Digital Design
Group Design Assignment

Group 27 (Design problem 1)

Design Problem Statement :

Design a digital bank token number display. It should display the three-digit token number that can contain numbers and letters. You must have seen this in public places when people have to wait in line

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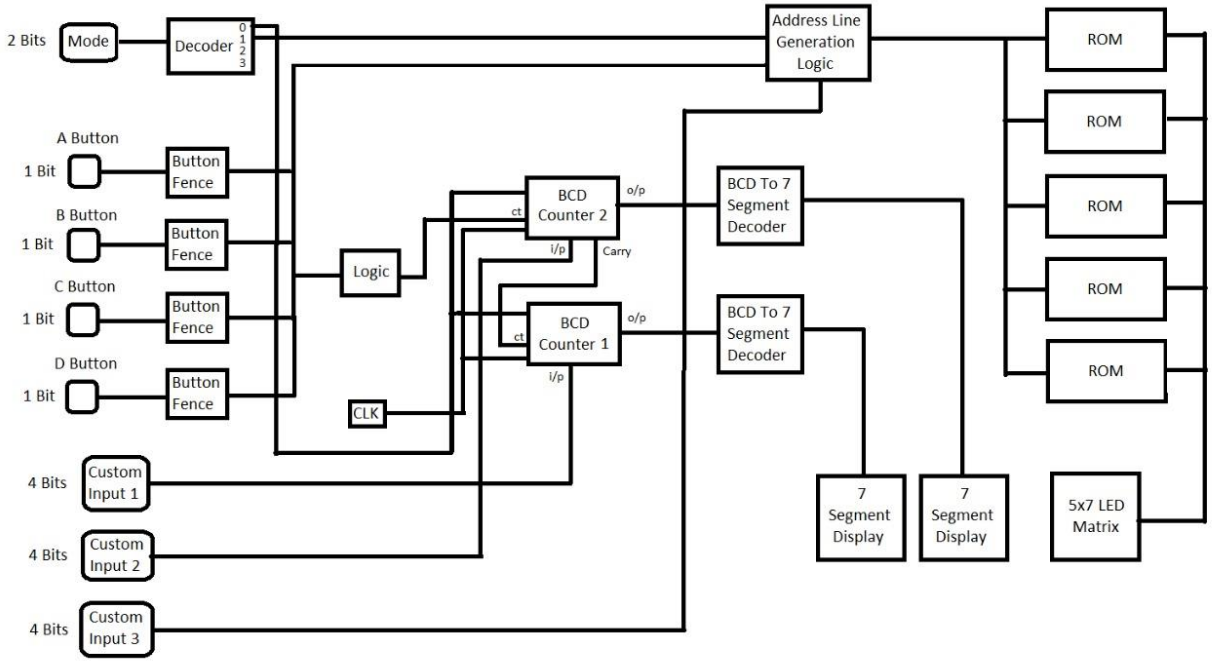
TOP LEVEL BLOCK DIAGRAM :



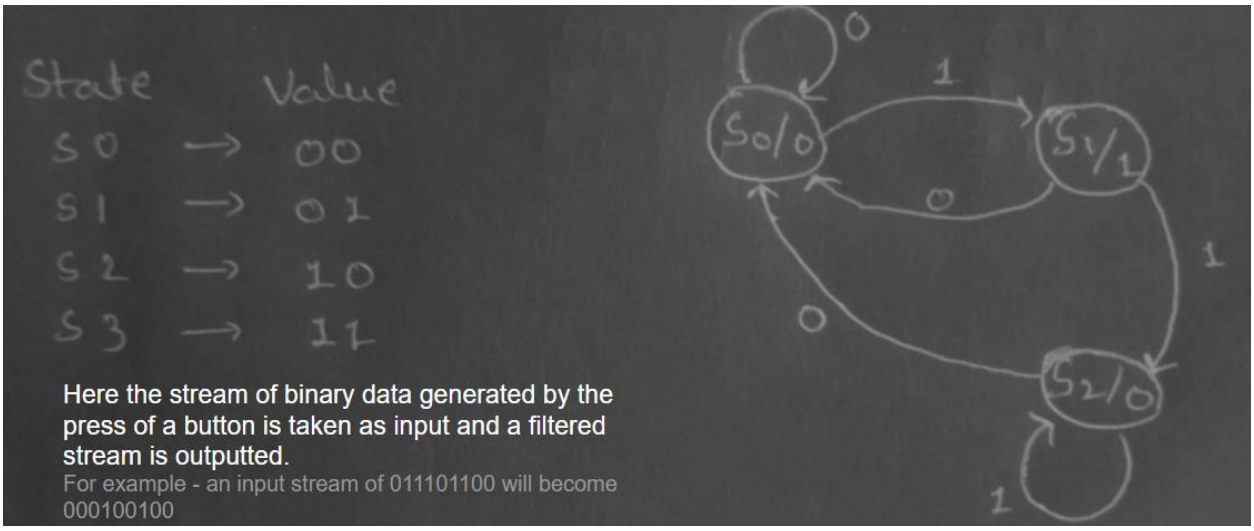
ASSUMPTIONS :

- The binary input for the leftmost display has the alphabets encoded as 0 for A, 1 for B and so on
- The binary input for the two 7 segment displays are in BCD
- The tokens are counted in an ascending sequence
- For counter modes, the right-most display indicates the station while the other two indicate token number
- The EPROM is pre programmed

STATE DIAGRAMS :

