Connect4-D

INEL5206 | Section 050 | Digital System Design

Fantastic 4 Team:
Coralys M Cortés Soto
Vincent I Prado Claudio
Noel Valentín Román
Jorge E Calderón-Carrasquillo

Introduction

- Connect 4 with the same rules as the classic game.

- The grid is 4x4 instead of 7x6.

- The grid was created using bicolor LEDs.

  - Color blue for player 1 and red for player 2.

  - Each led represents one cell in the grid.
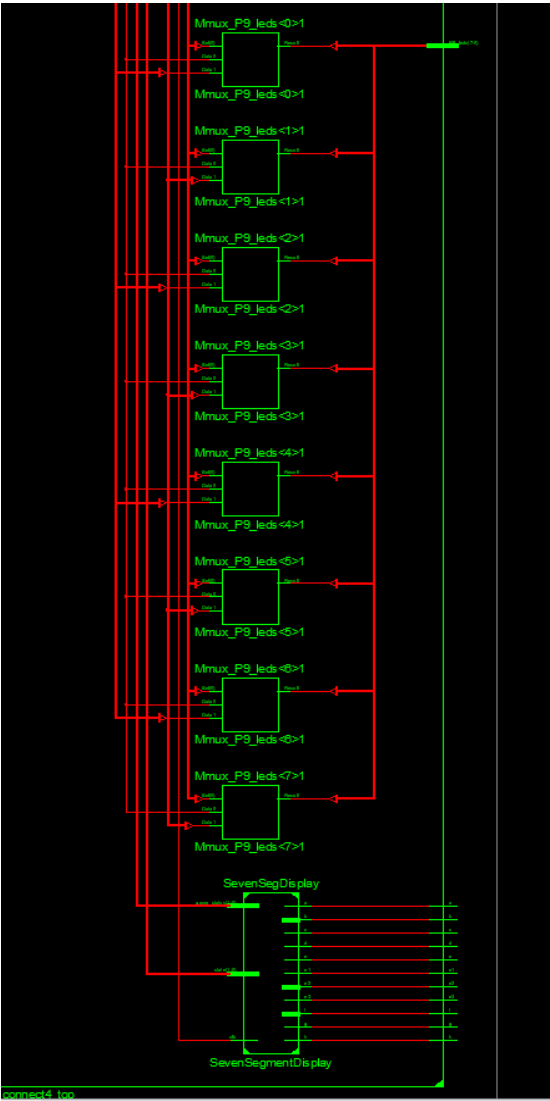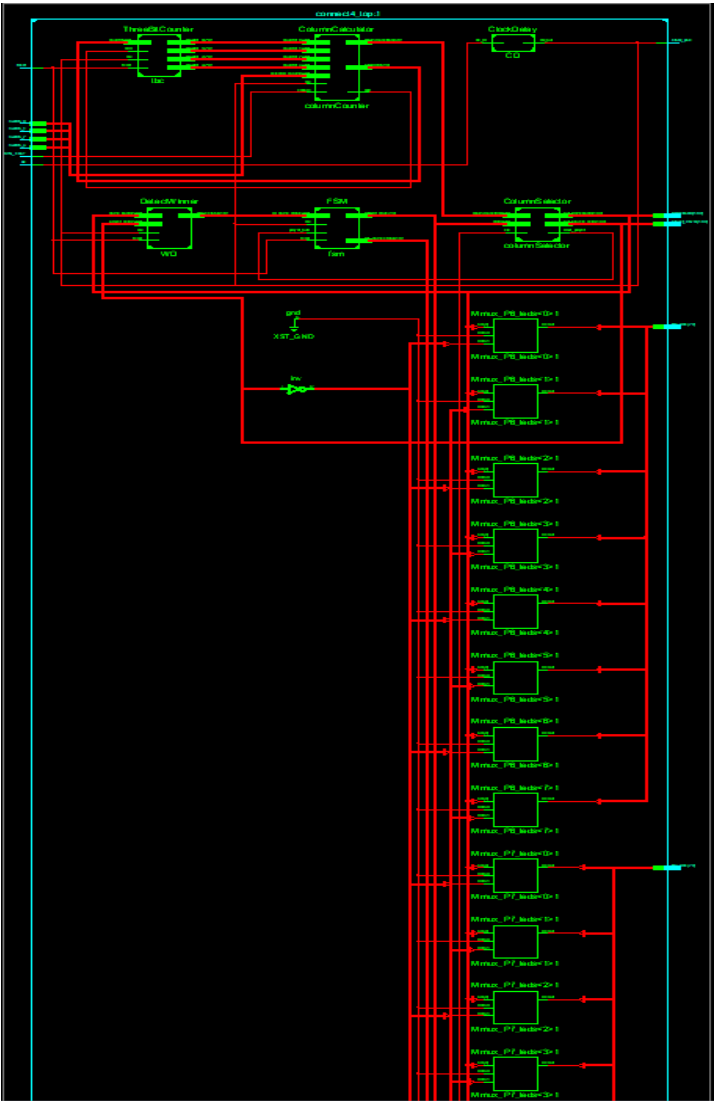
- We used the Mimas V2 Spartan 6 from Numato.

