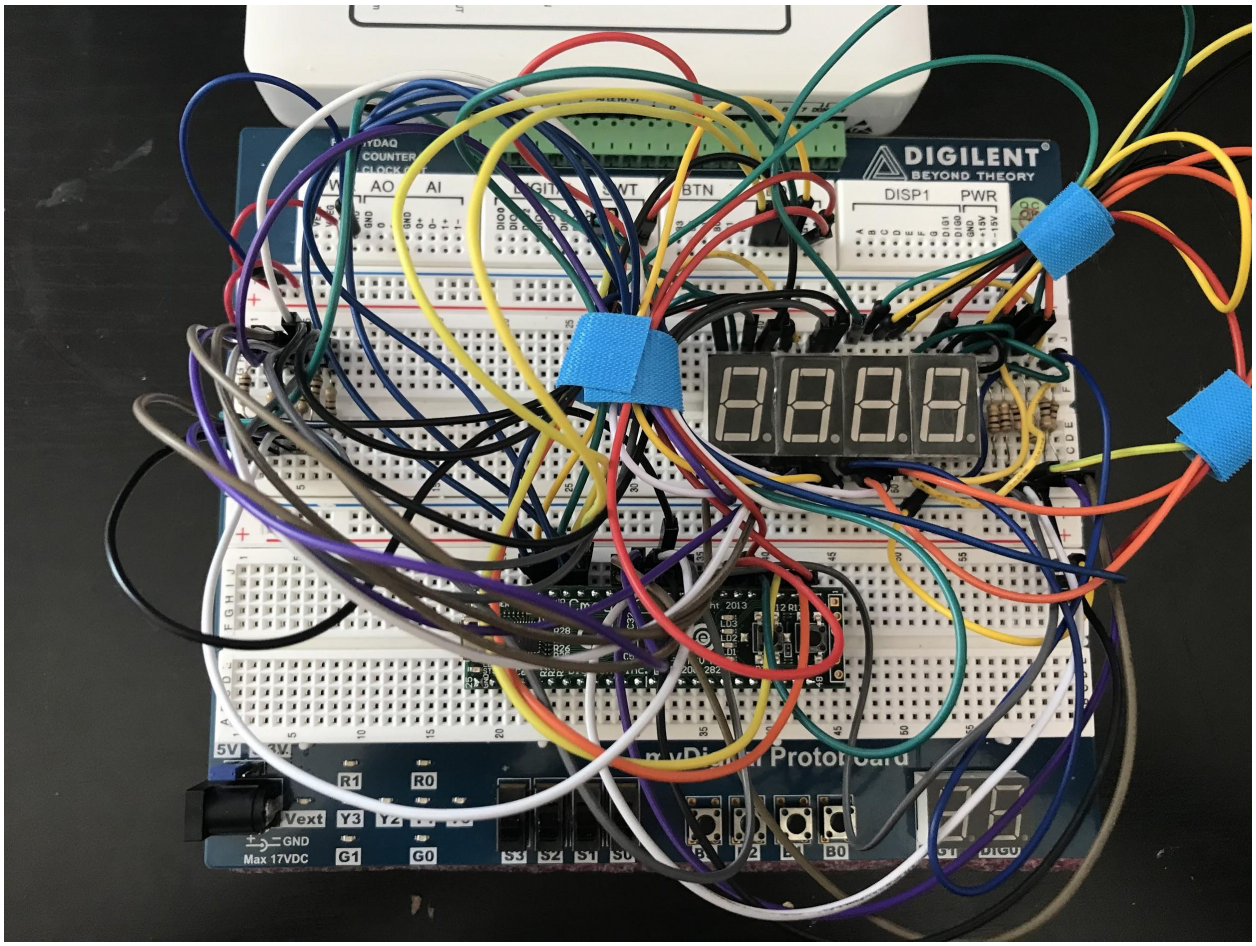
Moving Patterns



Project 2.3.5

Khushi Gupta
Period 7

3/9/2021

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Design Brief

Client	SF MoMA
Designer	Khushi Gupta
Problem Statement	SF MoMA would like a digitized, interactive art display for visitors to interact with in order to increase the amount of people coming to the museum.
Constraints	● There must be at least 4 inputs utilized for a total of 16+ states. ● There must be at least 5 outputs, which are not to be all dark for more than 2 states. ● Your display must be automated by a clock so that your states cycle automatically.
Individual Deliverables	● Documentation with: ○ Title Page - name, date, period, project name ○ Table of Contents - corresponding sections and page numbers ○ Design Brief & Display Definitions - design statement, constraints, summary of display - what will it look like?, inputs?, outputs? ○ Truth Table & Logic Expression - table and algebraic expressions ○ Solution - Simulation & Breadboard - images of simulation and breadboard shown clearly, multiple views as necessary, labels and descriptions of final design ● Video Presentation that demonstrates the circuit

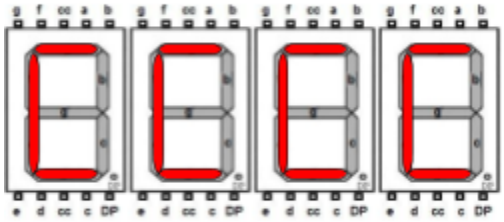
Display Definitions

Inputs
The inputs will be connected to four switches and will provide the binary count that will allow the display to cycle through the four design outputs. The four switches will be able to convert to a two-bit binary count that will power 5 segments on a common cathode display.

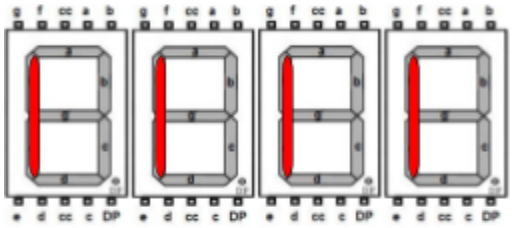
Outputs
