

Web Applications on embedded systems

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Gianpaolo Macario

<https://gmacario.github.io/>

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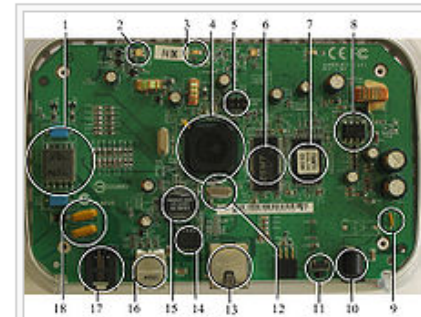
What is an embedded system?

Embedded system

From Wikipedia, the free encyclopedia

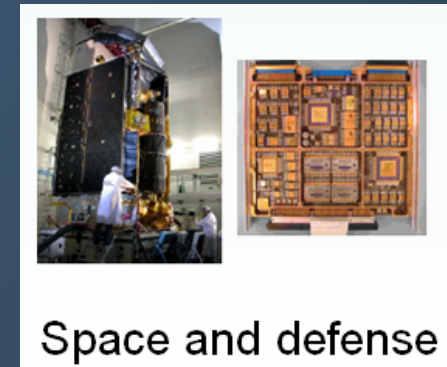
An **embedded system** is a [computer system](#) with a dedicated function within a larger mechanical or electrical system, often with [real-time computing](#) constraints.^{[1][2]} It is *embedded* as part of a complete device often including hardware and mechanical parts. Embedded systems control many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

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]



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).

