# ECE 3300 Lab 7 Group J

Introduction

In this lab, we designed and implemented a 16-bit combinational barrel shifter and rotator on the Nexys A7 FPGA. The system accepts a 16-bit input from slide switches and allows directional logical shifts or rotations by an arbitrary amount (0–15) controlled via debounced push buttons. The output is displayed on the rightmost four digits of the 7-segment display as hexadecimal values. This project reinforced our understanding of multiplexing logic, combinational circuit design, debouncing techniques, and digital display control, while also illustrating trade-offs between hardware complexity and functional versatility.
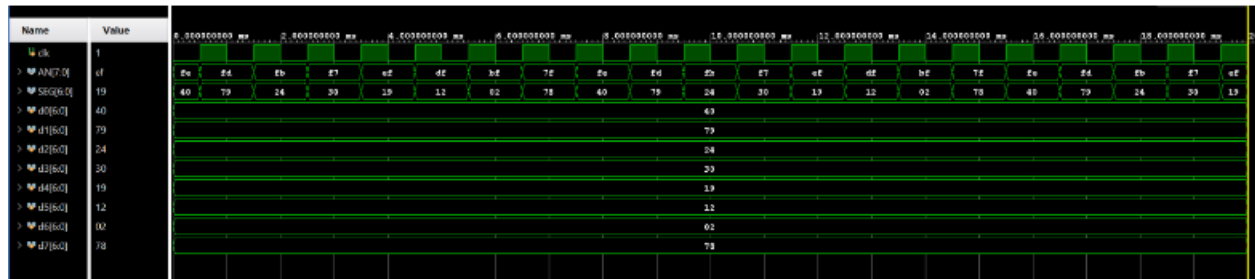
Testbench Waveform

barrel_shifter16_tb

debounce_toggle_tb
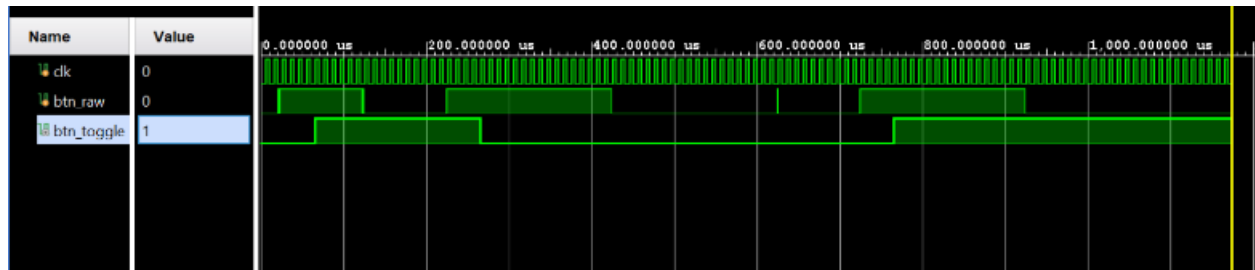
seg7_scan8_tb

Group Video Link

https://youtu.be/Hmzqk7g8VzM

Reflection

This lab provided valuable hands-on experience with implementing a complex combinational circuit, the 16-bit barrel shifter and rotator, and integrating it with user inputs and visual output through a 7-segment display. One key takeaway was the efficiency and scalability of using a multi-stage multiplexer tree to achieve instant shifting or rotating, highlighting the power of structural Verilog design. Additionally, the process of debouncing push buttons and synchronizing inputs with a fixed clock divider deepened our understanding of reliable hardware interfacing. Working through simulation, synthesis, and physical testing also emphasized the importance of modular design and thorough verification. Overall, the lab strengthened both our theoretical knowledge and practical skills in digital logic design and FPGA development.

Partner Contribution

Sean Go - code, lab report, video demonstration

Ryan Tran - code, lab report