The outputs are the four shapes indicated below. A different shape will show up based on the switch that is toggled. Using the 2-bit binary counter it will continue cycling through the shape toggled through the four common cathodes. Each switch will toggle the shape which will then continue cycling. The different colored LEDs will turn on according to the corresponding shape being cycled. Since all four of the common cathodes display the same value they will have the same outputs on the PLD. The ground connections will be connected to the counter that is connected to a demultiplexer, allowing for the cycling to occur. A set of five outputs will be on at every state, so no two or more states will be left completely off.

The cycle goes though the following displays.

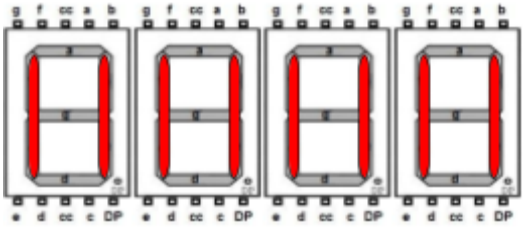
Shape One: C-Shape



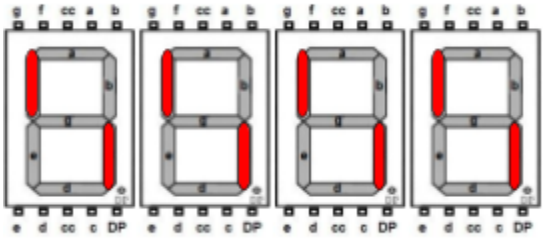
Shape Two: Horizontal line



Shape 3: Vertical Line

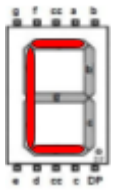
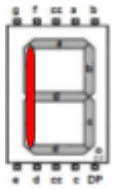
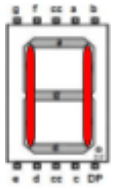
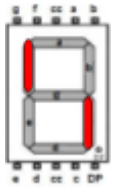


Shape 4: Scattered Line



Truth Table and Logic Expressions

Truth Table Logic for Common Anode Cycle

Inputs		Seven-Segment Display Segments							Display
X	**Y**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	
0	0	1	0	0	1	1	1	0	
0	1	0	0	0	0	1	1	0	
1	0	0	1	1	0	1	1	0	
1	1	0	0	1	0	0	1	0	

Unsimplified

A=X'Y'
B=XY'
C=XY'+XY
D=X'Y'
E=X'Y'+X'Y+XY'
F=X'Y'+X'Y+XY'+XY
G=0

Simplified

A=X'Y'
B=XY'
C=X
D=X'Y'
E=X'+XY'
F=1
G=0

Truth Table for Inputs (Converting 4 Switches to binary count)

