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. Vendraminetto
- Strumenti di progettazione e verifica
  - dott. L. Di Guglielmo
Introduzione

*Caratteristiche, applicazioni, progettazione e mercato*

Prof. F. Fummi
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

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
First computers in 1940’s were all Embedded Systems:

- not showing particular embedded

The Apollo world’s first:

- small size to guide Apollo

Mass production:

- 1961 with

No stop...
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

<table>
<thead>
<tr>
<th>Application</th>
<th>2001</th>
<th>2000</th>
<th>2004</th>
<th>AAGR%</th>
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<tr>
<td>Computers</td>
<td>10</td>
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<td>15</td>
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<td>Telecomm</td>
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<td>Consumer</td>
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<td>Industrial/Military</td>
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**World Embedded Systems Revenue**

- $ Millions
- G10$ in billions
- 0-25
- 5-20
- 10-15
- 15-20
- 20-25
- 25
- 20-20
- 15-15
- 10-10
- 5-5
- 0-0

**Legend**
- 2001
- 2000
- 2004
- AAGR%
Expected to increase from $92.0 billion in 2008 to $112.5 billion by the end of 2013:

- a compound annual growth rate (CAGR) of 4.1%
- embedded hardware from $89.8 billion in 2008 to $109.6 billion in 2013
- embedded software from $2.2 billion in 2008 to $2.9 billion in 2013, for a CAGR of 5.6%.

### ES Market: trend

![Embedded OS Sourcing Trends Chart](image)

**Source:** BCC Research

### ES Market: local companies

- ST
- EXOR
- Telecom Lab
- Siemens
- Telefin
- Actec
- Delta Sistemi
- Infracom
- RCH
- PDF Solutions
- Data 4
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
  - Buttery 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