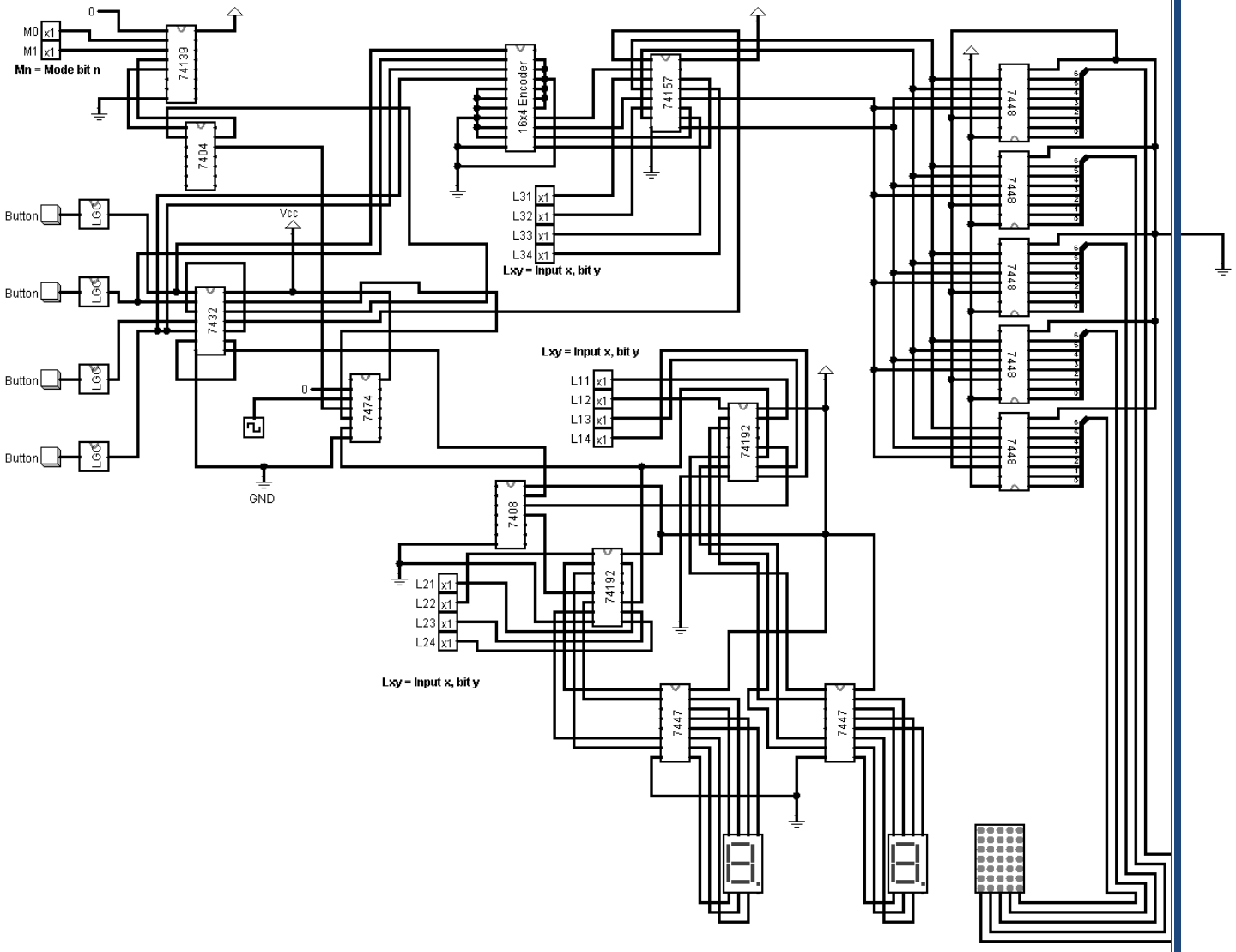
1. BCD Up counter

2. Button Fence

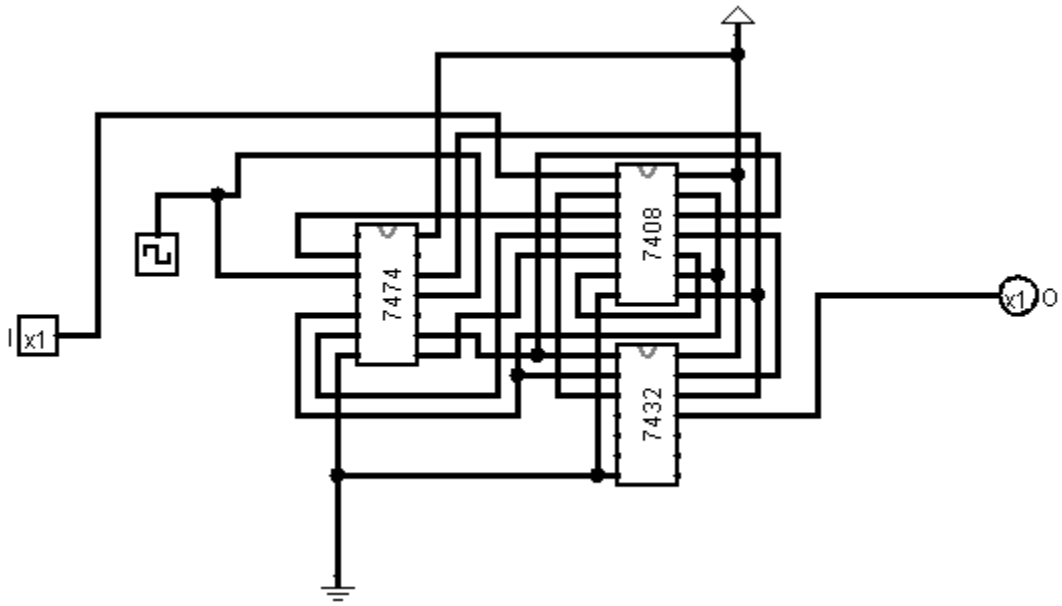


PINOUT DIAGRAM :

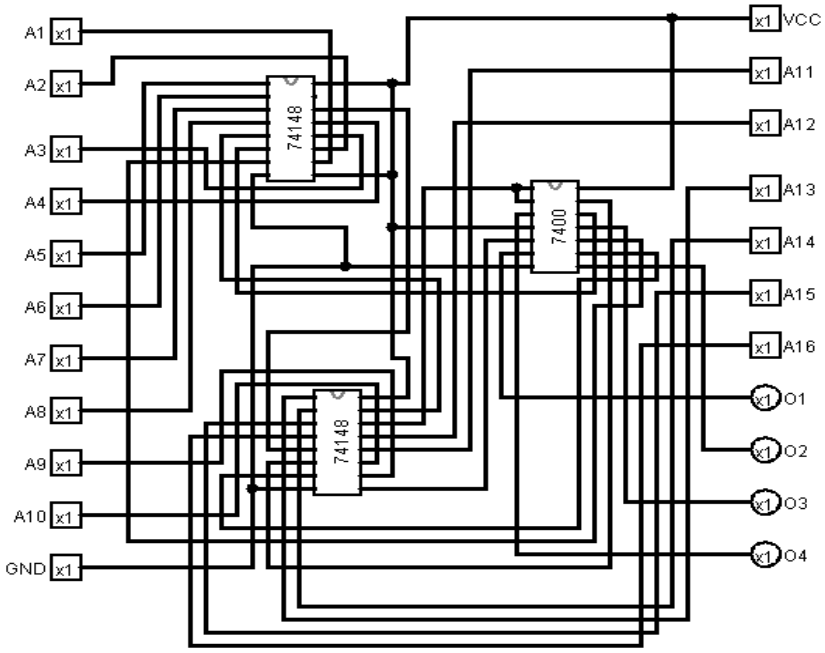
All pins are assumed to be in order on the IC. For example, on a 14 pin IC, pins 1(top) to 8 are assumed on the left, and pins 16(top) to 9 are assumed on the right.



