COE118L- ADVANCED LOGIC CIRCUITS AND SWITCHING THEORY
3st Quarter SY 2017-2018

5 Roads 2-Way Traffic Lights Using Multisim

Submitted By:

POTESTADES, Juan Gabriel P.

RABAGO, Brian Mae C.

REYES, Jean Marc D.

Engr. Carlos C. Hortinela, IV

Professor

Mapua University

March 2018

Acknowledgement

The group would like to thank the following for supporting us, without them, this project will not be possible;

First and foremost, God, who is always there to guide and give us courage, wisdom and knowledge for everything we do.

We would also like to thank our families not only for all the support they have given us, without them the group would not be inspired and motivated to do this project.

We would like to give our gratitude to our beloved professor, Engr. Carlos C. Hortinela IV for his lectures and guidance throughout the term.

And last, our friends who are always there to give support and offer help in the best way they can.

TABLE OF CONTENTS

Abstract

In a 5-way traffic, the traffic system uses right-of-way rules who may pass the intersection first. Chance of collision of vehicles passing the intersection is high. Even pedestrians are frightened to cross the street. The problem is that the traffic system does not consider the distance and time, hoping that first come first serve will do. The traffic lights systematically change the signal it gives to the people. Each of these traffic light gives ‘go’ signal when green, ready/slow down when yellow and stop signal when red. Our objective to design an equal or if possible better circuit in multisim. The following topics were successfully applied in this experiment: algorithmic state machine, asynchronous sequential circuit, synchronous sequential circuit, counters, registers, and random access memory. The circuit also includes the following significant elements/functionalities: master clock, reset for the master clock, area to specify the time delay, read and write operations, and reset switch for the delays previously placed. The outputs are mostly connected to LED probes. A Display of 5 roads were also depicted to give a better view of its real life application.

CHAPTER 1: DESIGN BACKGROUND AND INTRODUCTION

Introduction

As you drive around town on your daily commute, you may find yourself stuck in traffic and getting poor gas mileage. One of the big reasons could be the poor design of the traffic light system. The main goal of this project is to design a two-way traffic lights for 5 roads using Multisim. To approach the problem, using several traffic lights to manage the car and pedestrian traffic at the intersection. The traffic lights systematically change the signal it gives to the people. Each of these traffic light gives 'go' signal when green, ready/slow down when yellow and stop signal when red. See the figure for the flowchart of each traffic light for vehicles.

Objectives

At the end of this laboratory course, you should be able to:

1. Design a better traffic light system using MultiSim Software.
2. To use curve fitting with linear regression using Microsoft Excel to provide fair car-passing time for a 5-way intersection.

Fig 1. Taoyuan District, Taoyuan City, Taiwan 330

Project Setting

All the lessons and knowledge that we have learned in this course are applied here in this project. This project involves the use of algorithmic state machine, asynchronous sequential circuit, synchronous sequential circuit, counters, registers, and a random-access memory**.**

Statement of the Problem of the Project

In a 5-way traffic, the traffic system uses right-of-way rules who may pass the intersection first. Chance of collision of vehicles passing the intersection is high. Even pedestrians are frightened to cross the street. The problem is that the traffic system does not consider the distance and time, hoping that first come first serve will do. The yellow circle signifies the median where the traffic lights shall be located. As an example, the group used the 5-way intersection in front of Taoyuan Arena, Taoyuan District, Taoyuan City, Taiwan 330. The Figure below shows the satellite view of the example problem.

CHAPTER 2: DESIGN METHODOLOGY AND PROCEDURES

Methodology:

The traffic lights systematically change the signal it gives to the people. Each of these traffic light gives ‘go’ signal when green, ready/slow down when yellow and stop signal when red. See the figure for the flowchart of each traffic light for vehicles.

