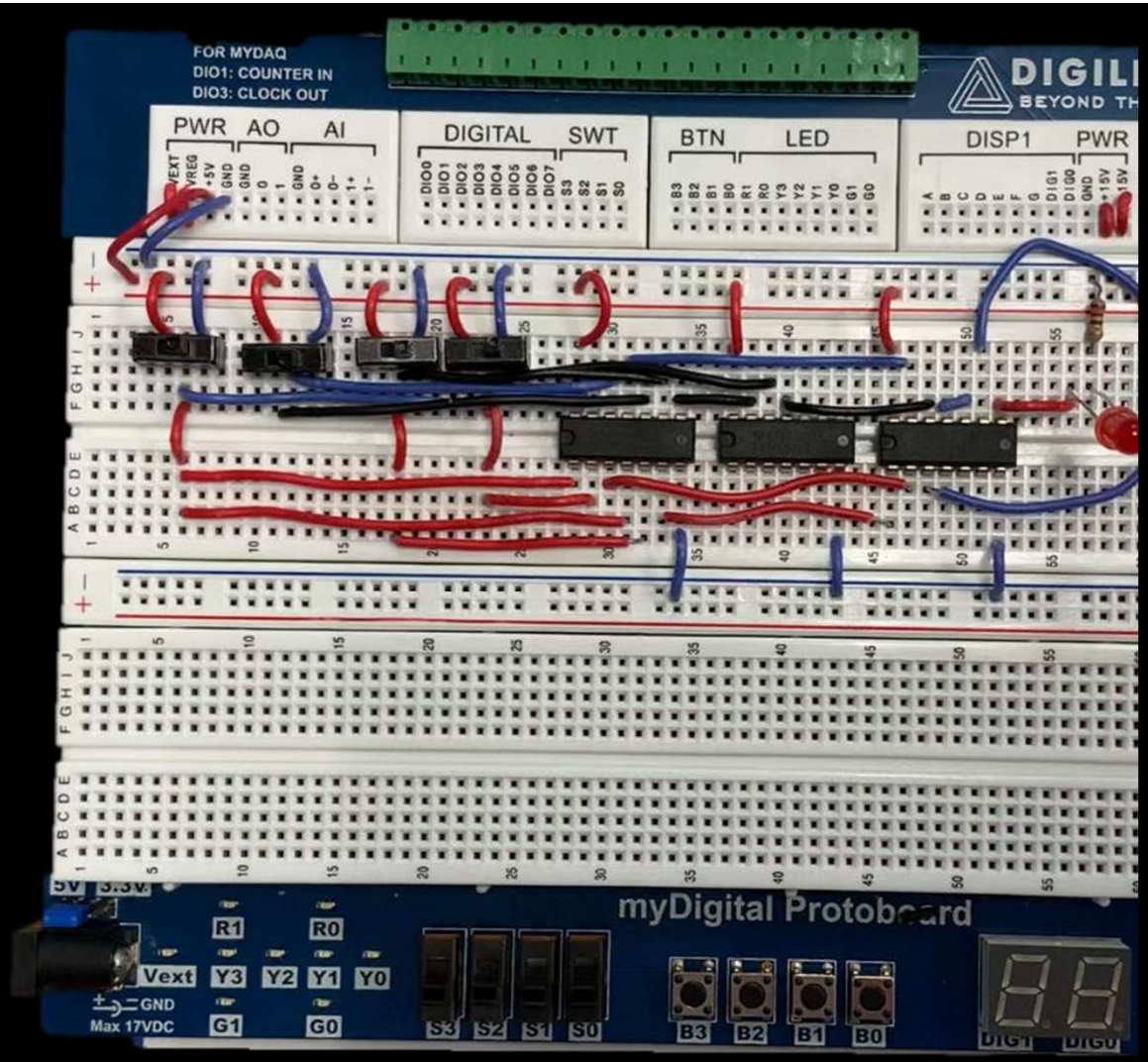
Majority Vote Portfolio

By Om Patel

Engineering & Robotics

September 28th, 2023



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Design Brief

In this project we were challenged to build an electronic voting machine that eliminates the need for paper ballots, due to their controversies regarding reliability.