Game Mechanics
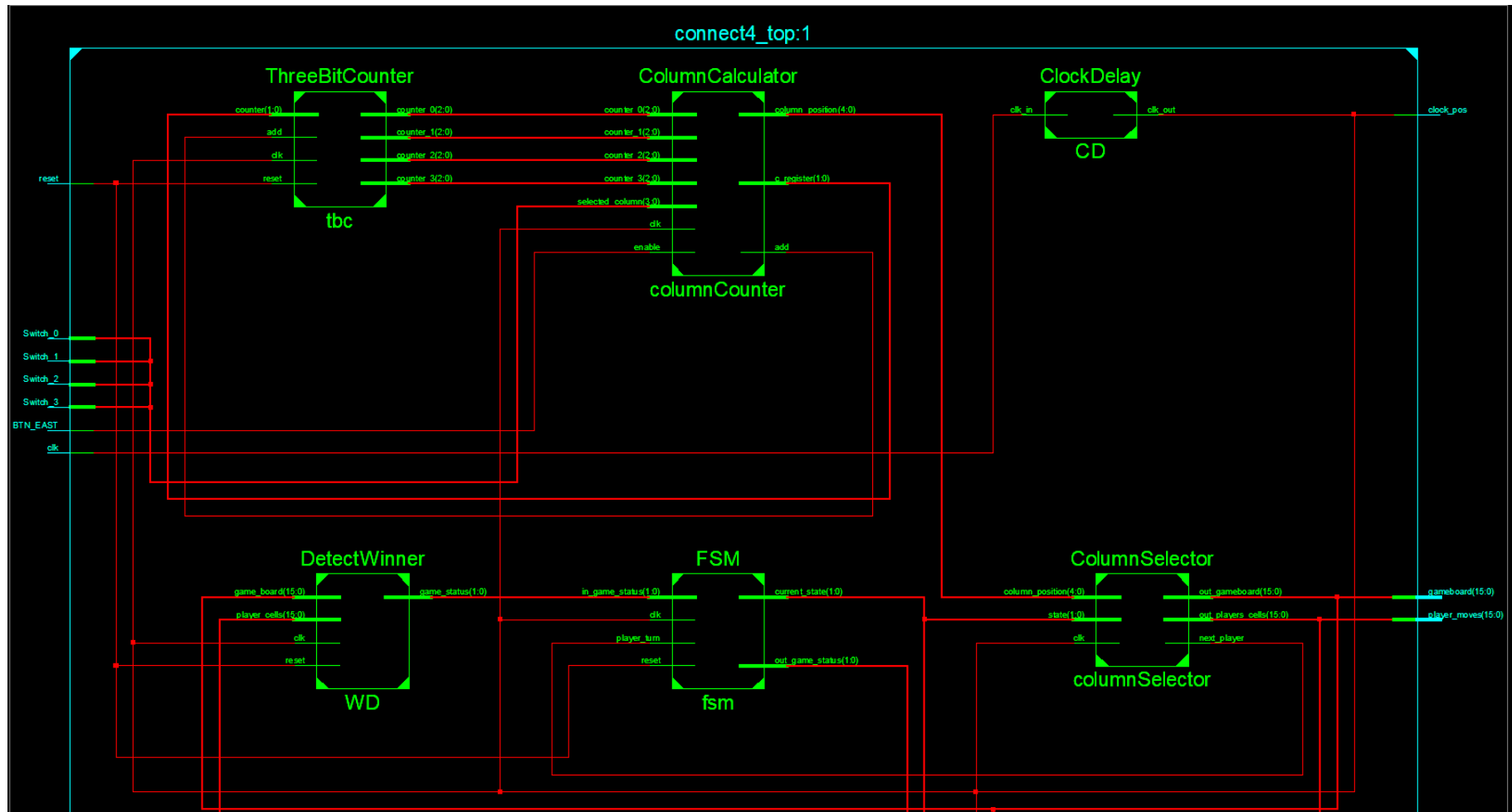

Clock LED
(D1)

Column Switches
(DP5-DP8)

Enable
Button
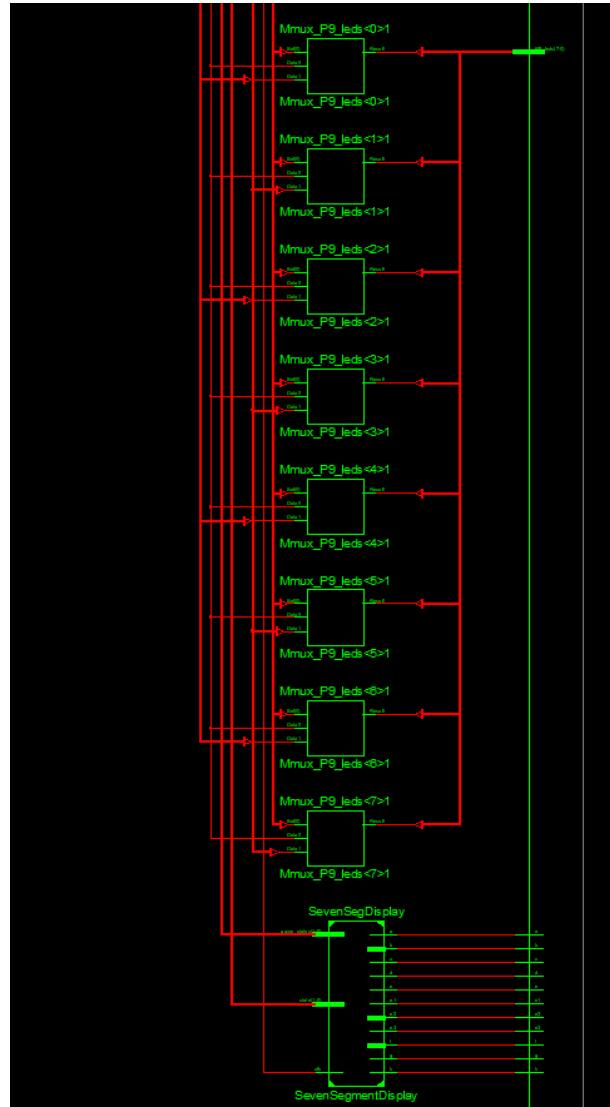(SW6)