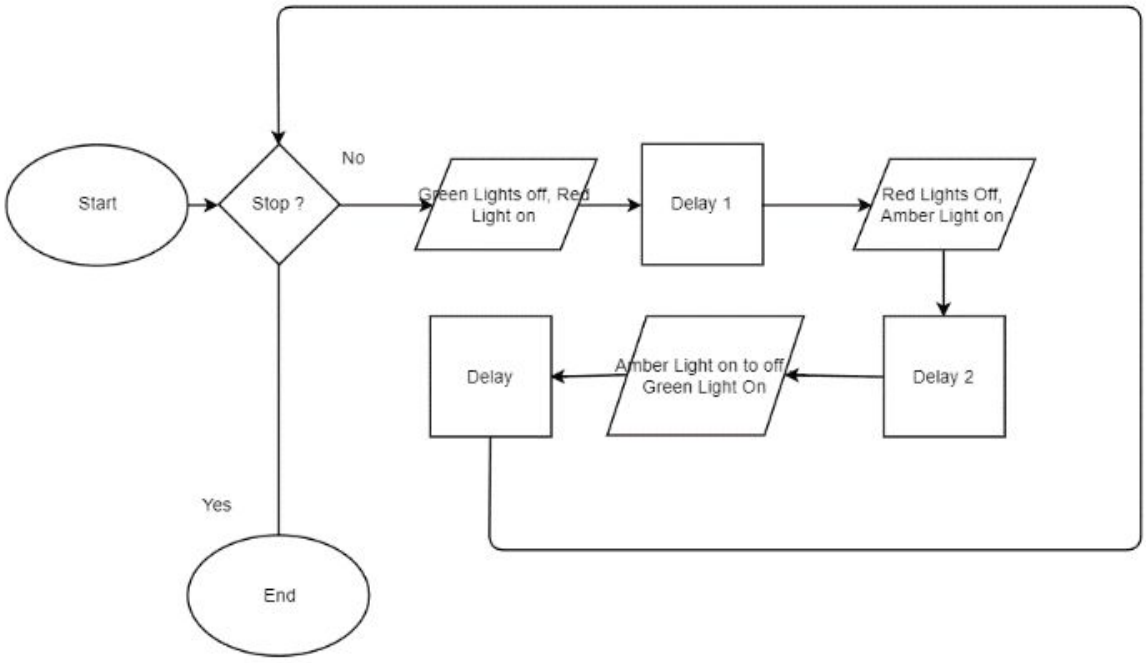


Figure 2. Traffic Light Flow Chart for Vehicles

For the pedestrian traffic light, there are only two signal lights, red and green, that has conventionally same meaning. The pedestrians can only pass the intersection via PedXing lines in the road when the light is green, otherwise, pedestrians cannot pass. The figure below is flowchart for the pedestrian traffic light.

