Embedded System Design

CS/ECE 6780/5780

Al Davis

Today's topics:

- course logistics & overview
- organize lab sessions

Disclaimer

- **Course traditionally taught by John Regehr (SoC) or Chris Myers (ECE)**
  - **both are on sabbatical (clueless administrative Fubar)**
  - **I took on this course as a voluntary overload**
    - » **It's required for CE majors who would be screwed if it wasn't offered – not acceptable to me**
  - **But**
    - » **my background is different**
    - » **add in 1st try**
    - » **→ we'll see how it goes**
- **Likely result**
  - **some mid-course corrections are probable**
  - **I'll be confused from time to time**
- **BUT**
  - **I'll give it my best shot**
  - **AND I'll be propped up by two outstanding TA's**
    - » **part of the bargain in taking on this course**

General Course Information

- Nothing set up yet – should be by Thursday
  - course web site
    - » http://www.eng.utah.edu/~cs5780
  - send questions to:
    - » teach-cs5780@list.eng.utah.edu
  - class mailing list:
    - » cs5780@list.eng.utah.edu
- TA's
  - Torrey Atcitty
  - William Lee
  - Office hours will be in the lab sessions
- Al's office
  - MEB 3424
- Lab: MEB 2265 (ECE Digital Lab)

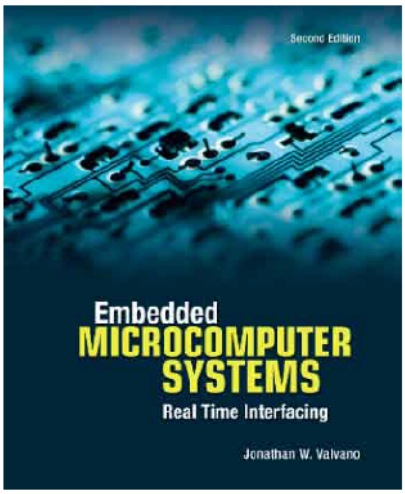
Course Content

- Introduction to embedded system design
  - programming microcontrollers
  - peripheral hardware design & control
- Topics
  - microcontroller architecture
  - embedded software design
  - interrupt synchronization
  - timing generation and measurement
  - digital I/O interfacing: serial and parallel
  - analog interfaces

Prerequisites

- **You are expected to know**
  - **programming in C (i.e. CS 1000, 2000, or ideally 4400)**
  - **data structures and their implementation in C**
    - » **queues, stacks, linked lists, etc.**
  - **assembly language programming**
    - » **doesn't matter which flavor**
    - » **we'll use the Motorola 6812**
      - **16-bit processor now produced by Freescale**
      - **more architectural details later**
  - **digital logic design**
    - » **binary arithmetic, gate level design, FSM's, tri-state logic, etc.**
  - **use typical laboratory equipment**
    - » **multimeters, o'scopes, power supplies**
  - **discrete analog circuits**
    - » **RLC**
    - » **bi-polar and MOS transistors, op-amps**

Textbook & Documentaion



- **2nd edition**
- **ISBN-10: 0-534-55162-9**
  - **should be in the bookstore**
  - **we won't be using the whole text**
  - **focus will be on labs**
- **Website documentation**
  - **microcontroller**
  - **project board**
  - **code development environment**
  - **other relevant material**

Grading Policy

- 5780
  - Lab reports & demonstrations – 60%
  - Midterms – 40%
    - » there will be 2
    - » no final exam
- 6780
  - Lab reports & demonstrations – 30%
  - Midterms – 40%
  - Project – 30%
    - » you'll choose something to build using the lab kits
    - » proposal, schedule, and demonstrations will consume the 2nd half of the semester
    - » both HW & SW design components
      - more information & guidelines will come later

Exams

- 3 types of questions
  - common – both 5780 & 6780 students will answer these questions
  - 6780 questions
    - » 5780 students won't answer these
  - 5780 questions
    - » 6780 student's won't answer these
- Note
  - this is an experiment so we'll see how it goes

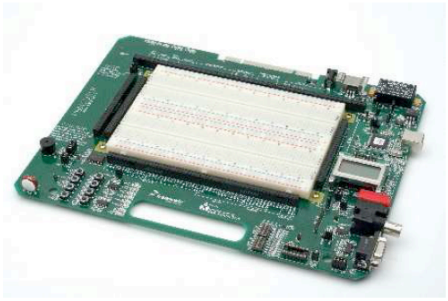
Labs

- Most important aspect of the course
  - professional discipline
    - » what you can do is important
    - » staying on schedule is equally important
      - hence NO late lab reports or demonstrations will be accepted
- Lab logistics
  - lab is staffed from 0730 – 1800
  - 24/7 card key access
    - » go to MEB 2355 to get access
      - get this done this week!!
    - » note:
      - If you're like me your student ID card won't work
      - you'll need to get a 2* proxy card in the Union Bldg.
  - 1 mandatory lab session per week
    - » we'll set up lab times today
    - » in your scheduled session
      - demo your assignment to the TA running that session

