Controlling a Counter with Push Buttons by Hardware

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Abstract

For this lab, the state of the push buttons will be read using hardware. We will also deal with the signal bouncing effects occurring in these simple input devices. A basic design will control the state of an LED using a push button. It will then be extended to the point where the push buttons can reset a counter, enable or disable its periodic increments, and change its counting direction and speed.

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Introduction

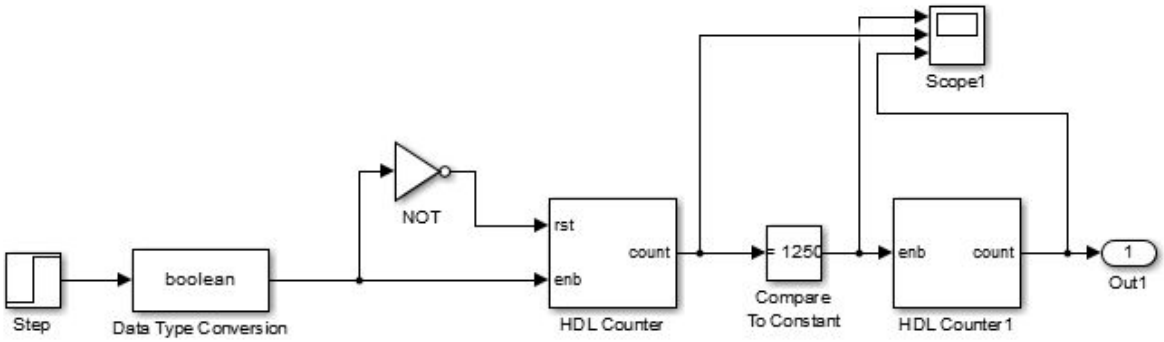
For this lab, the state of the push buttons will be read using hardware. We will also deal with the signal bouncing effects occurring in these simple input devices. A basic design will control the state of an LED using a push button. It will then be extended to the point where the push buttons can reset a counter, enable or disable its periodic increments, and change its counting direction and speed.

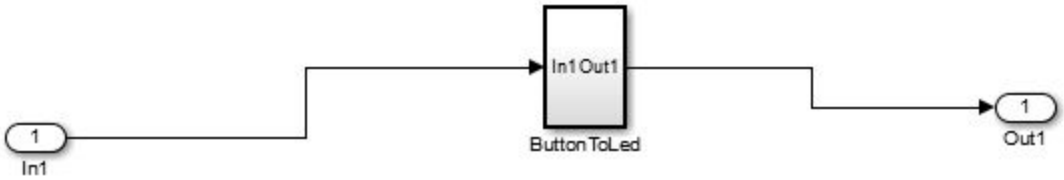
Lab Discussion

In order to develop the hardware that will be running on the Zedboard, Simulink was used. The pre-lab focused the contact bounce which we had to deal with in order to get the rest to work.

Results and Analysis

Assignment 1:





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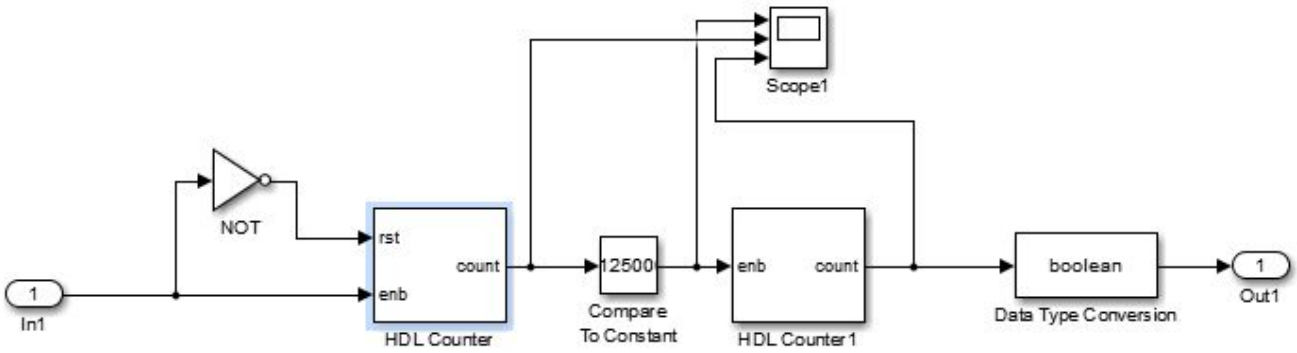

