



Sistemi Embedded



Formazione

Ricerca

Opportunità di impiego

15 Dicembre ore 14 - Aula D - Dipartimento di Informatica



Agenda (I)

- » **14:00 - Introduzione**
 - Caratteristiche, applicazioni, progettazione e mercato dei sistemi embedded
 - prof. F. Fummi
- » **14:20 - Esempi Reali**
 - Robot chirurgico di Surgica Robotica
 - dott. A. Monastero
 - Applicazioni per smartphone: guida e localizzazione
 - dott. D. Quaglia
 - Applicazioni per GP-GPU
 - dott. N. Bombieri
 - Applicazioni per reti di sensori
 - dott. G. Perbellini
 - Applicazioni per HMI evolute
 - dott. W. Vendramineto
 - Strumenti di progettazione e verifica
 - dott. L. Di Guglielmo





Agenda (II)

- » **15:00 - Relazioni aziendali**
 - Relazioni con Springsoft, VDEC, STMProducts
 - dott. G. Di Guglielmo
 - Applicazioni in DeltaSistemi
 - dott. S. Camporeale
 - Spin-off EDALab
 - dott. W. Vendraminetto
 - Spin-off AltairMed e Surgica Robotica
 - prof. P. Fiorini
- »» **15:45 - La ricerca avanzata**
 - I gruppi-laboratori di ricerca
 - prof. P. Fiorini
 - Le opportunità dei progetti EU
 - prof. G. Pravadelli
- » **16:10 - La formazione**
 - Il curriculum Sistemi Embedded
 - prof. T. Villa

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Introduzione

Caratteristiche, applicazioni, progettazione e mercato

Prof. F. Fummi



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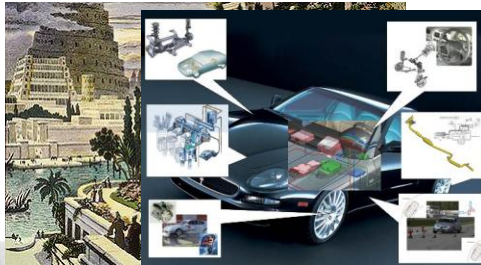
Embedded Systems: What?

» Like Hanging Gardens

- fragrant plants in dry climate

» Computer systems embedded in a non computer system to provide:

- flexibility
- efficiency and
- features



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Embedded Systems: Why?

» To do:

- specific tasks with limited resources meeting real time constraints

» To guarantee:

- safety and reliability even in critical situations
 - no power, no communication, high temperature, ...

» To provide:

- advanced features in several aspects of modern life

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Embedded Systems: Where?

The collage illustrates the ubiquity of embedded systems. It includes:

- Smart Home:** Motorized Blinds, Lighting Control, Climate Sensors, Water & Gas sensors.
- Surveillance:** A security camera.
- Consumer Electronics:** A washing machine, a digital camera, a mobile phone, and a camcorder.
- Industrial/Robotics:** A robotic arm in a factory setting.
- Automotive:** A car diagram with labels for:
 - Comfort & Convenience:** Internet Access, Telematics, DVD Players, GPS, Audio Systems, Digital Radio, Mobile Phones.
 - Driver Assistance System:** Night Vision & Lane Warning, Adaptive Cruise Control & Collision Warning, Tire Pressure Monitoring, Recyclable Instrument Clusters.
 - Information & Communication:** Rear-seat Entertainment, Multimedia Systems, Head Up Display, Games Consoles, Display Systems, Instrument Clusters, Park/Reverse Assist.
- Medical:** A medical scanner (CT or MRI).

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ES: History

» First computers in 1940's were all Embedded Systems:

- not showing particular embedded

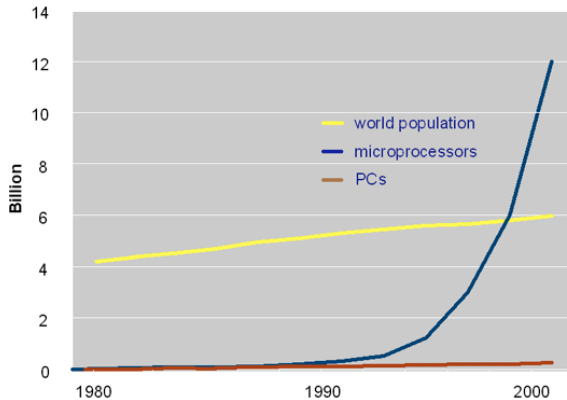
» The Apollo 11 was the world's first:

- small size to guide Apollo

» Mass production:

- 1961 with

» No stop...



