Kashvi Gupta (kg2968)
Apurva Reddy (akr2177)
Victoria Allen (vca2102)

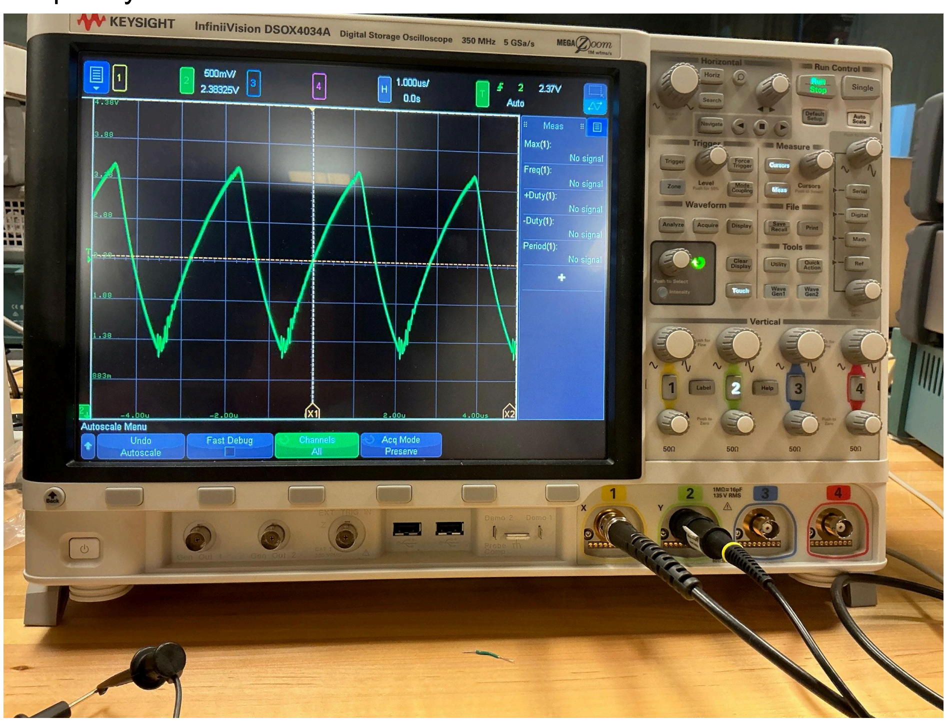
Lab Report 2

Question 1

Theoretically we expect to see the output of the capacitor as it charges and discharges as a discontinuous exponential curve. When the resistance value is low, the frequency is much lower than when the resistance is higher.

R = 0 ohms

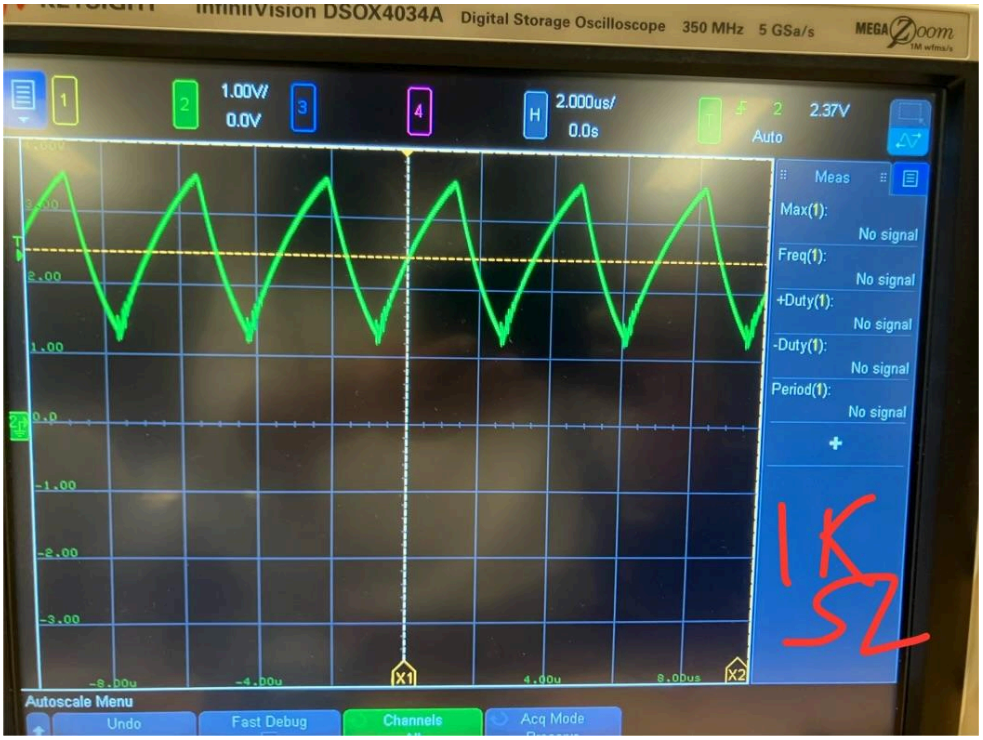
The capacitor charges and discharges extremely quickly.
Frequency: about 300K Hz.