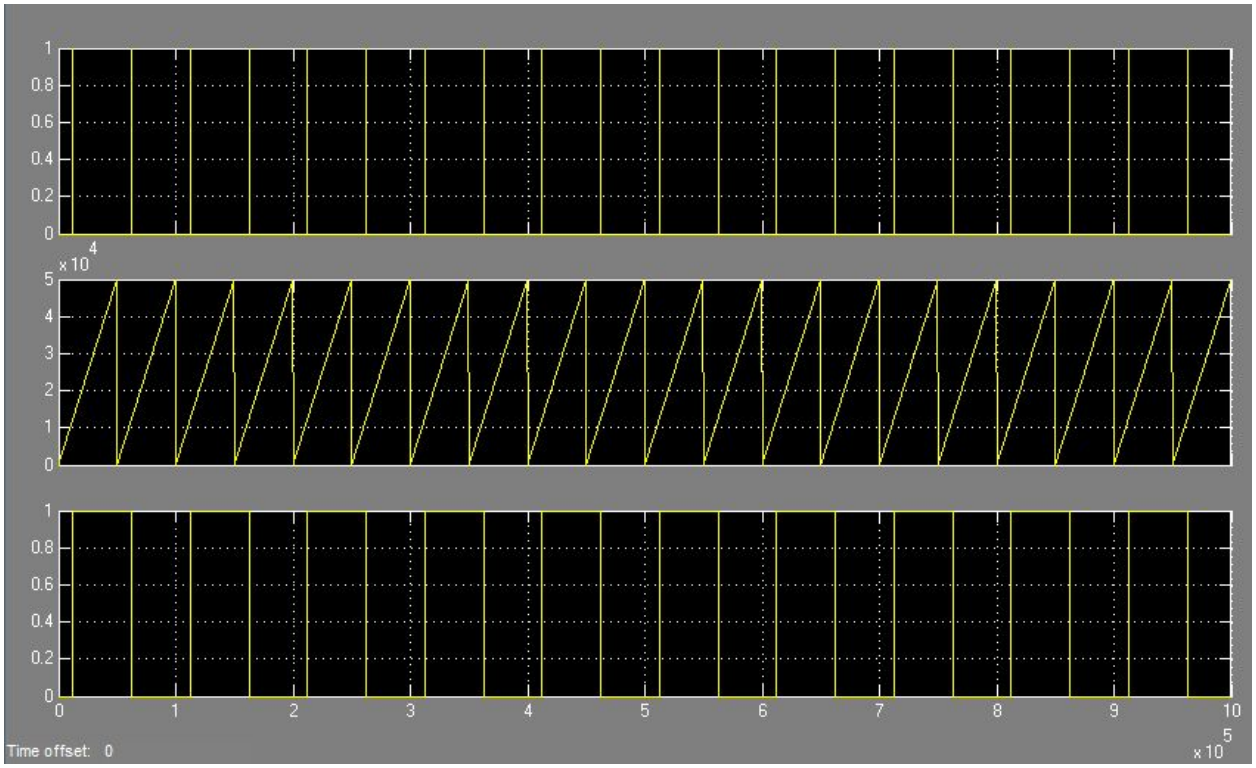

The scope shown is the expected output. The top one describes the pulse behavior. A button is pressed, and it takes .25 of a second before it registers. The button is registered as pressed very briefly before being in the state of not-pressed once again. The bottom graph shows what happens if the button is pressed and holds that state until pressed again. We can see how it toggles between the two states for an equal amount of time each. The middle graph represent the counter going up to 50,000 and then back to 0 again over and over. This is the visual output we were expecting to see.

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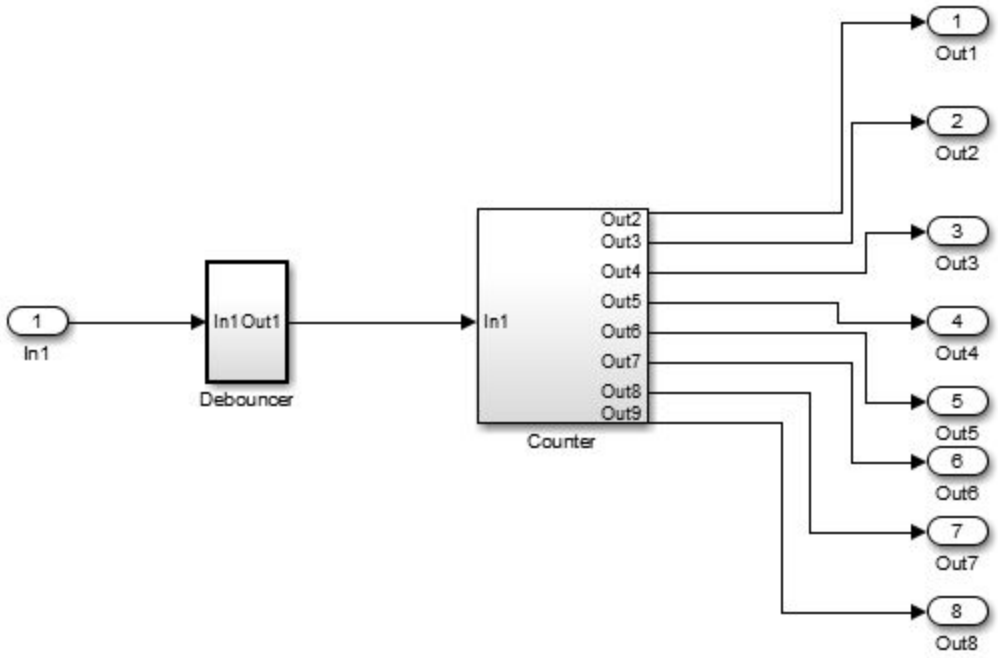
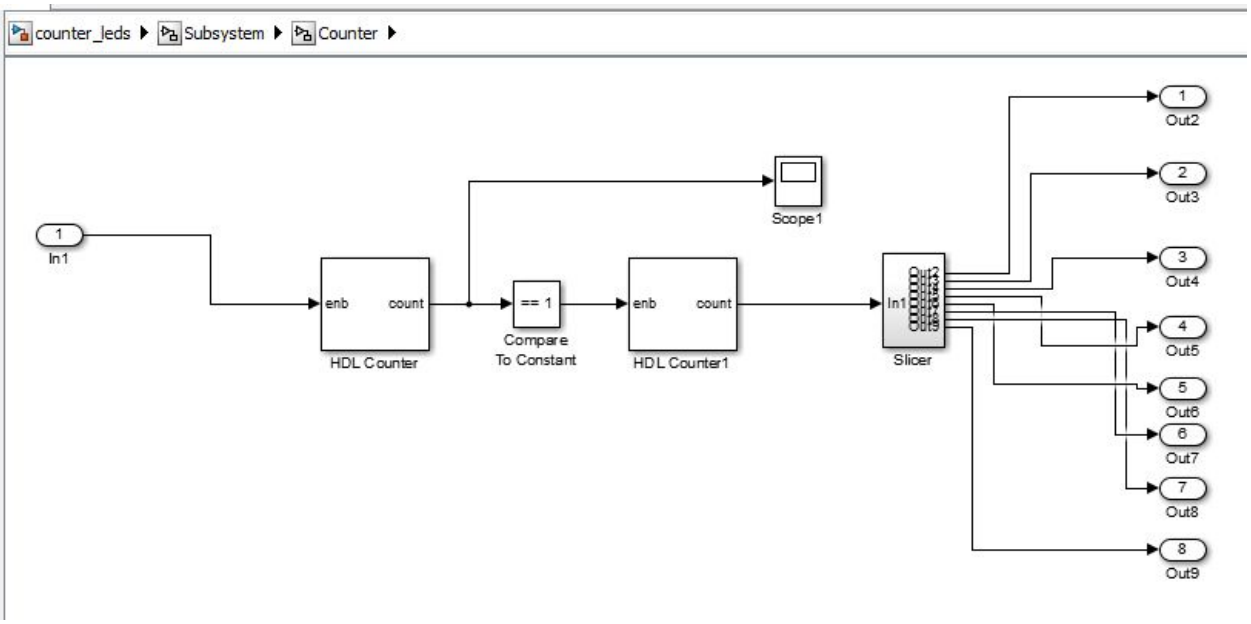
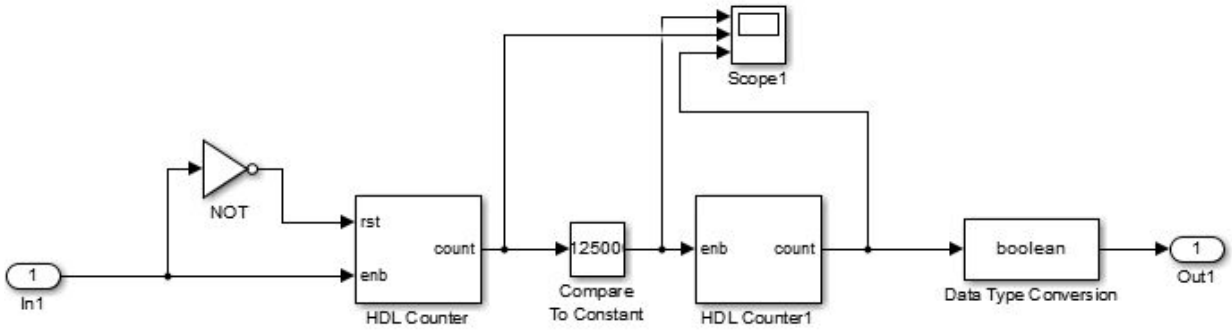
Assignment 2:

