Digital System Lab

Course Code: MTE 223

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Abstract

This technical report presents the design and implementation of a logic circuit for a two-way traffic light system. The circuit, comprised of a clock signal generator, counter, and logic circuit, orchestrates the sequencing of traffic lights at an intersection. Two sets of red, yellow, and green LEDs represent traffic lights for each direction, controlled by a dedicated traffic light controller. The system adheres to a predefined sequence, efficiently managing the transition of lights through green, yellow, and red phases. The design emphasizes simplicity, reliability, and synchronization with a clock signal to ensure consistent and safe traffic flow. While this report provides a fundamental overview, practical considerations, such as timing intervals and integration with real-world intersection features, contribute to the adaptability and effectiveness of the implemented circuit.

Table of Contents

Table of Figures

Circuit Sequence

Two Way	Traffic_1	Traffic_2
Color	Green	Red
	Yellow	Red
	Red	Green
	Red	Yellow

Colors Repetition

Green	1 per Cycle
Yellow	1 per Cycle
Red	2 per Cycle

Logical Thinking of the Circuit

PASSWORD	CLK	Q1	Q2	Q′1	Q′2
0	x	x	x	x	x
1	0	0	0	1	1
1	1	1	0	0	1
1	2	0	1	1	0
1	3	1	1	0	0

And every time the password get to zero start the circuit again from beginning.

Designing a logic circuit for a two-way traffic light involves creating a system that controls the traffic signals at an intersection. Here's a simplified explanation of the logic circuit for a basic two-way traffic light system:

Assumptions:

1. Each direction has its own traffic light (red, yellow, green).
2. The lights switch between red, yellow, and green in a predefined sequence.

Components:

1. Two sets of red, yellow, and green LEDs (representing traffic lights for each direction).
2. Timing mechanism or clock signal.

Logic Circuit:

```
   +-------+      +----------+      +-------+
---| CLK |------| Counter|------| Logic |---
   +-------+      +----------+      +-------+
                        |                 |
                 +-------------+  +---------------+
                 |Traffic Light|  | Traffic Light |
                 |  Controller |  |   Controller  |
                 +-------------+ +---------------+
```

1. **Clock (CLK):** A clock signal is used to synchronize the timing of the traffic light sequence. It ensures that the lights switch at regular intervals.
2. **Counter:** A counter keeps track of the current state of the traffic light sequence. The counter increments at each clock cycle, and its output determines which light should be activated.
3. **Logic Circuit:** This block takes the output of the counter and determines which lights should be on based on the traffic light sequence. The logic circuit generates signals to control the LEDs for each direction.
4. **Traffic Light Controller:** This block interprets the signals from the logic circuit and controls the actual traffic lights. It activates the appropriate LEDs based on the logic circuit's output.

Used Circuits:

- Decoder(4-to-16) One Line Used
- Decoder(2-to-4)
- Decoder(3-to-8)
- Normal Counter Up (0→3)

Used IC:

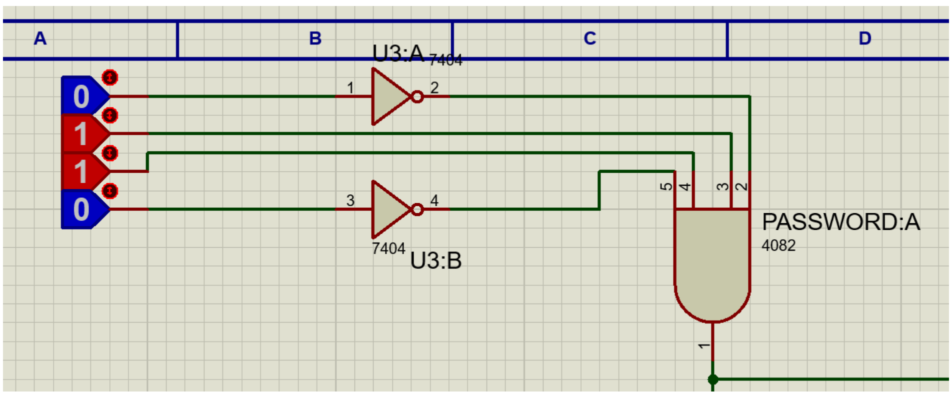
- 7414 Hex Inverter with Schmitt
- 7408 Quad 2-Input AND
- 7476 JK-Flip-Flop
- 7421 Dual 4-Input AND
- 7411 Triple 3-Input AND

