

# ECSE 444: Microprocessors

## Final Project

### Abstract

In the final project of the semester, final project groups will use their lab boards to build an interactive application that combines the features explored in the earlier labs. The project is open ended (you choose the final objective), but must meet requirements related to the number of board features it uses to be eligible for full credit.

### Deliverables

- Project proposal indicating planned features, development milestones, and expected contributions from each group member; requirements defined below (**due Nov. 18**)
- Initial demonstration of progress in the development of features (**week of Nov. 25**)
- Final demonstration of completed project (**week of Dec. 4th**)
- Final report (four pages) documenting the complete project and a zip file with all source code (**due Dec. 15th**)

### Grading

- 5% Project proposal
- 45% Final demonstration
- 8% Code quality
- 42% Final report

### Overview

For the final project, you will implement an interactive application that takes input from one or more sensors, performs some sort of computation, and provides audible or visual feedback. For full credit, make use of four (4) of the following features of your choice.

### *Feature checklist*

- ADC
- CMSIS\* DSP, or NN DAC Speaker
- DFSDM Microphone
- I2C Sensor\*\*
- Kalman filter for raw data processing
- OS for threading\*\*\* or power management
- QSPI Flash
- UART\*\*\*\*

Input must be taken from one or more sensors; the UART does not count as an input sensor. Output must be available from one or more of the LEDs, the speaker, or the UART.

*Note\*: for use of CMSIS to qualify as a feature, it must be used extensively in support of the application.*

*Note\*\*: with permission, another external sensor source may be substituted for this feature, e.g., an ultrasonic sensor interfaced with GPIO.*

*Note\*\*\*: trivial threading is not sufficient to count toward your four required features.*

*Note\*\*\*\*: using the UART for menu interaction or debugging purposes is not sufficient to count toward your four required features.*

### **Examples**

The expectation is that your groups be inspired to create something that excites you; feel free to use, extend, or take inspiration from the following ideas. Note that none of these suggestions have been tested for feasibility; further, not all ideas as specified necessarily meet the above feature requirements.

### Driving game

- Road and car position print on UART
- Accelerometer determines movement of car on road
- Speaker plays sound effects or ... something
- OS manages threads for different parts of the application

### Internet of Things (IoT) Appliance

- Any useful appliance
- Usually uses sensors, networking, intelligence
- Internal or cloud-based storage

### Musical instrument

- 3-axis accelerometer determines control of pitch and volume
- Speaker plays associated sound
- Push-button toggles recording to QSPI flash

### Singing game

- Match the duration and pitch of sounds played by the DAC
- Input taken by the microphone
- Something is stored in Flash
- Feedback provided by the UART

### Neural networks

- Make use of CMSIS NN to build a neural network
- Classify sensor input, and provide visual or audible feedback
- ...

## Proposal Formatting and Content

The proposal will define the project, indicate your planned features, and allow us to give you feedback on your project's overall direction. In this brief report, present the application you wish to develop, and how you plan to test it. Break the project into milestones, which can be individually tested and implemented. Include the expected contributions from each group member and how you plan to collaborate.

The proposal will be a document of one (1) page ([IEEE conference format](#)) consisting of:

1. Project Group Members
2. Description of Project
3. Project Milestones and Planned Timeline

The proposal does not have to be perfect, and it is expected that your project goals may change, but should be used to provide a roadmap as your project progresses. We will provide feedback as to whether your project is at the right level of difficulty and meets the above requirements.

This portion of the project will be graded as follows, out of 10 points:

1. Clarity— e.g., grammar, syntax, quality of figures (if any), 2 pts
2. Organization— e.g., structure and flow of the proposal, 2 pts
3. Technical content— e.g., proposed design, evaluation methodology, timeline, etc, 6 pts

Hand in, via MyCourses, a single PDF.