CMPEN 472
Microprocessors and Embedded Systems
Technical Elective in Computer Engineering and Computer Science

Catalog Data: Microprocessors and Embedded Systems (3)
Microprocessors: architecture, design, assembly language, programming, interfacing, bus structure, and interface circuits and their use in embedded systems. Prerequisite: CMPEN 331.


Course Objectives: CMPEN 472 has two major objectives. The primary objective is that students should learn about microcontrollers and embedded processing. Many electronic devices now include a microprocessor inside in what is known as an “embedded” processor system. After taking this course students should have the tools and knowledge needed to use the 68HC12 in an embedded system. They should be able to design both the software and hardware of such a system. In addition this background will allow a student to be better prepared to use other microprocessors/microcontrollers as desired. The second objective is to prepare students with the background they will need to take the laboratory/design course CMPEN 473 if they choose to take this senior elective. Approximately 50% of the course CMPEN 472 is spent on software and 50% on systems/hardware issues.

Primary Course Outcomes: Upon completion of the course, students should possess the following skills:

- Be able to design the hardware and software required to implement an embedded processing system.
- Be able to take a problem statement and implement a solution using a combination of hardware and software while using a microprocessor/microcontroller.
- Be able to use the standard ports and interface devices on a typical microcontroller.
- Be able to write simple assembly language programs which utilize microcontroller resources.

Relationship to Undergraduate Program Outcomes: CMPEN 472 builds on basic logic design and computer organization skills and knowledge that were introduced in CMPEN 271 and CMPEN 331 and the programming sequence. Students continue to develop and expand these skills and knowledge and specifically learn to apply them to their use in microprocessor and microcontroller systems, particularly in the embedded processing domain.

CMPEN 472 and which supports the following program outcomes:

- Design the electronic/logic circuits that form the basic building blocks of a computer system.
- Design the architecture and organization of the basic components of a computer system.
- Analyze algorithms or computer code for correctness and efficiency.
- Demonstrate independent learning by using unfamiliar computer systems, test equipment and software tools to solve technical problems.
- Be able to discuss major trends in industry and current research activities within the discipline.

Required Topics: Microprocessor architecture – programmers model (1 week)
Development environment, assembler, and debuggers (1 week)
Instruction sets and addressing modes (1 week)
Conditional branching and subroutines (1 week)
System programming (1 week)
Data structures and parameter passing (1 week)
System modes and interrupts (1 week)
Interfacing principles (1 week)
Parallel I/O ports & I/O devices (1 week)
Serial communications (1 week)
Timers & timing applications (1 week)
Pulse Width Modulation (1 week)
Analog-to-Digital conversion (1 week)
Embedded processing (1 week)

Class Format: Three 50 minute lectures per week.

Professional Component: CMPEN 472 prepares students for employment in a variety of industrial settings where computer control is employed, including embedded processing environments. Students use an assembler/simulator package to develop application programs that perform a variety of tasks and utilize some of the on-chip resources of a modern microcontroller, currently the Motorola 68HC12. A variety of applications are studied including pulse width modulation, pulse measurement, frequency control, ADC, and computer to computer communications. Students study both hardware and software aspects of microcontroller system design as well as some of the trade-offs between cost, speed, reliability, the development costs of such systems and the trade-offs between implementation in software versus hardware. CMPEN 472 is a senior level elective for Computer Engineers.

Evaluation: Students are evaluated using 2 or 3 mid-term exams and a final exam. In addition students are required to complete 5-10 homework assignments on a variety of hardware and software problems. Some instructors may also give pop quizzes and/or an extended design project.

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