Creating a design brief helps organize my work, helping me see what I have to do and allowing others to see what I have done.

Client:	**Board of Directors at my Company**
Designer:	Om Patel
Problem Statement:	The paper ballots caused votes to be over and under counted leading to election controversies
Design Statement:	Create a Majority Voting electronic voting machine using AOI logic (to eliminate paper ballots), allowing four board members, the president, the vice president, the secretary, and treasurer to cast a yes or no vote and display a pass or fail statues of the final decision. For a vote to be passed, a majority of the board members must vote yes, and in the case of a tie, the president's vote serves as the tie breaker.
Constraints:	-Use only AND, OR, and Inverters in the design -Use only two-input AND and OR gates in the design -Must be completed by September 29th, 2023
Deliverables:	-A truth table of all the possible voting decisions -A logic expressions derived of the minterms of positive outcomes, which describes the possible outcomes of the vote -A logic expressions derived of the minterms of positive outcomes which has been simplified using Boolean algebra, which describes the possible outcomes of the vote -A working simulation of the voting machine un-simplified circuit in a CDS -A working simulation of the voting machine simplified circuit in a CDS -A working simulation of the voting machine circuit in a digital breadboard -A working breadboard of the voting machine circuit -Evidence of working prototype

Truth Table

P	V	S	T	D	
President	Vice President	Secretary	Treasurer	Decision(Output)	Minterms
0	0	0	0	0	
0	0	0	1	0	
0	0	1	0	0	
0	0	1	1	0	
0	1	0	0	0	
0	1	0	1	0	
0	1	1	0	0	
0	1	1	1	1	<---------- P'VST
1	0	0	0	0	
1	0	0	1	1	<---------- PV'S'T
1	0	1	0	1	<---------- PV'ST'
1	0	1	1	1	<---------- PV'ST
1	1	0	0	1	<---------- PVS'T'
1	1	0	1	1	<---------- PVS'T
1	1	1	0	1	<---------- PVST'
1	1	1	1	1	<---------- PVST

A truth table is a diagram of all possible inputs in a system and their outcomes. If the output of the chart is 1 then the decision in this scenario is positive.

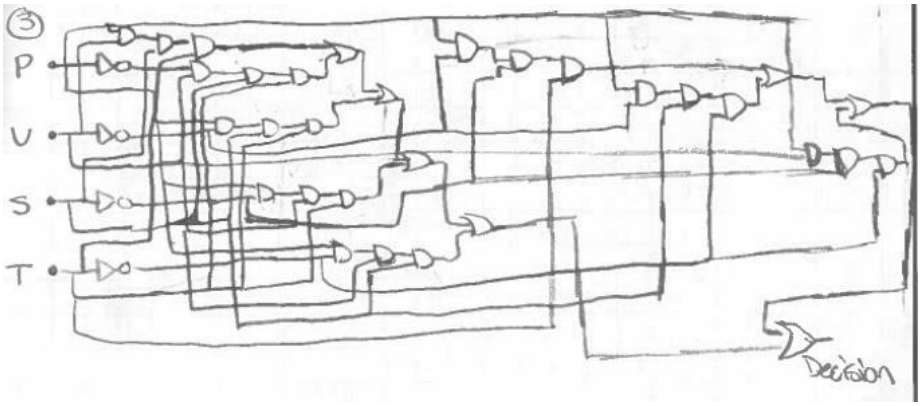
In this project, I used this chart to create my logic equation, by finding the minterms. I also used my truth table to check whether or not anything I simulated, built, or drew works.

