Traffic Buildup Detection System

Using NexysTM-4 DDR Artix-7 FPGA Board and Xilinx® ISE Webpack Design Software 14.7 version

Tammy Luu, Yinkai Liu, Shengzhuo Liu, Patrick Pantis
Electrical and Computer Engineering Department
School of Engineering and Computer Science
Oakland University, Rochester, MI
e-mails: ttluu@oakland.edu, yliu3@oakland.edu, sliu23@oakland.edu, pjpantis23@oakland.edu

I. INTRODUCTION

In this project a traffic build up detection system was chosen because of its uses outside in the real world. The benefit of this system is that unlike a regular traffic light, there is a push button sensor connected to the side roads left turn lane light that forces the light of the traffic signal to change after detecting a vehicle for a certain period of time. This prevents build up at the traffic light's left turn lane. On top of this, the system will change to all flashing yellow lights when pressing a button to represent the how a light would work at the time of night. All the count down times of the lights will be displayed on the 7-segment display to showcase the traffic light working off a time.

II. METHODOLOGY

A. *Traffic Light*

The Traffic light works by using case codes. Traffic light code includes 6 state. The first case is initiated, after a certain period of time; the second code is then initiated. This constantly loops indefinably until the program is either stopped with a clr button, or when the flashing button is initiated. In this case the green light is set to go on for 15 seconds for main street and 10 seconds for side street. The yellow light goes on for 3 seconds to prepare people properly to stop and 1 second for double red lights.

Traffic Light Cases			
state	Main Road	Side Road	Timing(sec.)
1(day pressed)	yellow	red	3
2	red	red	1
3	red	green	10
4	red	yellow	3
5	red	red	1
0	green	red	15
night pressed	Flashing Yellow	Flashing RED	Indefinite

Table 1

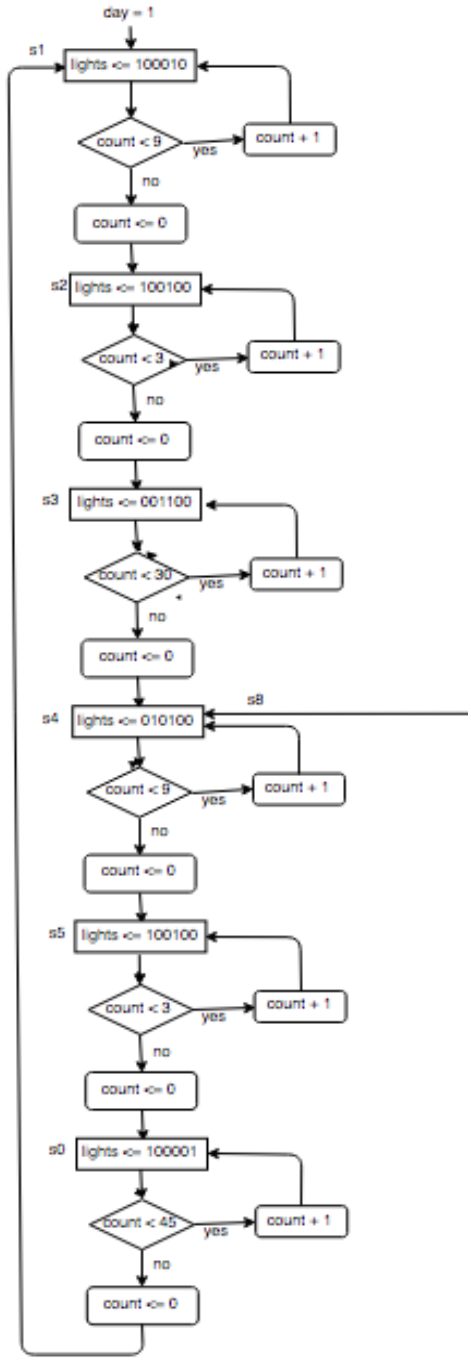

Figure1- ASM day part

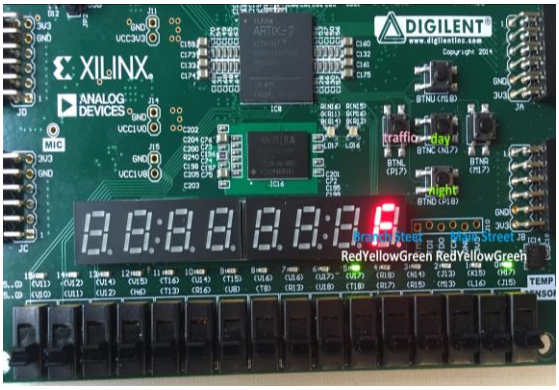

Figure 2- 3 input button and 6 output leds

B. Blinking Light

When the clrr button is pressed, the code for the blinking light is initiated. The side road's lights will blink red and the main road's will blink yellow. This works similar to the traffic light, but activates on and off. After 1 second with the lights on, the code initiates the light to be off for one third of a second. These two states loop until the code is reset back to the original traffic light code.

