La cuarta revolución industrial: Internet de las cosas y sistemas ciberfísicos

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Enginyers Industrials de Catalunya

Abril 2015 – Hispack

Fouth Industrial Revolution: Internet of things and cyber-physical systems

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Presentation and framework

About our background

- EIC is a Catalan Industrial Engineers association
- The Embedded Systems Working group in this association has members from various fields, such as designers, manufacturers, integrators and academia.
- The group is open to members from other associations and there are some profiles from economy, political science and innovators.

About our background

- From the beginning the group has been building a simple framework that includes:
  - Some definitions
  - A small taxonomy (classifications) of embedded systems
  - A group slogan
- So far it has proved to be useful as a tool to facilitate communication between us

Some definitions

- System (taken from INCOSE):

  "A system is a construct or collection of different elements that together produce results not obtainable by the elements alone"

- Embedded System:

  "An embedded system is a combination of hardware and software aimed to support a finite and numbered set well-defined functions, often with real-time process capabilities, integrated into a larger system"

Taxonomy (classifications)

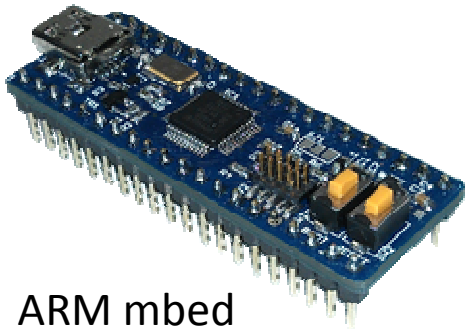
- In order to characterize and classify the embedded systems building blocks we take into consideration classify by:
  - Complexity
  - Intellectual property approach
  - Form factor

Taxonomy (classifications)

- Classification by complexity (Taken from professor Raj Kamal):
  - Small Scale Embedded Systems (No operating system, microcontrollers)
  - Median Scale Embedded Systems (Signal processors, DSPs)
  - Sophisticated Embedded Systems (Operating system based, like Linux or others)

Complexity

Small scale

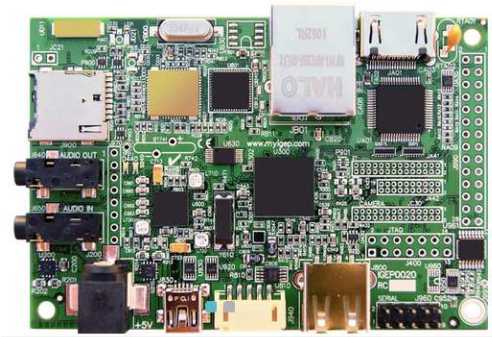


ARM mbed

ATTiny

Arduino Micro

Sophisticated scale



ISEE IGEP 3730 ARM A8

Raspberry Pi

Embedded professional

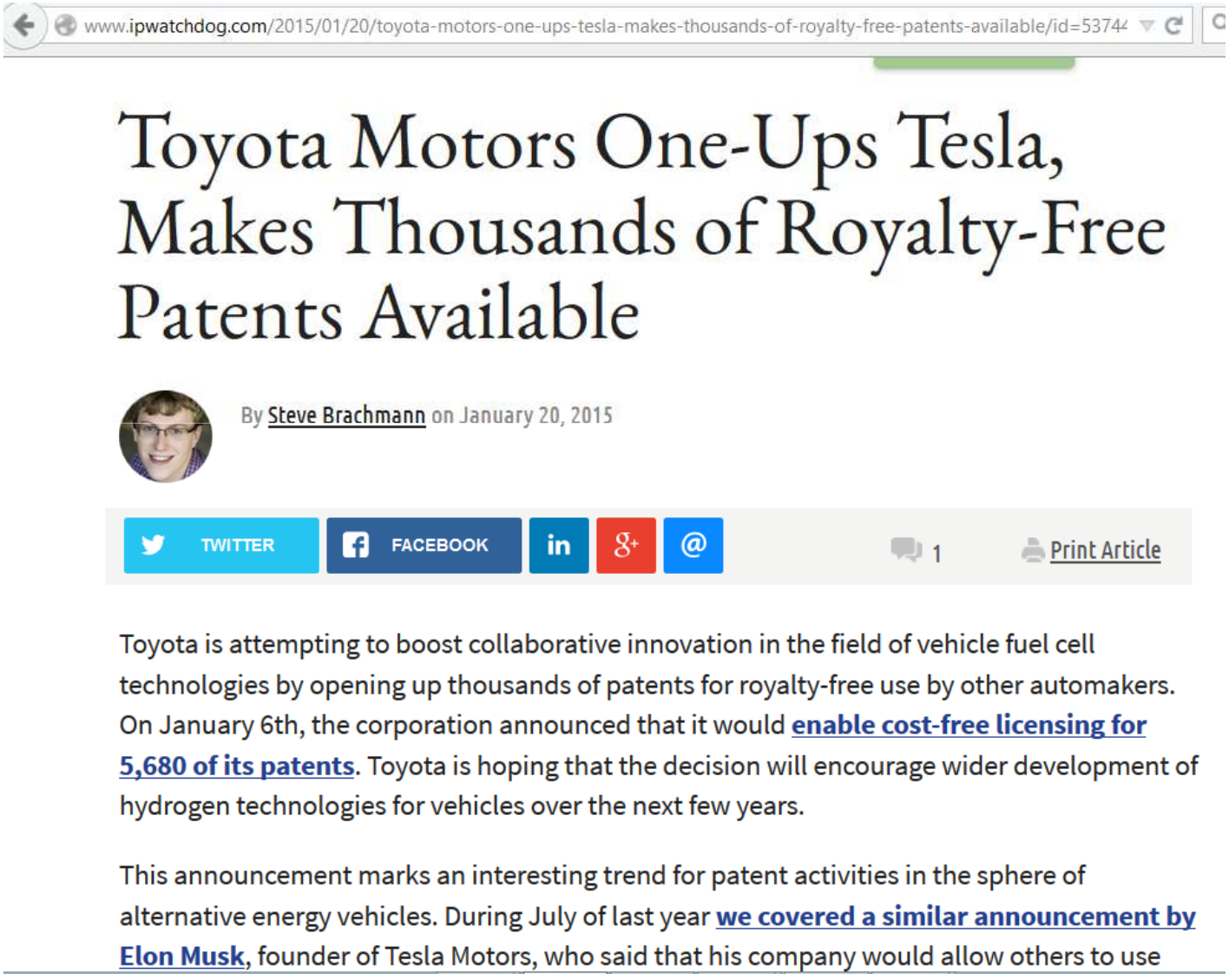
Embedded hobby (Makers)

Taxonomy (classifications)

- Classification by intellectual property approach
  - Proprietary (Software and/or hardware)
  - Open source (Software and/or hardware, a lot of variations, MIT, Creative Commons …)
  - Hybrid (Royalty-free patents)

- How open source is related to low cost ?

Royalty-free patents



www.ipwatchdog.com/2015/01/20/toyota-motors-one-ups-tesla-makes-thousands-of-royalty-free-patents-available/id=5374

Toyota Motors One-Ups Tesla, Makes Thousands of Royalty-Free Patents Available

By Steve Brachmann on January 20, 2015

TWITTER FACEBOOK 1 Print Article

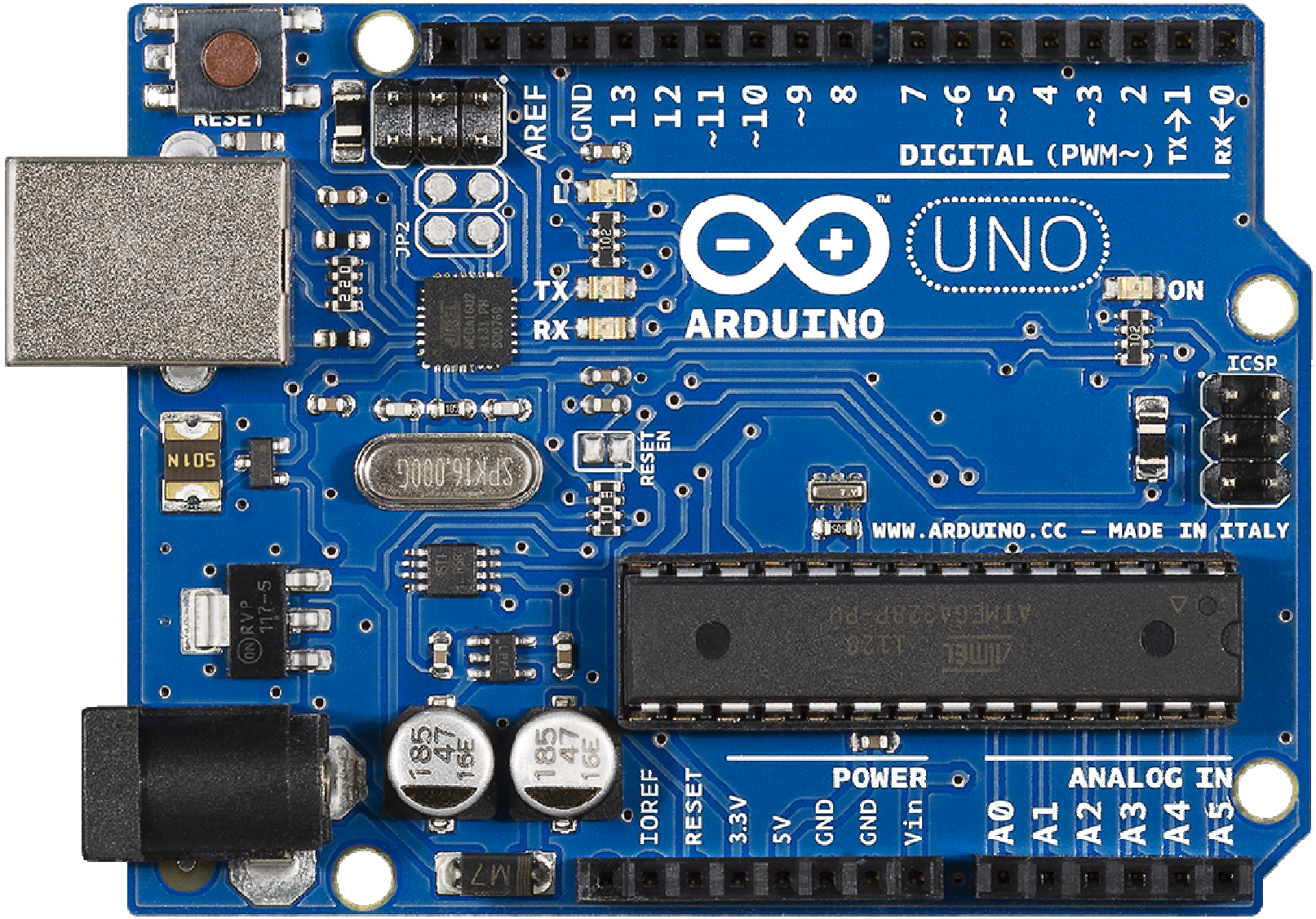
Toyota is attempting to boost collaborative innovation in the field of vehicle fuel cell technologies by opening up thousands of patents for royalty-free use by other automakers. On January 6th, the corporation announced that it would **enable cost-free licensing for 5,680 of its patents**. Toyota is hoping that the decision will encourage wider development of hydrogen technologies for vehicles over the next few years.

This announcement marks an interesting trend for patent activities in the sphere of alternative energy vehicles. During July of last year **we covered a similar announcement by Elon Musk**, founder of Tesla Motors, who said that his company would allow others to use

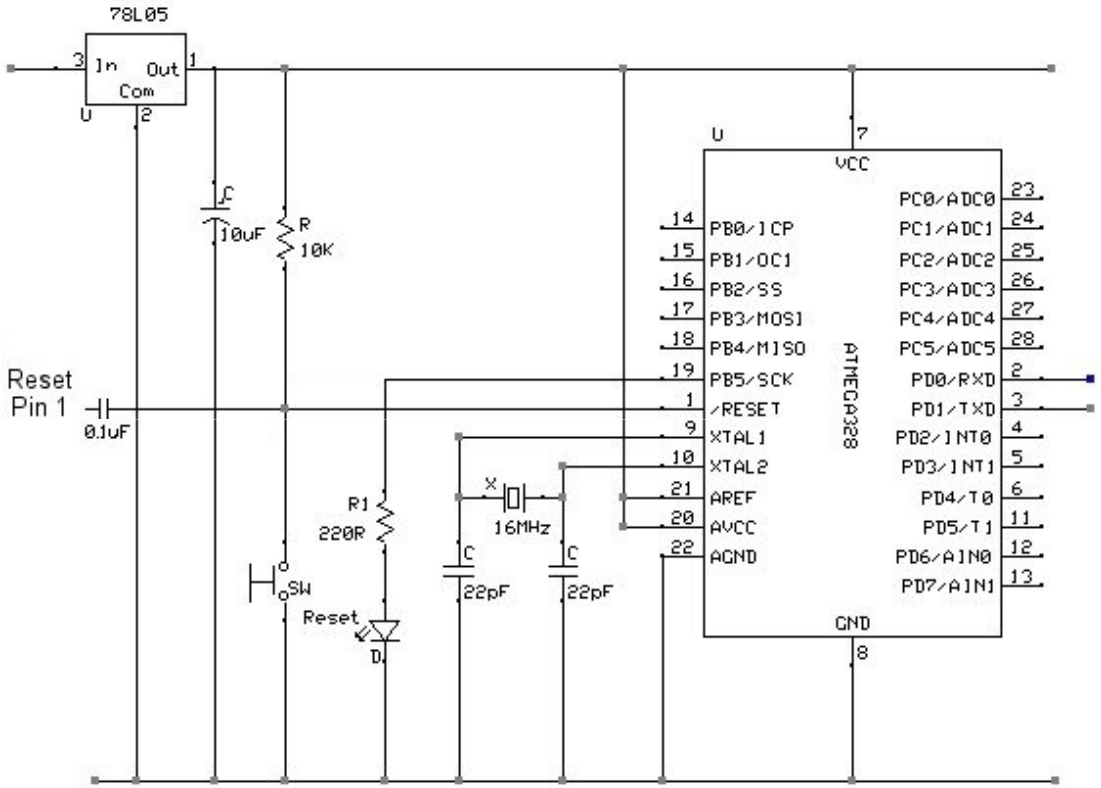
Taxonomy (classifications)

- Classification by form factor
  - Standard form factor used
  - Custom form factor used
- We understand Form Factor as a replacement criteria (physical dimensions and connections)