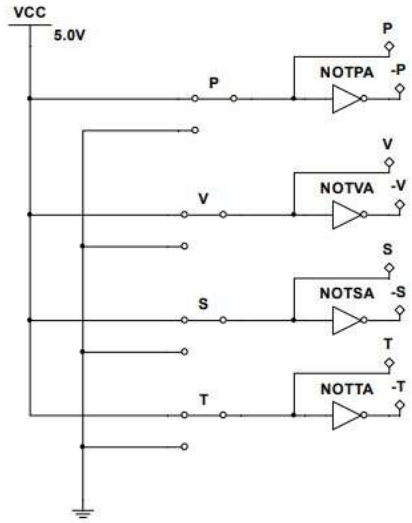
Un-simplified Circuit & Expression

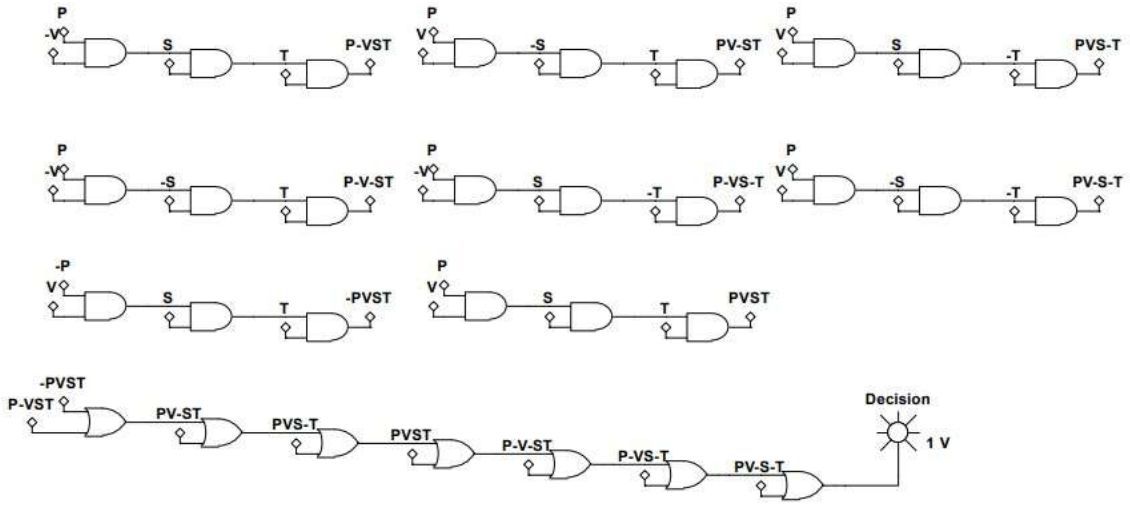
Using the truth table and it's minterms, I could then find the un-simplified SOP logic expression.

With this, I could then create a circuit that represents a voting machine. The purpose of creating this circuit rather than just simplifying it and then creating it in MultiSIM is to show how much simplification can help in production, with manufacturing costs and speeds and actual product speeds.

Decision = P'SVT + PV'ST + PVS'T + PVST' + PVST + PV'S'T + PV'ST' + PVS'T'