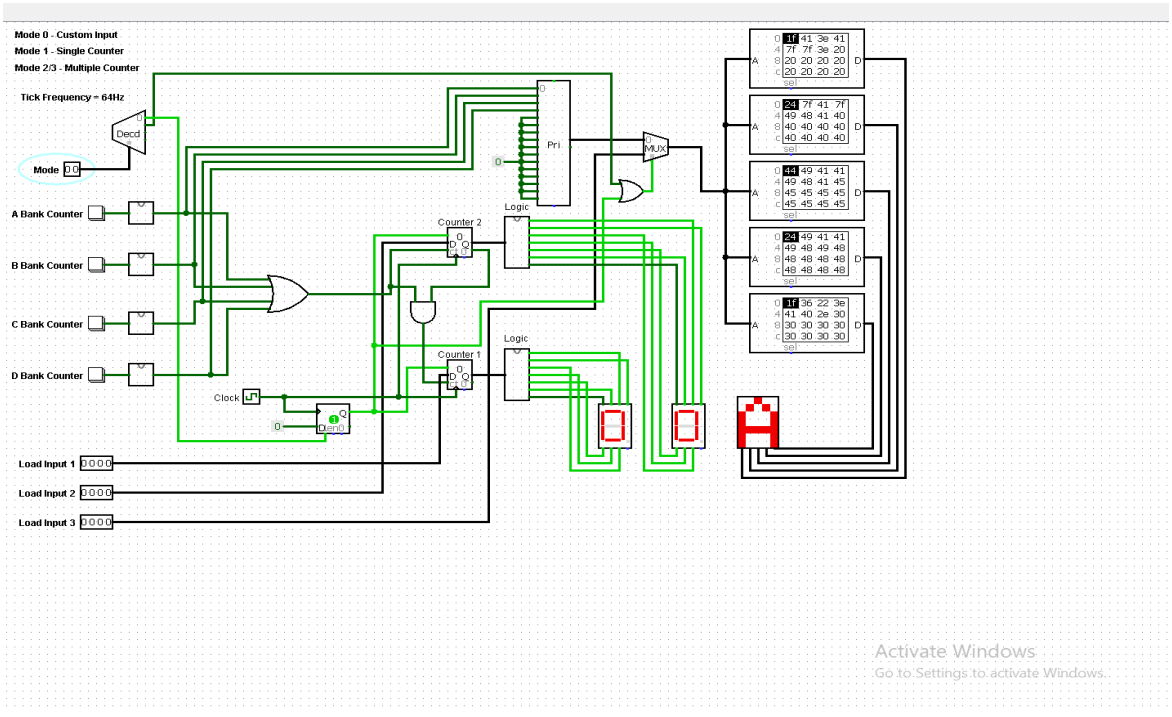
Pin out for Logic block LGC:



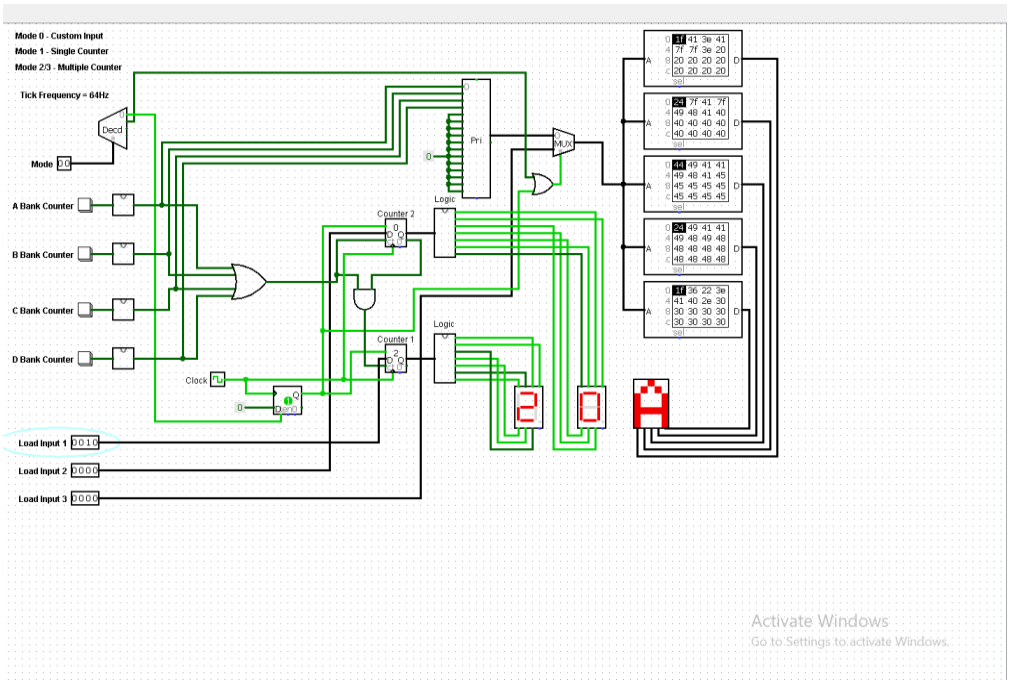
Pin out for 16x4 Priority encoder using 4 AND gates and 2 8x3 Priority Encoders:



