ECE 3411: MICROPROCESSOR APPLICATIONS LABORATORY – FALL 2015

Lecture: MoWe 3:30-4:30, LH 107, Lab: MoWe 4:30-6:30 PM, ITEB C30

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TA: Kamran Haider **Email**: syed.haider@uconn.edu **Office Hours:** By appointment on Tue 3:30-5:30

Course Description

The basis of sophisticated designs of modern digital systems that appear in products such as automobiles, appliances and industrial tools is the Micro Controller Unit (MCU); a microcomputer optimized for single-chip system design for controlling peripheral devices geared to real-time applications. We will use the Atmega328P microcontroller (from the Atmel MEGA series RISC microcontrollers) in a series of labs to design microcontroller based systems. In particular, we will explain how to read and use the Atmega328P datasheet and how to write self-explanatory C code for interfacing with the MCU and controlling peripheral devices. This includes initializing register values, writing Interrupt Service Routines (ISRs), constructing underlying Finite State Machines (FSMs), and using a task based programming approach based on hardware timers.

Learning Objectives (EAC outcomes (a) an ability to apply knowledge of engineering, and (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice):

To get familiarized with basic C-language concepts:

- To be able to program in basic C (without pointer constructs) by (1) emulation of read examples (how to apply C primitives and how to layout your C code and well-comment your C-code such that it can be interpreted and understood by colleagues), by (2) learning how to set up an Interrupt Service Routine (ISR) and how to communicate over microcontroller pins, by (3) writing Finite State Machines (FSMs) that specify state transitions based on interrupt events and explain how program variables change, and by (4) adopting a task based programming approach (without blocking delay functionality) and (5) writing non-blocking procedures (to communicate with e.g. UART and LCD).
- To be able to debug programming errors and use the debugging tool to observe how the microcontroller steps through assembly instructions that represent procedures and ISRs.
- To understand the importance of a Real Time Operating System (RTOS) and to be able to implement basic schedulers.

To read schematics and datasheets:

- To be able to understand how the pins of the microcontroller are connected to peripheral devices.
- To be able to read and understand the corresponding Atmega datasheet, in particular, how to enable interrupts and program their properties.

Textbook: Elliot Williams, *Make: AVR Programming*, 2014

Distribution of slide decks, lab problems, other reading material, etc.: If you have not already received an invitation, you can sign up for Piazza yourself by following the link piazza.com/uconn/fall2015/ece3411. We will use Piazza as a forum for discussion and Q&A as well as the method of preference to distribute reading material and emailing the class.

Organization Lectures:

- Each lecture (after week 2) starts with a closed-book question about your reading assignment (posted slide deck and book chapters) which you will need to answer within 5 minutes. *It is your responsibility to be in time for class.*
- The remaining time explains the posted slide deck in detail. If afterwards you have questions about the presented material you can make use of office hours or post question through Piazza.

Organization Lab:

- You are expected to be prepared and read the posted lab problems beforehand:
    - Week 1+2 tests your basic programming skills as a prerequisite to the remaining class, i.e., we will use "if statements", "while loops", "procedures", "arrays", etc. (an understanding of complex pointer based data structures is not needed for a successful completion of this course).
    - In weeks 3 to 7 we will guide the whole class step-by-step through solutions; partial solutions will be posted on-the-fly during the labs themselves and the final solutions will be posted after lab. Best is to have tried and solve the problems beforehand (or at least try them again without looking at the solutions): During lab tests you are expected to *independently* solve similar problems!
    - In weeks 8 to 11 we will let you work on lab problems independently and post full solutions afterwards.
    - In week 12 you will solve lab problems with minimal guidance from our side: you will even need to study the corresponding chapters of the datasheet on your own.
- During lab (and also outside lab) collaboration among yourselves is encouraged.
- During weeks 3 to 12, *you are expected to turn in a weekly lab report* which explains in bullet form the working of your lab problem codes (set up of ISRs, how tasks depend on one another) and a depiction of the underlying FSM. We will only make sure whether you made a serious effort (if your sentences or handwriting are impossible to parse, you did not make a serious effort) after which we will give your report back to you. Writing summaries are a good study strategy and this is the reason why we ask you to write lab reports. *If you do not hand in reports we will penalize your final grade.*

Office Hours:

- Lectures (~50 minutes) and labs (~110 minutes) are each Monday and Wednesday except for quizzes and lab tests every 2 weeks.
- Every two Tuesdays (i.e., the Tuesdays before a Wednesday quiz and lab test) office hours are scheduled from 3:30 to 5:30. Experience shows that students do not come to office hours during other scheduled time slots. If you like to ask questions during other weeks, you can email the TA and set up a time or use Piazza.
- If you come to office hours you need to be prepared with the questions you seek answers to. General questions such as "I do not understand the whole lecture" are not concrete enough. By thinking the material through you will find the concrete spots for which you can ask guidance during office hours.