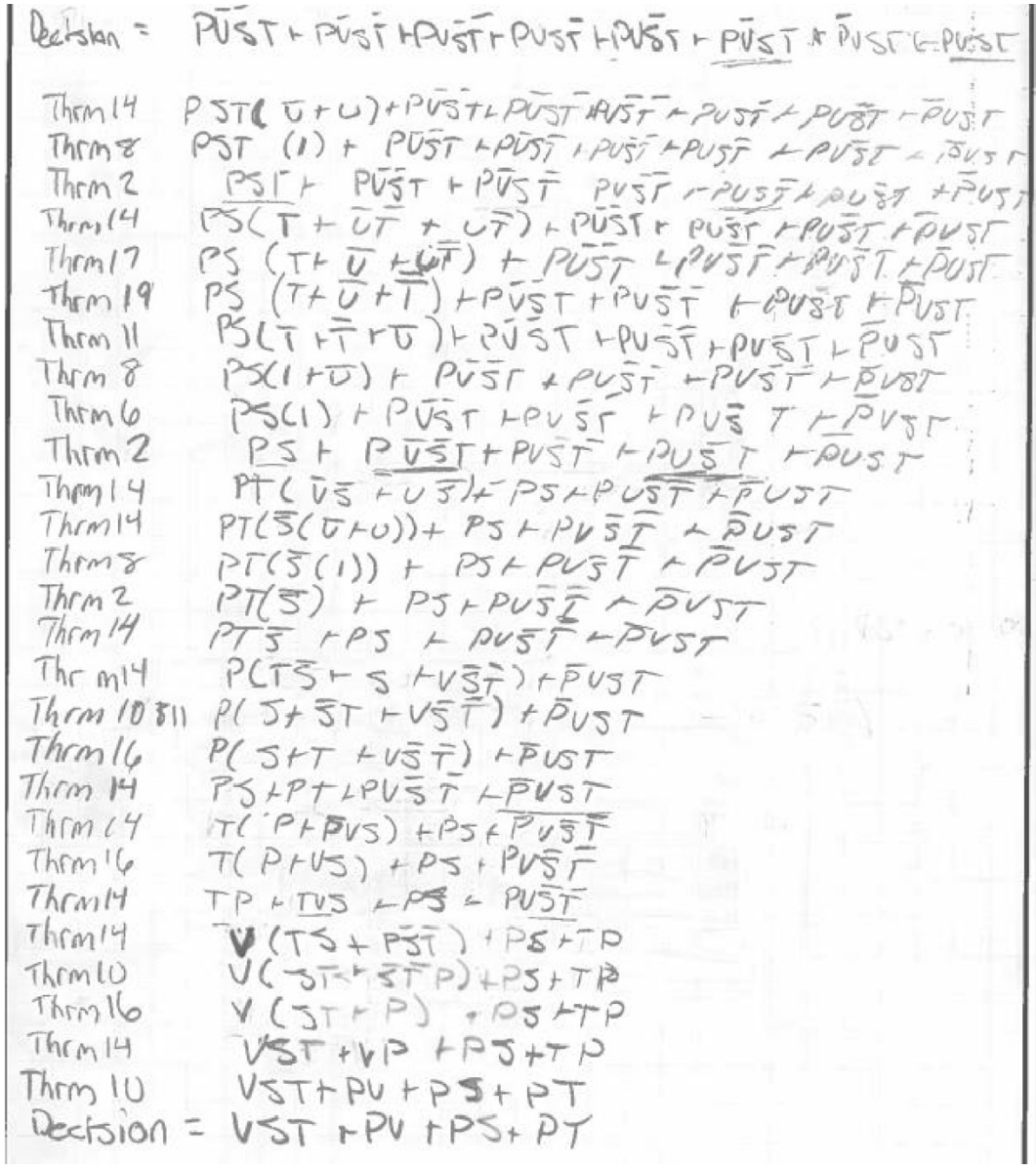



VCC
5.0V
P
NOTPA
-P
V
NOTVA
-V
S
NOTSA
-S
T
NOTTA
-T


P
-V
S
T
P-VST
P
V
-S
T
PV-ST
P
V
S
-T
PVS-T
P
-V
-S
T
P-V-ST
P
-V
S
-T
P-VS-T
P
V
-S
-T
PV-S-T
-P
V
S
T
-PVST
P
V
S
T
PVST
-PVST
P-VST
PV-ST
PVS-T
PVST
P-V-ST
P-VS-T
PV-S-T
Decision
1 V

Boolean Simplification

Boolean Algebra is a way to simplify binary variables or logic equations. Following a set of 21 theorems a person can simplify logic equations, as we did, simplifying from 8 minterms down to 4. Simplifying is very important as it allows manufacturers to cut down on costs and speed, gives products better processing speeds, and allows a circuit to take up less space.



