Slot Machine Project - Project 1

EGR 426

2/8/2024

Zack Peters

Introduction

This project focuses on the construction and programming of a digital slot machine using 7-segment LED displays. The objective is to simulate the classic gambling game with a digital twist, allowing users to experience the thrill of chance and anticipation. The machine utilizes three 7-segment LEDs to represent the spinning reels, each capable of counting from 0 to 9, and an additional four 7-segment LEDs to convey the game's status with messages like "WIN" or "SPIN". The design incorporates a user interface with buttons to control the game's flow, initiating the spin and resetting the system for a new round. The implementation of the game's logic will be demonstrated through test benches, ensuring each component behaves as expected under various scenarios. This project not only offers an engaging challenge for digital designers but also provides an excellent opportunity to apply concepts such as synchronous design, randomization, and user interaction within an embedded system.

Components

The VHDL code snippets you provided are part of a larger digital design project, likely a slot machine or similar display-based game implemented on an FPGA. Here's a brief explanation of each section:

Top Level:

This is the top-level entity that ties together all the components of the system. It declares the input/output ports and maps these to the internal signals and components. This entity manages the flow of data between the internal components such as clock dividers, debouncers, game logic, and display drivers.

- Clockk_Divider: A component that divides the frequency of the input clock to generate slower clock signals (`clk_1kHz` and `clk_10Hz`) used by other parts of the design.

- eight_digit_seven_seg: A component that takes 4-bit binary coded decimal (BCD) inputs num0 to num7 for each of the eight digits and converts them to the corresponding 7-segment display outputs.

- debouncer: Ensures that the input from a physical button (`btn0`) is stable before it is used in the system, filtering out any noise from the button press.

- mux_counter: Controls the multiplexing of the 7-segment display, sequentially activating each segment and providing the corresponding data.

- game_logic: Contains the logic of the game, including handling the spinning of the reels and determining the game outcome.

Game Logic:

The game_logic entity manages the game states and behaviors, such as spinning the reels, displaying the results, and resetting the game. It uses a state machine with states like Idle, Spin, and Display_Result to control the flow of the game.

Debouncer:r

The debouncer entity filters out the bouncing effect inherent in mechanical switches and buttons. It provides a stable output btn_out after the button btn_in has been pressed.

Clock Divider:

The Clockk_Divider entity takes a high-frequency clock input and generates lower frequency clock signals (`clk_1kHz` and `clk_10Hz`). These are used to control the rate of operations, like updating the display or the spinning of the reels in the game.

Mux/Counter:

The mux_counter entity is responsible for cycling through the displays (usually LED or LCD) to update each segment one at a time at a high frequency, giving the illusion that all segments are lit simultaneously.

Display:

The eight_digit_seven_seg entity converts 4-bit BCD inputs for each digit num0 to num7 into 7-segment display signals d0_out to d7_out. It contains a function to_seven_segment that maps each BCD value to the corresponding segments to be lit on the display for the desired number or character.

Each of these components would be implemented in their separate VHDL files and instantiated in the top-level file, allowing for a modular design that is easier to manage, test, and debug.

