Hardware Lab 4: EEE/CSE 120 Design Project
Spring 2017

Deliverables

You are to design two CONCEPTUALLY different finite-state synchronous machines by performing the tasks described for the **Gas Pump Controller** functional specification. (A design which differs by only the type of flip flop (e.g., J-K vs. D) or number of states (i.e., inserting more unnecessary states) is not considered conceptually different.

First, **you will need to implement both designs using Logisim and demonstrate to the CSE/EEE 120 simulation TA's in GWC 185 that both designs work correctly by the software due date (See Table 1 below). You will need to sign up in person at the front desk in GWC 273 for a time slot at which you will demonstrate your simulated design to a TA in GWC 185.** You may demo this by either 1) opening your file using the computer reserved by the TA on duty or 2) asking the TA to test your circuit on your laptop. **You will need to bring with you a printout of your report template into which you've cut/pasted your Logisim circuits**. It makes most sense to complete the lab template and print it before you go and demonstrate the designs to the TA. **You must have your design simulation working before asking the TA to test it because you will be given only one chance to prove that it works. You must also be able to defend your design**; the TA's will be asking questions to make sure that your design is your own original work. Upon completion of your simulation demonstration, the TA's will sign and apply a grade to your report template. You also need to include these simulations into your lab report template.

Second, **you will need to implement ONE design using the TTL parts you used in earlier lab work and demonstrate to only a CSE/EEE 120 hardware TA that your circuit works correctly**. **You must complete this demo by the due date (See Table 1 below). You will need to sign up in person at the front desk in GWC 273 for a time slot in which to build your hardware demo.** After reviewing the simulation TA's signature on your Logisim schematic printout, the hardware TA's will test your design and stamp the design pages of your completed report template. You must be able to explain why your circuit responds the way it does to a given input data stream. **You must have your report template completed and bring it with you to your in-lab hardware demonstration.** Your completed report template will be collected by the hardware TA at the conclusion of your demonstration.

You must use the design project template for your report.

Lab project make-ups will be allowed ONLY with written permission from your instructor.

You may discuss this project with each other; however, you must provide an individual report. In addition:

(1) You must go to the GWC 185 software lab individually to demonstrate your simulation of both designs AND
(2) You must go to the GWC 273 hardware lab individually to build one circuit in order to have your individual report count.

Grading Policy

The grade will be allocated as follows:

30% Design Simulation With Logic Works or Logisim

- 15% for the design of the first circuit and demonstration.
- 15% for the design of the second circuit and demonstration.

70% Build One Design in the Hardware Lab and Lab Report

- 30% demonstration of one design in the hardware lab.
- 11% for documentation in the report of how the first circuit performs the application.
- 11% for documentation in the report of how the second circuit performs the application.
- 5% for establishing reasonable criteria for picking one design as the "best" design. (The one design you build in the hardware lab does not need to be the "best" design.)
- 8% for picking a preferred, "best" design.
- 5% for following template guidelines.

5 points (Extra Credit) Completed Self-Assessment Worksheet

5 points (Extra Credit applied to the simulation demonstration) for signing up for a Simulation Demonstration time slot on a Monday, Tuesday, or Wednesday.

5 points (Extra Credit applied to the hardware demonstration) for signing up for a Hardware Demonstration time slot on a Monday, Tuesday, or Wednesday.

Table 1: Period of Performance

Instructor	Begin Simulation Demo	End Simulation Demo	Begin Hardware Demo Time Slots	End Hardware Demo Time Slots
Baumann, Goryll, Matar, Shafique, Wong	Monday, April 3rd	Friday, April 7th (5pm)	Monday, April 10th	Friday, April 14th (6pm)
Chickamenahalli, Osman	Monday, April 10th	Friday, April 14th (5pm)	Monday, April 17th	Friday, April 21st (6pm)

The Application: Gas-Pump Controller Design

The Clean Petroleum Company (CPC) is interested in reducing pollution in the atmosphere. When people overfill their gas tanks gas is spilled and evaporates causing air pollution. To minimize this problem, their pumps currently turn off when the back pressure from the gas tank gets too large while the nozzle handle switch is activated (i.e., compressed).

They have asked you to design a controller that does the following: If the nozzle handle switch is depressed and the pump pressure sensor indicates low pressure, then allow gas to be pumped. If the pump pressure sensor indicates high pressure then turn-off the pump. (The system clock pulses every one second and you may assume that once the pump shuts off, the pump pressure returns to normal within one second.) Once the pressure returns to normal, allow the pump to be controlled again by the nozzle handle switch. If the pump pressure sensor indicates high pressure a second time, turn off the pump as your final warning to stop. Once the pressure again returns to normal, allow the pump to be controlled by the nozzle handle switch. When the pump pressure sensor detects high pressure for the third time, your design will permanently shut down the pump, no more gas will be dispense, and the pump must be reset by the gas station personnel. Should your pump shut down due to 3 consecutive pressure detections, a warning light must illuminate at your pump to call the attendant. (Note that there are two inputs to your synchronous machine: the nozzle handle switch position, and the pump pressure sensor indicator. Your synchronous machine also has two outputs that control the pump and alert for the attendant.)

All information to complete this design may not be specified. **Write down and report any assumptions that you make in your design.**

Be sure to use debounced "logic switches" for driving the clock input to the flip-flops.

LAB MANAGER'S RULES FOR PERFORMANCE

1. You will only be allowed to do the project during the assigned times. If you miss the calendar dates, you will not be allowed to do the lab project unless you have a WRITTEN NOTE signed by your course professor.

2. Hardware Demo: You must have your lab report completed before you start the lab demo since you will need to give it to the lab TA at the completion of the demo. (Having your report finished will help you complete the lab project in the allotted time.) **YOU WILL NOT BE ALLOWED TO DO ANY PRACTICE RUNS OF THE LAB PROJECT INSIDE OF GWC-273**. You must be ready to complete the entire lab project when you come into GWC-273. However, outside of GWC-273 you may consult with anyone you wish to obtain help in designing the lab project.

3. Hardware Demo: You will have ONLY 2 HOURS to complete the lab project in GWC-273. Students registered with Disability Services requiring extra time for testing will be allotted 4 hours and must sign up for 2 back-to-back time slots. You must work alone with no lab partners to assist you. No friends, relatives or tutors may be with you. You may bring any textbooks, notes, reference books, lab notes, lab experiments, and lab reports into the GWC-273 lab area. You will definitely need your PIN-OUT diagrams of the IC chips. You will not be allowed to take any breaks from your 2-hour shift except for restroom and water. (Sorry: but you cannot bring in your own breadboards and IC chips because that would give you an unfair advantage over other students in the GWC-273 lab.)

4. Notice: Make sure you do the project ONLY during the hours in which any EEE/CSC 120 Hardware Lab TA is on duty inside of GWC-273. Only these TAs can assist, monitor and check-off your project. TAs in other courses are not permitted to assist you do the lab project.

5. You will be able to use any of the IC's we have in the lab for completing your project. Check in the lab if you are not sure which IC's are available. Be aware that in GWC-273 we **DO NOT** have the following IC's available: 7421, 7430, 74133, 74174, 74375.

6. Hardware Lab TA's on duty will assist you ONLY if there is broken lab equipment. Hardware Lab TA's will NOT assist you with troubleshooting or debugging your project lab design circuit.

Notice: If you are thinking of omitting this lab project from your schedule, be reminded that parts of this lab project may show up on the final exam for this course!