R = 1k ohms

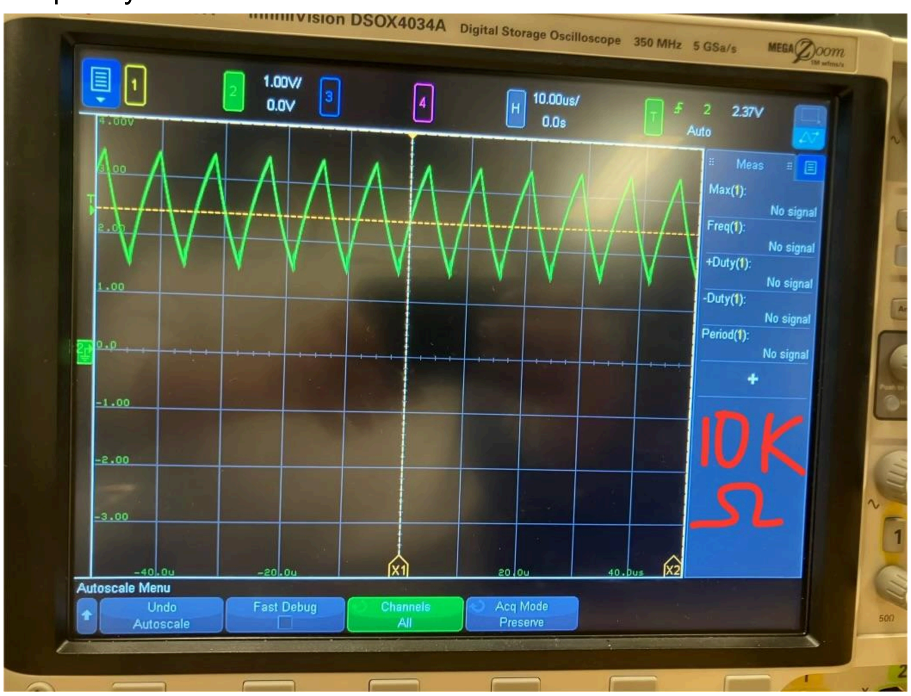
Frequency: about 275K Hz.

Kashvi Gupta (kg2968)
Apurva Reddy (akr2177)
Victoria Allen (vca2102)



R = 10k ohms

Frequency: about 125K Hz.



Kashvi Gupta (kg2968)
Apurva Reddy (akr2177)
Victoria Allen (vca2102)

R = 100k ohms

Frequency: about 16K Hz.

Through varying the values of R2, we can see as the resistance increased, the frequency decreased, and the duty cycle moved closer to fifty percent. Frequency is how many times in a single time unit, the signal completes a cycle, while duty cycle determines for how much of a single cycle the signal is “on”.

Theoretical Values:

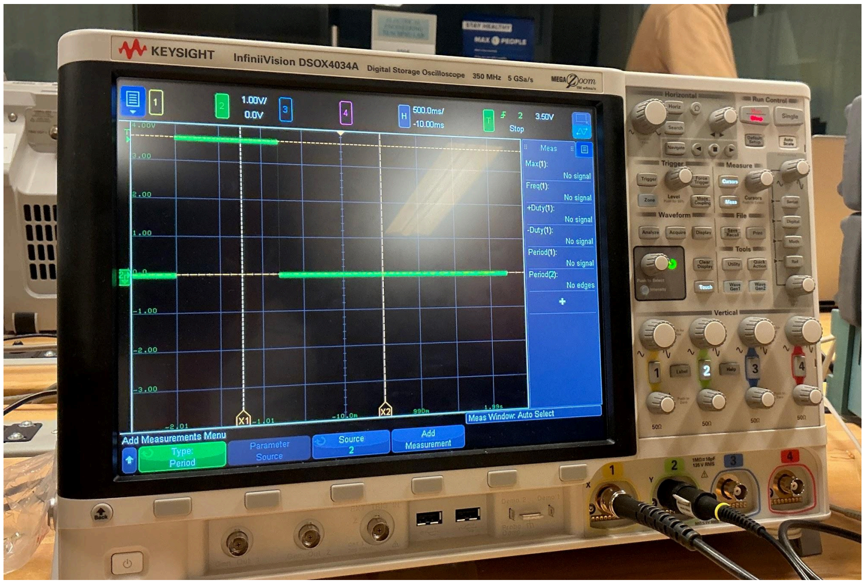
For min (R2 = 0): R1 + 2R2 = 2.2 * 10^3 + 2(0) = 2.2 * 10^3 Ohms. frequency = 1.44 / (2.2 * 10^3) * (270 * 10^-12) = **2.42 MHz**
Duty cycle = ((2.2 * 10^3) / (2.2 * 10^3)) * 100 = **100%** (output should stay high)

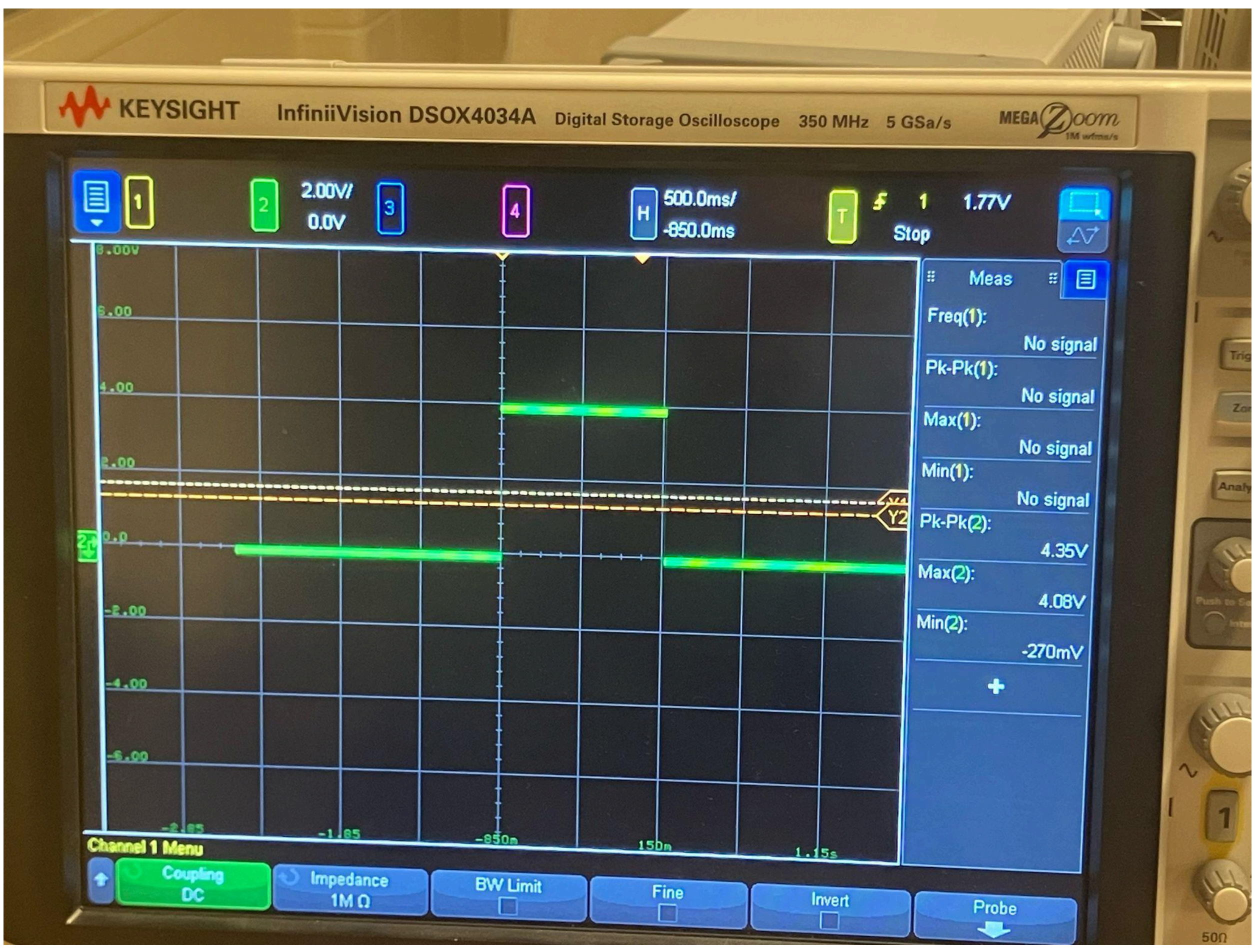
For max (R2 = 100k ohms): R1 + 2R2 = 202.2 * 10^3 Ohms. f = **26.4 kHz.** D = ((202.2 * 10^3) / (102.2 * 10^3)) * 100 = **50.56%** (high/low practically equal).