Test Benches

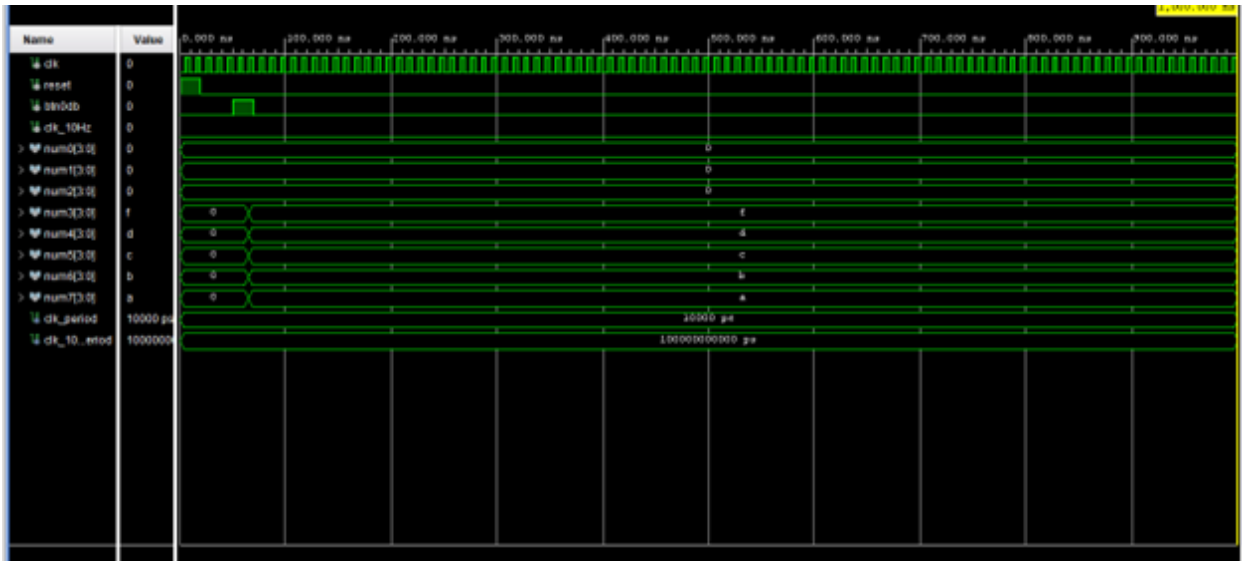

Figure 1: Game Logic Test Bench

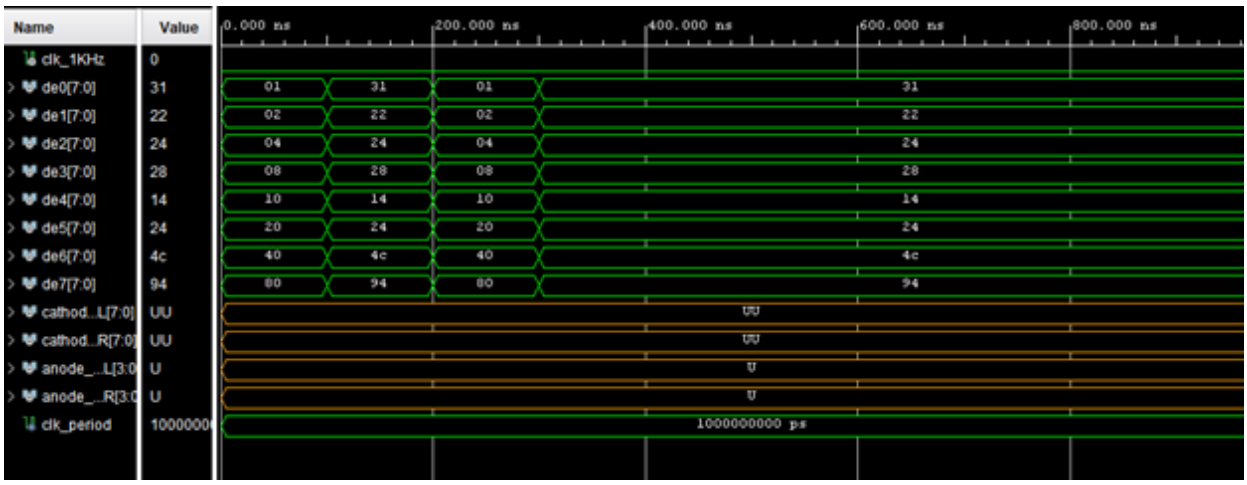

Figure 2: Mux/Counter Test Bench

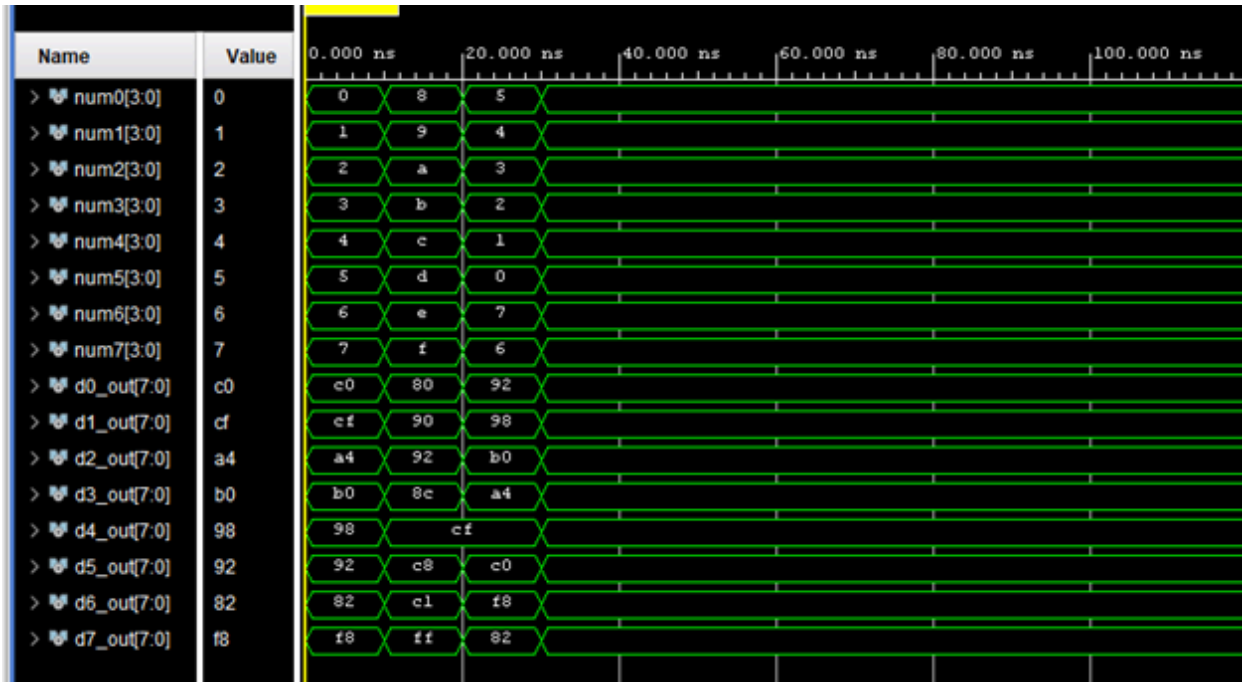

Figure 3: 7 Seg Test Bench

Conclusion

In conclusion, the slot machine project has been a comprehensive exercise in applying digital design principles to create an interactive and entertaining system. The test benches developed for this assignment have been instrumental in verifying the functionality of each aspect of the game, from the randomization of the reel's spin to the display logic for wins and spins. By successfully implementing a random number generator and designing a user-friendly interface, we have achieved a digital rendition of a slot machine that not only functions correctly, but also offers an engaging user experience. This project serves as a valuable learning tool, demonstrating the power of digital systems and the creative potential of integrating simple components to produce complex behavior.