

Bilkent University

Electrical and Electronics Department

EE102-01 Lab 7 Report:

“Finite State Machine”

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Purpose:

The main purpose of this lab was to create a finite state machine (FSM) on a breadboard by using D-Flip Flops (74HC74) and other logic IC's. A real-life situation a gym bro could face was created and implemented on the breadboard.

Methodology:

Firstly, a real-life situation was created. The situation contained the happiness and the well-being of a gym bro according to the events that happens in his life. After coming up with the problem and deciding on the inputs, a state transition diagram and a truth table were created in order to better visualize the problem. The final part was to implement the design onto a breadboard using jumper cables, push buttons, LED's, a signal generator for the 1Hz clock-input and logic IC's such as D-Flip Flop (74HC74), 2-input AND gate (74HC08), 2-input OR gate (74HC32) and 2-input XOR gate (74HC86).

Design Specifications:

The design shows us the well-being and the emotional status of a gym bro. This emotional well-being and mental status of a gym bro plays a pivotal role in shaping their academic and personal life. Regular exercise is scientifically proven to release endorphins which can elevate mood and act as a natural counter to stress and anxiety. This biochemical boost can enhance focus and motor skills, providing a clear mental edge that benefits the gym bro not only in the fitness world, but also in his life in general.

Especially considering a gym bro who is in his university years, the mental status becomes more important since university years are a critical phase, often marked by intense academic pressure, the stress of future career decisions, and the challenges of navigating personal relationships. When a college gym bro maintains good mental health, he can focus better, handle tough times, and do well in his lectures. However, if bro is having a hard time with his mental health, this leads to school becoming harder, making them want to be alone more and worse, this can even affect their body.

It is important to always remember that a good mental health is not just about avoiding problems; it's about growing personally and academically and laying a strong foundation for a healthy future. Therefore, in essence it is really important to have good mental health and emotional well-being, since it is crucial for a gym bro's success and overall happiness. I personally believe that mental health is something we usually don't care too much on our daily lives but this problem every gym bro is facing needs to be addressed and this is the reason why I came up with this design.

The design consists of two states representing the emotional status of a gym bro: Sad:"0" and Happy:"1". There is a single 2-bit vector input representing four different events happening in bro's life: drinking water:"00", having a productive workout:"01", having a girlfriend:"10" and failing an exam:"11". There is a single output that shows us bro's mental health: mentally unstable:"0" and mentally healthy:"1". Here you can see the state transition diagram (**Figure 1.2**) and the truth table (**Figure 1.1**) of the design:

Present State	Input	Next State	Output
Sad	00	Sad	0
Sad	01	Happy	1
Sad	10	Happy	1
Sad	11	Sad	0
Happy	00	Happy	1
Happy	01	Happy	1
Happy	10	Happy	1
Happy	11	Sad	0

Figure 1.1: Truth Table of the Proposed Design

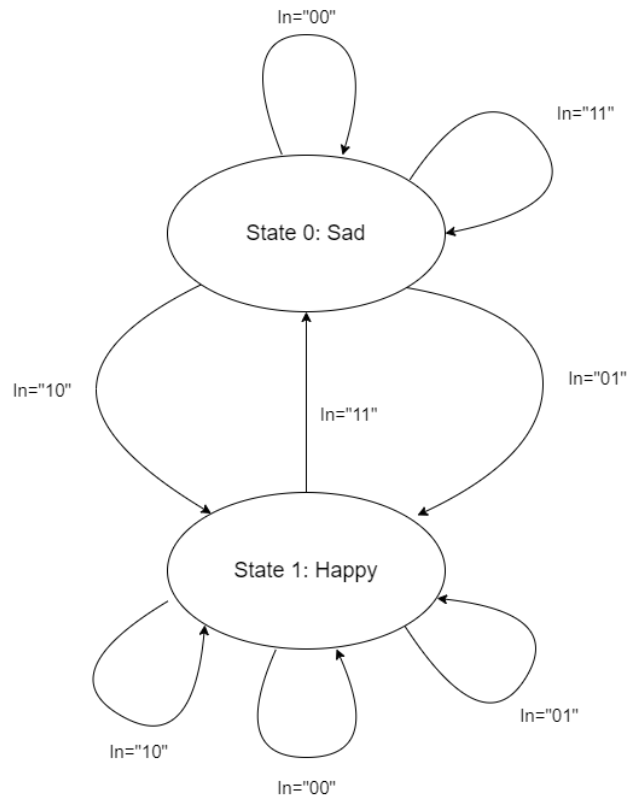


Figure 1.2: State Transition Diagram of the Proposed Design

Here is the pin configuration (**Figure 1.3**) and the function table (**Figure 1.4**) of the 74HC74. The IC component contains two separate D-Flip Flops. V_{cc} and GND pins were connected to 5V and 0V accordingly. CLR and PRE pins were connected to 5V. As for the D and CLK inputs, they were the ones that took some time to find out where to connect. After some thinking process, the data input was connected to the signal “In(0) XOR In(1)” and the clock signal was connected to “[In(1) OR In(0)] AND CLOCK” where CLOCK is the 1Hz square-wave signal.

