

Chapter 12

Personal Project: Part A

The purpose of this laboratory is to give you the opportunity to select your own digital design project, design this project, and successfully implement the project in the lab.

This laboratory assignment is much more open-ended than any of the other laboratory assignments. For this project, you and a partner will select a challenging digital design project that interests you and design this project on the FPGA boards in the lab. You will have two weeks to complete this project and demonstrate it working for the TA. There will be two laboratory write-ups (part A at the end of the first week and part B at the end of the second week). The first part of this assignment (i.e., part A) will involve the specification and initial design of the project. The second part of this assignment (i.e., part B) will involve the debug and downloading of the design on the FPGA board and documenting/archiving the project for the instructor.

Project Partners

You are *required* to work with a partner on this laboratory. The purpose of working with a partner is to help you develop teamwork skills and break up the project into two manageable pieces. Most of your professional engineering activities will involve other people and it is essential to develop and refine your teamwork skills.

If you are having trouble finding a partner, please see me and I will help find you a partner. Unlike previous projects that you completed on your own, a project with two people should involve more design and be more complex than projects with only one person. One of the criteria used to grade this lab will be the complexity and difficulty of your project.

Even though you will be working with a partner, each student working on the project must complete a lab write-up for each part of the lab. Some of your responses in the lab write-up will be the same but each student must complete the entire lab write-up.

Question: State the name of your lab partner.

Project Selection

The first step is to choose a project. For some people, this is the most difficult part of the lab. You should have a rough idea of your project before you come to the lab. The minimum requirements of the personal project are as follows:

- Your project must use the VGA display
- Your project must have some user input (buttons, switches, keyboard, or external digital input interface)
- You must use at least two of the following I/O interfaces (any exceptions to this must be approved by the instructor)
 - UART receiver
 - UART transmitter
 - SRAM memory controller
 - Seven Segment Display
 - Custom Digital interface

Some projects from previous 320 classes are listed below:

- A game using the VGA display. Games completed in previous semesters include: Battleship, Breakout, Connect Four, Memory card matching, Pong, Sudoku, Tetris, Tic-Tac-Toe, Tron, etc.
- Interface an external device to the FPGA board. Ideas from previous students include: video camera control chip, a Nintendo controller, an audio speaker, video game "hunting gun". etc. Interfacing an external device to the FPGA is challenging and more time consuming than using the on-board interfaces. You will need to work closely with a TA or the instructor when doing this to avoid damaging the board.
- An animated sequence using the VGA controller. Create several interesting sprite images and sequence them to demonstrate animation. Use the same principles as the character display lab (small image sprites are very similar to a character)
- Perform a dedicated computation hardware. Examples include video rendering, signal processing, etc.
- Build a small microprocessor and interface it to the VGA display and keyboard (i.e., LC3).

Once you have selected a project, write a brief summary of the functionality of the project (3-6 sentences) and submit it online. Feel free to contact the instructor to get feedback on a project idea. In addition to the project summary, provide a detailed specification of your project. Describe the inputs, outputs, and the user interface. Your specification should have enough detail that another student in the class could build the circuit you specify.

Question: Provide a brief summary of the functionality of your project (3-6 sentences).

Project Design

After meeting with your partner and deciding on a project, begin the project design. This initial design phase should consist primarily of state diagrams, block diagrams, ASMD diagrams, etc. You should NOT begin coding your VHDL until you have a detailed specification of the project behavior. Once you have completed your state diagrams, etc., begin the HDL design and simulation. You should complete most of the initial design of your project during this first week. Complete the following questions online at the end of the project week:

Question: Provide a *detailed* specification of your project. Describe the inputs, outputs, and the user interface. Your specification should have enough detail that another student in the class could build the circuit you specify. You will be graded on the completeness and clarity of your specification.

Question: Describe how you are going to divide the project between you and your partner.

Upload: Draw a block diagram of your project and ASMD diagram of your project. Turn in your diagrams to the homework box (clearly label your diagrams with the appropriate lab number).

Upload: Provide all of the VHDL that you have created so far for this personal project. This does not have to work at this point in the lab but it should demonstrate significant progress on the project.

Question: On a scale from 0-100, how far along are you with your project? You should be at least 50% along on your project to receive full credit for this question. The TA may deduct points on this question if he/she feels that you are not 50% along on the project.

Question: Summarize what you have left to do to complete the project.

Pass Off

Like all laboratory assignments, you must pass off this Part A of the personal project with the TAs to receive credit for the pass-off portion. Do the following to pass off your laboratory:

- Show the TA your project proposal
- Show the TA some VHDL code and some sample simulations. While these do not need to work, you must have some VHDL and some simulations completed to pass off this lab