

Networked Embedded Systems (ECE-ENG 597/697SD)

General Information

Instructor:	Fatima M. Anwar
Email:	<code>fanwar@umass.edu</code>
Office:	Knowles Engineering Building 209E
Office Hours:	Tue/Thur 12 - 1 pm or by appointment
Textbook:	Research papers, Datasheets and Web Search
Prerequisites:	Intro to Embedded Systems, Intro to Programming
Course Open to:	Junior, Senior & Graduate students; both in ECE & CS departments

Course Description

We are surrounded by ubiquitous embedded technologies that are revolutionizing smart spaces and changing the way we build, manage, and interact with our systems. These technologies span the cloud and the edge devices, and give birth to new system designs with various constraints. The design challenges lie in providing distributed intelligence for resource optimization and ease of integration for heterogeneous devices.

This course introduces the students to the design of embedded systems with a focus in unprecedented cyber-physical systems and internet of things applications such as health care, connected vehicles, and augmented/virtual reality. This course presents the unique capabilities of embedded technologies, and takes a holistic approach to design end-to-end systems. These systems span various thrusts that cut across both horizontal and vertical architectural layers. Focused horizontal thrusts are, 1) hardware platforms for emerging applications at the edge, 2) software for bare-metal platforms, and embedded OS 3) network based coordination for distributed entities and 4) cloud-based services for compute-intensive tasks. It also dives into details of vertical thrusts cutting across all layers such as security-aware design, programming paradigms, and resource optimizations in

current systems. Finally, the course explores system and security issues that arise with a human in the loop of embedded systems design.

The topics covered in this class equip students with the necessary skill set to research and implement embedded systems from ground up for emerging applications. Students are required to review and critique research papers assigned to them in class, actively participate and lead in discussions, define and implement a semester-long project approved by the instructor, along with presenting key findings and demonstrating the functionality of the project.

Course Syllabus

A list of topics is as follows,

- Introduction to embedded systems with emerging applications.
- Primer on embedded systems' building blocks such as sense, compute, communicate, control, and actuate components.
- Hardware platforms and software organization with an emphasis on embedded OS.
- Intelligence at the embedded edge and cloud.
- Time management and synchronization.
- Security risks in embedded system design.
- Programming paradigms.
- Resource-aware design: intermittent computing and communication.
- End-to-end architectural design.
- Future directions in human in the loop embedded systems.

Grading Policy

20% Technology Review

20% Research Paper Critique

10% Assignment

50% Course Project

Course Project's Grading Breakdown

20% Project Proposal, Interaction, and Updates

40% Quality of Work

20% Final Report/Paper

20% Presentation and Demo

Course Emphasis

This course places great emphasis on implementing projects. Students are expected to demonstrate their designed systems through hardware and/or software artifacts. These implementations can potentially lead to capstone projects and thesis options for interested students. Another emphasis of this course is on communication skills assessed through class participation, presentations, and demonstrations. Students are expected to share and discuss ideas. Each student should present her final project in various formats such as a poster presentation, and project demo to a wider audience. The purpose is to develop skills of communicating one's ideas concisely and effectively to a broader research community.