BOOLEAN LOGIC USING VAMAN

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Contents

Abstract

This manual explains logic Circuit for the following Boolean Expression using only NOR Gates :

$$(A+B).(C+D)$$

1 Introduction

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

Truth Table for NOR Gate

1.1 NOR Gate:

Use two input NOR Gate.The Logic symbol and truth table for NOR gate is shown above.In the truth table above A,B are inputs and Y is the output.

2 Components

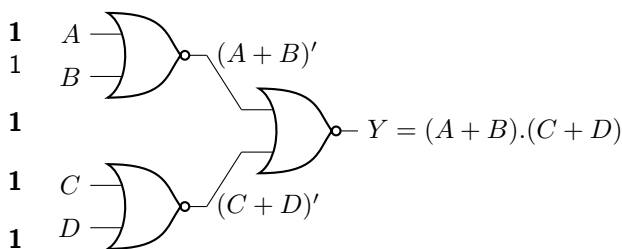| Component	Values	Quantity
VAMAN Board		1
JumperWires	M-F	7
Breadboard		1
USB-B Cable		1

3 Circuit Diagram

Figure.a

Evaluation of Output Y : In Digital Electronics the De Morgan's Laws are :
First Law: $(AB)' = A'+B'$.
Second Law: $(A+B)' = A'.B'$.
The output $Y=((A+B)'+(C+D)')'$
$=((A+B)')'.((C+D)')'$ (From De Morgan's Second Law)
$=(A+B).(C+D)$ since $((A)')'=A$

4 Truth Table

D	C	B	A	Y
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

TABLE 1

5 K-map

$$BA$$

Figure.b

Karnugh Map for Y: Draw k-map for the truth table shown in Table 1 .The Given expression (A+B).(C+D) is obtained by using the K-map in Fig.b The implicants in boxes 5,7,13,15 result in "AC" ,the implicants in boxes 9,11,13,15 result in "AD",the implicants in boxes 6,11,14,15 result in "BC",the implicants in boxes 10,11,14,15 result in "BD",
The output is expressed in terms of inputs D,C,B,A as:
Y=AC+BC+AD+BD
=C(A+B)+D(A+B)
=(A+B).(C+D)

2,4,6,8 GPIO Pins of J3 Bank in Vaman Board are configured as input pins and the required Logic for A,B,C,D are drawn from 5V (Logic '1'),GND (Logic '0'). Built in led will glow based on Y satisfying the Table-1

Input variables	IO PIN	QFN
A	IO2	6
B	IO4	3
C	IO6	62
D	IO8	61

Output variable	IO PIN	QFN
Y	IO18	38

The code below realizes the Boolean logic for F in (2.2) using 5V,GND of Vaman Board using Verilog Language

https://github.com/pavan170850/Fwciith2022/
blob/main/fpga-examples/codes/helloworldfpga.
v

6 Setup

1. Connect the Vaman to the Laptop through USB.

2. There is a button and an LED to the left of the USB port on the Vaman.There is another button to the right of the LED.

3. Press the right button first and immediately press the left button.The LED will be blinking green.The Vaman is now in bootloader mode.

6.1 Steps for implementation

1. Login to termux-ubuntu on the android device and execute the following commands:
   Make sure that the required installation and tool builds of pygmy-sdk had done prior executing below commands

   ```
   proot−distro login debian
   cd /data/data/com.termux/files/home/
   mkdir fpga−examples
   svn co https://github.com/pavan170850/Fwciith2022
       /trunk/fpga−examples/codes
   cd codes
   ql_symbiflow −compile −src /data/data/com.termux
       /files/home/fpga−examples/codes −d ql−eos−
       s3 −P PU64 −v helloworldfpga.v −t
       helloworldfpga −p quickfeather.pcf −dump
       binary
   ```

   This will generate **helloworldfpga.bin** file in codes directory transfer this bin file to laptop by executing the following command

   ```
   scp /data/data/com.termux/files/home/fpga−
       examples/codes/helloworldfpga.bin
       username_of_pc@IP_address:/home/username
   ```

   Make sure that the appropriate username,IP address of the Laptop is given in the above command.

2. Now execute the following commands on the Laptop terminal
   Make sure that required installation of programmer application had done prior executing below command

   ```
   python3 /home/username/TinyFPGA−Programmer−
       Application/tinyfpga−programmer−gui.py −−
       port /dev/ttyACM0 −−appfpga /home/
       username/helloworldfpga.bin −−mode fpga
   ```

3. After finishing the process of flashing with the programmer application press the button to the right of the USB port to reset. Vaman is now flashed with our source code