






Objective:

The primary objective of the traffic light control system is to ensure a safe and efficient flow of traffic at the two-intersection road network, thereby minimizing congestion and reducing the risk of accidents.
















Interface:

The interface consists of:

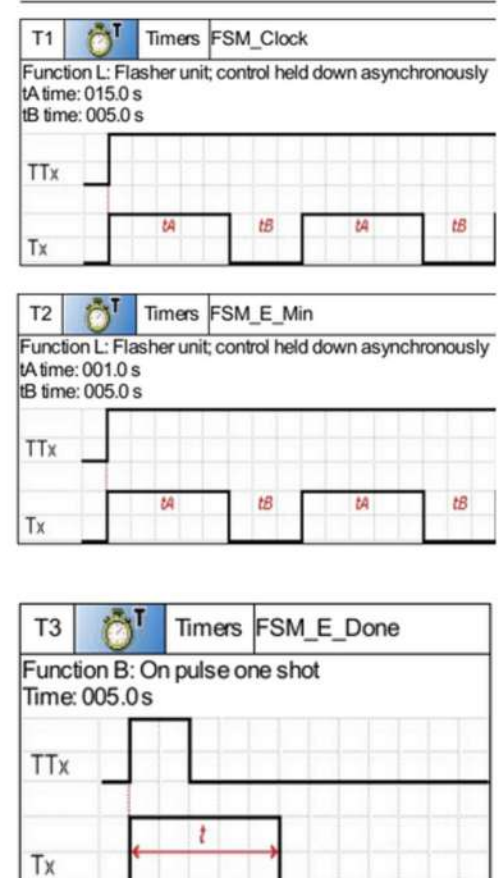
Physical inputs

No	Symbol	Function	Lock	Parameters	Location of (L/C)	Comment
I1		Discrete inputs	—	No parameters	(40/1)	Car_A
I2		Discrete inputs	—	No parameters	(40/2)	Car_B/C
I3		Discrete inputs	—	No parameters	(40/3)	Car_D/F
I4		Discrete inputs	—	No parameters	(32/2) (33/3) (35/4) (40/4)	Car_E
I7		Discrete inputs	—	No parameters	(40/5)	Circuit_Breaker

Physical outputs

No	Symbol	Function	Latching	Location of (L/C)	Comment
Q1		Discrete outputs	No	(13/6)	A_R
Q2		Discrete outputs	No	(16/6)	B_R
Q3		Discrete outputs	No	(31/6)	C_R
Q4		Discrete outputs	No	(17/6)	D/F_R
Q5		Discrete outputs	No	(21/6)	E_R
Q7		Discrete outputs	No	(30/6)	A_Y
Q8		Discrete outputs	No	(15/6)	B_Y
Q9		Discrete outputs	No	(14/6)	C_Y
QA		Discrete outputs	No	(22/6)	D/F_Y
QB		Discrete outputs	No	(28/6)	E_Y
QC		Discrete outputs	No	(27/6)	E_G
QD		Discrete outputs	No	(29/6)	A_G
QE		Discrete outputs	No	(20/6)	B_G
QF		Discrete outputs	No	(25/6)	C_G
QG		Discrete outputs	No	(26/6)	D/F_G


