GITAM

(DEEMED TO BE UNIVERSITY)

TITLE:HALF ADDER

Subtitle:PCB DESIGN

Name: Sinchana R
Roll No: BU22ECE0100441
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SIMULATION RESULTS:

A half adder is a basic digital circuit that performs the addition of two single-bit binary numbers. It has two outputs, Sum and Carry, representing the sum and carry-out of the operation, respectively.

TRUTH TABLE:

A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Explanation:

- For inputs (A=0, B=0), the Sum is 0 and the Carry is 0.
- For inputs (A=0, B=1), the Sum is 1 and the Carry is 0.
- For inputs (A=1, B=0), the Sum is 1 and the Carry is 0.
- For inputs (A=1, B=1), the Sum is 0 and the Carry is 1.

These results match the expected behavior of a half adder, where the Sum is the XOR of the inputs and the Carry is the AND of the inputs.

Functionality:

- A half adder performs the addition of two single-bit binary numbers and provides two outputs: Sum and Carry. It handles the least significant bit of binary addition.

Boolean Expressions:

- **Sum**: The Sum output is given by the Boolean expression Sum=A⊕B\text{Sum} = A \oplus BSum=A⊕B (XOR operation).
- **Carry**: The Carry output is given by the Boolean expression Carry=A&B\text{Carry} = A \& BCarry=A&B (AND operation).

Applications:

- Half adders are used in simple binary addition circuits. They are also fundamental building blocks for constructing more complex arithmetic circuits, such as full adders and binary adders, which are capable of handling multi-bit binary numbers.

Limitations:

- A half adder cannot handle carry-in from previous bit positions. For multi-bit addition, multiple half adders are combined with full adders, which can handle carry-in.

Implementation:

- **Logic Gates**: The half adder is implemented using basic logic gates: XOR for Sum and AND for Carry.
- **Integrated Circuits**: Common ICs like the 74LS86 (for XOR) and 74LS08 (for AND) can be used to build half adder circuits.

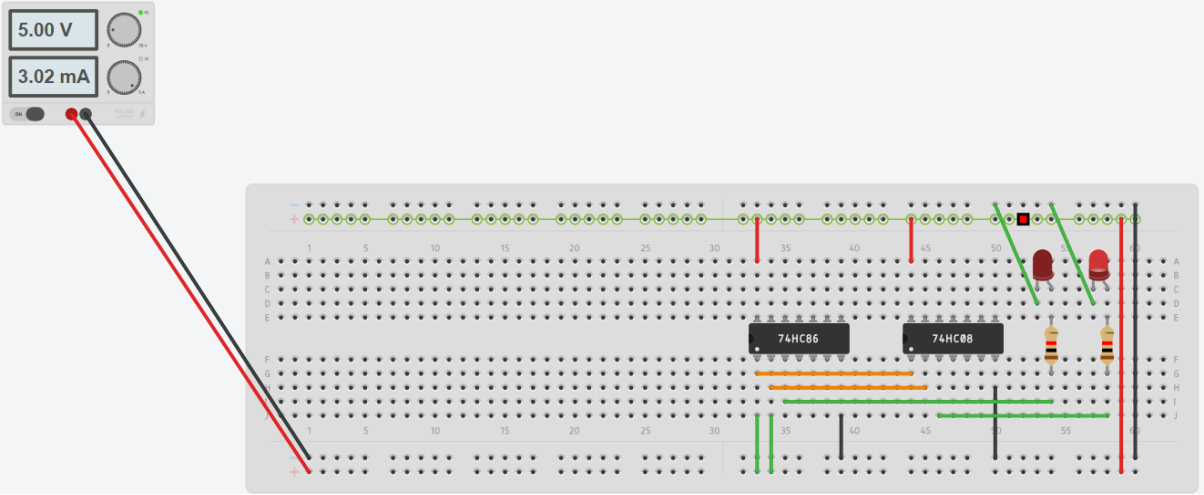
Circuit Design:

- When designing a half adder, you connect the inputs to the XOR and AND gates. The output of the XOR gate provides the Sum, while the output of the AND gate provides the Carry.

Use in Digital Systems:

- Half adders are fundamental in digital systems and arithmetic logic units (ALUs). They serve as basic components in constructing more advanced circuits for arithmetic operations.

TINKER CARD CIRCUIT:



