

SEQUENCE DETECTOR

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1 Problem

(GATE EC-2020)

Q.No.39. The state diagram of a sequence detector is shown below. State S_0 is the initial state of the sequence detector. If the output is 1, then

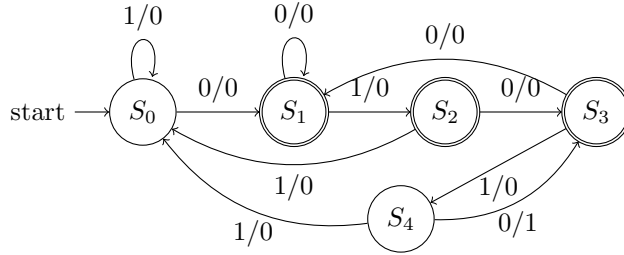


Figure 1: State diagram

1. the sequence 01010 is detected
2. the sequence 01011 is detected
3. the sequence 01110 is detected
4. the sequence 01001 is detected

2 Introduction

A sequence detector accepts as input a string of bits: either 0 or 1. Its output goes to 1 when a target sequence has been detected. There are two basic types: overlap and non-overlap. In a sequence detector that allows overlap, the final bits of one sequence can be the start of another sequence.

3 Components

Components	Value	Quantity
Resistor	220 Ohm	1
Arduino	UNO	1
Seven Segment Display		1
Decoder	7447	1
Flip Flop	7474	2
Bread Board		1
Jumper Wires		20

4 State Table

From state diagram, state table can be generated in Table 1.

Present State	Input	Next state	Output
S_0	0	S_1	0
S_0	1	S_0	0
S_1	0	S_1	0
S_1	1	S_2	0
S_2	0	S_3	0
S_2	1	S_0	0
S_3	0	S_1	0
S_3	1	S_4	0
S_4	0	S_3	1
S_4	1	S_0	0

Table 1: State Table

4.1 Truth Table

Present State	Input	Next state	Output
A B C	X	P Q R	Y
0 0 0	0	0 0 1	0
0 0 0	1	0 0 0	0
0 0 1	0	0 0 1	0
0 0 1	1	0 1 0	0
0 1 0	0	0 1 1	0
0 1 0	1	0 0 0	0
0 1 1	0	0 0 1	0
0 1 1	1	1 0 0	0
1 0 0	0	0 1 1	1
1 0 0	1	0 0 0	0

Table 2: Truth Table

5 Karnaugh Map

The karnaugh maps for the above truth table are given below

		CX			
		00	01	11	10
AB	00	0	0	0	0
	01	0	0	1	0
	11	X	X	X	X
	10	0	0	X	X

$$P = BCX \quad (1)$$

		CX			
		00	01	11	10
AB	00	0	0	1	0
	01	1	0	0	0
	11	X	X	X	X
	10	1	0	X	X

$$Q = BC'X' + B'CX + AX' \quad (2)$$

		CX			
		00	01	11	10
AB	00	1	0	0	1
	01	1	0	0	1
	11	X	X	X	X
	10	1	0	X	X

$$R = X' \quad (3)$$

		CX			
		00	01	11	10
AB	00	0	0	0	0
	01	0	0	0	0
	11	X	X	X	X
	10	1	0	X	X

$$Y = AX' \quad (4)$$

6 Connections

Connect the Arduino, 7447 ,two 7474 ICs and seven segment according to table 3.

	INPUT				OUTPUT						5V			
	A	B	C	X	P	Q	R	Y	CLOCK					
Arduino	6	7	8	9	2	3	4	5	13					
7474	5	9			2	12			CLK1 CLK2	1	4	10	13	
7474			5				2		CLK1 CLK2	1	4	10	13	
7447					7	1	2	6			16			

Table 3: Connection Table

7 Software

The arduino code for the given sequence detector is given below

```
#include <Arduino.h>
int X=0,C=0,B=0,A=0;
int Y,R,Q,P;

void fsm_read()
{
    A = digitalRead(6);
    B= digitalRead(7);
    C = digitalRead(8);
    X= digitalRead(9);
}

void fsm_update()
{
    P=(B&&C&&X);
    Q=(B&&!C&&!X) || (!B&&C&&X) || (A&&!X);
    R=(!X);
    Y=(A&&!X);

    digitalWrite(2, P);
    digitalWrite(3, Q);
    digitalWrite(4, R);
    digitalWrite(5, Y);
}
```

```

    digitalWrite(13, HIGH);
    delay(2000);
    digitalWrite(13, LOW);
    delay(2000);
}
void setup() {
    pinMode(2, OUTPUT);
    pinMode(3, OUTPUT);
    pinMode(4, OUTPUT);
    pinMode(5, OUTPUT);

    pinMode(13, OUTPUT);

    pinMode(6, INPUT);
    pinMode(7, INPUT);
    pinMode(8, INPUT);
    pinMode(9, INPUT);
}

void loop()
{
    fsm_read();
    fsm_update();
}

```