Experiment 3: `Fibonacci Detector` using basic `gates`

Sravan K Suresh
Roll Number: `22B3936`

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Overview of the Experiment

This report contains:

- Karnaugh-Map of function detecting *Fibonacci Numbers*
- RTL Waveform Simulation of the function
- RTL Gates Map of the function
- Image of LED outputs being tested on `XEN10` board

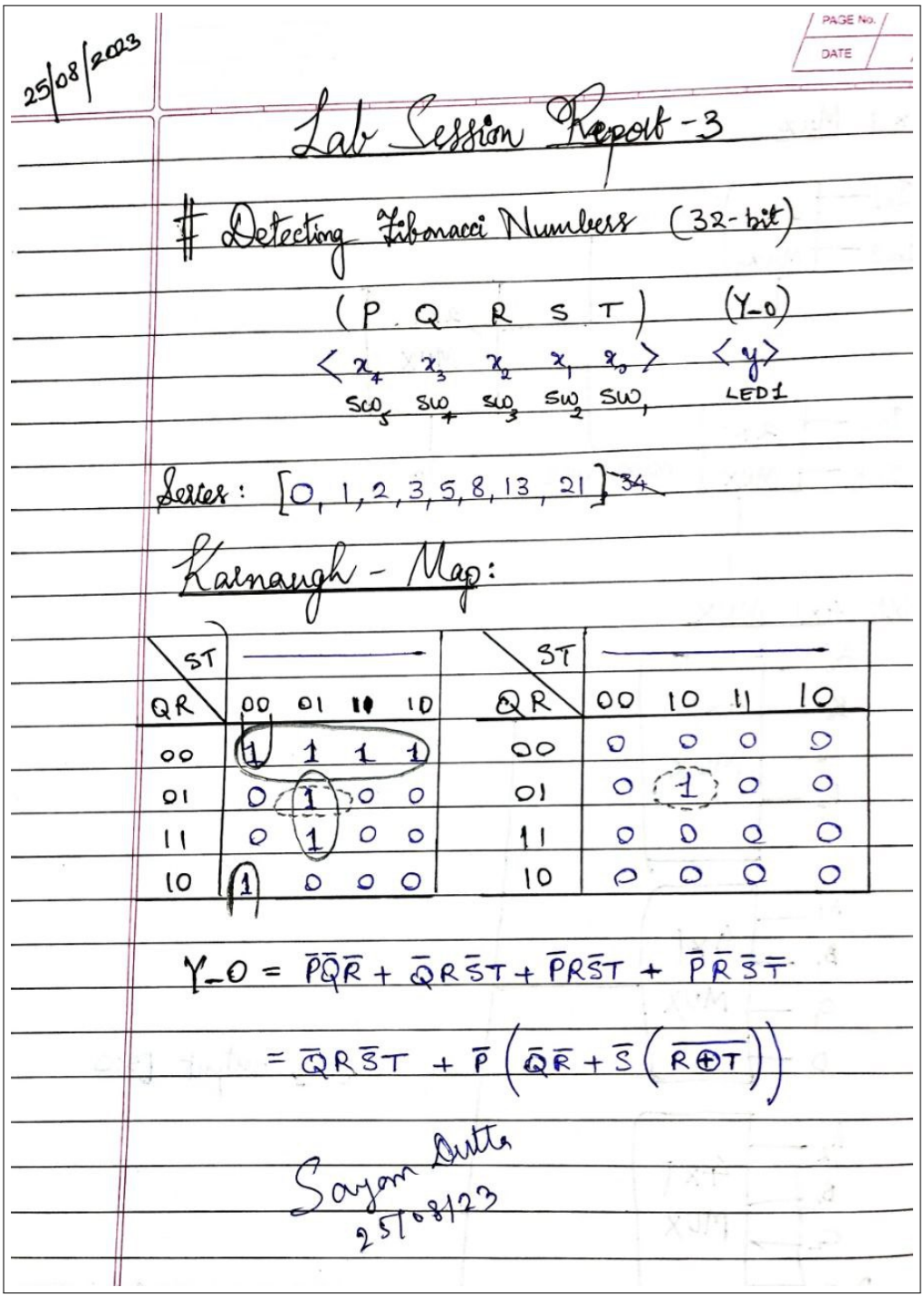
Problem Statement

Design a system that detects Fibonacci number. Any number between 0 to 31 will be given as input to the system which will be represented in binary form such as $0 \rightarrow 00000$, $1 \rightarrow 00001$ and so on. The output of the system will be '1' only when the given input is a Fibonacci number. Show the pen-paper design using K-Maps to the corresponding evaluating TAs.

