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COEN 21 Lab 3

Intro

Our circuit takes in four inputs - CS, LS, RS, and RR - and gives three outputs - CL, LL and RL. This circuit takes in the status of three car lanes and if round-robin is on/off, and then determines which of the three lanes' lights should turn on based on the inputs. In each combination of inputs, one of the outputs is active(one) and the rest of the outputs are not active(zero). In order to create this circuit, we used our pre-lab and used the Product of Sums of each output.

Simulation Strategy

From the truth tables, we created karnaugh maps which allowed us to find the minimized versions of SOP and POS of each output. Next, we compared the SOP and POS of each output and determined which version was cost-efficient. Using the most cost-efficient version of each of the outputs, we were able to create the logical circuit to get the desired output from the desired inputs. We did identify some errors in our design for this circuit. We found them when we ran a simulation of the circuit and did not get the desired output. To correct them, we worked as a team to reevaluate the logic gates used and the inputs going into each logic gate. For example, the first time testing, we didn't get the desired output for Left Light, so we had to retrace our path and fix the logic. Once we did that, we got the desired output for the Left Light.

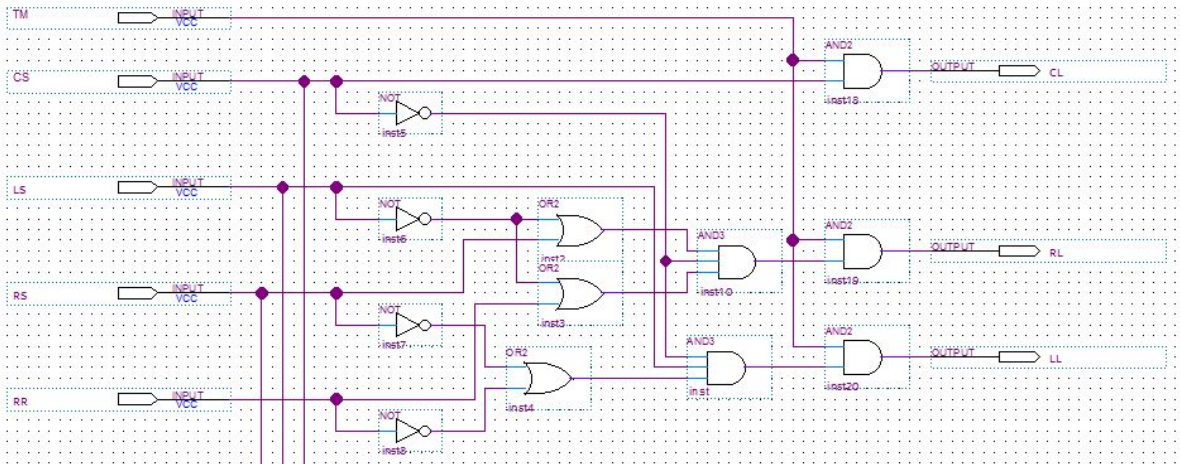
Our simulation strategy would work help to detect all design errors since you can not get the right desired output without having the correct design with zero errors.

Addition of ERR1

To create the new output ERR1 to detect if two or more lights have been turned on at the same time, we would need to add three AND gates summed together with a 3-input OR gate to detect if any two of the CS, LS, and RS signals are on with a canonical SOP of **(CS * LS) + (LS * RS) + (CS * RS)**. An equation that seems to exactly match the given boolean expression for the T1 Pin. Because T1 works as the MSB in a 2-bit "counter" (Full-Adder), it will only switch to true when the 2 or more inputs are on (The desired function).

Addition of TM Input

To account for this additional Timer Input, we would need to add 3 AND gates right before each of the three light outputs CL, RL and LL. One of the pins of each of these AND gates should be connected to the pin's corresponding outputs (the ones before the addition of these AND gates), and the other one should be connected to the new TM input. This will only "enable" (allow the output) to be passed to the pin when the TM input is set to 1 providing the desired effect.

