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Traffic Light Control System

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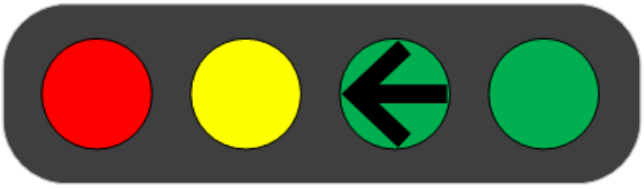
- **Introduction**

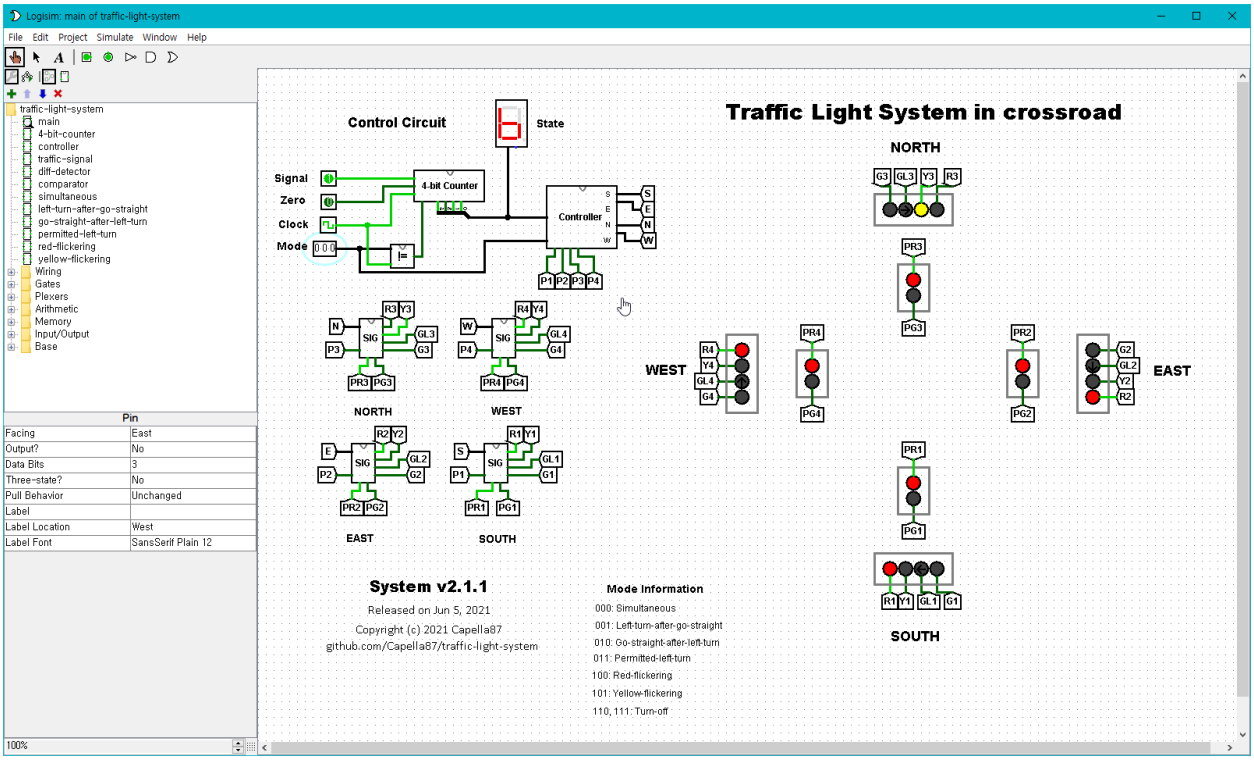
This project emulates a traffic light system, featuring multiple system routines that users can switch by altering the 'mode' signal. The system follows The World Advanced Traffic Light Control System which could be implemented in Oman Vision 2040, with dedicated traffic lights for cars and separate lights for pedestrians on each side of the crossroad.

- **Traffic Light**



State	Meaning
RED	STOP
YELLOW	Signal is about to changing
LEFT-TURN GREEN	Left Turn
GREEN	Go Straight

- **Existing Logic Circuit Solution:**



The Capella87/traffic-light-system GitHub repository contains a project related to a logic circuit developed during the 2021 Spring Semester. The project focuses on implementing a logic circuit solution for a traffic light system. It likely includes designs, code, and possibly simulations or hardware implementations for managing traffic lights in a controlled environment. You can find more detailed information about the project and its components by visiting the GitHub repository at https://github.com/Capella87/traffic-light-system.

Explanation for Control Circuit:

- A 4-bit counter is employed to cycle through states for a single traffic light. It interfaces with a controller and a signal line where 1 represents "On" and 0 represents "Off," synchronized with a clock and a mode signal for mode switching.
- The controller facilitates switching between the traffic light directions: East, North, West, and South. It's linked with a mode selector and the 4-bit counter.
- The SIG line carries the traffic light signal sequence, including green light, left turn green, yellow, and red phases.

- **Analysis of Current Solution:**

Features:

Simultaneous Signal: Cars are permitted to make left turns or go straight simultaneously.

Left Turn after Straight: Cars proceed straight ahead at both sides, then transition to left turns.

Straight after Left Turn: Cars make left turns at both sides initially, then transition to straight ahead.

Go Straight Only Both Sides: cars are only permitted to proceed straight when the green light for straight-ahead traffic is active on both sides.

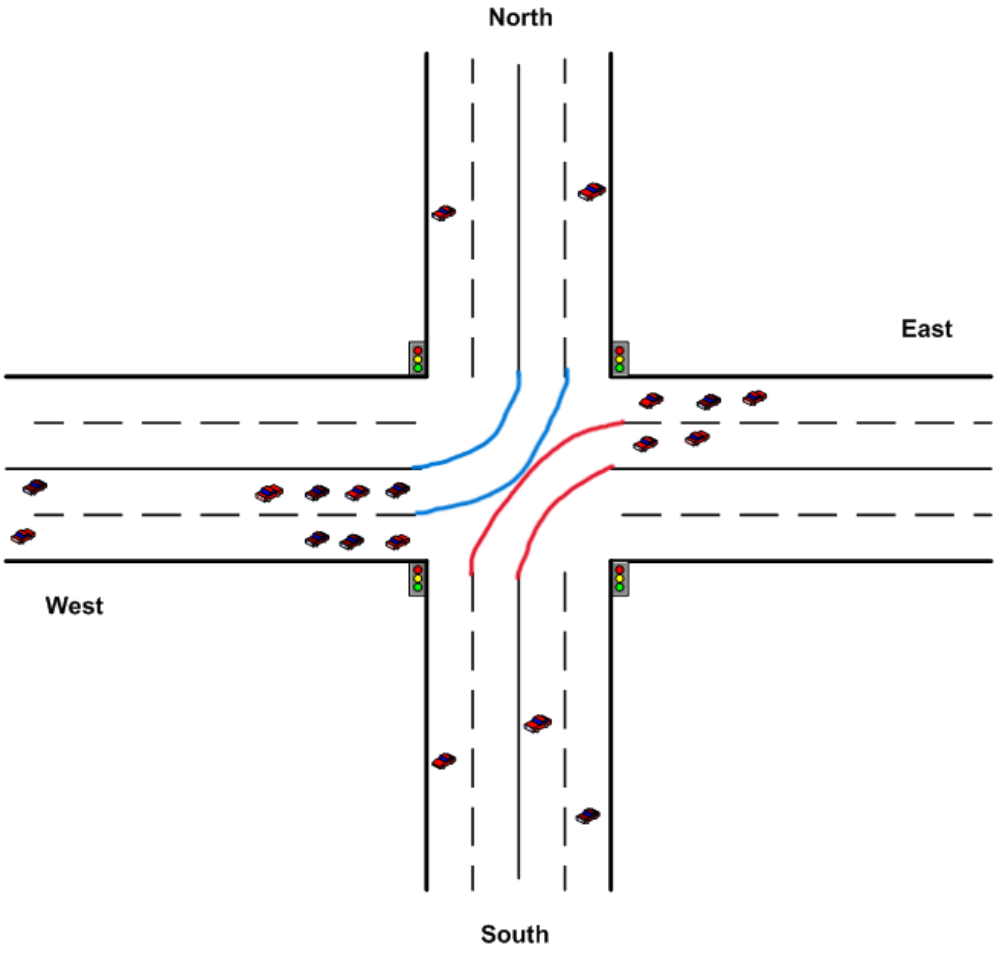
Red Flickering: The red-light flickers according to a clock signal. All other signals, including pedestrian traffic lights, are deactivated. Cars must stop once before proceeding straight or turning left. This mode is used at low-traffic intersections or during late-night hours.

