NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI
Department of Electrical and Electronics Engineering
EE LR 10 Circuits and Digital Laboratory
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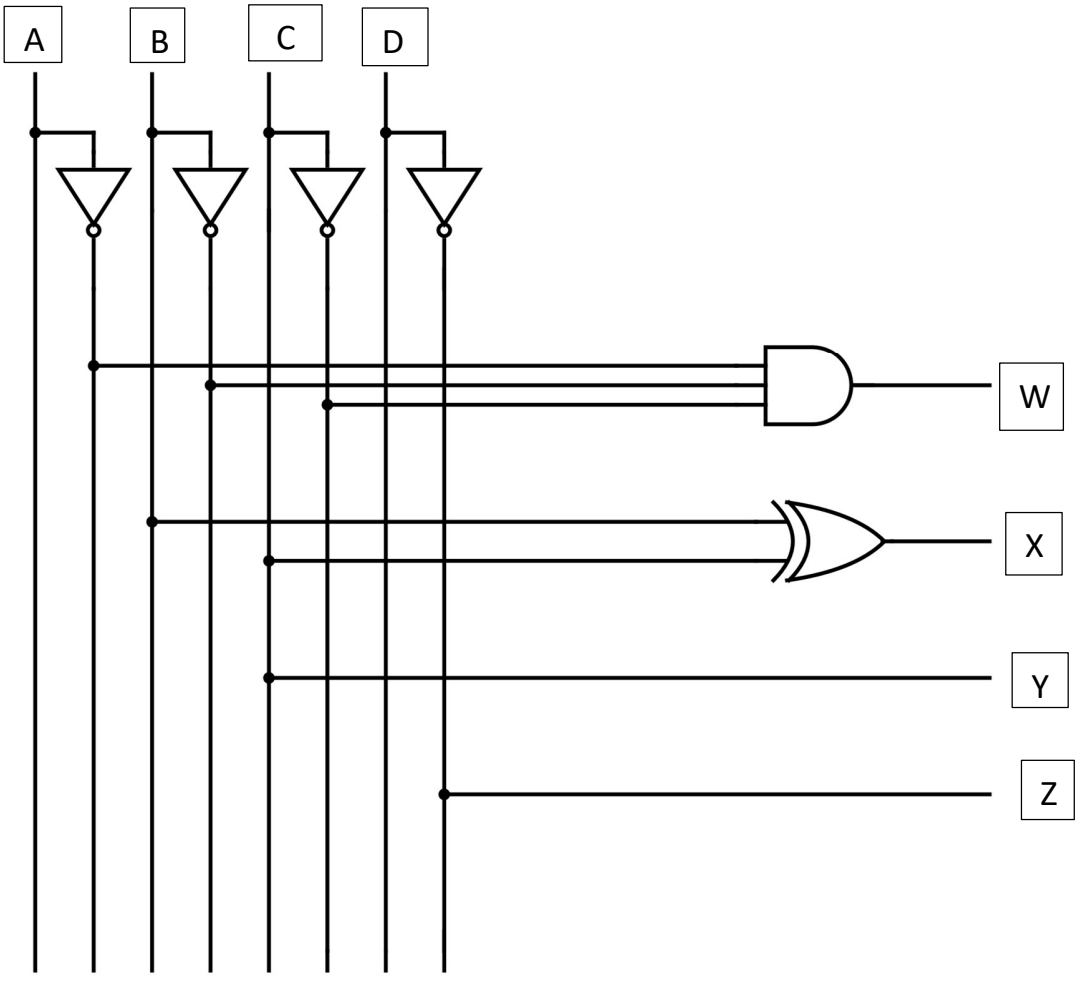
MINI PROJECT

Topic : Implementation of concept of 9s complement (0 to 9)

Apparatus Required:

S.No.	Components	Range / IC No	Quantity
1.	Breadboard	-	1
2.	LED	-	4
3.	Resistor	330Ω	4
4.	Hex NOT gate	7404	1
5.	XOR Gate Quad 2 input	7486	1
6.	AND Gate Triple 3 input	7411	1
7.	Power supply	(0-5) V	1
8.	Connecting wires	-	-

Circuit Diagram:



Truth Table :