“De facto” standard form factor

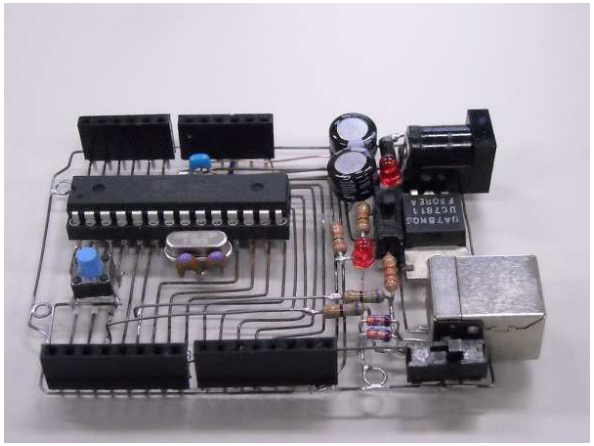


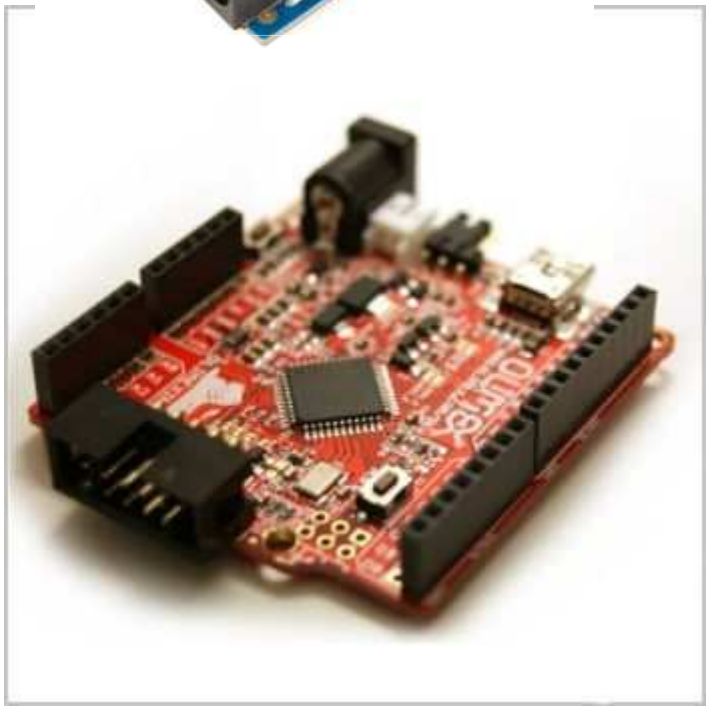
The basis: Atmel ATmega328

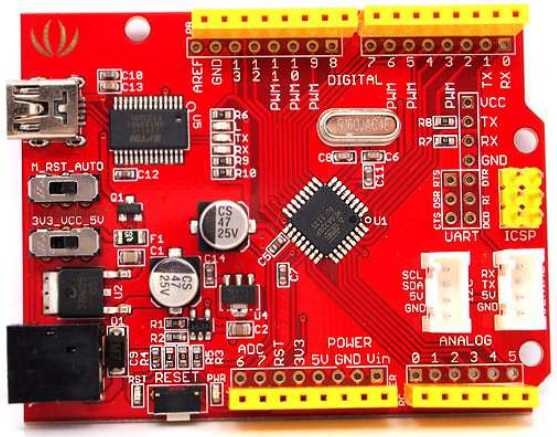


IDEA: Eliminating obstacles and letting people do, new and unexpected forms of innovation can emerge

Arduino form factor





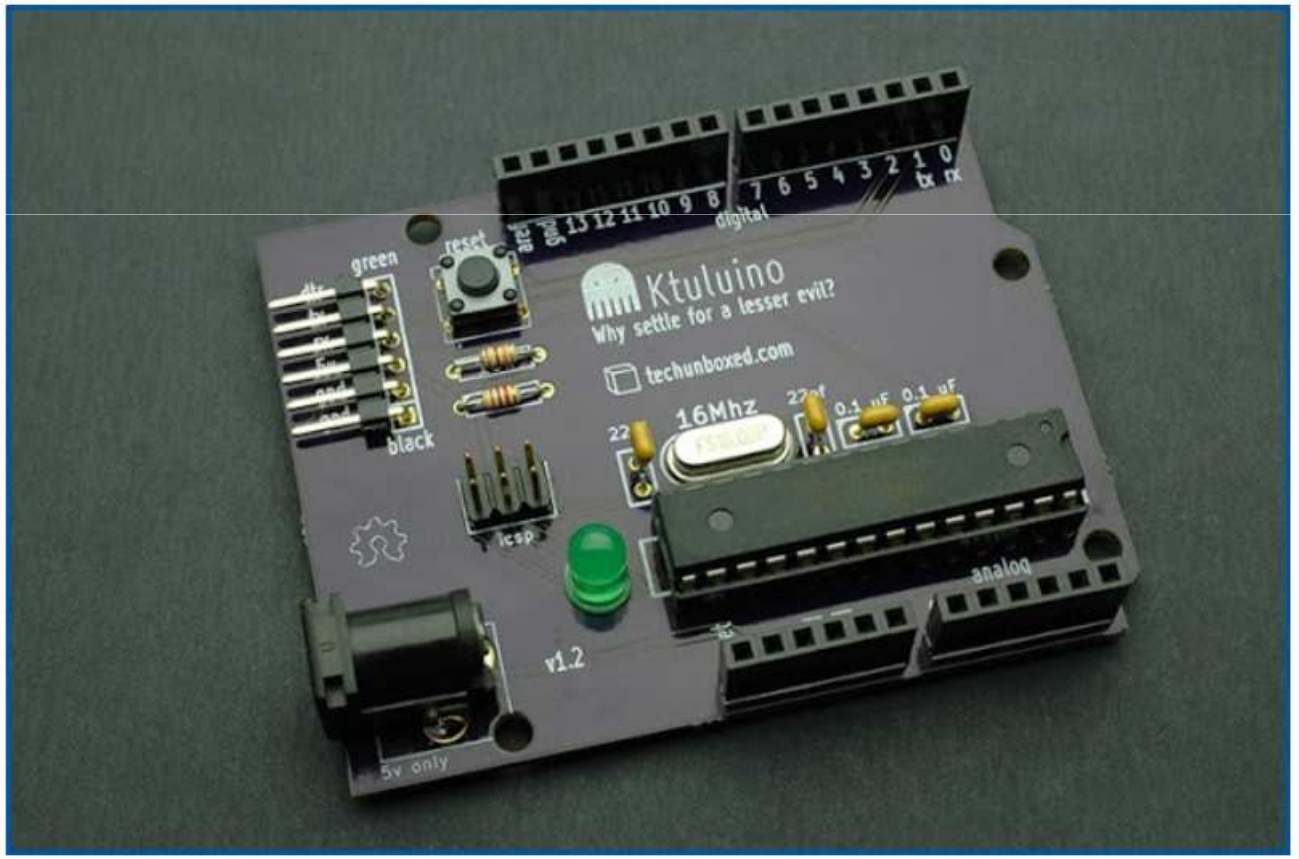


Arduino and its clones

www.techunboxed.com/2013/08/ktuluino.html

Saturday, August 31, 2013

Ktuluino - How to Build Your Own Arduino Clone

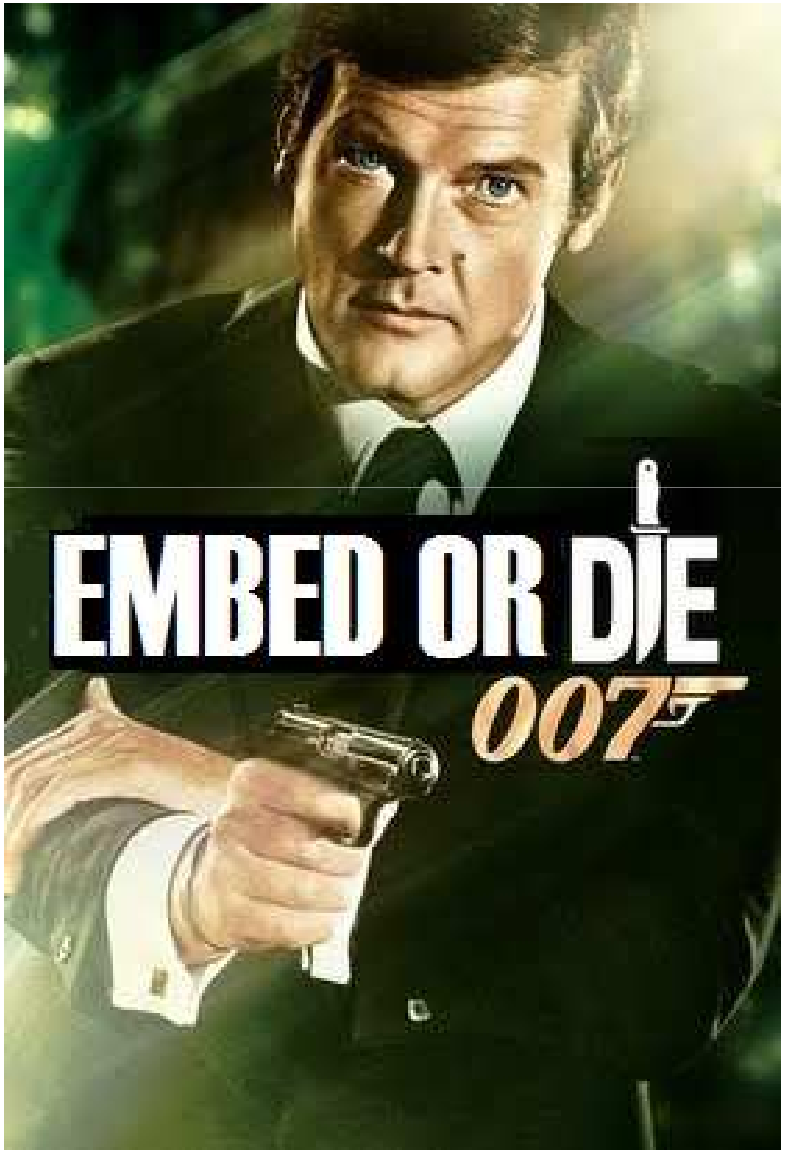


The notion of shield

Shields are add-ons or extension shields that can be plugged over the Arduino shield

- And we have and slogan

Embedded systems revolution ?