Using of Each Circuit:

1) Decoder (4-to-16) One Line Used

• Used as a Password to Operate the Circuit it will only work at pass (0110).
• The output will be used later as condition for all circuit Operation.

$$F(\text{used Line}) = \sum(1,2)$$



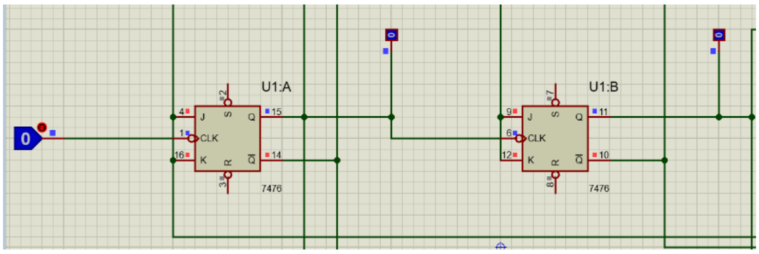
Password1 Figure

2)Normal Counter Up

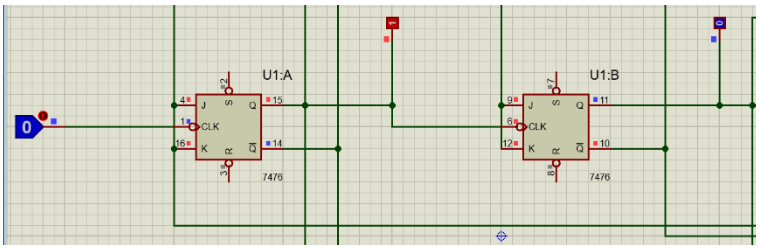
- To count (0,1,2,3) using Jk-Flip-Flop.

    00   01   10   11

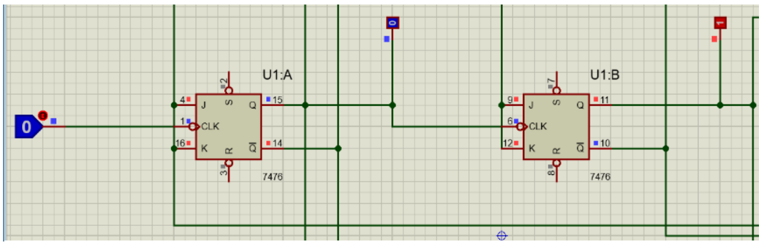
- Change the output by Changing the Input Clock.



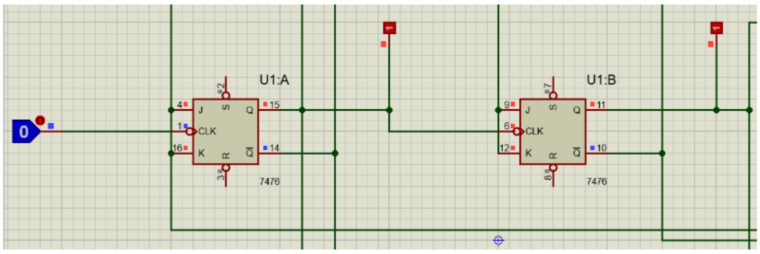
count (0)3 Figure



count (1)2 Figure



count(2)5 Figure



count(3)4 Figure

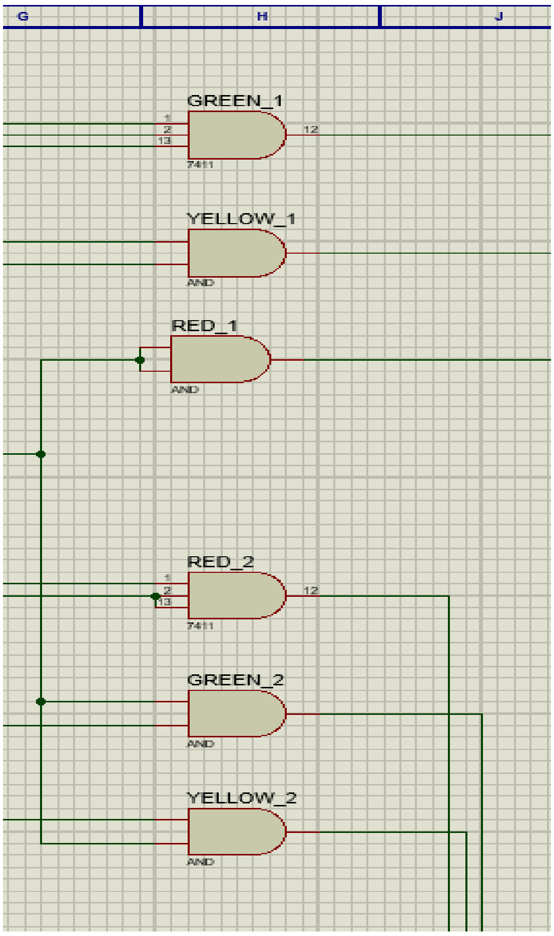
3)Decoder(3-to-8) & Decoder(2-to-4)