Simplified Circuit & Expression

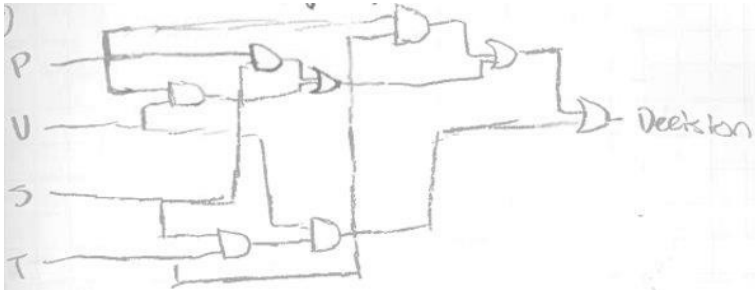
After using the Boolean algebraic theorems, I found the simplified SOP logic expression.

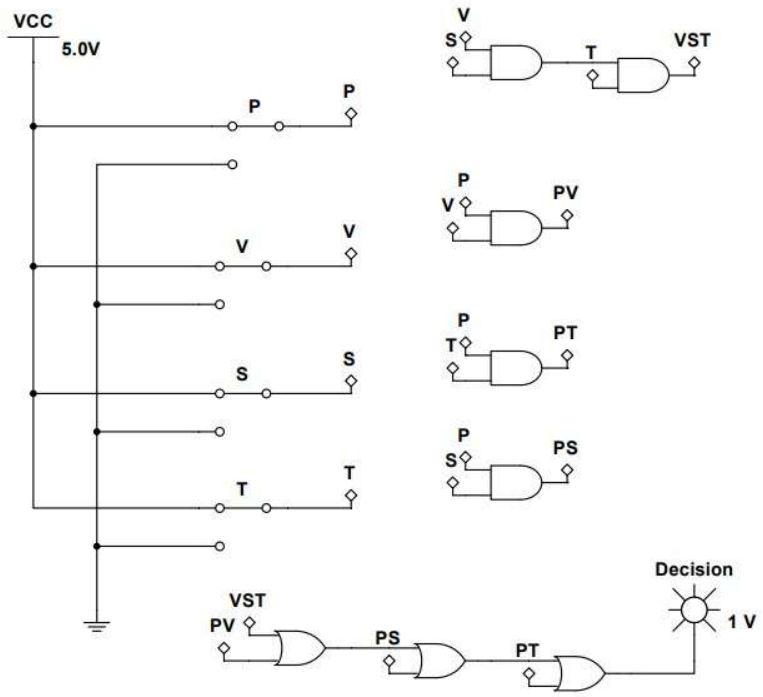
With this, I could then create a much smaller circuit that one could easily build in real life. With the simulation built, we could then compare the size and number of gates used in the two versions, showing a person how important it is to simplify.

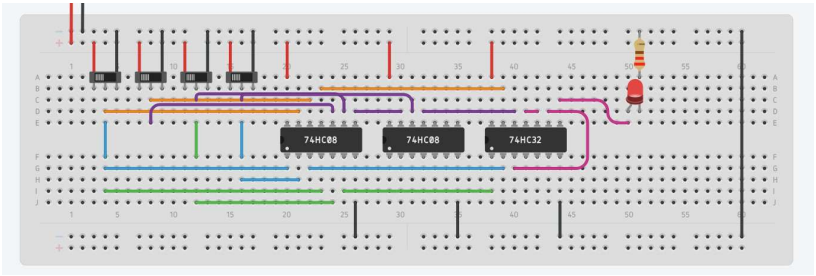
A simpler circuit makes building a circuit in real life much easier.

To visualize the circuit, I utilized a digital breadboard software called TinkerCAD. It allowed me to create a virtual breadboard prototype, which closely resembles the real-world circuit.