Timer




Configurable functions

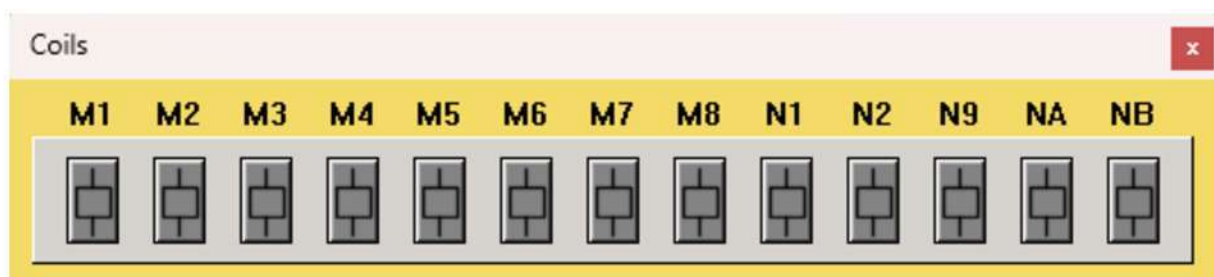
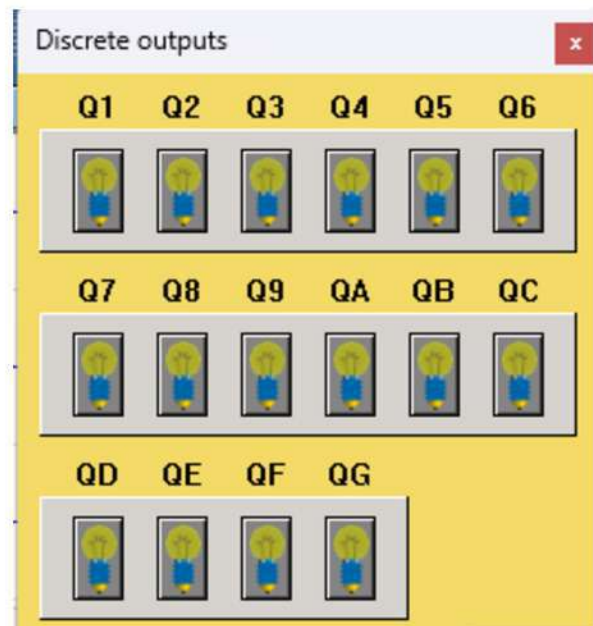
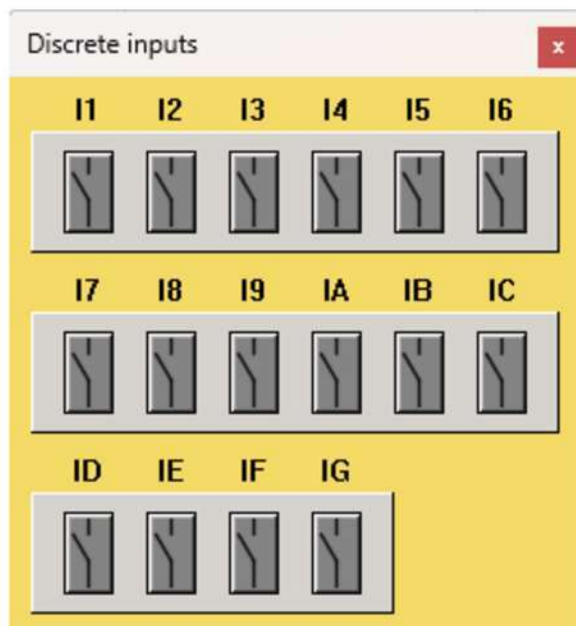
No	Symbol	Function	Lock	Latching	Parameters	Location of (I/C)	Comment
C1		Counters	No	No	Value to attain: 0 Pulses Output ON when the preset value is reached	2/6) (37/6)	Pair_Counter
M1		Auxiliary relays	—	No	No parameters	3/6) (12/1) (29/1) (30/2)	FSM_1
M2		Auxiliary relays	—	No	No parameters	8/6) (11/1) (29/2) (30/1)	FSM_2
M3		Auxiliary relays	—	No	No parameters	4/6) (10/1) (13/1) (14/4) (24/1) (25/1) (41/1)	FSM_3
M4		Auxiliary relays	—	No	No parameters	9/6) (14/1) (17/1) (21/1) (23/3) (24/2) (42/1)	FSM_4
M5		Auxiliary relays	—	No	No parameters	5/6) (7/1) (22/1) (23/2) (24/3) (26/1) (43/1)	FSM_5
M6		Auxiliary relays	—	No	No parameters	6/1) (10/6) (23/1) (24/4) (32/1) (33/1) (34/1) (44/1)	FSM_6
M7		Auxiliary relays	—	No	No parameters	4/1) (6/6) (18/1) (20/4) (27/1) (35/1) (36/1)	FSM_7
M8		Auxiliary relays	—	No	No parameters	5/1) (11/6) (19/1) (20/5) (28/1) (35/2) (37/1)	FSM_8
N1		Auxiliary relays	—	No	No parameters	(12/6) (20/1)	FSM_1/2/3
N2		Auxiliary relays	—	No	No parameters	7/6) (14/5) (15/1) (29/3) (30/3) (31/1)	FSM_5/6/7/8
N9		Auxiliary relays	—	No	No parameters	(32/6) (33/2) (35/3) (38/2) (41/6)	E_Detected
NA		Auxiliary relays	—	No	No parameters	(33/6) (34/2) (35/5) (36/3) (42/6)	E_Trigger
NB		Auxiliary relays	—	No	No parameters	(1/2) (36/6)	E_FSM_Jump
T1		Timers	No	No	See details below	(1/6) (2/1) (3/1) (8/1) (38/6)	FSM_Clock
T2		Timers	No	No	See details below	(34/6) (36/2) (39/6)	FSM_E_Min
T3		Timers	No	No	See details below	(1/3) (35/6) (40/6)	FSM_E_Done
V1		Counter comparators	No	—	$C1 + 0 = 1$	(3/3) (8/3)	FSM_1 (? 2)
V3		Counter comparators	No	—	$C1 + 0 = 2$	(4/3) (9/3)	FSM_3 (? 4)
V5		Counter comparators	No	—	$C1 + 0 = 3$	(5/3) (10/3)	FSM_5 (? 6)
V7		Counter comparators	No	—	$C1 + 0 = 4$	(6/3) (11/3) (38/1)	FSM_7 (? 8)
V8		Counter comparators	No	—	$C1 + 0 = 5$	(39/1)	
X1		Text blocks	—	—	See details below	(24/6) (43/6)	
X2		Text blocks	—	—	See details below	(23/6) (44/6)	