Reset Button
(SW5)
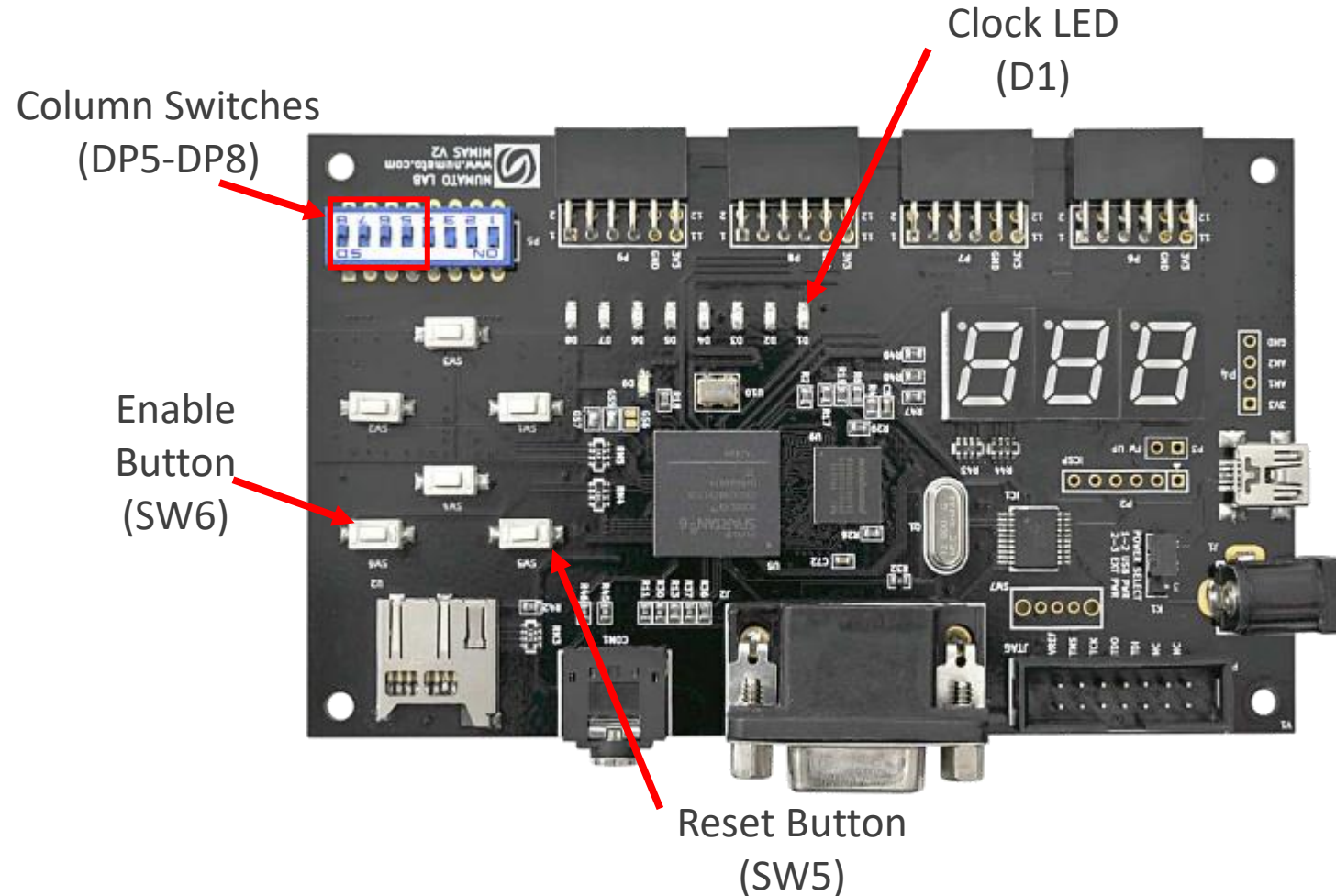