Yellow Flickering (Known/Common in Oman): The yellow light flickers according to a clock signal. Similar to Red Flickering, but cars are not required to stop before passing through. Instead, they should proceed slowly. This mode is used at low-traffic intersections or during late-night hours.

Pedestrian Traffic Lights: Consist of red and green lights. There are no dedicated traffic lights for bicycles and people, and they are deactivated during flickering modes.

- **Explanation for some of the Features**

Left Turn after Straight && Straight after Left Turn



This type of system is not currently implemented in Oman due to the high risk of accidents it poses. However, it is implemented in other countries where there is a high level of awareness and safety protocols. With increased awareness and safety measures, it may be possible to implement this system in Oman.

- **Identify Enhancement Goals:**

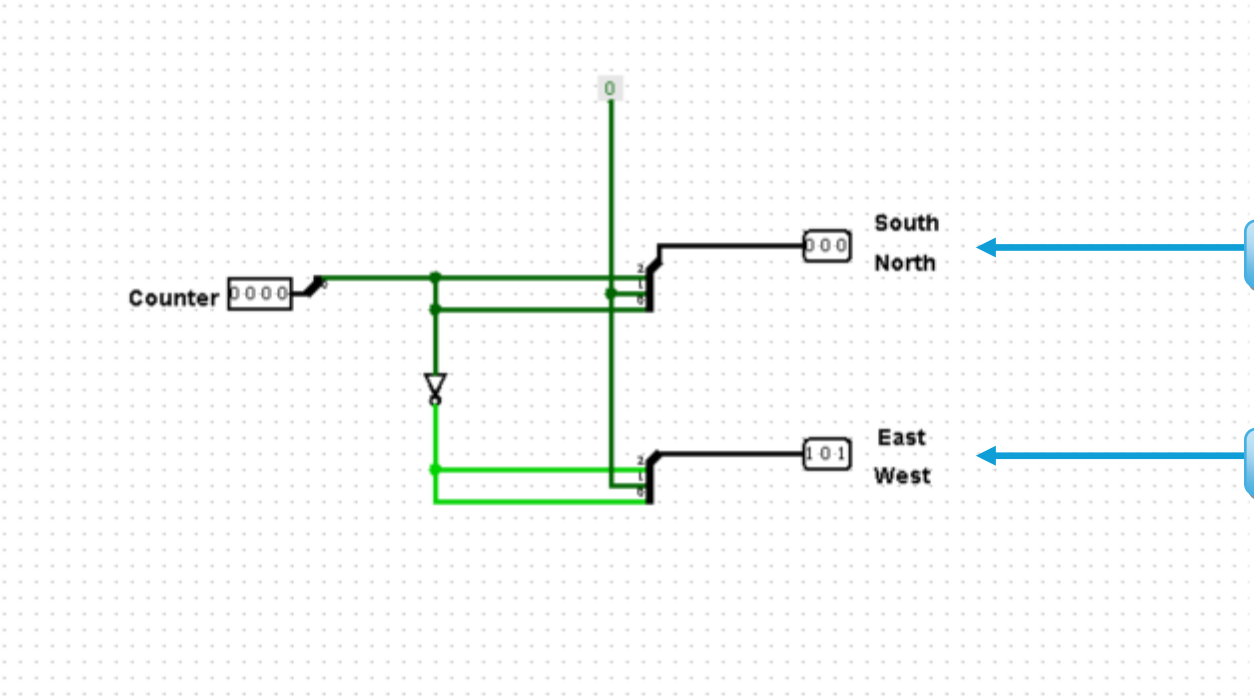
To enhance the traffic light system and make all lights blink simultaneously, you can modify the existing logic circuit to include a synchronous blinking mechanism for all traffic lights. Here's a step-by-step approach to achieve this enhancement:

1. **Synchronize Blinking:** Modify the control signals for each traffic light to synchronize their blinking pattern. Since you've defined the red light as "000," off as "101," and yellow as "010," you can create a new control signal that alternates between these patterns for all lights simultaneously.

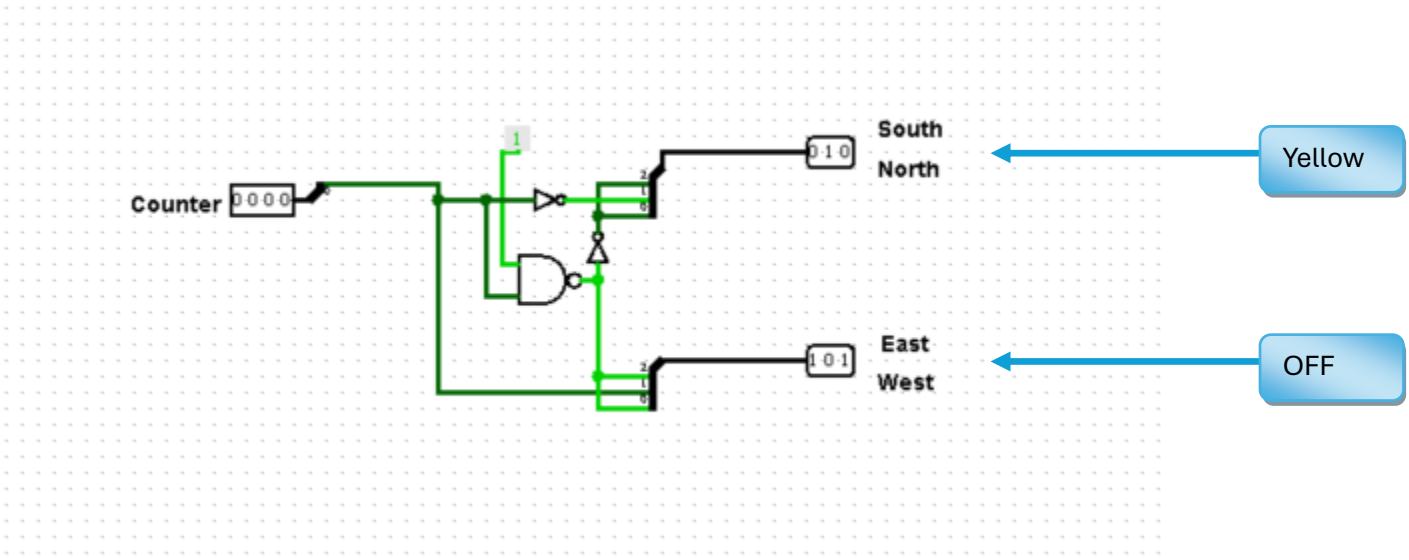
2. **Update Control Logic:** Adjust the control logic in logisim to incorporate the synchronized blinking pattern. This may involve changes in the timing and sequencing of signals sent to the traffic lights.