Text block

X1		Text blocks																
	P	e	d	e	s	t	r	i	a	n		G	R	E	E	R		
	K	o	a	d	s							L	D	.	E	.	F	J

X2		Text blocks																
	P	e	d	e	s	t	r	i	a	n		G	R	E	E	R		
	K	o	a	d	s							L	H	.	B	.	C	J

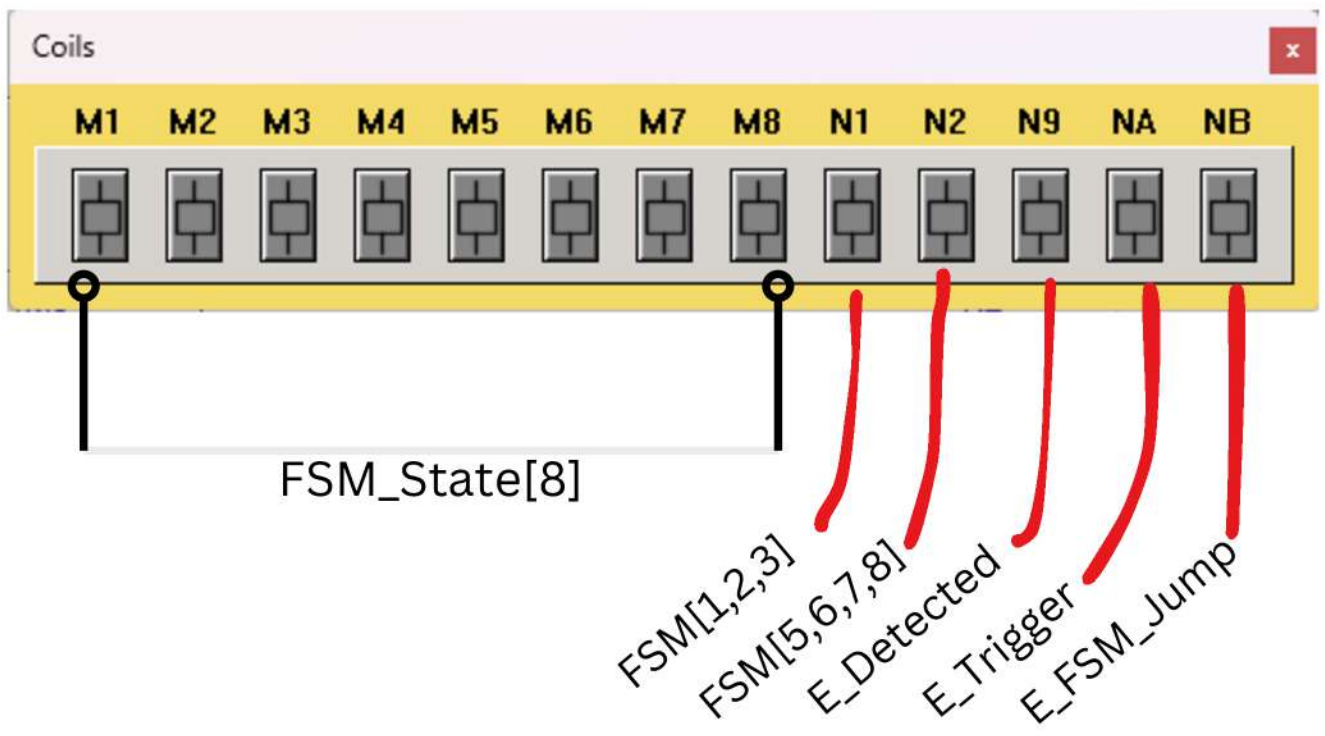