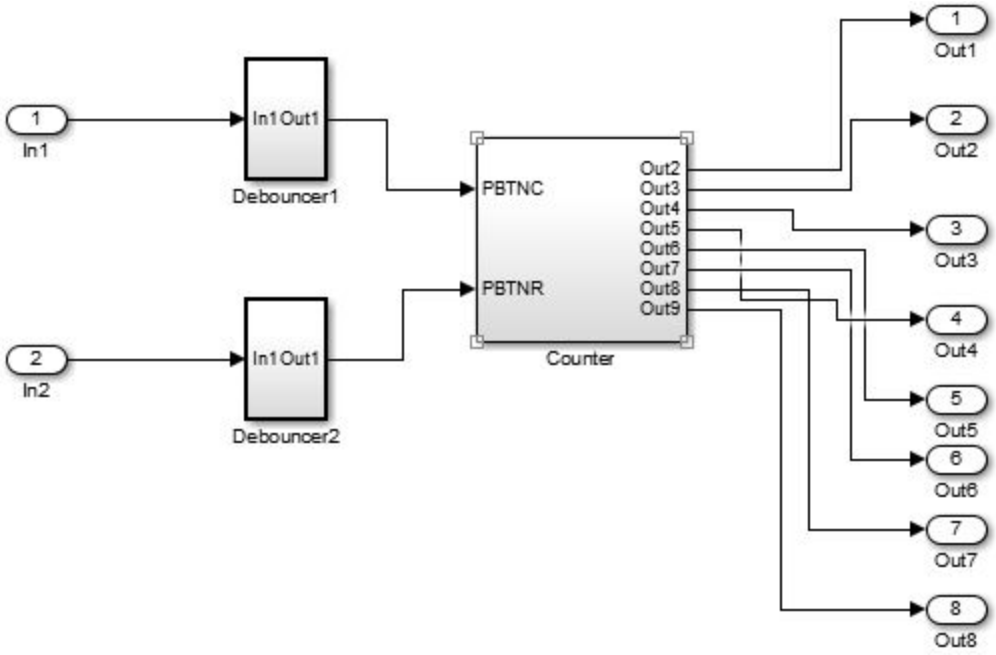






The debouncer is the same as the one in assignment 1. The goal is for it to wait .25 of a second to make sure that the push button was pressed completely and to deal with the bounce. The counter will then start once the push button has been pressed. We want the counter to count 2 per second (2Hz). The ZedBoard has a 50kHz clock so the first counter should be 25kHz. Thus, it will increment the counter by 2 every second since we are adding 1 whenever the first counter = 1. The second counter will hold the actual count itself. It will then be sliced up and displayed on the LEDs.

