Project Title: Four way Traffic Light Simulation.

Problem Statement:

Develop a 4-way traffic light control system using a sequential circuit, with four distinct states allowing safe passage for two directions at a time. The system should be designed with T flip-flops and ensure proper traffic flow across eight lanes.

Abstract

This project is a digital 4-way traffic light control system designed to manage traffic flow at a multi-lane intersection. The system operates based on a predefined sequence of four traffic states, each permitting safe passage for two directions at once (e.g., North-South, East-West).

South-North	South-East
North-South	North-West
East-West	East-North
West-East	West-South

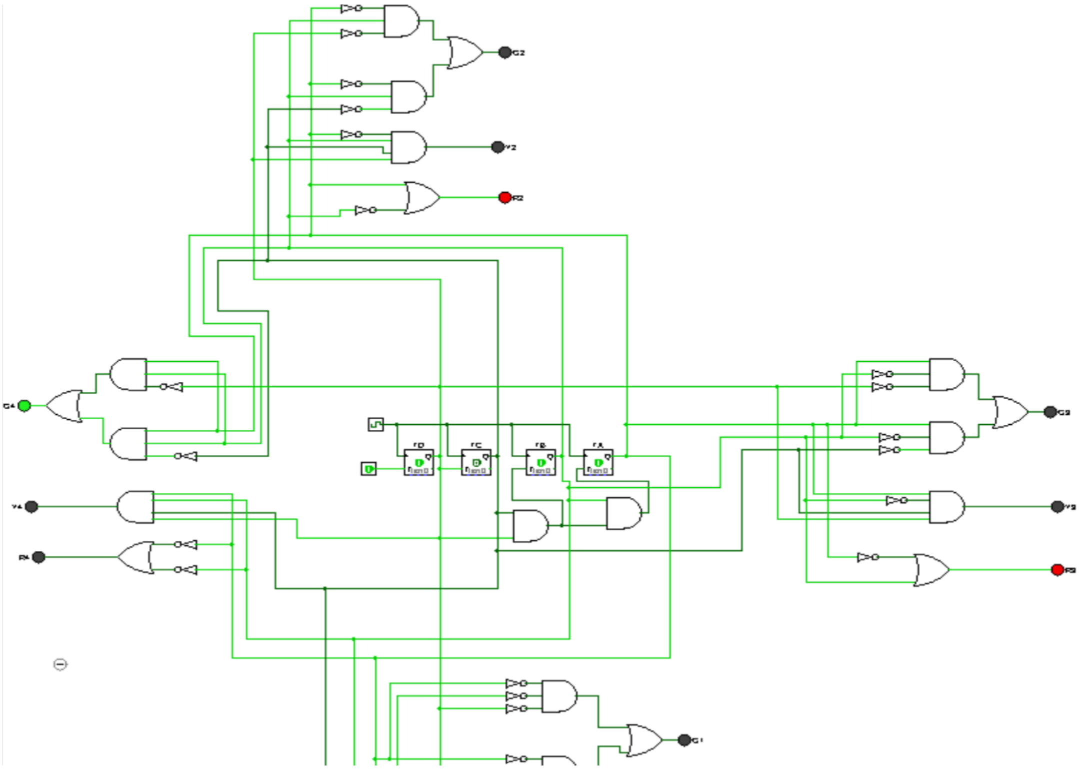
Using a state machine architecture and T flip-flops, the system transitions through states in an orderly manner. Each state is programmed to activate the appropriate traffic lights for its assigned

