

Project 2: Read/Write Cycle Finite-State-Machine

Due November 20th 2025

Using any of the CMOS or TTL integrated circuits (ICs) in JLab, including, *gates, flip-flops, counters, registers, muxes/demuxes, 555 timers*, implement a sequential logic circuit that,

- (1) Writes a byte into a 4 bit-per-word (bpw) RAM chip upon a single press from a *write-button*.
- (2) Reads a byte from a 4 bpw RAM chip into external parallel-out registers, upon a single press from a *read-button*.

You will demonstrate the correct output of your circuit at the beginning of class and submit a typed PDF report on the due-date.

Circuit Requirements:

- Use a **single 2114 SRAM IC**.
- Provide data inputs via DIP switches.
- Use no more than four breadboards.
- Use red wire for 5V and black for ground.
- Continuously display the contents of your external parallel-out registers on LEDs.
- All buttons must be debounced.
- TTL to CMOS interfaces properly accounted for (i.e. level conversion if required. See *74LS07 Hex buffer w/ open collector*.).

Circuit Demo

1. Set 8-bit pattern A_{7-0} on DIP switch inputs.
2. Press write button.
3. Set (random) 8-bit pattern B_{7-0} on DIP switch inputs.
4. Press read button.
5. Observe A_{7-0} displayed on output LEDs.

Report Requirements:

- Adhere to the following outline:
 - 1 **Introduction:** restate the problem in your own words. Briefly introduce your approach and give an outline of the following sections.
 - 2 **Methods:** detail how you arrived at your implementation. You must include,
 - Theory: Why do we employ finite-state-machines for interfacing with RAM? Why do we use external registers as the output interface?
 - State-diagram(s) and state transition table(s)
 - Truth-tables, boolean expressions, and logic diagrams.
 - Functional block diagram(s)
 - 3 **Implementation:** detail your circuit, including,

- a picture of your circuit with components labeled.
- explanation of TTL-CMOS interfacing if used.

4 Conclusion:

- Summarize the problem and your implemented solution. Discuss the limitations of your design. Suggest how this work may be used in a larger system/circuit.

Grading (100 pts):

- Valid state-diagram(s) + state-transition table(s) (20 pts)
- In-class demo of circuit (35 pts), 20 pts guaranteed if Logisim simulation demonstrated in-person (before class or office-hours) at least 1 week before the due date.
- Report (35 pts)
- Implementation and discussion (in report) of design choice(s) which improve user experience (audio/visual feedback) and/or provide additional circuit functionality (5 pts demo, 5 pts report).

Additional Considerations:

- Circuit
 - Neatness (color coding, right-angles only, no crossing wires)
- Report
 - Consistent typesetting
 - Schematics and diagrams done in CAD (or hand-drawn EXTREMELY NEATLY)
 - Correct use of technical terms
 - All tables and figures referenced in the text and accompanied by a caption.
 - Technical writing voice.