Lab 7 : Finite State Machine

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Section 1

Purpose

The purpose of this experiment is to build an FSM machine on a breadboard using a flip-flop. ICs with D flip-flops and logic gates will be used for this.

1. Design Specifications

The FSM machine is about a system that checks if the cargo conveyor belts are working properly. In this case, there are 3 states. These are No cargo (‘00’), there is a cargo (‘01’) and cargo stuck states (‘10’). Input is defined as the passing of a cargo. If the input is '1', the cargo passes, if '0' it does not. In order for the system to work properly, an input must be entered in a sequence like 1010100010.. so that '1' does not appear 2 times in a row. If '1' comes 2 times in a row, it means that the cargo is not continuing and is stuck and its state changes to '10'. When the input is '0' again, it returns to the no cargo ('00') state.

This FSM machine is a Moore type since next state depends on current state and input.

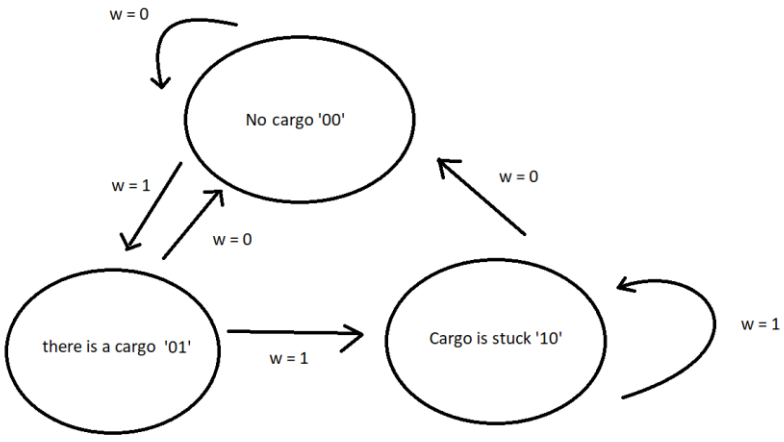

Figure 1 : State transition diagram

Current State y_2y_1	Next State w = 0 y_2y_1	Next State w = 1 y_2y_1	Output
00	**00**	**01**	**0**
01	**00**	**10**	**0**
10	**00**	**10**	**1**
d	**d**	**d**	**d**

Table1: State transition and output table (While w is input)

2. Methodology

Since we have 3 states, we have to use at least 2 flip-flops. Using Table 1, the outputs of these flip flops and output is;

$$Y_1 = y_1' \; and \; y_2' \; and \; w \qquad Y_2 = (y_1 \; or \; y_2) \; and \; w$$

$$Output = y_2$$

Based on these equations, The FSM circuit design' is found as follows;

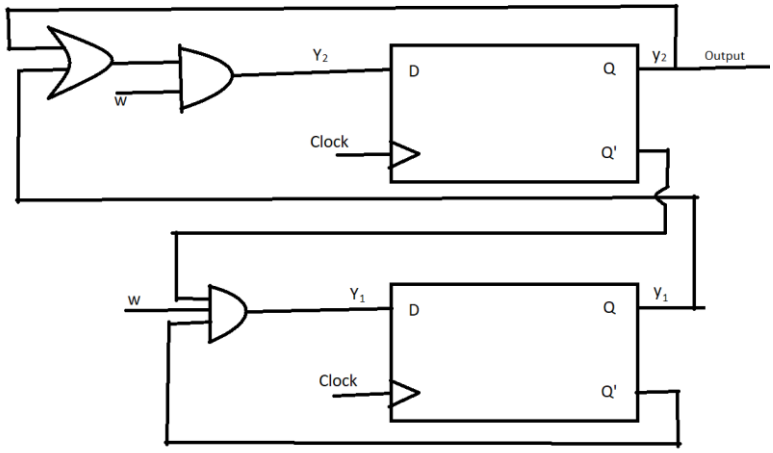

Figure 2: The FSM circuit design

The ICs used for the circuit are SN74HCS11, SN74HC74 and SN74HC32. 2 inputs AND gate provided by connecting the 2 legs of 3 inputs AND gate to each other. Signal generator is set to 5V,1Hz and 2.5DC offset, power supply is set to 5V. After the signal generator was set to give a square signal, (it was used as a clock) and jumper connections were made.

3. Results

The test results on the breadboard are shown in figures 3 to 6 below.