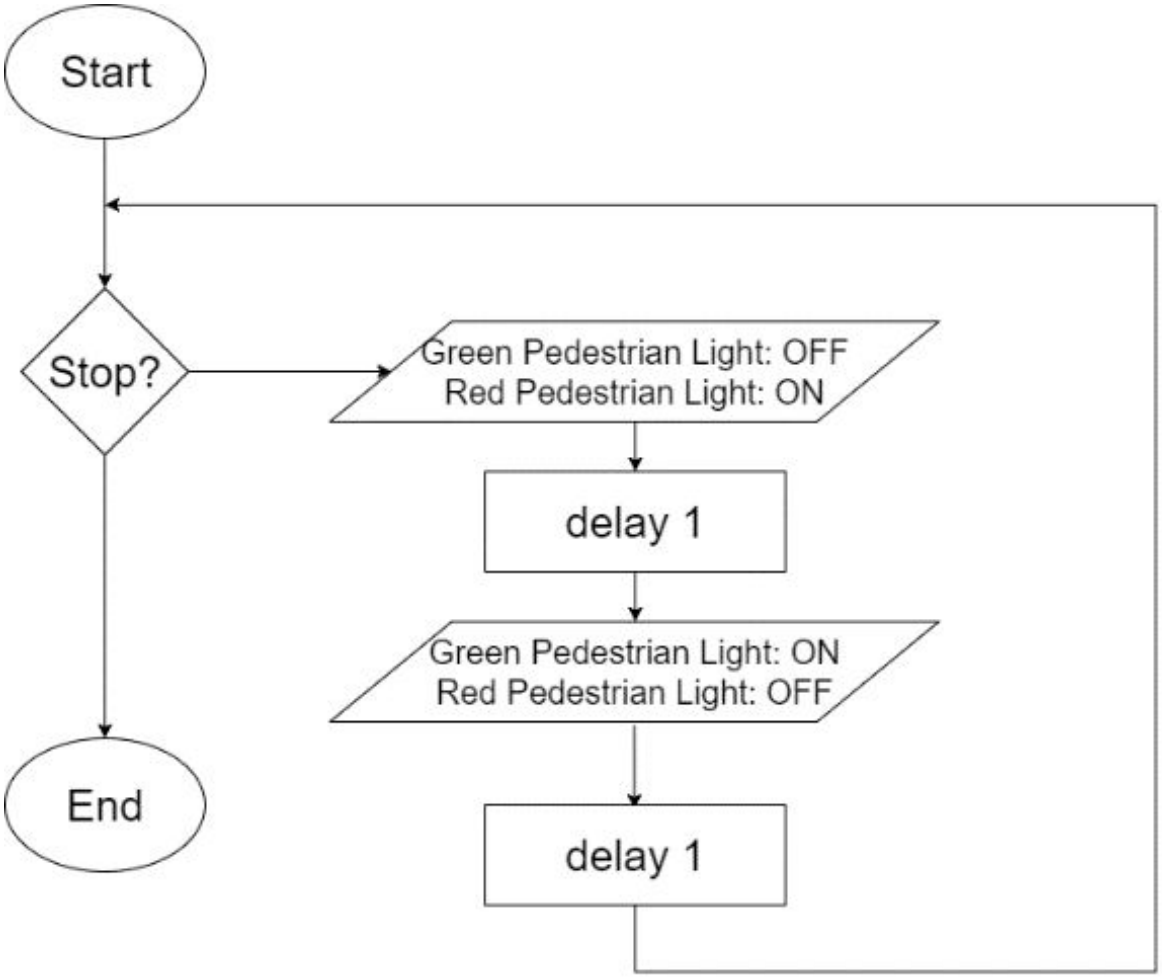


Figure 2.1 Traffic Light Flow Chart for Pedestrians

Working on the delays or time intervals, the researchers then analyzed first the independent variables which is the distances from Point A to another point, from Point B to another point, and other possible ways to pass the intersection. The data from the table 1 was acquired from the google maps driving directions by setting up direction from a designated point to a destination point.

