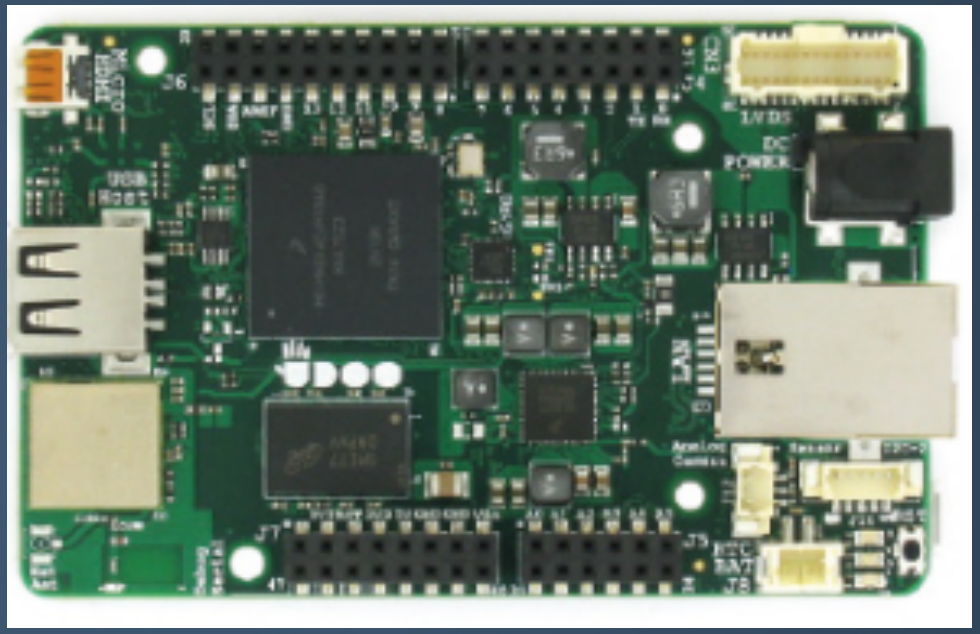
CHIP – The World's First Nine Dollar Computer

- CPU: 1 GHz Allwinner A13
- GPU: Mali400
- RAM: 512 MB
- Flash: 4 GB
- WiFi 802.11b/g/n
- Bluetooth 4.0
- OS: Debian



UDOO NEO

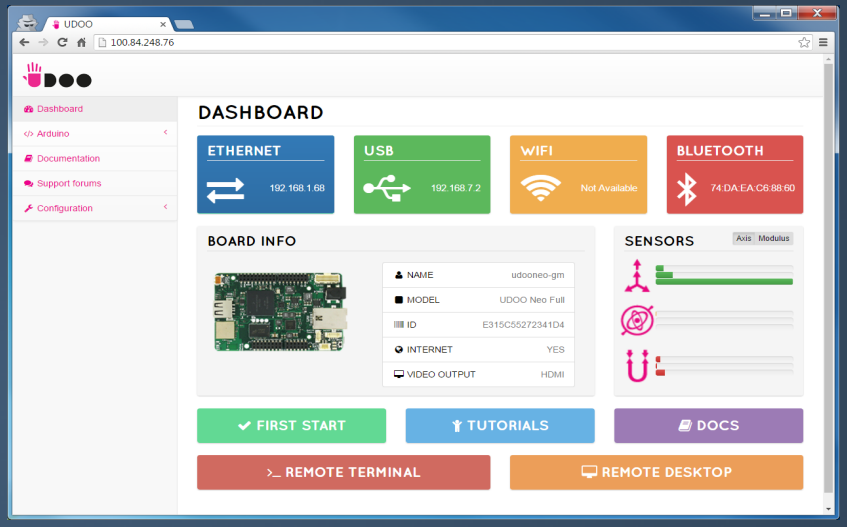
- CPU: Cortex A9
- MCU: Cortex M4
- RAM: Up to 1GB
- Integrated 2D/3D GPU
- Micro HDMI+LVDS
- Storage: MicroSD
- Audio: HDMI, S/PDIF
- USB: 1x2.0, 1xOTG
- Ethernet, WiFi, BT
- GPIO, Gyro, Accelerom, Magnetometer
- Arduino pinout



- OS: Android 5.1.1 / UDOObuntu2 (14.04 LTS)
- Price: Starting from $49.90

UDOO Board Web Config

- Web-based application
  - Runs on the A9 core
- Features
  - Get board info
  - Read on-board sensors
  - Remote Terminal
  - Remote Desktop
  - Build Arduino sketches
  - Program M4 core
- Architecture: Node.js, Express 4, Socket.io
- Sources: https://github.com/UDOOboard/udoo-web-conf

