**EE 316 Computer Engineering Junior Lab**

**Design Project 4**

**Spring 2024**

**Specification**:  **Digital Hangman using FPGA**

**Due Dates: Thursday, March 14 - lab demo**

**Monday, March 16, written report due.**

**Parts List:**

1. one Digilent’s Cora Z7
2. one 2-line/16 character I2C LCD display module
3. one Sparkfun 7-segment display (with I2C)
4. one FTDI USB to UART 5V/3.3V adapter
5. one PS/2 keyboard
6. one PS/2 socket

Design an electronic system for a Hangman game using Digilent's Cora Z7 involves multiple components and interfaces. Below is a detailed outline of the hardware and software aspects of the system:

**Hardware Design:**

**PS2 Keyboard Connection:**

* Connect the PS2 keyboard to PMOD port JA on the Cora Z7 board.
* Implement logic for recognizing English alphabet keys (A-Z).

**LCD Panel Connection:**

* Connect the LCD panel to PMOD port JB on the Cora Z7 board.
* Upon power-up, initialize the LCD to display a single cursor (underline) at the left side of the screen.

**USB to UART Adapter:**

* Use a USB to UART adapter for communication with the remote PC.
* Set the serial port parameters to a minimum baud rate of 9600, parity none, data bits 8, and stop bits 1.

**7-Segment Display:**

* Connect a 7-segment display to PMOD port JB to indicate the remaining guesses.

**Software Design:**

**PC Software (C++, C#, Python, JAVA, or any language):**

* Create a GUI to display the game's status and an image of a hangman's noose.
* Read a text file containing 50 words with variable lengths (not exceeding 16 letters per word).

**Game Initialization:**

* Display **"New Game?"** on the GUI and LCD.
* Wait for the player to press "Y" on the PS2 keyboard to start a new game.

**Word Selection:**

* Randomly select a word from the text file.
* Display the positions of each letter using underscores on the LCD (left-justified).

**Letter Guessing:**

* Allow the player to guess a letter using the PS2 keyboard.
* Display correct guesses in the word on the LCD.
* Update the hangman image and show the remaining guesses on the 7-segment display for incorrect guesses.

**Game Outcome:**

* If the player successfully guesses the word, display a congratulatory message on the LCD - **“Well done! You have solved N puzzles out of M”**.
* If the player fails, show the correct word and a message indicating the number of puzzles solved - **“Sorry! The correct word was XXXXX. You have solved N puzzles out of M”**. **”**. Since these messages have more than 20 letters and spaces, they should appear at the right edge of the LCD display and scroll across the screen at a rate appropriate for reading the message. The system should then display: “**New Game?”** The player can always request a new puzzle by typing “Y” unless all of the words from the text file have been used up. At this point, the player should be able to end the game by typing the letter “N”. The LCD should display the final message when the game ends: “**GAME OVER**.”

**Score Tracking:**

* Keep track of the number of puzzles solved.
* Display the final score on the LCD after the game ends.

**Game Over:**

* Display the final score ("X correct out of Y") on the LCD.
* After a short duration, show "**GAME OVER**" on the LCD.

This comprehensive design outlines the connections, interactions, and functionalities required for the Hangman game on the specified hardware platform. Adjustments can be made based on the specific capabilities of the chosen programming language and development environment.

**Documentation:**

Cora Z7 board

[Cora Z7 - Digilent Reference](https://digilent.com/reference/programmable-logic/cora-z7/start)

Help for PS/2 protocol

<http://www.burtonsys.com/ps2_chapweske.htm>

AT Keyboard Scan Codes

<https://webdocs.cs.ualberta.ca/~amaral/courses/329/labs/scancodes.html>

PS/2 Keyboard to ASCII Converter (VHDL)

<https://forum.digikey.com/t/ps-2-keyboard-to-ascii-converter-vhdl/12616>

VHDL Sample UART (make sure you have the permission to use this code)

<http://www.asic-world.com/examples/vhdl/uart.html>

Learn VHDL by example (search for Structural Modeling of HD-6402 on the page)

<http://esd.cs.ucr.edu/labs/tutorial/>

**Teams:**

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| --- | --- | --- | --- | --- | --- | --- |
| Team 1 | Team 2 | Team 3 | Team 4 | Team 5 | Team 6 | Writer |
| Drake | Ferreira | Collin | Rollins | Tusa | Olugbenle |  |
| Engle | Hassett | Art | Robinson | Arcate | Collins |  |
| Reino | Herrick |  | Hacic | Konik | Obrien |  |