

## **Lab 5: Finite State Machines**

ECE 218-L01

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Lab: 8 Mar 21

15 Mar 21

Due: 22 Mar 21

## Introduction

### Purpose

Design and build a finite state machine using classical design methods with the purpose of creating a working turn signal.

### Scope

Observe the output of the circuit to confirm whether the turn signal is working correctly. When the left switch is open the left light should blink, when the right switch is open the right light should blink, and when both switches are open the left and right lights should alternate with the center light.

## Theory

### Theoretical Basis

A Finite State Machine is a machine that can be in one of a finite number of states at any time. A good way to design an FSM is using a state diagram which allows designers to specify the output of the SFM as a function of the current states and any inputs.

### Preliminary Work

To prepare for this lab a circuit was designed, shown in experimental procedures, for the output of three D flip-flops which would trigger the LEDs representing the turn signals. Turn signal State Diagram

Input		Present State		Next State		Output
L	R	PS	$Q_2Q_1Q_0$	NS	$D_2D_1D_0$	LL HL RL
0	0	IDLE	000	IDLE	000	000
0	1	IDLE	000	RSIG	001	000
1	0	IDLE	000	LSIG	100	000
1	1	IDLE	000	H1	101	000
X	X	RSIG	001	IDLE	000	001
X	X	LSIG	100	IDLE	000	100
X	X	H1	101	H2	010	101
X	X	H2	010	IDLE	000	010

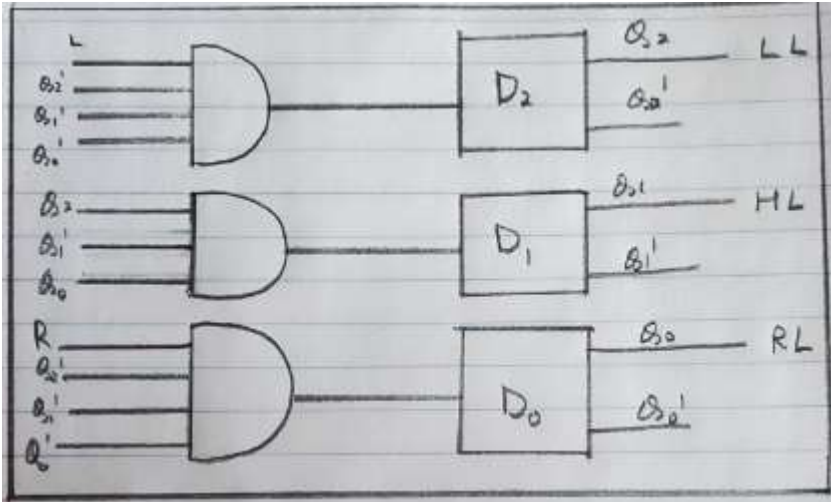
The equations for our flip-flops are:

$$D_2 = Q_2'Q_1'Q_0'L$$

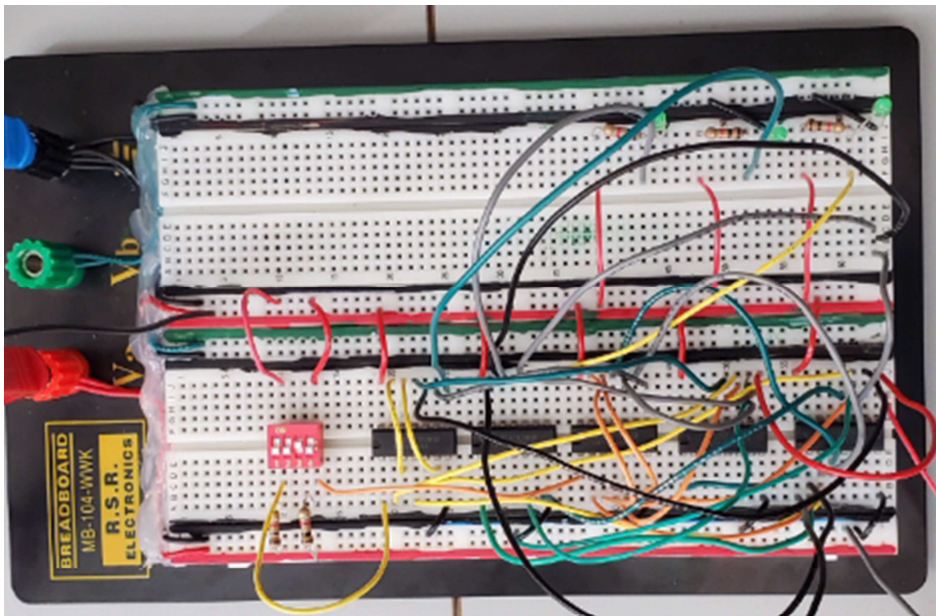
$$D_1 = Q_2Q_1'Q_0$$

$$D_0 = Q_2'Q_1'Q_0'R$$

## Experimental Procedure



Turn signal circuit diagram



turn signal breadboard

### Equipment:

- Copper wire
- SN74LS08N Dual 4-Input AND Gate
- SN74LS175N Quad D Flip-Flop
- DIP SPST switch
- $1k\Omega \pm 5\%$  resistors
- $1k\Omega$  resistor array
- Green LEDs

## Procedure

1. Set up circuit depicted in circuit diagram on breadboard.
2. Connect breadboard to desktop voltage source and set to 5V.
3. Connect breadboard to waveform generator and set to 1Hz square wave with an amplitude of 5V.
4. Test design and troubleshoot, as necessary.
5. Report successful results to the TA.

## Results

L	R	LL	HL	RL
LOW	LOW	OFF	OFF	OFF
LOW	HIGH	OFF	OFF	BLINK
HIGH	LOW	BLINK	OFF	OFF
HIGH	HIGH	BLINK	BLINK	BLINK

No calculations performed

## Interpretation

The results of the experiment were a success, each light operating as intended, each turn signal operated correctly along with the hazards.

## Conclusion

From the results in this lab, we can conclude that it is possible to represent a turn signal using an FSM and we have learned more about the design and implementation of FSMs.