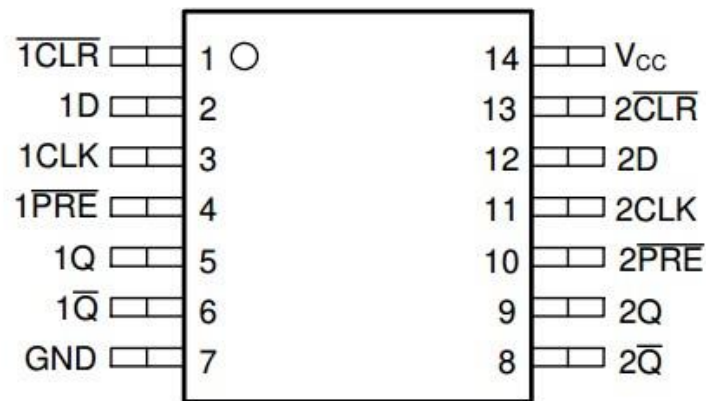


Figure 1.3: Pin Configuration of 74HC74

INPUTS				OUTPUTS	
PRE	CLR	CLK	D	Q	Q
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H ⁽¹⁾	H ⁽¹⁾
H	H	↑	H	H	L
H	H	↑	L	L	H
H	H	L	X	Q ₀	Q ₀

Figure 1.4: Function Table of 74HC74

Results:

After implementing the design on analog components, several input&state combinations from the truth table were simulated on the breadboard (**Figures 2.1, 2.2, 2.3, 2.4 and 2.5**).

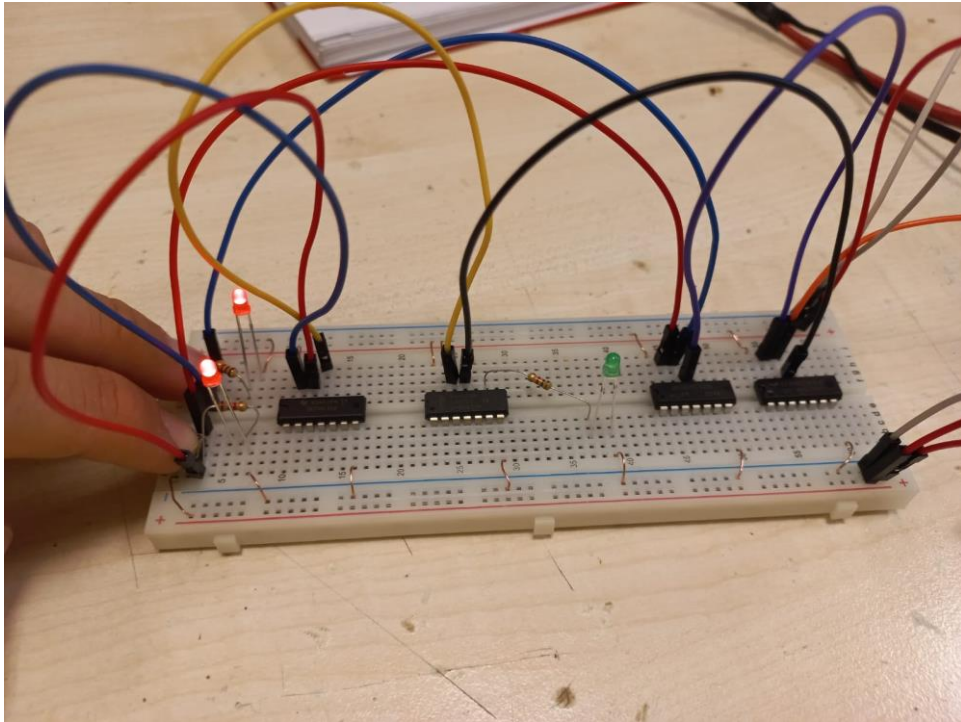


Figure 2.1: The Circuit when State="1", In="11"