Assignment 3:



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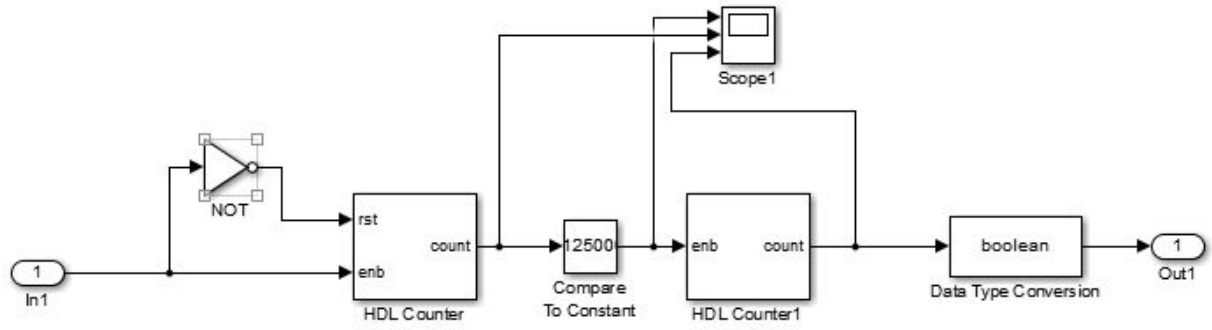

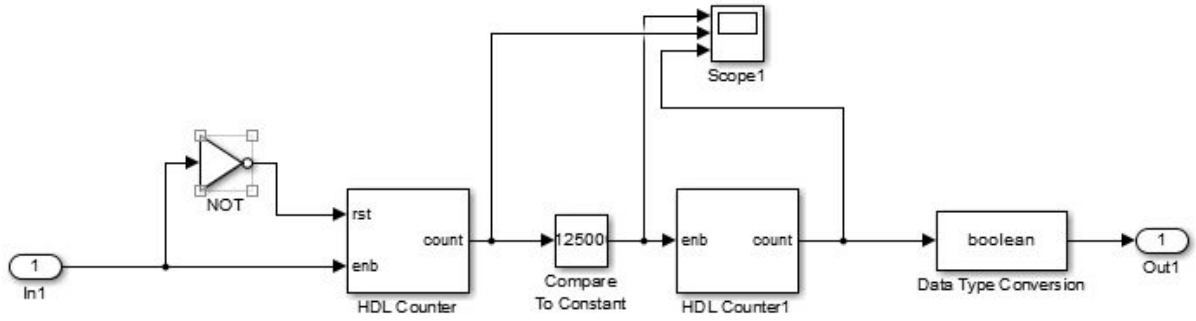

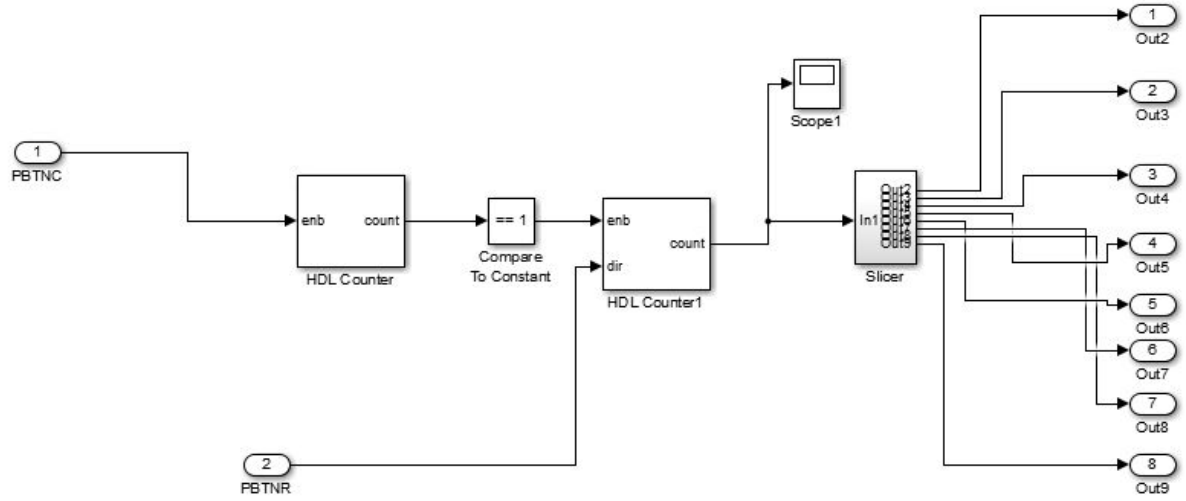

The debouncers are the same as in assignment 1. This time there is one button for starting the counter and another for changing the direction. Everything in the counter itself is the same as in assignment 2 except for one variable in an HDL counter that represents the direction of the counter that will change on a right button press.