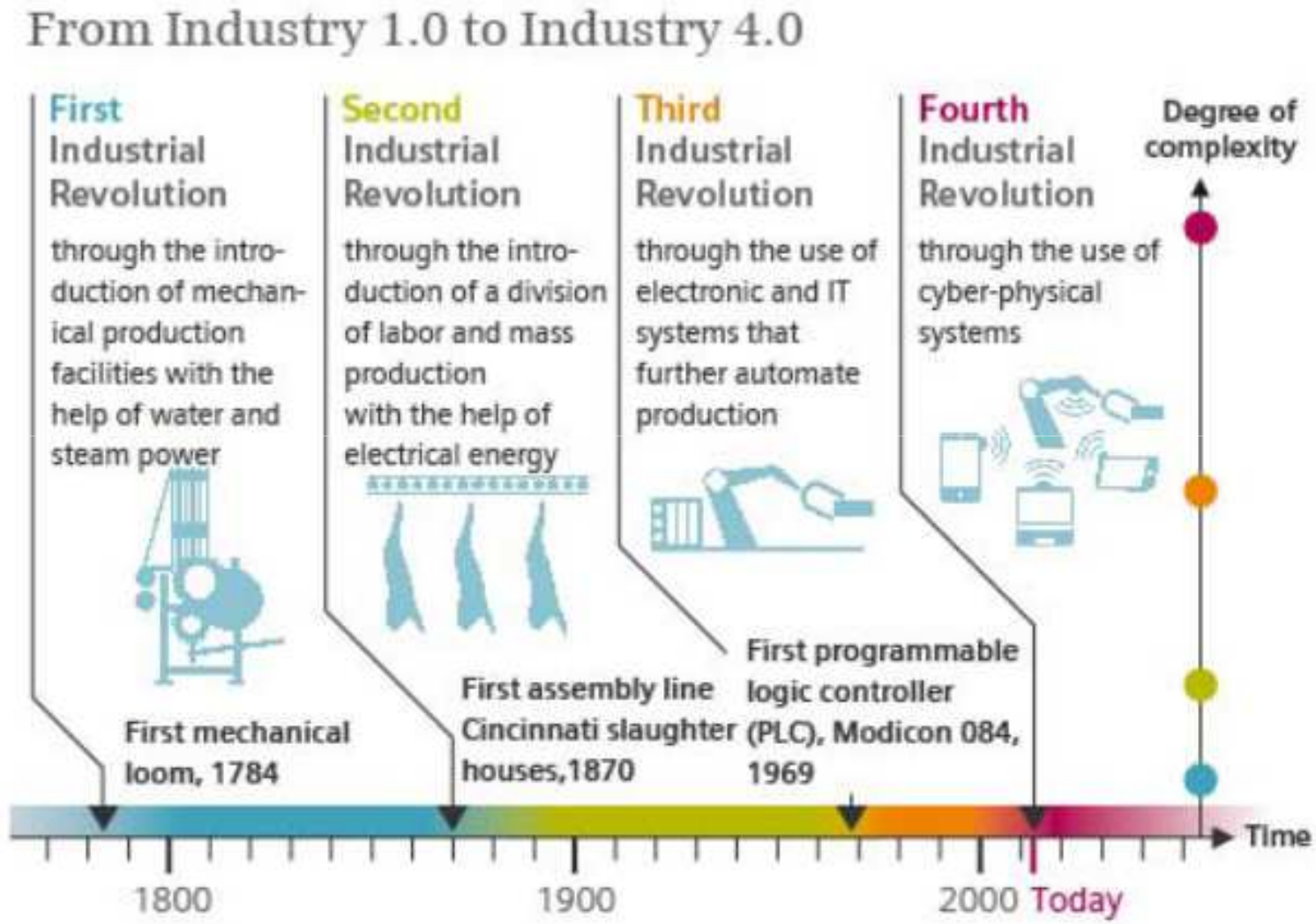


01

The Fourth Industrial Revolution

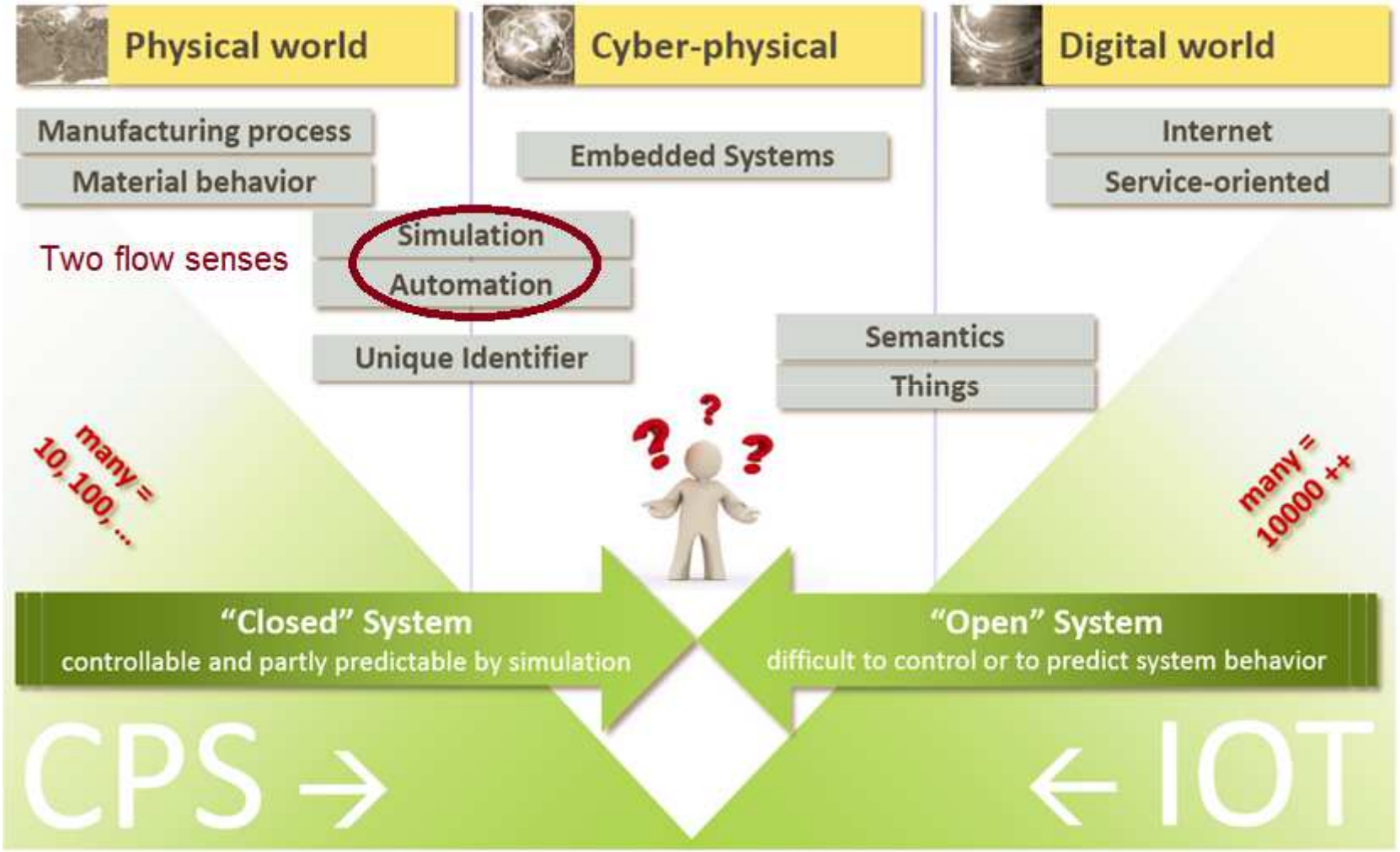
The seminal paper

The 4th Industrial Revolution

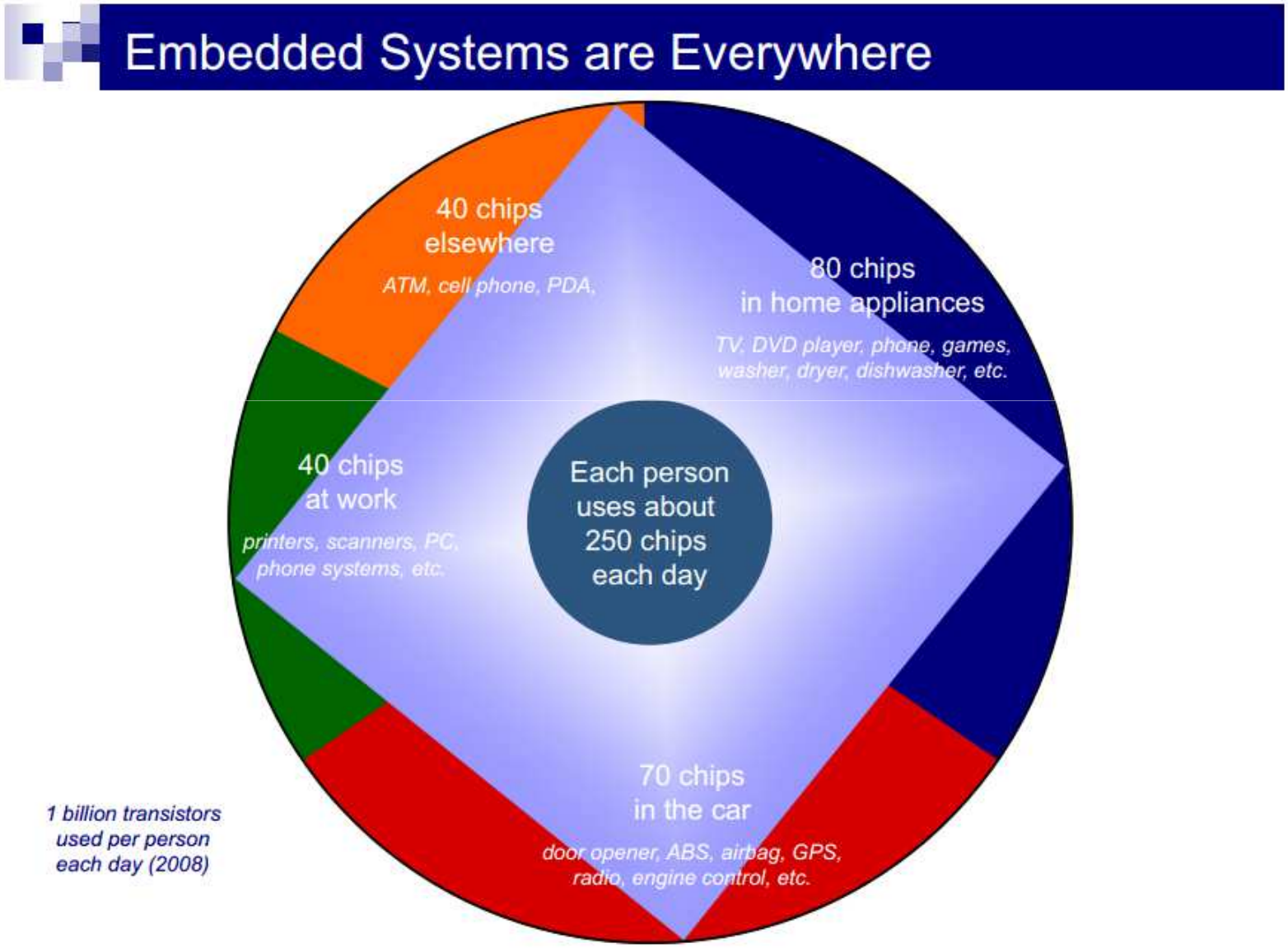


Source: DFKI (2011)

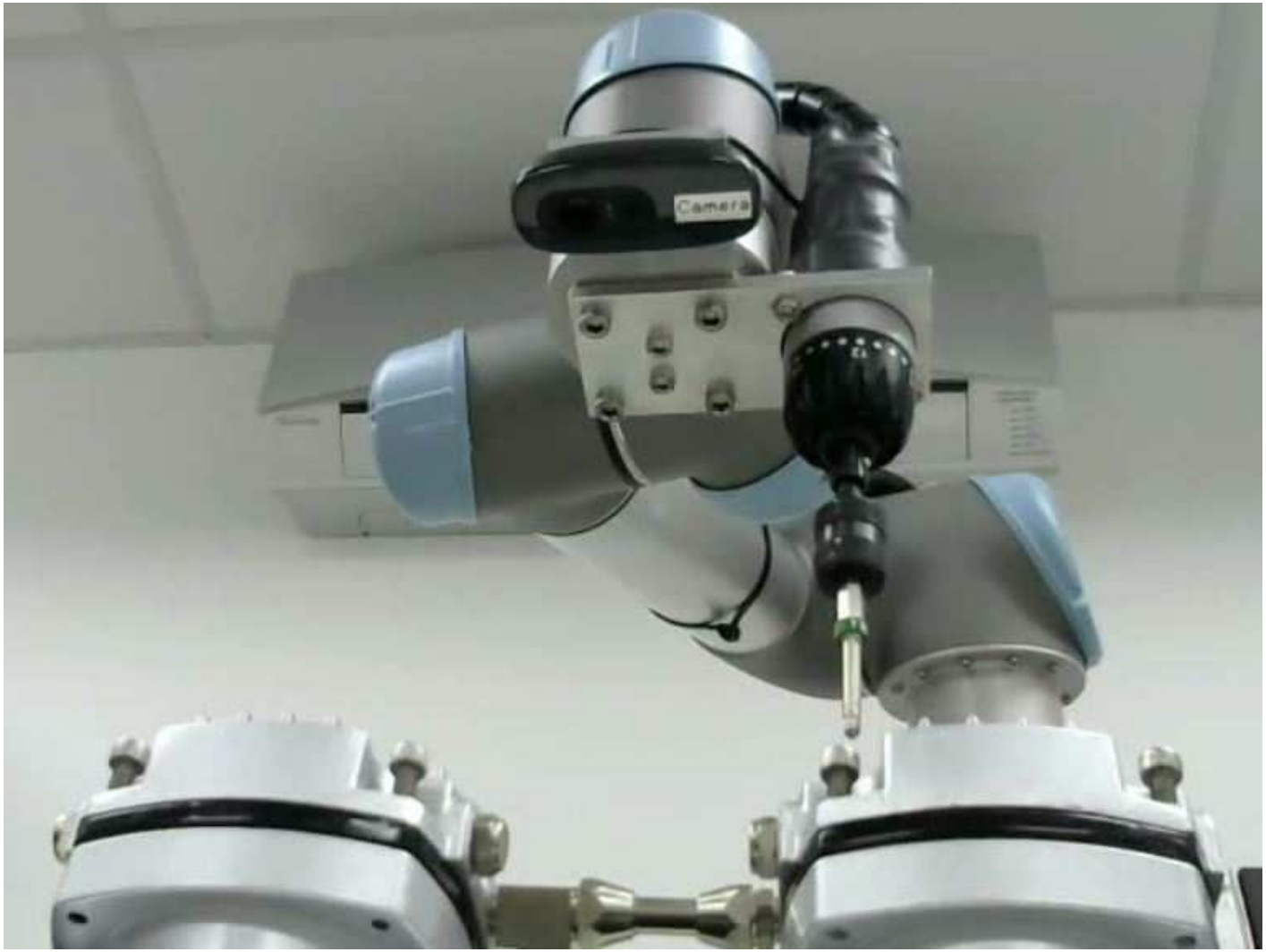
IoT and CPS


Physical world
Cyber-physical
Digital world
Manufacturing process
Material behavior
Embedded Systems
Internet
Service-oriented
Two flow senses
Simulation
Automation
Unique Identifier
Semantics
Things
many = 10, 100, ...
many = 10000 ++
"Closed" System
controllable and partly predictable by simulation
"Open" System
difficult to control or to predict system behavior
CPS →
← IOT