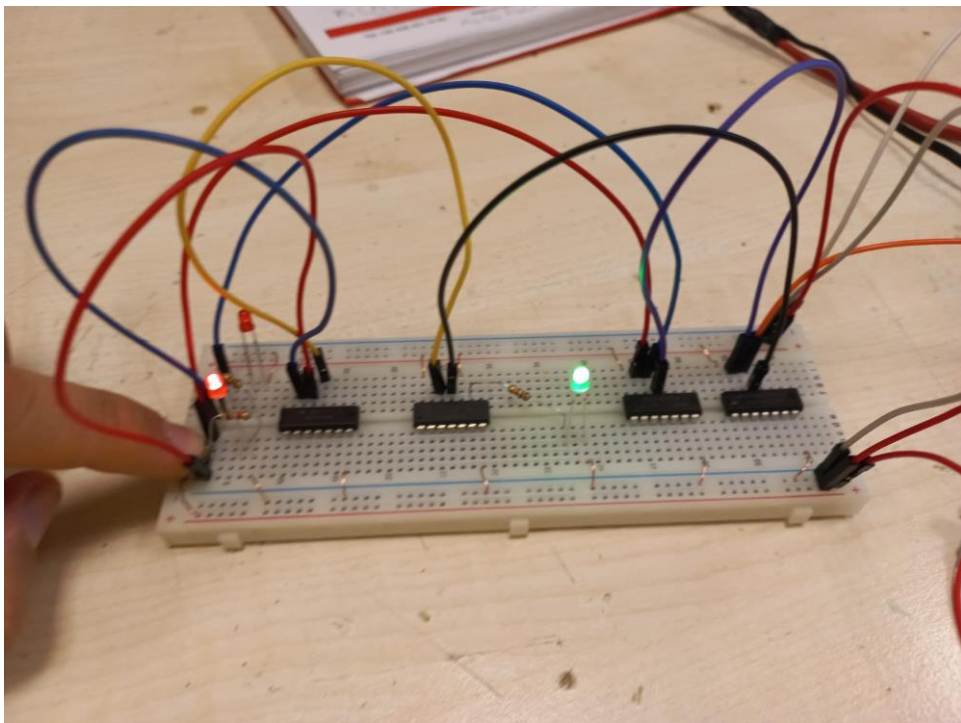


Figure 2.2: The Circuit when State="1", In="01"

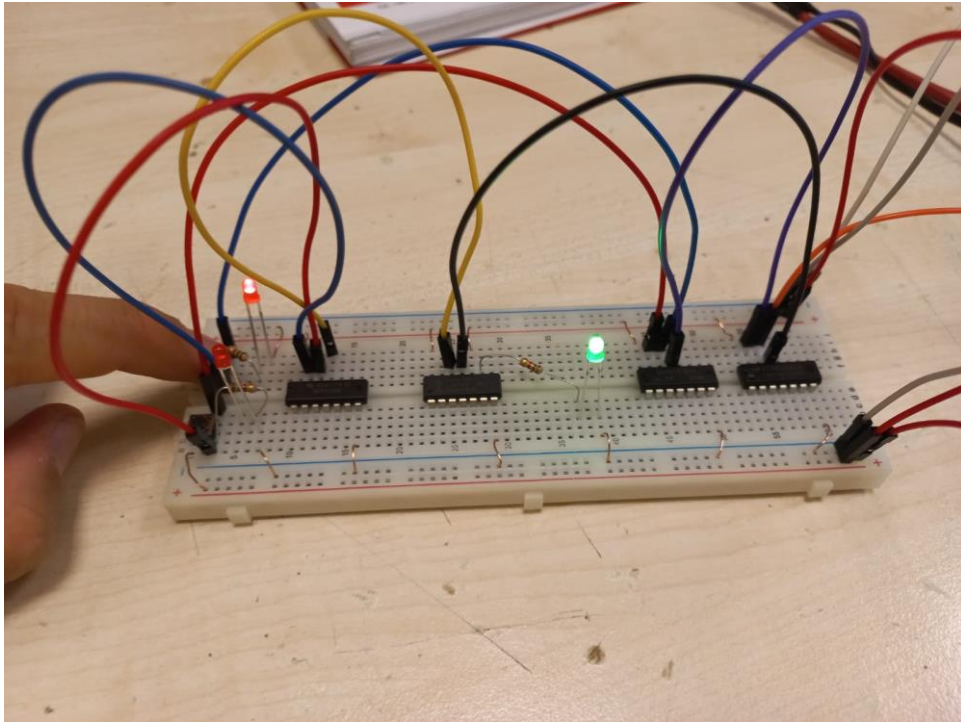


Figure 2.3: The Circuit when State="0", In="10"