We live surrounded by embedded systems

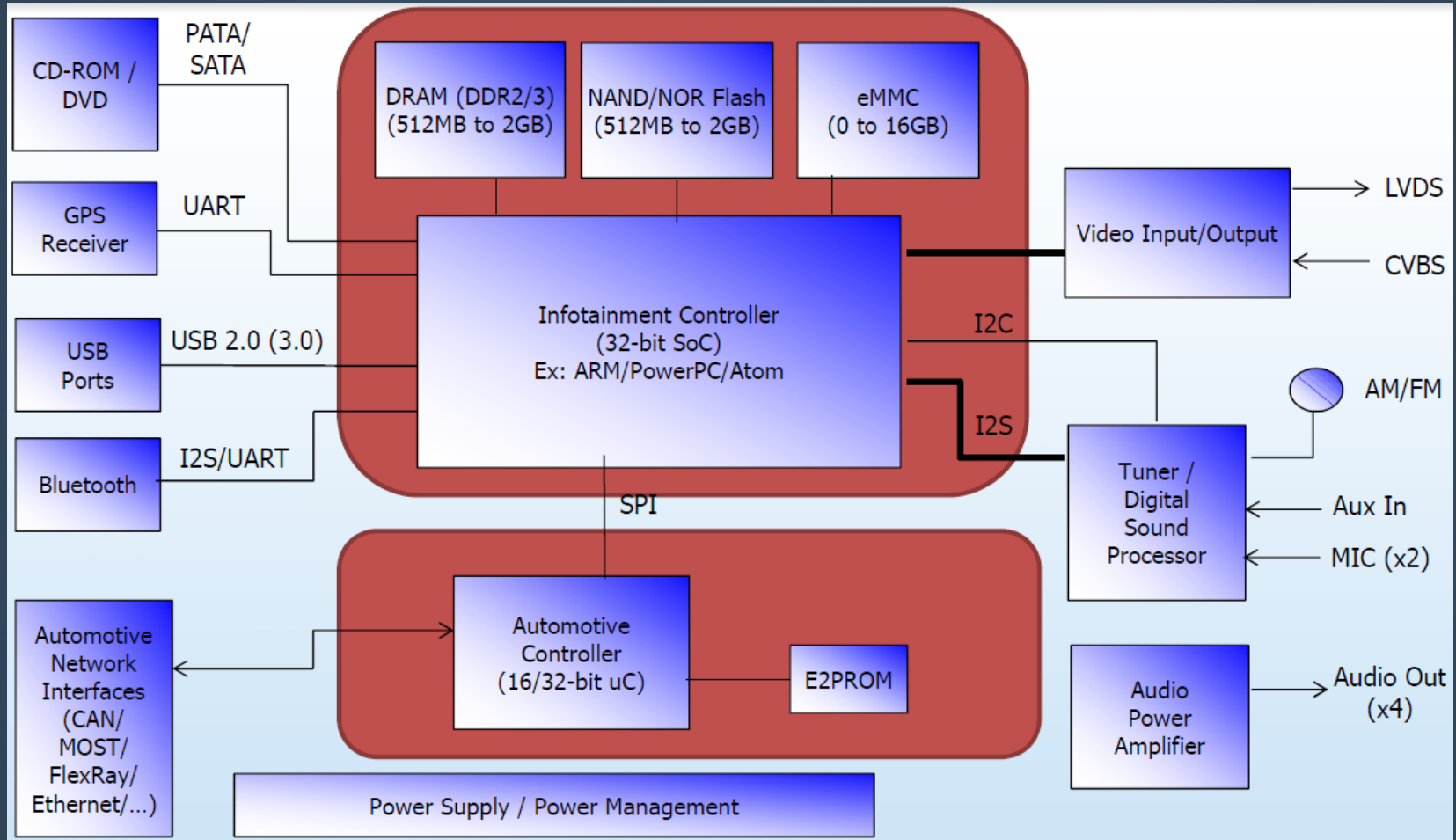


Typical characteristics of an embedded system

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%)
```

```
...
```

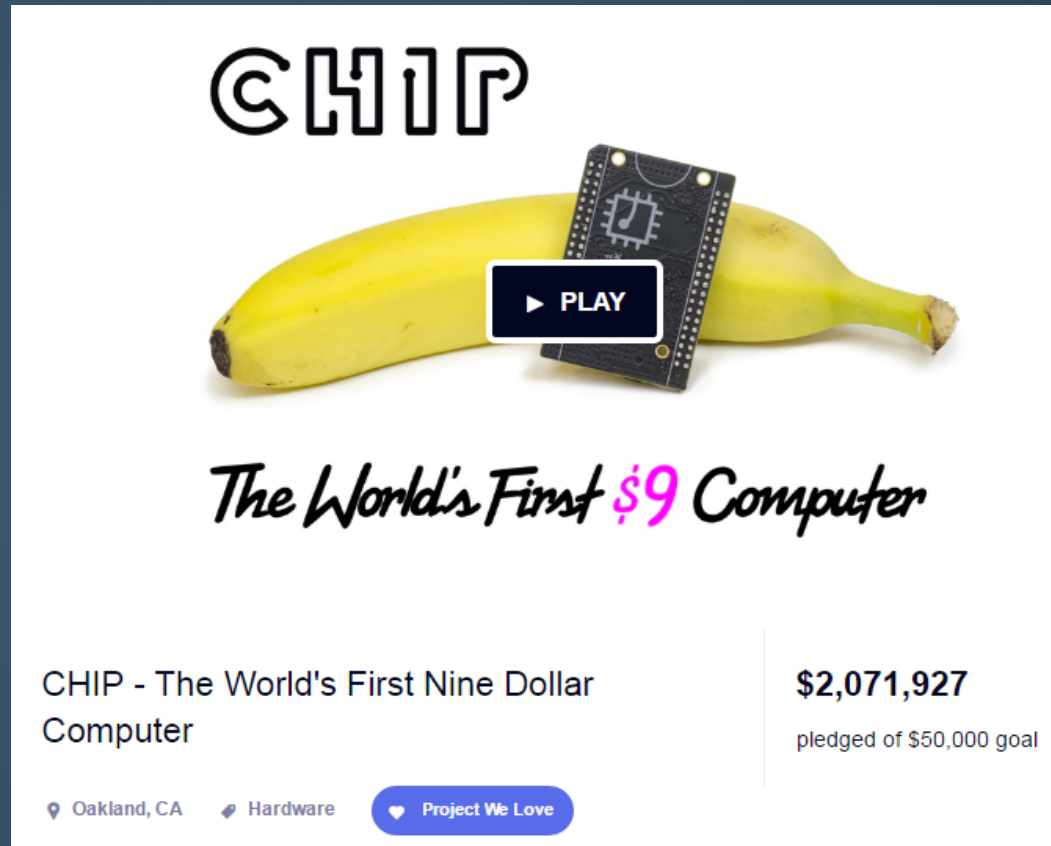
```
Total Physical Source Lines of Code (SLOC) = 59,405,160
```

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

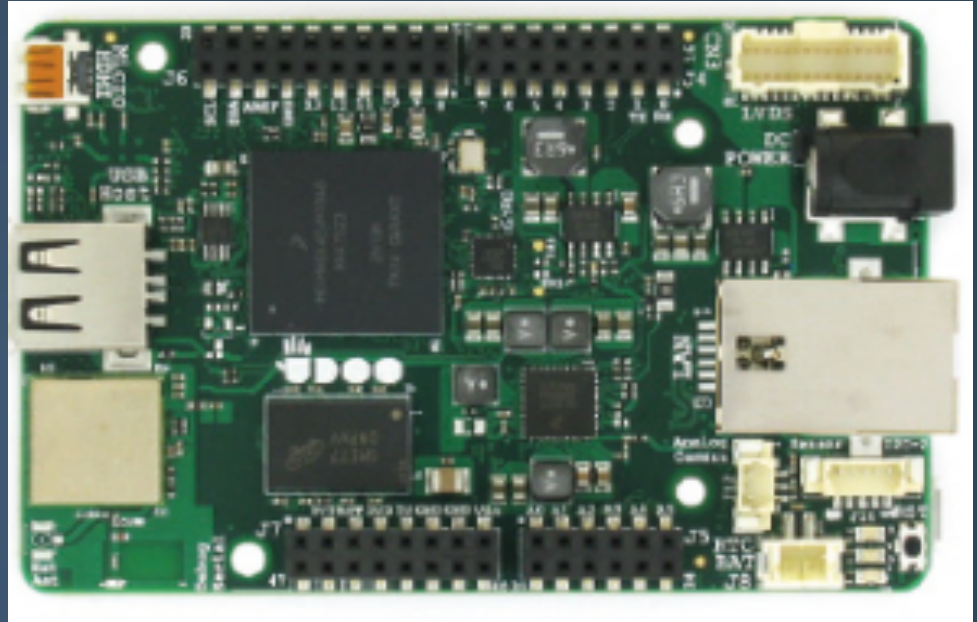
CHIP – The World's First Nine Dollar Computer

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



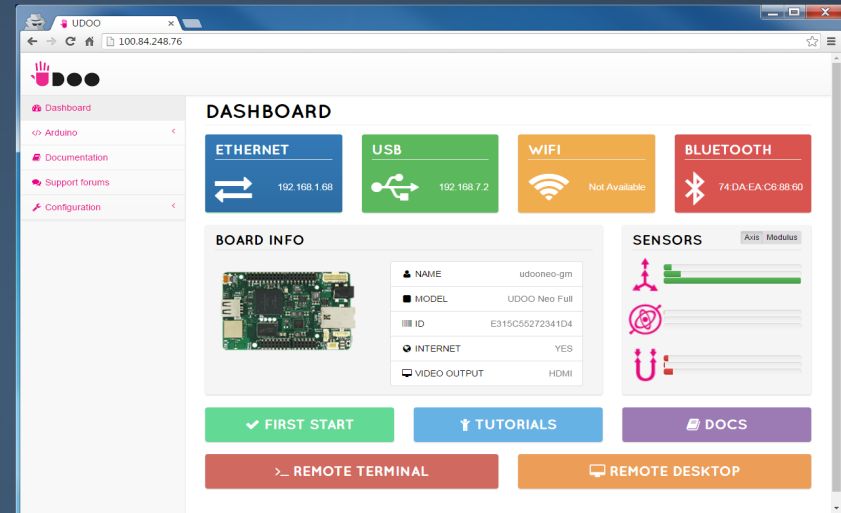
UDOO NEO

- 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 / UDObuntu2 (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...

The screenshot shows the Kickstarter page for the UDOO X86 project. The browser address bar displays the URL: <https://www.kickstarter.com/projects/udoo/udoo-x86-the-most-powerful-maker-board-ever>. The page header includes the Kickstarter logo and navigation links: Discover, Start a project, About us, Search Projects, Sign up, and Log in.

The main title of the campaign is "UDOO X86: The Most Powerful Maker Board Ever" by UDOO. The featured image shows the UDOO X86 circuit board, which is a green PCB with various components, including a large Intel Quad Core processor, RAM, and storage. A "PLAY" button is overlaid on the image. To the right of the image, the specifications are listed: "Intel® Quad Core up to 2.56 GHz", "up to 8GB RAM", "8GB eMMC", and "Intel® Curie". The price is "STARTING FROM \$89".

On the right side of the page, the funding progress is shown: 3,973 backers, \$735,970 pledged of a \$100,000 goal, and 4 days to go. A green "Back This Project" button and a "Remind me" link are also present.

Below the main image, there is a green banner with logos for Linux, Windows, Android, and Arduino™. The location is listed as Boston, MA, and the category is Hardware. A "Project We Love" badge is also visible.

The description states: "10 times more powerful than Raspberry Pi 3, x86 64-bit architecture". At the bottom, there are social sharing options: Tweet, Share, Embed, Pin, and Post.

On the right side, the project's funding deadline is noted: "This project will be funded on Mon, Jun 6 2016 7:02 PM CEST." The creator's name is UDOO, with 3 created projects and 1 backed project. The website udoo.org is listed, along with links to "See full bio" and "Contact me".

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