CENG4480
Lecture 01: Introduction

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香港中文大學
The Chinese University of Hong Kong

Overview

Overview

Important Notes

- Be PUNCTUAL to class
- Keep QUIET during class, unless
  - you are raising questions to teachers or tutors
  - during in-class activities

Academic Honesty

Zero Tolerance

- Plagiarism, cheating, misconduct in test/exam will be reported to the Faculty Disciplinary Committee for handing.

Penalty

- Zero marks for the concerned assignments/test/exam/whole course, reviewable demerits, non-reviewable demerits, suspension of study, dismissal from University.

University Guidelines to Academic Honesty

- http://www.cuhk.edu.hk/policy/academichonesty/

Student/Faculty Expectations

- Let's join hands to create a positive, respectful, and engaged academic environment inside and outside classroom.
- Full version of Student/Faculty Expectations on Teaching and Learning
- http://www.erg.cuhk.edu.hk/upload/StaffStudentExpectations.pdf

Overview

Grading System

- Homeworks (15 marks)
- 9 Labs (20 marks)
- Midterm Exam (25 marks)
- Final Exam (40 marks)
- (Optional) Final Project (5 marks)

A student must gain at least 50 marks in order to pass the course.

Grading System – Tips

- Individual lab (academic honesty!)
- About Absence in mid-term
- ~~Class attendance: in-class quiz~~
  Ex: http://www.cse.cuhk.edu.hk/~byu/doc/quiz_example.pdf
- Lecture review
- Bonus question
- Please read your marks from Blackboard (https://blackboard.cuhk.edu.hk)

Overview

Computing System





- Computing systems are everywhere
- Most of us know general-purpose computers
  - Laptop
  - PC
  - Server
  - Mainframe
  - Supercomputer
- But there is another type of computing system; And it is far more common

An Era of Embedded Computing Systems

Computing system type	Mainframe	Mini computer	Personal computer	Embedded computer
Era	1950s on	1970s on	1980s on	2000s on
Form factor	Multi-cabinet	Multi-board	Single board	Single chip
Owner type	Corporates	Departments	Persons	Things
Users/system	1000s ~ 100s	100s ~ 10s	10s ~ 1s	1s ~ 1/10s
Cost	$1 Ms +	$100 Ks +	$10Ks – $1Ks +	$100s – $1s +
Total units	10Ks +	100Ks +	Billions +	Trillions +

Embedded System Overview

Definition

- A short name for embedded computing system
- Different from general-purpose computing system, such as desktop computers, it is usually embedded in a larger physical system
- Carry one or a fixed set of specific tasks by design or usage

- Nearly any computing system other than laptop, desktop, server, mainframe, and supercomputer
- About 50 per household and per automobile
- Billions of units produced yearly, versus millions of desktops

Computers are in here...

and here...

and even here...

Embedded System Examples

- Consumer electronics
  - Digital camera and camcorder
  - Cell phone
  - CD player
  - Wireless router
  - TV
  - Blu-ray player
  - Microwave oven
  - USB key
  - Remote control
  - Digital watch and clock

  ...

Embedded System Examples

- Also in your desktops and laptops
  - Graphics card
  - Sound card
  - Network card
  - Hard disk
  - DVD drive
  - Keyboard, mouse
  - Touch pad
  - LCD monitor
  - Even inside laptop battery

  ...





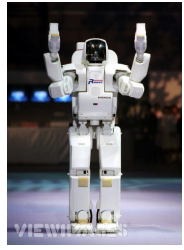

Embedded System Examples

- In robots
  - Vision system
  - Arm and leg control

  ...
- In medical instruments
  - Blood pressure monitor
  - Diabetes monitor

  ...
- In telecommunications
  - Internet switch and router
  - Mobile phone base station

  ...






Embedded System Examples

- In aircraft
  - Auto pilot system
  - Communication system
  - ...
- In watercraft
  - Navigation system
  - Radar system
  - ...
- In automobile
  - Engine control system
  - Anti-lock braking system (ABS)
  - Navigation system
  - Collision protection system
  - ...






Embedded System Examples

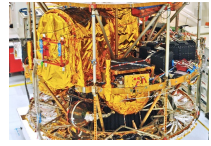
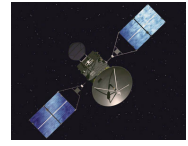
- In space shuttle
  - Positioning system
  - Communication system
  - Navigation systems

  ...
- In satellite
  - Communication system
  - Power control system

  ...
- In Mars rover
  - Automatic driving system
  - Automatic lab system

  ...



Characteristics of Embedded Systems

Limited functions

- Doing a specific set of tasks repeatedly
- High-end embedded systems are often multi-function systems
- Cell phone, slate ...

