

EENG 460a/CPSC 436a/ ENAS 960 NETWORKED EMBEDDED SYSTEMS AND SENSOR NETWORKS

Course website <http://www.eng.yale.edu/enalab/courses/eeng460a>

Brief Description

This course is an introduction to fundamental concepts of networked embedded systems and wireless sensor networks. Covered topics include: embedded systems programming concepts, low power and power aware design, radio technologies, communication protocols for ubiquitous computing systems, and some of the mathematical foundation of sensor behavior. Laboratory work consists of a set of programming consider a set of the issues described in class. **Prerequisites:** Senior or Graduate Student Standing in Engineering or Computer Science. Basic understanding of algorithms and data structures is required (CPSC 223 or equivalent, ideally CPSC 323).

Expanded Description

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Class Material:

Primary text: “Principles of Embedded Network Design”, Pottie and Kaiser, Cambridge University Press Fall 2004. (see attached synopsis)

Recommended Text: “Wireless Sensor Networks”, An Information Processing Approach by Zhao and Guibas.

Both texts can be found on reserve at the Engineering Library

Papers and Handouts will also be distributed in class during the course

Lab Resources: To complete the programming assignments for the course, the students will have access to the Computer Engineering Lab in CO-40. In the first part of the semester, the students will use the lab to complete 2-3 programming assignments in embedded systems and networking protocols. Later on, the students will use the resources of the lab to work on their course projects.

Prerequisites: Senior or Graduate student standing. Exposure to algorithms and data structures is Desirable.

Targeted Audience: Senior and Graduate students in electrical engineering, computer science and other students in engineering interested in wireless embedded systems , sensor networks and related technologies.

Course Objectives: On completion of this course, the students would have a good understanding of networked embedded systems. More specifically, they will learn the fundamentals associated with embedded systems programming, real-time operating systems and power-aware communication protocols for networks of small devices. Students will also be exposed to a large set of recently developed methods in wireless sensor networks and ubiquitous computing. During the latter part of the course students are expected to apply their knowledge to construct innovative-networked systems as part of their course project.

Course Description: This course provides an introduction to networked embedded systems and wireless sensor networks from a computer engineering perspective. The course leverages the recent advancements in microprocessor, wireless and MEMs technologies and to explore different dimensions associated with the design of sensor networks and ubiquitous computing systems. The course begins with the introduction of embedded processors and embedded operating systems. Using that as a stepping-stone, it then explores, radio technologies, distributed communication protocols and low-power design. Scheduling and optimization concepts are the applied to the design of low-power, self-configuring systems and smart environments. The second half of the course surveys, the recent advances in the field and illustrates how concepts from a diverse set of science and engineering can be applied to these systems. The course project will allow students to apply their engineering knowledge together with the acquired in the course to design large networked systems.

Requirements and Grading:

Class Discussion and Participation (5%), Homeworks (25%), 2 Midterms (30%), Final Project (40%)

Topics Covered (Fall 2004)

Week 1

Sep 2: Introduction Networked Embedded Systems

Week 2

Sep 7: Sensor Network Motivating Applications, Embedded Processors Overview

Sep 9: Embedded Processors and Sensor Network Platforms

Week 3

- Sep 14: Embedded Systems Programming
- Sep 16: Embedded Programming, Signal Behaviors and Sensor Interfaces
- Week 4
- Sep 21: Introduction to Location Discovery and Basic Optimizations
- Sep 23: Overview of Location Discovery Algorithms
- Week 5
- Sep 28: Advanced Localization Techniques
- Sep 30: Time Synchronization and Calibration
- Week 6
- Oct 5: Sensor Technologies (Guest Lecture: Prof. Cullurciello, Prof. Koser)
- Oct 7: Radio Technologies and Medium access protocols
- Week 7
- Oct 12: Medium access control and routing
- Oct 14: Routing – Part II
- Week 8
- Oct 19: Data Aggregation and Introduction to Em* (Guest: Prof. Ganesan, Umass, Amherst)
- Oct 21: Clustering and Aggregation
- Week 9
- Oct 26: Mobility and Collaborative Control
- Oct 28: Mobility and Collaborative Control – Part II
- Week 10
- Nov 2: Learning and Emerging Behaviors
- Nov 4: Learning Applications in Sensor Networks
- Week 11
- Nov 9: Collaborative Signal Processing & Applications
- Nov 11: Collaborative Signal Processing & Applications Part II

Week 12

Nov 16: Security Issues and Data Integrity

Nov 18: Midterm 2

Week 13

Nov 30: Misc Topics in Sensor Networks

Dec 2: Emerging technologies and conclusions

**VISIT COURSE WEBSITE FOR UP TO DATE INFORMATION AND
RESOURCES ABOUT THE COURSE**