• Changing the light of the traffic from (red-yellow-green).

• The main controller of this changing is the output of the Counter.

• The Password works as an Enable for All this AND Gate.

• So the 3-Inputs is (the two output from the counter and the password output from the decoder), and the 2-Inputs is (the two output from the counter).



Final Output Colors6 Figure

IC Data Sheet

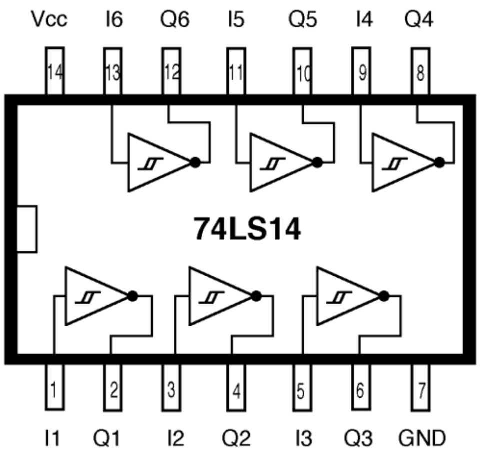


Figure 10 7414

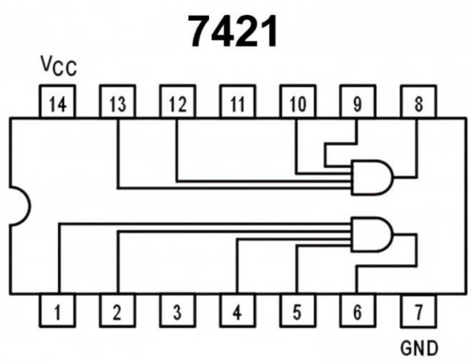
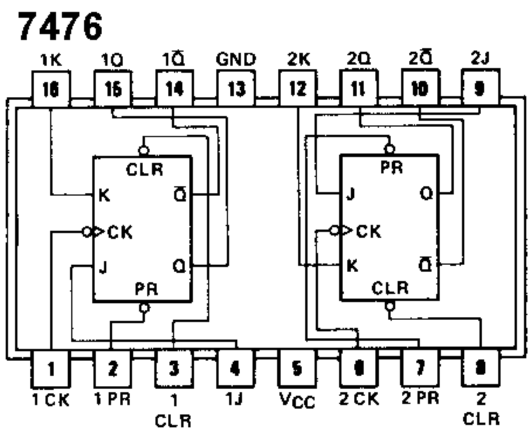
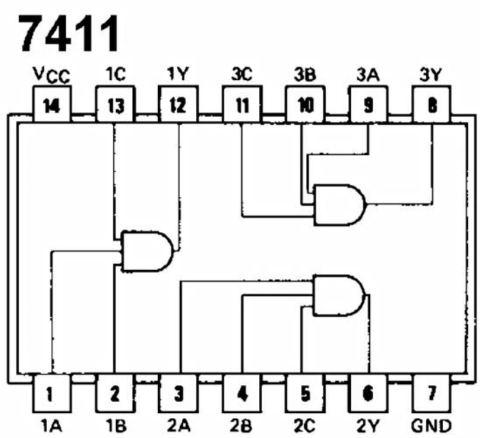


