Middle East Technical University

CENG 232

Logic Design

Spring 2017-2018

Lab - 4 Part-2

Part 2 Due date: Wednesday, April 25, 2018, 23:59
Late submissions are not allowed

1 Login/Logout System For An Online Game (Teamwork)

This part of the lab will be performed and submitted with your group partner. Only submit a single copy per group.

1.1 Problem Definition

In this part, you are going to implement a login/logout system for a simple online RPG (Role Playing Game) called **Heroes of Logic** in Verilog. The game consists of different characters with differing attributes. In the game, there are two teams, namely, **LogicPower** and **CengForce**. You are expected to implement the login/logout system of this game which is summarized as follows:

Firstly, a user ID will be assigned for each player to be used to login/logout the game. Every user ID consists of a randomly produced 4-bit number. The most significant bit (MSB) of this 4-bit number represents the team and the remaining 3-bits represent the character. When a player wants to login the game by selecting a team from login menu, the system first checks the MSB of the user ID, and decides whether the selected team and the team information represented by MSB of userID are same. If these are same, the system then checks whether the capacity of the determined team is not full and another player with the same ID did not login before: If all these conditions are satisfied, the user can login the game in this team. You are expected to design the system summarized above having the following specifications:

1) Players can either login or logout the game in their teams with their user IDs.

2) The capacity of teams is five.

3) Different players can have the same 4-bit code.

4) You should keep count of the current number of players logged in a team. In case a player login/logouts from the game, the number of players for his/her team should be updated.

5) The login of players into the teams are arranged as follows:

- **a)** If the MSB of user ID of a player is 0, the player can login the game only in LogicPower team.
- **b)** If the MSB of user ID of a player is 1, the player can login the game only in CengForce team.

6) If a player violates the rules described in item 5, the system will give a warning and the player will not be allowed to login.

7) In case a player wants to login the game in a team that is allowed, the following should be checked:

- **a)** The system will check whether the player with the same 4-bit user ID exists in the team. If exists, the player is "not" allowed to login the game. (no warning is required)
- **b)** The system will check whether the team is completely full or not. If the team is completely full, the player is not allowed to login the game and the system will give a warning.

8) Initially, number of logged in users in both teams will be 0.

9) If the number of logged in users in one or both of the teams are 0, the system will give warning(s).

10) If a player is allowed to login the game in a team, his/her user ID will be inserted into the memory of this team.

11) If a player wants to logout the game, his/her user ID will be deleted from the memory of his/her team.

12) There will be four modes in the system:

- **a) Login Mode:**
  - **i)** Players can login the game only when the system is in Login Mode.
  - **ii)** If a player is allowed to login (correct team, no same user ID logged in before and enough capacity in the team), the system will record the user ID into the first empty slot of the memory of that team. Otherwise, the player will not be allowed to login and the system will give a warning.
- **b) Logout Mode:**
  - **i)** Only players who are currently logged in a team can logout the game with their user ID. It will not be tested that if a student who is not currently logged in the game can logout or not.
  - **ii)** If a player logouts the game, his/her 4-bit user ID recorded will be deleted from the memory of that team.
- **c) Find Mode:** The user ID that is entered will be searched in the memory of the given team. If user ID is found, the system will give a warning.
- **d) List Mode:**
  - **i)** It should be indicated if the system is in the list mode.
  - **ii)** In this mode, the user IDs that were stored in the given team's memory will be displayed one by one in every pulse of the CLK. The order of the display is the order of the records in that memory.
  - **iii)** Empty slots should not be ignored while displaying the user IDs. The empty slots will be shown as "0000".

13) Initially, each record of the team memories will be "0000".

14) "0000" will not be used as user ID; hence, a player can not have "0000" as his/her user ID.

1.2 Input/Output Specifications

Name	Type	Size
userID	Input	4 bits
Clock (CLK)	Input	1 bit
team	Input	1 bit
mode	Input	2 bits
numPlyLP	Output	8 bits
numPlyCF	Output	8 bits
teamWng	Output	1 bit
capWngLP	Output	1 bit
capWngCF	Output	1 bit
findRes	Output	1 bit
listOut	Output	4 bits
listMode	Output	1 bit