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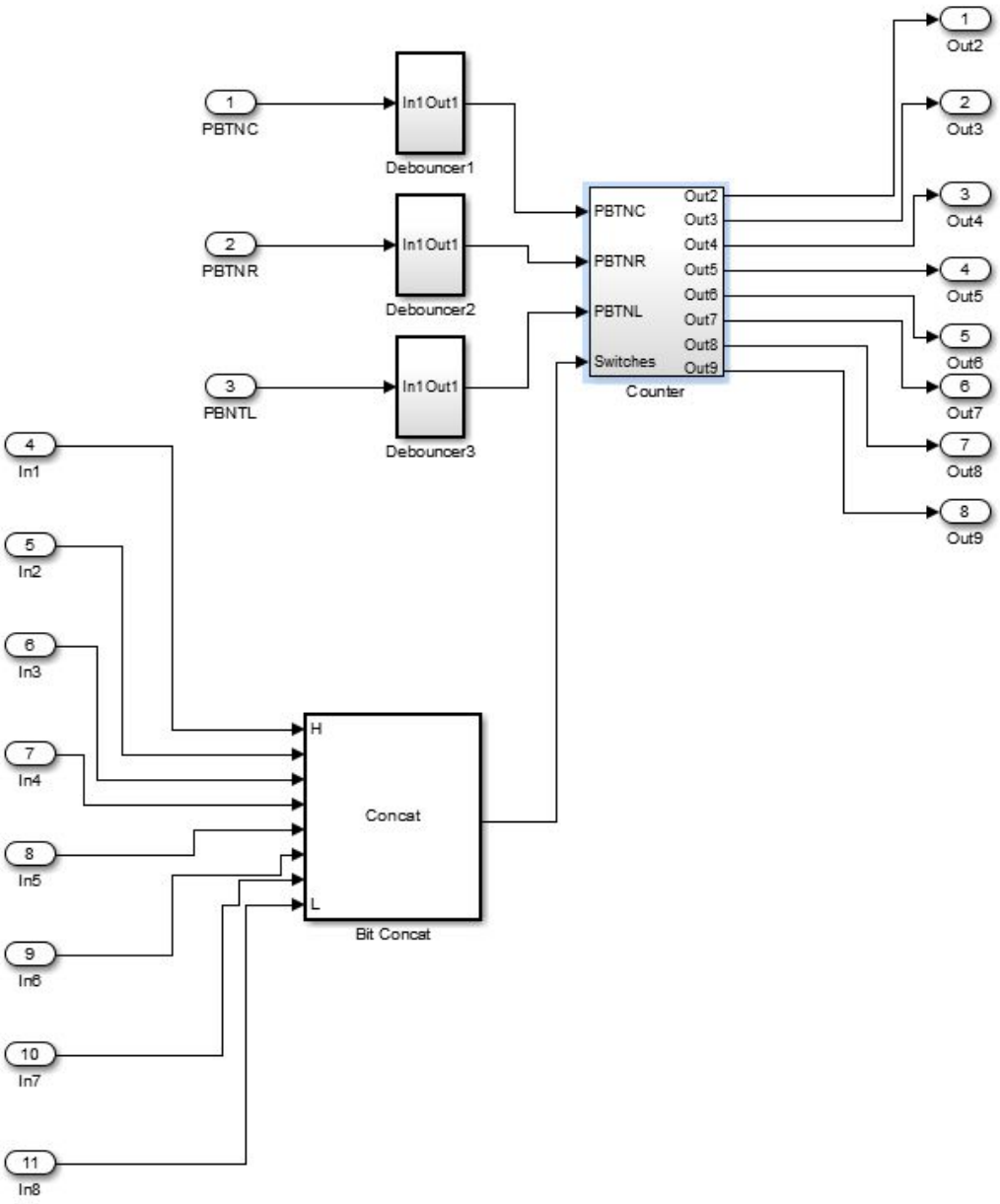
Assignment 4:



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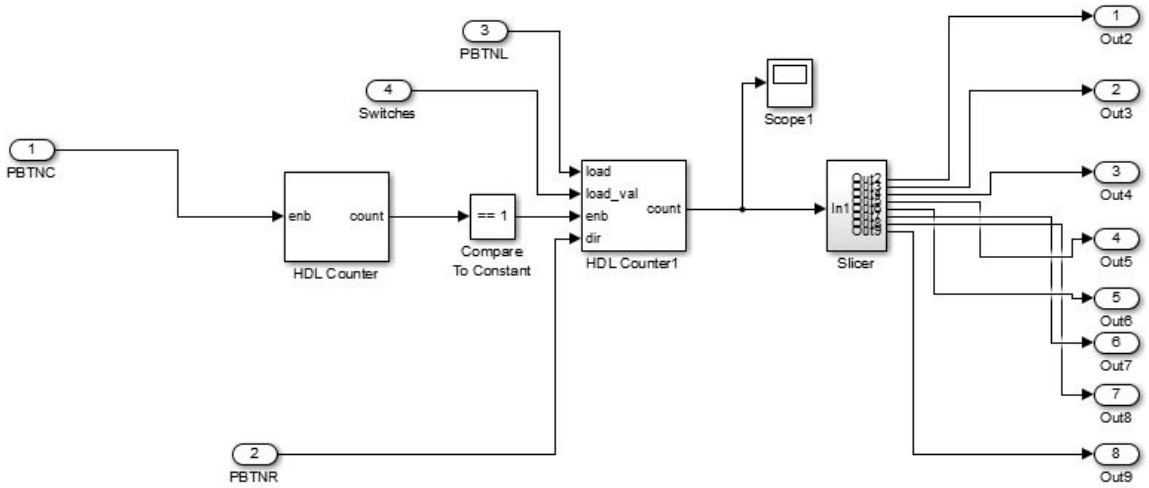