Figure 77421

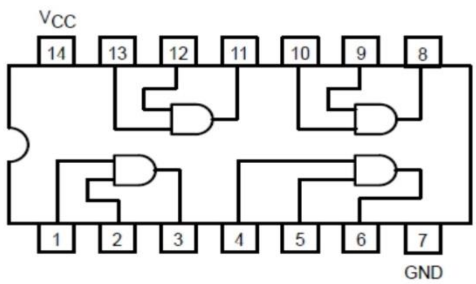


74768 Figure



74119 Figure

Quad 2-input AND gate



740811 Figure

Used Gates Truth Table

Truth Table of 2 input AND gate

Inputs		Outputs
A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

2-Input AND 14 Figure

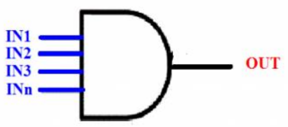
NOT gate Truth Table

Input A	Output $X=\overline{A}$
0	1
1	0

Inverter 15 Figure

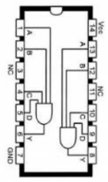
A	B	C	D	O
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

4 input AND GATE Truth Table



4-Input AND Gate SYMBOL

7421 AND IC



7421 Dual 4-Input AND Gates

Projectiot123.com

4-Input AND 12 Figure

CLK	INPUTS		OUTPUT Q+1	ACTION
	J	K		
X	0	0	Q	NO CHANGE
1	0	1	0	RESET
1	1	0	1	SET
1	1	1	$\overline{Q}$	TOGGLE

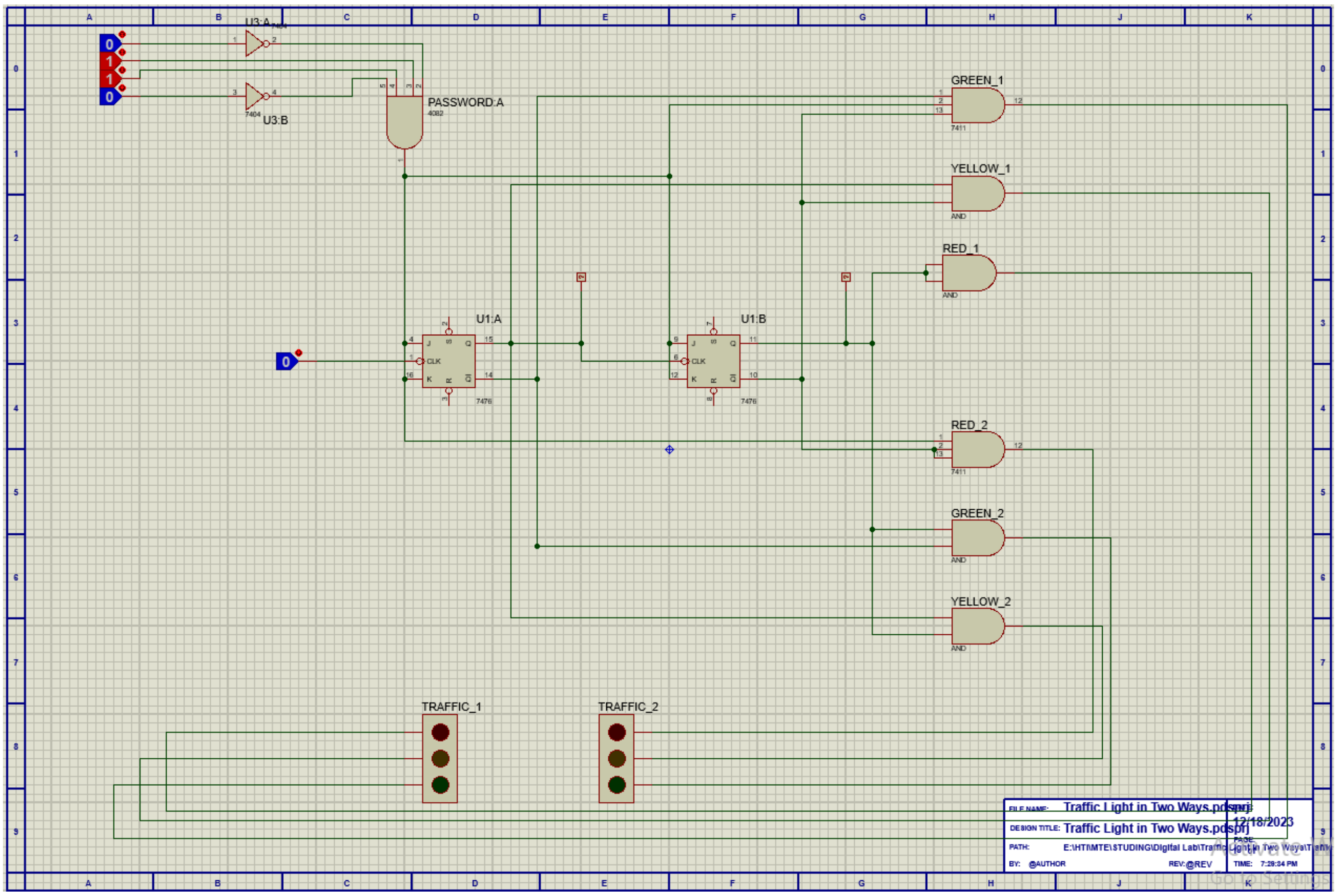
J-K Flip Flop 13 Figure

3 Input AND Gate Truth Table

Inputs			Outputs
A	B	C	X
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

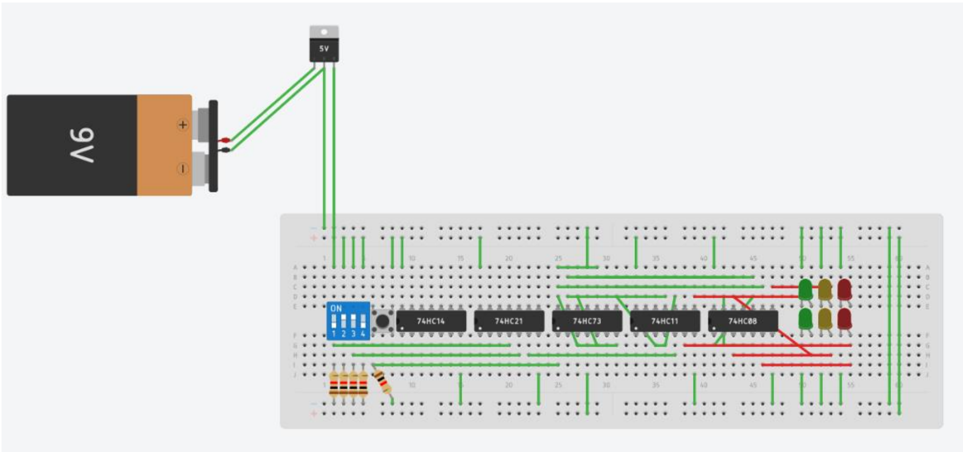
3-Input AND 16 Figure

