Report: Finite State Machine

Bilkent University Electrical and Electronics Department

EE102-01 Lab 7

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Purpose:

Purpose of this lab is to study essentials of Finite State Machines (FSMs) by building one on breadboard using logic gates and a flip flop. Through this work, we will learn about Moore and Mealy machines and how they work. We'll also get practice building the circuits for them.

Methodology:

In this lab we designed a finite state machine we chose. There are infinite ways to build a finite machine according to what we want. We can create a Moore or Mealy machine. In this lab we are going to create a combinational circuit which acts like an emergency flash. This circuit will open when we give input 1 and it will close when we give input 0.

Design Specifications:

This design has one input and one output where output is the LED (flashlight) and input is on/off switch. Additionally, a green LED is used to show the clock pulses, making it easier to observe when the circuit updates. Since the output of the circuit depends only on the state stored in the flip-flop and not directly on the input, this design follows the structure of a Moore machine. The behaviour of the output is determined by the internal state of the system rather than immediate changes in the input. You can find the state diagram (Figure 1), circuit design (Figure 3) and state table (Figure 2) in the following figures.

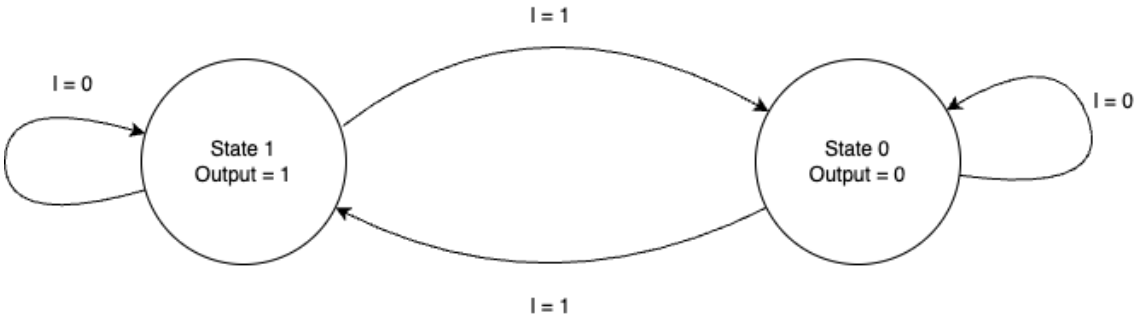


Figure 1: State Diagram

- State 1 Output: 1
- State 0 Output: 0

Present State	Next State I=0 I=1	Output
0 1	0 1 1 0	0 1

Figure 2: State Table

After creating the Karnaugh map for D input of D-flip-flop we can design the circuit as Figure 3.

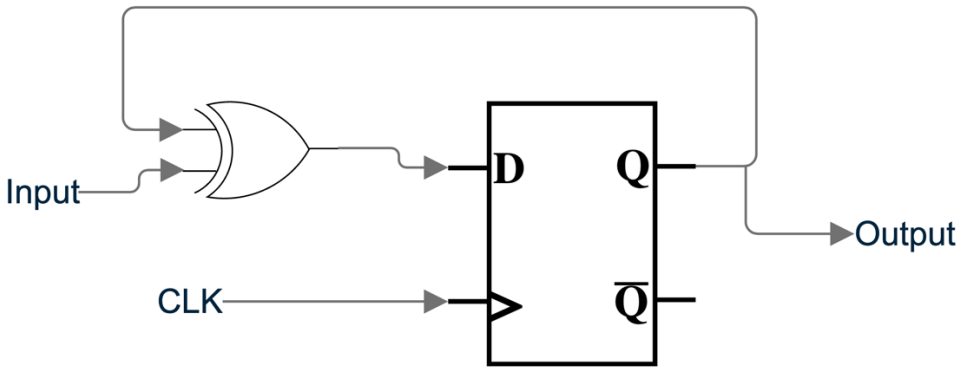
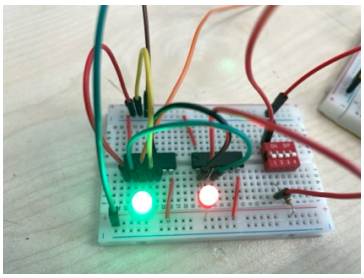


Figure 3: Circuit Design

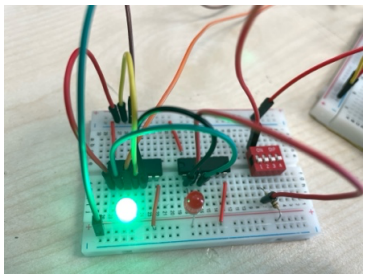
To implement this design a XOR gate and a D-flip-flop has been used. As a XOR gate we used 74HC86 and as a D-flip-flop we used two input 74HC74.

Results:

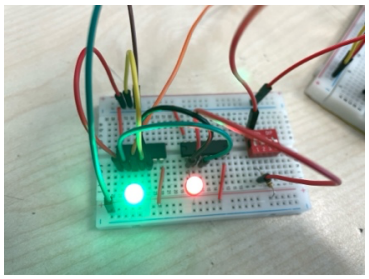
The circuit was built on a breadboard using the necessary gates and connections, and its states and outputs were observed. The following images show how the circuit looks on the breadboard. To make the circuit's operation easier to see, two LEDs were added: the red LED represents the output of the finite state machine, and the green LED indicates clock ticks to observe the cycles.



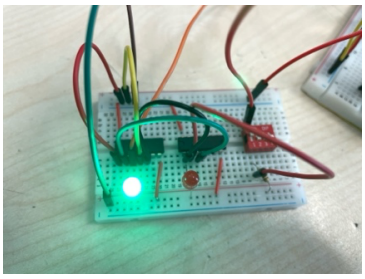
a) State 1 Input: 0



b) State 0 Input: 0



c) State 1 Input: 1



d) State 0 Input: 1

Figure 4: Working Circuit on Breadboard

Conclusion:

During this lab, the process of designing a finite state machine and building it on a breadboard using integrated circuits was learned. Several important concepts were strengthened, including understanding how a Moore machine operates, how to design and implement this type of circuit, and how to combine combinational and sequential circuits in a basic way.

References:

https://github.com/SemihAkkoc/EEE102