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ELEN/COEN 21L 47363

Laboratory #1: Introduction to Logic Gates

January 20, 2017

Objective

During this lab, we familiarized ourselves with the breadboard and created a light and alarm system based on our Pre-Lab truth table and circuit diagram (Figures 1 and 2). We learned how to work with the breadboard and connected sensors, output component, and ICs with logic gates. We translated the problem statement into the working light and alarm circuit that we designed, tested, and implemented.

Pre-lab

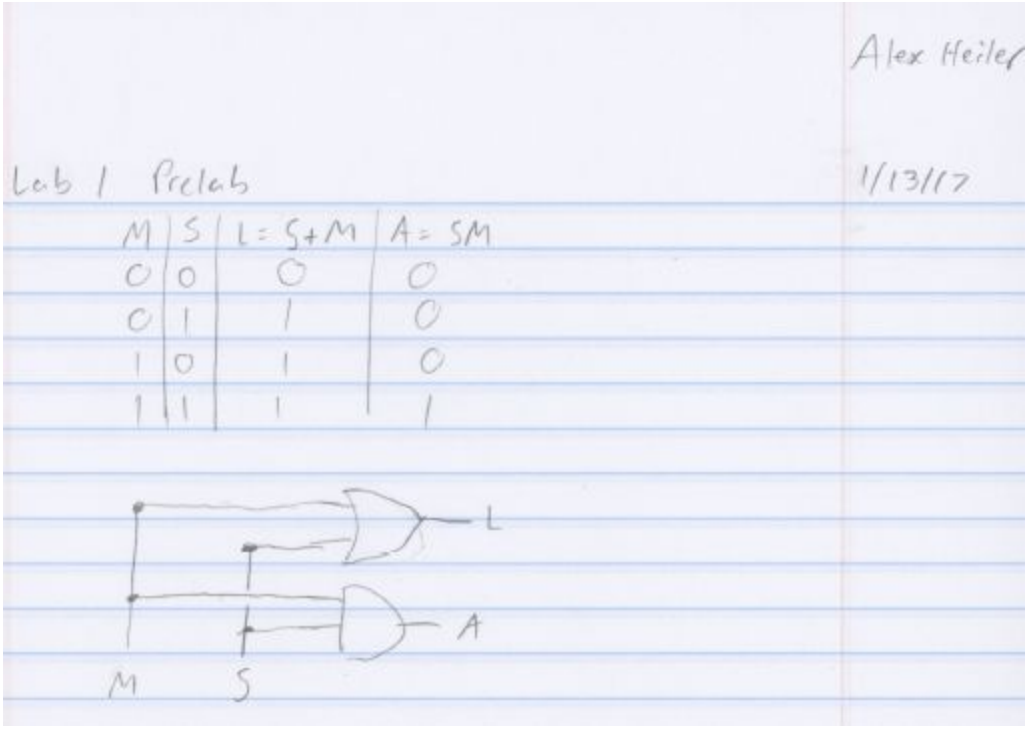

Figure 1: Pre-lab for Alex Heiler

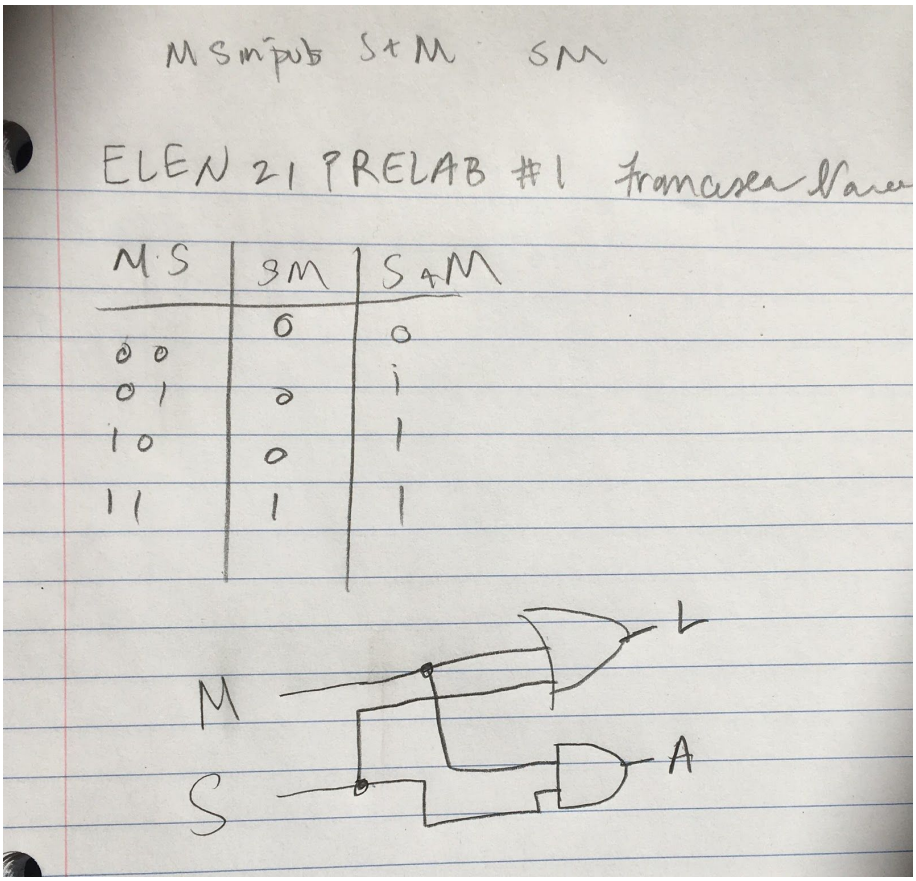

Figure 2: Pre-lab for Francesca Narea

Observations

First, we tested the LEDs with both +5V and GND connections. When connected to +5V, the red LED lights up, and when connected to GND, the green LED shines. The red LEDs are internally connected to GND, because the red LED makes a complete circuit and lights up when connected to +5V. The green LEDs are internally connected to +5V because they make a complete circuit and light up when connected to GND.