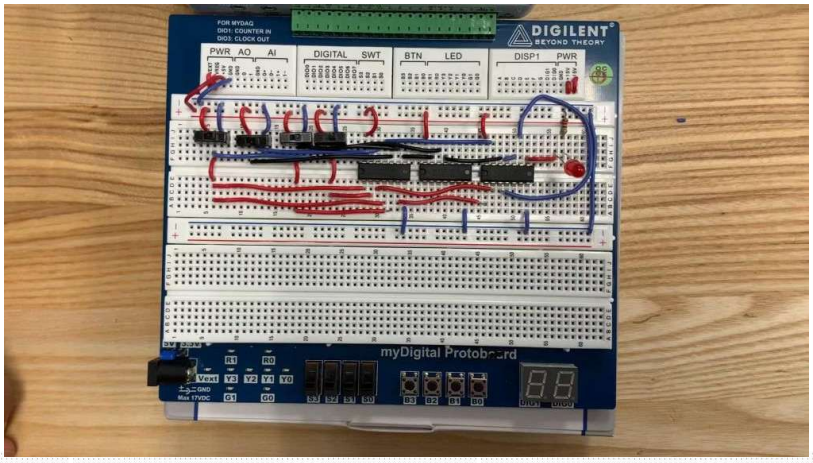
Decision = VST + PV + PS + PT

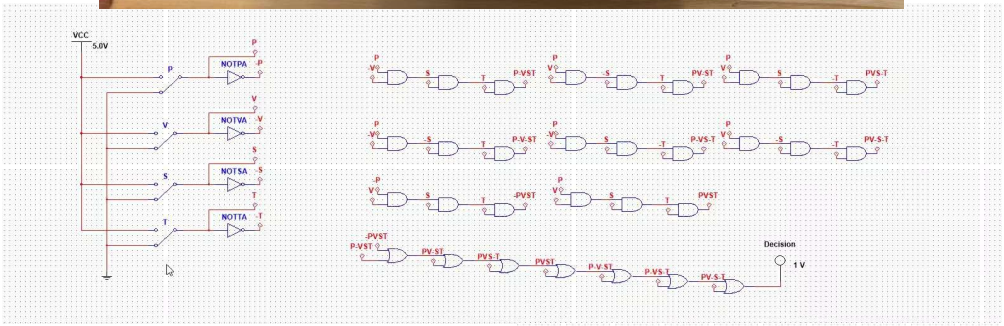


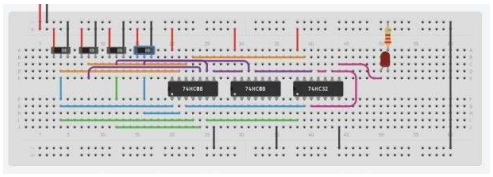

VCC
5.0V
P
P
V
V
S
S
T
T
V
S
T
VST
P
V
PV
P
T
PT
P
S
PS
VST
PV
PS
PT
Decision
1 V

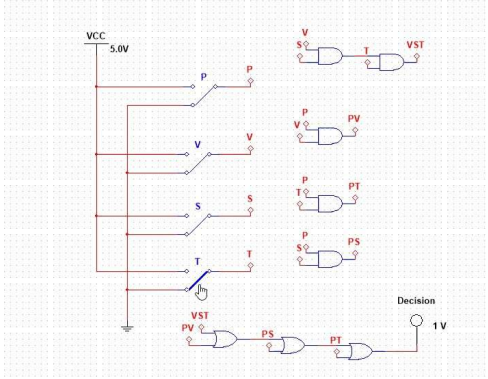

74HC08
74HC08
74HC32

Evidence


DIGILENT
BEYOND THEORY
DIGITAL
SWT
BTN
LED
DISP1
PWR
myDigital Protoboard


VCC
5.0V
NOTPA
NOTVA
NOTSA
NOTTA
Decision
1 V




VCC
5.0V
VST
PV
PT
PS
Decision
1 V