3. **Test Timing Mechanism:** Ensure that there's a timing mechanism in place to control the duration of each blinking cycle. the use counters or timers to manage the timing intervals for the blinking pattern.

4. **Test and Validate:** After implementing the changes, thoroughly test the system to ensure that all traffic lights blink simultaneously and that the timing of the blinking pattern is as expected.



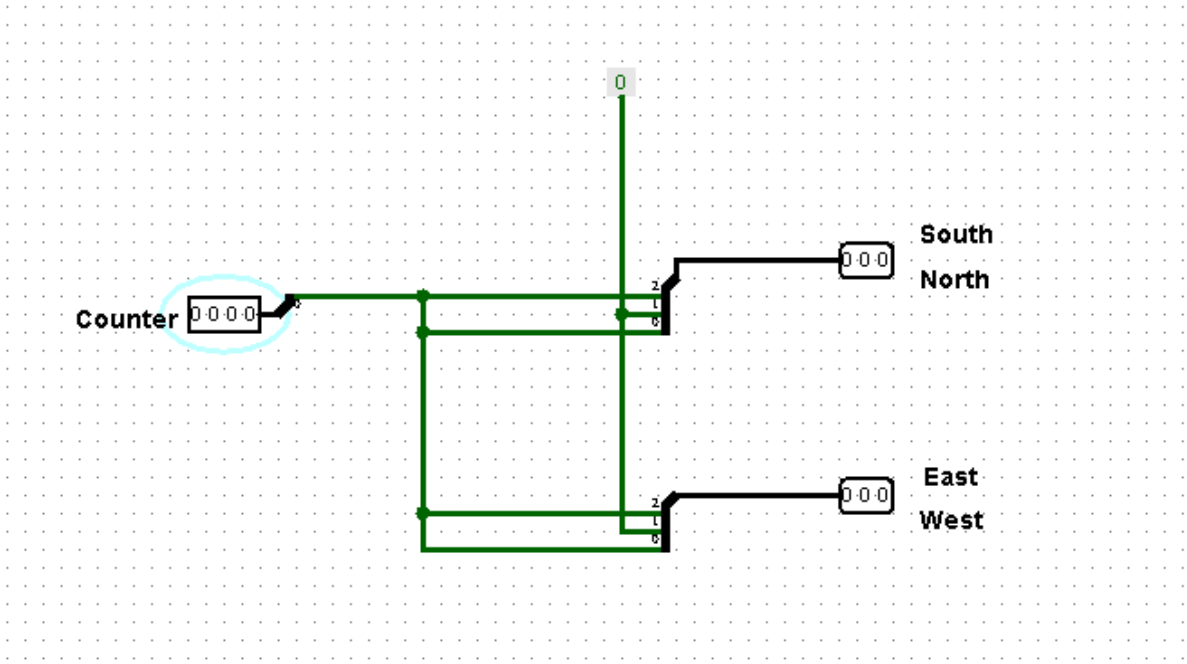
(Red Flickering)



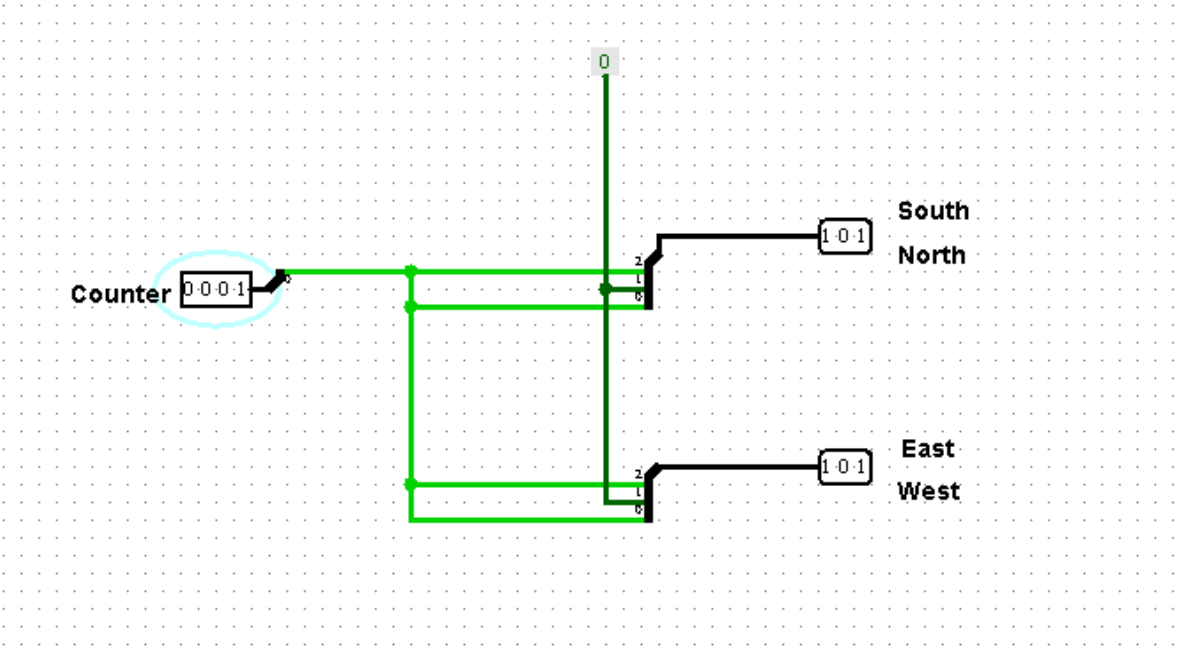
(Yellow Flickering)

- **Implementation of Enhancements:**

We have made changes and deleted the NOT gate to synchronize the Red Flickering all at once.