Next we connected S1 to the LED1. When the switch was 0, the green LED lit up, and when the switch was 1, the red LED lit up.

After testing all the switches, we tested the function generator. When the frequency generator was switched to 1, the red LED switched on 30 times in 30 seconds. When the dial was moved to 10, the red and green LEDs switched rapidly. When the dial was moved to 100, both LEDs appeared to remain lit because they were switching so incredibly fast. When the dial was moved to 100k, red LEDs 3, 4, and 5 and green LED 4 remained lit because the voltage spilled over to red LEDs 3 and 5.

If +5V and GND are accidentally connected, the 7 segment numeric displays shut off to prevent short-circuiting any of the components.

Procedures

First, insert both the 74x08 and 74x42 ICs into the breadboard and connect their power pins to +5V and their GND pins to ground. Insert the motion sensor and alarms into the board, wiring both of them to ground and the motion sensor to +5V. Wire S1 and the motion sensor output to two of the input pins for IC 74x32 and the output pin to LED 1. Similarly, wire S1 and the motion sensor output to the input pins for IC 74x08 and the output pin to the input of the alarm. After turning on the breadboard, calibrate the motion sensor by covering it for 30 seconds. Test the circuit, using S1 and the motion sensor to light up LED 1 and sound the alarm (see Figure 4 below for our completed circuit).

The breadboard circuit matched the circuit designed during the Pre-Lab.

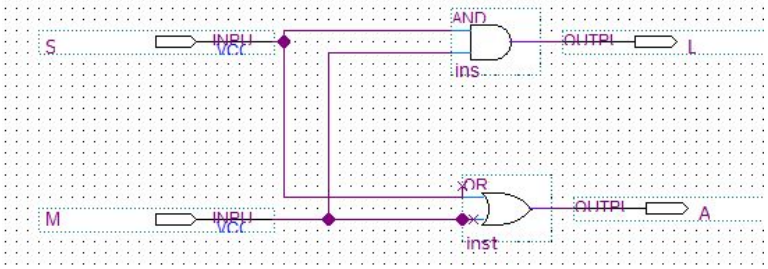

Figure 3: Circuit Diagram

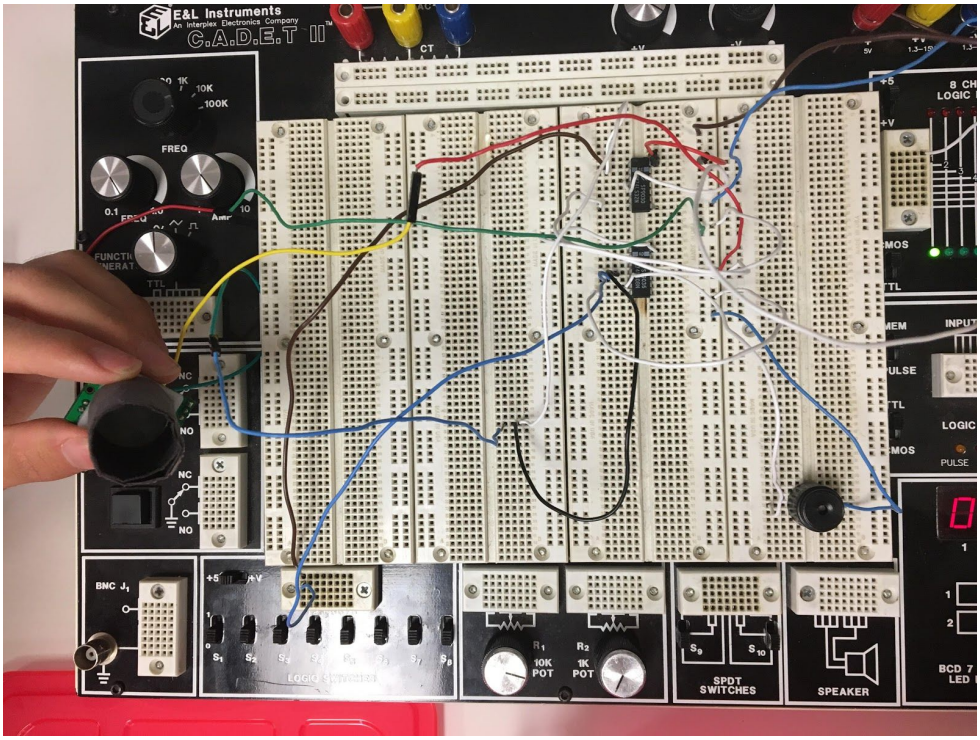

Figure 4: Breadboard circuit

Conclusion

If the alarm activated as soon as motion is detected, the switch may be malfunctioning or there is a faulty connection in the AND gate. The system is acting incorrectly if the alarm sounds while the switch is off.

If the alarm goes on regardless of the other inputs, any of the components could be malfunctioning, including the switch, motion sensor, and AND gate. To determine what is malfunctioning, replace the inputs with different components.

During this lab, we learned how to implement a logic circuit based upon a truth table, equation, and schematic. We used ICs and troubleshooted the circuit to ensure it functioned properly.