Design of Digital Circuits and Systems, Lab 6
Choose Your Own Project!

Lab Objectives

Take what you've learned in this class and design and implement a fun/cool project that utilizes the DE1-SoC board and peripherals.

Project Requirements

Be creative! You are **required** to use:

1) A VGA display (building off of Lab 5).

2) Some form of significant memory storage (*e.g.*, pixel data, audio clip, other game data). You can refer to Labs 2–4 for a refresher on initializing and using memory.

3) Some form of user input, which could be the switches and push buttons or some of the peripherals listed below.

You can, and are encouraged to, use additional peripherals. All drivers you will need for this lab can be found in the `drivers` folder on Canvas within the `lab6` folder. Unfortunately, we are limited to the currently available interfaces on LabsLand, but these include:

- Sound output from a speaker (building off of Lab 3).

- A virtual 360-degree joystick.

- An "N8" controller, shown in the form of an old controller from the Nintendo Entertainment System (4 directional pad, Select, Start, A, B).

ⓘ **Notes for using a *VGA display*:**

Please note that the provided VGA driver in the `drivers` folder is different and more fully-featured than the one provided in Lab 5.

ⓘ **Notes for using *audio output*:**

Recall that LabsLand does not allow you hear your audio live. Unfortunately, this means you can't do things like producing sounds/noises at certain events as they would only be heard in the recording afterward. However, it would be acceptable to produce an audio output as a final artifact based on the user input (*e.g.*, a beat or drum generator).

Project Ideas

> 💡 You are allowed to take inspiration and code from elsewhere (*e.g.*, a software implementation, your 271/369 project), but make sure that you cite your sources. However, these portions will *not* count towards the overall difficulty of your project – we care about what you will be implementing this quarter.

Category 1: Games

- **Side-scrolling:** The player(s) move through a level, avoiding or destroying obstacles or enemies.
- **Combat:** Two or more players compete to collect points and/or defeat the others, maybe with projectiles or by growing their own body as an obstacle.
- **Tile-matching:** Tetris, Bust-a-Move, Candy Crush, or something of similar complexity.
- **Card:** Blackjack, Solitaire, Set, or something of similar complexity.

Category 2: Audiovisual

- **Paint:** Allow the user to draw on the VGA or otherwise change an image output.
- **Audio Visualization:** Use an audio input file to display some sort of reactive visualization.
- **Music Generation:** Take in user input to generate sound, *e.g.*, music notation/composition.

> ⚠️ Basic pixel-by-pixel painting is not complex enough to be used as the sole feature of a project – this will need to be extended with other, more complex features.

Category 3: Create Your Own

Come up with your own idea that satisfies the list of requirements above and submit a proposal to the course staff! Past class video with other examples: https://youtu.be/3J6ZwsfqRKQ

Do note that that video is from when the course was using DE1-SoC lab kits, so there were different peripherals available.

Project Explanation Video

You are required to a video documenting your project that satisfy the following basic requirements. We will primarily grade the video on content/substance so you don't need to spend tons of time creating it if you don't want to, though some bonus points are available if have the time to get creative and do fancier editing, narration, effects, etc.

- We are expecting a length of roughly 3-5 minutes, but this is not a strict requirement.

- You should go over all the main components of your project *at a high level*: how they were used, what they do, and how they fit together.

- Demo the project while talking the viewer through what's happening.

> (i) You don't need to go into that much detail – don't bother discussing code or showing simulations. Just point out the hardware components and what modules you implemented so someone watching has a good idea of what the finished project does and some idea of how it was put together. Hint: Your top-level block diagram will likely be helpful here.

- If you have a significant visual component, make sure it can be clearly seen.

- If you have a significant audio component, make sure it can be clearly heard.

- Please don't do vertical video:

Examples

Here are some links (UW login required) to past project videos that earned full scores *on the video* (*i.e.*, not necessarily on the project itself):

- Flood Fill Algorithm:
  https://drive.google.com/file/d/1wQ0kaWS5sYTW_nqx97thSxf5XRjbGFSy/view?usp=sharing

- Red Light, Green Light Game:
  https://drive.google.com/file/d/17OUh_Y5rUIQt0QEx2tVa1p-a4yn0tr5e/view?usp=sharing

Video Submission

To submit, you should upload your videos to your UW or CSE Google Drive (not YouTube). Right-click your video file and select "Get shareable link." Then turn Link sharing on and copy the URL. Create a short text document (*e.g.*, called `lab6_video_<netid>.txt`) that contains the Google Drive URL.

Project Demonstration/Turn-In Requirements

In-Person Demo

- Demonstrate your completed project working on LabsLand.
- Be prepared to answer questions on both the theoretical and practical parts of the project.

Project Report (submit as PDF on Gradescope)

- Include the required **Design Procedure**, **Results**, and **Experience Report** sections.
  - If you worked with a partner, include a partner work summary in your Experience Report.
- Don't forget to also submit your SystemVerilog files ($.sv$), including testbenches!

Project Explanation Video (submit Google Drive URL in separate TXT on Gradescope)

Lab 6 Rubric

Grading Criteria	Points
Name, student ID, lab number	2 pts
Design Procedure	20 pts
Results	14 pts
Experience Report	14 pts
SystemVerilog code uploaded	5 pts
Code Style	5 pts
PROJECT DEMO	70 pts
▪ Bonus points available for particularly impressive projects	(10 pts)
PROJECT VIDEO	10 pts
▪ Bonus points available for particularly impressive videos	(5 pts)
	140 pts