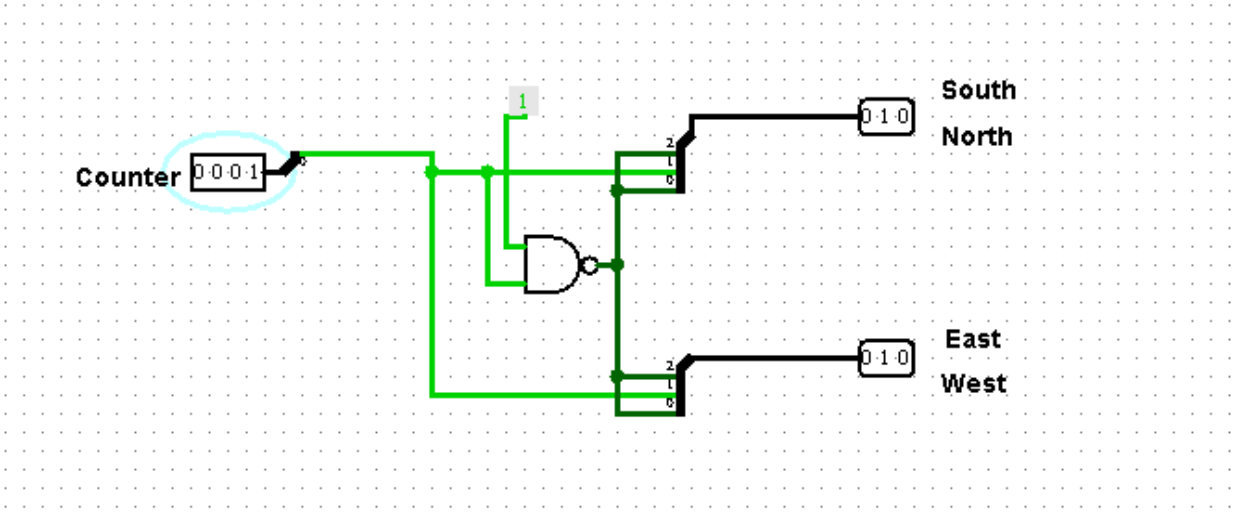


(Red Flickering=Red)

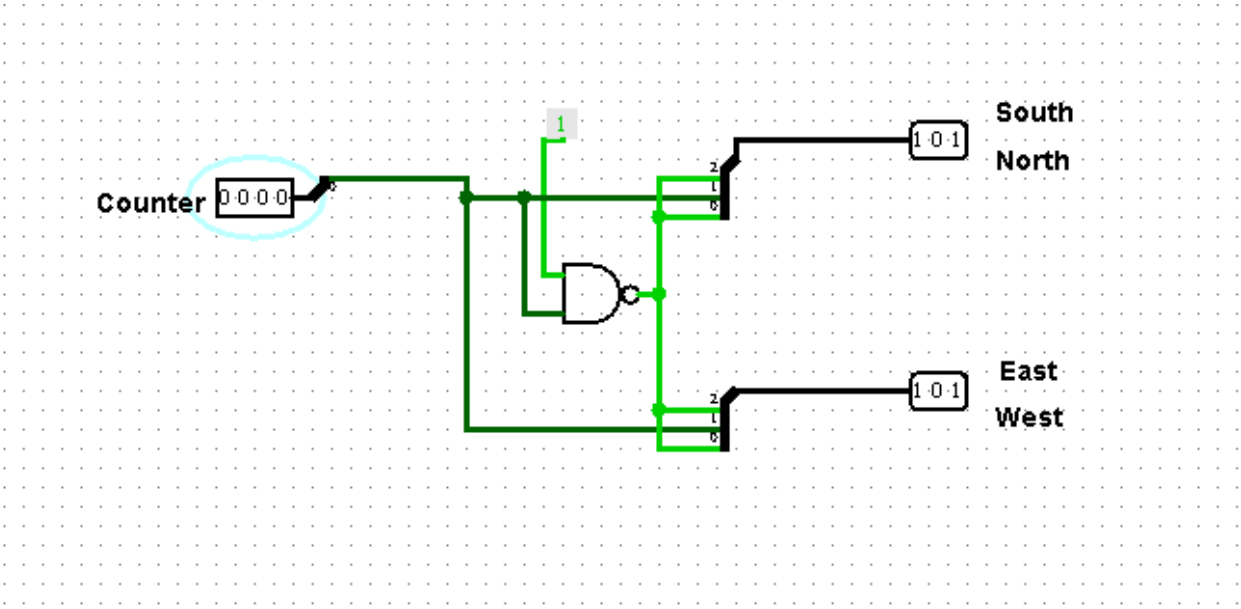


(Red Flickering=Off)

We have made the changes and deleted the NOT gates after the to synchronize the Yellow Flickering all at once.

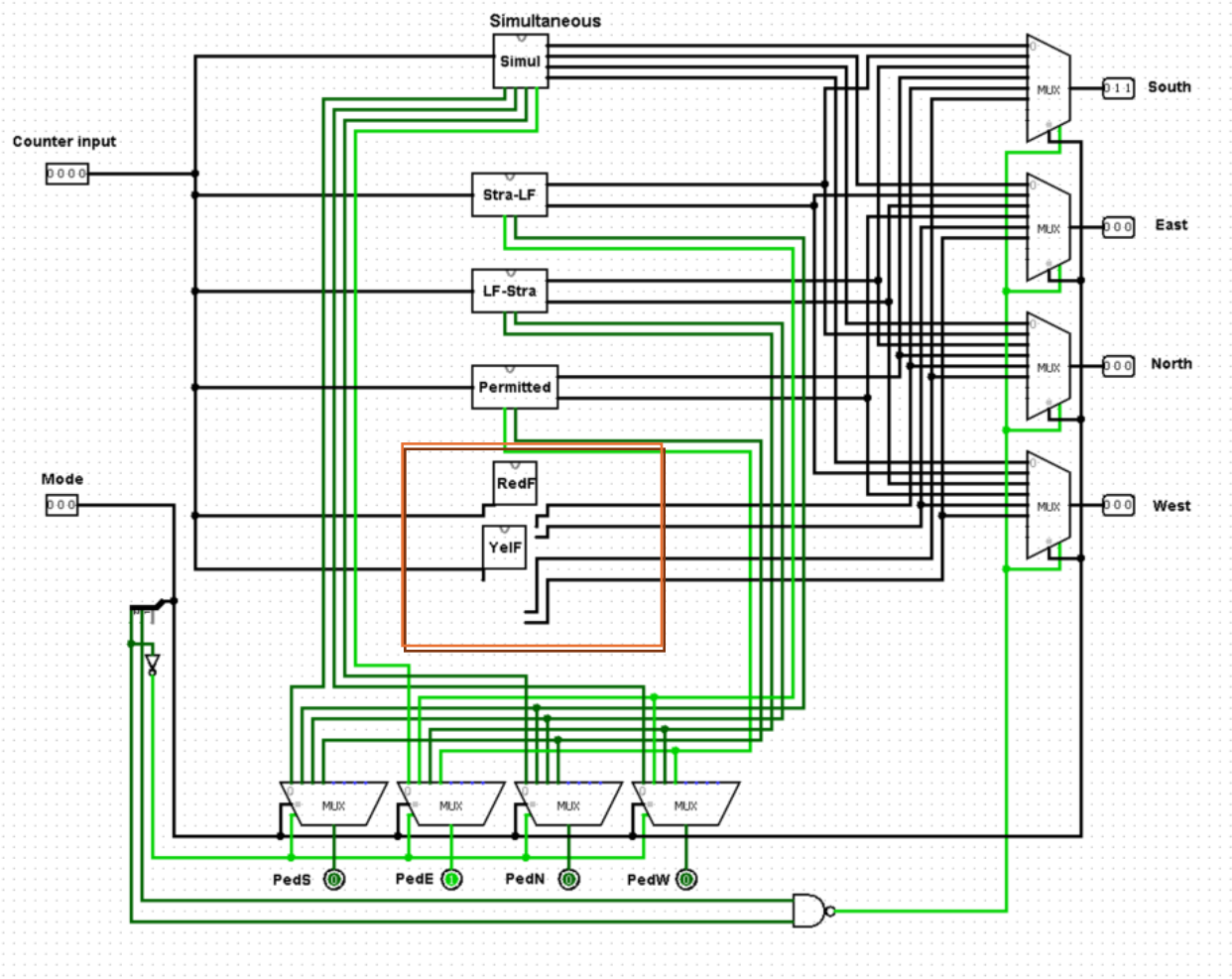


(Yellow Flickering=Yellow)