- **userID** represents 4-bit user ID.
- **CLK** is the clock input for the module.
- **team** is used for the selection of the team.
  $team = 0 \Rightarrow$ Team Logic Power
  $team = 1 \Rightarrow$ Team Ceng Force
- **mode** indicates the selected mode among the following 4 modes:
  $mode = 00 \Rightarrow$ Logout mode
  $mode = 01 \Rightarrow$ Login mode
  $mode = 10 \Rightarrow$ Find mode
  $mode = 11 \Rightarrow$ List mode
- **numPlyLP**, **numPlyCF** keeps the number of current players already logged in Logic Power and Ceng Force teams, respectively.
- **teamWng** shows whether the player wants to login to the correct or wrong team.
  $teamWng = 0 \Rightarrow$ Correct team.
  $teamWng = 1 \Rightarrow$ Wrong team.
- **capWngLP/capWngCF** shows whether Logic Power/Ceng Force team is full/empty or not.
  $capWngLP/capWngCF = 1 \Rightarrow$ Logic Power/Ceng Force team is either full or empty.
  $capWngLP/capWngCF = 0 \Rightarrow$ otherwise.
- **findRes** shows whether 4 bit user ID to be searched in the given team memory is found or not.
  $findRes = 1 \Rightarrow$ Found.
  $findRes = 0 \Rightarrow$ Not found.
- **listOut** shows the user ID in the given team's memory sequentially each time CLK pulse is given.
- **listMode** indicates whether the system is in list mode or not.
  $listMode = 1 \Rightarrow$ System is in list mode.
  $listMode = 0 \Rightarrow$ Otherwise.

1.3 Sample Input/Output

Between current state and next state, there will be one CLK cycle.

Initial Values:

Team Logic Power Memory				
0000	0000	0000	0000	0000

Team Ceng Force Memory				
0000	0000	0000	0000	0000

teamWng	capWngLP	capWngCF	findRes	listOut	listMode
0	1	1	0	No output	0

a) A player with user ID 1000 wants to login the game in Ceng Force team and the system allows the login (correct team):

Current State

Team Logic Power Memory				
0000	0000	0000	0000	0000

Team Ceng Force Memory				
0000	0000	0000	0000	0000

userID	team	mode	teamWng	capWngLP	capWngCF	findRes	listOut	listMode
1000	1	01	0	1	1	0	No output	0

Next State

Team Logic Power Memory				
0000	0000	0000	0000	0000

Team Ceng Force Memory				
1000	0000	0000	0000	0000

teamWng	capWngLP	capWngCF	findRes	listOut	listMode
0	1	0	0	No output	0

b) A player with user ID 1001 wants to login the game in Logic Power team and the system does not allow login (wrong team) and gives warning:

Current State

Team Logic Power Memory				
0001	0010	0100	0101	0110

Team Ceng Force Memory				
1000	1010	1011	1100	1111

userID	team	mode	teamWng	capWngLP	capWngCF	findRes	listOut	listMode
1001	0	01	0	1	1	0	No output	0

Next State

Team Logic Power Memory				
0001	0010	0100	0101	0110

Team Ceng Force Memory				
1000	1010	1011	1100	1111

teamWng	capWngLP	capWngCF	findRes	listOut	listMode
1	1	1	0	No output	0

c) A player with user ID 0010 wants to login the game in Logic Power team and the system does not allow login since a player with same user ID is already logged in:

Current State

Team Logic Power Memory				
0001	0010	0100	0101	0110

Team Ceng Force Memory				
1000	1010	1011	1100	0000

userID	team	mode	teamWng	capWngLP	capWngCF	findRes	listOut	listMode
0010	0	01	0	1	0	0	No output	0

Next State

Team Logic Power Memory					Team Ceng Force Memory				
0001	0010	0100	0101	0110	1000	1010	1011	1100	0000

teamWng	capWngLP	capWngCF	findRes	listOut	listMode
0	1	0	0	No output	0

d) A player with user ID 1001 logins the game in Ceng Force team and the capacity of Ceng Force memory gets full as a result and the system gives warning:

Current State

Team Logic Power Memory					Team Ceng Force Memory				
0001	0010	0100	0101	0110	1000	1010	0000	1100	1011

userID	team	mode	teamWng	capWngLP	capWngCF	findRes	listOut	listMode
1001	1	01	0	1	0	0	No output	0

Next State

Team Logic Power Memory					Team Ceng Force Memory				
0001	0010	0100	0101	0110	1000	1010	1001	1100	1011

teamWng	capWngLP	capWngCF	findRes	listOut	listMode
0	1	1	0	No output	0

e) A player with user ID 0100 logouts the game and the record is deleted from Logic Power Memory:

Current State

Team Logic Power Memory					Team Ceng Force Memory				
0001	0010	0100	0101	0110	1000	1010	0000	1100	1011

userID	team	mode	teamWng	capWngLP	capWngCF	findRes	listOut	listMode
0100	0	00	0	1	0	0	No output	0

Next State

Team Logic Power Memory					Team Ceng Force Memory				
0001	0010	0000	0101	0110	1000	1010	0000	1100	1011

teamWng	capWngLP	capWngCF	findRes	listOut	listMode
0	0	0	0	No output	0

f) Listing the user IDs in Ceng Force memory in list mode:

Current State

Team Logic Power Memory					Team Ceng Force Memory				
0001	0010	0100	0101	0110	1000	1010	0000	1100	1011

team	mode	teamWng	capWngLP	capWngCF	findRes	listOut	listMode
1	11	0	1	0	0	No output	0

Next State

Team Logic Power Memory					Team Ceng Force Memory				
0001	0010	0100	0101	0110	1000	1010	0000	1100	1011

teamWng	capWngLP	capWngCF	findRes	listOut	listMode
0	1	0	0	1000	1

In every CLK pulse, the listOut will display the next record. (1010, 0000, 1100, 1011). After all the records are displayed, it will start displaying from the beginning.

g) Searching the user ID 0100 in Logic Power memory:

Current State

Team Logic Power Memory					Team Ceng Force Memory				
0001	0010	0100	0101	0110	1000	1010	0000	1100	1011

userID	team	mode	teamWng	capWngLP	capWngCF	findRes	listOut	listMode
0100	0	10	0	1	0	0	No output	0

Next State

Team Logic Power Memory					Team Ceng Force Memory				
0001	0010	0100	0101	0110	1000	1010	0000	1100	1011

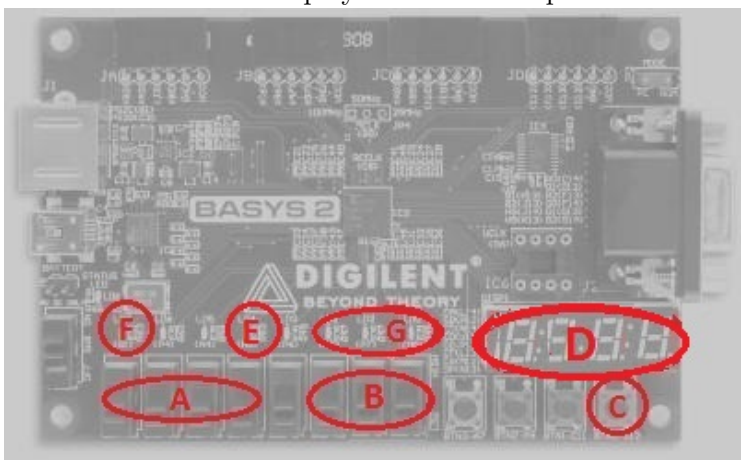
teamWng	capWngLP	capWngCF	findRes	listOut	listMode
0	1	0	1	No output	0

1.4 FPGA Implementation

You will be provided with a Board232.v file (and a ready-to-use Xilinx project), which will bind inputs and outputs of the FPGA board with your Verilog module. You are required to test your Verilog module on the FPGA boards.

Name	FPGA Board	Description
userID	SW7,SW6,SW5,SW4	Left-most 4 switches (A)
Clock (CLK)	BTN0	Right-most button (C)
team	SW0	Right-most switch (B)
mode	SW2,SW1	The next 2 switches next to SW0 (B)
teamWng	LD7	Left-most led (F)
capWngLP	LD0	Right-most led (G)
capWngCF	LD1	The led next to LD0 (G)
findRes	LD2	The led next to LD1 (G)
listOut	7-segment display	(D) **
listMode	LD4	The led next to LD3 (E)

**:Each individual bit will be displayed in each component of the 7-segment display (D)



1.5 Deliverables

- Implement your module in a single Verilog file: *lab4_2.v*. Do NOT submit your testbenches.You may share your testbenches on the newsgroup.
- Submit the file through the COW system before the given deadline. **April 25, 2018, 23:59hrs.**
- This part is supposed to be done with your group partner. Make sure both of you take roles in implementation of the project. Any kind of inter-group cheating is not allowed.
- Use the newsgroup metu.ceng.course.232 for any questions regarding the homework.