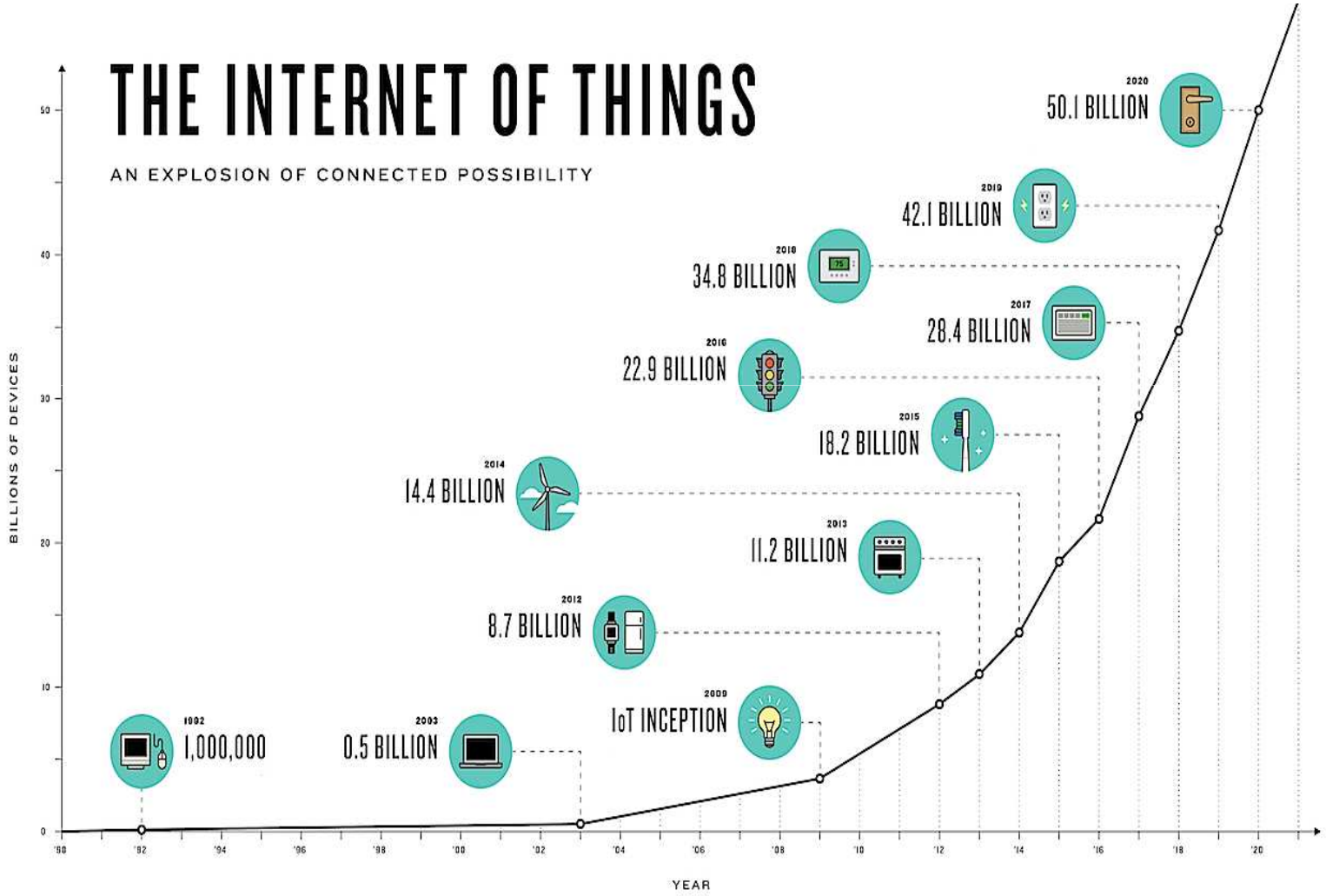
Transversallity



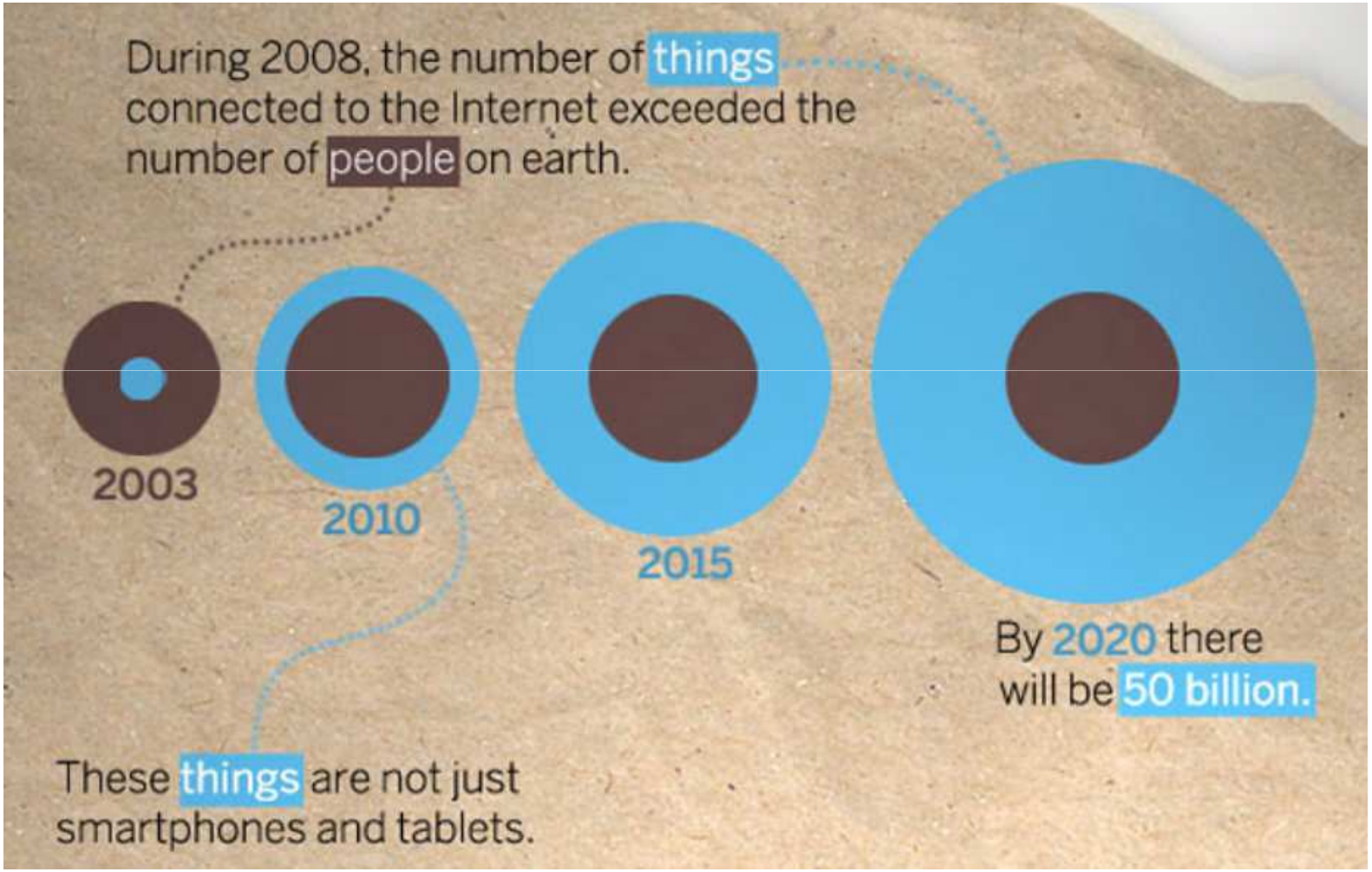
Transversallity



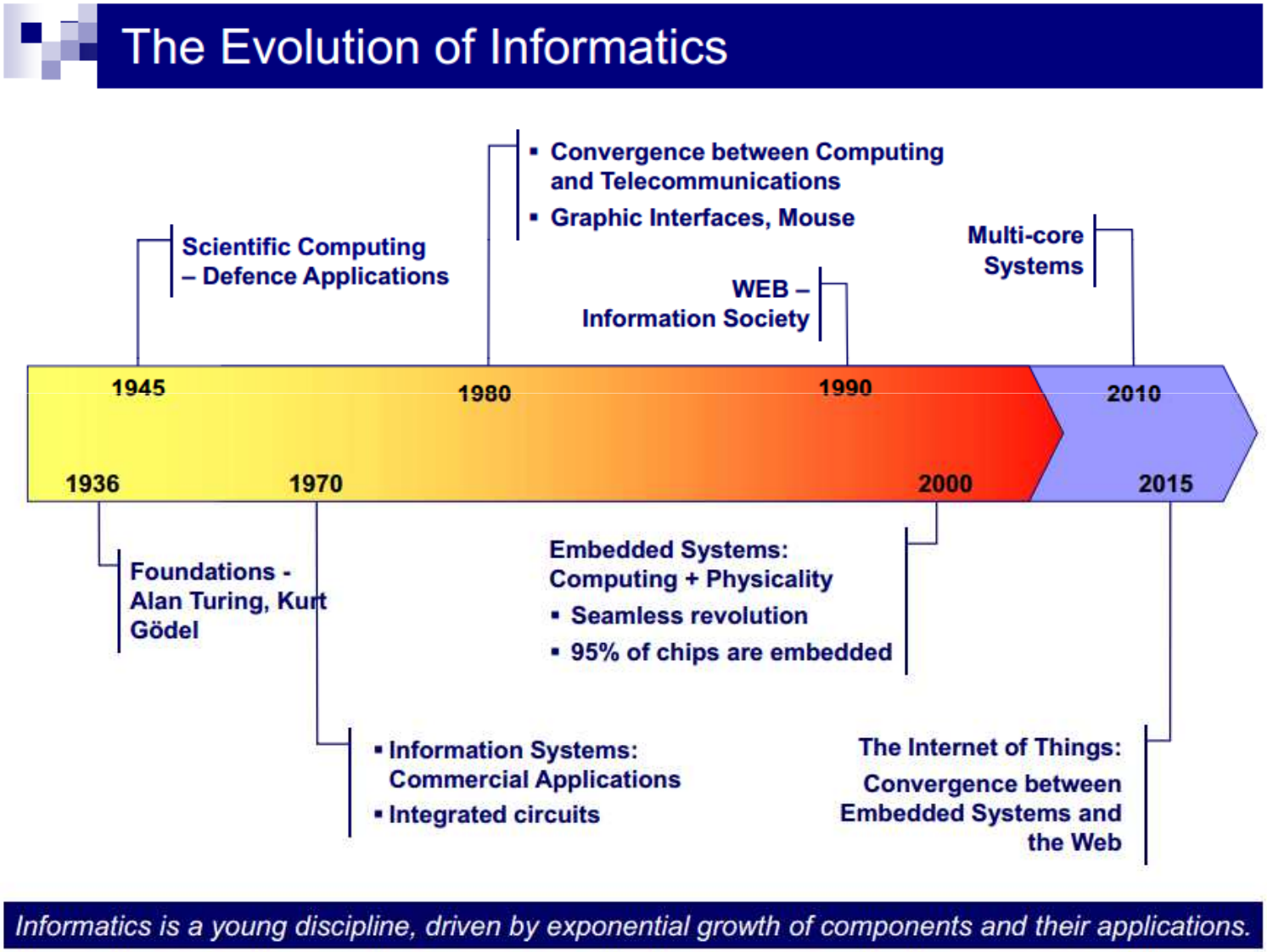
First pillar: Internet of Things (IoT)



First pillar: Internet of Things (IoT) - II



Second pillar: Cyberphysical systems



Cyber-physical systems: Joseph Sifakis (Turing Prize 2007)

Proposed Vision

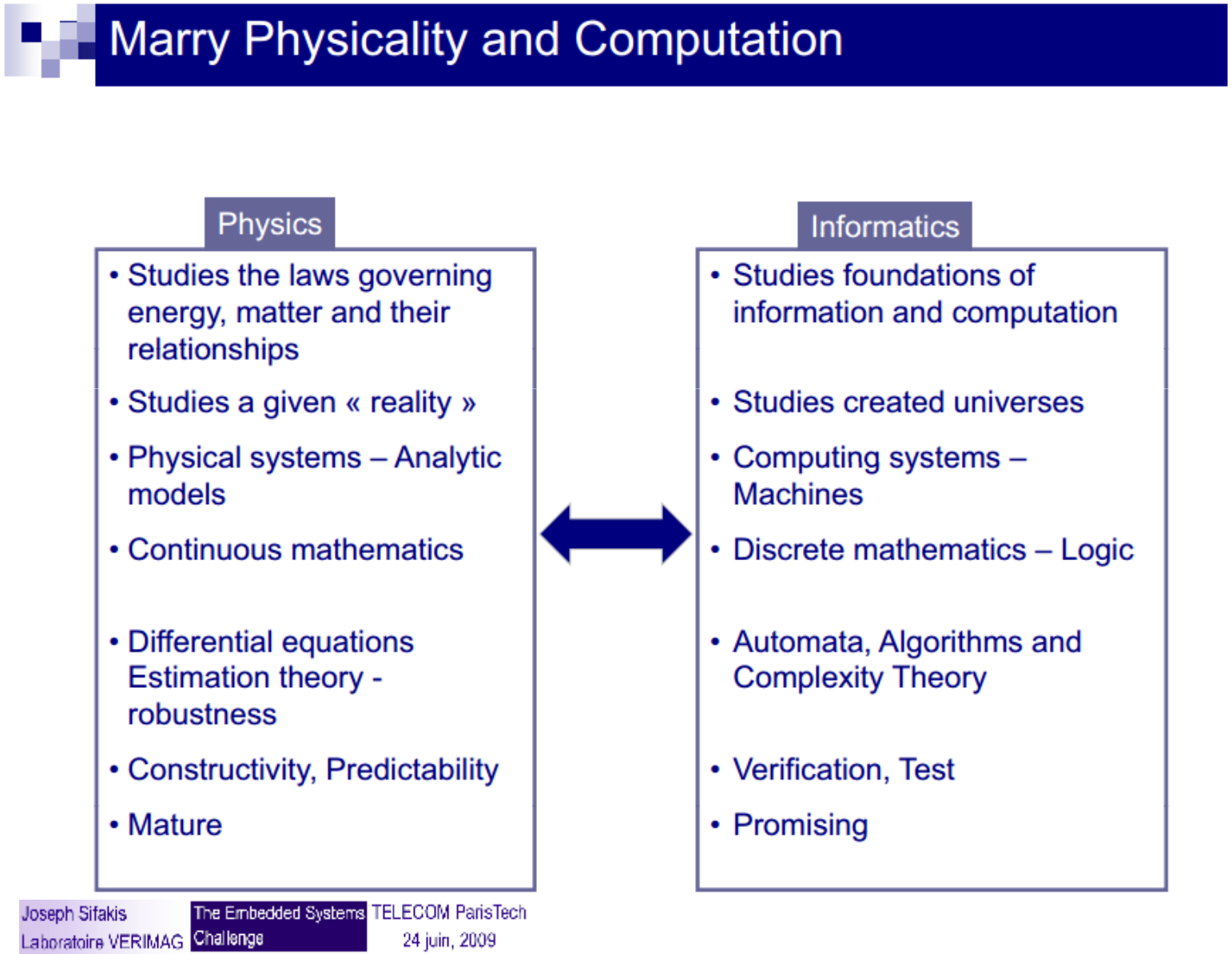
By their nature, Embedded Systems need results and paradigms from both Computing Systems and Physical Systems Engineering

We need a new formal foundation for Embedded Systems, which systematically and even-handedly marries computation and physicality performance and robustness

What is being computed? At what cost?

How does the performance change under disturbances? (change of context; change of resources; failures; attacks)

Prevision for 2015 (“The marriage”)



Example of practical discourse

- How apply Internet Of Things?
  - Any measure we could read could be accessed immediately via web-service (for example a display)
  - Any actuation could be activated immediately via web-service (on/off actions are the simplest, …)
- If these rules are applied to every equipment rules will change (prediction):
  - Dramatic increase of engineering integration tasks with an exponential growing of combinations possibilities.
  - Consolidation of open approaches (open standards, open protocols, open source software, open source hardware, TCP/IP, Bluetooth 4.0, ...

02

The 3th DIY wave: Makers movement (Citizens empowerment)

Maker Movement

el Periódico

Cosas de la vida | GRAN BARCELONA

La nueva vida de un negocio tradicional

Las olvidadas tiendas de electrónica renacen gracias al fenómeno 'maker'

Los comercios digitales ganan el pulso a las webs chinas de venta gracias a su inmediatez y atención

Muchos extranjeros visitan en BCN estos locales, que ya han desaparecido en numerosos países

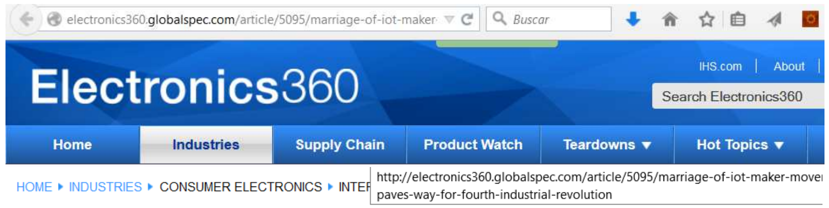
itinerarios

ESPACIOS PARA INTERCAMBIAR

LUGARES DE ENCUENTRO

EL BAR MÁS ACTIVO

REDES SOCIALES



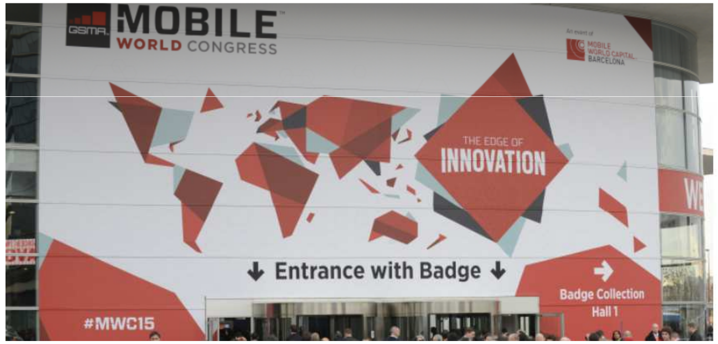
Internet Enabled Consumer Devices

Marriage of IoT, Maker Movement Paves Way for 'Fourth Industrial Revolution'

Jennifer Baljko

09 March 2015

Share Tweet Email



Intel, for instance, has been a proponent from some time. At the Make Fair in Rome in 2013, the chipmaker announced a partnership with Arduino, and its Galileo Gen 2 board was the first product specifically designed for makers, students, educators and DIY electronics enthusiasts.

Atmel, too, has had a track record in this area, with its microcontrollers often powering a number of Arduino boards. The company operates a "Tech on Tour" mobile trailer that travels to locations throughout the U.S. in an effort to reach out to the maker community.

Outreach to the maker community from these semiconductor companies and others is evidence that the industry sees the potential for innovation coming from new sources--and wants to be a part of it.