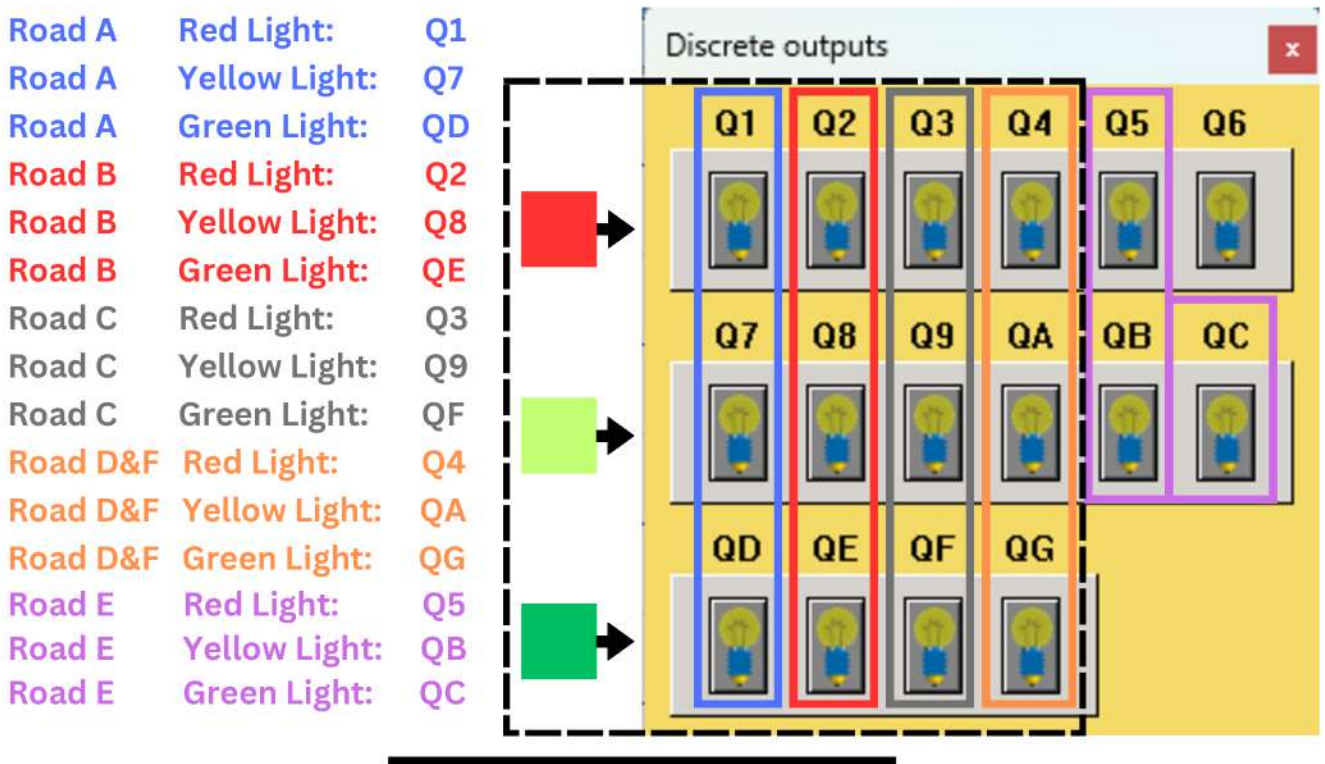
In the simulation, every input is depicted as a switch, and each output is symbolized by a light bulb. The push button is characterized as Zx Keys. Similarly, counter values and coil states are illustrated below.