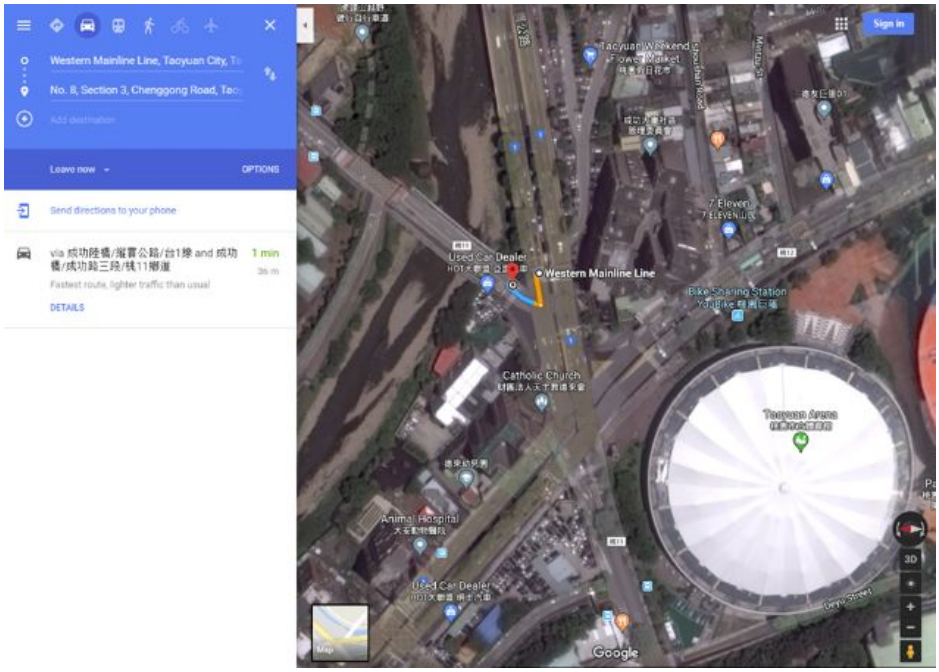


Figure 2.2 Acquisition of Independent Variables

Far left lane of the road has a traffic rule that implies U-turn only rule that give our distance data from point A to itself as unnecessary to be gathered.

Point-to-Point Distance between Intersections (meters)					
	A	B	C	D	E
A	N/A	91	75	130	120
B	75	N/A	66	120	110
C	79	45	N/A	110	110
D	150	120	110	N/A	45
E	160	130	110	36	N/A

Table 1. Distances between Intersections

To provide a fair passing time for vehicles in a 5-way intersection the students need to consider the following: the distance traveled in the intersection, the time needed to travel, and the transition of traffic lights from green to red to amber.

For the transition of traffic light, the students follow the usual flow of traffic lights as shown in the flow chart.

As seen in the flowchart the traffic lights transition from green to red to amber in a loop. However, to use this set of traffic light in a 5-way intersection, it is necessary to adjust the delay time of their transition in a way where it could provide a fair passing time for each intersection for this the students use the D flipflops to get the best combination of delay time.

Using the 5-way intersection in Taoyuan Arena the students gathered the data for the distances traveled between intersections as well as measured the Testing.

State	GA and E	YA and E	RA and E	GB and C	YB and C	RB and C	GD	YD	RD
0	1	0	0	0	0	1	0	0	1
1	0	1	0	0	0	1	0	0	1
2	0	0	1	1	0	0	0	0	1
3	0	0	1	0	1	0	0	0	1
4	0	0	1	0	0	1	1	0	0
5	0	0	1	0	0	1	0	1	0

Table 2. State Table for the Possible States of the Traffic Lights

Using the information available on the Taoyuan Arena Intersection, the students would integrate the given data to fit onto a curve that will determine a more effective way of dispersing vehicles on an intersection.

The traffic lights in the 5-way intersection each have one green, yellow and red traffic lights. The students can assign traffic lights at A as GA, YA, RA; at B as GB, YB, RB; at C as GC, YC, RC; at D as GD, YD, RD; at E as GE, YE, RE. Since there are 5 roads it is possible to allow two traffic lights at a time to turn green while the rest are red. Given this situation the students list the possible states:

Given in Figure 3, the students classified the synchronous bit counter to connect sequential logic JK flip flops. The circuit can have less states from 60 states to only 32 states through the use of 5 JK flip flops

There are only 6 possible state for the 5-way intersection. Every green traffic light will turn on for one and a half minute and the maximum time for the traffic light to be red is about two minutes. Using this information relayed from the state table, the students can translate and apply that to our traffic lights system. The students can also implement this given data to create a traffic light system for the PedXing and apply it to the table below.

The yellow block is JK flip-flops, which controls how long the lights glows. The orange part is combination logic that transfer binary codes to states codes. The green part is combination logic that transfer states codes to the timing of which light glows. Finally, is the blue part, it controls the clock from 0 only to 179 but not 255, because the whole period of this system is 180 seconds.

The final circuit design for the traffic light that control traffic for the vehicles in the intersection comprises of three parts. The blue part is significantly the clock from 0 to 179. The yellow part is the JK flip-flops that controls the time frame for the light to glow. Lastly, the orange part is the combination logic how binary codes are converted to