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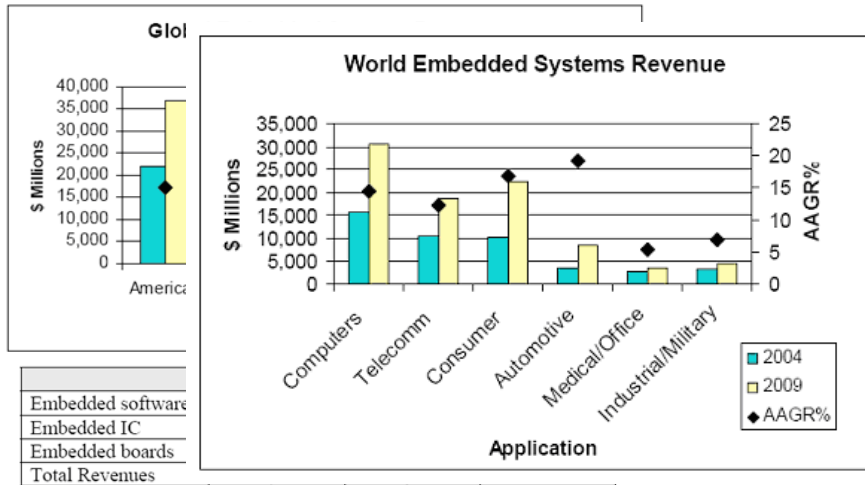
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ES: Historical perspective

- **From computer ('60-'80):**
 - General purpose systems for solution of general problems
- **To digital control systems ('80-'90):**
 - Systems dedicated to control and automation
- **To distributed systems ('90-'00):**
 - General purpose systems and/or dedicated systems cooperating through the network
- **To embedded systems ('00-):**
 - Distributed systems integrated in non-computing objects and in the environment
 - To **cyber-physical systems** ('10-):
 - embedded systems integrated with physical processes



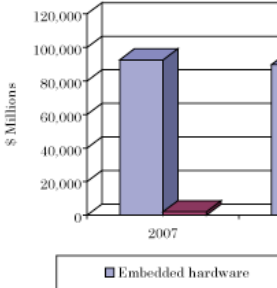
ES Market



ES Market: trend

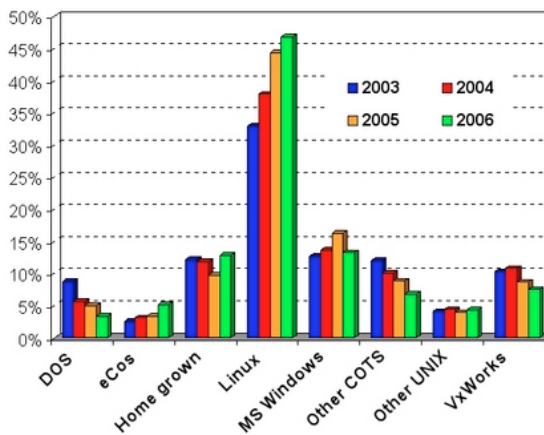
Expected to \$112.5 billic

- a compon
- EMBEDDED TECHNO
- embedded



Source: BCC Research

Embedded OS sourcing trends



ES Market: local companies





ES: How to design?

» We cannot design embedded systems like general purpose systems

- Different design constraints, different goals
- Embedded design is about the system, not about the computer



» E.g.

- In general purpose computing, design often focuses on building the fastest CPU
- In embedded systems the CPU simply exists as a way to implement control algorithms communicating with sensors and actuators




ES: Design constraints

» Size and weight

- Hand-held electronics
- Weight costs money in transportation
- Human body cannot eat desktops

» Power

- Battery power instead of AC

» Harsh environment

- Power fluctuation, RF interferences, heat, vibration, water, ...

» Safety critical and real time operations

» Low costs



- » **HW architecture alternatives**
 - for a correct HW/SW trade-off
- » **SW design skills**
 - lots of languages continuously extending
- » **HW/SW interaction mechanisms**
 - O.S., MW, HdS for efficient SW development
- » **Network infrastructure**
 - all ES are now networked embedded systems
- » **Computation effort estimation**
 - theory is important when used in practice
- » **Join 3C: computation, control & communication**