Project Report: 8-Bit Calculator in Logisim

1. Introduction

This project presents a functional 8-bit calculator created using the Logisim simulator. The calculator performs basic arithmetic operations (addition and subtraction) on binary numbers and displays the result on seven-segment displays. This project showcases a hands-on approach to digital circuit design using logic gates, registers, multiplexers, control logic, and buses.

2. Objective

The goal of the project is to:

- Design an 8-bit calculator using Logisim.
- Understand binary operations and digital components.
- Simulate real-world digital computation.
- Display output through binary-to-decimal conversion on seven-segment displays.

3. Tools and Components Used

- Software: Logisim Evolution
- Main Components:
  - Input switches (for binary number entry)
  - Registers (for storing operands and results)
  - Control logic (for choosing operations)
  - ALU (Arithmetic Logic Unit)
  - Multiplexers
  - Binary-to-decimal converters (for display)
  - Seven-segment displays

4. Circuit Design Overview

Inputs: Toggle switches x0 to x9 for binary numbers and control signals.

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Control Logic: Flip-flops and gates for managing operations.

ALU: Performs addition and subtraction based on control signals.

Display: Result converted to decimal using BCD logic and shown on 7-segment displays.

5. How It Works

1. User sets binary values using toggle switches.
2. Selects operation using add or sub switches.
3. Control logic routes signals to the ALU.
4. Result is calculated and stored.
5. Binary result is converted and displayed.

7. Challenges and Solutions

- Register synchronization with flip-flops.
- Multiplexer logic for operation control.
- Display conversion via Binary-to-BCD logic.

8. Results

- Accurate 8-bit addition and subtraction.
- Dynamic 7-segment display output.
- Smooth switching between operations.

9. Conclusion

This project provided practical experience in digital design. The calculator is functional, modular, and expandable for further logic and arithmetic operations.

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10. Future Improvements

- Add signed number support.

- Implement logic operations.

- Add multiplication/division.

- Improve user input and output interface.

6. Screenshot of Circuit Design