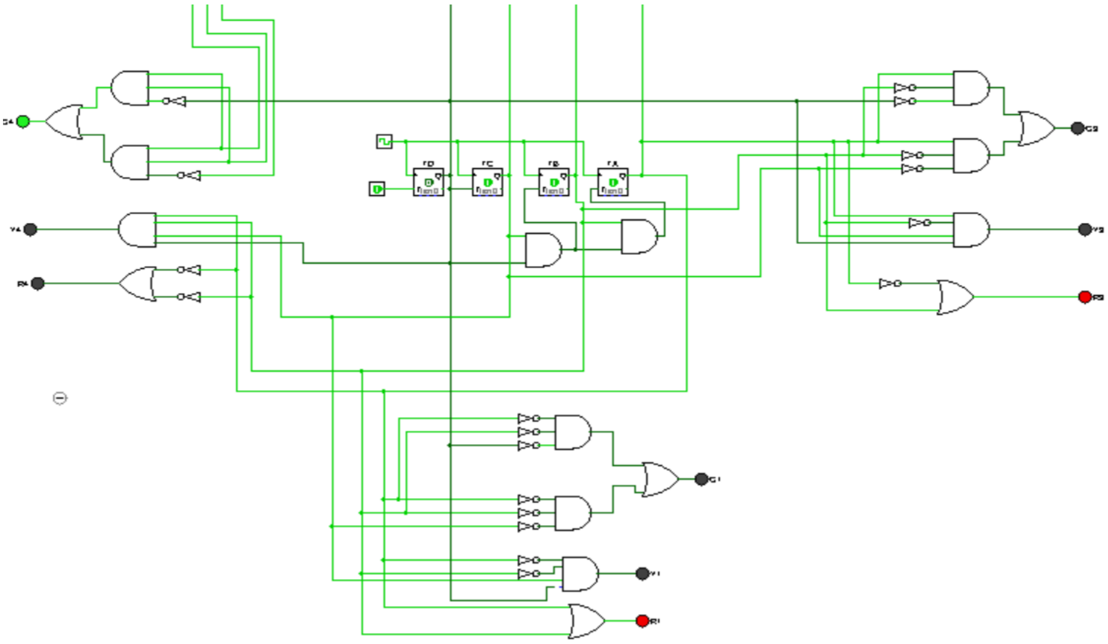
directions, coordinating signal changes to prevent cross-traffic conflicts. The design maximizes safety and efficiency by reducing congestion and ensuring predictable traffic patterns through a synchronized control mechanism. The system’s logic is defined by a state transition table, which helps maintain a steady traffic flow by specifying the conditions under which each state changes to the next.

Components Used:

COMPONENT	SPECIFICATION	QUANTITY
AND Gates	IC7408	14
NOT Gates	IC 7404	18
T flip flop	IC 7476	4
OR Gates	IC 7432	7
LED’s	-	12

Circuit Diagram:



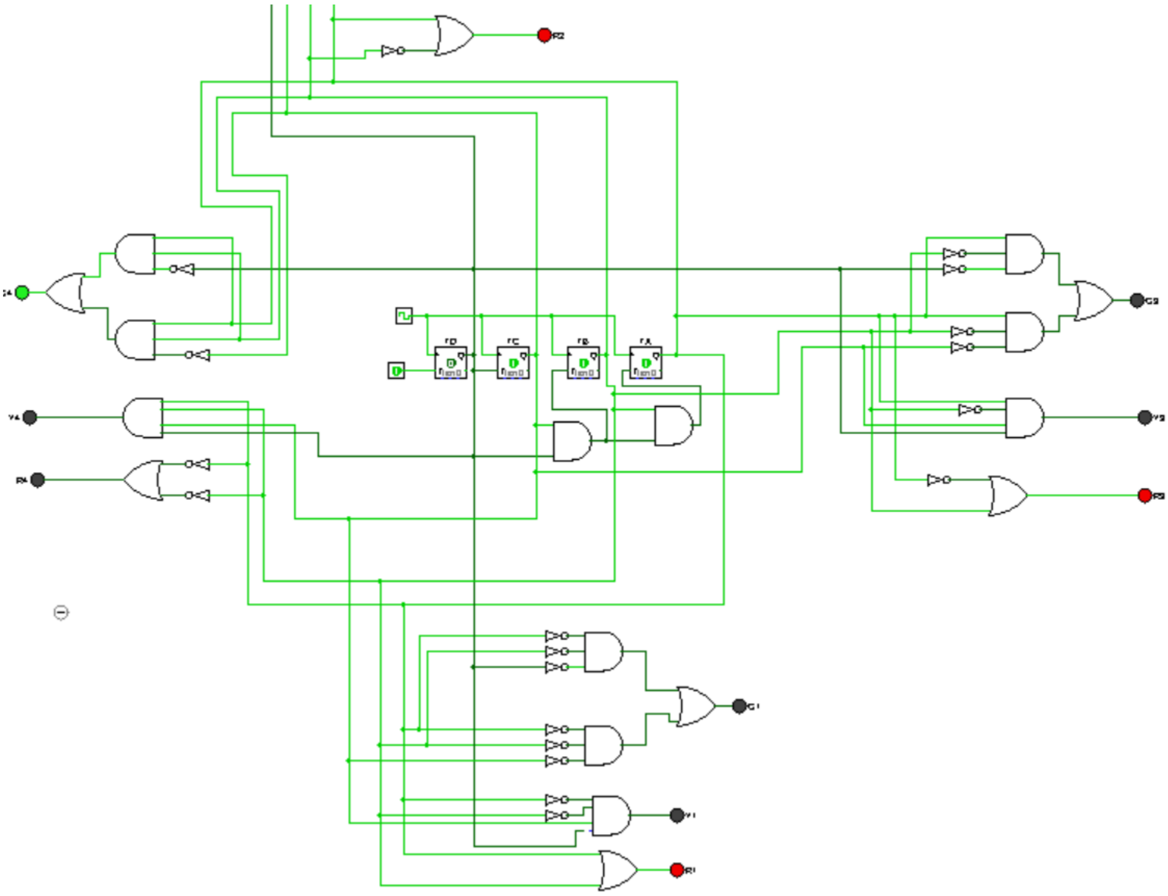


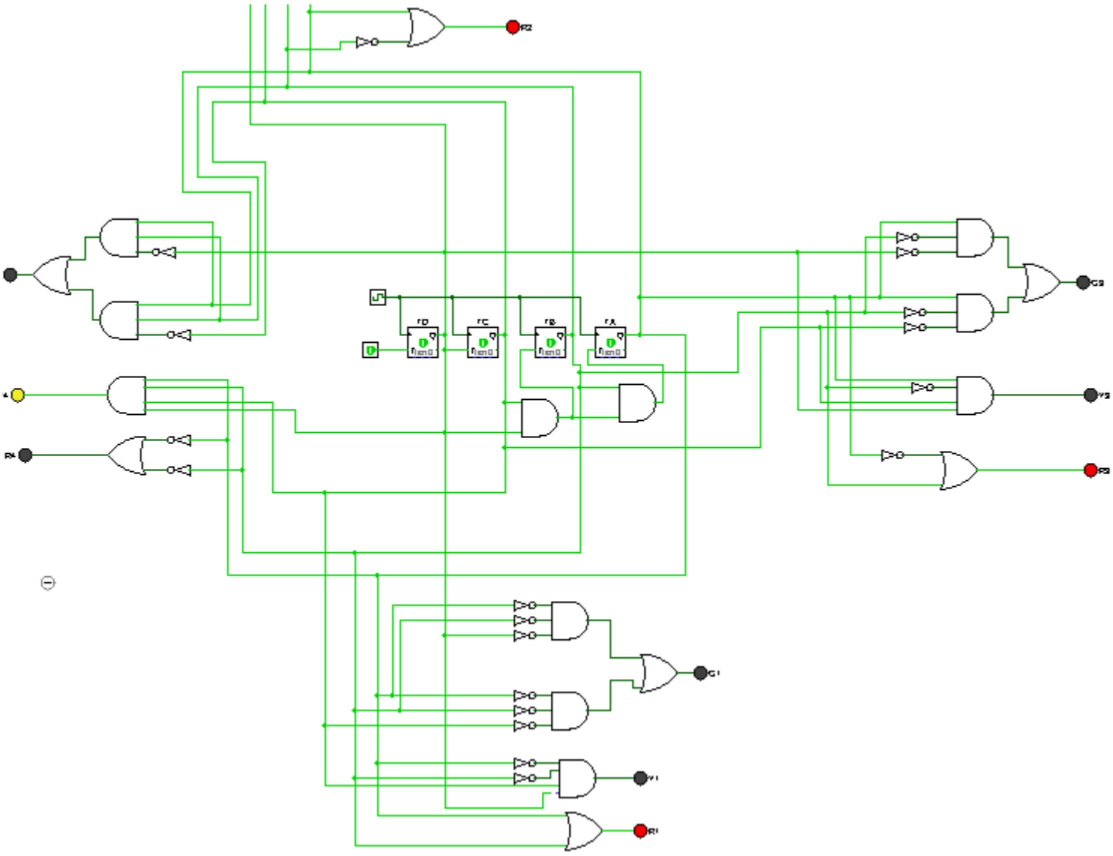
Explanation:

The traffic light control circuit uses T (Toggle) flip-flops and logic gates to manage the sequence of lights at an intersection. Each T flip-flop (such as TA,TB,TC ,TD) toggles its state with each clock pulse, controlling the timing of the traffic light states in a coordinated sequence. Logic gates, including AND, OR, and NOT gates, combine the outputs from the flip-flops to implement the Boolean logic for each light signal. These gates define the conditions for when each traffic light (green, yellow, or red) should be active. For example, the green light (G1) and yellow light (Y1) are activated based on specific combinations of outputs from the flip-flops,while other lights remains inactive, which are simplified using Karnaugh Maps (K-Maps) to minimize the number of gates required. This simplification optimizes the circuit design, ensuring that the lights switch efficiently between states. The circuit ensures that only one direction has a green light at any time, with a yellow transition before switching to red, effectively controlling the traffic flow. By coordinating the outputs of the flip-flops and logic gates, the circuit enables a smooth, orderly transition between traffic light signals, promoting safe and efficient movement at the intersection.

Outputs:

When one gate remain green& yellow, others are red.





Truth Tables:

Input	Present State	Next State
T	**Qn**	**Qn+1**
0	0	0
0	1	1
1	0	1
1	1	0

Present State				Next State				T flip flop ip's			
A	**B**	**C**	**D**	**A+**	**B+**	**C+**	**D+**	**TA**	**TB**	**TC**	**TD**
0	0	0	0	0	0	0	1	0	0	0	1
0	0	0	1	0	0	1	0	0	0	1	1
0	0	1	0	0	0	1	1	0	0	0	1
0	0	1	1	0	1	0	0	0	1	1	1
0	1	0	0	0	1	0	1	0	0	0	1
0	1	0	1	0	1	1	0	0	0	1	1
0	1	1	0	0	1	1	1	0	0	0	1
0	1	1	1	1	0	0	0	1	1	1	1
1	0	0	0	1	0	0	1	0	0	0	1
1	0	0	1	1	0	1	0	0	0	1	1
1	0	1	0	1	0	1	1	0	0	0	1
1	0	1	1	1	1	0	0	0	1	1	1
1	1	0	0	1	1	0	1	0	0	0	1
1	1	0	1	1	1	1	0	0	0	1	1
1	1	1	0	1	1	1	1	0	0	0	1
1	1	1	1	0	0	0	0	1	1	1	1

K-Maps:

CounterState   1st signal   2nd signal   3rd signal   4th signal

A	B	C	D	G1	Y1	R1	G2	Y2	R2	G3	Y3	R3	G4	Y4	R4
0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	1
0	0	0	1	1	0	0	0	0	1	0	0	1	0	0	1
0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	1
0	0	1	1	0	1	0	0	0	1	0	0	1	0	0	1
0	1	0	0	0	0	1	1	0	0	0	0	1	0	0	1
0	1	0	1	0	0	1	1	0	0	0	0	1	0	0	1
0	1	1	0	0	0	1	1	0	0	0	0	1	0	0	1
0	1	1	1	0	0	1	0	1	0	0	0	1	0	0	1
1	0	0	0	0	0	1	0	0	1	1	0	0	0	0	1
1	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1
1	0	1	0	0	0	1	0	0	1	1	0	0	0	0	1
1	0	1	1	0	0	1	0	0	1	0	1	0	0	0	1
1	1	0	0	0	0	1	0	0	1	0	0	1	1	0	0
1	1	0	1	0	0	1	0	0	1	0	0	1	1	0	0
1	1	1	0	0	0	1	0	0	1	0	0	1	1	0	0
1	1	1	1	0	0	1	0	0	1	0	0	1	0	1	0