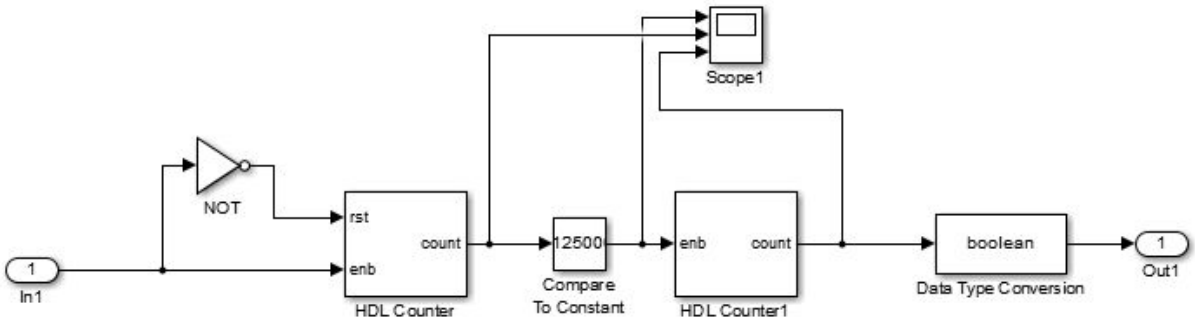

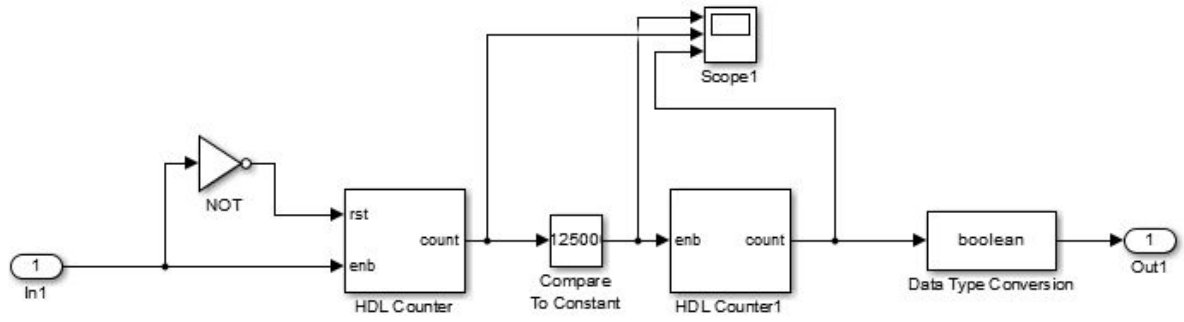

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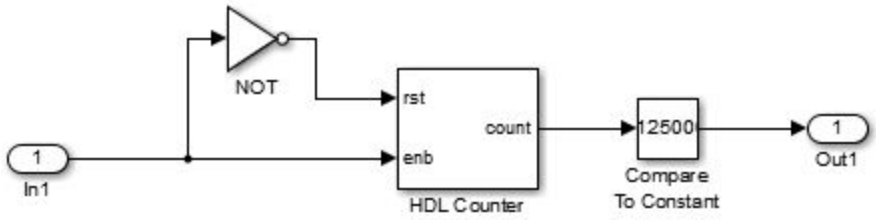

