Activity 9

Aim Implement the Design of ALU

Theory An Arithmetic Logic Unit (ALU) is a fundamental component of a computer's central processing unit (CPU). It performs arithmetic and logical operations, making it essential for processing data and executing instructions. The ALU typically supports operations such as addition, subtraction, AND, OR, XOR, and shifting. It can handle both signed and unsigned data.

The design of an ALU involves integrating combinational circuits like adders, multiplexers, and logic gates. A multiplexer is used to select specific operations based on control signals. For n-bit operations, the ALU is designed with n parallel bit-slices to process inputs simultaneously. Flags like carry, zero, or overflow are used to indicate results' status.

In a COA lab, implementing an ALU involves using hardware description languages or simulation tools to model its functionality. Testing is performed by verifying outputs for different operation codes and inputs, ensuring the design's correctness.

Circuit Diagram

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S3 S2 S1 S0 Operation

0 X X Addition/Subtraction

0 X 0 X Addition

0 X 1 X Subtraction

1 0 0 0 AND(AB)

1 0 0 1 OR(A+B)

1 1 0 0 EX-OR(A’B+AB’)

1 1 0 1 B

1 0 1 0 AND(AB’)

1 0 1 1 OR(A+B’)

1 1 1 0 EX-OR(A’B’+AB)

1 1 1 1 B’

Simulation Result

AU: Arithmetic Unit Block

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Building an ALU in Logisim

LEARNING OUTCOME

Through this experiment, I understood the design and functionality of an ALU, including the selection of arithmetic and logic operations using control signals. Students will learn to implement multiplexers, combinational circuits, and logic gates, enabling them to perform operations like addition, subtraction, AND, OR, XOR, and complement efficiently in digital systems.