a)Ta Flip Flop

0	0	0	0
0	0	1	0
0	0	1	0
0	0	0	0

Ta=BCD

b)Tb Flip Flop

0	0	1	0
0	0	1	0
0	0	1	0
0	0	1	0

Tb=CD

G1

1	1	0	1
0	0	0	0
0	0	0	0
0	0	0	0

G1=A’B’D’+A’B’C’

Y1

0	0	1	0
0	0	0	0
0	0	0	0
0	0	0	0

Y1=A’B’CD

a)Tc Flip Flop

0	1	1	0
0	1	1	0
0	1	1	0
0	1	1	0

Tc=D

b)Td Flip Flop

1	1	1	1
1	1	1	1
1	1	1	1
1	1	1	1

Td=1

R1

0	0	0	0
1	1	1	1
1	1	1	1
1	1	1	1

R1=A+B

G2

0	0	0	0
1	1	0	1
0	0	0	0
0	0	0	0

G2=A’BD’+A’BC’

R2

1	1	1	1
0	0	0	0
1	1	1	1
1	1	1	1

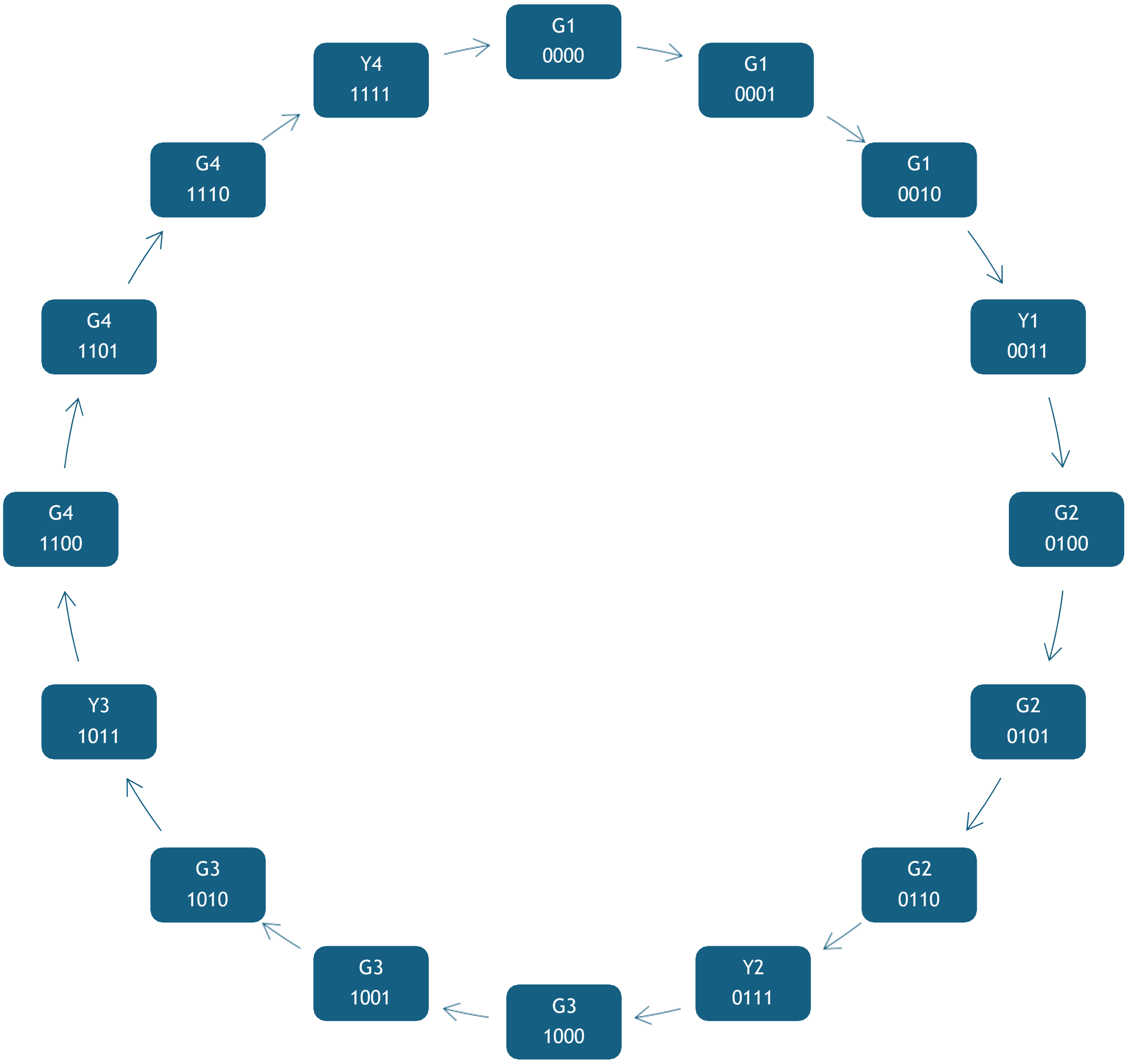
R2=B'+A

Y2

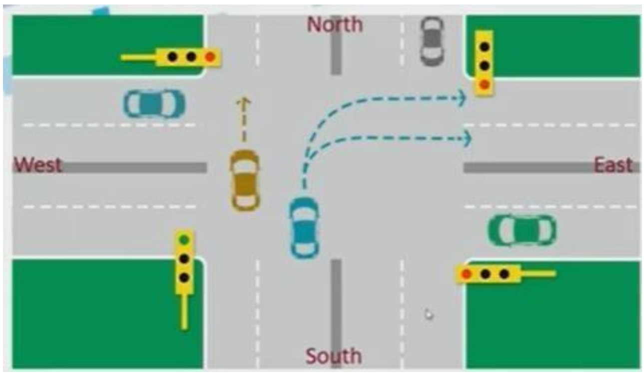
0	0	0	0
0	0	1	0
0	0	0	0
0	0	0	0

Y2=A'BCD

STATE DIAGRAM:



Output Analysis:



The 4-way traffic light control system operates in a predictable, cyclic manner across four states, each allowing traffic to flow in two opposing or non-conflicting directions. Each state is assigned a specific pair of directions, enabling smooth transitions between active and inactive lanes while preventing cross-traffic conflicts. The system progresses sequentially through states with a brief overlap for yellow lights to signal impending changes, helping drivers adjust to upcoming stops. This organized approach optimizes traffic flow by reducing waiting times and enhancing safety through well-defined directional assignments.

By using T flip-flops to control each state, the circuit ensures stability in its transitions. When a state is active, the lights for that direction turn green, permitting movement while other directions see red lights, instructing them to stop. The yellow lights in each transition warn drivers of the upcoming change, minimizing abrupt halts. This predictable cycling results in balanced traffic distribution at the intersection, as every direction receives green lights in a controlled, repeated sequence. The structured control enables a streamlined, efficient management of traffic, reducing potential congestion at the intersection.

Learning Outcomes:

In this project, we are gaining insights into sequential circuit design using T flip-flops and logic gates to create a state machine for traffic management. We are learning to control traffic flow at multi-directional intersections while ensuring safety and efficiency. The project emphasizes timing and synchronization in state changes. We are also developing problem-solving skills by addressing conflicting requirements, like balancing clear movement for some directions with halted movement for others. Overall, this experience is enhancing our understanding of digital logic and preparing us for more complex applications in traffic control.