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Project Report: Designing a Basic 2-Bit ALU Using TTL Gate ICs

1. Introduction: The aim of this project is to design a basic 2-bit Arithmetic Logic Unit (ALU) using Transistor-Transistor Logic (TTL) gate integrated circuits. The ALU is a fundamental component of a Central Processing Unit (CPU) responsible for performing arithmetic and logic operations. This project focuses on creating the building blocks of the ALU, including basic operations such as ADD, AND, OR, and NOT.

2. Components Required: To implement the 2-bit ALU, the following components were used:

- 7404 NOT Gates (x2)
- 7408 AND Gates (x7)
- 7432 OR Gates (x4)
- 7486 XOR Gates (x2)
- Push Switches (x6)

3. Project Overview: The project is divided into two main components: the ALU and the control bus. These components, along with D flip-flops, MUX, and DEMUX, provide essential functionality for the basic CPU.

3.1 ALU Design: The ALU performs four operations: ADD, AND, OR, and NOT. It takes two 2-bit inputs and produces a 2-bit output. The design incorporates the following TTL gate ICs:

- 7404 NOT Gates: Used for inverting signals.
- 7408 AND Gates: Used for bitwise AND operations and for also designing the adder.
- 7432 OR Gates: Used for bitwise OR operations.
- 7486 XOR Gates: Used for making the adder circuit.

The ALU design includes logic circuits for each operation, enabling the execution of various calculations and logical functions. The outputs are generated based on the selected operation.

3.2 Control Bus: The control bus or the control bits select the operation to be performed. The four operations out which choice can be made are ADD, OR, NOT and AND.

4. ALU Operation:

- **ADD Operation:** Utilizes XOR and AND gates to perform binary addition.
- **AND Operation:** Uses AND gates for bitwise ANDing of input bits.
- **OR Operation:** Implements OR gates for bitwise ORing of input bits.
- **NOT Operation:** Utilizes NOT gates for bitwise inversion of input bits. Performed only on A input

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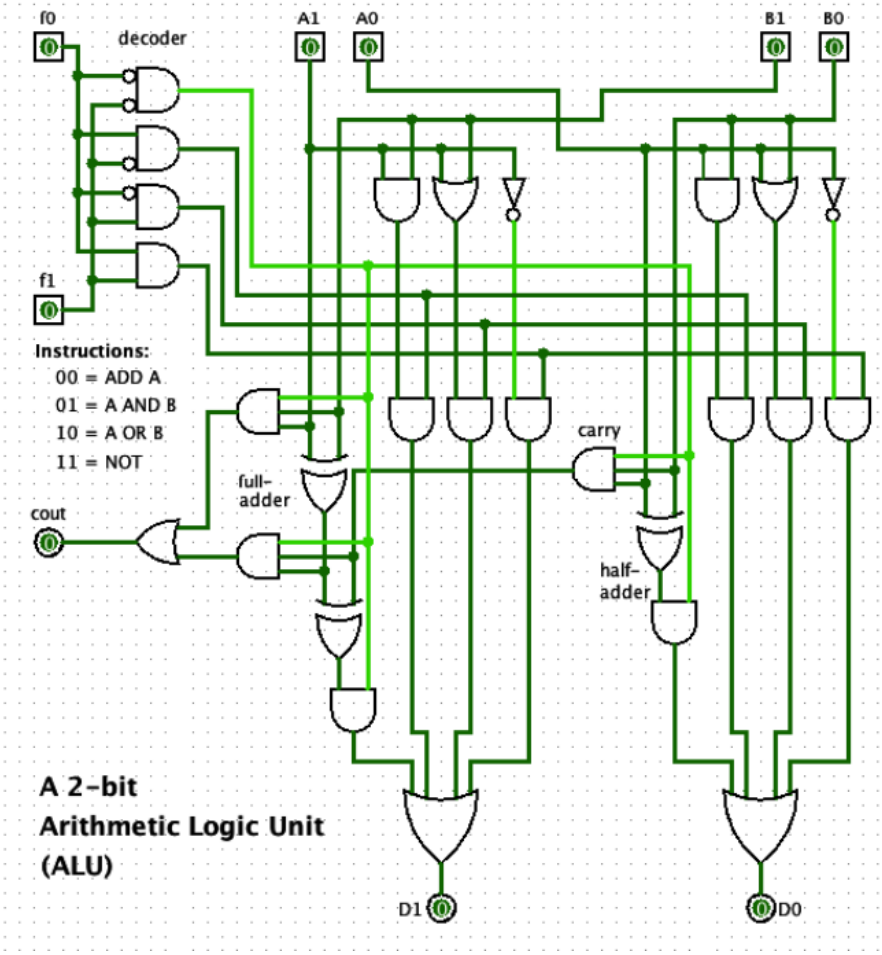
5. Testing and Verification (SUMMARY): The ALU's functionality was tested using push switches to input binary values and observe the output based on selected operations. The results were compared against expected outcomes, ensuring the correctness of the ALU design.