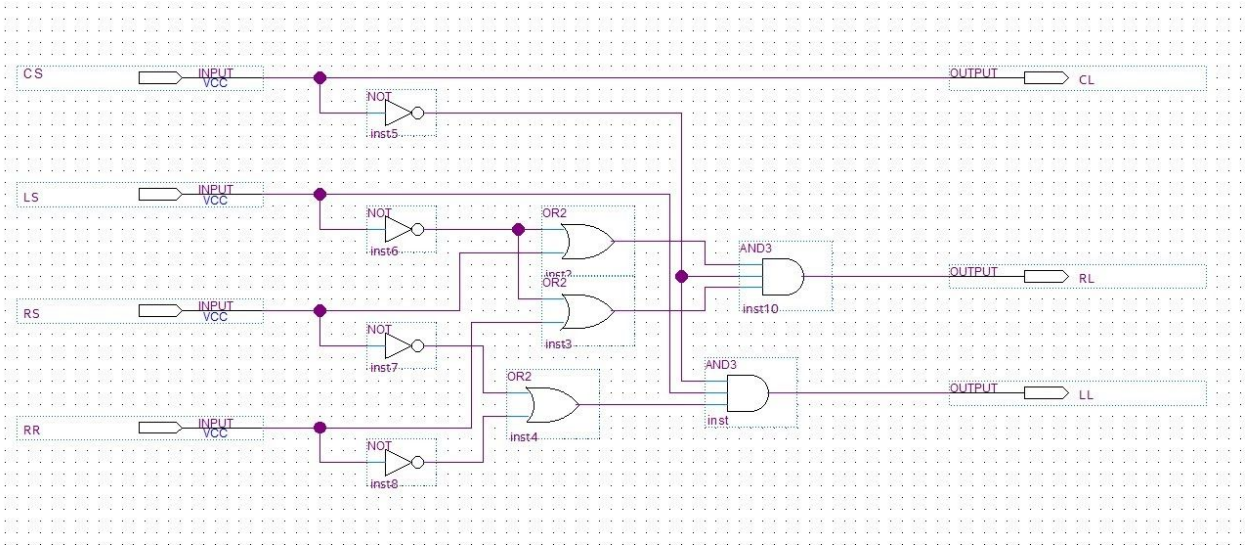


Strategy to Prevent Carpool Blockage

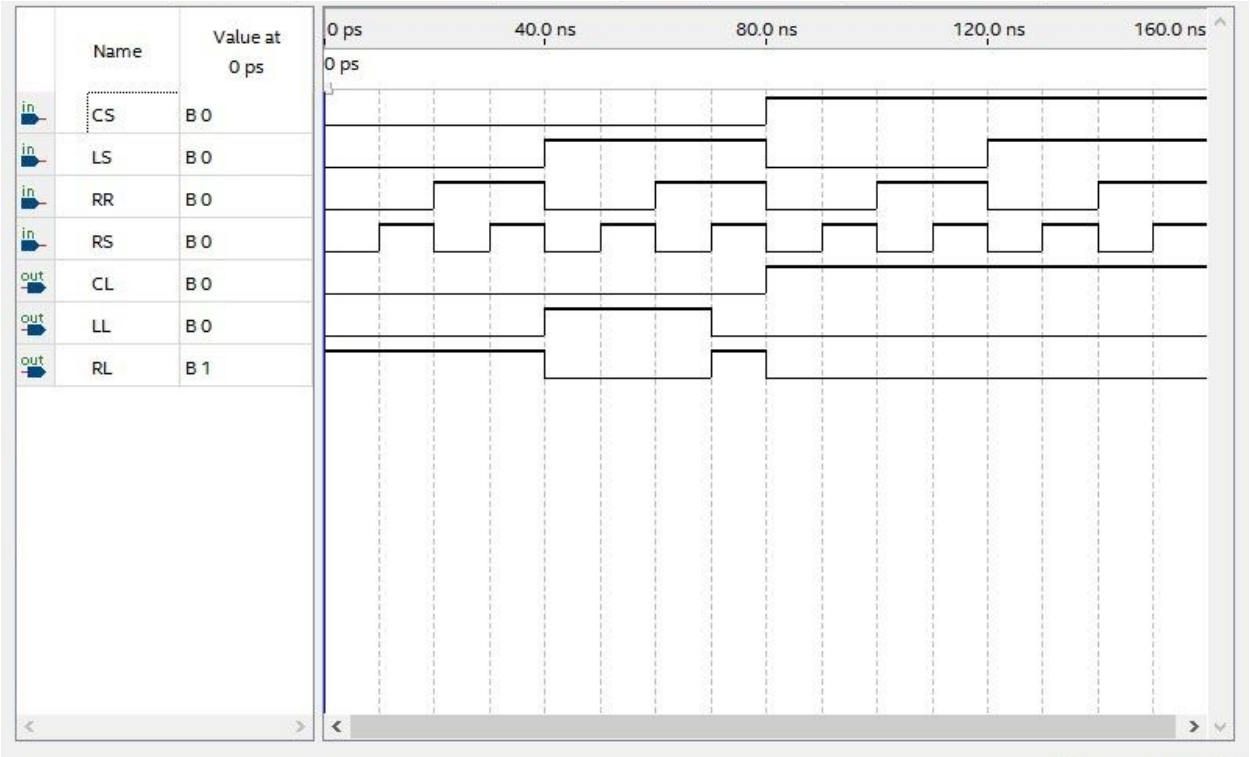
A strategy that would stop traffic and clog in the non-carpool lanes would be to insert a stop light for each lane to go and stop one-by-one. The light will alternate between the carpool lane and each of the other lanes so carpool lane then left lane then carpool then right. While there may still be traffic, the non-carpool lanes won't be dead stopped and waiting for the carpool lane to start.