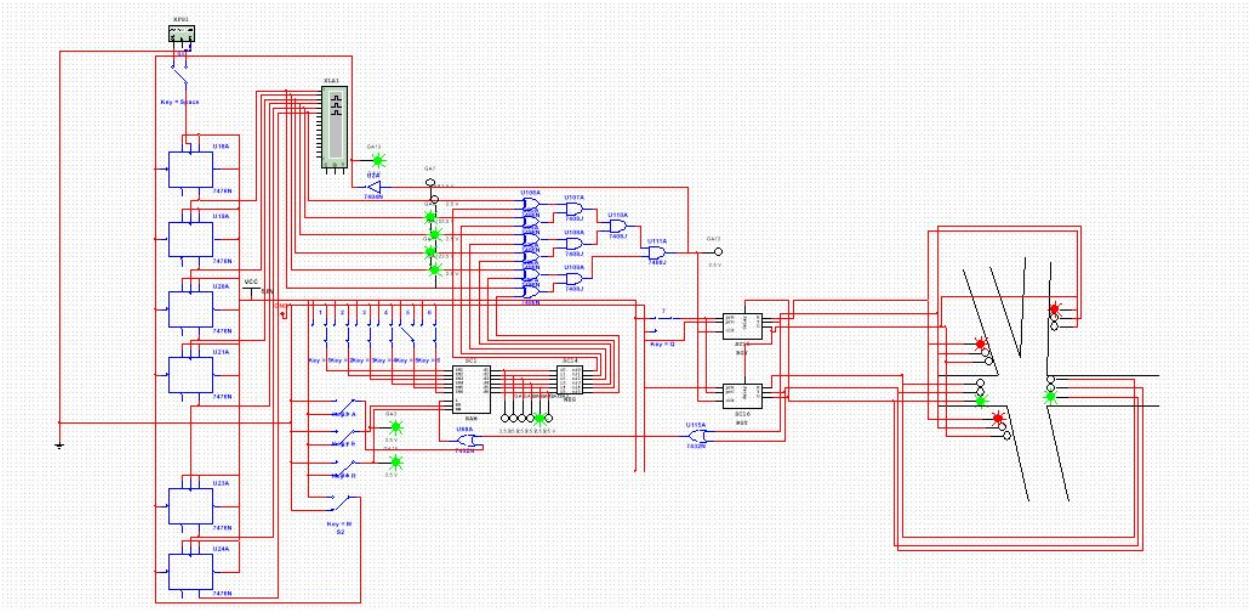


Fig 2.3 **Roads 2-Way Traffic Lights Using Multisim**

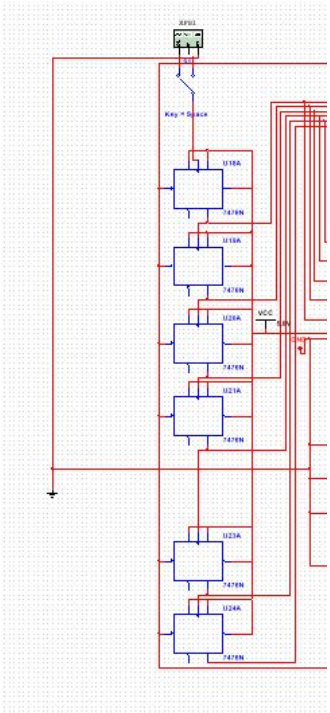


Figure 2.4 Asynchronous Sequential Counter

Figure 2.4 is an Asynchronous Sequential Counter. An asynchronous circuit, or self-timed circuit, is a sequential digital logic circuit which is not governed by a clock circuit or global clock signal. Instead it often uses signals that indicate completion of instructions and operations, specified by simple data transfer protocols.