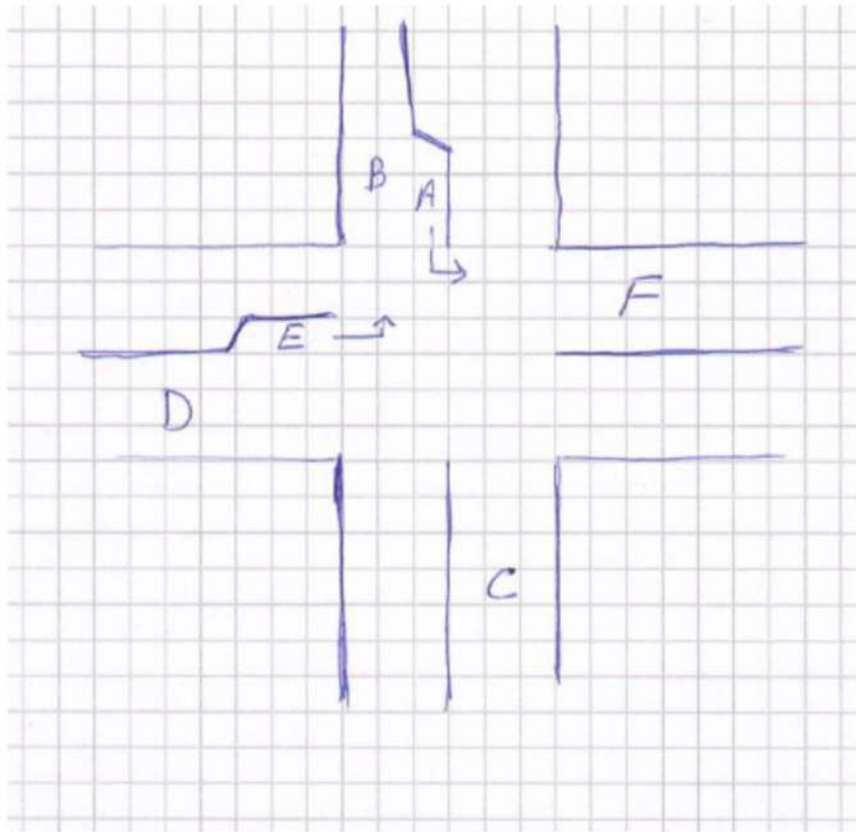
Function blocks					
No	Function	Label	Type	Preset	Comment
001	Timer	T1	L: Asymmetr	T1A = 015.0 S T1B = 005.0 S	FSM_Clock
002	Timer	T2	L: Asymmetr	T2A = 001.0 S T2B = 005.0 S	FSM_E_Min
003	Timer	T3	B: On pulse	T3 = 005.0 S	FSM_E_Done
004	Counters	C1	Output ON v	C1 = 00000	Pair_Counter
005	Counter c	V1	C1 + 0 = 1		FSM_(1 ? 2)
006	Counter c	V3	C1 + 0 = 2		FSM_(3 ? 4)
007	Counter c	V5	C1 + 0 = 3		FSM_(5 ? 6)
008	Counter c	V7	C1 + 0 = 4		FSM_(7 ? 8)
009	Counter c	V8	C1 + 0 = 5		
010	Text bloc	X1			
011	Text bloc	X2			

Key_Map:

The lamps that will be controlled are the following:



The Design:

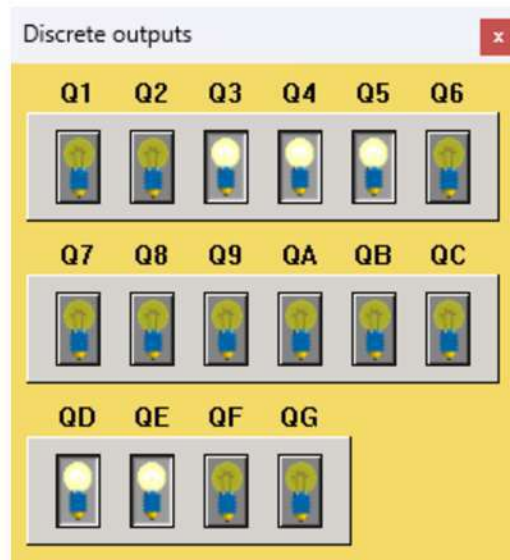


Key features include:

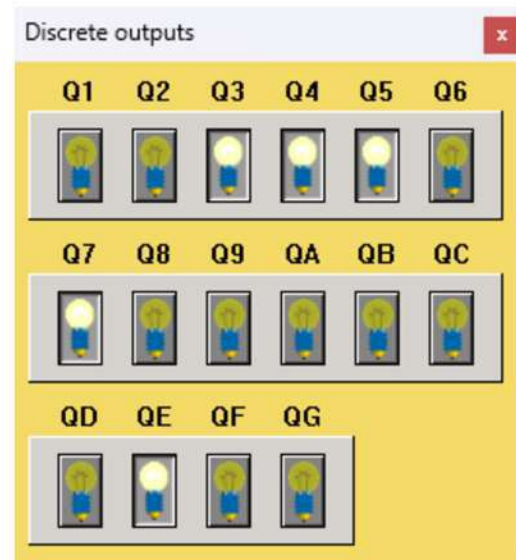
- **Controlled Left Turns:** The system controls left turns on Road A and Road E, allowing them only during specific states and restricting them during others to reduce the risk of accidents.
- **Yellow Light Warning:** The system provides a yellow light warning before changing the traffic lights to red, allowing drivers to slow down and prepare to stop, and reducing the risk of accidents.
- **Fixed Time Intervals:** The system operates on fixed time intervals, with each state having a designated duration to ensure a predictable and consistent traffic flow, and minimize congestion.