Connect 4 Demo
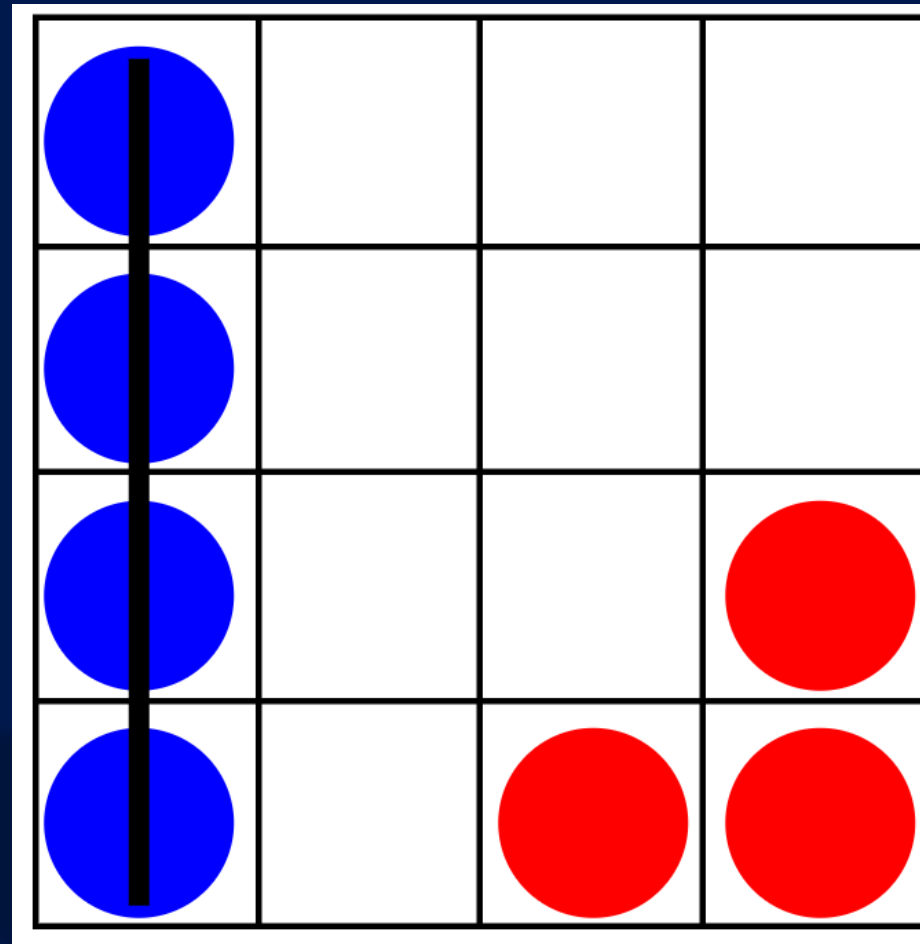
Circuit Diagram