(Yellow Flickering=Off)

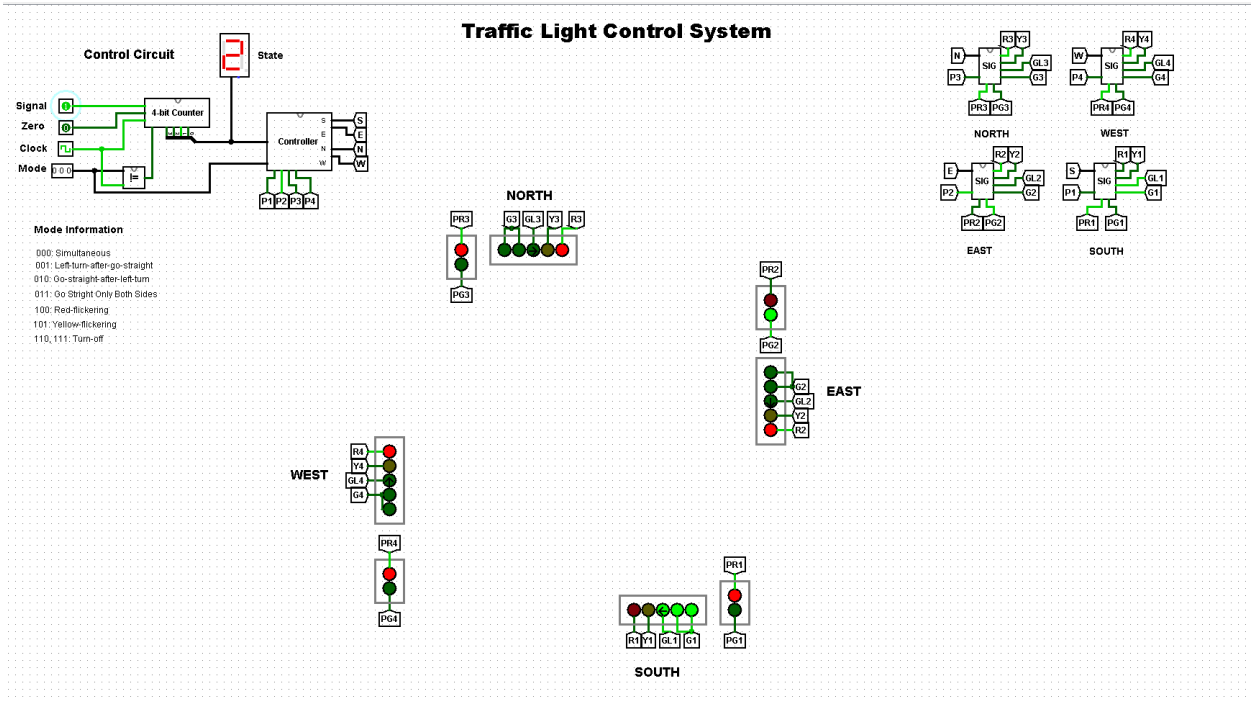
After synchronizing the Red Flickering (RedF) and Yellow Flickering (YelF) in the controller of the traffic light system and removing the NOT gates following the Yellow Flickering to synchronize it simultaneously, the traffic light system now operates with coordinated blinking for all lights.



I have synchronized the Red Flickering (RedF) and Yellow Flickering (YelF) signals in the controller, ensuring smooth functionality during simulations.

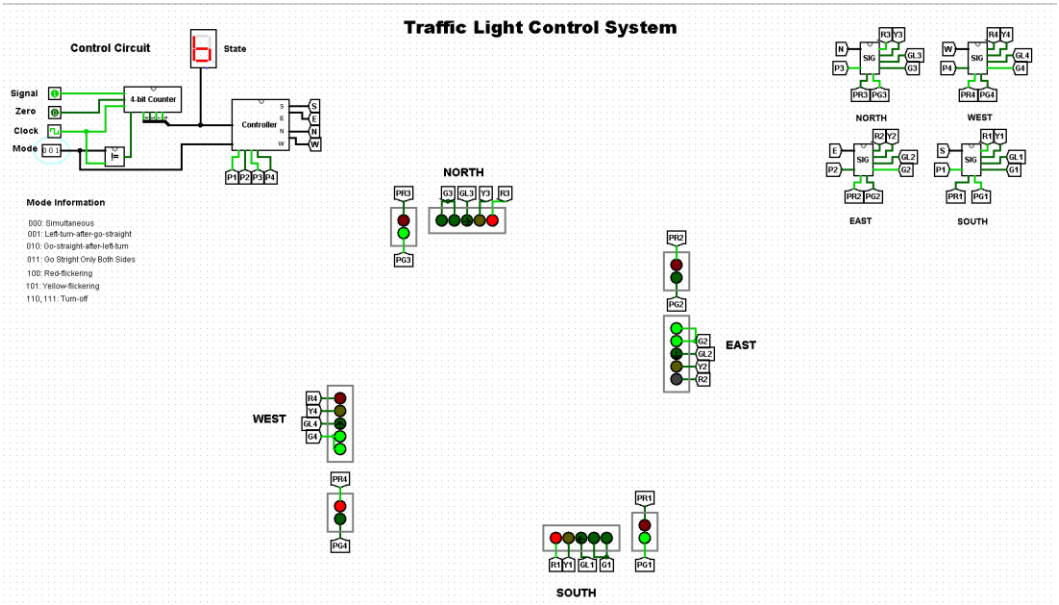
- **Simulation:**

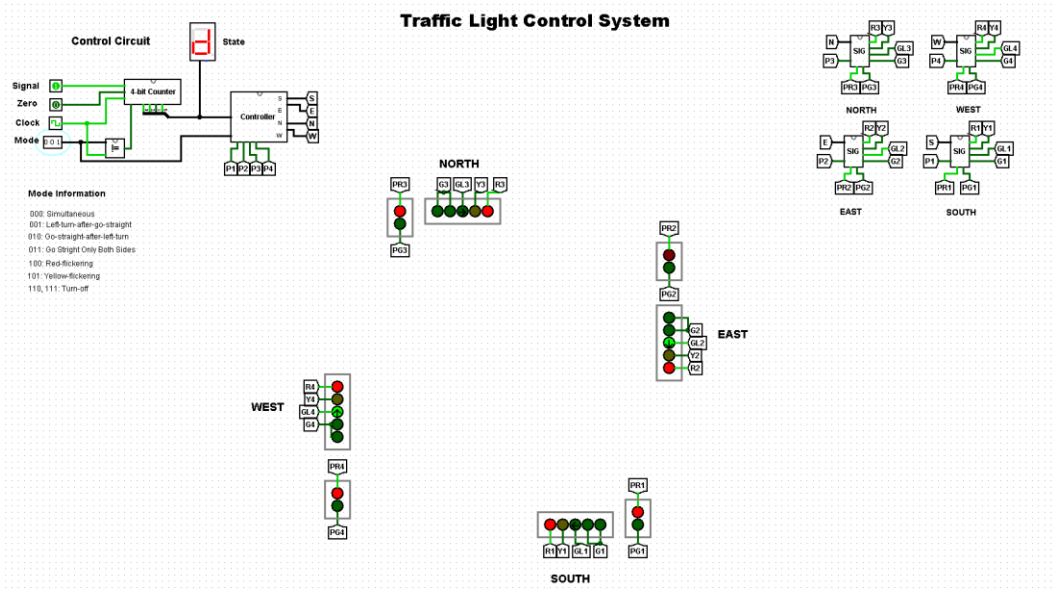
Mode= 000 : Simultaneous Signal



In the traffic light system, the normal traffic light signals follow a sequence starting from south to east, then north, and finally west. This sequence repeats itself continuously to manage the flow of traffic effectively.