VHDL Description

VHDL description for the given problem statement:
Inputs(4-bit): $x_4x_3x_2x_1x_0$
Output(1-bit): y
Tracefile format: $< x_4x_3x_2x_1x_0 >< y > 1$

1 Pen-paper Design using Karnaugh-Map



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Detecting Fibonacci Numbers (32-bit)

(P Q R S T) (Y_0)

$\langle x_4\ x_3\ x_2\ x_1\ x_0 \rangle$ $\langle y \rangle$

$SW_5\ SW_4\ SW_3\ SW_2\ SW_1$ LED1

Series: [0, 1, 2, 3, 5, 8, 13, 21] 34

Karnaugh - Map:

ST \ QR	00	01	11	10
00	1	1	1	1
01	0	1	0	0
11	0	1	0	0
10	1	0	0	0

ST \ QR	00	10	11	10
00	0	0	0	0
01	0	1	0	0
11	0	0	0	0
10	0	0	0	0

$$Y\_0 = \bar{P}\bar{Q}\bar{R} + \bar{Q}R\bar{S}T + \bar{P}R\bar{S}T + \bar{P}\bar{R}\bar{S}\bar{T}$$

$$= \bar{Q}R\bar{S}T + \bar{P}\left(\bar{Q}\bar{R} + \bar{S}\left(\overline{R \oplus T}\right)\right)$$

