

Lab 8: Final Lab

Introduction:

Now that you have learned all of the basic tools of logic design (everything beyond this point is layers of abstraction and complexity coping mechanisms), it's time to do something amazing. There are tutorials in various places around the web for working with many of the more obscure inputs and outputs of the De1 board, many of which are peripherals you might find in modern PC hardware.

This lab will be graded on your project's complexity and on how well you carried it off. A very ambitious project that does not work is worth much less than a rock-solid, working, well considered design of a simpler project. It is a VERY good idea to get started with your design's outline as soon as possible, as this project is the most ambitious of this class!

Notes on Peripherals:

Your De1 has a breadboard mounted to it with header pins connecting to the GPIO (General Purpose Input/Output) header. To access these, add "inout logic [35:0] GPIO_0" to your top level module. With these, you can do a wide variety of tasks. One major task you might want to accomplish is talking to an 8x8 LED display module. Note that most of the recommended projects below feature this module. It is possible to do well on this lab without it, but keep in mind that you would need to justify NOT having the 8x8 display by doing something equally challenging with all that effort you save. (There is also a VGA output on the board, and using it can be pretty tricky, but gets you much higher resolution than the 8x8 LED display!)

Sound can be made by a GPIO flipping up and down at a certain frequency, connected to an earphone jack. Another neat trick is "breathing LEDs" which operate by Pulse Width Modulation.

You should probably not try to make any of your own clocks. Start with CLOCK_50 and divide it down if you need slower speeds. (You probably need slower speeds.)

Grading:

As stated above, the first priority is to have a working system which does what you say it will. Beyond that, you should try to add extra features if at all possible, as more complex working systems are worth more than less complex working systems.

Due Date:

Due to time constraints, you won't have any time after the last day of class to demo your project, and a failed demo means rescheduling with a TA who may not have enough time! Be sure to demo as early as you can to make sure there will be time to fix anything that goes wrong!

Suggested Projects:

The real assignment of this lab is "do something cool". Below are some examples. Many of these potential assignments are references to things which may be unfamiliar to you, so you might want to look them up on Wikipedia, etc.

Frogger:

Use the 8x8 display to operate a game of the arcade classic "Frogger". The graphics will be crude on such a small screen, but you'd be surprised how little old games had to work with! A reproduction of this should let you use the keys to navigate a green dot around on the screen and avoid red dots (cars) going from one end to the other.

Conway's Game Of Life:

Conway's Game Of Life is an example of a "finite state automata" simulation, where each pixel is an FSM that operates based on information about the game board. The 8x8 display is large enough to display a halfway decent chunk of this simulation. By itself with a single start board, this is too easy a project, so you'll also need to be able to "draw" a pattern on the LEDs with the De1's key and/or switch inputs.

DDR (Dance Dance Revolution):

Rhythm games such as DDR and Crypt of the Necrodancer operate by having the player watch moving lights and react, hopefully at exactly the right time. On the 8x8 display, a set of dots for the four keys can be displayed in a way similar to the arrows on DDR. For this project you should be able to interpret how closely the player key input matches the arrival of the dots at the top (or bottom) of the display and keep score. This should also feature player-adjustable speed.

Flappy Bird:

You should probably use two colors for this so you can tell the difference between the "pipes" and the "bird". There are lots of ways to simulate motion in a flappy bird clone, some easier than others. This should also keep score.

Snake:

The classic game of Snake features a representation of a snake trying to eat pellets and not die (hit its own tail) and a decent game can be had on the 8x8 display.

Do Whatever:

There are a lot of potentially very impressive projects to be done on the De1, and not all of them involve shiny graphics. It is possible, for instance, to build a CPU complete with memory and limited peripheral support and even get it to run a simple program. (This might sound like a huge challenge, but it can be done with a similar amount of verilog to the above projects.) Demonstrations like this might not look like much, but demonstrate a level of understanding that is just as impressive as something with a lot of graphics.