Circuit Diagram Continuation

Circuit Diagram Continuation

FSM State Diagram

- Inputs are defined as follow:
  - 1 bit for reset signal, MSB.
    - ❑ 0 – reset signal activated
    - ❑ 1 – reset signal deactivated
  - 2 bit for game status signal, two bit following the MSB.
    - ❑ 00 – Next player turn
    - ❑ 01 – Player 1 wins
    - ❑ 10 – Player 2 wins
    - ❑ 11 – Tie game
  - 1 bit for player turn signal, LSB.
    - ❑ 0 – Player 1 turn
    - ❑ 1 – Player 2 turn
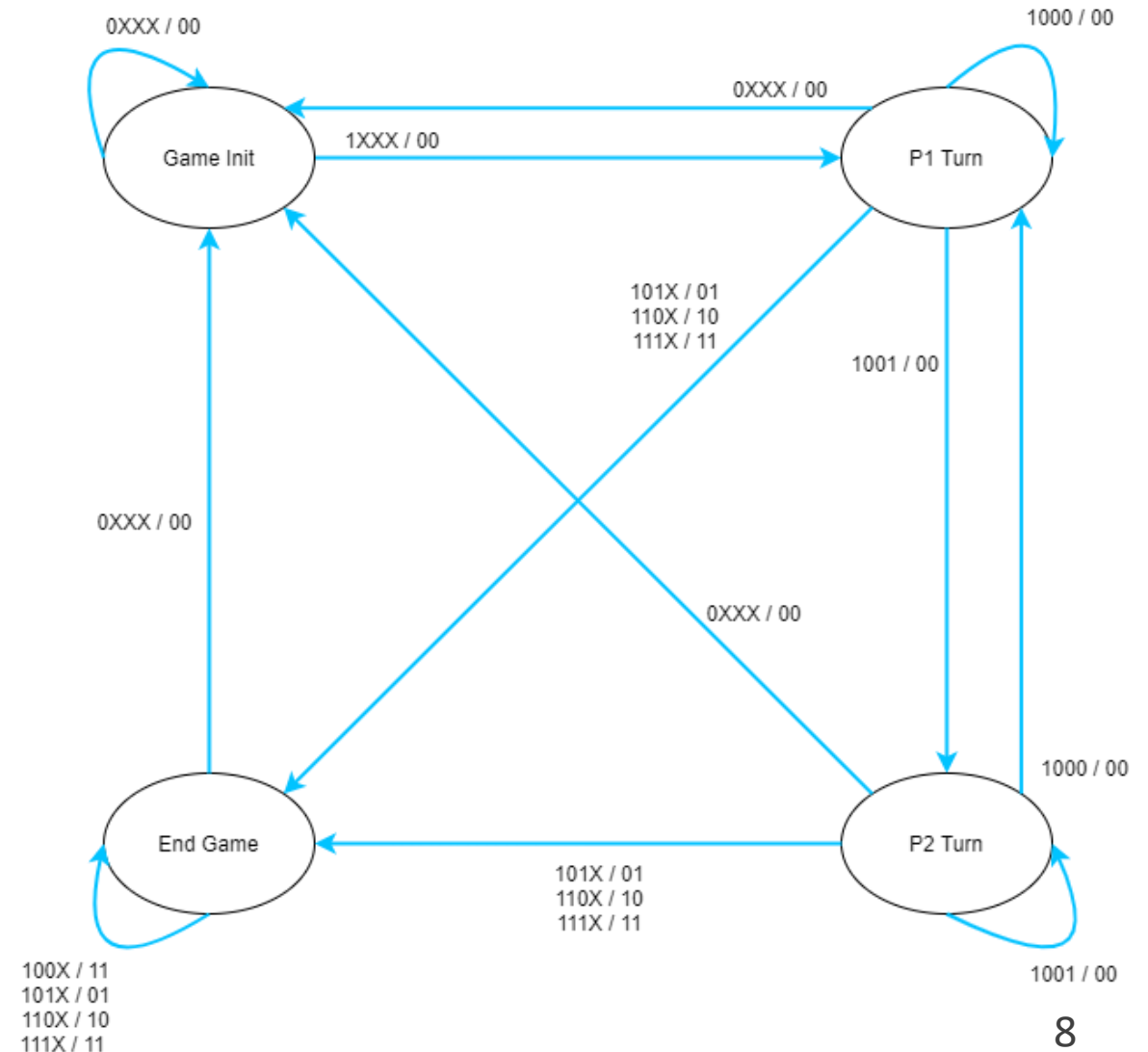
Filling the Game Board

