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Designing XOR Gate using NAND Gates

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Abstract

This manual shows how to design 2-input XOR gate using 4 NAND gates.

1 Introduction

1.1 XOR Gate

The full form of XOR gate is Exclusive-OR gate. Its function is the same as that of OR gate but with few output changes. The output of an Exclusive-OR gate goes "HIGH" when its two input terminals are at "DIFFERENT" logic levels with respect to each other. In other case the output goes "LOW".

Boolean Expression Q = A.B' + A'.B

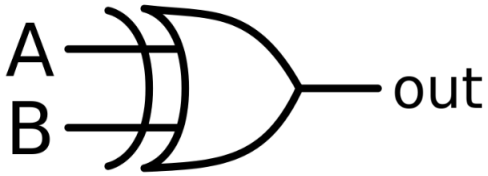

Figure 1: XOR Gate

1.2 XOR Gate using NAND Gates

XOR gate is achieved by combining standard logic gates together to form more complex gate functions that are used extensively in building arithmetic logic circuits, computational logic comparators and error detection circuits. One can construct a XOR gate by using minimum of 4 NAND gates. It is also possible to design an XOR gate using more than four NAND gates.

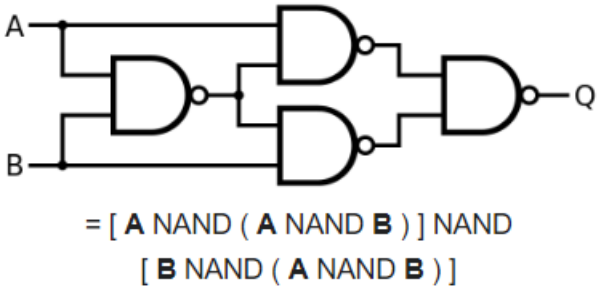

Figure 2: XOR gate with 4 NAND gates

2 Truth Table

A	B	Q
0	0	0
0	1	1
1	0	1
1	1	0

Table 1: Truth table

3 Components

Component	Value	Quantity
Resistor	220 ohm	1
Arduino	UNO	1
Bread board		1
Jumper wires	M-M	4

Table 2: Components

4 Hardware

Make connections between LED and Arduino as shown in Table 3.

Arduino	13	GND
Led	+VE	-VE

Table 3: Connections

5 Software

Execute the following program after downloading it.

https://raw.githubusercontent5.com BavyaVemulapalli/FWC-IITH/main/IDE/idecodecpp

6 Conclusion

We observe the LED going LOW and HIGH depending on the operation of 2-input XOR gate using NAND gates.