Inputs				***Outputs***	
A	**B**	**C**	**D**	**X**	**Y**
0	0	0	0	x	x
0	0	0	1	0	0
0	0	1	0	0	1
0	0	1	1	x	x
0	1	0	0	1	0
0	1	0	1	x	x
0	1	1	0	x	x
0	1	1	1	x	x
1	0	0	0	1	1
1	0	0	1	x	x
1	0	1	0	x	x
1	0	1	1	x	x
1	1	0	0	x	x
1	1	0	1	x	x
1	1	1	0	x	x
1	1	1	1	x	x

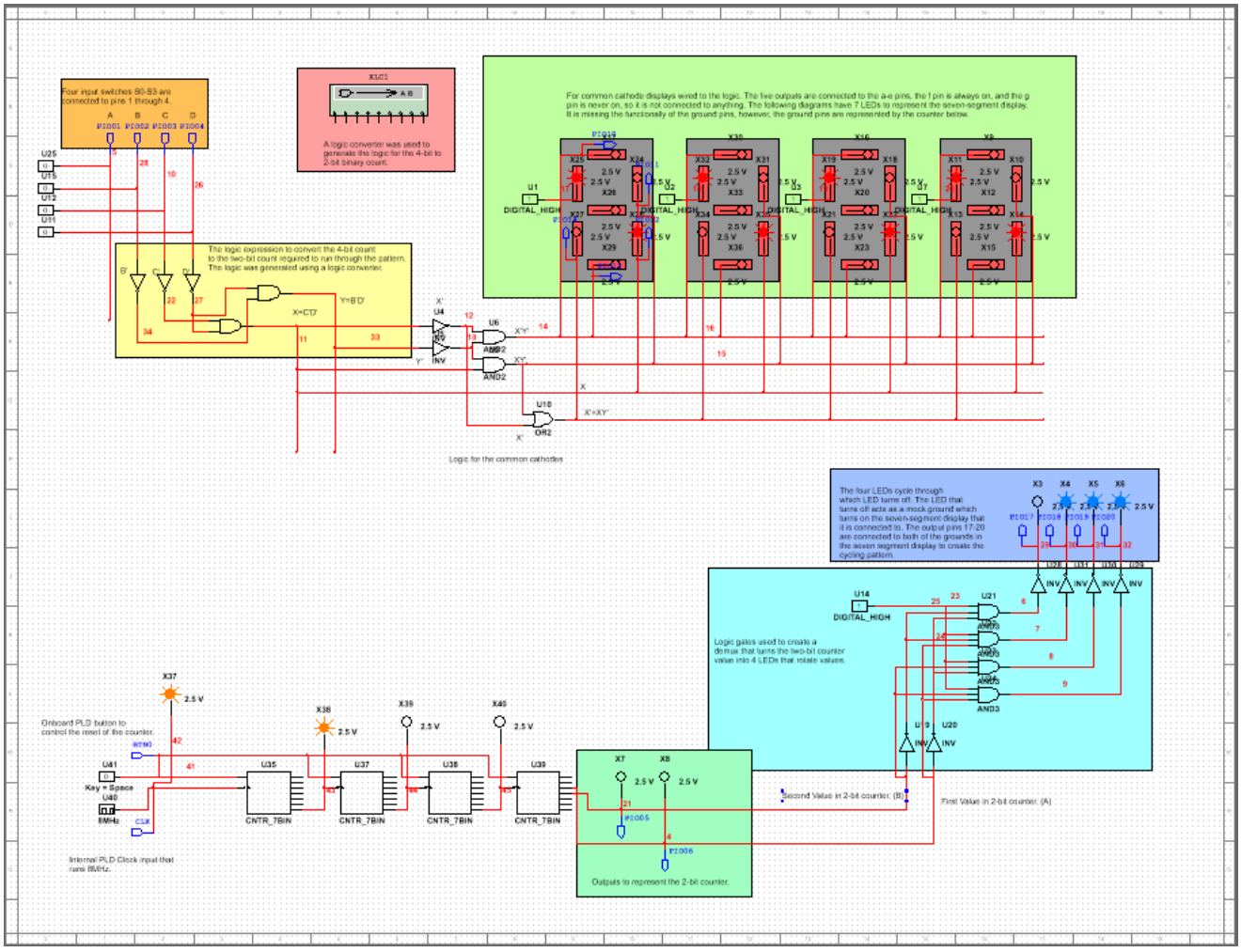
Unsimplified Logic Expressions
X=A'BC'D'+AB'C'D'
Y=A'B'CD'+AB'C'D'