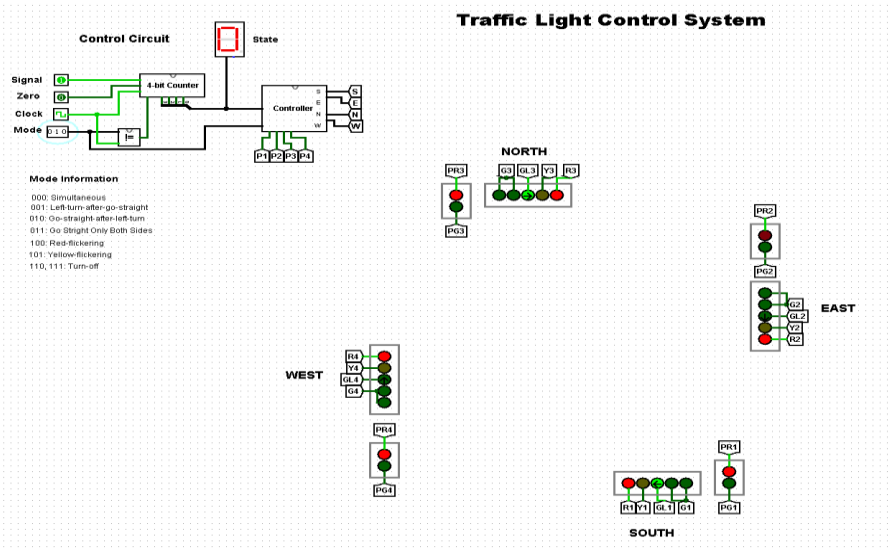
Mode= 001 : Left Turn after Straight

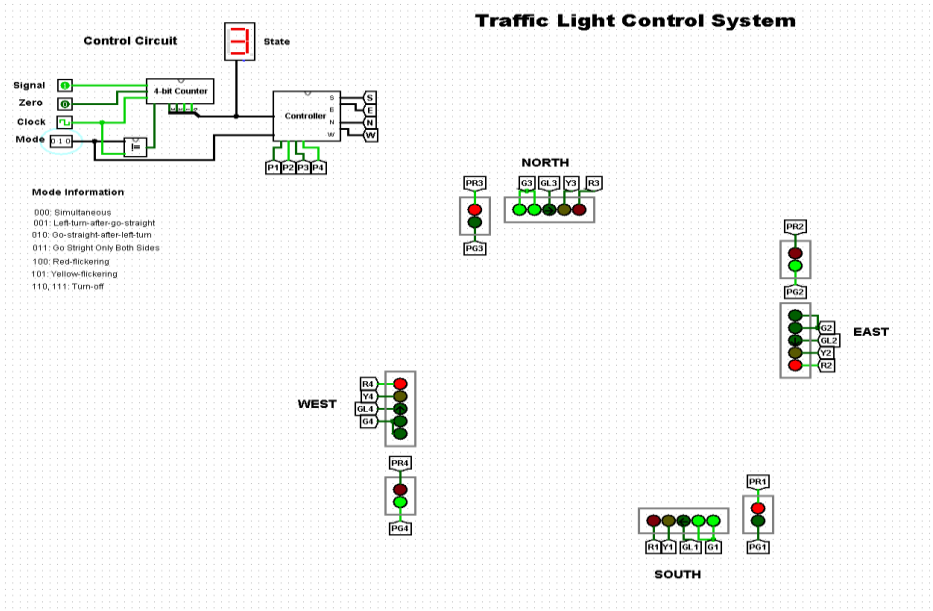




In the "Left Turn after Straight" mode of your traffic light system, both sides proceed straight initially, and then they make a left turn simultaneously. After this sequence, the system switches to control other sides of the traffic lights.