Traffic Light States (Normal Execution):

- **State 1:** Green: Road A and B, Red: Road C and D/F and E.
(15 seconds)
- **State 2:** Green: Road B, Yellow: Road A, Red: Road C and D/F and E.
(5 seconds)



State 1



State 2

- **State 3:** Green: Road B and C, Red: Road A and D/F and E.
(15 seconds)
- **State 4:** Yellow: Road B and C, Red: Road A and D/F and E.
(5 seconds)

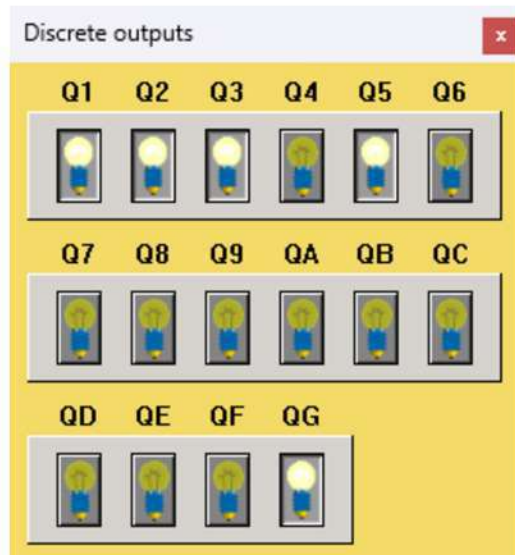


State 3

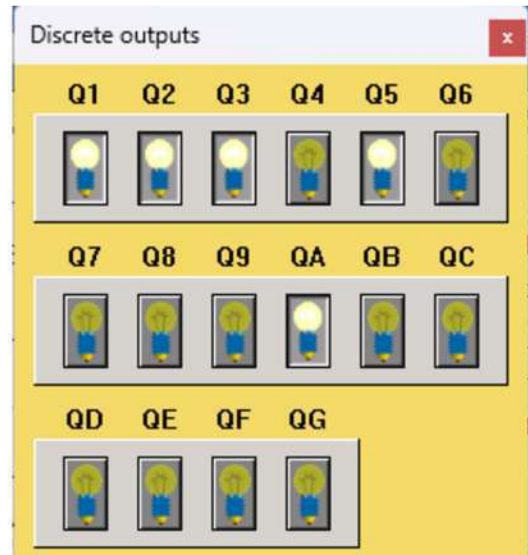


State 4

- **State 5:** Green: Road D/F, Red: Road A and B and C and E.
(15 seconds)
- **State 6:** Yellow: Road D/F, Red: Road A and B and C and E.
(5 seconds)



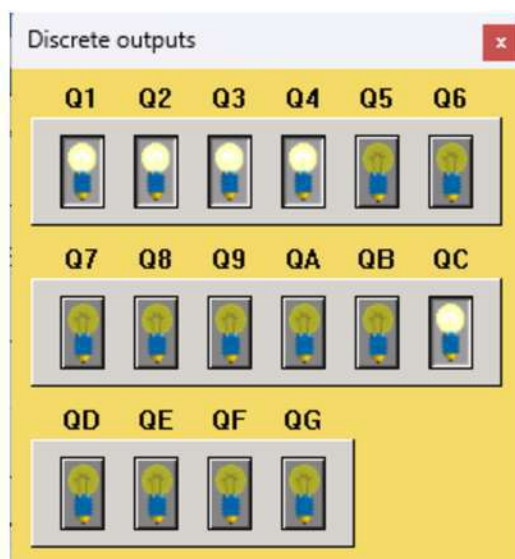
State 5



State 6

Traffic Light States (Car Detected on Road E):

- **State 7:** Green: Road E, Red: Road A and B and C and D/F.
(15 seconds)
- **State 8:** Yellow: Road E, Red: Road A and B and C and D/F.
(5 seconds)