- How are the moves stored?
  - 16-bit registers:
    - ❑ Game Board
      - MSB(15) <- 0001000110011101 -> LSB(0)
    - ❑ Player Cells
   - 0000000010001100

- Input Logic
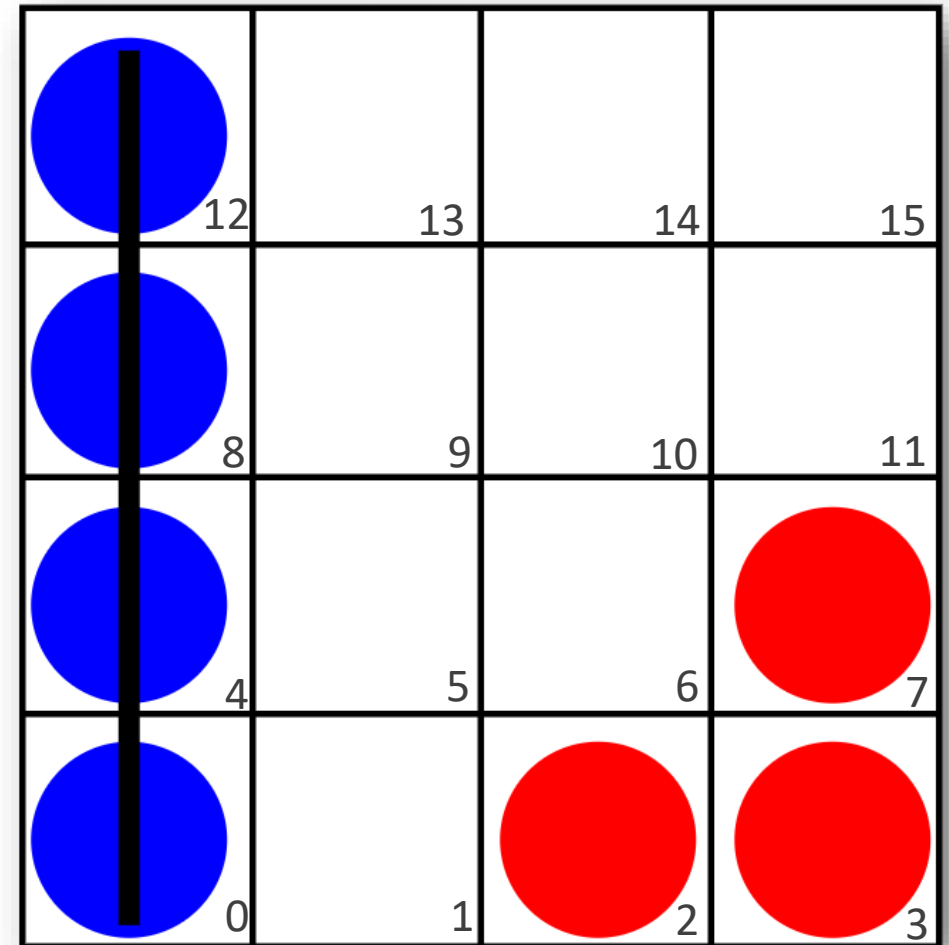
Detect Winner

- Possible winning combinations
- First verify Game Board, then verify player cells
- Two bits output stating the status of the game
  - Still playing: 00