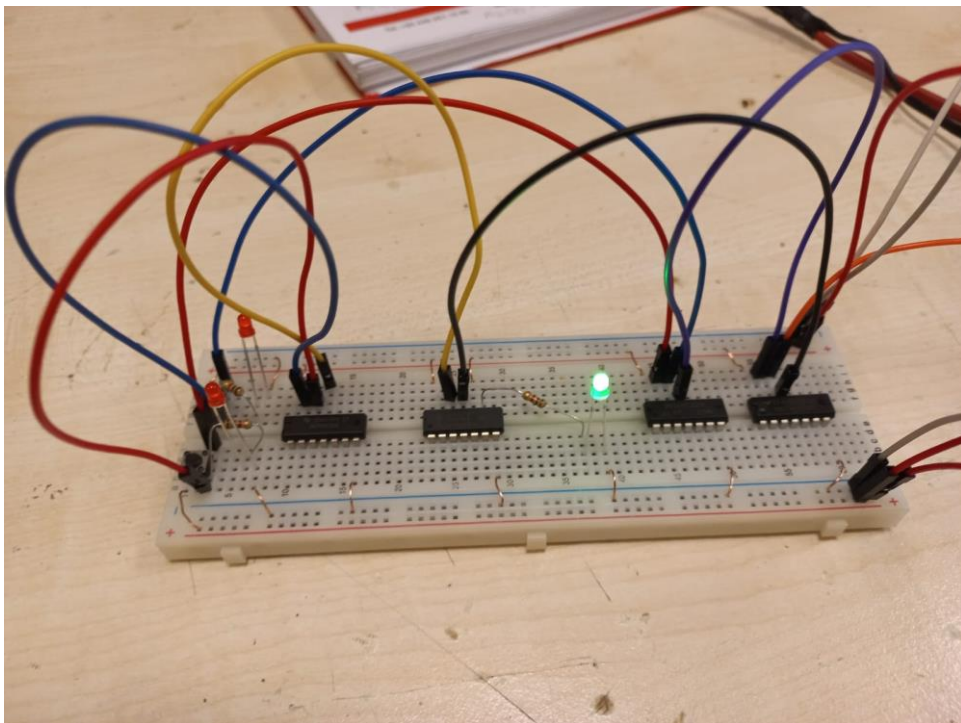


Figure 2.4: The Circuit when State="1", In="00"

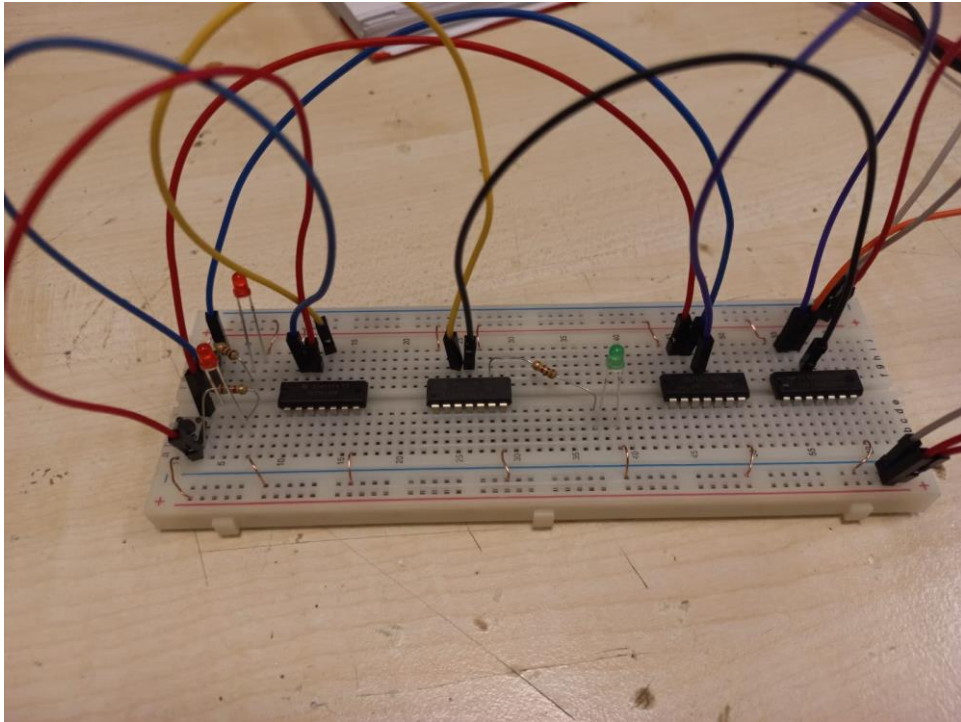


Figure 2.1: The Circuit when State="0", In="00"

Conclusion:

In this lab the main purpose was to create a finite state machine using logic IC's and some analog components. The design was successfully implemented on the breadboard without any trouble. Some connection issues on the legs of some components were the only encountered problem but since troubleshooting was fast, it did not take much time to fix it. The lab was helpful in understanding the finite state machines.