Part 1

Circuit Schematic

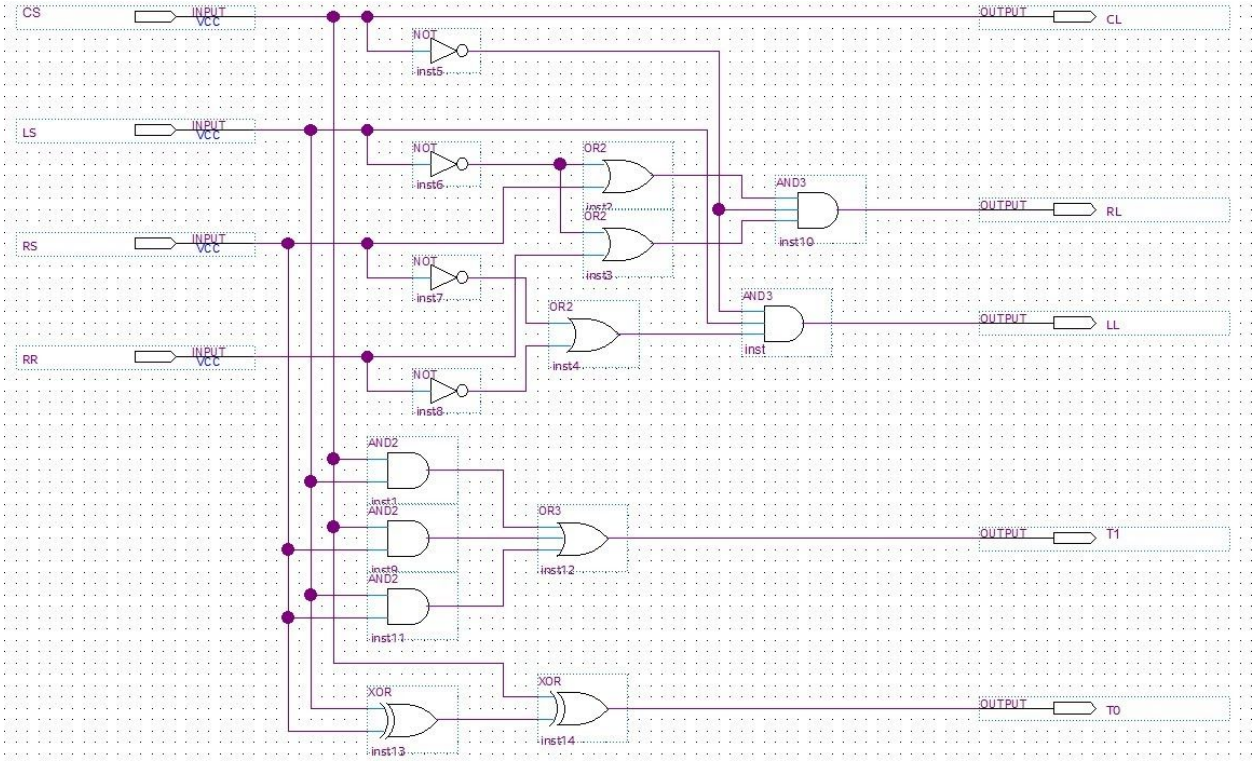


Timing Diagram Waveform



Part 2

Circuit Schematic



Timing Diagram Waveform