ECE 243 Computer Organization
Project Information
February 20, 2025

The final project in this course, which is worth the equivalent of 3 labs (7.5% of the course grade), will be done together with your lab partner. You will choose your project, with some oversight from the instructors and your TA. The core constraint is that the project must run/execute on the DE1-SoC on the real hardware of the board (although you're free to debug using CPUlator, as always). The project can relate to any of the topics in the course, including the later topics after Lab 7.

Note that one of the difficulties of an open project like this one, is that it will be difficult for you to judge how much to attempt; indeed, this is one of the big struggles for all engineers, throughout their career – estimating the time/effort required to achieve a specific set of goals. Your instructor and TA can give you advice on this front, but the best way to learn is to break the project into pieces and estimate the effort required for the pieces. Then, as the project proceeds, check and see if your estimates are realistic, and adjust as you go.

The amount of work for your project should be roughly equivalent to three labs.

Here are some suggested topics/projects that you may wish to consider:

1. Some more sophisticated sound synthesis or processing, beyond what was done in Lab 6. This can also involve a keyboard or mouse, or a MIDI controller - see item 3 below). Perhaps you could illustrate something along with sound input or output.

2. Create an animation or game that you find interesting, that is controlled by the switches or pushbuttons (and possibly the PS/2 mouse or keyboard, which also available on CPULATOR). This could include sound generated.

3. Attach some hardware to the DE1-SoC board, perhaps something like this or some other form of input or output hardware that you're interested in, that would be connected through the Expansion Parallel Port (the 40-pin headers that you also used in ECE 241), which is described in Section 2.4 on page 5 of the document **DE1-SoC_Computer_NiosV.pdf** that was handed out with Lab 1.

Other Input Devices

You may wish to use other forms of input not covered in the course: the PS/2 keyboard interface (which is also available in CPUlator) or the PS/2 Mouse. These interfaces are described in Section 4.5 on page 21 of document **DE1-SoC_Computer_NiosV.pdf** (which is given out with Lab 1). The CPUlator documentation describes how CPUlator emulates these devices: https://cpulator.01xz.net/doc/#io_devices (click on the left-hand side for PS/2 keyboard and

mouse).   A more complex device would be some form of video input, which is also described on page 19 of **DE1-SoC_Computer_NiosV.pdf**.

Project Uniqueness

A requirement of the project is that it must be different from all the other projects in the class and so you must obtain 'uniqueness approval' from the instructors/head TA.   You must do that in the following process: To propose your *unique* project, go to the Piazza Thread @238 (pinned at the top of Piazza) in this year's Piazza page for this Course, and give a one or two-line statement of what your project would be.   The *first* group to claim a project (that is approved) is the only one allowed to do that project, so review the previous posts before you post to this link.   Your post should be a short sentence or two that has enough information to understand the goal and roughly the work to be done.

Good Example Piazza Proposal Post: *Platformer game. Jump on platforms to get to a goal at the top of the screen.*

Insufficient Example: *Speed typing game.* [Not enough information to know what this means].

- **Improved version**: *Speed typing game: the player must type words shown on the VGA display, using a PS2 keyboard, within the time limit to succeed in the game*.

A Second Good Example: *Attached array of light sensors, used to build a primitive camera that can display on the VGA display.*

If the instructor or TA responds with 'approved' you have uniqueness approval. If they respond with 'project taken' you must propose another.   You must only suggest one project at a time. Approval will be granted if the description is sufficient, and the topic has not already been taken by a group that posted previously.   Your project must have uniqueness approval to proceed.

Once you've got uniqueness approval, we suggest that you correspond with your TA to discuss a greater level of detail of what you plan to do.   You will need to do this in your Lab 6 or Lab 7 period.   Your TA can give you feedback on the scope of the project and suggest ways to carefully plan the project.   We strongly suggest that you create a plan that gets the basic idea working in the first or second lab, and then leaves time for enhancements, or 'stretch' goals.

Grading – Total Grades of Project: 7.5% of final grade, broken out as follows:

Due During Project Week 1 Lab Day: **1%** For block diagram plan presented and initial progress during week of Project Lab #1 (graded out of 10)
Due During Project Week 2 Lab Day: **1%** For progress shown during the week of Project Lab #2 (graded out of 10)
Due During Project Week 3 Lab Day: Demonstration of the final working project.
Due Monday April 7 by 6pm: Code and Report (see below).

The final demonstration and report will be worth **5.5%**

Projects will be graded on the level of functionality (how much you did) and difficulty (how challenging was the project). Difficulty comes from both code/algorithm complexity as well as any hardware I/O or device complexity.   Having more devices is better (as long as they are useful and not just added for the sake of more), and making use of interrupts (when warranted) is also considered more difficult.

<u>Submitting Project code and report:</u>

You will need to submit your code and a report, in (in PDF) that describes in a short paragraph what the project is, gives an updated block diagram of it, and how to operate your project. You must also include an 'attribution' table in the report that indicates what fraction of the work each partner did, with a short description of what work each partner performed.   That code and report must be submitted by April 7th at 6pm to the Quercus "Course Project Demonstraction & Report" assignment.

During your final lab day, you must show your TA a demonstration of your project and answer questions.

There will be a meeting among instructors and the TAs to create a uniform grading standard across all projects.

Below are some example videos of projects from previous years.   Note that in previous years, some of these projects were done in 2 weeks, not 3 as we are doing this year, and there was a big focus on games; with a 3 week project there could be many other choices, as above:

- [Tanks](#) (3 week project)
- [Asteroids](#) (2 week Project)
- [Ball Bounce and Slice](#) (2 week Project)
- [Submarine](#) (2 week Project)
- [Police1](#) [Police2](#) (2 week Project)
- [Gravity](#) (2 week Project)
- [Airplane](#) (2 week Project)

<div align="center">Project Timeline</div>

Week (Monday)	Project Activity
March 10	During Week of Lab 7, Get Uniqueness Approval for Project, Discuss Scope of Project with TA.
March 17	Project Lab #1 – Come to Lab with a block diagram of the project ready to build and test one part; TA will evaluate your diagram and

	plan. Grade assigned: 1%
March 24	Project Lab #2 – continue to work on project; use TA as consultant to help. Show progress from Lab 1 to 2. Grade assigned 1%
March 31	Project lab #3 – final demonstration of your project to your TA, and answer question; take a video!
April 7, @6pm (Last day of classes)	Upload all code for Project to Quercus, Along with PDF report, described above, including attribution table. Grade assigned: 5.5%