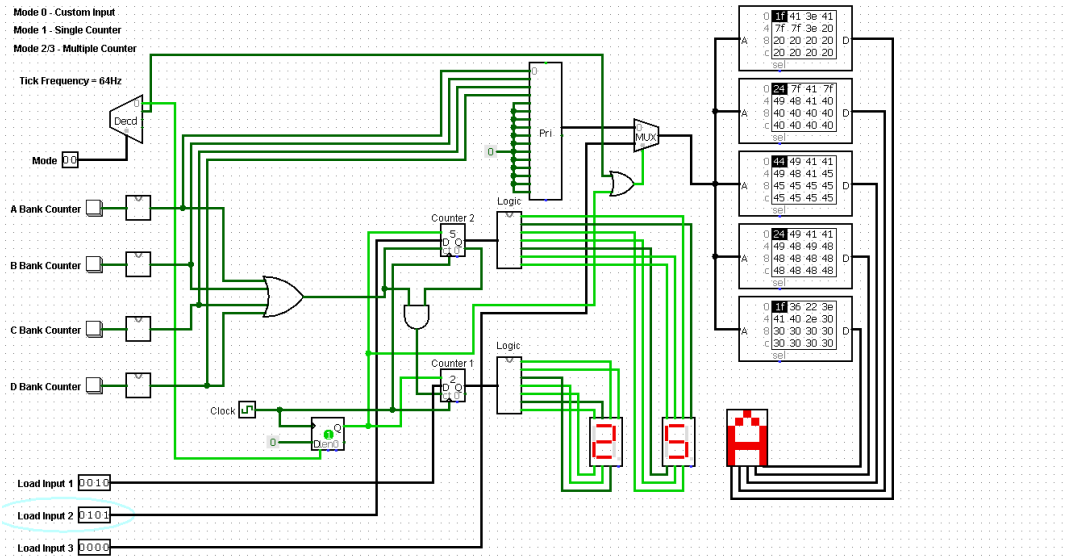
SAMPLE INPUT/OUTPUT :



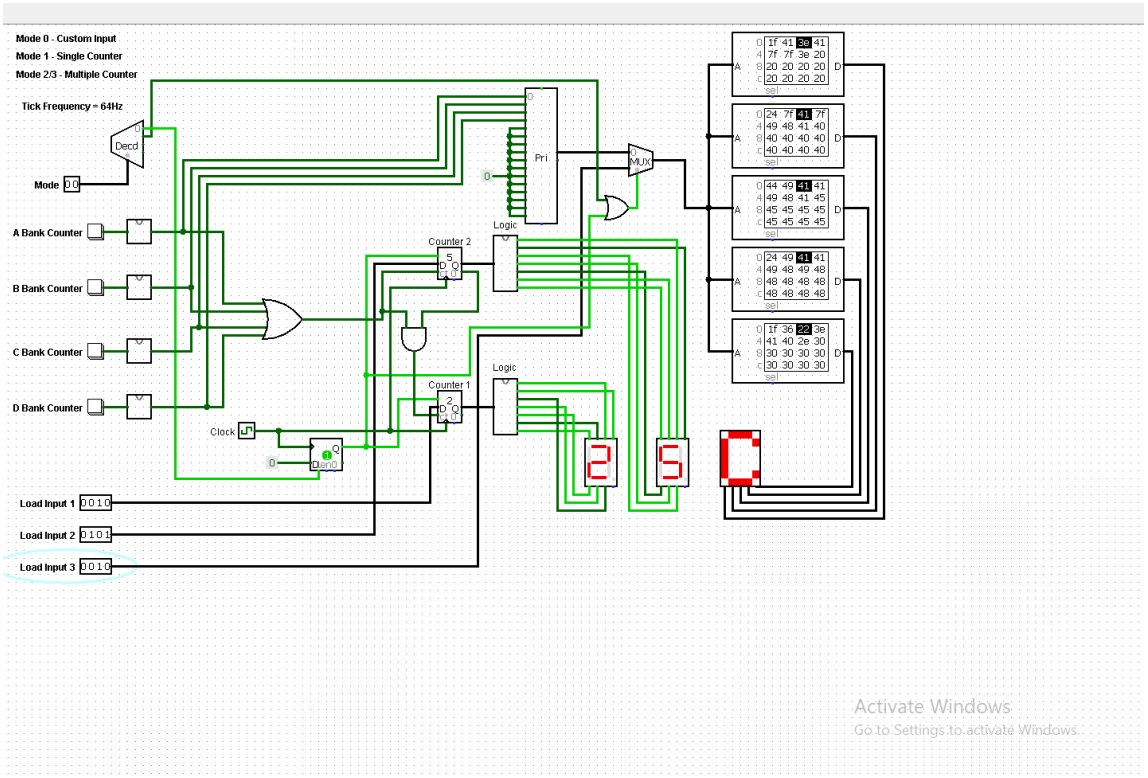
Mode set to 0, so user-defined input will be displayed.



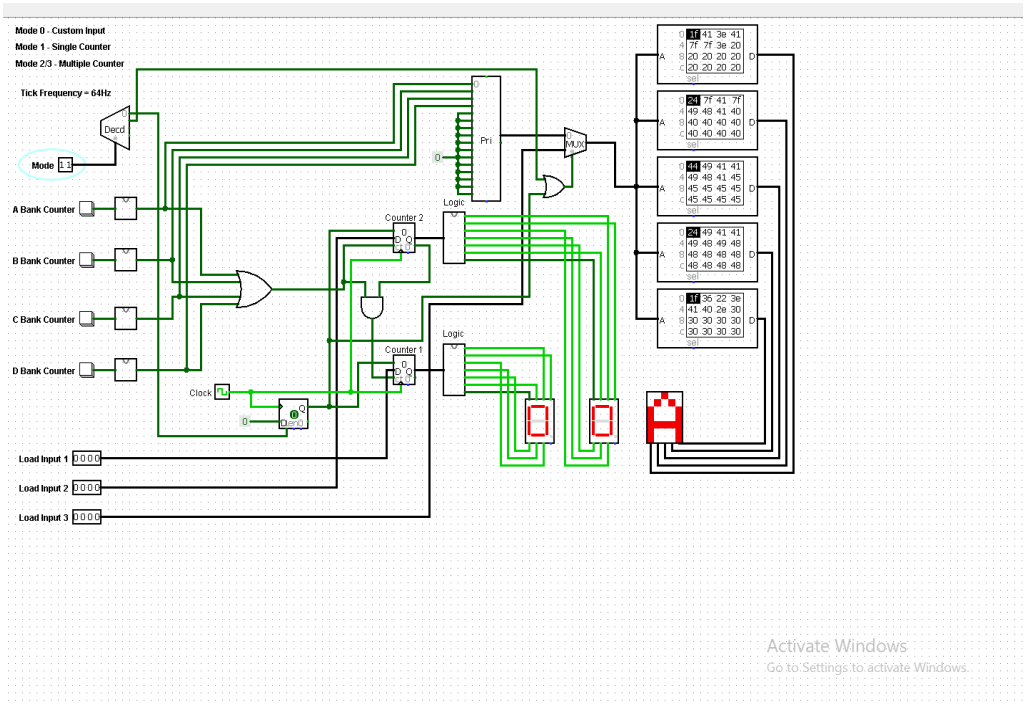
Counter 1 given the value “2” through Load Input 1, which gets displayed accordingly.



