EE123

Design Lab: Engineering Solutions for Community Challenges

Stanford University

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Office Hours/Class Location: TBD

Course Description: What if your next engineering project could help your community? In this immersive, hands-on design lab, students will take on real challenges facing California—from wildfire preparedness to everyday safety—by designing and prototyping devices that make a difference. Working with local community partners, you will brainstorm, design, and build low-cost engineering solutions that combine creativity, empathy, and technology.

Early lectures will provide guided experience with electronic sensors, microcontrollers (e.g., Arduino), motors, and servos, along with an introduction to programming for hardware control. A case study on tent safety systems—designed to increase security for unhoused people living in encampments—will serve as a concrete example to ground technical discussions and highlight the importance of human-centered design. Students will collaborate with local homeless service organizations as community partners, ensuring that their projects reflect real needs and community perspectives. Students may iterate on this idea, or may pursue other locally relevant, low-cost applications in areas such as environmental sustainability, women's and veteran's health, or personal safety based on need and interest.

Class sessions will balance short lectures with hands-on lab time, allowing teams to test ideas, troubleshoot, and iterate on their designs. Midterm presentations provide an opportunity for peer, community member, and instructor feedback, while the final presentation highlights fully realized prototypes and their potential community impact. By the end of the course, students will have experienced the full cycle of engineering design—from problem definition to prototype demonstration—while building broadly applicable skills in collaboration, problem-solving, and technical communication. This course gives students a chance to see how engineering can make a tangible difference in the world—right here in the Bay Area!

No prior engineering experience is required; students from all majors are welcome.

Prerequisite: None.

Syllabus:

Week	Topic	In-Class Activities	Assignments / Deliverables
1	Course Introduction & Team Formation	Course overview and community partner(s) introduction; introduction to engineering design process; introduction to sensors (Part 1).	Interest survey; teams will be formed based on skills/interests/community impact.
2	Sensors & Case Study	Lecture: types of sensors and applications (Part 2); case study on tent safety system.	Teams brainstorm project directions and submit initial concept outline, along with list of required components.
3	Microcontrollers	Lecture: All about Arduinos; intro to C programming for basic hardware control.	A few basic Arduino tutorials will be assigned as homework. Students will begin designing first programs to read and control the sensors for their projects.
4	Mechanical Components	Mini-lecture: motors, servos, etc.; integrating mechanical components with microcontrollers. Work on projects in teams, meet with community members for feedback.	Prepare for midterm project presentation. Create initial parts list and estimated cost for production.
5	Midterm Project Presentations	Team presentations of ideas and early prototype progress; peer, instructor, and community member feedback.	Midterm project presentation; begin implementation of feedback into design.
6	Advanced Prototyping & Iteration	Optional mini-lectures based on need (wireless communication, power management, enclosures); extended project lab time.	Work on projects.
7	Project Development	Dedicated lab time for building, testing, and refining projects; troubleshooting with instructor.	Preparation for final presentation. This should include community need, a timeline, final parts list, fabrication/assembly/testing cost estimates, and demonstration of prototype.
8	Final Presentations & Showcase	Team presentations of prototypes to peers, instructors, and community members; group reflection on design process; discussion of applications and community impact.	Final project report and reflections.

Grading Breakdown:

- **Participation (20%)**
  Active involvement in lectures, labs, discussions, and teamwork. Includes attendance, and constructive contributions/suggestions to class activities.
- **Weekly Deliverables (20%)**
  Short assignments and team submissions (e.g., design proposals).
- **Midterm Project Presentation (20%)**
  Team presentation of initial prototype and design process. Evaluations based on clarity, technical progress, and responsiveness to feedback (from peers, instructors, and community members).
- **Final Project & Prototype (30%)**
  Functionality, creativity, and technical execution of the final prototype, as well as the team's ability to demonstrate and explain it; and the feasibility to produce the product in volume at an affordable price.
- **Final Report & Reflection (10%)**
  Written documentation of the design process, lessons learned, and community impact of the project.

Learning Objectives:

By the end of this course, students will be able to:

1. Apply the engineering design process to identify, prototype, and evaluate solutions to community-oriented challenges.
2. Demonstrate proficiency with basic electronics, sensors, microcontrollers, and mechanical components.
3. Collaborate effectively in interdisciplinary teams to manage projects from concept to prototype.
4. Communicate technical ideas clearly through oral presentations, written documentation, and prototype demonstrations.
5. Reflect on the social, ethical, and community impact of engineering solutions.
6. Develop an understanding for the costs involved in producing a viable product.
7. Engage collaboratively with community partners to co-create solutions, incorporating community knowledge, needs, and feedback throughout the design process.