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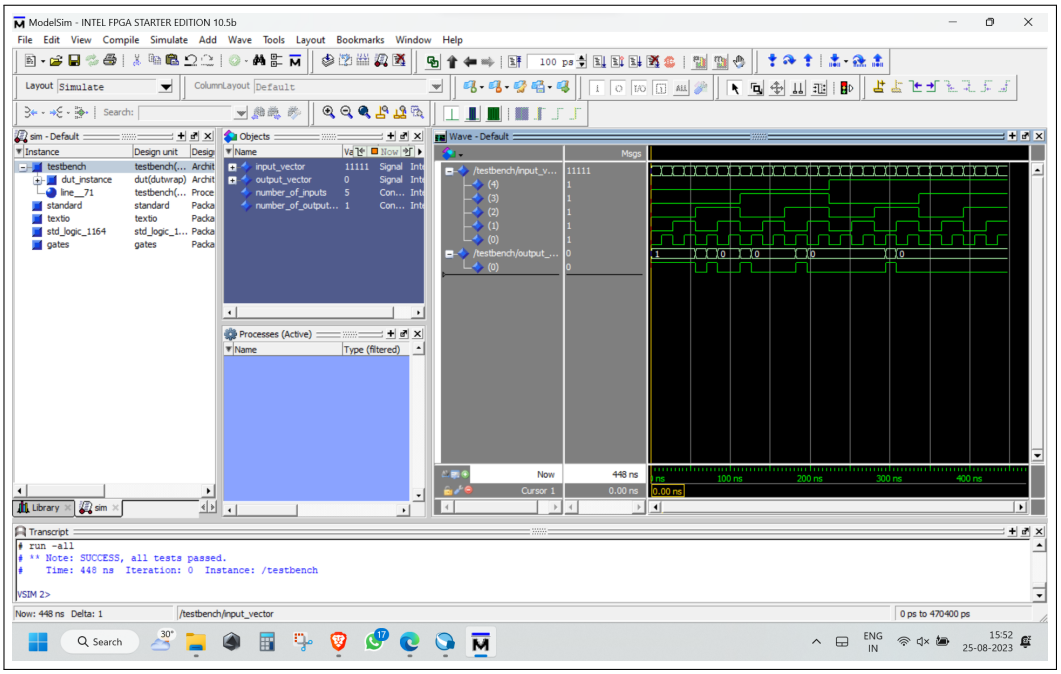
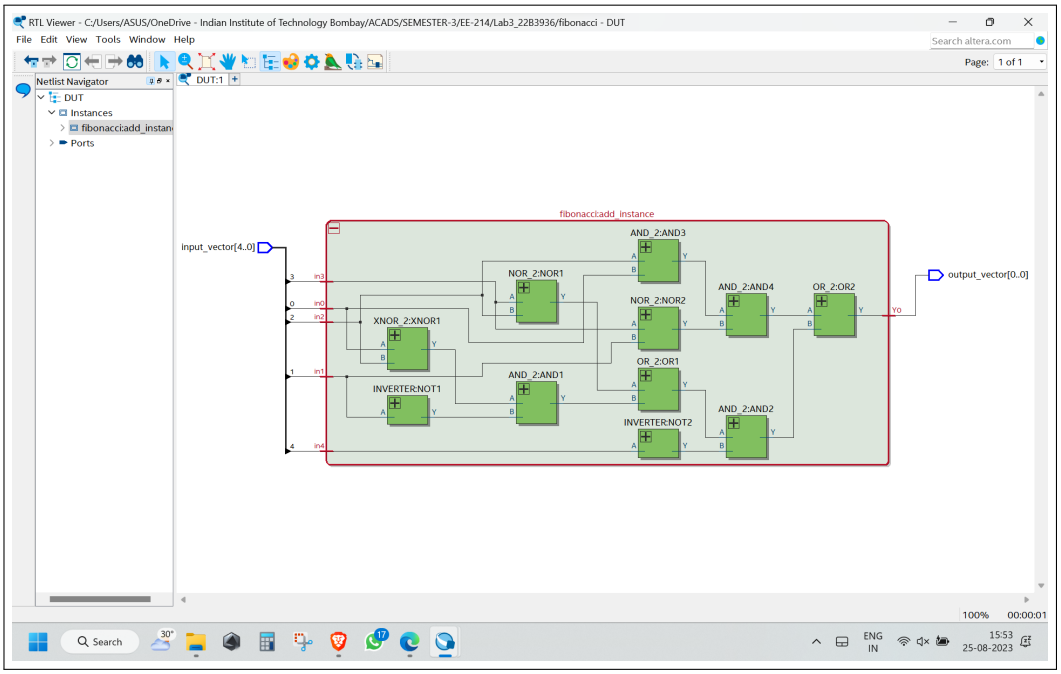
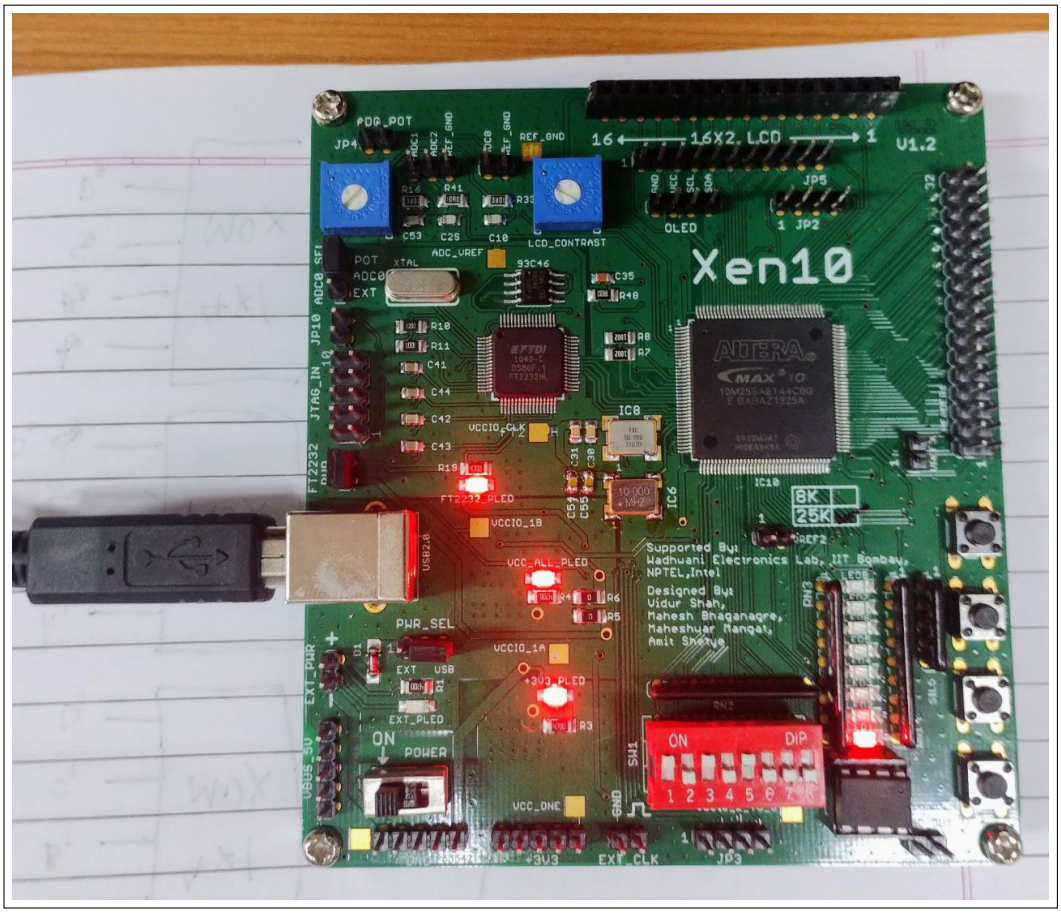
2 RTL Waveform Simulation



3 RTL Gates Map



4 Image of Output testing on XEN10 Board



Observation:
The above image displays a sample check of the number `21` represented in the binary number system as `10101` by switching on SW_1, SW_3 `and` SW_5 and switching off all the other bits.
Since `21` belongs the *Fibonacci Series*, therefore the `OUTPUT` signal Y_0 represented by `LED1` is on. Thus, the number `21` passes the test of being in *Fibonacci Series*.