Implementation of given Boolean Logics using Vaman FPGA

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1 Problem

(GATE EC-2022)
Q.6. Which one of the following is NOT a valid identity?

1. $$(x \oplus y) \oplus z = x \oplus (y \oplus z) \tag{1}$$
2. $$(x + y) \oplus z = x \oplus (y + z) \tag{2}$$
3. $$x \oplus y = x + y, if xy = 0 \tag{3}$$
4. $$x \oplus y = \sim (xy + (\sim (x) \sim (y)) \tag{4}$$

2 Introduction

The Aim is to implement the above four logics and find out the one which is not true or not valid.

3 Components

1. Vaman Board
2. LEDs - 4
3. Breadboard
4. Jumper Wires (M-F) and (M-M)

4 Hardware

A total of 4 LEDs will be used in hardware each one representing one logic. The logics will keep running in loop. The X, Y and Z values will be given as inputs to the Vaman Board. Whenever the logic is true the led will glow. And whenever the logic is false the led turns off.
One out of the given 4 logic is false for some cmbination of X, Y, Z values. While the remaining 3 logics is true for all the combination of X, Y, Z values.

This way we can find the odd one out.

The truth table for the circuit is given in below table

X	Y	Z	L1	L2	L3	L3
0	0	0	1	1	1	1
0	0	1	1	1	1	1
0	1	0	1	1	1	1
0	1	1	1	0	1	1
1	0	0	1	1	1	1
1	0	1	1	1	1	1
1	1	0	1	0	-	1
1	1	1	1	1	-	1

Table 1: Truth Table

5 Software

The Arduino code for the given circuit using IC 7474 is

```
module bhar(
    input wire X,
    input wire Y,
    input wire Z,

    output wire optiona,
    output wire optionb,
    output wire optionc,
    output wire optiond
    );

    always @(*)
    begin
  optiona = (((X^Y)^Z)==(X^(Y^Z)));
  optionb = (((X|Y)^Z)==(X^(Y|Z)));
  optionc = ((X^Y)==(X|Y));
  optiond = ((X^Y)==(~((X&Y)|((~X)&(~Y)))));
    end
endmodule
```

The pin connections for the above code is

```
set_io X  64
set_io Y  62
set_io Z  63

set_io optiona  59
set_io optionb  57
```

```
set_io optionc  56
set_io optiond  55
```