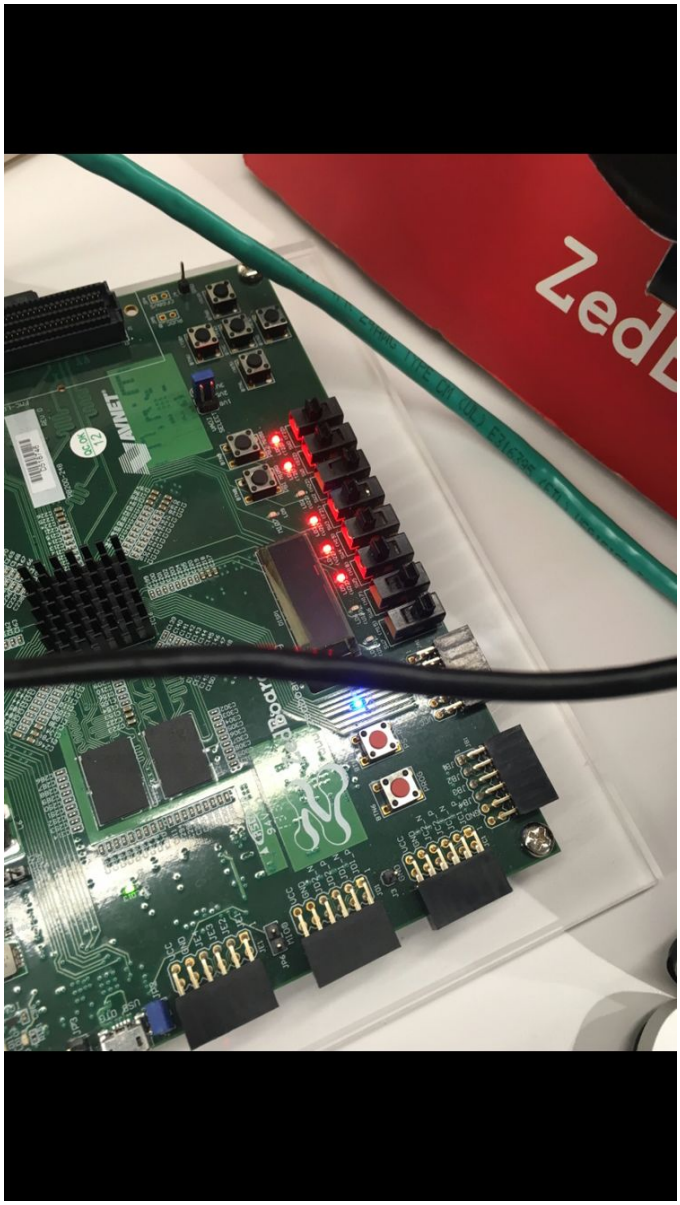

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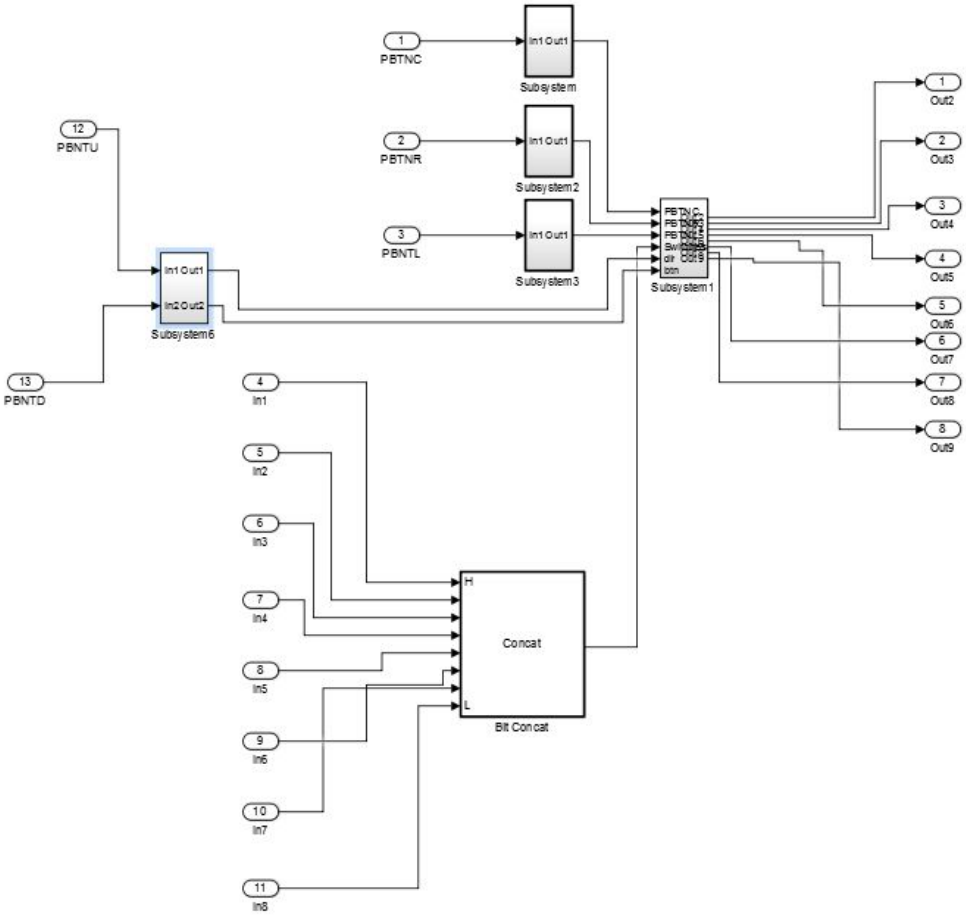
This assignment adds another button to reset the LEDs to that of the switches. All that is added is a concat that takes in 8 bits and converts it to an int8. This loaded val and the state of the new button is added to the HDL counter that keeps track of the actual count. The LEDs light up as expected on reset as seen in the picture.

Assignment 5:



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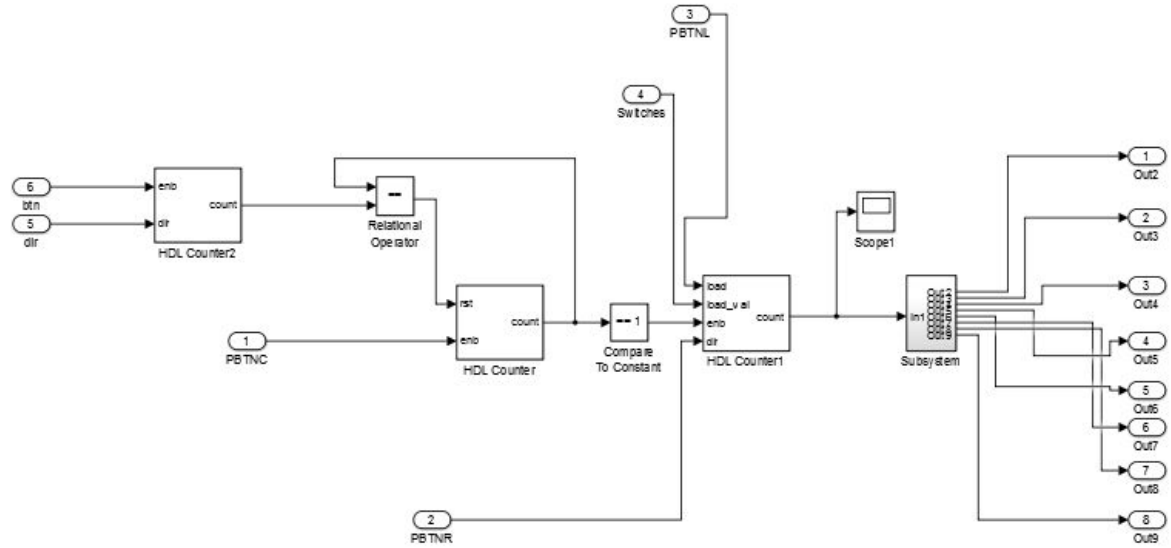

