

The Impact of Logic Gates on Modern Technology

Rohit Kumar

Assistant Professor

COER UNIVERSITY, Roorkee

(rkrohitkumar824@gmail.com)

Abstract: This paper discusses different types of logic gates (AND, OR, NOT, NAND, NOR, XOR, XNOR) and their corresponding truth tables. Logic gates are the foundation of any digital computer system. They perform logical operations on bits of information, which are represented digitally as 0 and 1. Any smart system that can make decisions is made up of these simple logic gates. This paper aims to explain how these digital logic gates work in our daily life. It gives examples of real-time applications like burglar alarms and security systems.

By studying various physical systems like mechanical, optical, electrical, thermal, and natural systems, we can say that any similar system can be logically modeled with the help of a Boolean expression. As a result, such a system can be studied mathematically. This paper is a general guide to understanding the Boolean mathematics behind the physical systems around us. It's like a friendly introduction to the world of logic gates and their applications

Index Terms – AND, OR, NOT, NAND, NOR, XOR, XNOR Gates

I. INTRODUCTION

Sure, let's simplify that! Sense gates are like the brain of digital bias. They take in one or further inputs and give an affair grounded on those inputs. The affair is either a 0 or a 1, which in digital terms means 'off' or 'on'. There are different types of sense gates, each performing a introductory function. For illustration, a "NOT" gate has just one input and one output. However, the affair will be 'off', and vice versa, If the input is 'on'. These gates 2are made from electronic factors like diodes and transistors, which act like bitsy switches. When we combine lots of these gates, we can make a device do complex tasks. A verity table is a handy tool that shows us what the affair of a gate will be for every possible combination of inputs. It's like a cheat distance for understanding how a sense gate works! So, in a nutshell, sense gates are the structure blocks that power the digital world around us. From computers to smartphones, they are at the heart of it all!

II . TYPES OF GATES

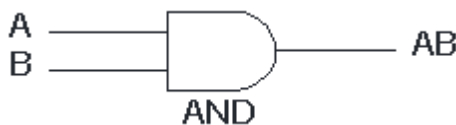
2.1 AND GATE

An AND gate is a basic part of digital devices. It gets two inputs, 'A' and 'B', which are bits (either 0 or 1). The output is shown as $A.B$ or $A \wedge B$.

Here's how it works: If both A and B are 'on' (which means both are 1), then the output is also 'on' (1). But if either A or B is 'off' (which means 0), then the output is 'off' (0).

Where $A \wedge B = \begin{cases} 1 & \text{if } A=1 \text{ and } B=1 \\ 0 & \text{otherwise} \end{cases}$

An AND Gate is shown below :



TRUTH TABLE

2 Input AND gate		
A	B	$A.B$
0	0	0
0	1	0
1	0	0
1	1	1

2.2 OR GATE

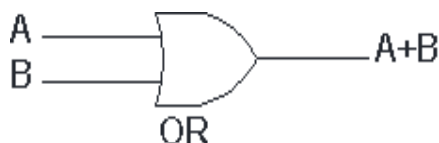
An OR gate receives two inputs, 'A' and 'B', where A and B are bits. The output is denoted by $A+B$ or $A \vee B$.

The output of an OR gate is defined as follows:

$A \vee B = \begin{cases} 1 & \text{if } A=1 \text{ or } B=1 \end{cases}$

0 otherwise

An OR Gate is shown below



TRUTH TABLE

2 Input OR gate		
A	B	$A+B$
0	0	0
0	1	1
1	0	1
1	1	1

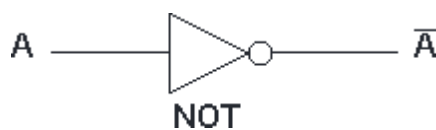
2.3 NOT GATE

A NOT gate, also known as an inverter, is a basic part of digital devices. It gets one input, 'A', which is a bit (either 0 or 1). The output is represented as \bar{A} .

Here's how it works: If A is 'on' (which means 1), then the output is 'off' (0). But if A is 'off' (which means 0), then the output is 'on' (1).

So, in simple words, a NOT gate will always say the opposite of its input.