  - P1 wins: 01
  - P2 wins: 10
  - Tie: 11

| 12	13	14	15
8	9	10	11
4	5	6	7
0	1	2	3

Seven Segment Display

- The Numato Spartan6 FPGA has three integrated 7-segment digits.

- Displays the game status:
  - P1 turn: 1 on left digit
  - P2 turn: 2 on right digit
  - P1 wins: 1 on all digits
  - P2 wins: 2 on all digits
  - Tie: 0 on all digits
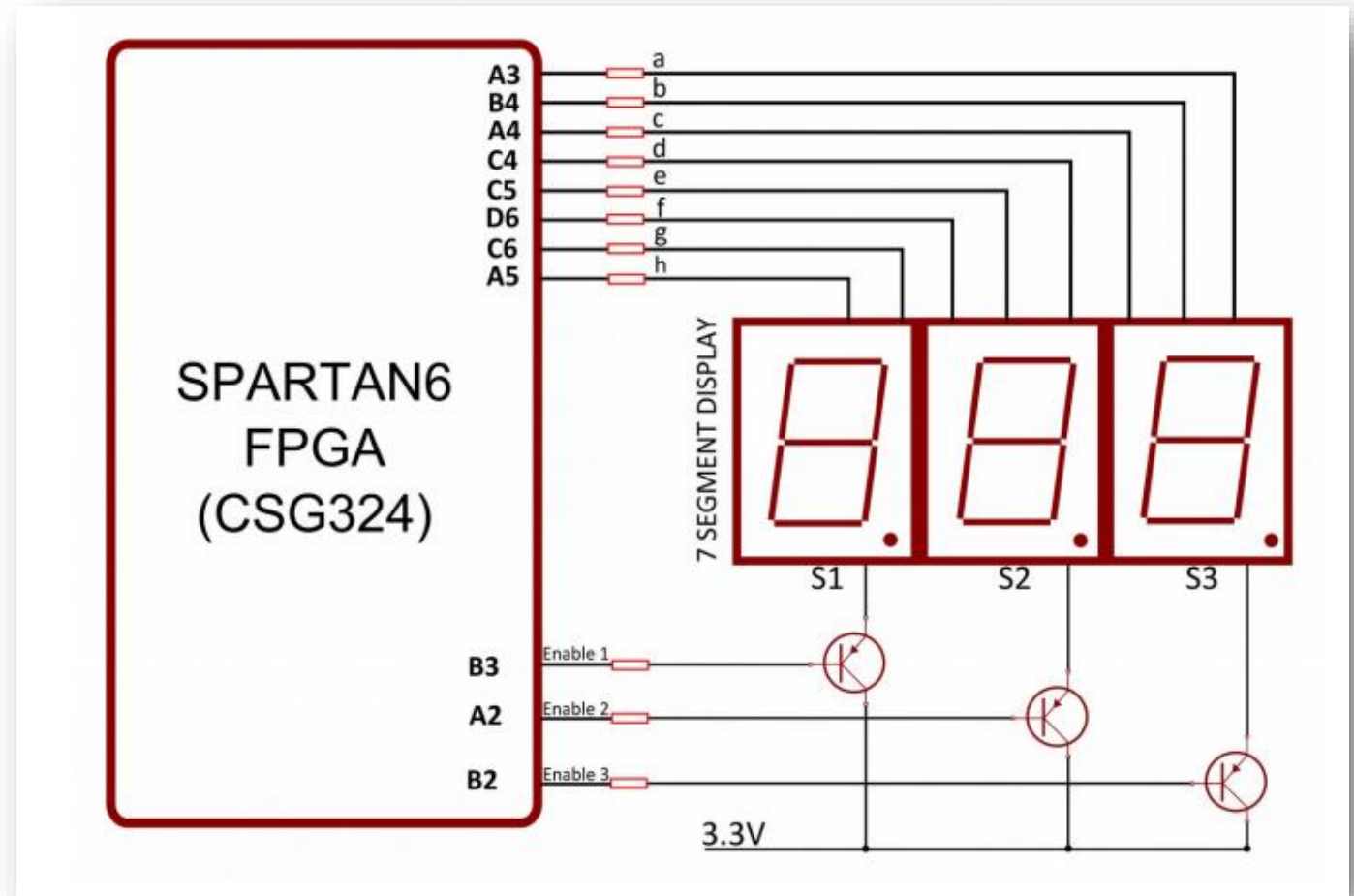
Conclusion

