Project Fall 2025
Sequence generator and detector

Tutorial Videos: https://www.youtube.com/watch?v=dShBQFFCIvY

Note: the sequences in the video are different from the sequences of this project but the idea is the same

References

1. Chapter 5 (Synchronous Sequential Logic), Sections 5.1-5.5, 5.7-5.8 M&C6

Objectives

- Design a sequence generator and detector using Finite State Machine

Overview

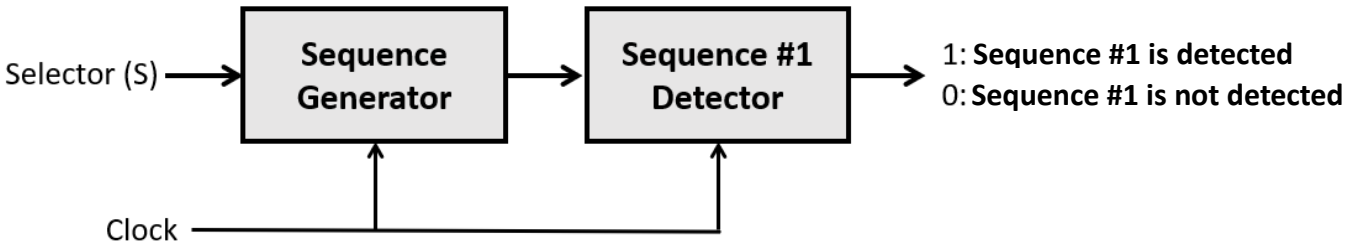

Figure 1: illustration for the project.

As shown in Figure 1, the project has two parts: a sequence generator and a sequence detector that are connected to the same clock. The generator has an input S that selects between two different sequences to generate: sequence #1 = 0001 and sequence #2 is 1110. When S = 0, the sequence 0001 is generated and when S = 1, the sequence 1110 is generated. The selected sequence is repeatedly produced. For instance, if S = 1, the generator circuit produces 1110 1110 1110 ….. In every clock cycle, one bit of the sequence is generated by the sequence generator circuit and inputted to the detector circuit. The output of the detector is 1 when sequence #1 is detected otherwise it outputs 0. The project should work this way; when S = 0, sequence #1 is generated and the output of the detector is 1 and when S = 1, sequence #2 is generated and the output of the detector is 0. You may need to connect an LED to the output of the detector circuit to visually display the decision of the detector.

Part 1 of the project: A sequence generator

Your task is to design an FSM to generate these two repeating sequences 0001 and 1110 when S = 0 and 1, respectively. **Use D flip-flops to store the circuit's states**. In this part of the project, do the following:

(1) Draw the state diagram and explain how it works.

(2) Write the state table.

(3) Implement your designed FSM in the Digital tool. Use the Digital versions of the 74xx logic ICs for your simulation.

(4) Using your lab parts kits, draw the circuit showing the chips used and the pin connections.

(5) Implement the circuit and test it.

(6) Draw a timing diagram showing the clock, the current state of the circuit, and the output of the generator when S = 0 and when S = 1.

Equipment

- Your laptop or PC
- Breadboard
- Connecting cables (Male-to-Male or Male-to-Female)
- Analog Discovery 2
- 7400-series chips

Deliverables:

The report of part 1 of the project should have the following:

(1) The state diagram of the generator. **[5 points]**

(2) The state table of the generator. **[5 points]**

(3) Implementation of the Digital tool of the generator. **[5 points]**

(4) Draw the generator circuit showing the chips used and the pin connections. **[5 points]**

(5) The timing diagrams of the clock, the current state of the circuit, and the output of the sequence generator when S = 0 and when S = 1. **[5 points]**

(6) Testing of the generator circuit. **[10 points]**

The following things will also be considered in grading: overall quality of the presentation in the assignment, organization of the lab assignment, the spelling mistakes, grammatical errors, writing style, clarity and organization of the contents etc.

Encourage you all to strive for efficiency in your technical writing.

Part 2 of the project: A sequence detector

The detector circuit receives the sequence generated by the generator (the output of the generator circuit) and produces 1 when sequence #1 is detected, otherwise it produces 0. In part 2 of the project, you will do the following tasks.

(1) Draw the state diagram of the detector and explain how it works.

(2) Write the state table of the detector.

(3) Implement your designed FSM of the detector in the Digital tool. Use the Digital versions of the 74xx logic ICs for your simulation.

(4) Using your lab parts kits, draw the circuit showing the chips used and the pin connections.

(5) Implement the circuit and test it.

If you do not have enough chips or space on the board to implement both the generator and the detector, first build the generator, demonstrate it to the TA, and then use an AD2 virtual circuit—as done in Lab 8—to emulate the generator while you implement the detector. Alternatively, you may manually provide the detector's clock using a switch and set its input to a specific sequence to emulate the generator's behavior.

(6) Draw a timing diagram showing the clock, the input sequence, the current state of the detector, and the output of the detector when S = 0 and when S = 1.

Equipment

- Your laptop or PC
- Breadboard
- Connecting cables (Male-to-Male or Male-to-Female)
- Analog Discovery 2
- 7400-series chips

Deliverables:

Your project report should have the following:

(1) The state diagrams of the detector. **[5 points]**

(2) The state table of the detector. **[5 points]**

(3) Implementation of the Digital tool of the detector. **[5 points]**

(4) Draw the detector circuits showing the chips used and the pin connections. **[5 points]**

(5) The timing diagrams of the clock, the current state of the circuit, the input sequence and the output of the detector when S = 0 and when S = 1. **[5 points]**

(6) Testing of the detector circuit. **[10 points]**

The following things will also be considered in grading: overall quality of the presentation in the assignment, organization of the lab assignment, the spelling mistakes, grammatical errors, writing style, clarity and organization of the contents etc.

Encourage you all to strive for efficiency in your technical writing.