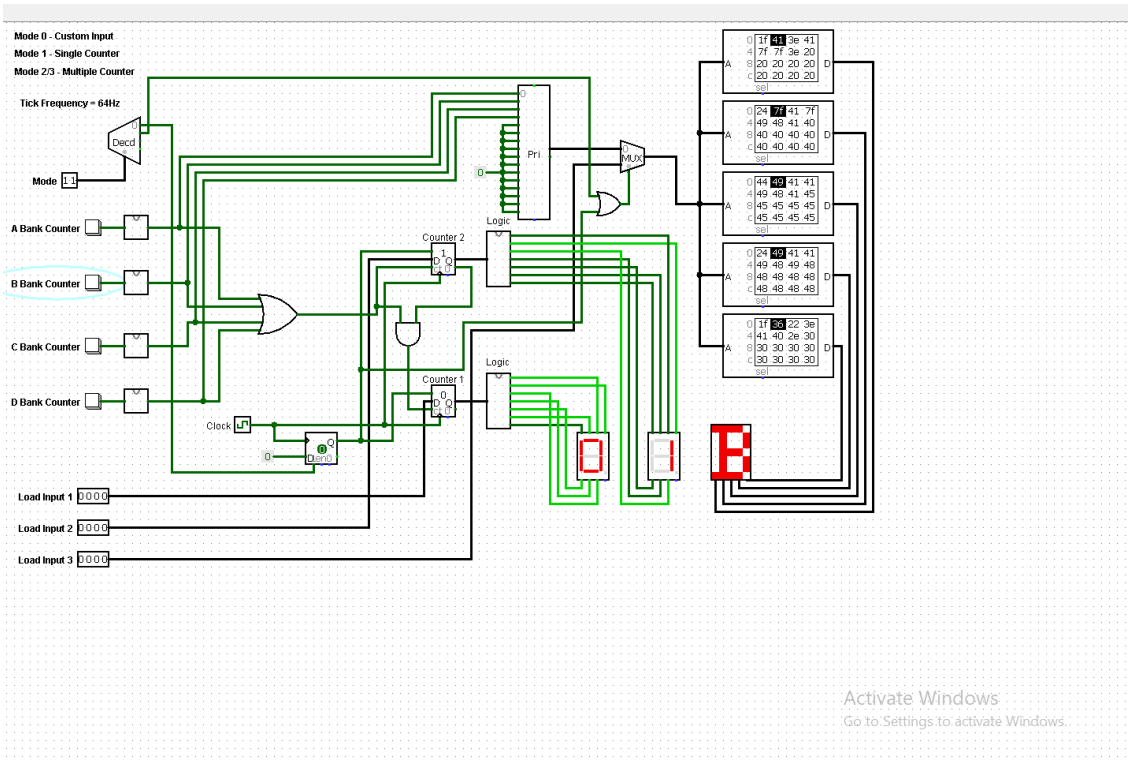
Counter 2 given the value “5” through Load Input 2.



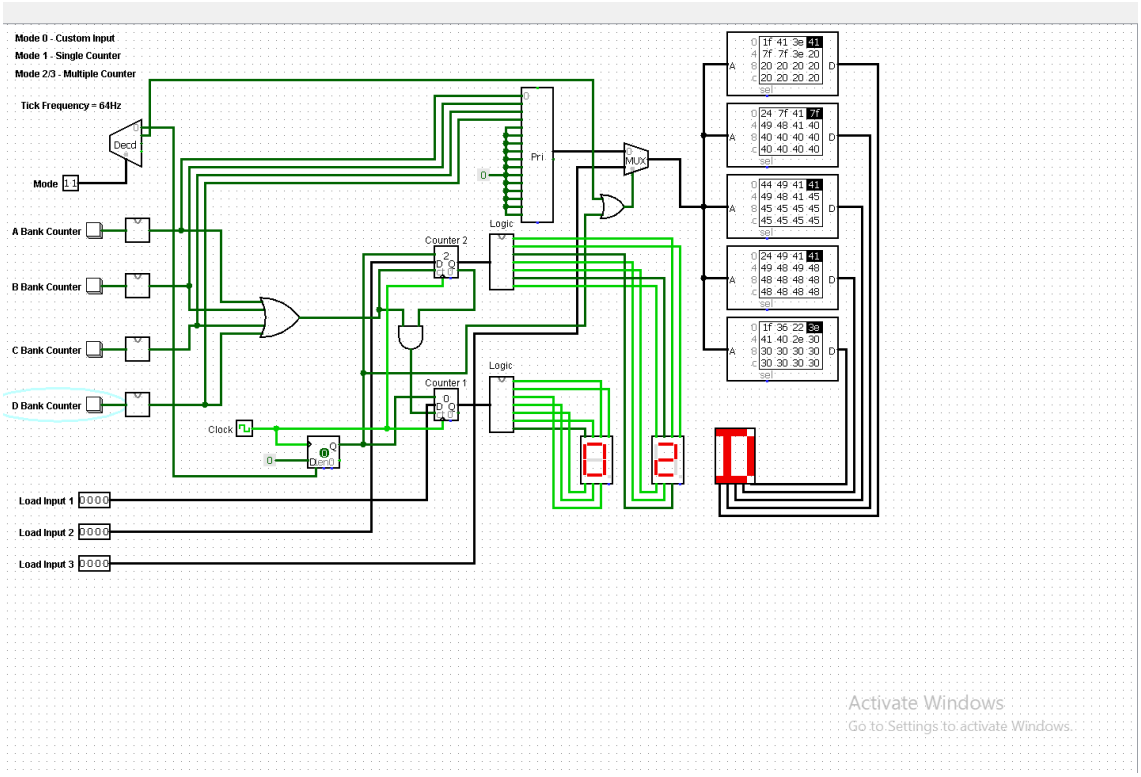
Bank Station ID is set to “C” through Load Input 3.