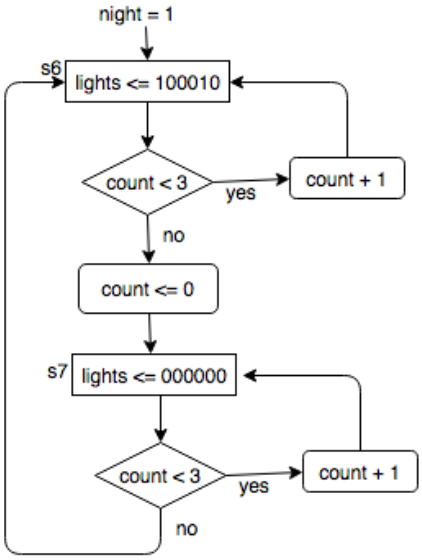

Figure3 - ASM night part

C. Main Road Traffic build up

On the main road, there is a push button sensor that detects whether or not a car runs over it. When the button "sensor" is activated, that portion of the code is ran. If the push button sensor detects a vehicle running over, it loops the code to change the light to go green for the main road (case 3). This change lasts for the same duration of the original light and puts priority on the push button sensor over the case functions of the Traffic Light.

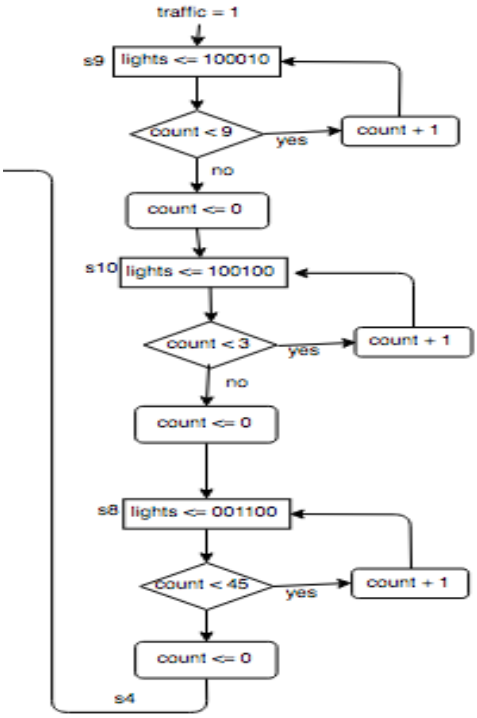

Figure4 - ASM traffic part

D. Light Clock 7-seg Display

To use the 7-seg display, a delay had to be created. The idea was to delay the state using two clock codes, one to control the traffic, another one is used to control the 7-seg display. This was done by counting up the time of the traffic light and displaying it on the 7-segment display. This was to primarily demonstrate the timing of the lights.

For the first clock code, a 3Hz frequency clock was used so it could count each 3 count responses for each second. For example, in state1, yellow for main street and red for side street. 9 clock cycles were counted which translates to 3 seconds. If the count was less than 9, the state will stay in state 1. Though, when the count reaches 9, it will reset the count and go to next state.

In the last delay, a 100 MHz clock was used to generate a 1 Hz clock, which means that clk=1 for a 50 MHz clock cycle and clk = 0 for another 50 MHz clock cycle.. In this project's code, we used two process to reset the count and seconds. Seconds in this project was the output for the clock code. It was used by the HEX as an input to select the signal in the 7-segment display, or another words, as a timer.