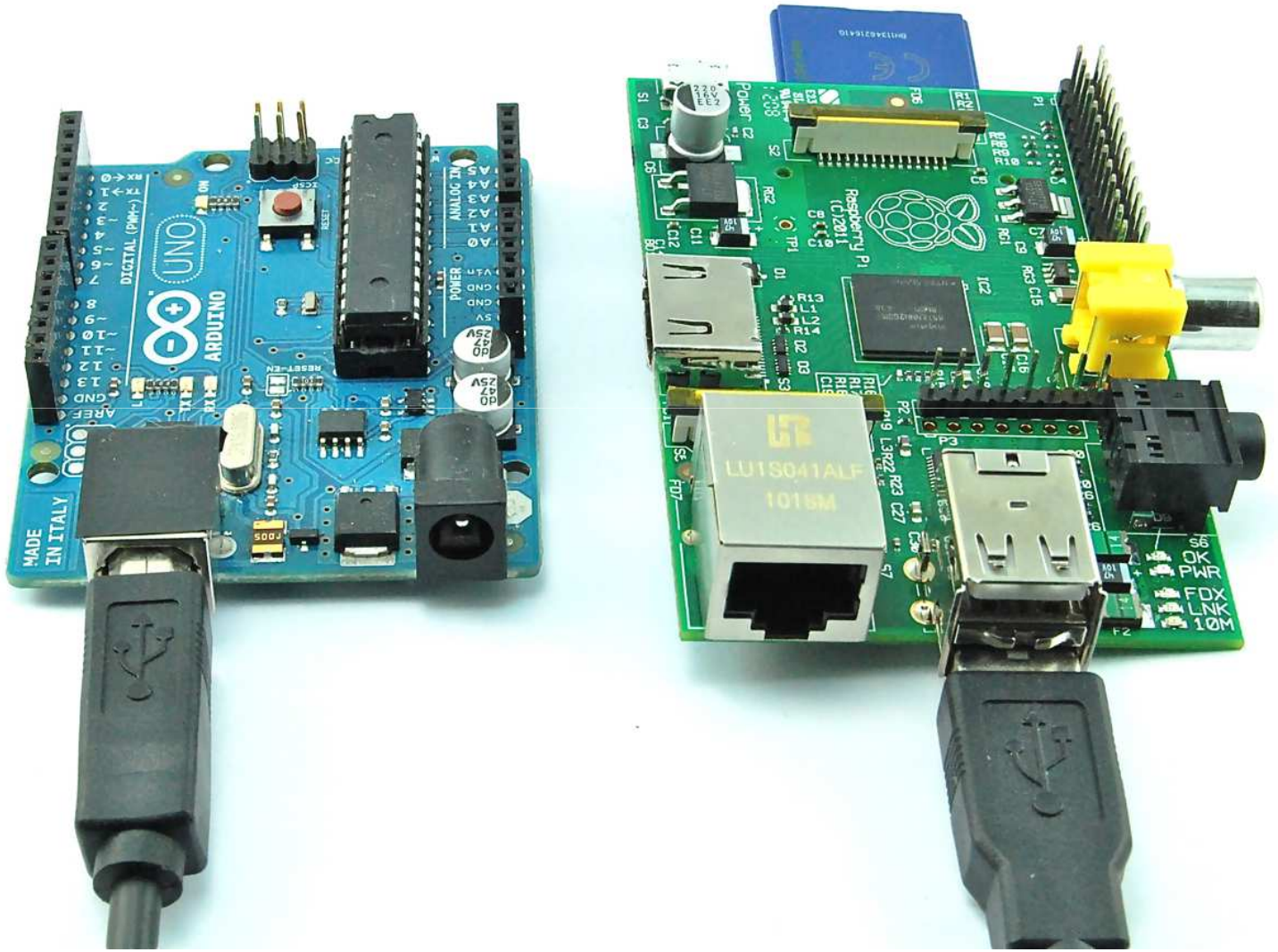
As author Chris Anderson recently wrote in the *Guardian*, "The Maker movement has a long way to go before it can really be said to have come of age. But that doesn't mean it should be ignored or regarded solely as a hobbyist's or niche manufacturer's paradise. It represents the first steps in a different way of doing business."

Questions or comments on this story? Contact Jennifer.baljko@ihs.com

Living Labs (Ateneus de fabricació / Manufacturing Atheneus)

Home Labs (The myth of the Apple Garage). What happens at citizen homes?

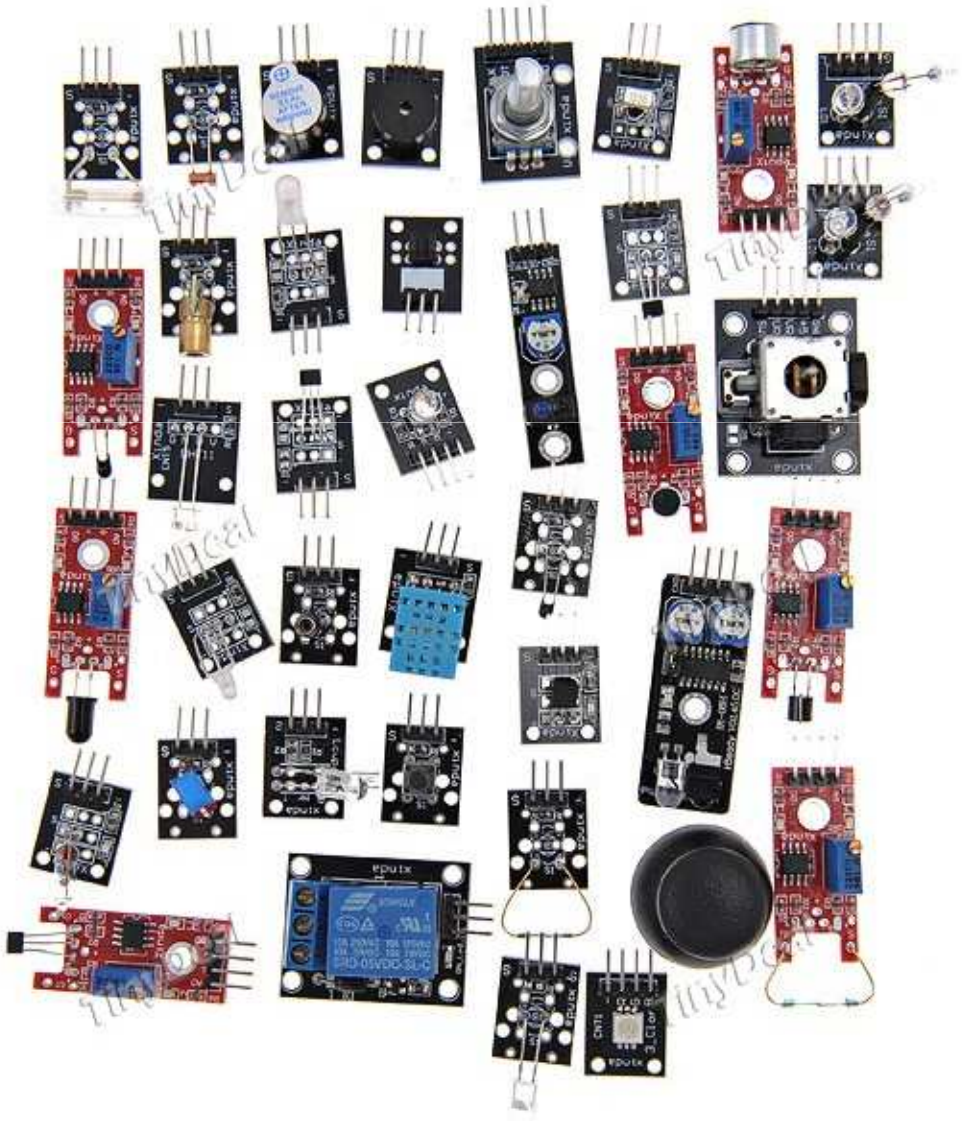
Popular boards: Arduino and Raspberry Pi



Arduino and Raspberry Pi

- Arduino is a project born in Ivrea in 2005, Olivetti's historical headquarters, that consists of a small controller conceptually similar to an industrial PLC (Programmable Logic Controller). It is the *Open Source Hardware* world reference.
- Raspberry Pi is a project born in the University of Cambridge in 2009, that consists of a small card with a full fledged Linux computer.

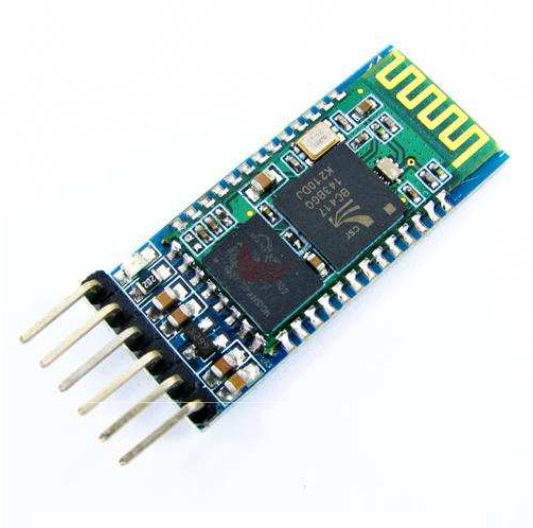
Sensors (Arduino)

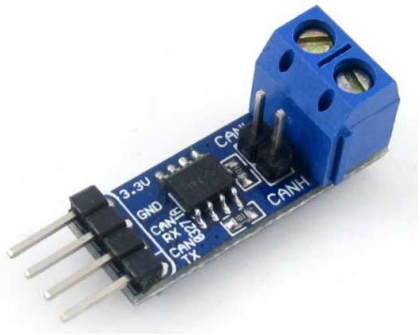


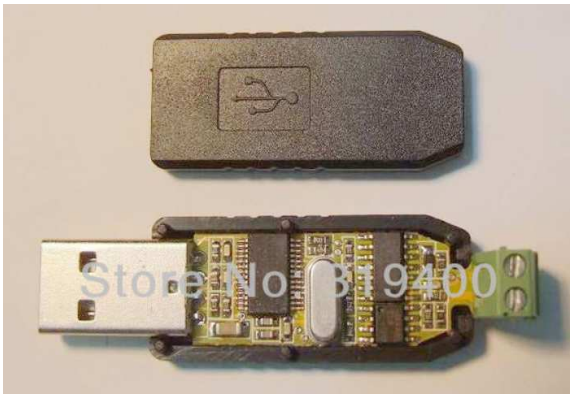
- All kind of sensors for Arduino:
  - Temperature
  - Pressure
  - Gas
  - Light
  - Etc

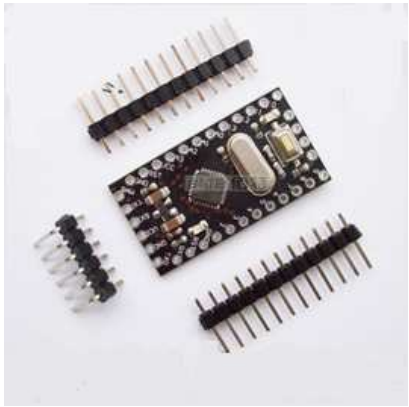
"37-in-1 Sensor Module Kit for Arduino (ECT-219472)"

