Breadboard Computer

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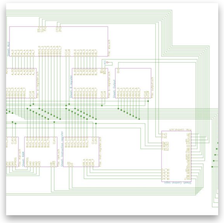
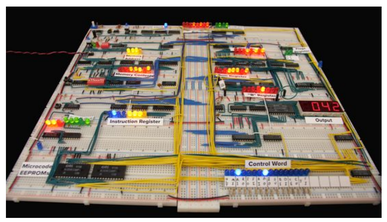
WINLAB | Wireless Information Network Laboratory

Objectives

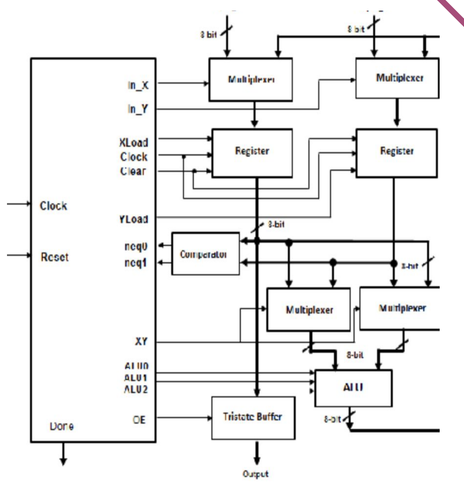
- ❏ **GOAL**: Built an 8-bit computer from scratch on a breadboard for fun.
- ❏ Learn and teach how to build a computer using different components
- ❏ Documented the step-by-step process using schematics, notes, and images so that others can replicate the creation





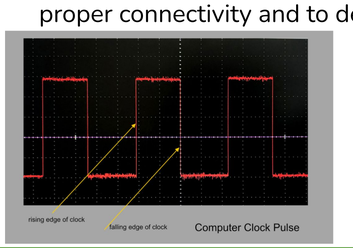
Architecture and Components

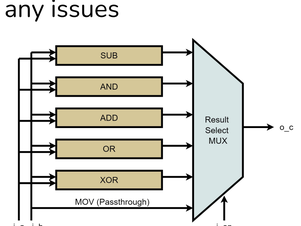
- ❏ 2 8-Bit General Purpose Registers
- ❏ 16 Bytes of RAM
- ❏ 8-Bit Program Counter
- ❏ 8-Bit Instruction Register
- ❏ ALU Based on the Chip 74LS181
- ❏ Control Unit with 1 EEPROMs Decimal Display (7-Segment Display)
- ❏ Clock Module
- ❏ 8-bit Bus System



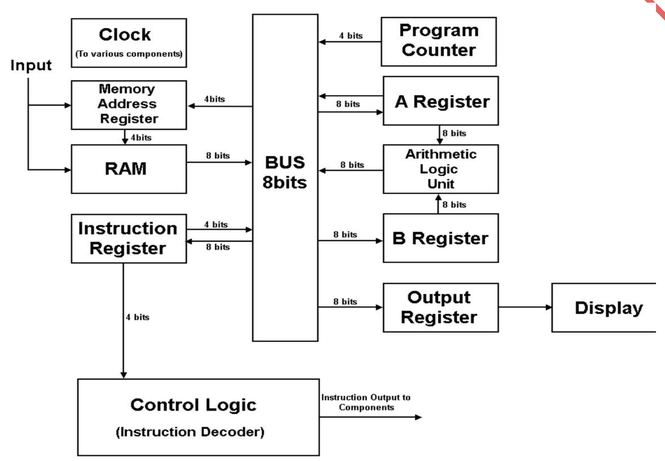
Challenges

- ❏ Difficulties in pinpointing faults in complex wiring like the ALU
- ❏ Encountered many connectivity issues, especially in the clock module
- ❏ Used Oscilloscope to check voltages and signals to ensure proper connectivity and to debug any issues





Methodologies



Subcompents

- **310 wires and 500 connections total**
- Clock: Test modules to ensure proper functionality.
- ALU
- RAM
- Registers

Intergration

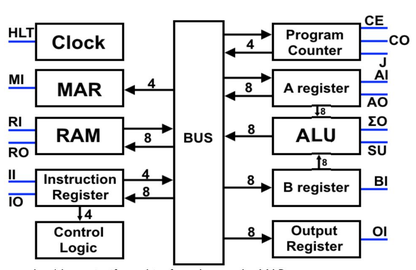
- All subcompents completed; intergration left to do
- Power and ground connections are very important
- Various chips, including flip-flops and 555 timers

Completion

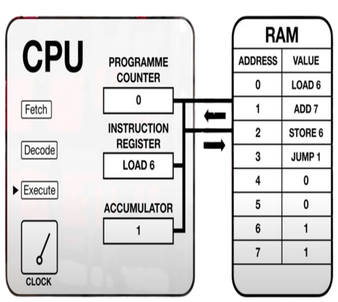
- EEPROMs to store and load programs into memory
- Will function as 8 bit computer and Calculator

Structure of CPU

- ❏ Enable or disable the EEPROMs with the necessary control signals
- ❏ EEPOMS generate active high control signals for CPU
- ❏ The control unit uses the instruction register to fetch the current instruction from memory



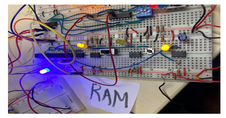
- ❏ Signals determine the specific operation the ALU needs to perform

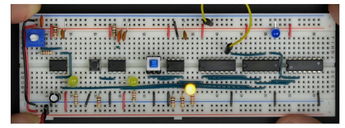


- ❏ CPU's fetch-decode-execute cycle as it processes instructions stored in the RAM

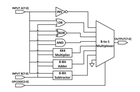
Results

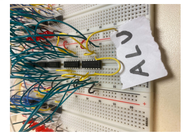
Constructed the clock module to serve as the timing backbone for the computer





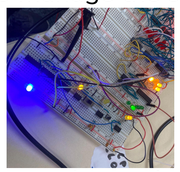
Developed the Arithmetic Logic Unit (ALU) to handle all arithmetic and logical operations.



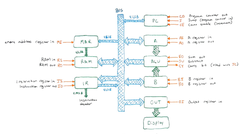


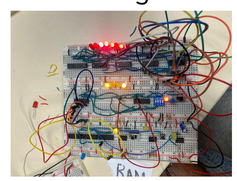
Built the A and B registers for temporary data storage during processing.

Created the program counter to manage the sequencing of instruction execution.



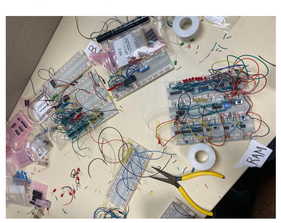
Assembled the RAM module for storing and retrieving data and instructions during operation.





Conclusion and Future Goals

- ❏ Successfully built a working Breadboard Computer from scratch
- ❏ Gained an understanding of CPU architecture
- ❏ Created a intrustuiton guide that could be followed to replicate a working computer



Future Goals

- ❏ Expand the Breadboard Computer to be able to run programs in assembly code via an online IDE
- ❏ Add more peripherals such as displays, keyboards, or communication interfaces

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