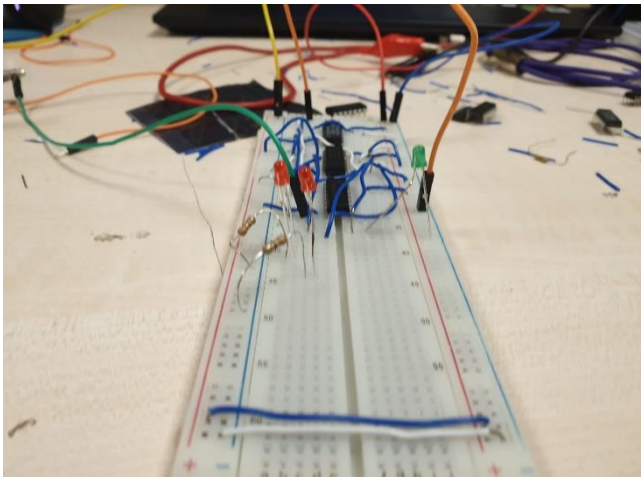

Figure 3 : input =0 ,state = '00' No cargo

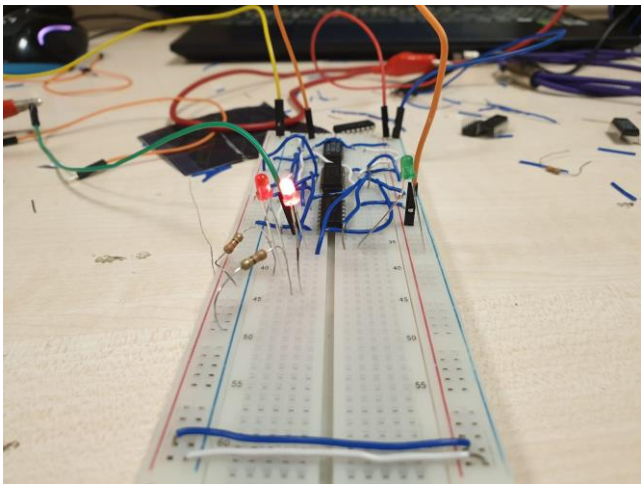

Figure 4: input =1 ,state = '01' There is a cargo

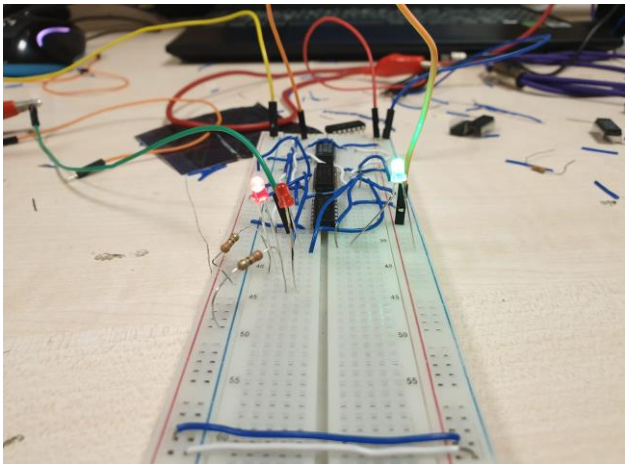

Figure 5: input =1 ,state = '10' cargo is stuck

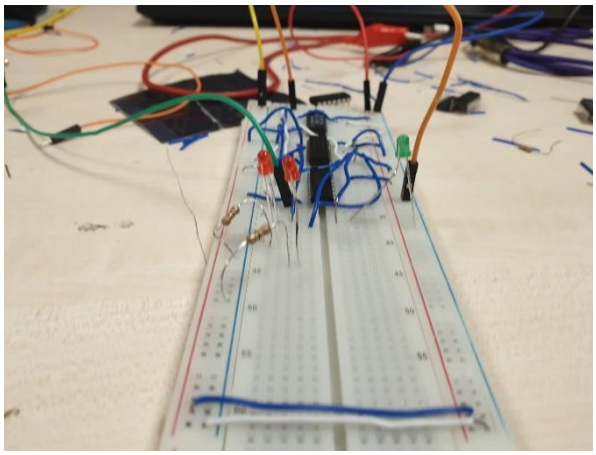

Figure 6: input =0 ,state = '00' No cargo

The circuit is works properly.

Conclusion

The purpose of the lab is to create an FSM machine using ICs and display it via leds. The experiment was successfully completed as shown in the result section.