Commodity communication modules



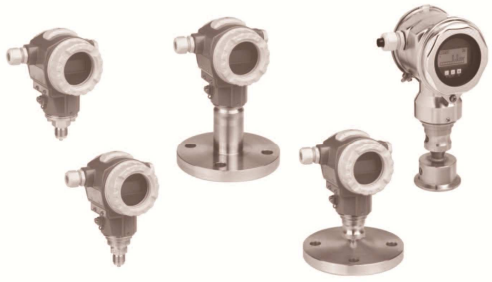




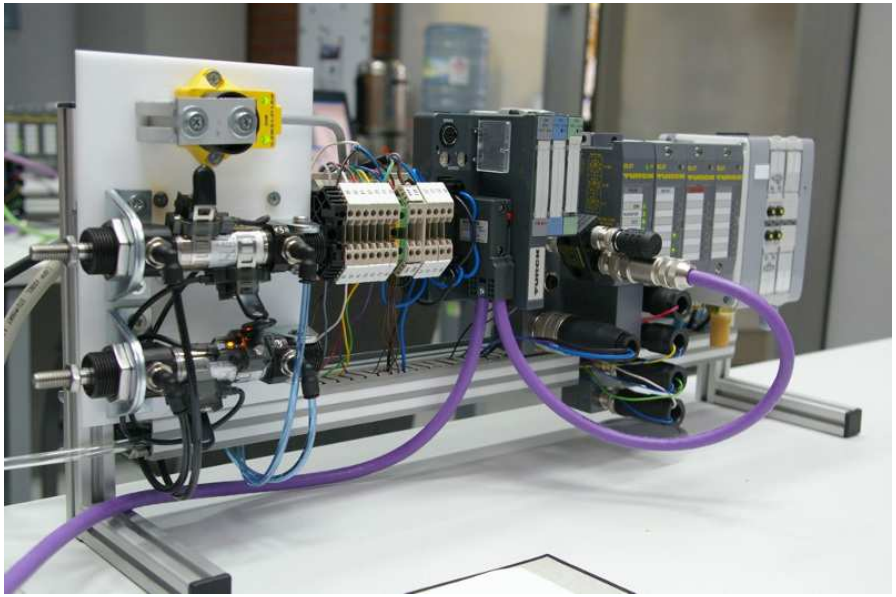


Low cost Bluetooth, Bluetooth LE, Wi-Fi, CAN Bus, RS-485 (Modbus), Arduino

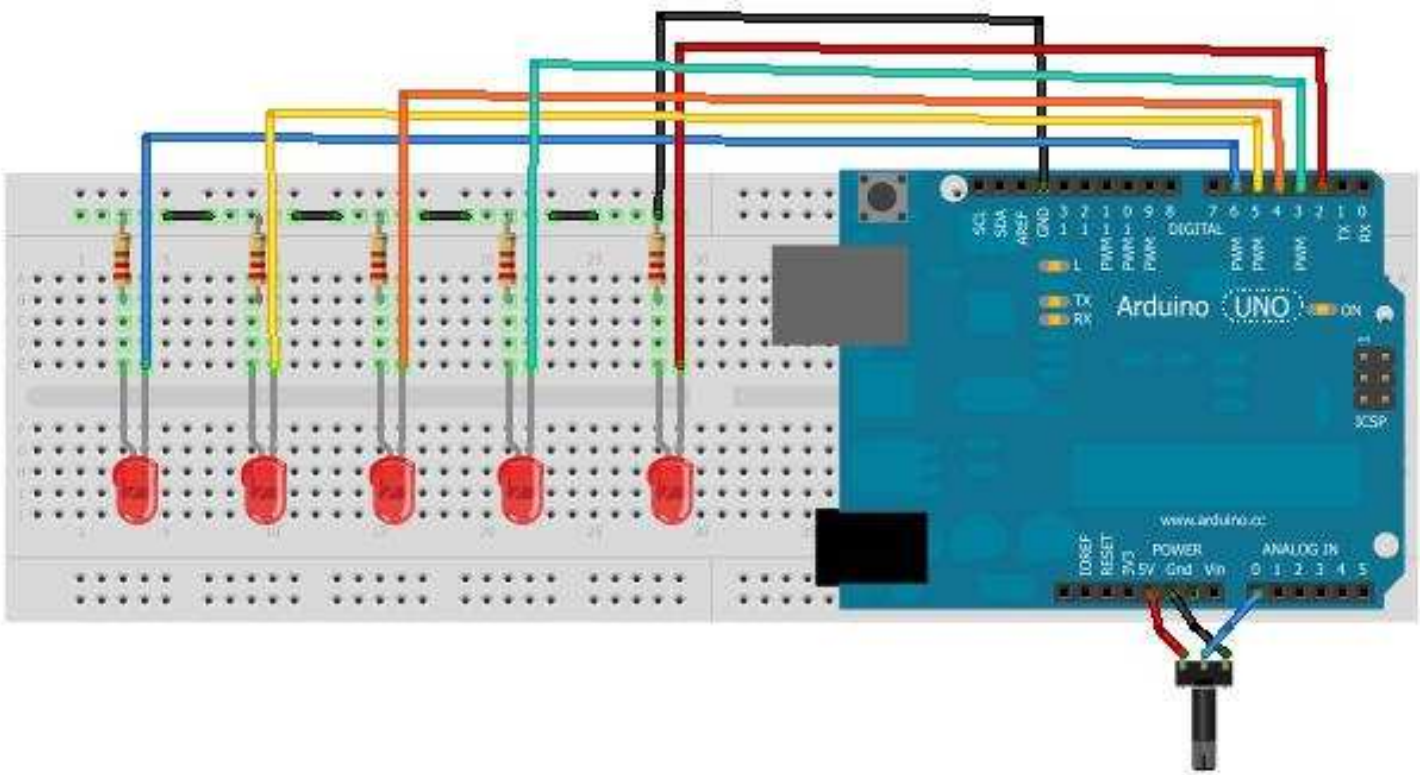
Industrials sensors



Industrials actuators

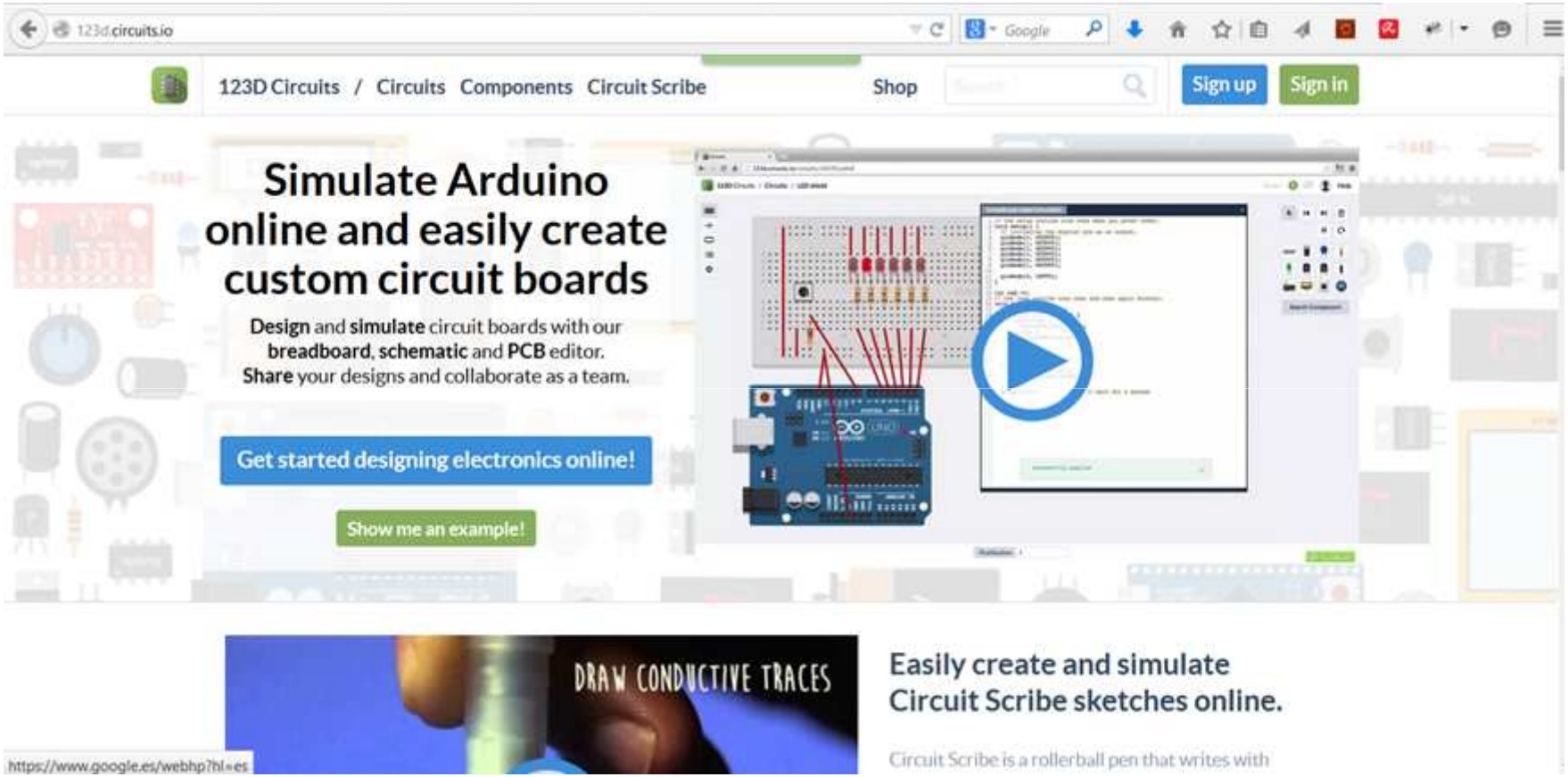


- External protoboard

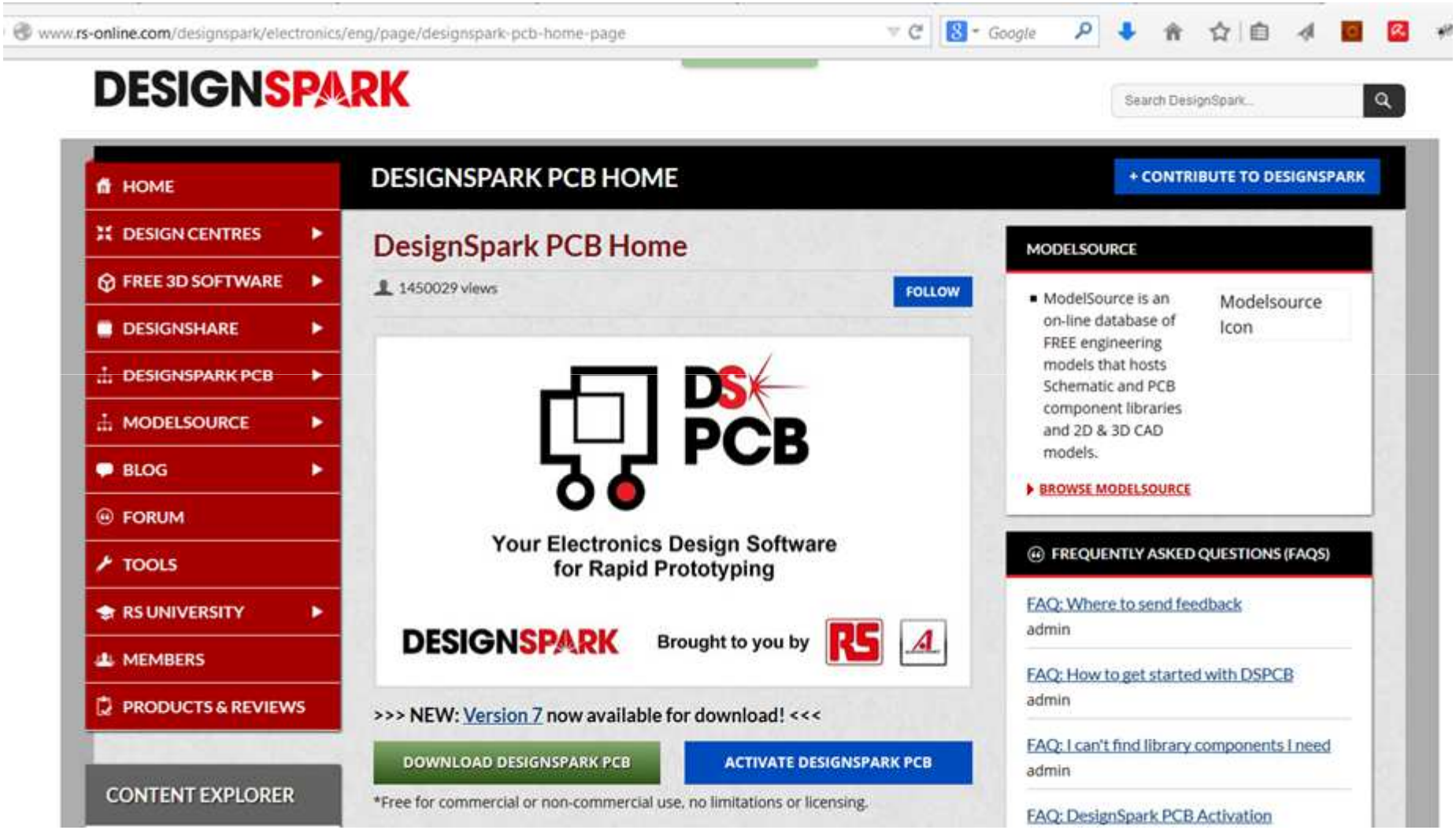


Usually is the maker starting point

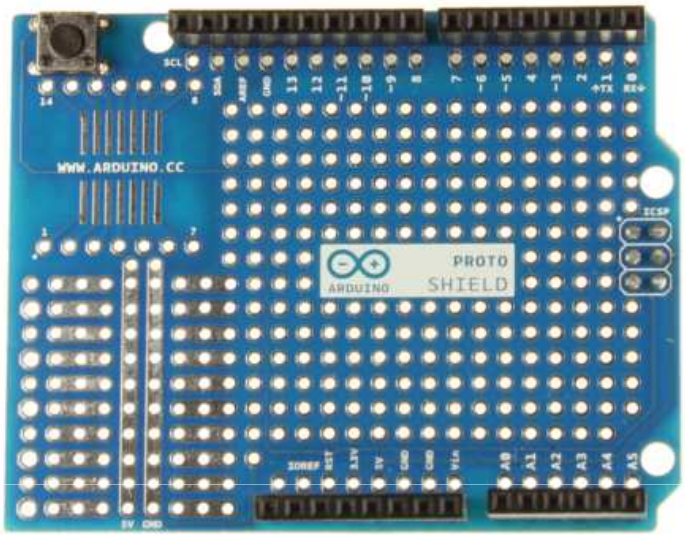
Using simulations

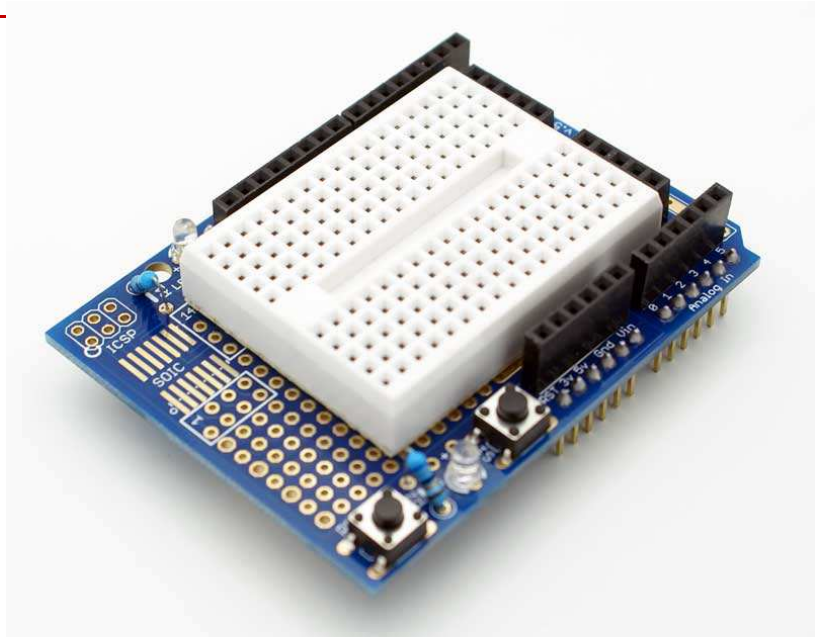


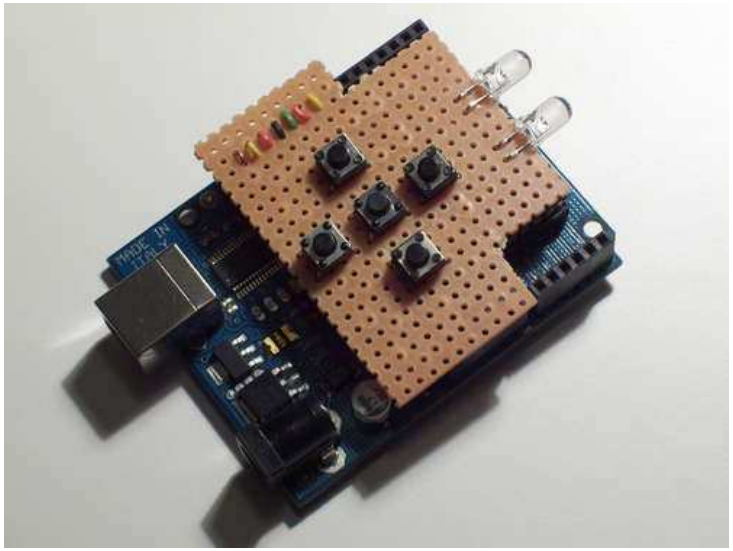