Question 2

Theoretically, we chose R = 1 mega ohm and C = 1 microfarad to get a pulse of 1 second. However, in practice, it took a resistance of R = 820 kilo ohms and C = microfarad to get a 1 second pulse. This is not within 10% tolerance, but it is quite close.

Kashvi Gupta (kg2968)
Apurva Reddy (akr2177)
Victoria Allen (vca2102)





Kashvi Gupta (kg2968)
Apurva Reddy (akr2177)
Victoria Allen (vca2102)

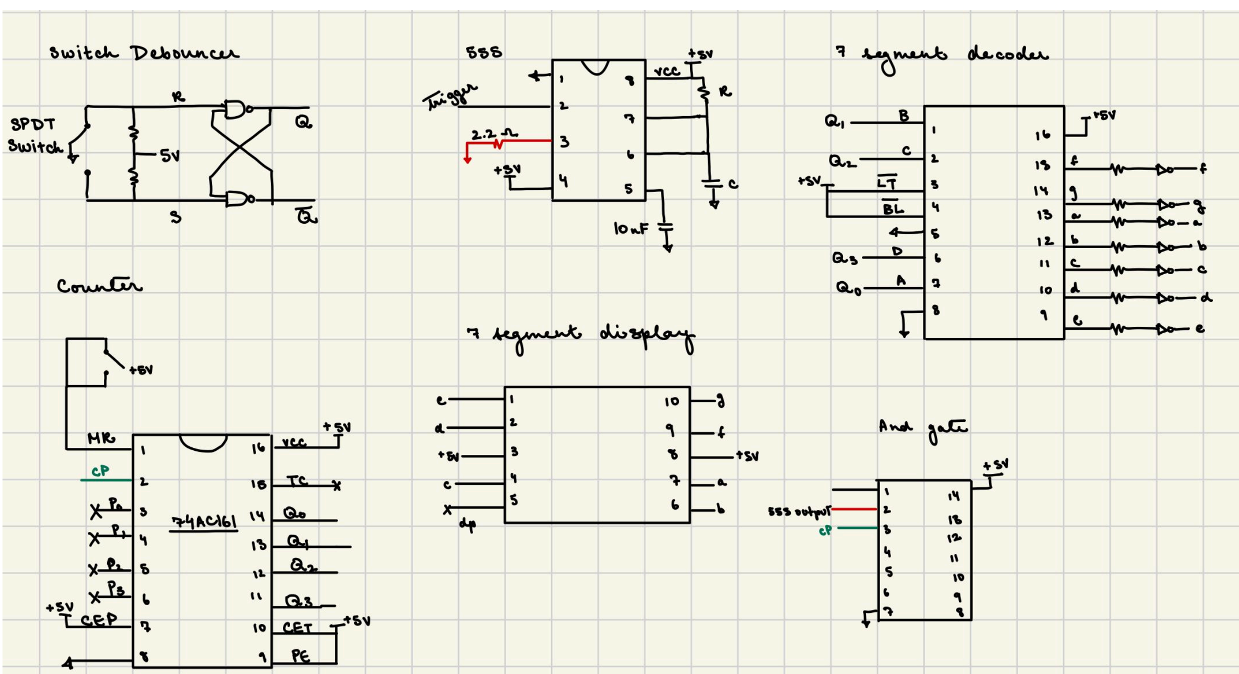
The debouncer prevents the device from being triggered multiple times. When the switch is triggered, the chip then produces a single square pulse. By choosing R and C values such that their time constant is one second, we can control the length of the pulse created by the chip to be one second long. When the capacitor charges to a certain threshold it causes the discharge transistor to turn on, returning to its stable state of 0.