Decimal	Binary conversion				9s Complement			
0	0	0	0	0	1	0	0	1
1	0	0	0	1	1	0	0	0
2	0	0	1	0	0	1	1	1
3	0	0	1	1	0	1	1	0
4	0	1	0	0	0	1	0	1
5	0	1	0	1	0	1	0	0
6	0	1	1	0	0	0	1	1
7	0	1	1	1	0	0	1	0
8	1	0	0	0	0	0	0	1
9	1	0	0	1	0	0	0	0

Calculation:

Finding expression for W,X,Y,Z :

For W :

	$\overline{C}\overline{D}$	$\overline{C}D$	CD	$C\overline{D}$
$\overline{A}\overline{B}$	1	1	0	0
$\overline{A}B$	0	0	0	0
AB	x	x	x	x
$A\overline{B}$	0	0	x	x

$W = \overline{A}\,\overline{B}\,\overline{C}$

For X :

	$\overline{C}\overline{D}$	$\overline{C}D$	CD	$C\overline{D}$
$\overline{A}\overline{B}$	0	0	1	1
$\overline{A}B$	1	1	0	0
AB	x	x	x	x
$A\overline{B}$	0	0	x	x

$X = \overline{B}\,C + \overline{C}\,B$

$X = B \oplus C$

For Y :

	$\overline{C}\overline{D}$	$\overline{C}D$	CD	$C\overline{D}$
$\overline{A}\overline{B}$	0	0	1	1
$\overline{A}B$	0	0	1	1
AB	x	x	x	x
$A\overline{B}$	0	0	x	x

$Y = C$

For Z :

	$\overline{C}\overline{D}$	$\overline{C}D$	CD	$C\overline{D}$
$\overline{A}\overline{B}$	1	0	0	1
$\overline{A}B$	1	0	0	1
AB	x	x	x	x
$A\overline{B}$	1	0	x	x

$Z = \overline{D}$

Why 330 Ω resistor used before LED?

The 330-ohm resistor is often used in series with an LED in electronic circuits to limit the current flowing through the LED. LEDs (Light Emitting Diodes) have a forward voltage drop, and they are designed to operate within a specific current range. If we apply too much current to an LED, it can get damaged.

The relationship between voltage, current, and resistance is given by Ohm's Law, which is expressed as:

$$I=V/R$$

Where:

- I is the current flowing through the circuit,
- V is the voltage across the circuit, and
- R is the resistance.

For an LED, we typically have a forward voltage drop (V_f) specified in the datasheet(for our model). For common LEDs, V_f is usually around 2 to 3 volts. To limit the current through the LED and prevent it from being damaged, we used current-limiting resistor in series. The value of this resistor is calculated using Ohm's Law.

For example, if we have a power supply voltage (V) of 5 volts and the forward voltage drop (V_f) of the LED is 2 volts, then the voltage across the resistor (V_R) is $V-V_f=5-2=3V-V_f=5-2=3$ volts.

If we want a current (I) of 10 mA (0.01 A) through the LED, we can use Ohm's Law to calculate the resistance (R):

$$R=V/R=3/0.01=300\ \Omega$$

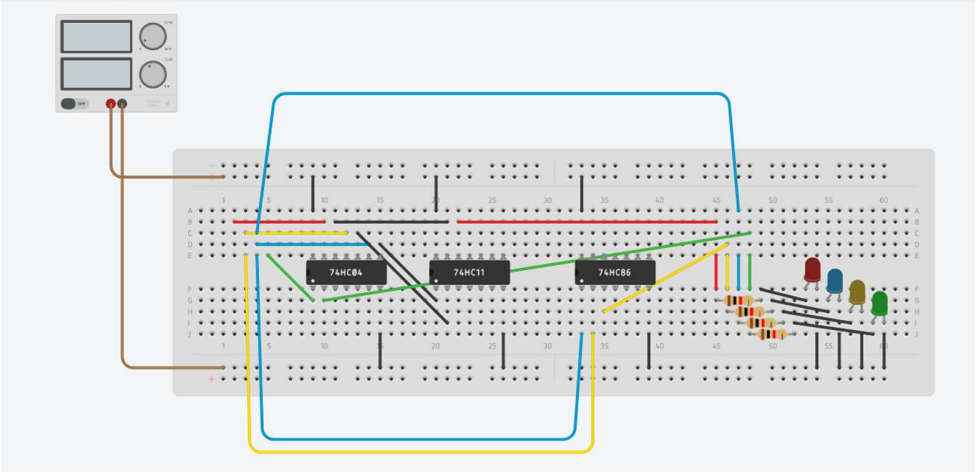
In this case, a standard 330-ohm resistor would be used to limit the current to a safe value for the LED.

