

Embedded Systems: An Application-Centered Approach

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Outline

1. Introduction
2. Homework

Your teacher's background

Embedded systems researcher with 100 publications in the area.

Have reviewed a huge number of papers on the topic, served as technical program committee co-chair for a top embedded systems conference.

Co-founded wearable electronics company with product coming to market in near future.

Learned the hard way that customer discovery is important in research, and essential in business.

Embedded system definition

Embedded system: A computer within a host device, when the host device itself is not generally considered to be a computer.

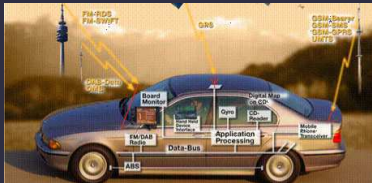
Embedded systems examples



Medical devices



Sensor networks



Automobiles



Smartphones

Embedded system market size

Dominates general-purpose computing market in volume.

Similar in monetary size to general-purpose computing market.

Growing at 15% per year, 10% for general-purpose computing.

Example: cars

40% of value in embedded electronics, from zero a few decades ago.

Hot embedded topics

Internet of things

Mobile computing

Wearable electronics

Cyber-physical systems

Distributed wireless communication systems

Intelligent infrastructure/transportation

Smart buildings

Embedded system security

Embedded system requirements

Hard real-time

Wireless

Reliable

First time correct

Rapidly implemented

Low price

High-performance

Low power

More on these later.

What you can do in the course project.

Develop better embedded system design or analysis ideas.

Automate aspects of embedded system design process that are currently done manually.

Find a way to solve a new real-world problem with an embedded system.

Course goals I

Define, design, and prototype an embedded system.

Build broad knowledge of the field.

Understand how to select and define a problem that others want solved.

Customer discovery interviews. Literature surveys. Market research.

Have a general understanding of embedded system uses and design process.

Covered in lecture, practical reading material, and study for project.

Course goals II

Have a general understanding of current embedded system research topics.

Covered in lecture, research papers, and study for project.

Have a deep understanding of one particular research problem.

Primarily covered through self-study of research and technical documents while working on project.

Be prepared for research on, and development of, embedded systems.

Be capable of writing technical papers, presenting, and selling your work.

Today's goals

- 1 Start picking project topics and forming teams.
- 2 Know how to get access to course resources.
 - Website.
 - CTools.
 - References.
 - Piazza.
- 3 Understand work and grading policies.

Class prerequisites

Knowledge of **some** of the following topics.

- Computer architecture.
 - Distributed systems.
 - Cache effects.
 - Power consumption impact of architectural decisions.
- Networking.
- Systems programming.
 - Project-oriented course with substantial programming component.
- Algorithm design and analysis.
 - Computational complexity analysis.
 - Efficient algorithm design.

Pick project team members carefully.

Course structure I

Lectures

- Initially background material, survey papers, classical (old) research papers.
- Then recent research papers.
- Near the end of the course, project presentations will be given.

Office hours

- Immediately after lecture and by appointment.
- I will need to have in-depth discussions with teams as projects progress.
- 2417-E EECS.

Course structure II

Lab sessions

- Initially, descriptions of past projects to provide examples.
- Coverage of practical implementation problems.
- Help on specific project problems.
- Near the end of the course, project demos will be given.

Course structure III

Project reports (25% weight), demos/design (50% weight), and presentations (25% weight)

- 7 Jan: Topics of interest.
- 9 Jan: Team formation.
- 12 Jan: Written project proposals with clear plan for checkpoint 1 and checkpoint 2.
- 14 Jan and 16 Jan: Project proposal presentations to get feedback from classmates and instructor.
- 20 Feb: Checkpoint 1 report.
- 27 Feb and 2 Mar: Checkpoint 1 presentation and demo.
- 25 Mar: Checkpoint 2 report.
- 27 Mar and 30 Mar: Checkpoint 2 presentation and demo.
- 17 Apr and 20 Apr: Final presentation and demo.
- 21 Apr: Final report.

Grade weighting scheme

Product–market search: 30% weight
Interviews every week.

Projects: 30% weight
Design/research quality.

Presentations: 25% weight
Clarity, story telling, brevity, and delivery.

Exam and quizzes: 15% weight

- Will have many short quizzes on reading and lecture material.
- Unpredictable timing.
- Lowest quiz grade will be dropped.
- Exam is for breadth. Projects are for depth.

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What to do before Friday

- 1 Follow the CTools link to Piazza and use Piazza to find a teammate.
- 2 Narrow down your topic of interest to an embedded system idea and describe it in 3-4 sentences.
- 3 Be prepared to state your idea in Friday's lecture.
- 4 Get and read Chapter 5 (and ideally also 1-4) in Naeem Zafar's book.
- 5 (Optional) Do a few interviews of people who might value what you are trying to provide and take detailed notes. This stops being optional after Friday.