Lab Teams

- Labs will be done in 2 person teams
  - teams must be formed this week
    - » getting the right partner will VASTLY improve your life in this course
    - » both team members will need to attend the same scheduled lab session
  - assignment 1 (this will be on the web soon)
    - » send email by Friday 1/15/10 before 2359
      - to ald@cs.utah.edu
      - list
        - which lab session you'll attend
        - team member names and email addresses
      - each person will be assigned a secret integer in a return email
- 5780 students partner w/ 5780 students
  - same for 6780 students
    - » projects will be done by the same team

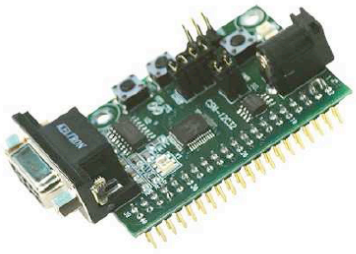
PMBCUSLK: Microcontroller Project Board



- Breadboard
- 60-pin MCU connector
- USB BDM pod
- LCD Module
- COM Port
- 8 DIP Switches
- 5kΩ potentiometer
- 8 green LEDs
- 8 push buttons
- Buzzer

Schematic and documentation will be on the course website

16-Bit HCS12C32 Student Learning Kit



- MC9S12C32 MCU
  - 32K Byte Flash EEPROM
  - 2K Bytes RAM
  - 31 I/O lines
  - 8-Ch 16-bit Timers
  - SCI/SPI Ports
  - CAN 2.0 Module
  - 8-Ch 10-bit ADCs
  - 8MHz Internal Bus
  - 25MHz Operation
- 40 pin connector
- RS-232 Serial Port
- 3 push buttons (2 user/reset)
- 3 LEDs (2 user/VDD)

Lab Kit Checkout Policy

- Each partnership
  - receives 1 project board and a HCS12C32 module
    - » kit includes software, cables, wires, documentation, etc.
  - both partners must be present to checkout the kit and sign the loan agreement form
- Kit must be returned before April 28th
  - in CLEAN, COMPLETE, & WORKING CONDITION
- You are responsible for up to $250 for loss or damage
  - so make sure you do things carefully
    - » like make sure power and ground aren't shorted before turning on the power

Labs and Lab Reports

- Labs begin next week
  - maybe the week after
- Prelab checked at the beginning of you lab section
- Working lab must be demonstrated to the TA during your lab section
  - lab reports are due to the TA at the beginning of your next lab section
    - » they must be turned in as a hard copy unless prior arrangements to submit via email is made w/ the appropriate TA
  - late reports will not graded
- Graded lab reports will be returned one week after they are turned in
- Grade questions must be resolved by the appropriate TA
  - 1 week after the reports are returned – grades will be final
  - so be prompt with questions

Use of Email

- All students must be on the class mailing list
  - a link on the web page will allow you to do this
  - anybody who is not on the mailing list by 1/15/10 @ 2359 will need to drop the course
- Don't mail the class mailing list unless you want everybody to receive it
- teach-cs5780 goes to Al, Torrey, & William
  - this is the address that should be used for specific questions
- Include your full name in any email
  - If it isn't there – your message will be instantly deleted
- We prefer to get email from University accounts
  - non University accounts may get spam filtered
    - » If we don't get the emails then you lose so make it easy on yourself
- Don't send big attachments
  - they may get filtered as well
  - If you have some default smilies, animations, etc. – get rid of them
    - » twerps use these things – professional people don't – it's that simple

Final Grades

- Normalized system
  - based on the best student (5780 & 6780 are separate bins)
    - » 90% of best is an A of some sort
    - » 80% of best is a B of some sort
    - » 70% of best is a C of some sort
    - » and so on
  - grades will be posted on the web site
    - » indexed by your secret integer
- Pest control
  - for some reason some students have a tendency to pester the TA's on almost every grading decision
    - » remember if you question grading decisions – the review may raise OR lower your grade
      - pests tend to notice the latter
    - » however we want to be consistent and correct
      - so questions are encouraged
      - just don't be a pest

Cheating

- If you cheat you will fail the course
  - no warnings will be given
- Collaboration with other student teams is encouraged
  - the point is to learn the material
  - BUT
    - » copying code or text is cheating
    - » everything you write (code or lab report text) MUST be original
    - » modifying a copy is also cheating
      - we have tools which detect this so don't even be tempted
- Apology
  - it's too bad that this topic even needs to be covered
    - » but incidences of cheating are definitely increasing
    - » hence the need to cover this uncomfortable topic
  - this is a professional discipline
    - » plagiarism results in instant termination in the workforce
    - » so we will follow this standard