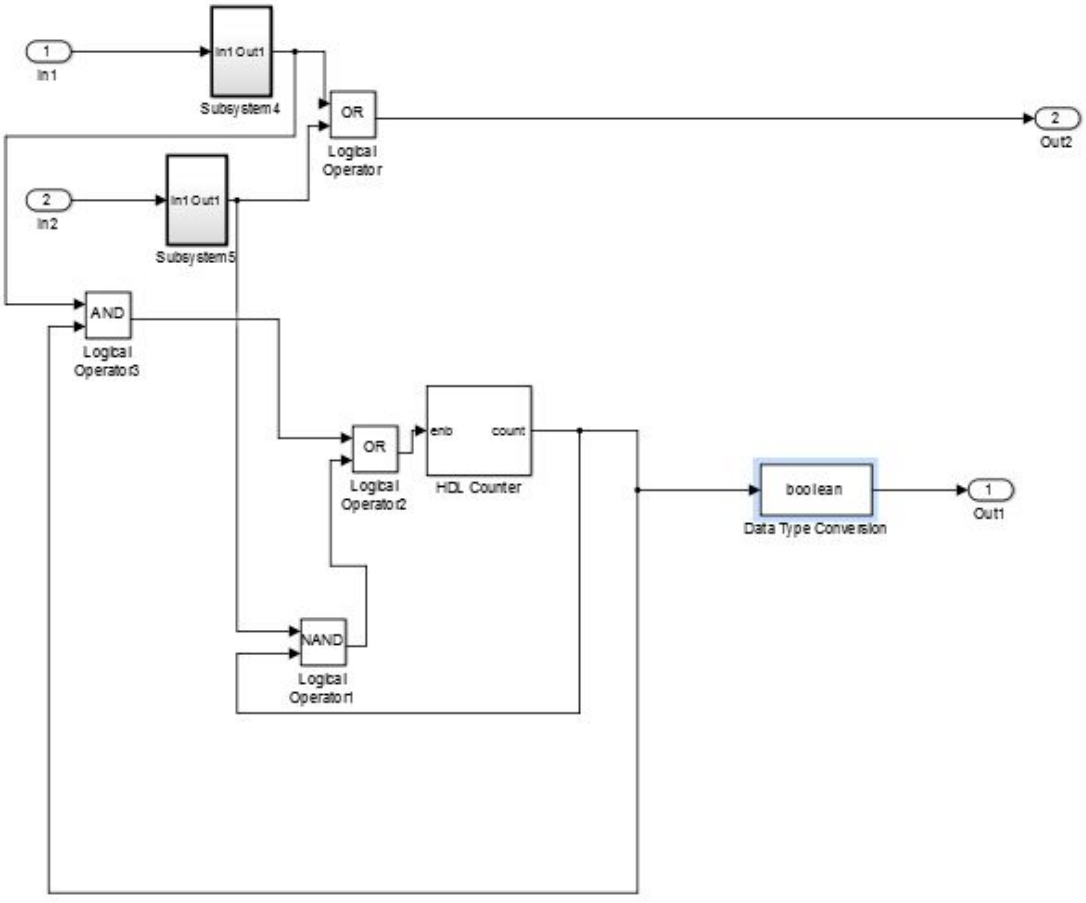

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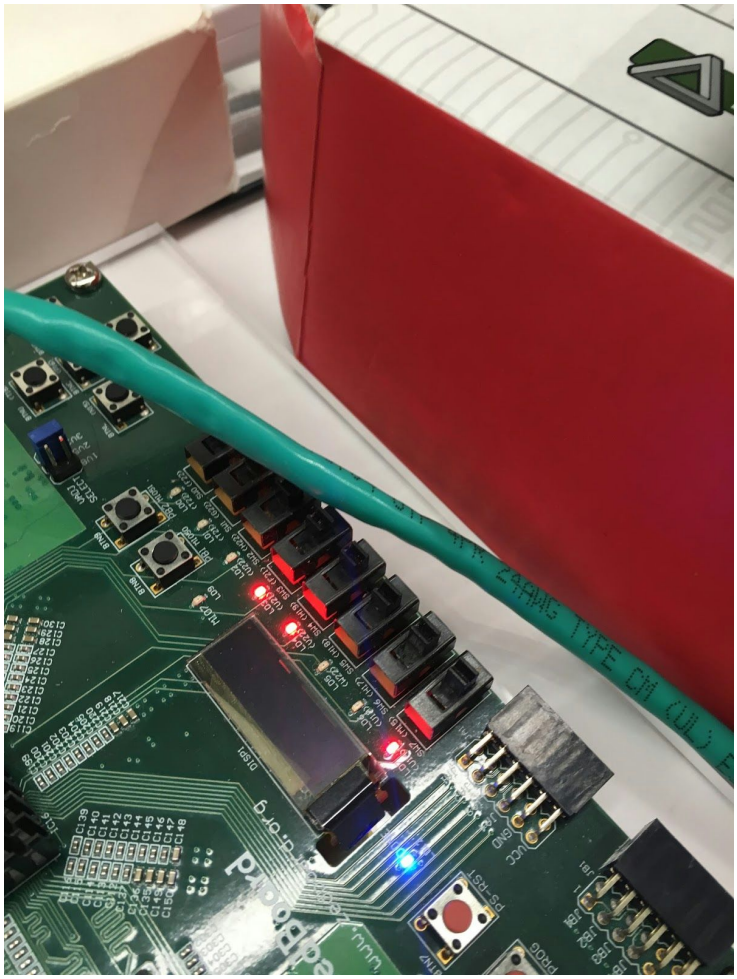

The last part of the lab uses a couple new counters. The first, which is attached to the HDL counter that controls timing of counts. This new counter will reset the old counter to make the count go either faster or slower. The number in the new counter is hooked to the up and down buttons. When either button is pressed the counter will increment, just depending on the status of another counter, it will change directions, making the value go higher or lower depending on which button is pressed. The third counter is to ensure that the direction of counting does not change with every button press, just when the other button is pushed.

Conclusion

In this lab, the state of the push buttons were read using hardware. Signal bouncing from the buttons were dealt with. A variety of things were done with the buttons and the LED lights. A basic design controlled the state of an LED using a push button. It was then be extended to the point where the push buttons could reset a counter, enable or disable its periodic increments, and change its counting direction and speed. In the future, for more work, more cool designs could be made that manipulate the lights. The designs could also be remade to be clearer and more modular. Most importantly, more testing could be done to make sure that the desired effects were achieved to the full extent. The lights' timing could be checked using a stopwatch.

References

N/A