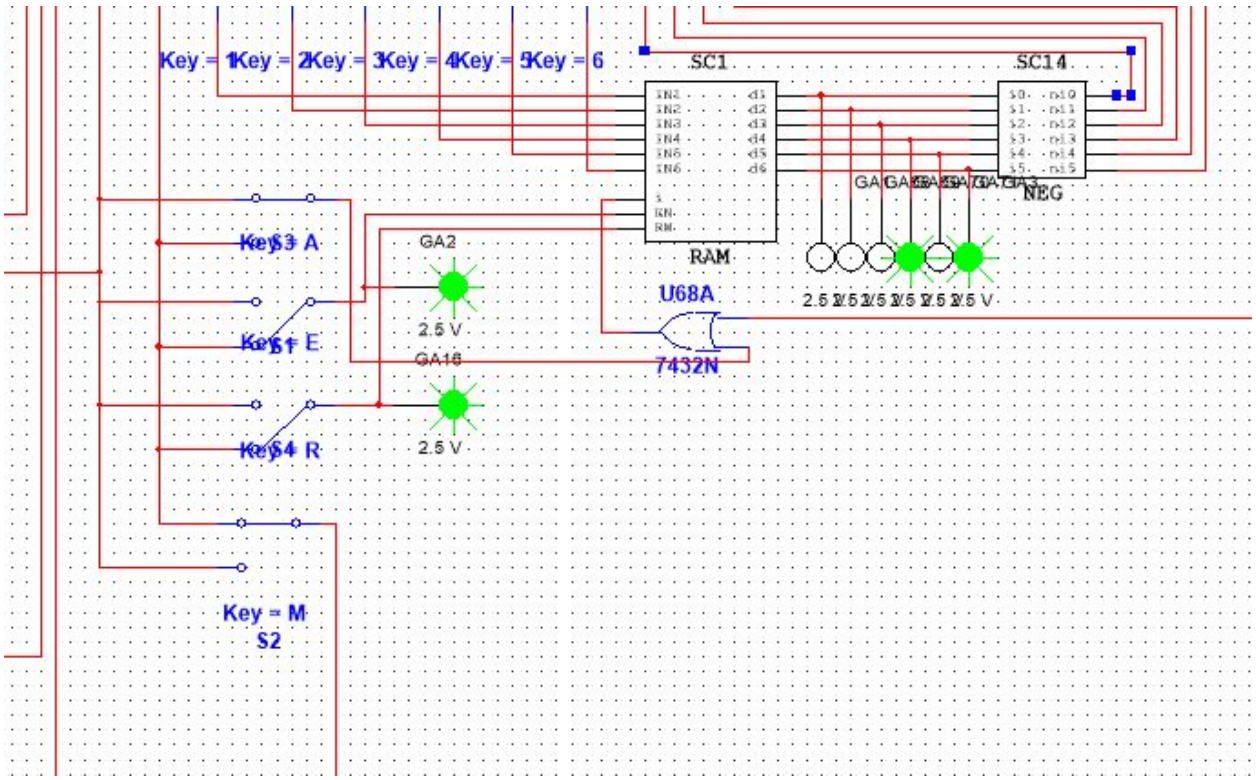


Figure 2.5 RAM

Figure 2.5 is a Random Access Memory. It only requires the user to input a certain delay from transitioning from red to green. Also, to input a delay for the yellow light. The key M represent the master reset of the clock.

