ECE 243 Computer Organization
Project Information
March 11, 2024

The final project in this course, which is worth the equivalent of 3 labs, 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 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 2.3.5 on page 5 of the document **DE1-SoC_Computer_NiosII.pdf** that was handed out with Lab 1.

4. Relating to the latter part of this course about the digital design of a processor, you could try to build a processor using Verilog and Quartus, and have it run a program. This requires some sophistication and interest in digital design.

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 19 of document **DE1-SoC_Computer_NiosII.pdf** (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

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 @416 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 has to 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. 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.

Submitting Project and Grading:

Submit your code to Quercus, prior to being graded on your final lab day, in the week of April 8. You should include a report (in PDF) that describes how to operate your project. Also include in the report an 'attribution' table that indicates what fraction of the work each partner did, with a short description of what work each partner performed.

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

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. There will be a meeting among instructors and the TAs to create a uniform grading standard across all projects.
Here is are some example videos of projects from previous years. Note that in previous years, 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:

- Asteroids
- Ball Bounce and Slice
- Submarine
- Police1 Police2

Project Timeline

Week	Project Activity
March 18	No Lab, Get Uniqueness Approval for Project, Discuss Scope of Project with TA.
March 25	Project Lab #1 – Come to Lab ready to build part of project; get TA to sign-off on your overall plan
April 1	Project Lab #2 – continue to work on project; use TA as consultant to help
April 8	Project lab #3 – demonstrate your project to your TA, and answer question
April 10, @9pm	Upload all code for Project to Quercus, Along with PDF report, described above.