Levels of difficulty in electronics DIY



Prototyping extensions and DIY



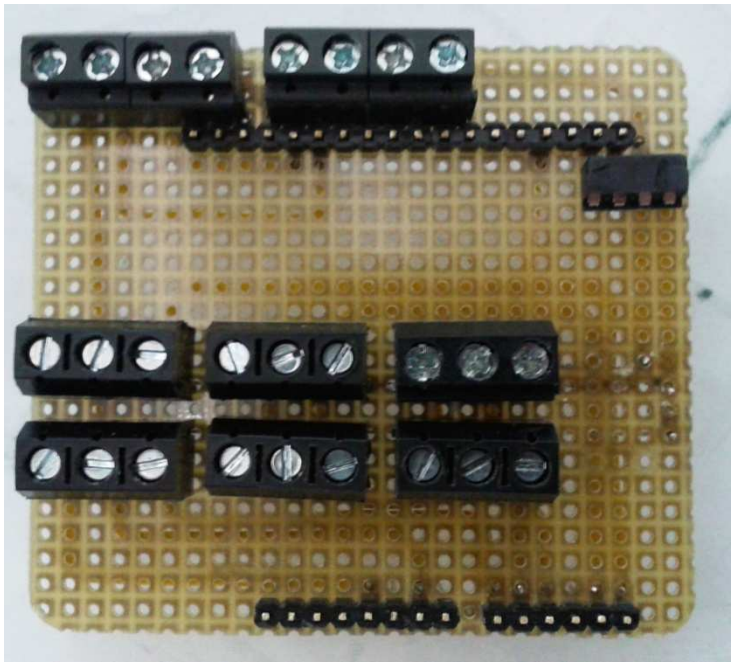


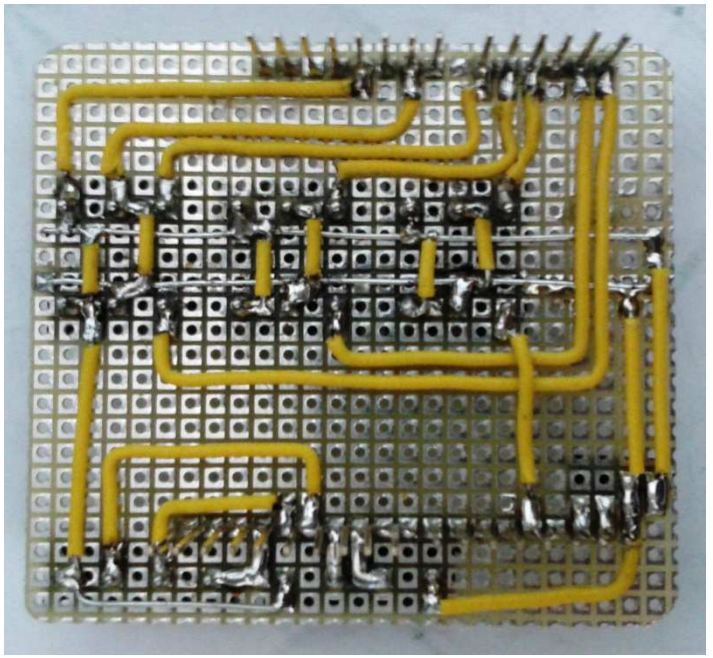


Classical universal boards

Levels of difficulty in electronics DIY

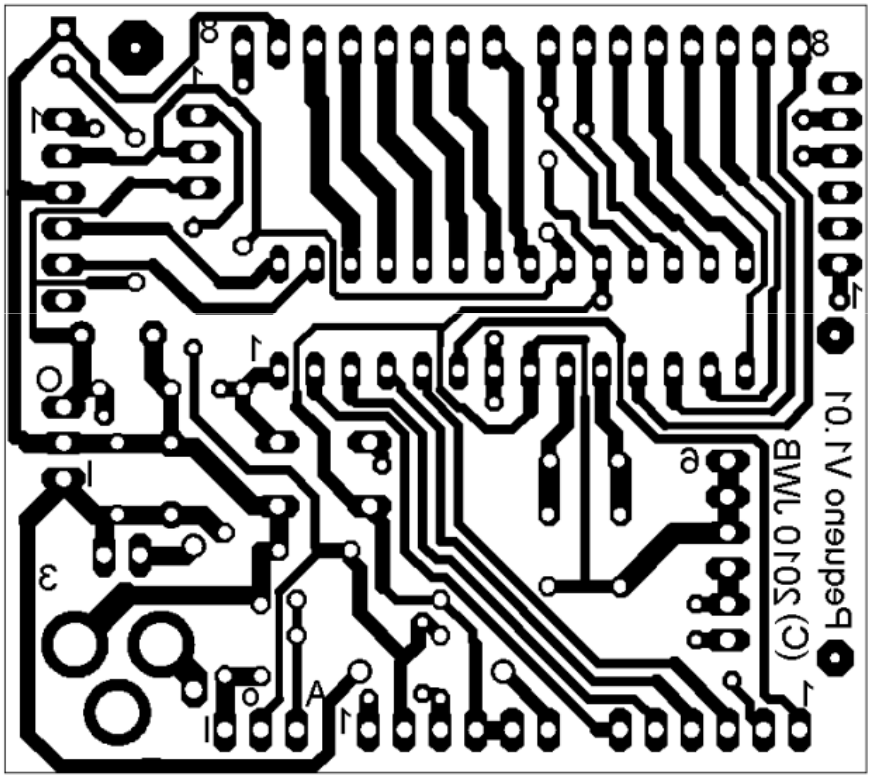
- Universal boards for soldering

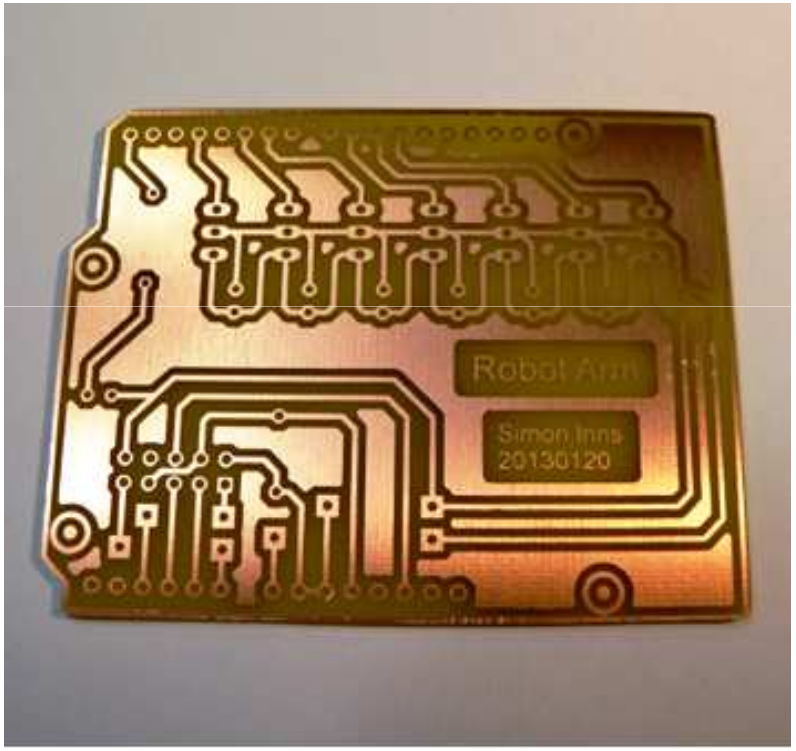




Levels of difficulty in electronics DIY

- Printed Circuits Boards

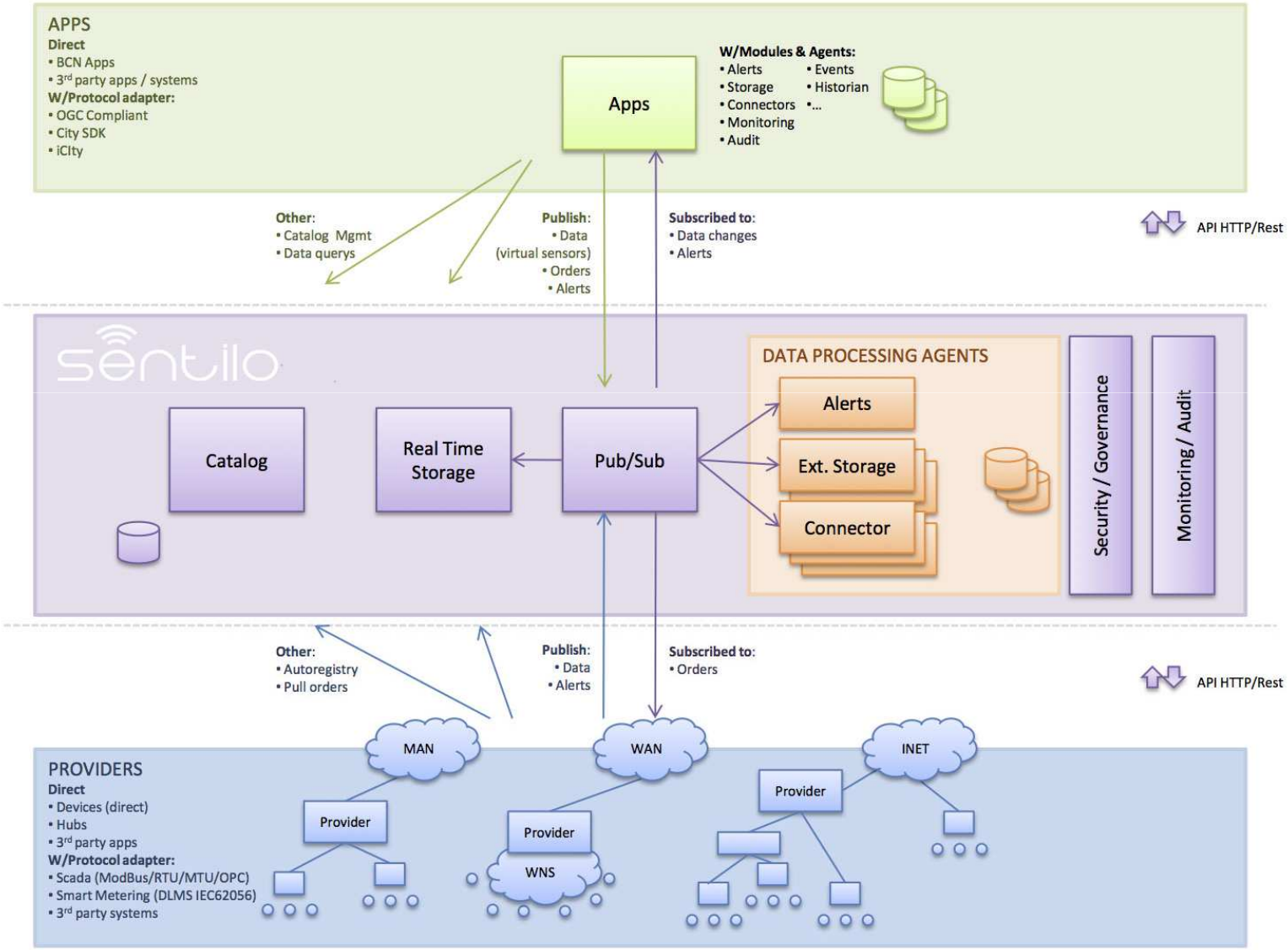




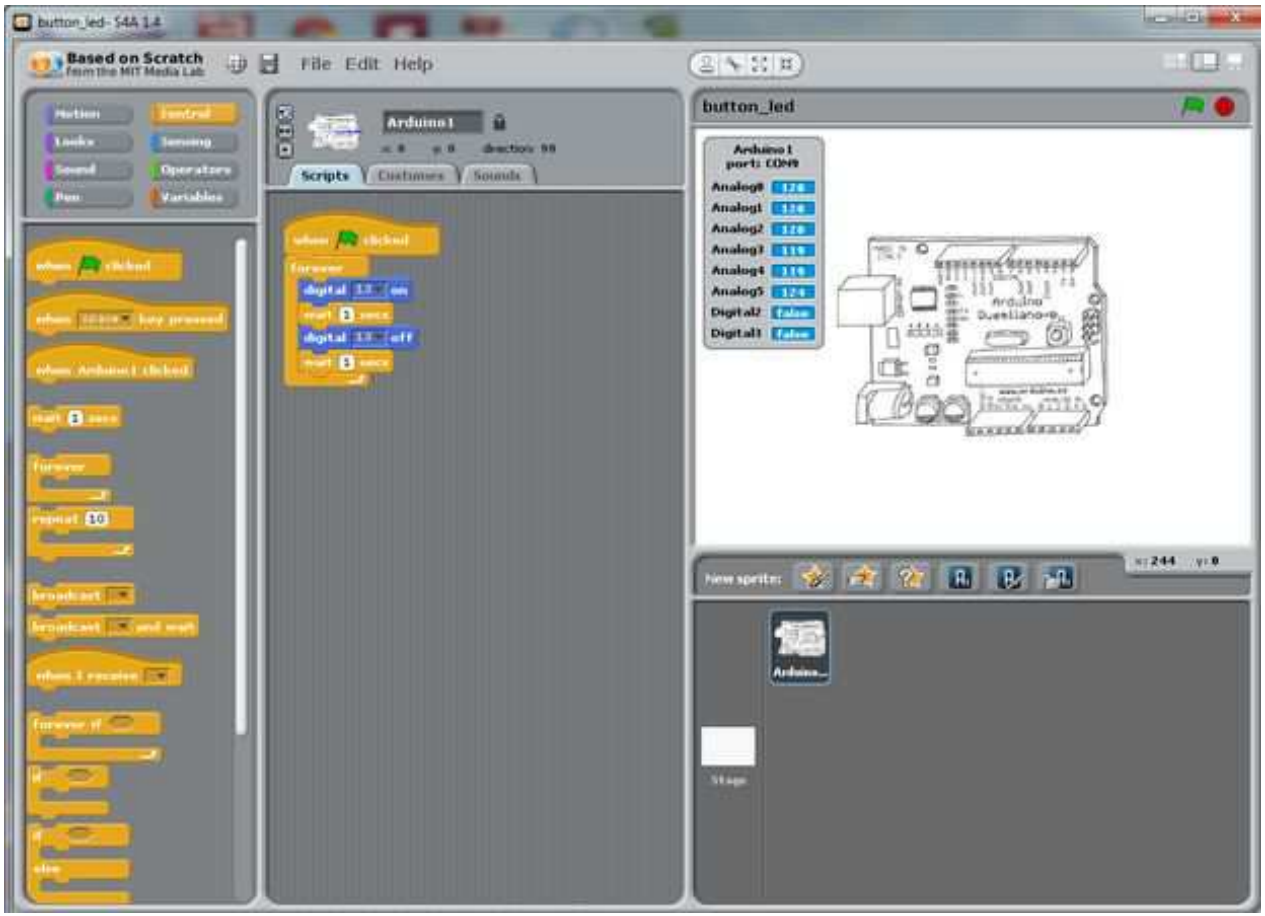
Difficult, but it is the `revious phase to hight production