7 Quizes / 7 Lab Tests / 1 Final:

- Quizes have a number of (short) questions / problems and test overall understanding; quizzes are closed book and take 45 minutes. You do not need to learn the datasheet by heart as we will provide the necessary portions of the datasheet as an appendix to quizzes.
- Lab tests are a couple of programming assignments: You will program own code, however, lab tests are open book/laptop and this means that you can reuse code from lab problems. Your codes should compile and we generally do in-lab grading (i.e., as soon as you accomplished a task and demonstrate its working). If you cannot demonstrate a successfully working code for a task, then you will need to email the code to your TA. If your code does not compile, expect to only be able to receive at most 50% of task's credit. Lab tests take 100 minutes.
- The final is closed book and takes 115 minutes.
- We will post example quizzes, lab tests, and final. Their solutions will be posted 24 hours before the start of the examination (this means that you are forced to study the material and test yourself beforehand maximizing your learning efficiency).
- If for any reason you are unable to take a quiz/test or you need to miss a question, you need to contact the instructor/TA beforehand: The TA will arrange a make-up opportunity as a combination of an oral test and lab assignment; you will need to provide an oral explanation of your answers. A make-up opportunity will only be given for an acceptable absence (unacceptable absence will result in a zero score).
- Plagiarism and other anti-intellectual behavior cannot be tolerated in any academic environment that prides itself on individual accomplishment.

Sec. 10a-50. (Formerly Sec. 10-334g). Absence of students

Students should inform their instructor about any potential conflicts with scheduled exams or other assignments and a religious holiday that they observe. For conflicts with final examinations, students should, as usual, contact the Office of Student Services and Advocacy (formerly the Dean of Students Office).

Collaboration policy: You are encouraged to collaborate and study together. In fact, students who form study groups generally do better than do students who work alone. If you do work in a study group, however, you owe it to yourself and your group to be prepared for your study group meeting. Specifically, you should spend at least 30-45 minutes trying to understand lecture material and solve any of the open questions beforehand. If your group is unable to solve a problem, talk to other groups or ask the instructor.

Grade:

- The quizzes during lecture and tests during labs (7 in total) count for 70% of your final grade:
  - Generally, your combined quiz/test grade is computed as follows: The quiz portion will be about 40% and the lab test portion will be about 60%.
  - Q1 is testing your preliminary coding skills before the first drop out date (based on its score you may decide to withdraw from the course without this being reported on your grade list).
  - We will test progress and in the end your final understanding is most important. To reflect this grading philosophy we will take the best 3 quizes among Q4, Q5, Q6, and Q7 and weigh these double, we discard Q1 and the worst quiz score among Q2 to Q7, and we keep the remaining quizzes. Example: Q2 < Q4 < Q5 < Q3 < Q7 < Q6 will lead to a weighted average of your quizzes/tests of [2*(Q5+Q6+Q7) + (Q4+Q3)]/8 which will be counting towards 70% of your final grade.
  - We will email each student a prediction of their final grade midterm based on quiz and lab test scores. If your prediction is a C- or less, we will ask you to set up an appointment with the instructor.
- Questions at the start of lectures count for 5% of your final grade.
- The final (closed-book) is a 2-hour exam which counts for 25% of your final grade.
- We penalize missed lab reports, see table below where

  A = 70%*(weighted quiz/test average) + 5%*(average questions) + 25%*(final) + 2.

Lab reports skipped:	Impact:
0	None
1	A minus 10/100 (one-hundredth of a letter grade)
2	A minus 10/10 (one-tenth of a letter grade)
3	A minus 10/4 (one fourth of a letter grade)
4	A minus 10/2 (one-half of a letter grade)
5	A minus 10 (one letter grade)
6	A minus 20 (two letter grades)
7 or more	Fail

Grade conversion is done according to the following table:

Range of A minus penalty:	Letter grade:
91 - 100	A (excellent)
89 - 90	A-
87 - 88	B+ (very good)
81 - 86	B (good)
79 - 80	B-
77 - 78	C+
71 - 76	C (average)
69 - 70	C- (fair)
67 - 68	D+ (poor)
61 - 66	D
59 - 60	D- (merely passing)
Under 59	F (Failure)

Disabilities: The Center for Students with Disabilities (CSD) at UConn provides accommodations and services for qualified students with disabilities. If you have a documented disability for which you wish to request academic accommodations and have not contacted the CSD, please do so as soon as possible. The CSD is located in Wilbur Cross, Room 204 and can be reached at (860) 486-2020 or at csd@uconn.edu. Detailed information regarding the accommodations process is also available on their website at www.csd.uconn.edu.

Let the instructor know as soon as possible if you need adaptations or accommodations because of a disability (e.g. learning disability, attention deficit disorder, psychological, physical), or if you have emergency medical information which you should share with the instructor, or if you need special arrangements in case the building must be evacuated.

Policy Against Discrimination, Harassment and Inappropriate Romantic Relationships: The University is committed to maintaining an environment free of discrimination or discriminatory harassment directed toward any person or group within its community – students, employees, or visitors. Academic and professional excellence can flourish only when each member of our community is assured an atmosphere of mutual respect. All members of the University community are responsible for the maintenance of an academic and work environment in which people are free to learn and work without fear of discrimination or discriminatory harassment. In addition, inappropriate Romantic relationships can undermine the University's mission when those in positions of authority abuse or appear to abuse their authority. To that end, and in accordance with federal and state law, the University prohibits discrimination and discriminatory harassment, as well as inappropriate Romantic relationships, and such behavior will be met with appropriate disciplinary action, up to and including dismissal from the University. More information is available at http://policy.uconn.edu/?p=2884.

Sexual Assault Reporting Policy: To protect the campus community, all non-confidential University employees (including faculty) are required to report assaults they witness or are told about to the Office of Diversity & Equity under the Sexual Assault Response Policy. The University takes all reports with the utmost seriousness. Please be aware that while the information you provide will remain private, it will not be confidential and will be shared with University officials who can help. More information is available at http://sexualviolence.uconn.edu/.