Project 1

Design a 4x4 Multiplier Circuit with Displays in Logisim

# 1) Design Objectives

1. Design a circuit to calculate the product of two 4-bit binary numbers, and then display the decimal result in three HEX displays.
2. Use software tool LogiSim for your design implementation.

# 2) Description

1. The inputs are two 4-bit binary numbers.
2. The system can display each input binary number using two HEX displays.
   * For example, if an input is “1110”, you shall display 1 4 in two HEX displays.
3. The system can display the decimal result in three HEX displays.
   * For example, if the result is “0110 0001”, you shall display 0 9 7 in three HEX displays.
4. To display decimal digits, the “**double dabble**” algorithm shall be used. Check the following links before your design
   * <http://en.wikipedia.org/wiki/Double_dabble>
   * <http://www.johnloomis.org/ece314/notes/devices/binary_to_BCD/bin_to_bcd.html>

# 3) Design Constraints:

1. Using only AND, OR, NOT, XOR, and the modules you design in this project.
2. The design shall have the following subcircuits (modules)
   1. 1-bit half adder
   2. 1-bit full adder (using 1-bit half adders in the design)
   3. 4-bit adder (using 1-bit full adders in the design)
   4. 4x1 multiplier
   5. 4x4 multiplier (using 4-bit adders and 4x1 multipliers in the design)
      1. *This is the circuit you shall already have for exam 2.*
   6. An “Add-3” circuit for double dabble algorithm
   7. A binary-to-BCD subcircuit with 4 inputs and 8 outputs
      1. 4 inputs represent a 4-bit binary number
      2. 8 outputs represent 2 BCD codes for two decimal digits, which can be used to control 2 HEX displays.
   8. A binary-to-BCD subcircuit with 8 inputs and 12 outputs
      1. 8 inputs represent an 8-bit binary number
      2. 12 outputs represent 3 BCD codes for three decimal digits, which can be used to control 3 HEX displays.

# 4) Report

You shall upload a zip file in ecourse. The zip file shall include one file for the report and one file for the circuit.

The report must have the following content.

1. Cover Sheet with title, name, student number, etc.
2. Use one section to explain the whole system.
3. For each module above, use one section to explain the main ideas.
4. For the binary-to-BCD subcircuit with 4 inputs and 8 outputs, explain the details of the “double dabble” algorithm, including the history, the current applications, and the main ideas of the algorithm with illustrative examples.

# 5) Demonstration

You shall prepare a PC in the demonstration and execute the simulation in the demonstration.