Simplified Logic Expressions
X= C'D'
Y=B'D'

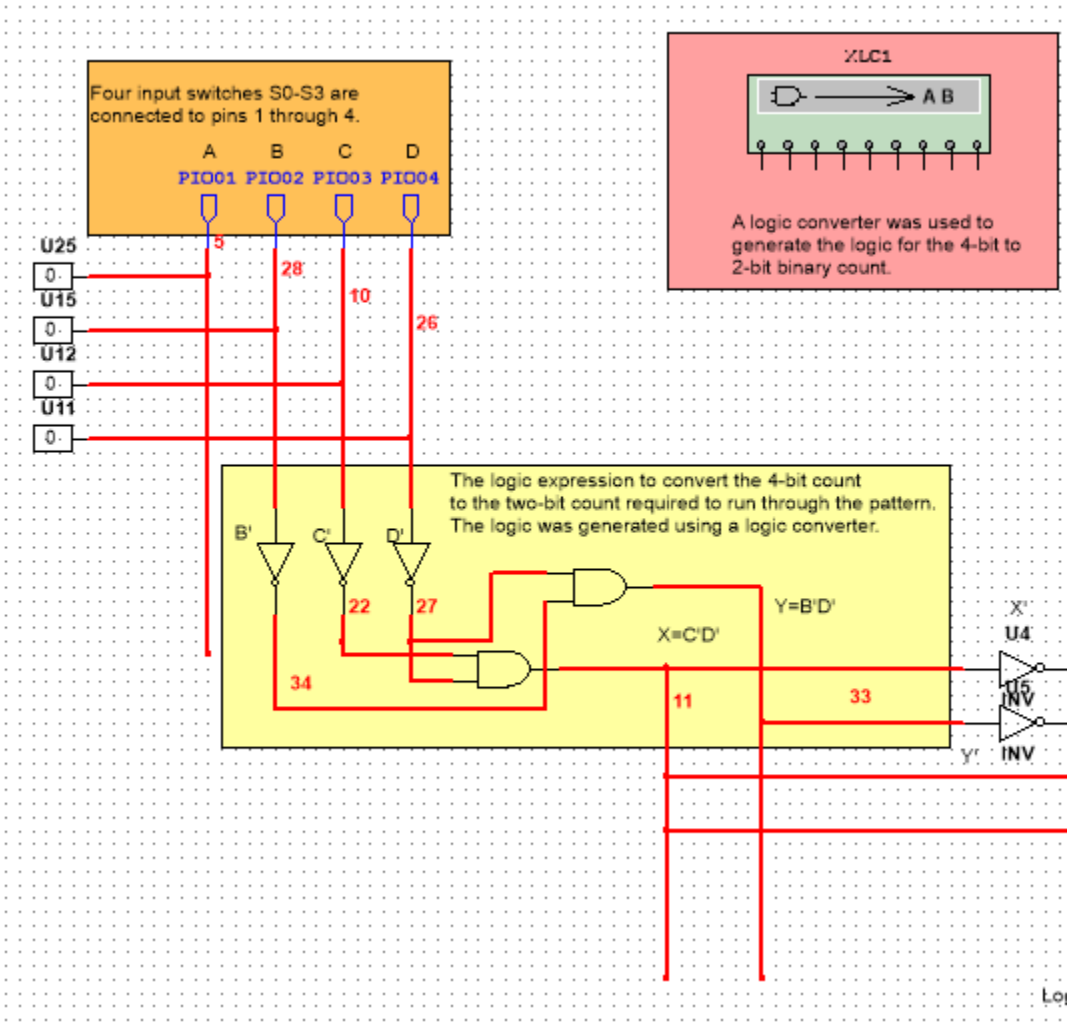
Solution - Simulation & Breadboard

Simulation

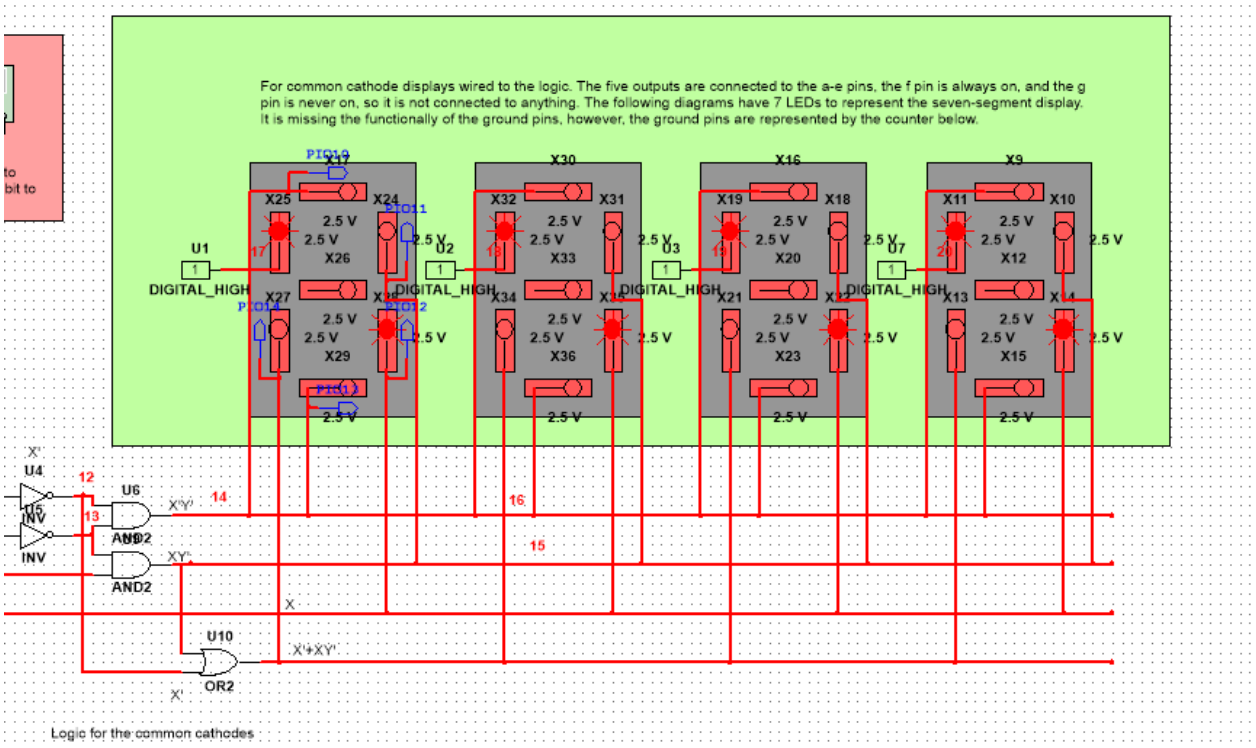
Overview



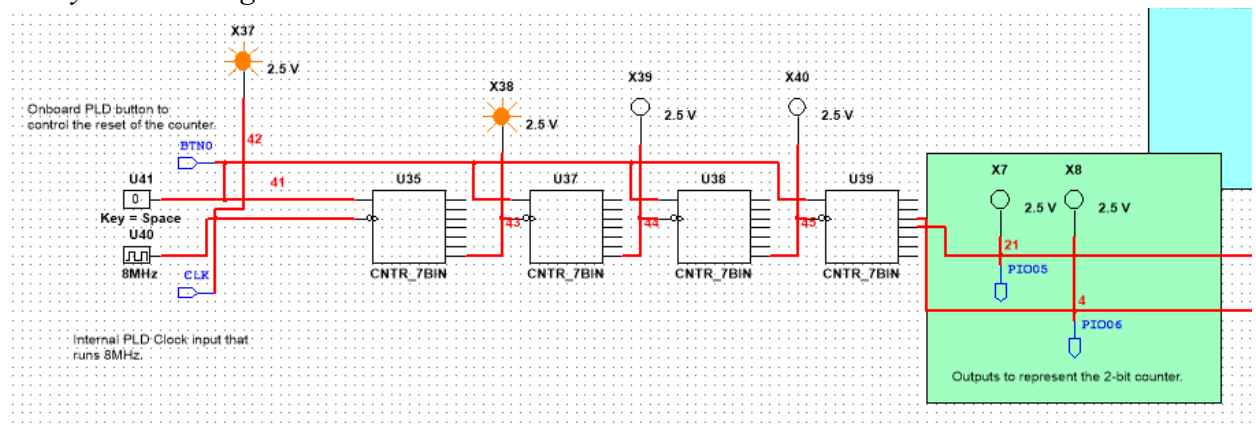
Input Logic


Four input switches S0-S3 are connected to pins 1 through 4.
A B C D
PIO01 PIO02 PIO03 PIO04
XLC1
A B
A logic converter was used to generate the logic for the 4-bit to 2-bit binary count.
U25
U15
U12
U11
5
28
10
26
The logic expression to convert the 4-bit count to the two-bit count required to run through the pattern. The logic was generated using a logic converter.
B'
C'
D'
22
27
34
11
33
Y=B'D'
X=C'D'
X'
U4
INV
Y'
INV