Boom Arduino and Raspberry Pi i traditional electronic components shops

Sentilo Barcelona sensor platform (Open source) www.sentilo.io

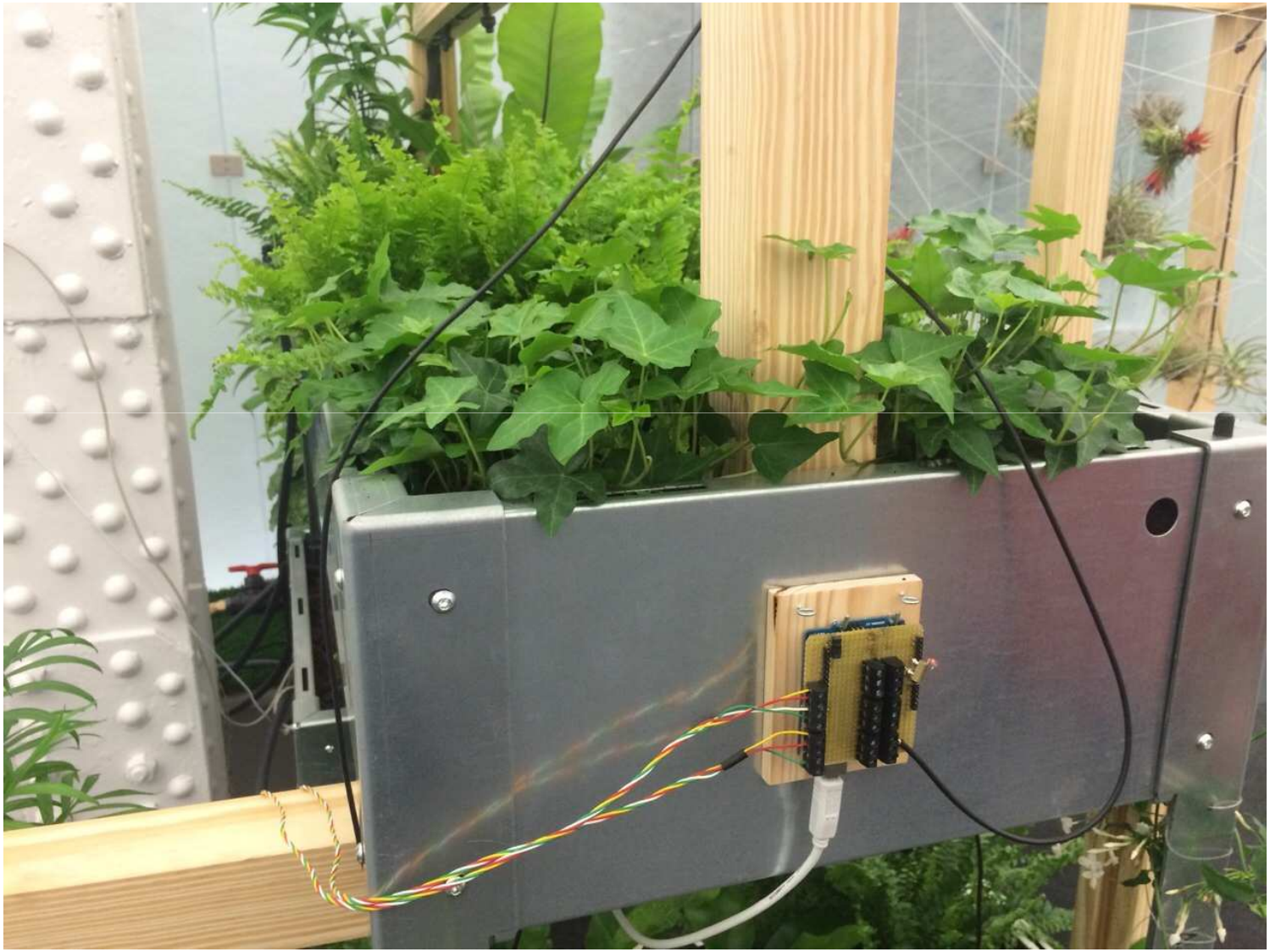


Minimizing knowledge barriers: Scratch for Arduino (S4A)

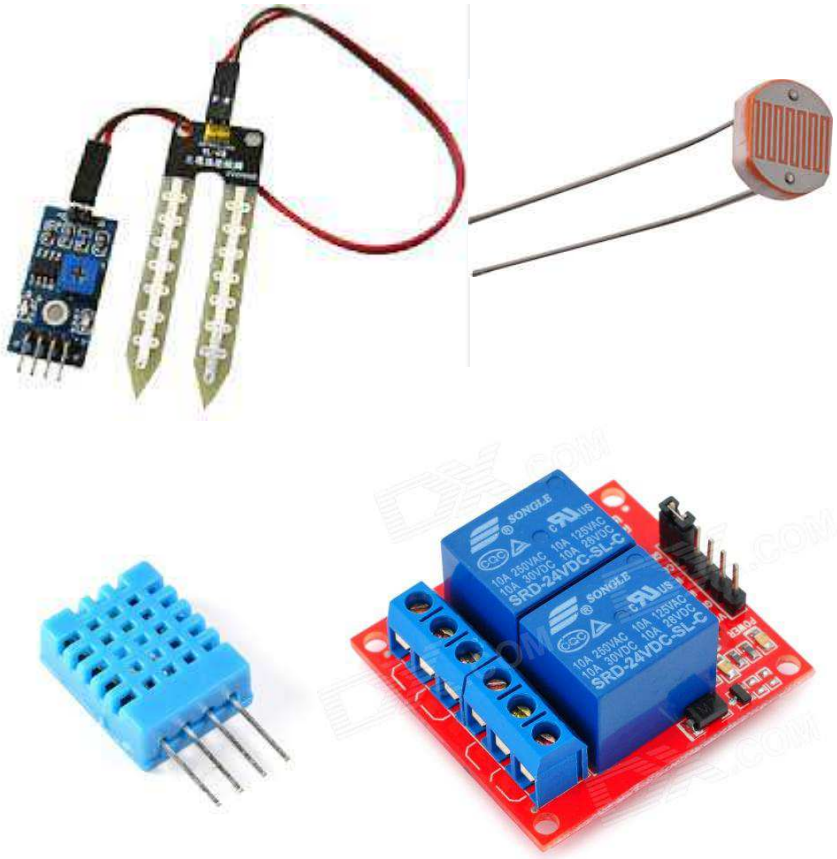


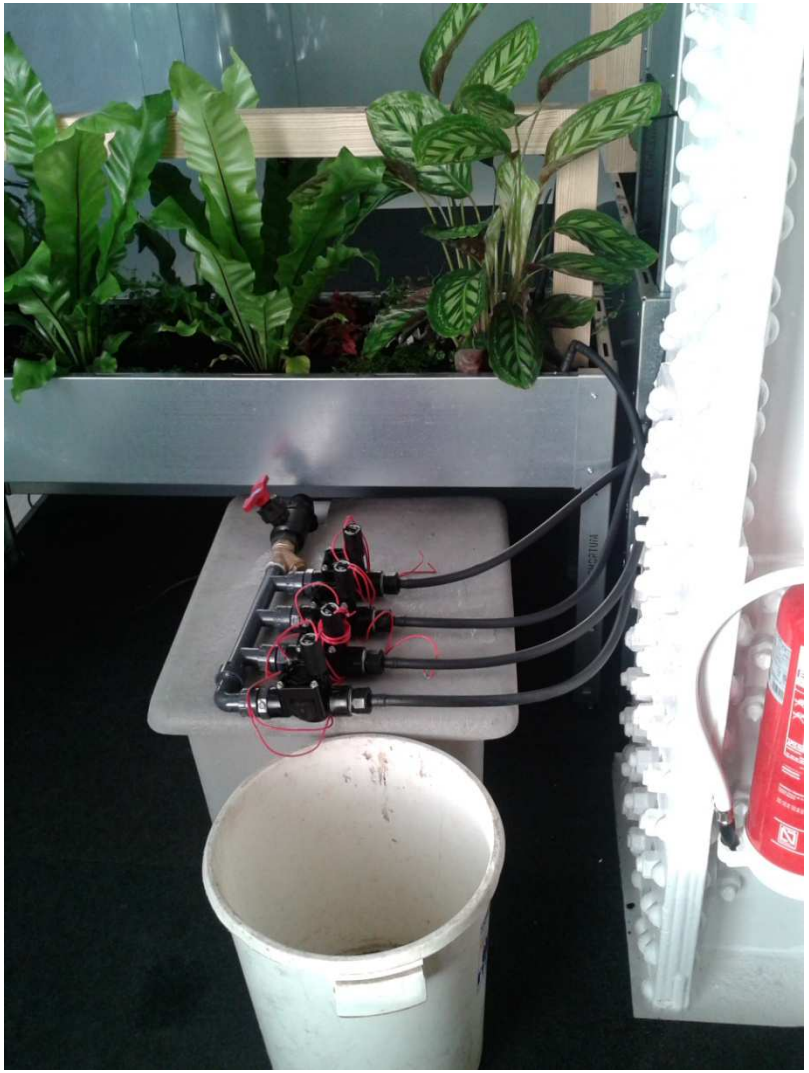
- Arduino can be controlled from a PC or a Raspberry Pi by kids using the Scratch program language

Case study at Mobile World Center (BCN)



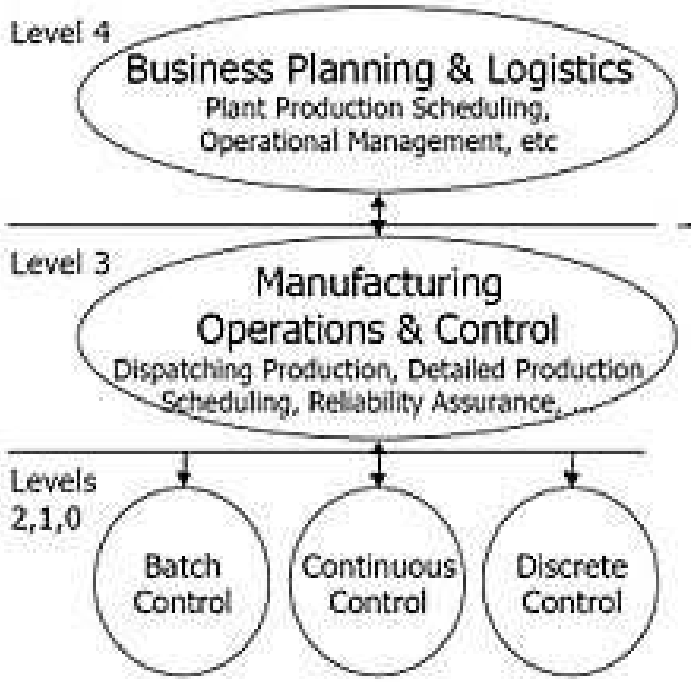
Sensors and actuators of the case study



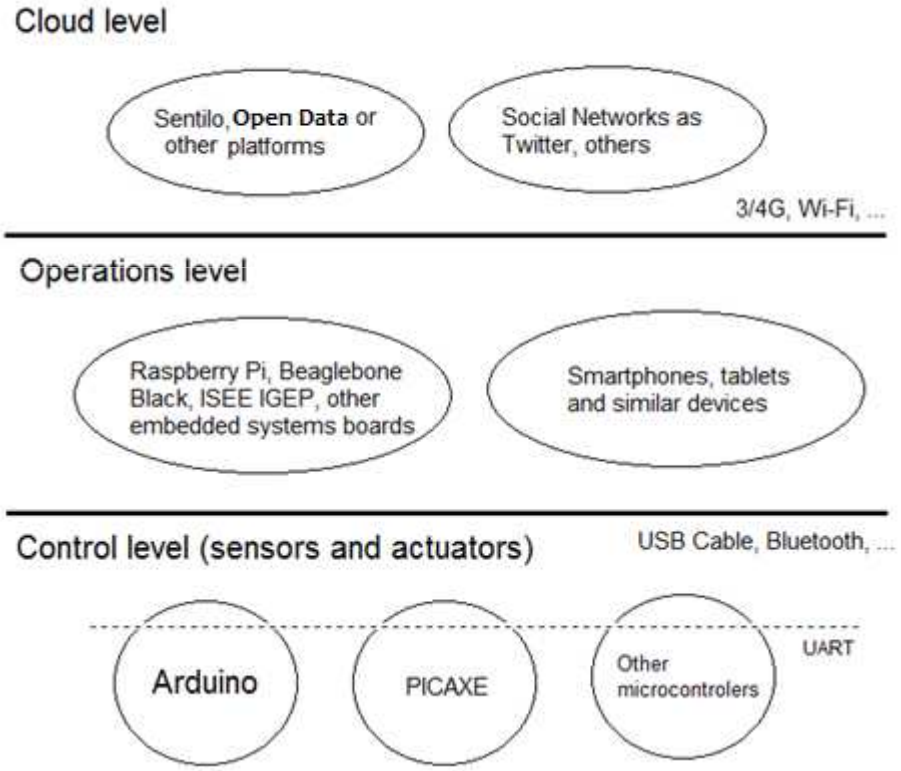


Fiting all together (From Barcelona City Council Innovation Dept)

- RaspBCN architecture is inspired by Purdue Industrial Network Architecture in the context of the 4th Industrial Revolution.

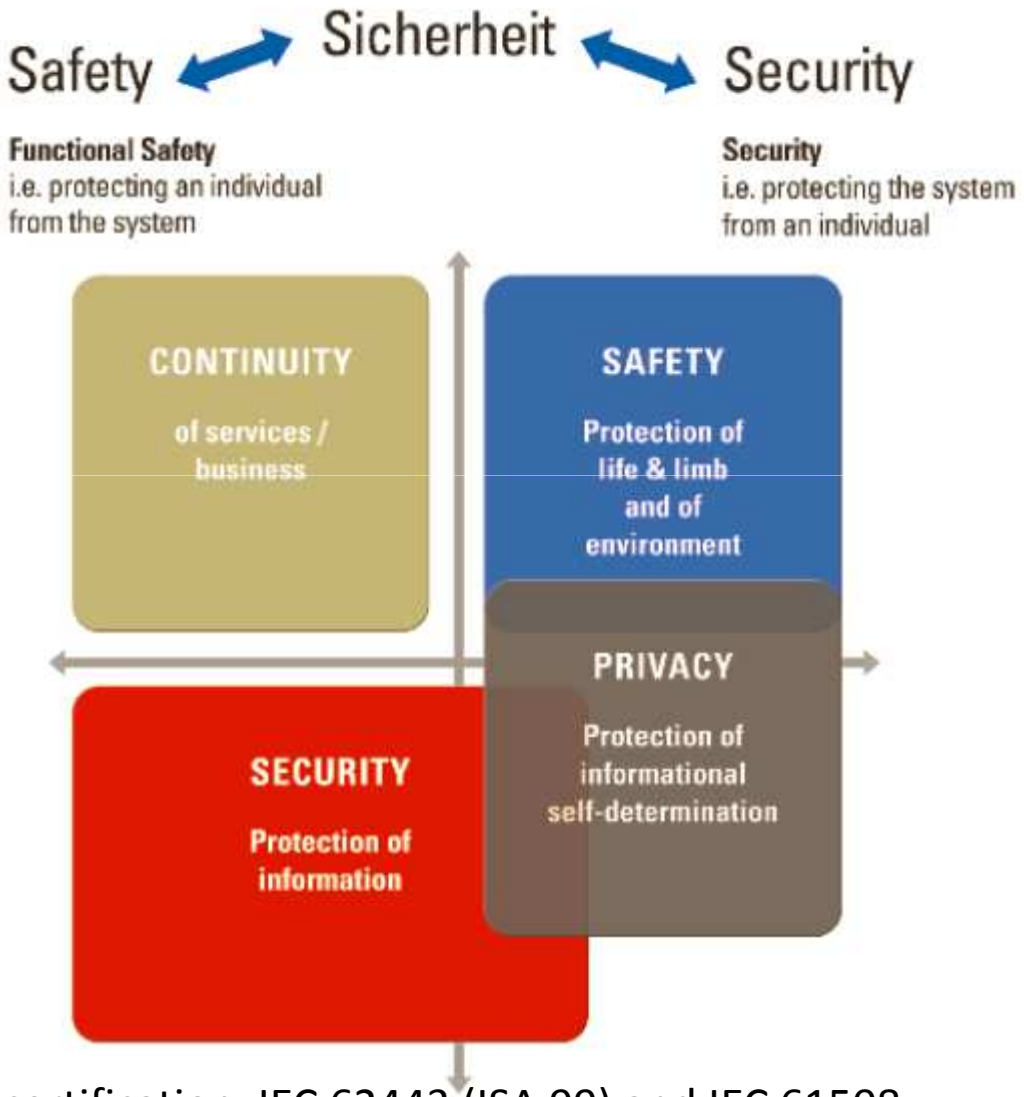


Purdue Architecture



RaspBCN Architecture

A Big Challenge: Safety & Security



TÜV offer dual certification IEC 62443 (ISA 99) and IEC 61508

Thank you

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