CDA 3201L – Computer Logic Design Laboratory

Lab Exercise 8

Final Project

Points: 15% of overall grade

Design and implement a finite state machine which controls the operation of an elevator in a 2-story building.
The finite state machine (FSM) has 1 input:

1. *enable* (enables operation of elevator)

The FSM has three outputs:

1. *door (*if door == 0, door is closed if door == 1, door is open)
2. *Current floor number* (display the current floor using a 7-segment display).
3. *Moving* (display that the elevator is moving)

The operation of the elevator is as follows:

- The elevator must begin in an *idle* state (on one of the two valid floors) with the door closed.
- The user should set the ***enable*** input to move the elevator to the other floor. It is the responsibility of the user to reset the ***enable*** input before leaving the elevator.
- When the user sets the ***enable*** input, the elevator should perform the following sequence:
    - Open the door for 4 seconds
    - Close the door
    - Move the elevator to the destination floor in 4 seconds and display the current floor number using the 7-segment display
    - Open the door for 4 seconds
    - Close the door
    - Remain in the same floor until the enable input is set again.
- Assume that the clock frequency is 4 Hz
- You are free to use any TTL chips in the lab including the following:
    - Binary counter – 74LS163
    - BCD to 7-segment decoder – 74LS247

Hints:

1. The counter 74LS163 can be used to calculate the duration of stay at any state. If the clock frequency is assumed to be 4 Hz, then the wait of 4 seconds can be accomplished by counting from 0 to 15. The Terminal count (TC) output of the counter can be used to trigger the end of 16 clock pulses and to move to the next state. The counter can be controlled using two signals: Count Enable Trickle Input (CET) and Synchronous Reset (SR). At any time only one of the two signals need to be active to achieve the functionality required for this problem.
2. If the floors are numbered 0 and 1, the floor numbers can be stored using a flip flop. If T-flip flop is used to store the floor numbers, it is sufficient to generate a trigger to change the floor numbers.
3. Use BCD to 7-segment decoder to display the floor # on the 7-segment display.
4. The outputs ***door open/closed*** and ***moving*** depends only on the current state. The floor # can be controlled using the combination of the current state and the Terminal count (TC) output of the counter.
5. We recommend using two separate states for the ***door open/closed*** functionality in your FSM design. One state to represent ***door open/closed*** before moving the elevator and one state to represent ***door open/closed*** after reaching the destination floor.

Important: Always state your assumptions! If you make an assumption in your design, state the assumption and justify your reasoning as to why your design decision makes sense. There are cases which may occur during regular operation of the controller that are not mentioned in the specification.

References:

"Fundamentals of Logic Design", 7th Edition, by Charles H. Roth Jr. and Larry L Kinney, 2014, ISBN-13: 978-1133628477 or ISBN-10: 1133628478, CENGAGE Learning, Stamford, CT, USA

Notes:

1. You can use http://en.wikipedia.org/wiki/List of 7400 series integrated circuits to find the TTL chip you need.
2. Datasheets of some commonly used TTL chips can be found at the following sites:
    - http://www.jameco.com
    - http://www.ti.com/sc/docs/psheets/databook.htm
    - http://www.datasheetcatalog.com/fairchildsemiconductor/1/