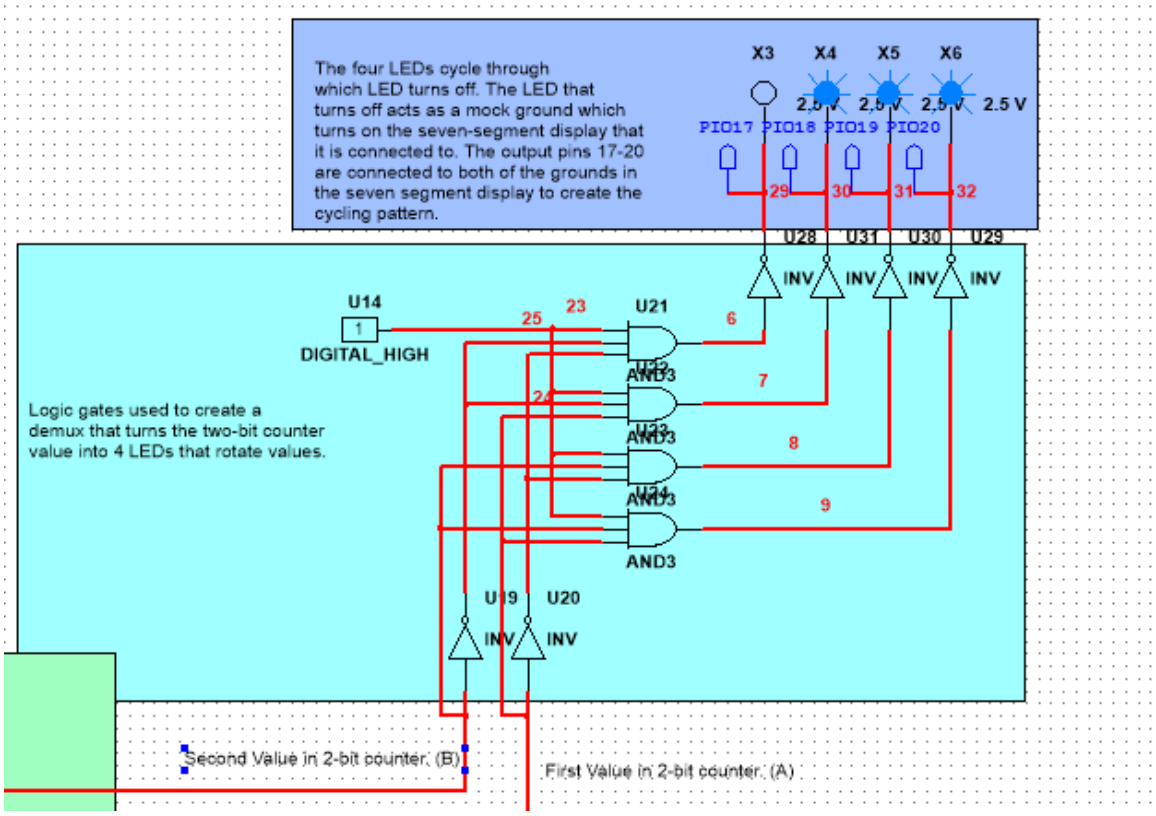
Common Cathode Logic



Binary Counter Logic

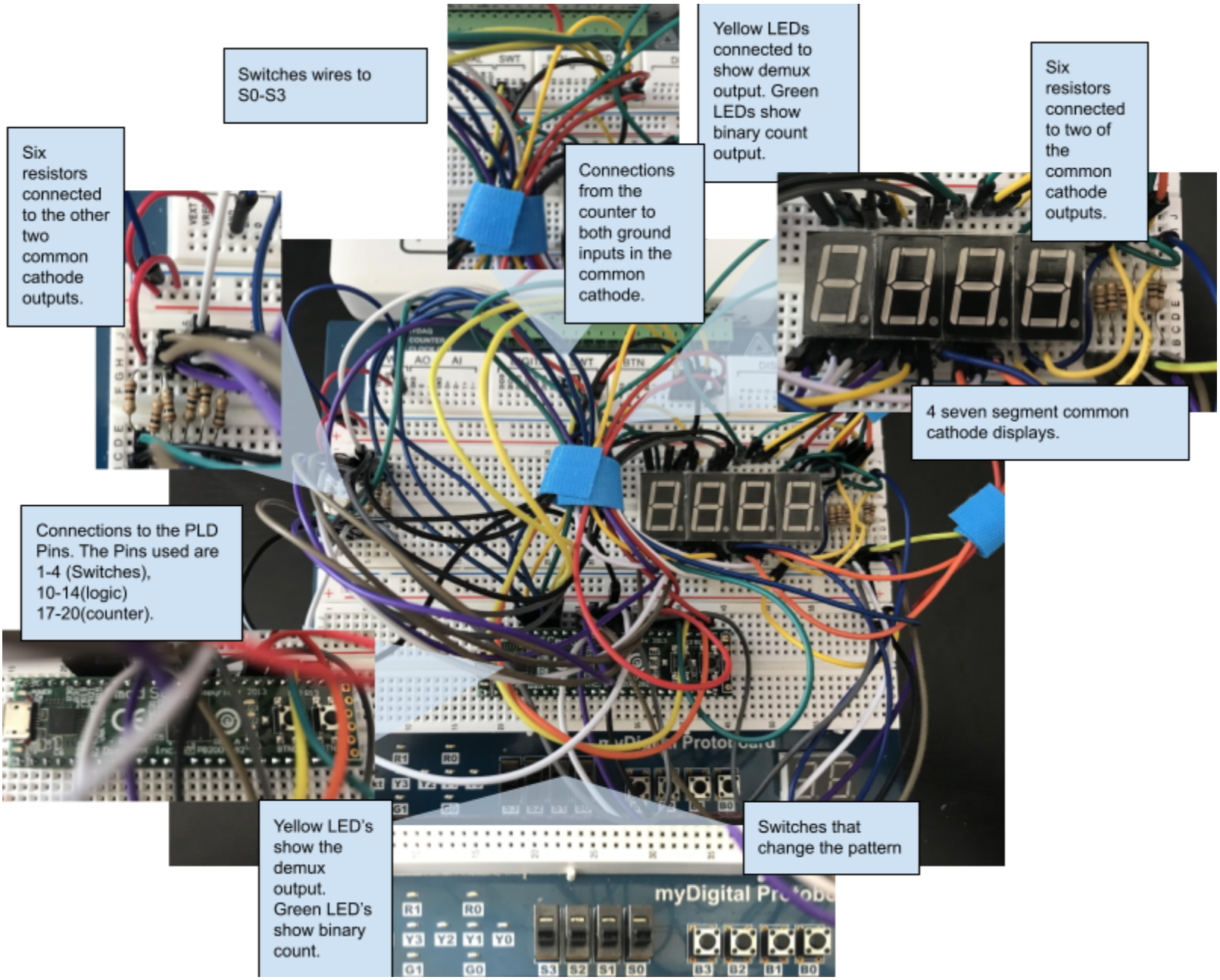


Demultiplexer to output pins

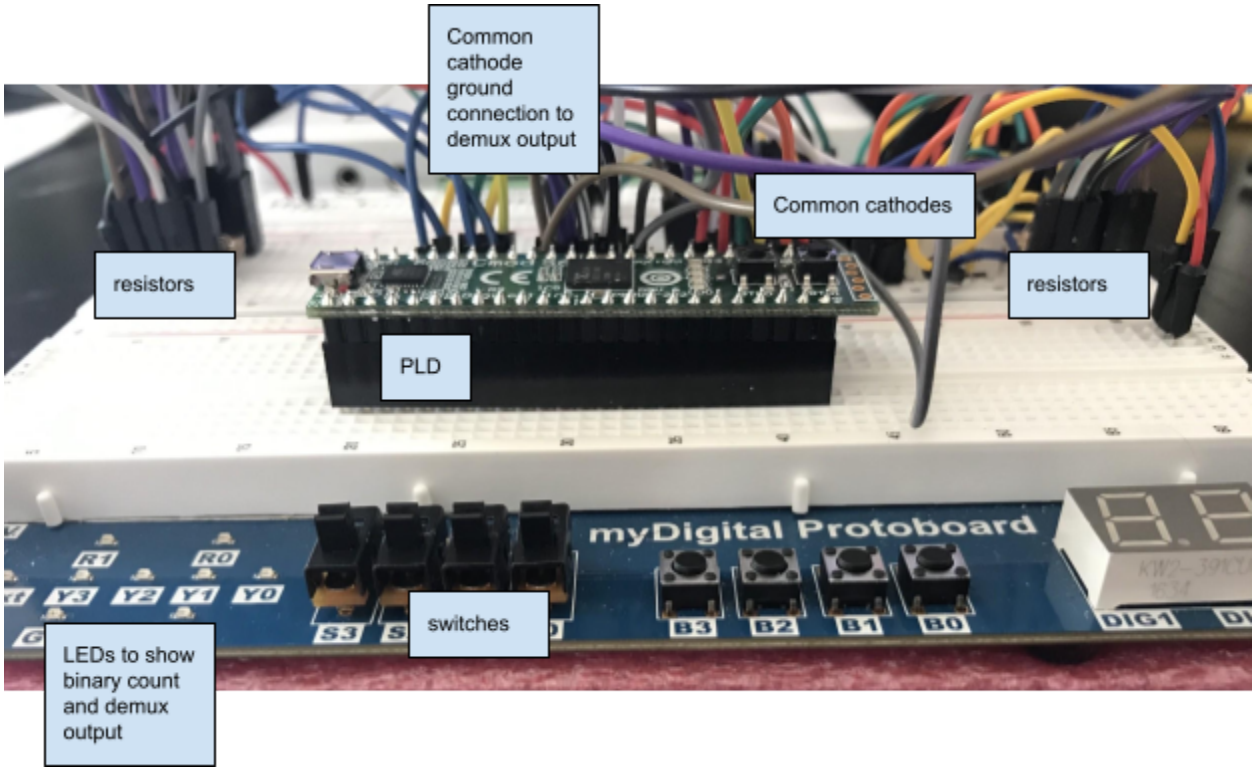


Breadboard

Front View



Side View



Final Summary

This circuit uses four input switches and 5 segments on 4 common cathodes as the output. The four switches allow the user to cycle through 4 patterns. When toggled the pattern will change accordingly. The pattern continuously cycles through the four common cathode displays by using a two bit counter connected to a demultiplexer. This is because the LED that turns off acts as a mock ground, temporarily turning on the corresponding seven segment display until the LED turns on again. The button (Button 0) on the PLD allows the user to stop cycling and make it restart form the right most seven segment display. There are 100 Ohm resistors on both sides. To lessen the amount of resistors used, I wired two resistors to two seven segment displays. The simplified AOI expressions were used in the PLD. To lessen the amount of wires used, I just used the same five outputs on all of the displays since they output the same values. Some issues that I ran into while designing the circuit is that the demultiplexer in the simulation failed to export, so I ended up making one with AOI logic instead. I also realized that I required resistors as otherwise my common cathodes would short circuit, so that required more wiring. Overall, the circuit performs as desired and is able to be used as an interactive display in an art museum.