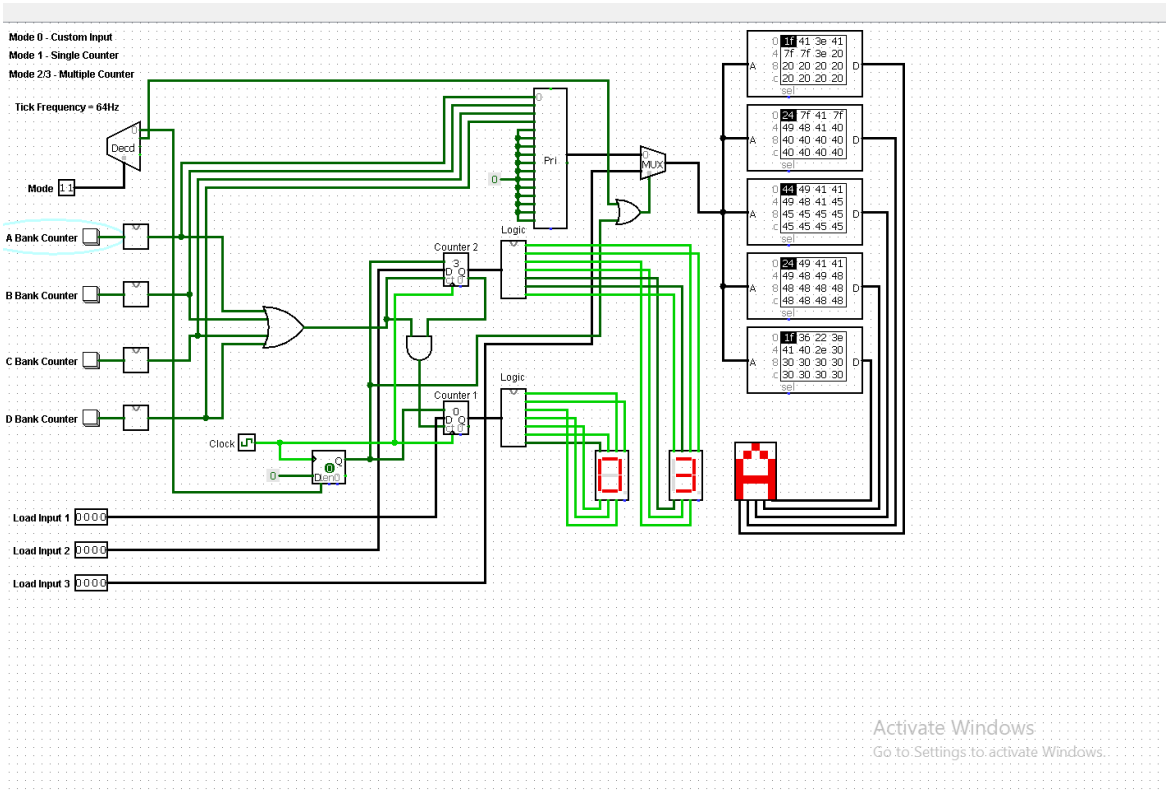
Mode set to 3, in which various stations can simultaneously use the counter.



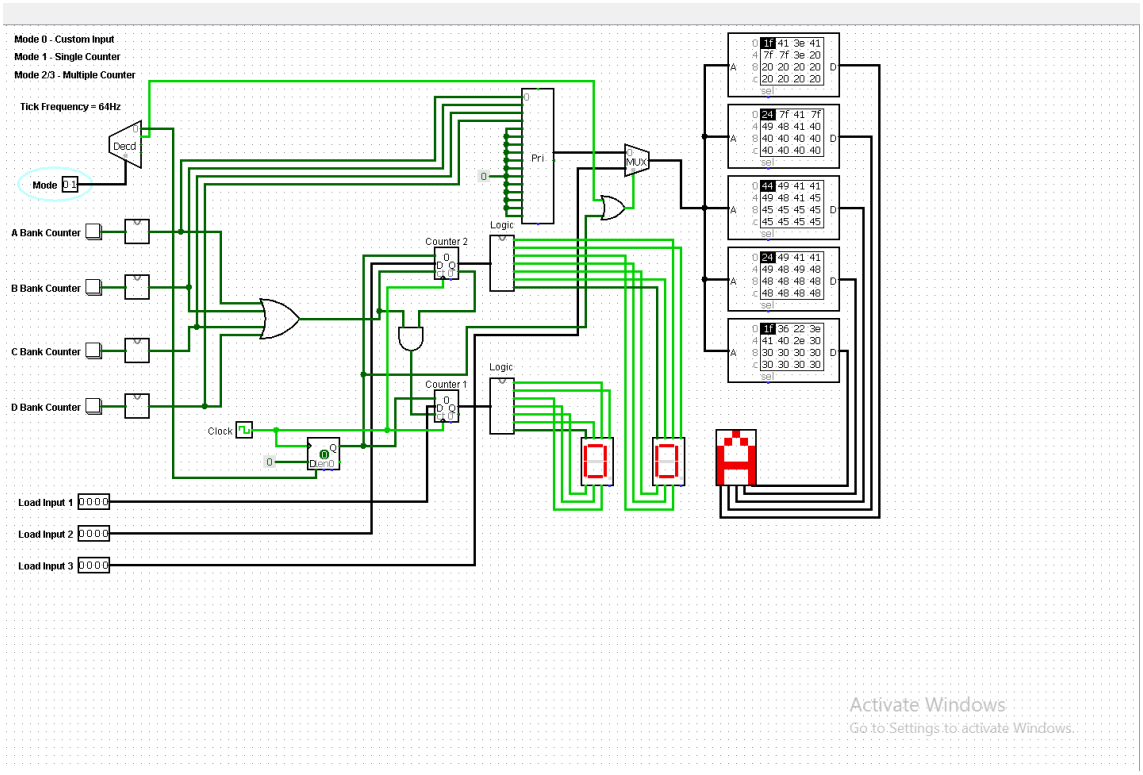
Clicking on the button for B Bank Counter sets the token display to 01B.