- Result
  - Fully working Connect-4 game with a 4x4 grid composed of bi-color LEDs and status-monitoring display

- Biggest challenges in the design
  - Timing and synchronization
  - Implementing the visual aspect of the grid with LEDs

- Future additions to the project
  - Increase grid size
  - Include a win counter
  - Set a time limit for player turns
  - Integrate VGA Display
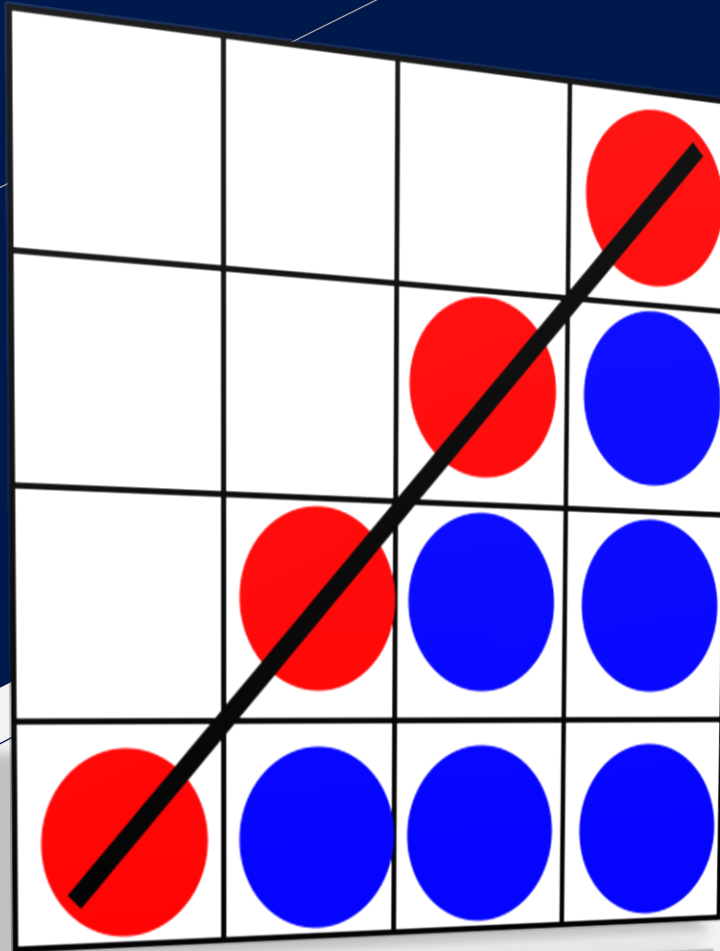
THANKS FOR YOUR ATTENTION!

Fantastic 4 Team