Question 3

Approach and Challenges

Using the circuit debouncer from the previous lab, we built a frequency counter that uses the 555 timer chip. Using 555 chip on one-shot mode allows us to emit a pulse for a certain length of time (1 second), which is the duration for which the counter will count the number of cycles of the signal outputted by the function generator. (The circuit resets when the button on the debouncer is pressed.) Our challenges with designing the circuit included issues with the chips- we could not get the correct pulse length for the 555 chip, and had issues wiring the AND gate (for which we had to use a NAND and inverter). Additionally, our initial circuit was wired backwards, such that the timer chip's steady state was 1 instead of 0, so we would get a constant pulse with 1 second's respite instead of the other way around.

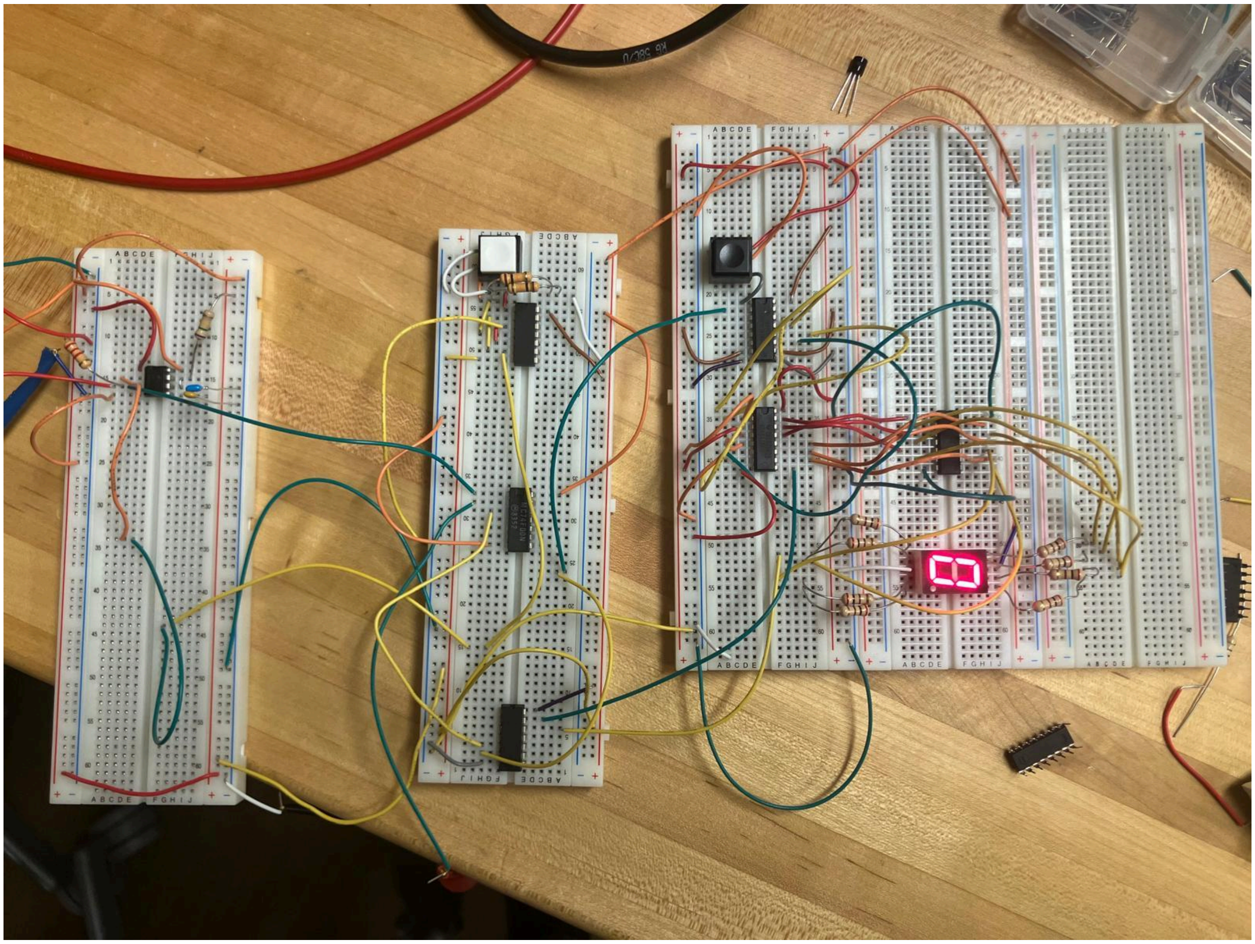
Schematic



Kashvi Gupta (kg2968)
Apurva Reddy (akr2177)
Victoria Allen (vca2102)