The NOT gate is shown below



TRUTH TABLE

NOT gate	
A	\bar{A}
0	1
1	0

2.4 NAND GATE

A NAND gate is like a team player in digital devices. It's actually an AND gate and a NOT gate combined. The output of all NAND gate are high if any of the input are low.

The NAND gate is shown below



TRUTH TABLE

2 Input NAND gate		
A	B	$\overline{A.B}$
0	0	1
0	1	1
1	0	1
1	1	0

2.5 NOR GATE

A NOR gate is a combination of an OR gate and a NOT gate. It gives an 'off' (0) output if either input is 'on' (1). If both inputs are 'off' (0), it gives an 'on' (1) output. The symbol for a NOR gate is an OR gate symbol with a small circle at the end.

The NOR gate is shown below



TRUTH TABLE

2 Input NOR gate		
A	B	$\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

2.6 EX-OR GATE

An 'Exclusive-OR' gate, also known as XOR gate, gives an 'on' (1) output if either, but not both, of its inputs are 'on'.

The EX-OR gate is shown below



TRUTH TABLE

2 Input EXOR gate		
A	B	$A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

2.7 EX-NOR GATE

The 'Exclusive-NOR' (XNOR) gate is a digital logic gate that outputs true or '1' only when the both the input is even.

The EX-NOR gate is show below



TRUTH TABLE

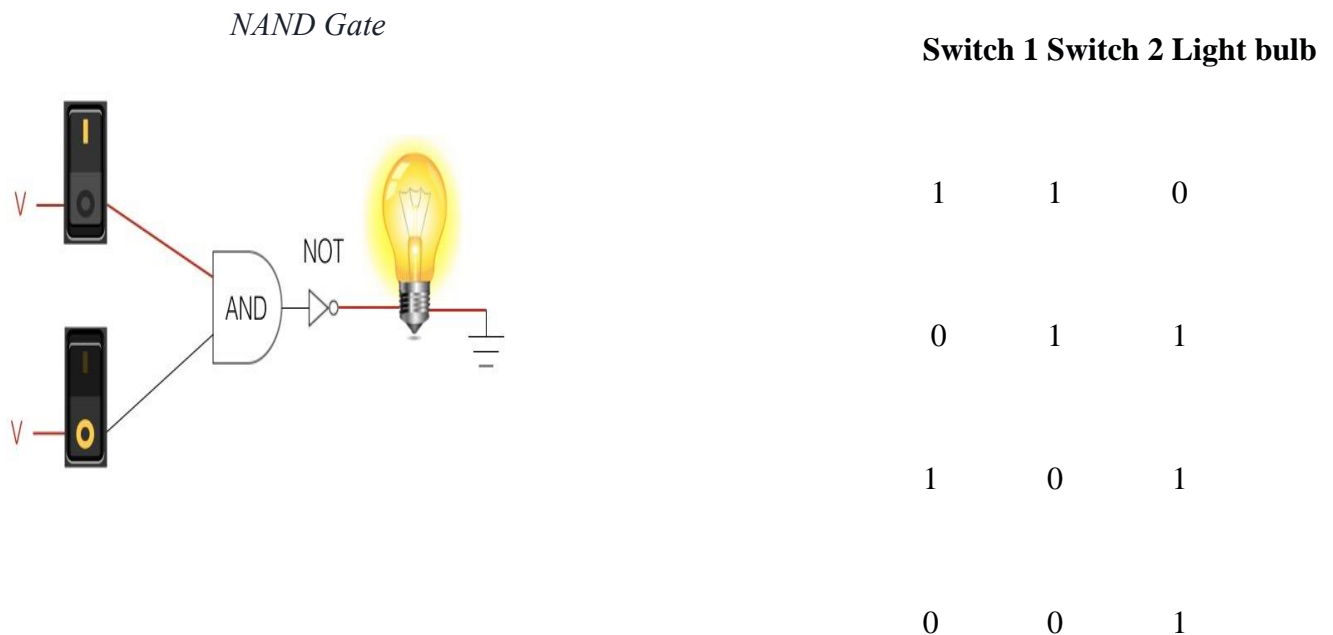
2 Input EXNOR gate		
A	B	$\overline{A \oplus B}$
0	0	1
0	1	0
1	0	0
1	1	1

III APPLICATIONS

application of logic gates are mainly determined based upon the truth table i.e their The mode of operations. The basic logic gates are used in many circuits like a push-button lock, light-activated burglar alarm, safety thermostat, an automatic watering system, etc. Digital communication cannot happen without logic operations. Daily life application of XOR (EOR) and XNOR (ENOR) gate can be related to ladder switches used in homes or can be found in water level checker circuits.