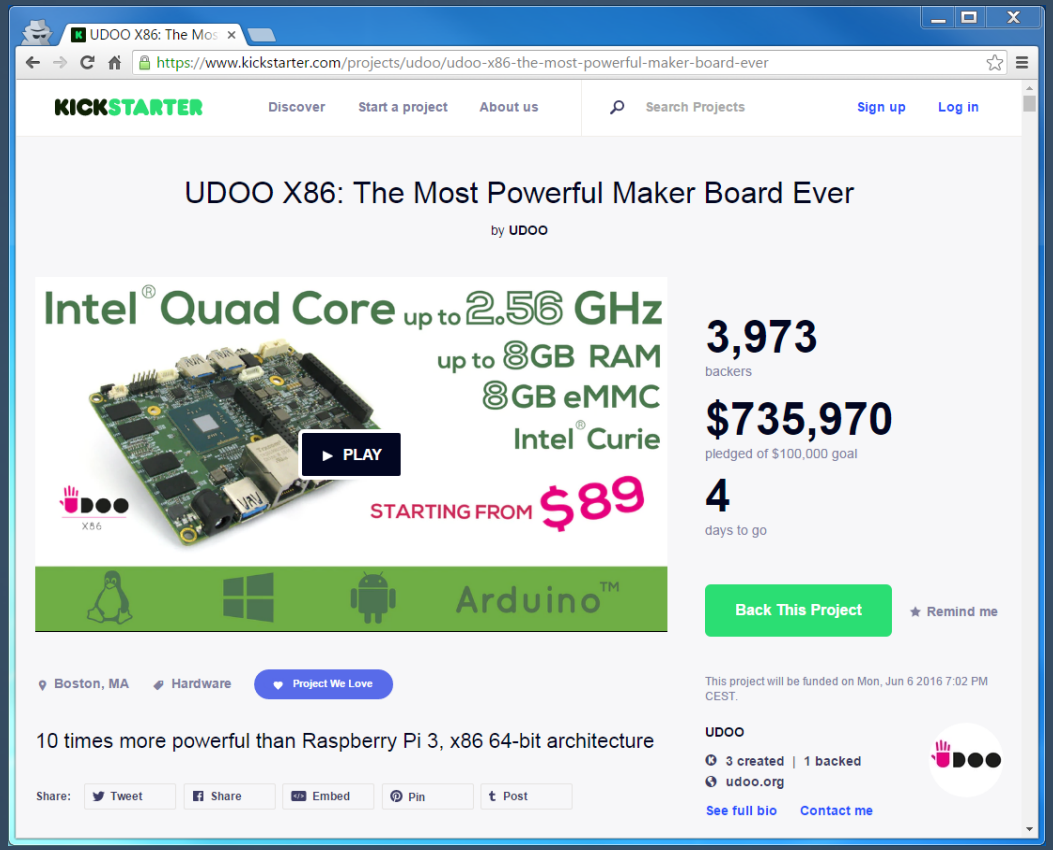


Meteor.js on UDOO

https://udoo.hackster.io/tomfreudenberg/meteor-on-udoo-and-others-a98e6d

https://github.com/4commerce-technologies-AG/meteor

UDOO X86: The definition of "embedded system" is broadening...



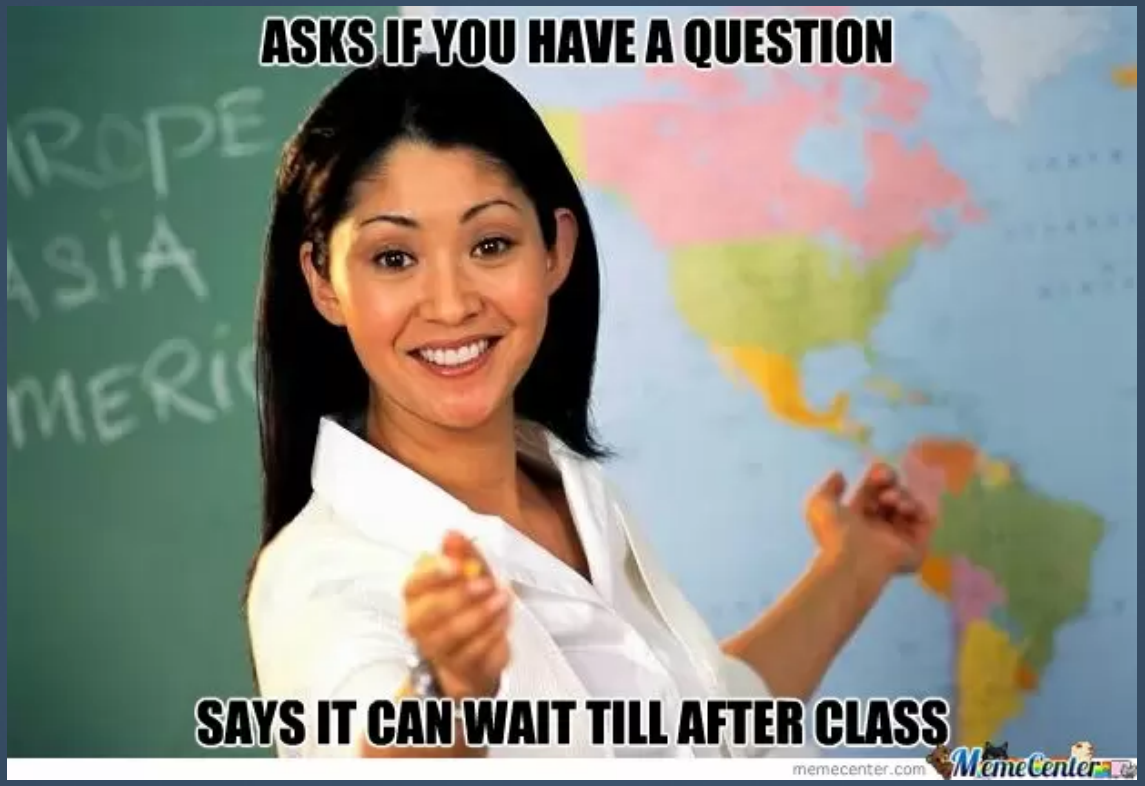
Summary

- Embedded Systems: **more features, more capabilities**
  - HW is becoming a commodity unless for huge volumes
  - SW development and system validation becomes the issue

- Low-cost, standard HW platforms are now available - complete with a broad choice of Open Source software
  - Standard Web Frameworks and Tools are now affordable also on many types of embedded systems

- Relying on **proven and validated HW/SW platforms** allows embedded system developers to focus on application level and maximize the value to the end user

Thanks!



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BACKUP SLIDES