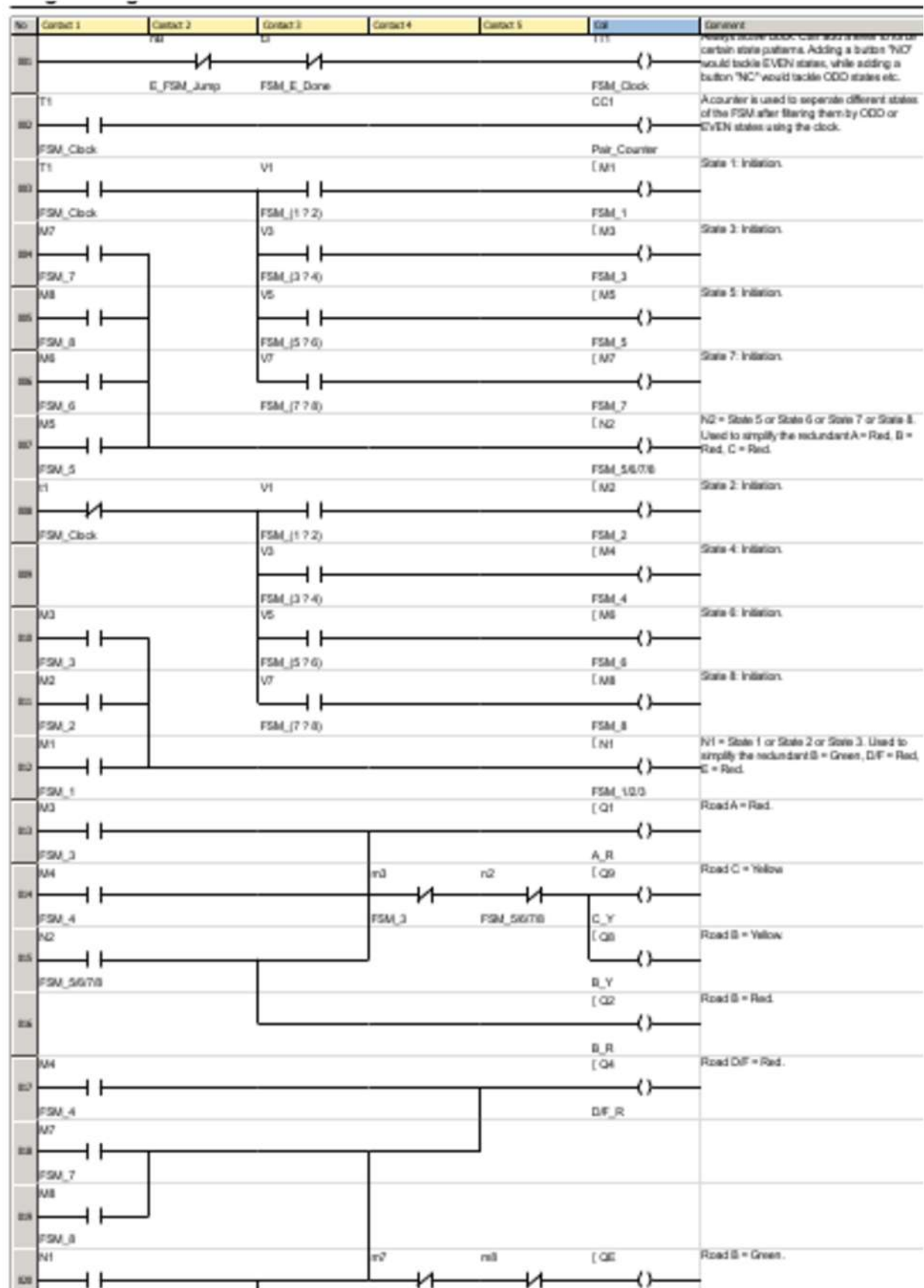
State 7

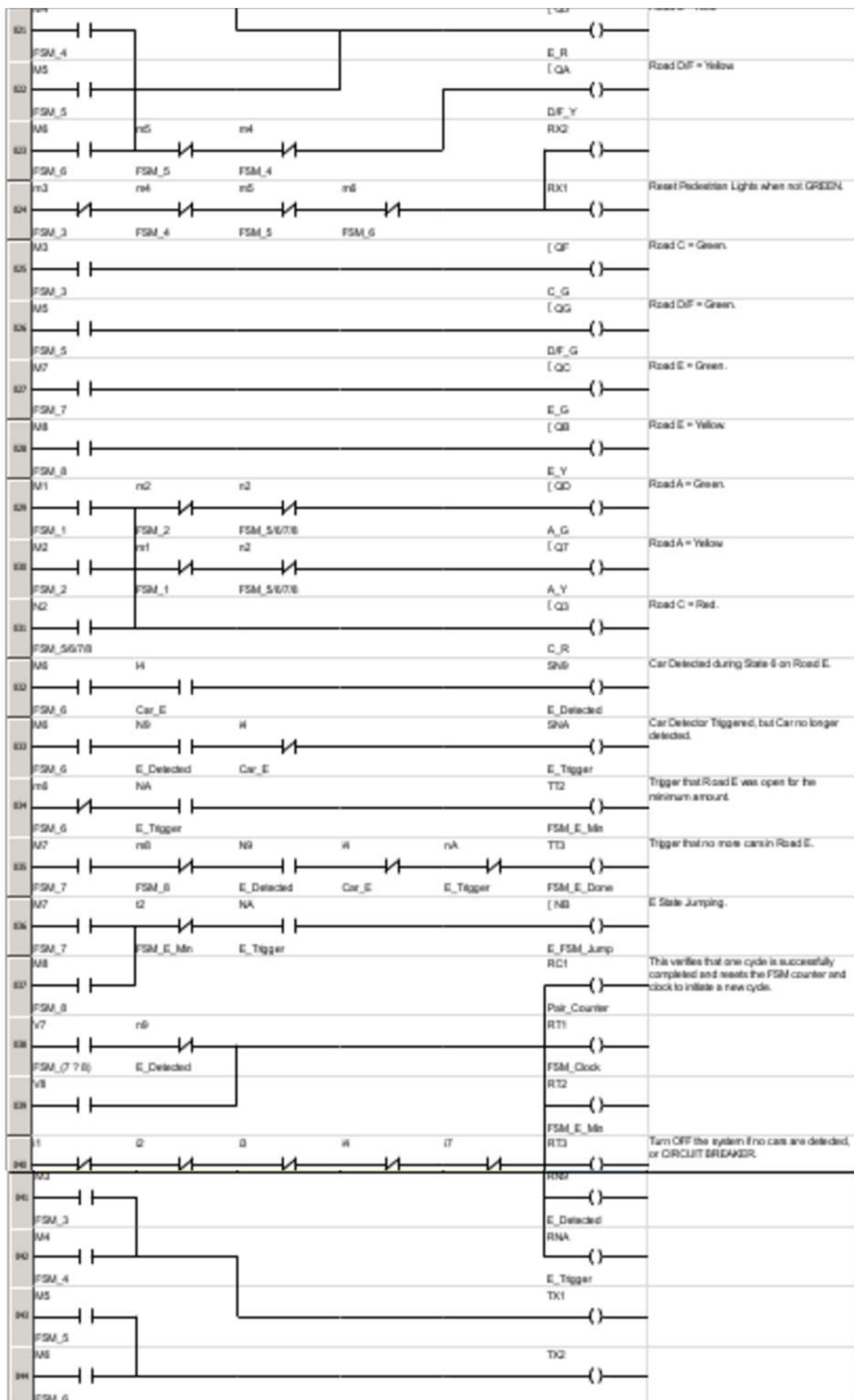


State 8

The System:

Below is the system design that fulfills the objective and focuses on all the scenarios listed.





Estimated Price Breakdown:

- 3 Standard Traffic Lights: \$3,500 - \$4,000
- 2 Traffic Light with Arrow: \$3,000 - \$3,200
- PLC: \$200 - \$300
- Mast Arms: \$28,000 - \$30,000
- Installation: \$5,000 - \$5,500

- Total: \$39,200 - \$42,400

Additional Suggestions:

- **Traffic Sensors:** Integrate traffic sensors to monitor traffic volume and adjust the timing of the traffic lights accordingly, optimizing traffic flow and reducing congestion.
- **Emergency Vehicle Preemption:** Implement emergency vehicle preemption to prioritize emergency vehicles and ensure their safe passage through the intersection.
- **Redundancy and Backup Systems:** Incorporate redundancy and backup systems to ensure the system remains operational in the event of a failure or power outage.
- **Traffic Light Synchronization:** Synchronize traffic lights with adjacent intersections to create a smooth and efficient flow of traffic, reducing congestion and minimizing travel times.

Conclusion:

The system is designed to be simple and efficient, with a straightforward sequence of states that minimizes complexity and reduces the risk of errors, making it easier to implement and maintain.