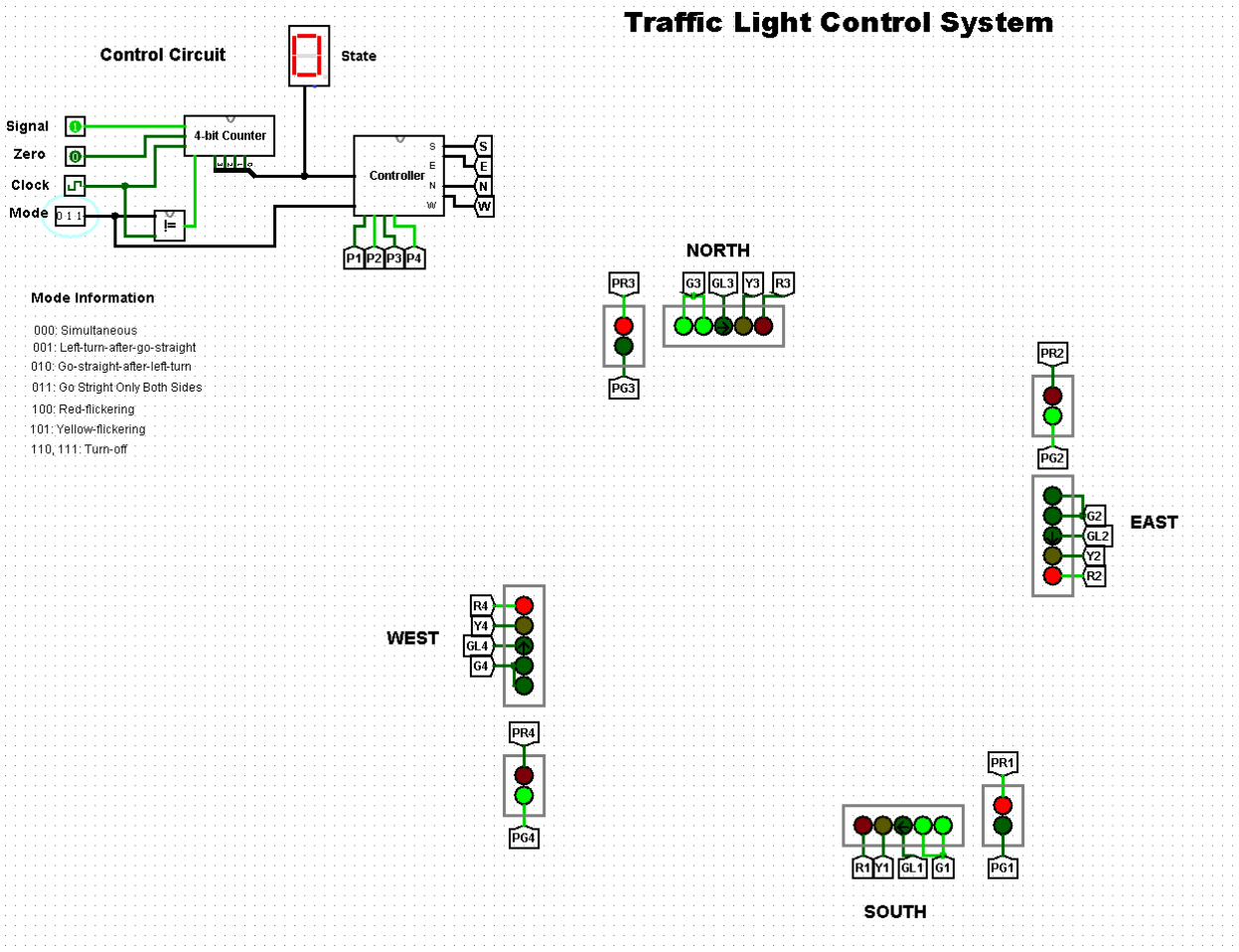
Mode= 010 : Straight after Left Turn





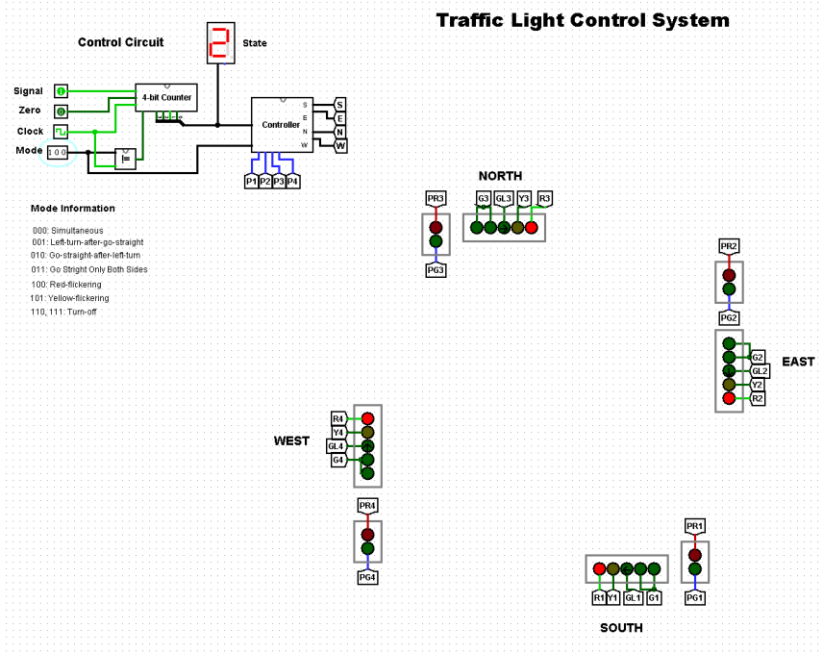
In the "Straight after Left Turn" mode of your traffic light system, the sequence is reversed compared to the "Left Turn after Straight" mode. It starts by allowing both sides to turn left simultaneously, then they proceed straight together, followed by switching control to the other sides of the traffic lights.

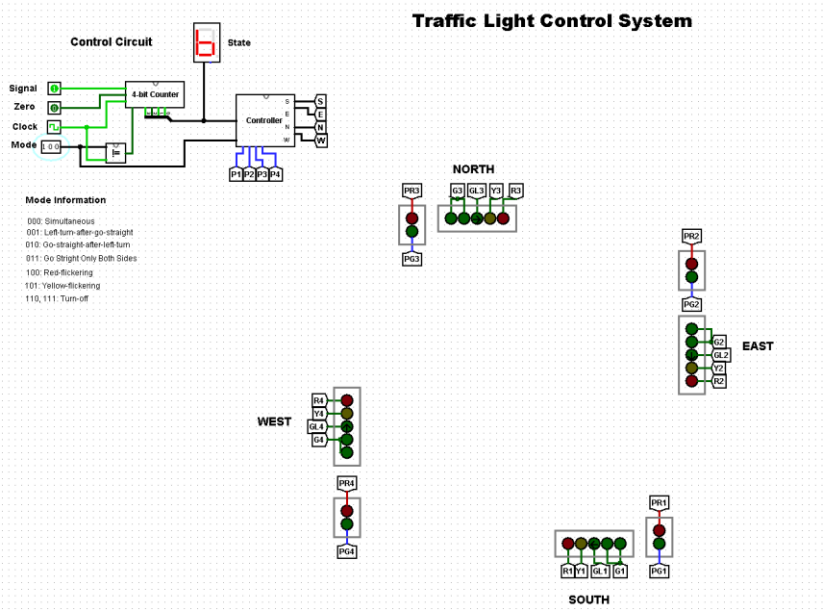
Mode= 011 : Go Straight Only Both Sides



In the "Go Straight Only Both Sides" mode of your traffic light system, both sides proceed straight simultaneously without any turning actions, and then control switches to the other sides of the traffic lights.