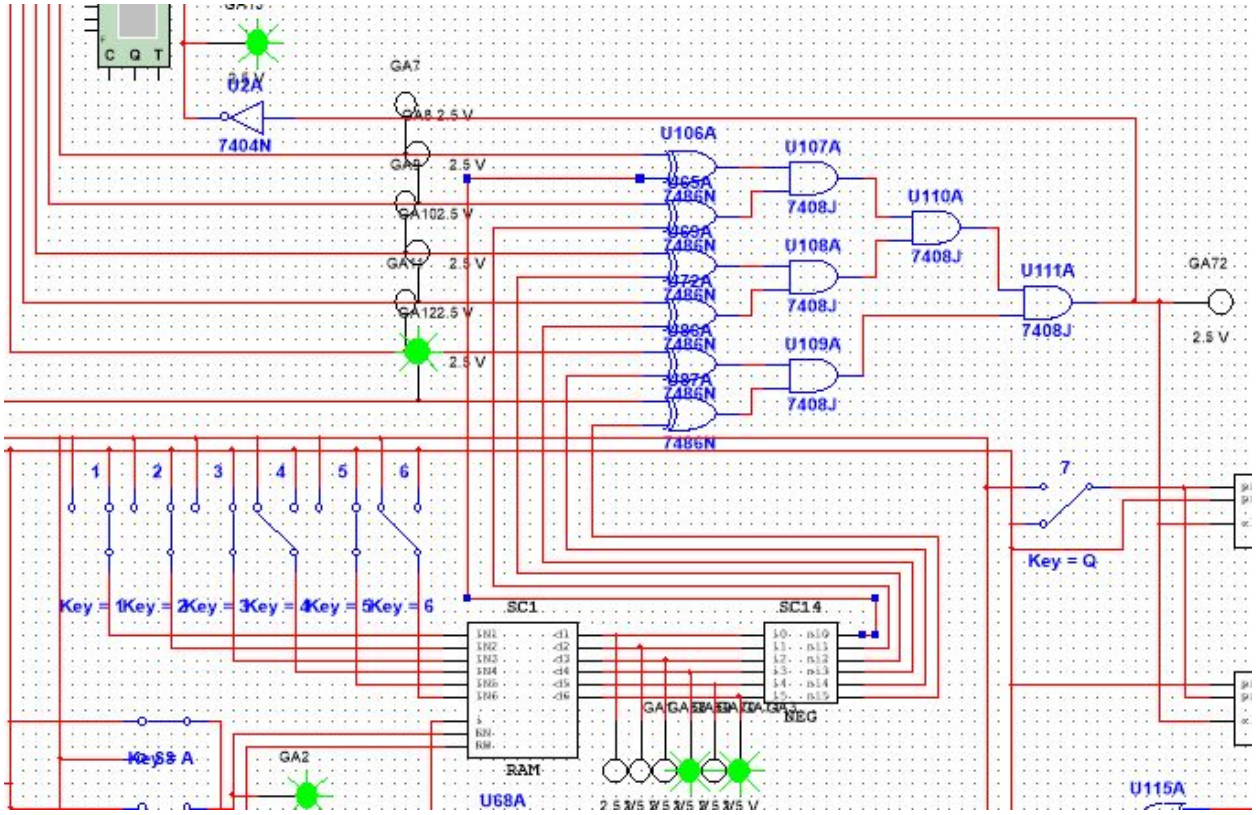
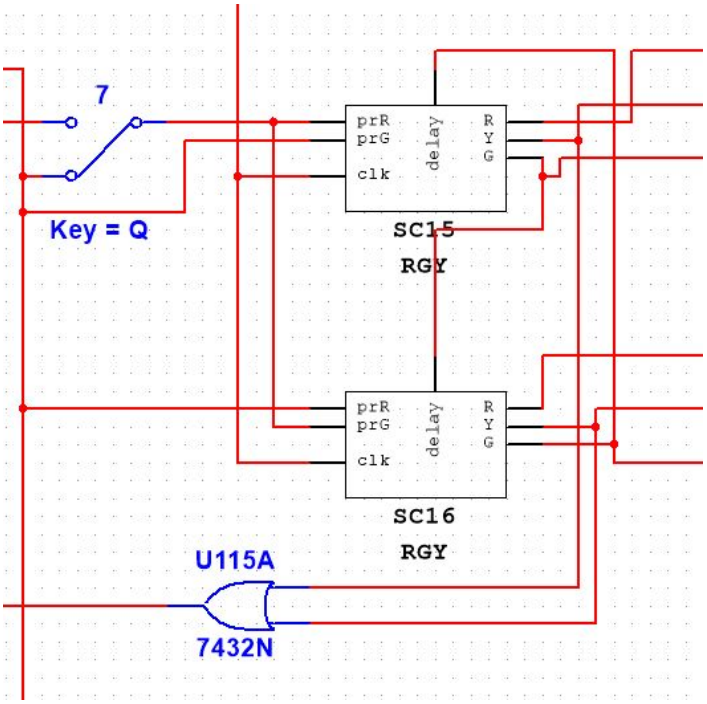
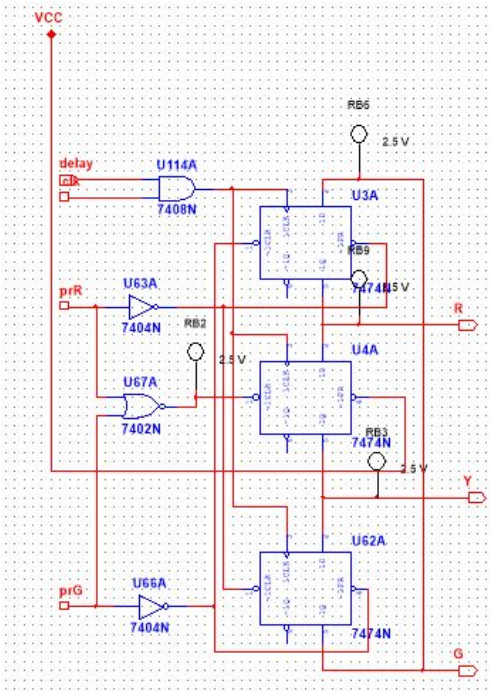