The circuit diagram presented above depicts the ALU (Arithmetic Logic Unit). It is evident from the diagram that four distinct functions have been incorporated, and their execution is determined by a two-bit instruction command.

Schematic of a 2 bit CPU with Control bus, registers and an ALU.

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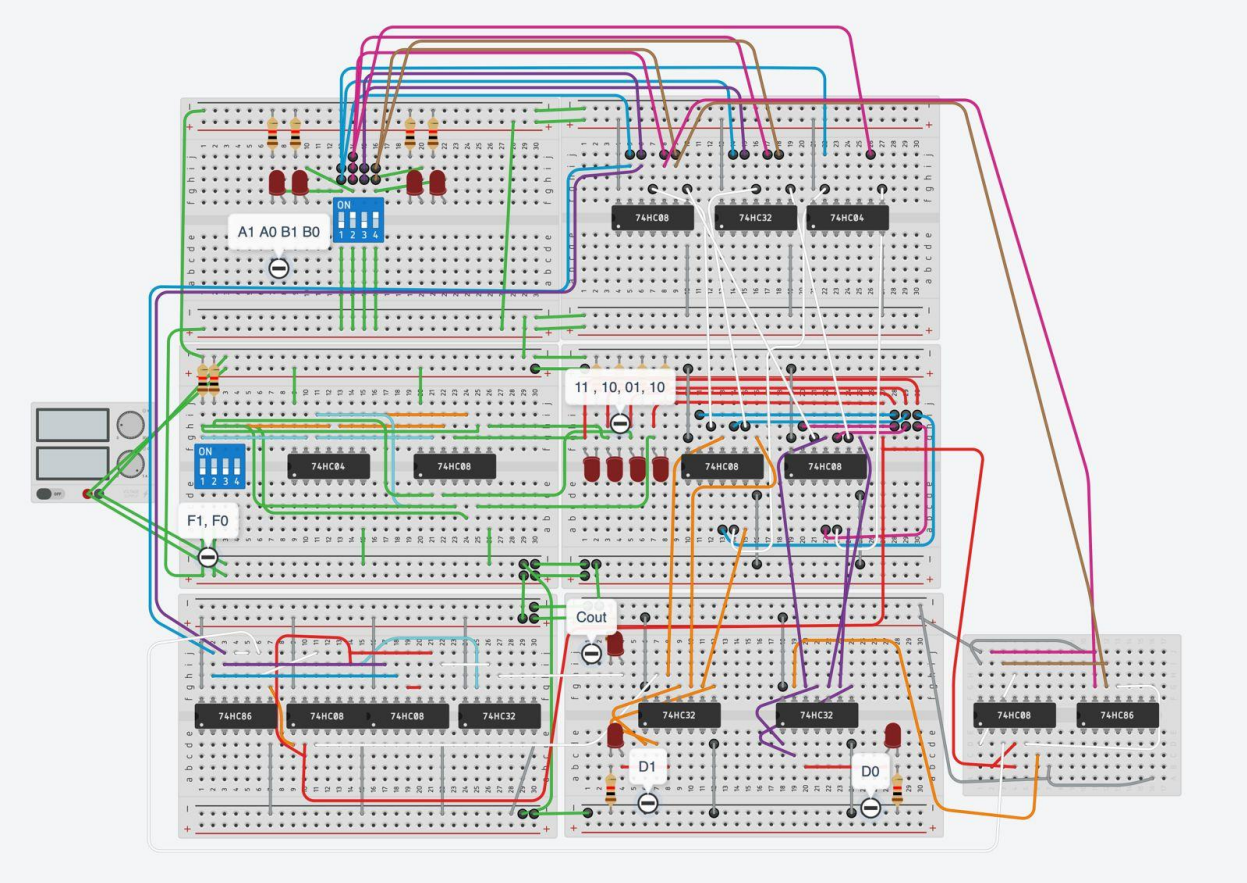

Breadboard layout of the ALU