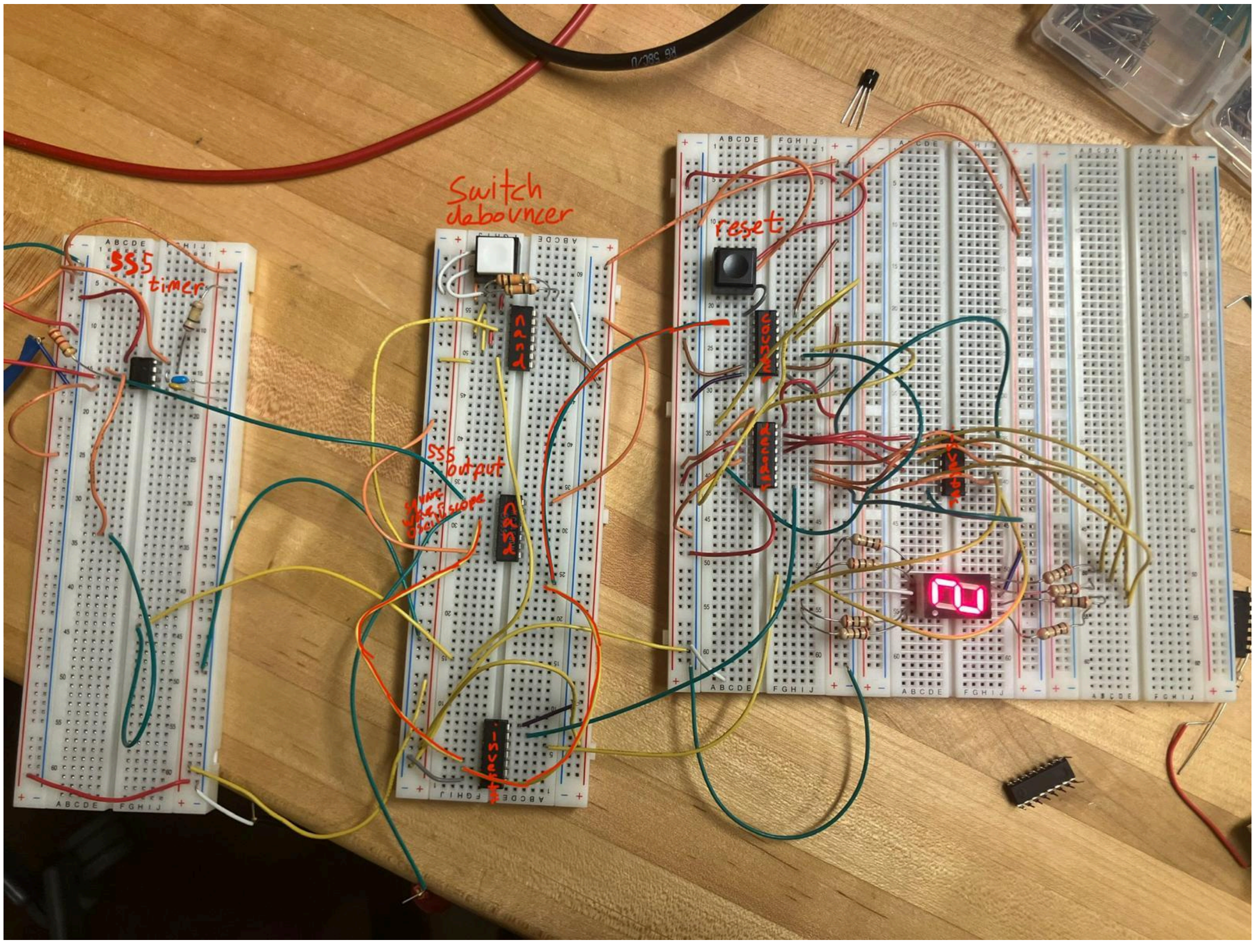
Working Circuit Videos

Digi Systems Lab Working Circuit Videos



Picture of final circuit

Kashvi Gupta (kg2968)
Apurva Reddy (akr2177)
Victoria Allen (vca2102)



Annotated version