HARDWARE USED ：

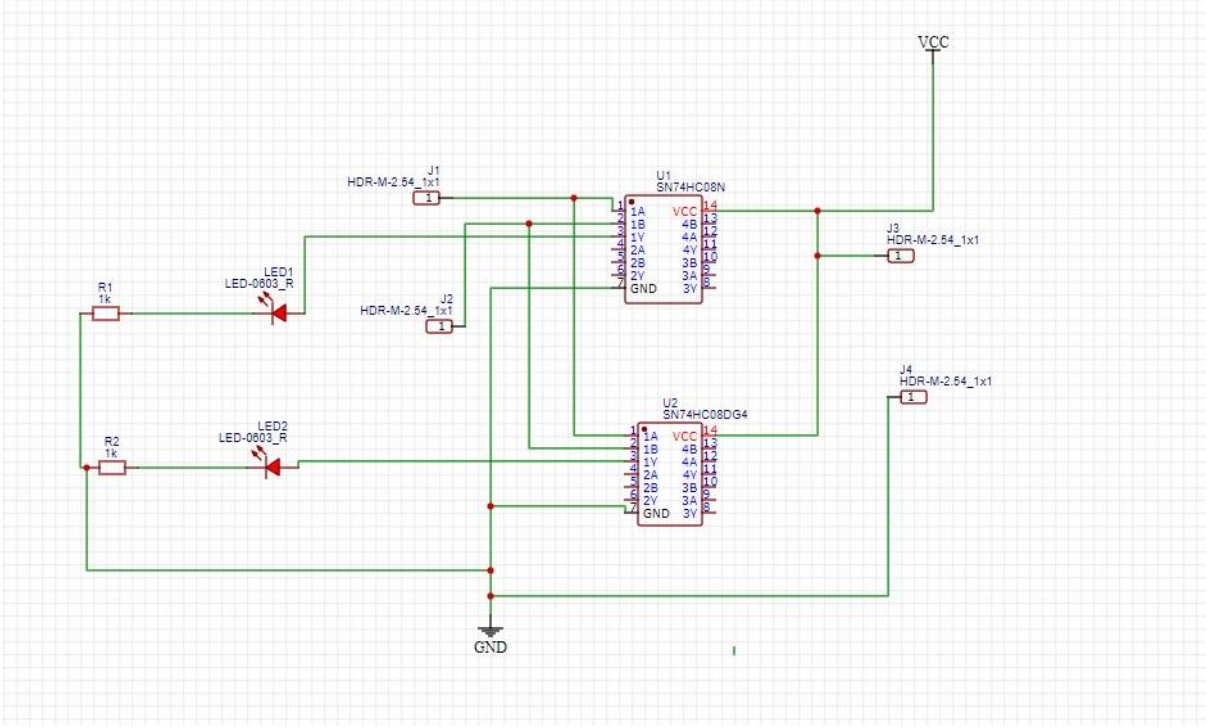
1. **AND Gate**: Calculates the Carry resulting from the addition.

In summary:

- The **XOR gate** gives the Sum output: Sum=A⊕B\text{Sum} = A \oplus BSum=A⊕B.
- The **AND gate** gives the Carry output: Carry=A&B\text{Carry} = A \& BCarry=A&B.

These gates can be found in logic gate ICs, such as the 74LS86 (for XOR gates) and 74LS08 (for AND gates).

EASYEDA:



Steps to Design a PCB for a Half Adder in EasyEDA

1. **Create a New Project:**
    - Go to EasyEDA's website and sign in or create an account.
    - Click on "New Project" and give it a name (e.g., "Half Adder").
2. **Schematic Design:**
    - Open the Schematic Editor: Once your project is created, open the Schematic Editor from the project dashboard.
    - Place Components:
        - Add XOR Gate: Click on the “Libraries” panel, search for “XOR” and place an XOR gate symbol on the schematic. This gate will be used for the Sum output.
        - Add AND Gate: Similarly, search for “AND” and place an AND gate symbol. This gate will be used for the Carry output.

        - Add Input and Output Ports: Search for “Input” and “Output” symbols and place them on the schematic to represent the A, B inputs, and Sum, Carry outputs.
    - Wire Components:
        - Connect the inputs (A and B) to the XOR gate and the AND gate.
        - Connect the output of the XOR gate to the Sum port.
        - Connect the output of the AND gate to the Carry port.
    - Label Your Connections: Label the inputs and outputs clearly for easy identification.
3. **Convert to PCB Layout:**
    - Open PCB Layout Editor: Once the schematic is complete, switch to the PCB layout editor.
    - Define Board Dimensions: Set the dimensions for your PCB by defining the board outline.
    - Place Components: Drag the components from the schematic onto the PCB layout. Arrange them to fit within the board dimensions.
    - Route Traces: Connect the components using traces (wires). Use the auto-router or manually route the connections to ensure all components are properly connected.
4. **Design Rule Check (DRC):**
    - Run DRC: Perform a design rule check to ensure that there are no violations such as traces that are too close together or missing connections. EasyEDA will highlight any issues that need fixing.
5. **Generate Gerber Files:**
    - Export Gerber Files: Once your PCB design is complete and verified, export the Gerber files. These files are used for manufacturing the PCB. Go to the "Fabrication Output" section and generate the necessary files.
6. **Order PCB:**
    - Order PCB: You can order the manufactured PCB directly through EasyEDA or use the Gerber files to order from another PCB manufacturer.

Example Components and Connections

- Inputs: Two input pins (A and B).
- XOR Gate: Connects A and B to produce the Sum.
- AND Gate: Connects A and B to produce the Carry.
- Outputs: Two output pins (Sum and Carry).

APPENDIX:

The half adder is a basic digital circuit that adds two single-bit binary numbers. It outputs two values: Sum, calculated using an XOR gate, and Carry, calculated using an AND gate. While it is fundamental for binary addition, it does not handle carry-in from previous bits. Thus, it is often used as a building block for more complex circuits like full adders, which manage multi-bit additions. Understanding the half adder is essential for grasping digital arithmetic and designing more advanced electronic systems.