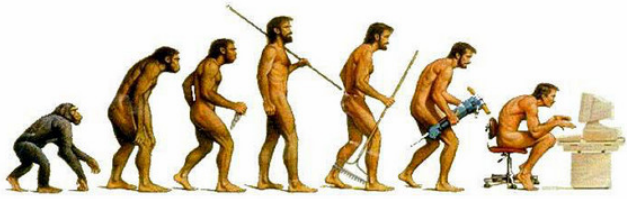
Tightly constrained

- Low cost, energy efficient, small, fast, etc.
- Usually must meet the performance requirement (such as speed)

Reactive and even real-time

- Continually reacts to changes in the system's environment
- Some systems must compute certain results in real-time without delay
- ABS, auto-pilot system ...

Tools of the Information Age



- Information is the center of the Information Age
- Information is any knowledge, and one possible method to represent information is by data which are quantities with or without natural physical meanings.
- Embedded system is used to collect, convert, store, protect, process, transmit, retrieve, and share information
- Human spend more time to design and let embedded system to do tedious and dangerous jobs

Companies Developing ES

Develop ES applications

- Microsoft, Google, telecom companies, banks ...

Develop ES

- IBM, Apple, Samsung, NEC, Philips, Oracle, Dell, HP, Sony, Nokia, Cisco, Huawei, Lenovo ...

Develop IC for ES

- Intel, AMD, TI, ST, Qualcomm, Broadcom, Xilinx ...

Develop design automation tools for ES

- Cadence, Synopsis, Mentor Graphics ...

Many companies work in multiple areas instead of one

Overview

Overview – Part A

How to build up a Robot?

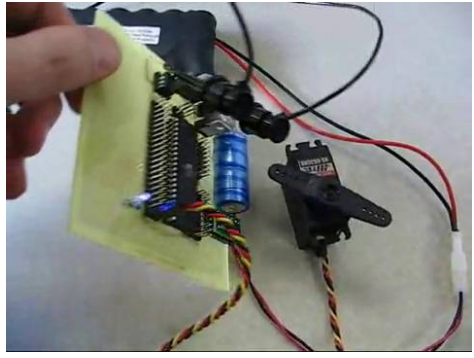
Overview – Part A

A1 Sensors

- Use of different sensors and their characteristics

A2 Op Amps and Analog Interfacing

- How to connect sensors to systems



Sensor demo (http://www.youtube.com/watch?v=9NEiBDBXFEQ)

Overview – Part A

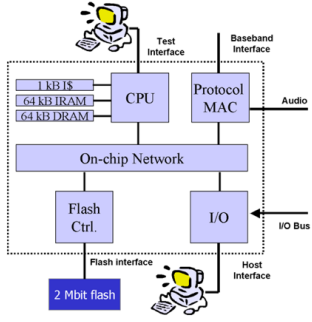
A3 Analog-to-digital conversions ADDA

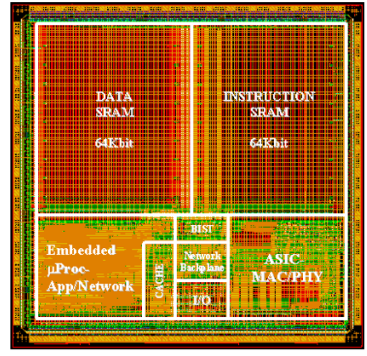
- Internal operations of different ADDA devices

A4 PID controller

- feedback control of motors

Overview – Part B





How to design an embedded system?

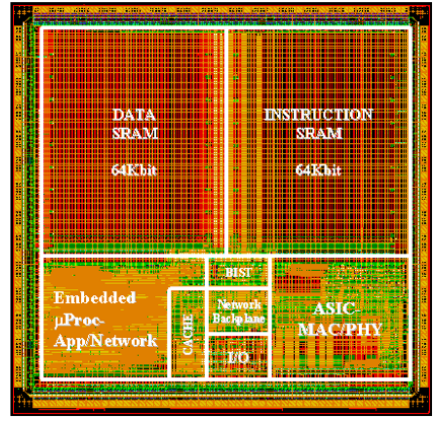
Overview – Part B

B1 HW/SW Co-design

B2 Memory

B3 Clock

B4 Design Style (Optional)



Overview – Project Demos

- Demo 1: Self-Balancing Robot
  https://youtu.be/dQWATsLa30g
- Demo 2: Robot Car w. Color Sensor
  https://youtu.be/PKCPdWjZCqY
- Demo 3: Robot Hand
  https://youtu.be/ai94rHHuaXc
- Demo 4: Robot
  https://youtu.be/1D0e7SS85Xc

Arduino

- https://www.arduino.cc/
- https://youtu.be/nL34zDTPkcs