CalPolyPomona | College of Engineering

California Polytechnic State University Pomona
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

Digital Circuit Design Verilog Lab
ECE 3300L
Final Project Report

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Presented to
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Project Description: The objective of this project was to design and implement a basic Pong game using Verilog, which utilizes VGA output to display graphics on a screen. The game features a single paddle controlled by user input and a ball that bounces around the screen. Collision detection, paddle movement, and ball dynamics are implemented, adhering to the standard rules of Pong. The project demonstrates the ability to use Verilog for real-time video signal generation, game logic, and hardware-based VGA interfacing.

Elements Included:

VGA Signal Generation:

- A horizontal and vertical sync generator (hvsync_generator) is implemented to produce the VGA-compatible signals required for displaying graphics on a monitor.
- The module calculates the horizontal (CounterX) and vertical (CounterY) positions of pixels on the screen.

Paddle Movement:

- The paddle's position is updated based on button inputs (btn_up and btn_down) to move it up or down on the screen.
- Overflow and underflow conditions are prevented, ensuring the paddle stays within the display area.

Ball Movement:

- The ball's position is continuously updated and bounded by collision detection logic.
- The ball's direction changes when it hits the paddle or screen borders.

Collision Detection:

- Logic is implemented to detect collisions between the ball and the paddle or screen boundaries.

Graphics Rendering:

- The paddle, ball, and screen borders are rendered as visual elements.
- The red, green, and blue (vga_R, vga_G, vga_B) signals are manipulated to represent the game elements visually on the VGA display.

Challenges and Outcome:

Even though my partner and I feel like we did everything right, we couldn't get the full result we were aiming for. While our implementation seemed logically correct and aligned with the project goals, it did not function exactly as intended. After troubleshooting extensively and verifying our design, we could not identify the source of the issue within the time constraints. To understand what the final result should look like, we found a video online that demonstrated a correctly implemented version of the Pong game. This video provided clarity on how the game was supposed to appear and behave.

Conclusion:

This Pong game implementation highlights the power and flexibility of Verilog for creating interactive hardware-based applications. It integrates multiple aspects of digital design, including VGA signal generation, input handling, collision detection, and dynamic graphics rendering. This project serves as an excellent example of how Verilog can be used for real-time video game design and demonstrates practical knowledge of hardware-level programming.