Figure 2.6 RAM to Inverter

Figure 2.6 represents the RAM to inverter to logic gates.

Based on Figure 2.6, the user will input a delay for the red-to-green signal and a delay for the median (yellow light). After which, the inputs will be stored in the RAM and the logic gates will compare the delays to the RAM. If the comparison of the RAM and the logic gate satisfies, it will proceed to the next address then the light emitting diode (LED) will toggle and compare again to satisfy the condition. The LEDs that are between the RAM and the inverter signifies the inputted delay of the user. The LEDs near the logic XOR gates represents the count of the clock.





(a) (b)

Figure 2.7 D Flip-Flop

Referring to the figure 2.7(a), SC15 and SC16 are subcircuits that contains three D flip-flops. The subcircuits are arranged in a sequence from red-to-yellow-to-green-to-red similar to a 3 bit register. From figure 2.7 (b), there is a bonus input in the delay that handles if the delay in the yellow signal is done. For the Q switch, it simply resets and presets the signals because 1 bit was set and the others are cleared so for example, if red is the starting point, preset red (prR) will be the configuration of Q switch.

CHAPTER 3: CONCLUSION AND RECOMMENDATION

Conclusion

This 5 Roads 2-Way Traffic Lights Using Multisim covers the necessary information we have learned in this course, Advanced Logic Circuits and Switching Theory. The following topics were successfully applied in this experiment: algorithmic state machine, asynchronous sequential circuit, synchronous sequential circuit, counters, registers, and random access memory. The asynchronous sequential circuits were made up of several JK flip-flop which are connected to the master clock. The ram utilized for this circuit is a 2x6 ram which has 6 address lines and an input bit line. The delays for the colors can be set and is compared to the circuit's counter to identify the change of state. If the circuit's counter is equal to the delay set, then such phenomena will occur. The use of multiple LEDs are also significant it lets the user see the counting, comparing and changing of colors. The neatness of the structure was also considered

and is possible due to the use of hierarchical blocks. This allows the excess circuits to be organized like the several use of Not gates in this circuit. Lastly, a mock display of 5 roads were also depicted to give a better view of its real life application.

Recommendation

The circuit created is functioning properly and is currently well organized. However, there are also possible ways to improve the circuit on the appearance aspect such as possibly the use of more hierarchical blocks to lessen the elements on the main worksheet. Instead of LEDs, the use of hex display can also be done.

CHAPTER 4: BIBLIOGRAPHY

[1] Google. (n.d.). [Google Maps directions for Tao Yuan Arena]. Retrieved December 2, 2017. Retreived from https://www.google.com.ph/maps/dir/24.9960291,121.3232044/

[2] Jiaxing Xu, Weihua Sun, Naoki Shibata, Minora Ito, "GreenSwirl: Combining traffic signal control and route guidance for reducing traffic congestion", Vehicular Networking Conference (VNC) 2014 IEEE, pp. 175-182, 2014, ISSN 2157-9865.

[4] H. Taale, "Comparing methods to optimise vehicle actuated signal control", Road Transport Information and Control, pp. 114-119, 2002.

[5] M. Sasaki, T. Nagatani, "Transition and saturation of traffic flow controlled by traffic lights", Physica A: Statistical Mechanics and its pplications, vol. 325, no. 3–4, pp. 531-546, Jul. 2003.