

Lab Exercise #8 - Pong

(The first week of a multi-week lab)

Objectives

- Build experience with FPGA implementations of digital designs.
- Build experience with language directed (VHDL) design capture.
- Have some fun in the process

Description

In this lab, you will design and implement a WWU version of the classic game of Pong where a ball is “batted” between two players. Ball motion is simulated by sequentially illuminating LEDs across an 8-row by 16-column array of LEDs. The rate and motion of the “moving” light is controlled by the circuit you design.

While you will define the specifics of how the game you design will function, the following is a generic description of the game. The circuit is first initialized with a reset input. A start switch starts the game by placing the ball (an LED) at the extreme right. Player one must press a paddle switch (most likely a switch on the FPGA board, but could be a switch external to the FPGA board) to start the ball moving to the left. The single light shifts to the left until it reaches the leftmost position, at which time player two must press a second paddle switch to start moving the ball back to the right. If a player presses the paddle switch too soon or too late, the ball disappears and the light goes off. If either player does not activate their “paddle” switch when the appropriate outermost LED is lit, the point is over and the opposite player scores a point. After an appropriate time of good play, the game should speed up until one player fails to hit the ball correctly. The first player to reach 9 points wins, with the scores shown on digits of the seven segment display.

An innovation for your design is a serial data link between two FPGA boards to allow play with the players physically separated.

Design Flow

- Create a complete description of how your game and associated hardware will work. (I.e. a refined problem definition).
- Design the circuit by first drawing a block diagram.
- Design any state machine(s) that may be required (i.e. create state diagrams)
- Write VHDL statements for each block of your system & test.
- Assemble the complete system & test.
- Extra credit: Any worthwhile bells and whistles you add to your design.

Notes

The 8x16 LED array has 128 LEDs in it. To directly control each LED would require 128 outputs on the FPGA. But there are not that many I/O pins on the FPGA. So, controlling the LEDs uses multiplexing. You will need a circuit that multiplexes outputs and continually scans through the LEDs turning on repeatedly those that should be lit at any given time. More documentation on LED configuration will be posted.

Expectations and a request

I expect that the design you do will be based on the problem statement, your careful consideration of it, and your creative formulation of a solution. I ask that you don't google looking at other solutions for your solution. Create your VHDL description based on your block diagram and the problem definition. See me for help as needed

To Turn In

A report is expected and should contain:

- An introduction that states what you set out to do

- Specifications for your design

 - explanation of game operation

 - description of play

- Block diagram(s), state diagram(s), timing diagram(s), and similar documentation

- Comments regarding problems encountered, things learned, anything you wish others to know..

- Results. What worked (everything we hope, but if not, clearly state your results).

- Screen shot of the Device Summary matrix in ISE.

- Appendix - VHDL listing(s).