

Lab 8

Overview

For Lab 8, you have the option of doing one of two projects: design a two-function calculator with special operations, or design an LED ping-pong game. The due date for this lab is the last lab session of the semester. Along with the normal notebook-keeping that you have been doing for your last few labs, this lab has some additional requirements:

- You must create a block diagram of the system prior to implementation, showing all functional parts and their connections, and have it approved by your T.A.
- After your project has been implemented, you must demonstrate it to your T.A.
- After your project has been successfully designed, implemented, and approved, write a 2-3 page report (single space, 1" margins, 12pt font) with figures that includes information on:
 - Your design approach
 - Your block diagram
 - Your implementation procedure (along with any problems you encountered)
 - Your conclusions, reviewing your work on the project and noting how you might approach it differently in the future.

If you have any questions about these requirements, Attach all of your VHDL code as an appendix to your report, with each VHDL file clearly labeled to correspond to blocks on your system block diagram. If you have any questions about these requirements, contact Dulany at dweaver@unm.edu.

Two Function Calculator

Consider the system represented by the block diagram showed in Figure 1.

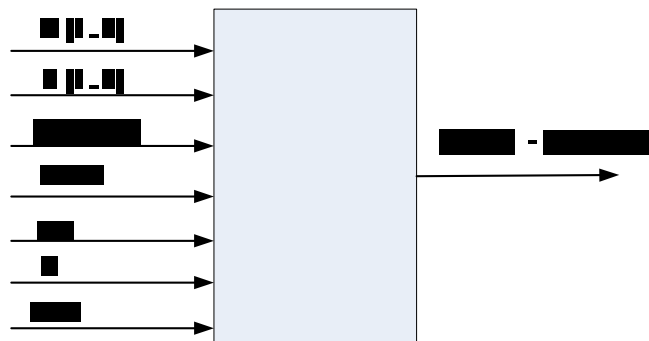


Figure 1. Block diagram of the system.

The system should accept 2 parallel two-bit input numbers **A** and **B**, and multiplies them when **Operation** = 1 and adds them when **Operation** = 0. Let **R** be the result of this operation. Then, the system has to count forward cyclically from 0 to 99 in steps of **R**,

synchronously with the system clock **Clk**. This clock will be implemented as we did it in Lab 5 (using a button of the XCR board). The digits of the counter will be displayed on the two-digit display. The counter stops if the serial sequence **X** = 1101 is entered, and restarts if a second sequence **X**=1101 is detected. The input **mclk** is the clock of the XCR board, and it will be just used to connect to the display controller as we did in Lab7 (see Lecture notes Lab 7, page 4, Figure 3). But, you need to keep in mind that the system clock (which will be used for the sequence detector and the counter) is the input **clk**.

LED Ping-Pong Game

In this project, you will create a ping-pong game using the programming board, with a lighted LED representing the ball and two switches representing the paddles. The LED's light up in sequence to represent the moving "ping-pong ball". Whenever the "ball" is moving right, the right player must toggle his/her switch when the ball is in its rightmost position to "hit" it. When the "ball" is moving left, the left player must toggle his/her switch when the "ball" is in the leftmost position to "hit" it. If the player toggles his/her switch at the correct time, the "ball" should reverse direction and head towards the other player. If either player does not toggle their switch in time, the "ball" disappears and the opponent gets a point. It is also a miss if the toggle switch is in the "1" position when the "ball" reaches the endmost point. After a miss, the player who missed can "serve" the ball by toggling his/her switch. The first player to 10 points wins. The game can be reset at any time using the Reset signal.

The inputs to your system will be the two "paddle" switches, a reset, and a clock. The outputs will be the LED's representing the ping-pong ball, and the scores for the two players on the seven-segment displays. Extra credit will be considered for any interesting additions to the game (special display when a player wins, light tail effects for the ball, keeping track of set scores, etc.)

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