

Fall 2024: CSCI 181RT

Real-Time Systems in the Real World

Lecture 26 - Fin

Tuesday, December 3, 2024

Edmunds Hall 105

2:45 PM - 4:00 PM

Professor Jennifer DesCombes

Agenda

- Go Backs
- Discussion on Reading
- Missed Real-Time Topics
- Lab #13 Preview
- Action Items

Go Backs

- General?
- Action Item Status
 - AI240924-1: At what point as a development team grows does it make sense to have dedicated software and integration testers?
 - AI241024-1: Provide documentation on how to disable compiler optimization.
 - AI241107-1: Generate drawing showing location of Task Test Points on evaluation board.

Discussion on Readings

- The Soul Of A New Machine
 - Chapters 11 - 16 & Epilog: Shorter Than A Season, Pinball, Going To The Fair, The Last Crunch, Canards (unfounded rumor or story - discusses PALs), Dinosaurs (insightful), Epilog

Discussion on Readings

- Mythical Man Month or The Soul Of A New Machine
 - Have Ready to Read One General Comment on Either Soul of the New Machine or Mythical Man Month.

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From of *The Soul Of A New Machine*, Canards, Page 274

Quote from Rosemarie Seal “We all had something different to prove and we were all trying to prove the same thing.”

From of *The Soul Of A New Machine*, Dinosaurs, Page 287

West added: “It was a summer romance. But that’s all right. Summer romances are some of the best things that ever happen.”

Missed Real-Time Topics

- Drawn From Class Surveys in Lecture 1- Tuesday, August 27
 - Case studies of real-time systems gone wrong
 - (Digital) Signal Processing
 - Hacking
 - Security in real-time systems
 - Hardware monitoring and life expectancy
 - Real-time DSP design and implementation

Missed Real-Time Topics

- Case Studies of Real-time Systems Gone Wrong
 - BD Internal Hardware Design Team
 - 3 Year Delay
 - Poor Design Results
 - Lack of Imagination
 - Lack of Understanding of Overall System Timing Needs
 - Some Portion on 1 μ s Timing
 - Some Portion on Human Timing (100s ms)

Missed Real-Time Topics

- Case studies of real-time systems gone wrong
 - Mars Climate Orbiter - 1999
 - <https://science.nasa.gov/mission/mars-climate-orbiter/>
 - https://en.wikipedia.org/wiki/Mars_Climate_Orbiter
 - Requirements Failure
 - System Wide
 - Interface Documents
 - Integration Failure
 - Simulation Data Exchange?

Missed Real-Time Topics

- (Digital) Signal Processing
 - Broad Topic
 - FPGAs and DSPs
 - Key Debounce
 - PWM Concepts
 - Input Signal Detection and Monitoring
 - Nyquist Theorem
 - Perhaps Add Some Digital Filtering?

Missed Real-Time Topics

- Hacking
- Security in Real-time Systems
 - Interfaces to the Outside World
 - Defensive Coding
 - Error Checking and Corrective Action
 - Buffer Size Checking
 - Capture All Cases - Supply Code to Support Out of Bound Conditions
 - Updates to OS and Support Software
 - Certified Versions of OS - Common Criteria (CC) and FIPS 140-2 (cryptology)

Missed Real-Time Topics

- Hardware Monitoring and Life Expectancy
 - Life Expectancy is a Hardware Characteristic
 - Mean Time Between Failure (MTBF)
 - Summed Reliability of All Components in a System
 - Inverse Relationship to Temperature
 - Environmental Conditions - Shock and Vibration
 - Monitoring Usually Performed as a Low Priority Task
 - Remote Sensors - Often I2C or SPI Interface
 - Polled Operation
 - Temperature, Voltage, Current, Vibration, Shock
 - Can be Logged for Out-of-bounds Conditions and Trend Analysis

Missed Real-Time Topics

- Real-time DSP Design and Implementation
 - Software Design is Very Similar
 - OS Selection, Poling, Tasks, Semaphore
 - Hardware May be Optimized for Specific Functions
 - Audio, Video, Motor Control, Process Control
 - May Include Hardware Digital Filters
 - Special IO for Specific Tasks
- Fixed Point Math vs Floating Point Math
 - Fixed Point: 16-Bit, 24-Bit, 32-bit
 - Floating Point: Single Precision, Double Precision

Lab #13 Review

- Commentary on Labs
 - Addition of Charts at Start?
- If Have Working Code From Last Lab, Send Me Your Code
- Simple Digital Filter
 - FIR vs IIR
 - https://en.wikipedia.org/wiki/Finite_impulse_response
 - https://en.wikipedia.org/wiki/Infinite_impulse_response
 - <https://community.sw.siemens.com/s/article/introduction-to-filters-fir-versus-iir>

Action Items and Discussion

AI#:	Owner	Slide #	Document	Action