ECE-218 Embedded Microcontroller Projects:
Project 4: Final Design Project

This project will be completed in teams. Design and teamwork skills will be emphasized and assessed in this project.

Project Objective

This project will provide you with an opportunity to design and implement an embedded system to meet a specification of your choosing. We will follow the engineering design process from developing a problem definition and specification, decomposing the problem into subfunctions, developing a conceptual design solution, fleshing that out into a detailed design, implementing a prototype, and then testing the prototype against the original design specifications. There will be three project milestones with deliverables. Below is a summary of each. Please read carefully to avoid missing key deadlines and information, and contact me with any questions.

(20%) M1: Problem Definition and Conceptual Design – Due February 25, 28

Select a problem that addresses some sort of human need. The problem should require the use of a microcontroller and some of the sensors, displays and actuators that you have experience with, as well as others that you believe are similar enough to be manageable. A list of potential hardware and some general and specific project ideas are attached to this assignment. Discuss ideas with your instructor in lab.

The conceptual design should give an overview of how you intend to solve the problem. It will break the problem down into parts (detecting things, actuating things, etc). It will include a rough sketch of the physical system, a block diagram of your system hardware and a very top level diagram of your software modules.

You will submit the **proposed problem and solution in written form** by **Saturday, February 25**. You will also present it as **a "pitch" to your classmates on Tuesday, Feb 28**. In your written submission you will identify your component needs (electronic and structural) and propose a plan for procuring your parts. Each team will have a $30 budget for additional components beyond what is readily available in the ECE department, but keep in mind the short time available to order and incorporate new parts.

(30%) M2: Detailed Design – due Friday, March 3

The detailed design is what you will work from to develop the final code and hardware. You will prepare and submit a document with:

- Problem Definition – updated definition to specify your final system
- System Diagram – include and explain a detailed drawing of the final structure/system
- Hardware – include and explain a detailed schematic with all ports, powering strategies, and interfaces
- Software - include and discuss the module diagram and detailed pseudocode and any critical code snips that are completed.

- Implementation Plan – provide a list of tasks needed to complete the implementation and a deadline for each.

(50%) M3: Code, Prototype, Summary & Video/Live Demos – due Week 10

Your final implementation results will be evaluated based on

- a written summary of your results (not a full report since you already submitted M2),
- your final system code,
- a live demo of basic functionality during the last lab period of the class,
- a more complete video demo, targeted at a general audience
- and a team CATME survey.

Specific deadlines and an evaluation rubric will be available on Nexus.

Project Guidelines

- You may use code from the textbook repository as needed, but the project should not be one of the examples from the textbook.
- The complexity of projects with three team members should be more than projects with two team members.
- The final system should have at least 2 or 3 sensors, use the serial monitor, and have at least one other output.

Project Parts and Ideas

Some hardware components that are left over from past ECE 218 classes and projects:

- ultrasonic sensors
- continuous motion servos
- slider (two position, SPDT) switches
- 3x4 membrane keypads
- active (send different frequencies for different tones) buzzers

Some other parts should be straightforward to use in your projects, but some must be ordered:

Analog or digital sensors
: temperature,
humidity,
distance,
altitude,
motion,
light level,
sound,
acceleration, etc.

Digital switches
: capacitive touch, pushbutton, slider, reed switch (detects magnetic field), tilt switch, etc.

LEDs
: single color, multi-color

Relays

Solenoids

Serial I/O components

i2c or SPI devices (LCDs covered in Chapter 6)

Some general project ideas:

- Tracking system – detect something and point something toward it
- Monitoring system – monitor something and actuate outputs depending on the inputs
- Feedback control system – use feedback from sensor and user input to control something
- Models – uses sensors and actuators to model a system (entertainment, accessibility, etc)

Some specific projects from a similar course taught with the same textbook (I have no further information on these).

- Controller for refrigerated chambers
- System for the control of an organic garden
- Intelligent entry system for people with measurement of temperature and consumption of gel alcohol
- Control of room temperature, room humidity and luminosity
- Performance of sensors to be used in the nodes of a verticality monitoring system
- Automatic sterilizer for knives and sharpeners
- High Precision Temperature Controlled Chamber for Use in Relative Humidity Metrology
- HARDWARE and FIRMWARE of a ROVER
- Soil temperature and humidity monitoring system.
- Home kitchen security system
- Automatic control system of a greenhouse

Some former ECE-218 projects (implemented with a different microcontroller and IDE)

- Touch free musical instrument.
- Object detection for the blind
- Control of mechanical claw
- Automated lighting system
- Industrial security system
- Precision actuator controller
- Silent alarm security system
- Automated fish feeder
- Music tuner
- Tachometer with RPM limit