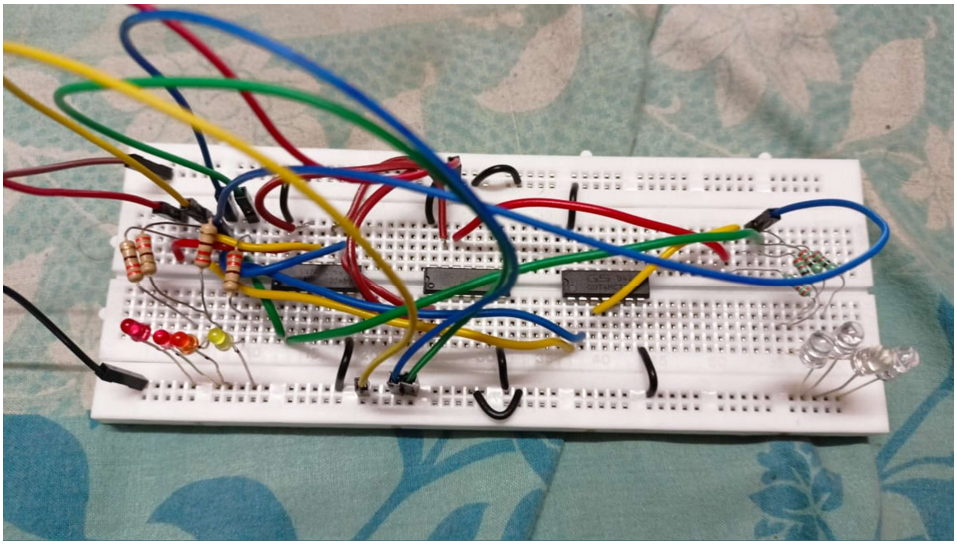
Result :

For every given input as binary equivalent, we got its 9s complement on breadboard

Circuit :

Tinkercad:





Uses:

The 9's complement is a mathematical operation used in digital systems and computer science to perform subtraction or reverse addition operations. It involves finding the complement of a number with respect to 9. Here are some practical uses of 9's complement:

1. Subtraction: The 9's complement is often used to perform subtraction operations in digital systems. To subtract one number from another, the 9's complement of the

subtrahend (the number being subtracted) is taken, and then added to the minuend (the number from which subtraction is being done) using normal addition. This technique simplifies subtraction by converting it into addition.

2. Checksum Calculation: Checksums are commonly used in computer networks and data transmission to detect errors in data. The 9's complement can be used to calculate a checksum for a sequence of numbers. By taking the 9's complement of the sum of the numbers, a checksum value can be obtained. This checksum can be transmitted along with the data, and the receiver can verify the integrity of the data by recalculating the checksum and comparing it with the received checksum.

3. Error Detection and Correction: In some error detection and correction algorithms, the 9's complement is used to perform calculations. For example, in certain error-detecting codes like the checksum complement method, the 9's complement is used to encode and decode data. By taking the complement of a number with respect to 9, error-detecting codes can be generated or verified.

4. Binary Coded Decimal (BCD) Arithmetic: BCD is a binary representation of decimal numbers commonly used in digital systems. The 9's complement can be applied to BCD numbers to perform arithmetic operations such as addition and subtraction. By taking the 9's complement of a BCD number, addition can be performed using normal binary addition operations.

5. Digital Display Manipulation: The 9's complement can be used to manipulate digital displays, such as 7-segment displays. By taking the 9's complement of a number, it is possible to display the number on a 7-segment display by lighting up the appropriate segments.

These are some practical applications of the 9's complement in various fields, including digital systems, computer science, and data transmission.

Inference :

1) We learnt how the IC gates (i.e. 3 input AND gate,XOR gate,hex NOT gate) works in circuit.
2) We also learnt the uses of 9s complement.