EE 3921 Lab 2: FSM/FSMD

1 dedicated lab period, 2 lab periods to complete

Name:_____

Objectives

- Review FSM and FSMD concepts
- Utilize the switches and seven segment displays

Prelab **student check off**

- Review the SSEG display info from CE1911 ☐
- Review the FSM and FSMD class notes ☐
- Review the Development process from Lab 1 ☐

Assignment

Part 1: Create a controller for a simple Elevator

Specifications:

1) The number of floors is specified via a generic: NUM_FLOORS (must work for ANY positive value)
2) If a "desired_floor" value above the maximum is input – the elevator should go to the top floor
3) No negative floor numbers (starts at 1)
4) If the wait time on a floor exceeds the DELAY_CNT(generic) clks, automatically return to floor 1
5) If the "desired_floor" input changes while in transit, the new "desired floor" value will take effect immediately
6) If the "desired_floor" input changes while returning to floor 1 automatically, the new "desired_floor" input will be ignored until floor 1 is reached
7) Generics:
   a. NUM_FLOORS
   b. DELAY_CNT
8) Input signals:
   a. rstb
   b. clk
   c. desired_floor (? bits)
9) Output signals:
   a. Desired floor displayed on SSEGs in hex (assume no more than 255 floors for this part only)
   b. Current floor displayed on SSEGs in hex (assume no more than 255 floors for this part only)
   c. LED indicating desired floor has been reached

Additional Requirements:

1) Implementation must be via an FSM
2) A separate binary_to_sseg_hex block must be implemented and instantiated in the DE10 implementation
3) Run simulation(s) to verify operation (see following for the required sequence)
4) Create a DE10 implementation of your design
   a) Provide support for 60 floors (NUM_FLOORS)
   b) Set the DELAY_CNT generic to 10
   c) SW0 resets to floor 1
   d) SW1 – SW6 indicate the desired floor in binary

e) LED0 indicates desired floor reached
f) Desired floor displayed on SSEGs 5/4 in hex
g) Current floor displayed on SSEGs 1/0 in hex

~~Part 2: Create a GCD calculator block~~

~~Specifications:~~

~~1) Calculated the GCD of two numbers~~
~~2) Input numbers are n-bit binary~~
~~3) Inputs:~~
~~a. rstb~~
~~b. start~~
~~c. number_1 (n bits)~~
~~d. number_2 n bits)~~
~~4) Outputs:~~
~~a. Input number_1 in binary~~
~~b. Input number_2 in binary~~
~~c. complete~~
~~d. GCD result in binary~~

~~Additional Requirements:~~

~~1) Implementation must utilize the process described below~~
~~2) Implementation must be via an FSMD~~
~~3) The design must be broken into 3 parts: FSM, Data Path, FSMD~~
~~4) A separate binary_to_sseg_hex block must be implemented and instantiated in the DE10 implementation~~
~~5) A separate binary_to_sseg_decimal block must be implemented and instantiated in the DE10 implementation~~
~~6) Run simulation(s) to verify operation (see following for the required sequence)~~
~~7) Create a DE10 implementation of your design~~
~~a) N = 4~~
~~b) SW0 for reset~~
~~c) KEY0 for start~~
~~d) SW5-2 for number 1 in binary~~
~~e) SW9-6 for number 2 in binary~~
~~f) LED(5) for complete~~
~~g) SSEG 0/1s for number 1/2 in hex~~
~~h) SSEG 4/5 for the result in DECIMAL~~

Check Off

You must demonstrate your working design(s) prior to the end of the 2nd lab period

- Demo the Elevator FSM (Simulation, DE10) 80% _____
- ~~Demo the GCD block (Simulation, DE10) 40% _____~~

Lab Report (informal)

- Due at 4:00 pm, 1 day after 2nd lab – in the box
- Include a properly documented informal lab report. 20% _____

Elevator Simulation

NUM_FLOORS = 60, DELAY_CNT = 10

Up to 18

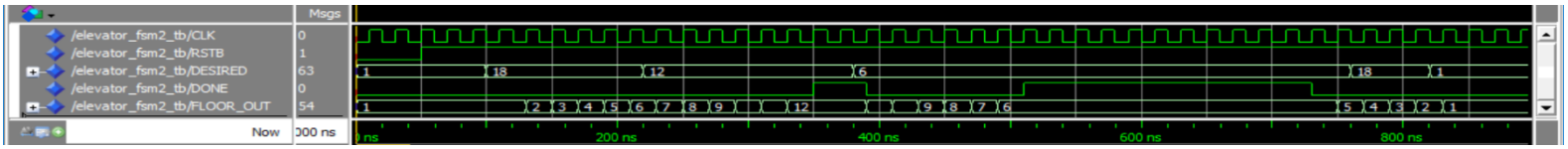
Change to 12 part way (should change)

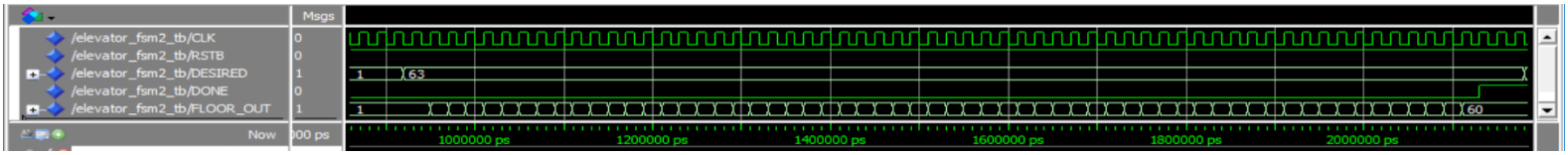
Down to 6

Wait long enough for an automatic return

Attempt to change during return (should not change)

Attempt to go to 63 (should stop at 60)

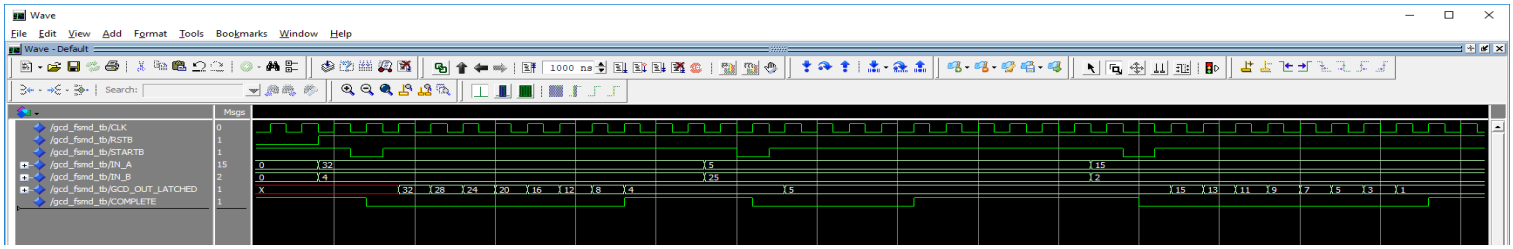




GCD Algorithm – using only subtraction

```
gcd(a, b)
    if a == b
        return a
    if a > b
        gcd(a - b, b)
    else
        gcd(a, b - a)
```

Note: the recursion is accomplished by going through the datapath again



For DE10 – use

(N = 4)

15 and 3

5 and 12

14 and 14