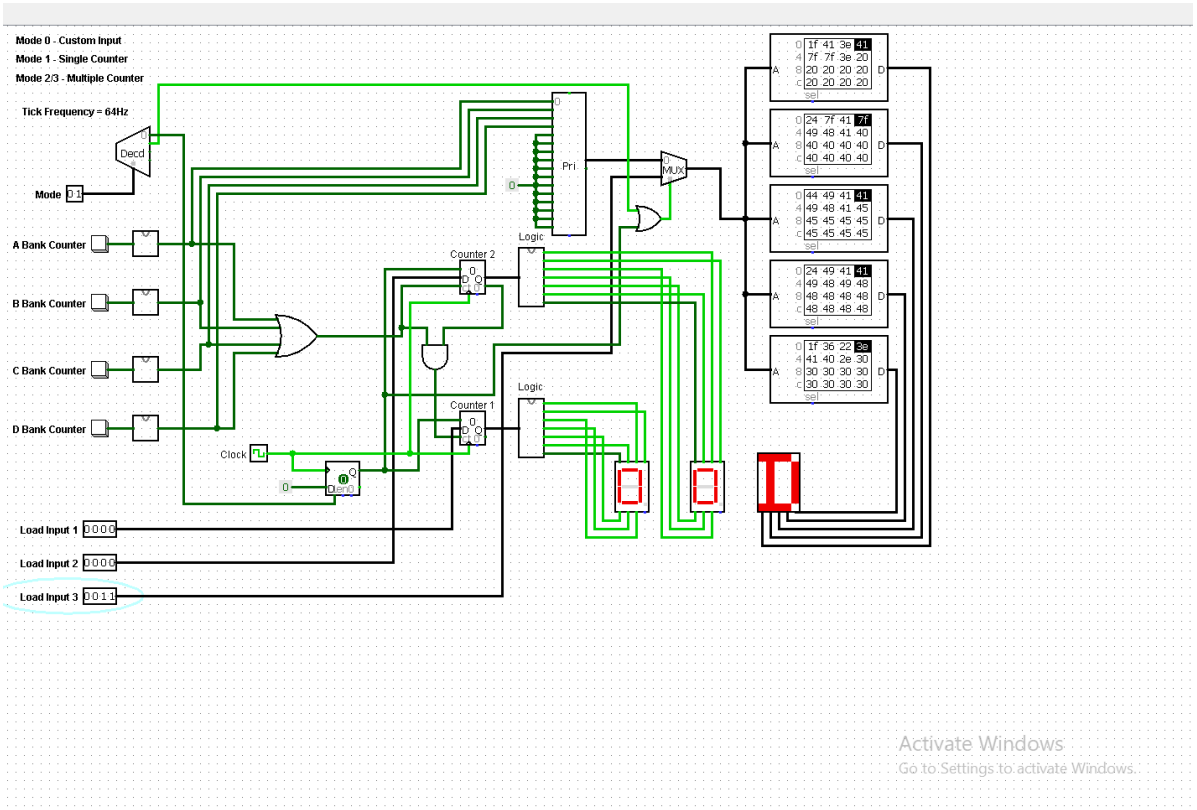
Clicking on the button for D Bank Counter sets the token display to 02D.



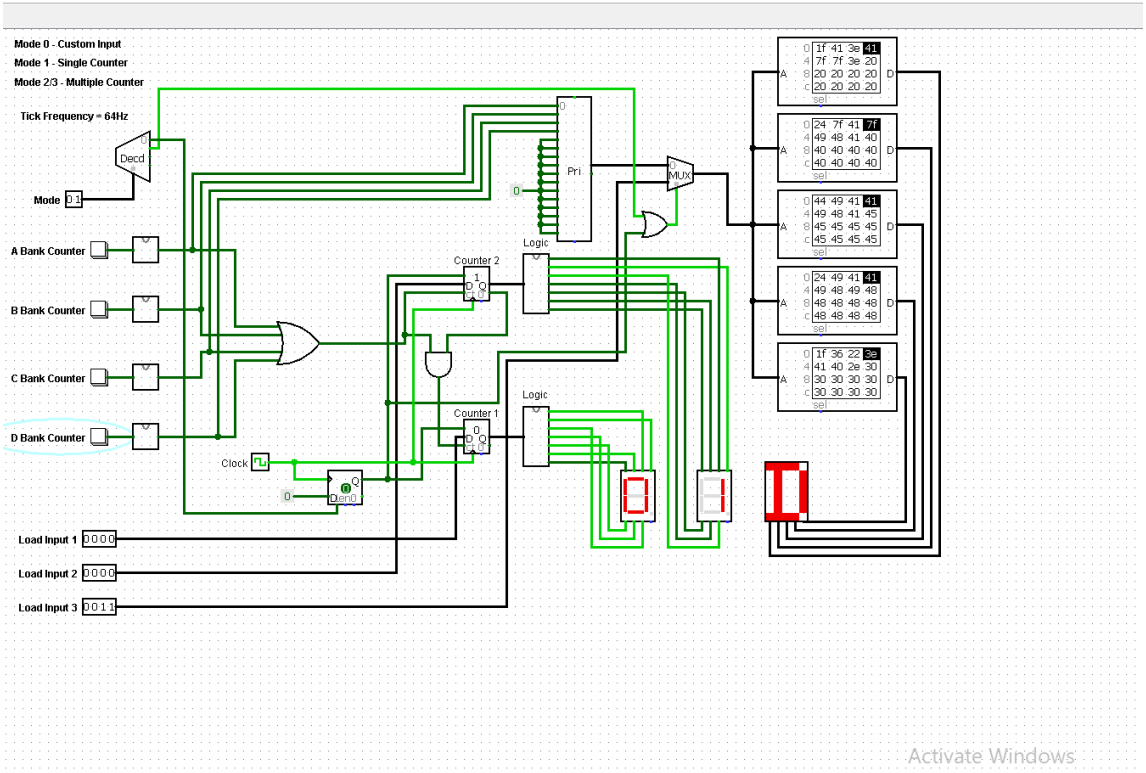
Clicking on the A Bank Counter button sets the token display to 03A.