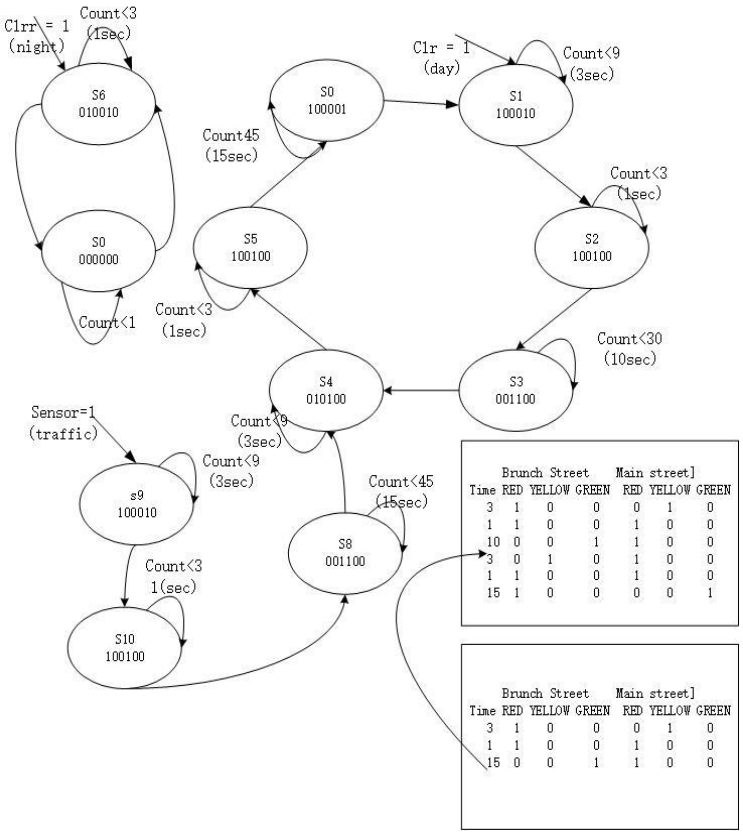

Figure5- FSM for three parts

III. EXPERIMENTAL SETUP

Using Xilinx® ISE Webpack Design Software 14.7 version the project was simulated with the coding done in VHDL. All the code was then uploaded to the NexysTM-4 DDR Artix-7 FPGA Board to display the function of the lights using the LEDS and 7-seg on the board. A push button sensor was used for detecting if an object was sitting at the light on the main street.

IV. RESULTS

The light's case code ran appropriately with the timing displayed on the 7-seg. The light went through all cases, changing it's light based on the states time. If it detected an object on the main street, the code would loop back to case 3 making that light change to green. The code would then keep running from the

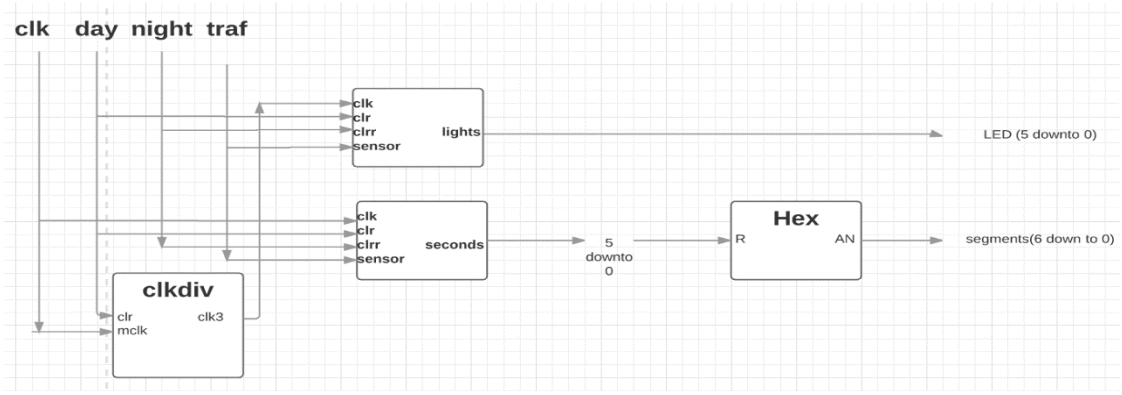

Figure6- Datapath 1

changed lights case (case 3). When the button was pressed to initiate nighttime, the lights were then changed to a flashing yellow. This blinked on for 1 second, then another third of a second off. This looped indefinitely until the code was reset to the original traffic light code.

V. CONCLUSIONS

In this project we learned how to use case codes and timing functions to create a traffic signal. This is extremely beneficial when programing things that go from one state into another. Depending on whether the program passes that state, it will determine if it will continue onto the next state or restart its current state until the program is satisfied. Some issues ran into this project were setting the timing of the lights right and displaying the appropriate time onto the 7-seg display for each state of the lights.

Some Things that could have been improved was to add more sensors into the traffic system making it more proactive in preventing traffic buildup. The 7-seg display could also count down time instead of counting up to demonstrate the time left at the light more clearly. The blinking yellow lights could been tied to a clock, so after 18 hours of running the traffic lights system, the blinking yellow would initiate from the times of 12am to 6am. Another improvement could be to use two 7-segment displays to show the timing of the lights. This allow drivers or pedestrians to see the remaining time till the light changes. Lastly, a push button for the pedestrian crosswalk could have been added. When a pedestrian wants to walk across the sidewalk, they can presses the button, which then calls the light to change to their favor. All these examples would need a new system with new state codes and more conditions for the 7-segment to run.