Embedded System Design

ECEN 4613/5613 – Spring 2009

Wednesday Evenings, 5:30pm–8:00pm, ECEE 1B28
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Course Web Site: http://ece.colorado.edu/~mcclurel/index.html

ECEN 5613 is also being offered through CAETE (Continuing Education) during Spring 2009. See the CAETE web site for tuition and enrollment information:
http://caete.colorado.edu/nondegree/ececertificates.aspx#Embedded
http://caete.colorado.edu/registration
CAETE enrollment will begin in December. Contact CAETE for more information.

Course Description

In this class, the fundamentals of embedded system hardware and firmware design will be explored. Issues such as embedded processor selection, hardware/firmware partitioning, glue logic, circuit design, circuit layout, circuit debugging, development tools, firmware architecture, firmware design, and firmware debugging will be discussed. The Intel 8051, a very popular microcontroller family, will be studied in depth. The architecture and instruction set of the microcontroller will be discussed, and a wirewrapped microcontroller board will be built and debugged by each student. The course will culminate with a significant final project which will extend the base microcontroller board completed earlier in the course. Learning may be supplemented with periodic guest lectures by embedded systems engineers from industry. This course serves as an excellent preparatory course for ECEN 4573 (ECE Capstone) and ECEN 4623/5623 (Real-Time Embedded Systems). This course also counts towards the Embedded Systems Certificate. See the course web site for more detailed information.

Required Background

Knowledge of microprocessor architecture and assembly language, microprocessor peripherals, digital design, and the C programming language is a prerequisite for this course. The corresponding CU-Boulder courses are ECEN 2120, ECEN 3100, and CSCI 1300. Although not listed as formal prerequisites, circuits/electronics (ECEN 3250) and computer organization (ECEN 4593) are highly recommended. An understanding of compilers, assemblers, linkers, operating systems, analog design, diodes, transistors, and electromagnetic fields and waves will be useful.

Course Context

Embedded systems are involved in almost every facet of modern life. Cell phones, pagers, PDAs, answering machines, microwave ovens, televisions, VCRs, CD/DVD players, video game consoles, GPS devices, network routers, fax machines, cameras, music synthesizers, planes, spacecraft, boats, and cars all contain embedded processors. Late model cars may contain as many as 65 embedded microprocessors, controlling such tasks as antilock braking, climate control, engine control, audio system control, airbag deployment, etc. Logic analyzers and digital storage oscilloscopes utilize embedded processors to support real-time operation. Even PCs, which are designed around powerful CPUs, contain embedded systems. Storage drives (floppy, hard disk, solid state, CD-RW, DVD-ROM, Blu-ray), and external peripherals such as printers, scanners, and other SAS, USB, or IEEE 1394 devices all contain embedded processors. During 2007, microprocessor manufacturers sold on the order of 100 million processors for use as computer CPUs. In comparison, during the same time frame, microprocessor manufacturers sold more than **3 billion** embedded processors, primarily consisting of 32-bit, 16-bit, 8-bit, and 4-bit devices. The tremendous number of applications for embedded computing has given rise to high demand for engineers with experience in designing and implementing embedded systems. This course will give students hands-on experience and opportunities for experimentation in this exciting field.