3.1 NAND GATE

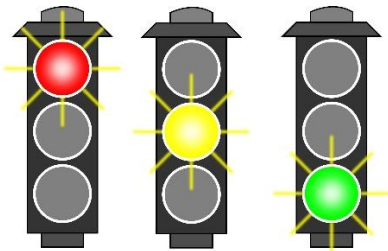
NAND gates are used in a variety of real-life applications. Here are a few examples Alarm Systems, Push Button Locks, street Light These are just a few examples. The NAND gate is a powerful tool in digital electronics and its applications are vast in modern technology.



if both switches are on, it is off (false.) Otherwise, the NAND Gate will output on (true.)

3.2 NOR GATE

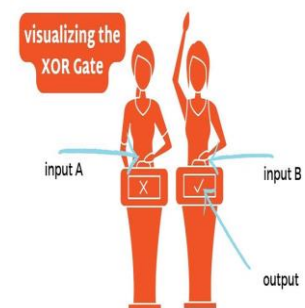
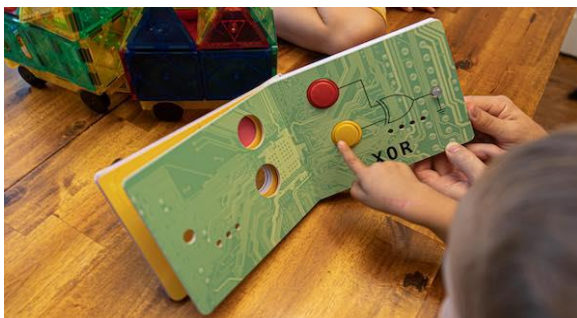
NOR gates in traffic control systems can help manage signal patterns. For instance, if two roads intersect, a NOR gate ensures only one road's signal is green at a time, enhancing safety.



Steps	A	B	Red	Yellow	Green
0	0	0	1	0	0
1	0	1	1	1	0
2	1	0	0	0	1
3	1	1	0	1	0

3.3 EX-OR GATE

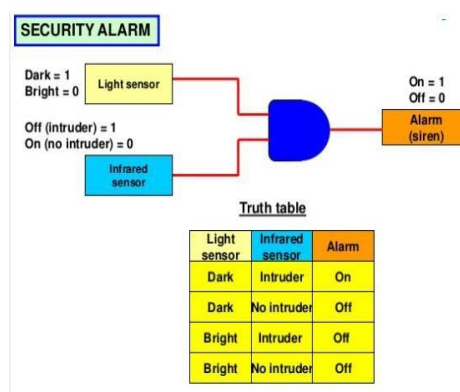
A real-life example of an XOR gate is a game show buzzer system. If two contestants buzz in, the XOR gate ensures that only the first one to buzz in gets the chance to answer, while the other is locked out. This is because an XOR gate outputs '1' when exactly one input is '1'.

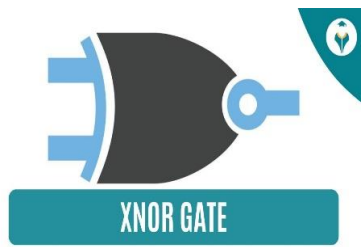


The XOR module is a logic gate with two inputs and one output. The output of an XOR Gate is **only HIGH (1) if either one, but not both, are high**

3.4 EX-NOR GATE

The Exclusive NOR (EX-NOR) gate, also known as XNOR gate, is a digital logic gate that outputs true or '1' only when the number of true inputs is even. A real life example of an EX-NOR gate is home security system .





An XNOR gate in a home security system can be used to trigger an alarm .

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