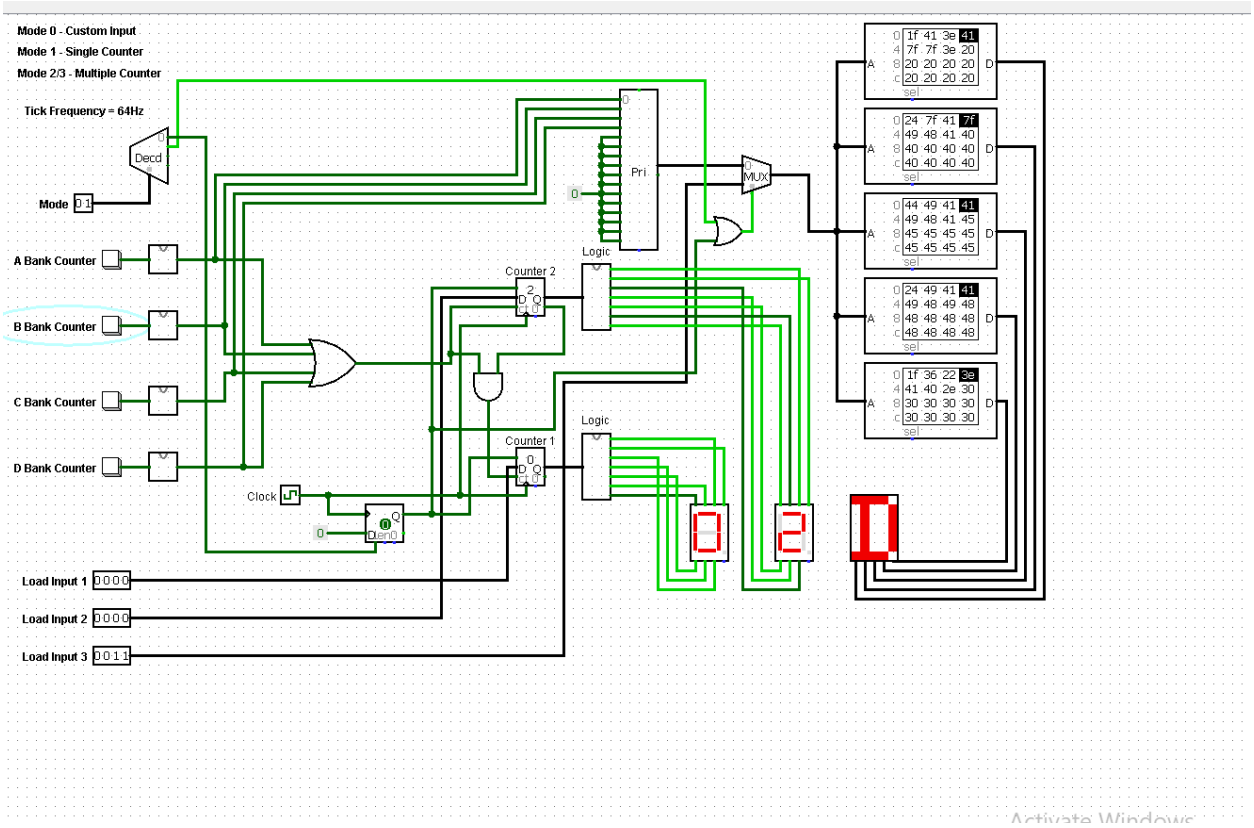
Mode set to 1, which updates the token number while keeping the station ID static.



Through load input 3, the station ID is set to “D”



Clicking on any bank counter button now updates the token number for D.



ADDITIONAL FUNCTIONALITIES :

- The device can function in three modes:
    a. Mode 0: As a static display that takes input for all displays
    b. Mode 1: As a counter for a single bank station, with the station id as the input and the token number part as counter
    c. Mode 2: As a counter for parallel bank stations. In this mode, various stations for the same process can simultaneously use the counter. Depending on the station where the request is initiated, the station id is changed while maintaining a common counter for all stations. This is useful in situations where multiple stations are doing the same job and the token issued to customers includes only his position in queue while the station is read from the display
- **Can start counting from any value** by loading it from the parallel input and then using the counter functionality as usual
- Can be easily pre programmed to **display any desired characters**
- **Invalid inputs** to the display are displayed as **'?'**
- **Extra input rejection**: One button press can only give a single count signal by using a fence to detect edges

BILL OF MATERIALS :

NAME	IC NUMBER	NUMBER	COST /UNIT	COST
Quad OR Gates	7432	5	₹ 18	₹ 90
Quad AND Gates	7408	6	₹ 18	₹ 108
Dual D-Type Flip Flop	7474	5	₹ 20	₹ 100
8:3 Priority Encoder	74148	2	₹ 55	₹ 110
Dual 2:4 Decoder	74139	1	₹ 17	₹ 17
Counter	74192	2	₹ 37	₹ 74
EPROM	7488	5	₹ 50	₹ 250
Quad 2:1 Multiplexer	74157	1	₹ 50	₹ 50
BCD to 7 Segment Display	7447	2	₹ 43	₹ 86
Hex Inverter	7404	1	₹ 17	₹ 17
7 Segment Display	-	2	₹ 7	₹ 14
5x7 LED Matrix	-	1	₹ 80	₹ 80
Tactile Switches	-	4	₹ 8	₹ 32
				TOTAL: ₹ 1027

APPENDIX

Datasheets of ICs used:

1. 7404 - Hex Inverter : https://drive.google.com/file/d/11sy_PCYUHAI2ijXNvfLJ-egEfjlo-FZB/view?usp=sharing
2. 7408 - Quad 2 input AND Gates : https://drive.google.com/file/d/10m3LRt0WPD9aujCuROvTCLHKz-95k4Xa/view?usp=sharing
3. 7432 - Quad 2 input OR Gates : https://drive.google.com/file/d/10m3LRt0WPD9aujCuROvTCLHKz-95k4Xa/view?usp=sharing
4. 7447 - BCD to 7 segment Display : https://drive.google.com/file/d/161rqRtd4TBLZoK4AnkUCd47Zgl1vJyJo/view?usp=sharing
5. 7474 - Dual D-Type Flip Flop : https://drive.google.com/file/d/1AG-aAXDtK2BBm0TB_ADCRhYapBxHZ2Rx/view?usp=sharing
6. 7488 - 256 bit EPROM : https://drive.google.com/file/d/1pjrMHFaVy7rybayD9P_6DpjbJYEXwOE2/view?usp=sharing
7. 74139 - Dual 2:4 Decoder : https://drive.google.com/file/d/1cfvVOGw1GxhLzYmfGwu_tLRDBQ_zvd-e/view?usp=sharing
8. 74148 - 8:3 Priority Encoder : https://drive.google.com/file/d/1cfvVOGw1GxhLzYmfGwu_tLRDBQ_zvd-e/view?usp=sharing
9. 74157 - Quad 2:1 Multiplexer : https://drive.google.com/file/d/1cfvVOGw1GxhLzYmfGwu_tLRDBQ_zvd-e/view?usp=sharing
10. 74192 - BCD Presettable Counter : https://drive.google.com/file/d/1rKSnapQnfkbAcmb85GsJJwbjgdMvTGIJ/view?usp=sharing

Datasheets for Input and Output devices:

1. 7 segment common anode display : https://drive.google.com/file/d/1zkNKwQvGD9PcWvDp70I_wM_tRQD3SaRe/view?usp=sharing
2. 5x7 LED Matrix : https://drive.google.com/file/d/1g8Tqw_bwj53YSKRZBz221koJyG0DasT0/view?usp=sharing
3. Tactile Switches - Buttons : https://drive.google.com/file/d/1zxezgnFlZILG6yfLJAfCCTpdWFc4y1dQ/view?usp=sharing