Whole Circuit On Proteus

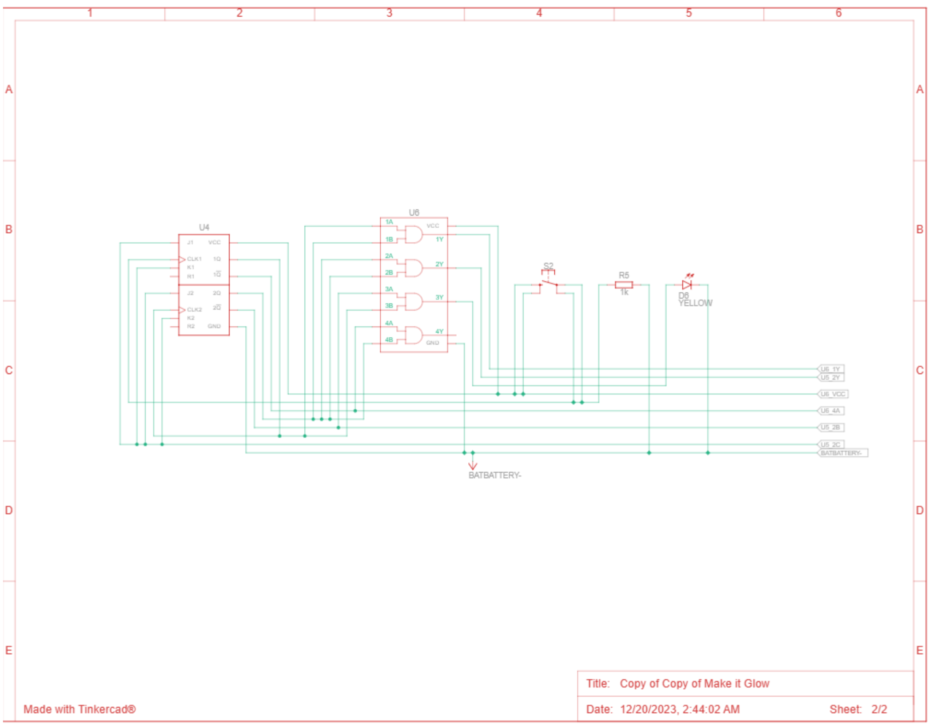


Full Proteus Project17 Figure

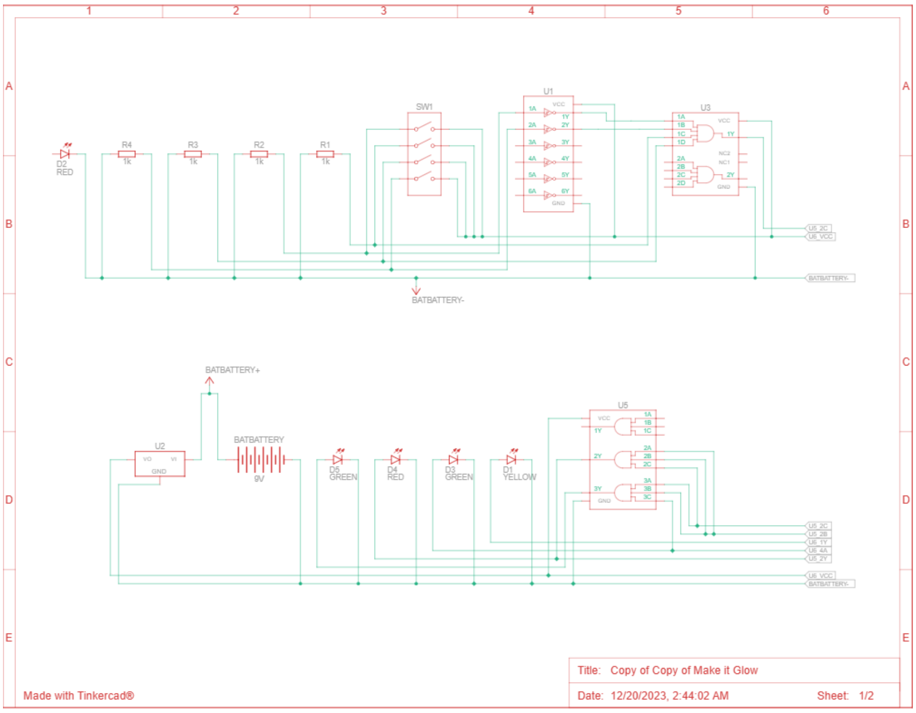
Simulation Hardware &Connections Using Tinkercad



Hardware Simulation18 Figure



Circuit Connections-119 Figure



Circuit Connections-220 Figure

Component List		
BATBattery	1	9V Battery
SW1	1	DIP Switch SPST x 4
R1 R2 R3 R4 R5	5	1 kΩ Resistor
U1	1	Inverting Schmitt Trigger
U2	1	5V Regulator [LM7805]
U3	1	Dual 4-Input AND gate
U4	1	Dual J-K Flip-Flop
U5	1	Triple 3-Input AND gate
U6	1	Quad AND gate
D1 D6	2	Yellow LED
D3 D5	2	Green LED
D4 D2	2	Red LED
S2	1	Pushbutton

Components Used21 Figure

Conclusion:

In conclusion, the designed two-way traffic light control circuit successfully addresses the imperative task of regulating vehicular movement at an intersection. The systematic arrangement of components, including the clock signal generator, counter, and logic circuit, ensures a seamless transition between traffic light states. By employing a dedicated traffic light controller for each direction, the circuit provides an efficient and reliable means of managing the intersection's traffic flow.

The emphasis on simplicity and synchronization with a clock signal contributes to the circuit's adaptability and ease of implementation. This design, while foundational, serves as a robust platform for further customization and integration of additional features, such as pedestrian crossings or advanced sensing mechanisms.

As traffic management is a critical aspect of urban infrastructure, the presented circuit not only fulfills the primary objective of controlling traffic lights but also lays the groundwork for more sophisticated traffic control systems. Future enhancements could involve real-time monitoring, adaptive signal timing, and integration with smart city initiatives. In summary, the two-way traffic light control circuit presented herein represents a crucial step towards fostering safe and efficient traffic management in urban environments.