ece204: Embedded Real-Time Systems

TOPICS:

1. Introduction to R/T Embedded Systems
2. System Requirements
3. Specification, Design, Implementation
4. Real-Time Systems
5. Model Taxonomy
6. Specification Languages
7. Embedded Processors
8. The Embedded Computing Platform
9. Real-time interfacing & exception handling
10. System Performance
11. IP- and Platform-Based SoC Designs
12. System-Level Design Space Exploration
13. Static and Dynamic Performance Exploration
14. Behavior-Architecture Co-Design
15. Real-time scheduling
16. Hardware Accelerators (hw/sw co-design)
17. Power issues in embedded systems

Prerequisite: ece 182/201 or permission of the instructor

Textbooks

1. W. Wolf, “Computers as Components: Principles of Embedded Computing System Design”, Morgan Kaufman, 2001 (Required)
2. F. Vahid & T. Givargis, “Embedded System Design”, J. Wiley & Sons, 2002 (Required)
3. H. Kopetz, “Real-Time Systems: Design Principles for Distributed Embedded Applications”, Kluger Academic Publishers (Suggested)
4. R. Grehan et al, “Real-Time Programming: A Guide to 32-bit Embedded Development”, Addison-Wesley (Suggested)
5. Class web page with transparencies and related articles:
   http://www.student.seas.gwu.edu/~kallitec/ece204/

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ECE 204 course syllabus

1. CLASS TRANSPARENCIES
2. Wolf's Examples
3. **Student abstracts**
4. **Student research papers**
5. **Student projects (**proposal_format, earlier projects, 2004 projects)
6. Other papers related to the course
7. **Correspondence area**
8. Other related links

1. CLASS TRANSPARENCIES

Syllabus and Grading

Course Transparencies and Reference Material:

1. **Embedded Systems: Introduction (transparencies, reference)**
2. **System Requirements (transparencies, reference)**
3. **Specifications, Design, Implementation (transparencies, reference)**
4. **Real-Time Systems (transparencies, reference1, reference2, reference3)**
5. **Model Taxonomy (transparencies, reference1, reference2, reference3)**
6. **Specification Languages (transparencies, spec-example, reference1, reference2)**
7. **Embedded Processors (transparencies, reference1, reference2, reference3)**
8. **The Embedded Computing Platform (transparencies)**
9. **Real-Time I/O Interfacing (transparencies)**
10. **IP- and Platform-Based Embedded SoC Designs (transparencies, reference1, reference2, reference3, reference4, reference5)**
11. **Embedded Computer Systems Performance (transparencies)**
12. **Multitasking-Multithreading (transparencies)**
13. **Improving Performance with Hardware Accelerators (transparencies)**
14. **Behavior-Architecture Co-Design (transparencies, reference1, reference2, reference3)**

Course Execution - Grading

1. (10%) EVERY WEEK: Read a paper (on a topic related to the course) and write an one-page abstract (with your name, source, etc). Submit this abstract along with the paper. These abstracts and papers will be placed on the class's web page for your classmates' access.
2. (15%) PRESENTATION #1: Review one specific application example and present it in class (15-20 minutes; as the class progresses; see next page)
3. (15%) PRESENTATION #2: Of a published research paper of your choice related to the course material. (15-20 minute presentation). Make a copy of paper & your transparencies to be posted on the class web site. (Due: March 29; presentations will be at beginning of April)
4. (50%) "DESIGN" PROJECT: see page after next
5. (10%) EXAM

Examples

(The first 13 examples have ready slides)

1. SYSTEM DESIGN TECHNIQUES (WOLF, CH. 9) – Jan. 21
2. PROGRAM DESIGN (WOLF, CH. 5) – Jan 28
3. UML AND MODEL TRAIN CONTROLLER (WOLF, CH. 1) – Febr. 4
4. ARM RISC PROCESSOR (WOLF, CH. 2) – Febr. 11
5. SHARC DSP PROCESSOR (WOLF, CH. 2) – Febr. 18
6. DATA COMPRESSOR (WOLF, CH. 3) – Febr. 25
7. SOFTWARE DEVELOPMENT – DEBUGGING - ALARM CLOCK (WOLF, CH. 4) – March. 3
8. COMPILATION TECHNIQUES (WOLF, CH. 5) – March 10
9. PROGRAM VALIDATION AND TESTING – SOFTWARE MODEM (WOLF, CH. 5) – March 31
10. ANSWERING MACHINE (WOLF, CH. 6) – April 7
11. VIDEO ACCELERATOR (WOLF, CH. 7) – April 14
12. ELEVATOR CONTROLLER (WOLF, CH. 8) – April 21
13. HARDWARE DESIGNS (WOLF, APP. B) – April 28

(The next examples are weighted heavier)

14. DIGITAL CAMERA (VAHID, CH. 7)
15. UPS (GREHAN, CHS 8 & 11)
16. ANSWERING MACHINE (GAJSKI, APP A & B)
17. CHAPTER 9 EXAMPLES (WOLF, CH. 9)

"Design" project (50% of class grade)

1. Project Proposal (5 points): due week 2 (Jan. 28)
2. System Requirements (5 points): due week 4 (Febr. 11)
3. System Specifications (using UML) (10 points): due week 7 (March 3)
4. System Architecture–Design (20 points): due week 10 (March 24)
5. Build (at least a simulation of) the system (20 points): due week 13 (April 14)
6. Final Written Report (20 points): due week 13 (April 21)
7. Final Oral Presentation & Demo (15 points): will be done during second half of April
8. Relative difficulty of project: (5 points)