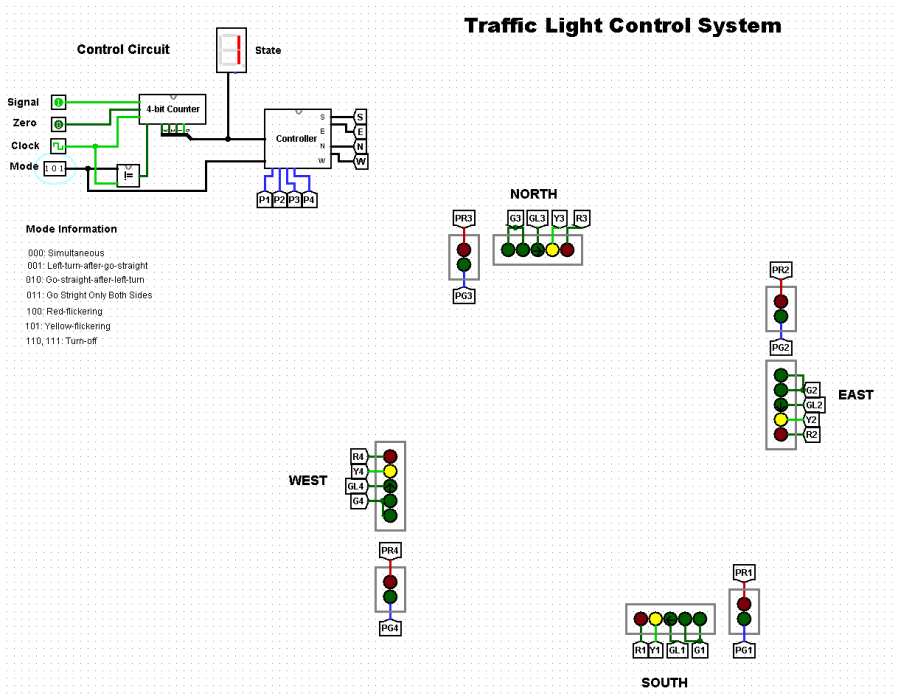
Mode= 100 : Red Flickering

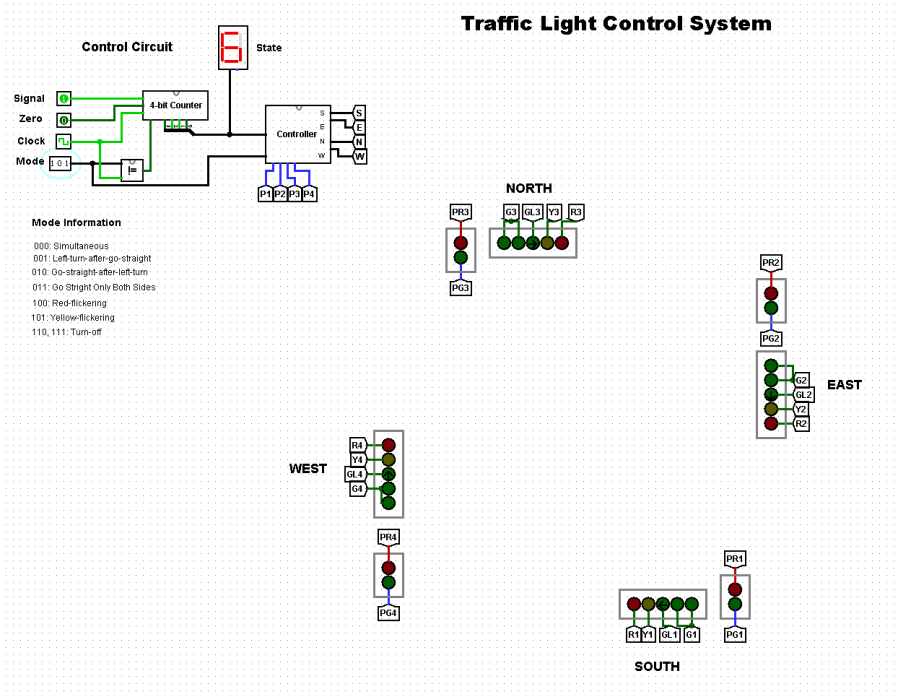




In the "Red Flickering" mode involves the red light flickering according to a clock signal, deactivating all other signals except for pedestrian traffic lights. Cars must stop once before proceeding straight or turning left in this mode, which is typically used at low-traffic intersections or during late-night hours.

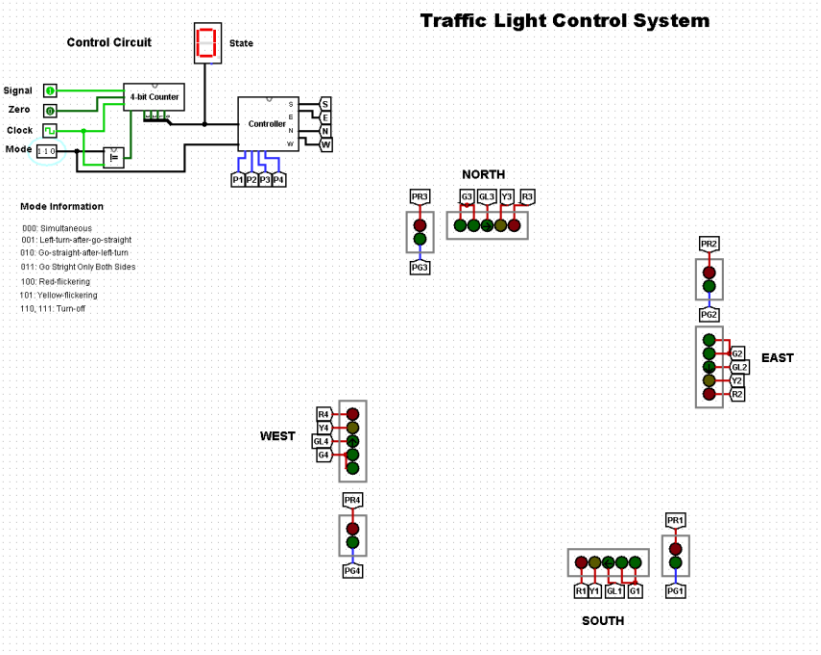
Mode= 101 : Yellow Flickering

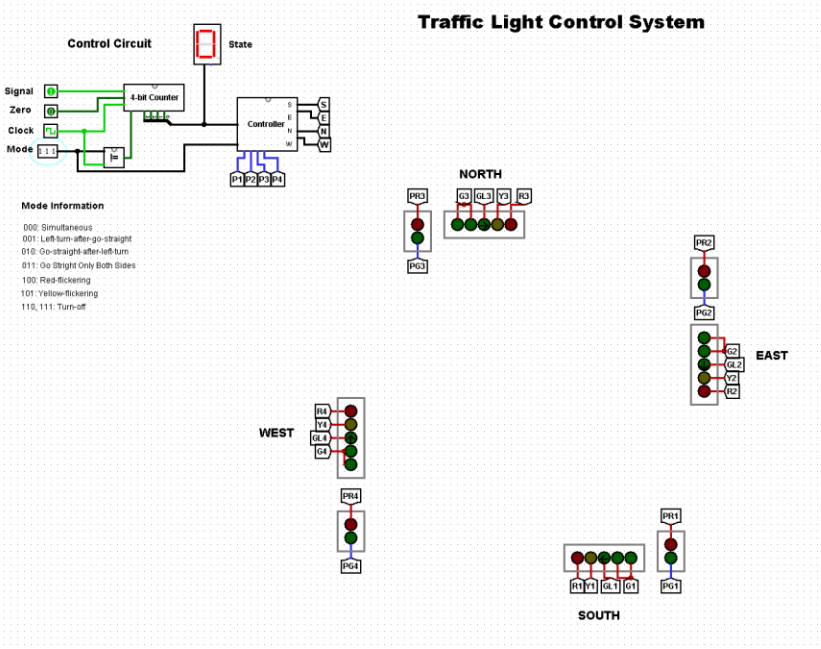




During Yellow Flickering, the yellow light flashes in sync with a clock signal. Unlike Red Flickering, vehicles are not mandated to halt before moving forward; rather, they should proceed cautiously. This mode is typically employed at intersections with low traffic or during late-night periods.

Mode= 110,111 : Turn Off





To turn off the traffic light signals by modifying the mode into 110,111, you would typically set the mode input of the controller to these values. This change in mode should be interpreted by the controller logic to deactivate all traffic light signals, effectively turning them off.

- ## Conclusions:

The assignment on traffic light system design and optimization holds significant importance in the field of logic circuit design and traffic management. By developing a comprehensive understanding of various traffic light modes and their functionalities, we've contributed to improving traffic flow efficiency, ensuring safety, and addressing specific scenarios like low-traffic intersections or late-night hours.

This work has several implications for future endeavors in logic circuit design and optimization:

- **Safety Enhancement:** Implementing modes like Red Flickering and Yellow Flickering ensures that traffic signals are adaptive to different traffic volumes and situations, enhancing overall safety on the roads.

- **Traffic Flow Optimization:** The different modes, such as Simultaneous Signal and Go Straight Only Both Sides, optimize traffic flow by allowing simultaneous movements or restricting certain maneuvers when necessary.

- **Resource Efficiency:** By incorporating clock signals and synchronized operations, we've demonstrated efficient resource utilization, which is crucial for scalable and sustainable traffic management systems.

- **Scalability and Adaptability:** The modularity and flexibility of the traffic light system allow for scalability and easy adaptation to changing traffic patterns or infrastructure requirements.

- **Technological Advancements:** Future work in logic circuit design can leverage these concepts to integrate advanced technologies like AI-based traffic prediction, dynamic signal control based on real-time data, and smart city initiatives.

In essence, this assignment serves as a stepping stone towards developing intelligent, adaptive, and efficient traffic management systems, paving the way for safer and smoother transportation experiences in the future.

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