

**CSARCH1 Design Exercise #2**  
**S14 - Group 3**

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**Submitted to:**  
**The best CSARCH1 professor *Sir Carlo Adriano***  
**That will definitely accept our late submission 😊**

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## Dice Game

### I. Introduction

BoBing (also known as Bo Bing or Pua Tiong Chiu) is a traditional Chinese dice game typically played during the Mid-Autumn Festival. It involves rolling dice and matching the resulting combinations to win prizes.

**Below are the objectives of the game as specified in the [specification](#):**

**Input:** Each dice  $D_i$  is represented as a 3-bit input. There are 6 dice ( $D1, D2, D3, D4, D5, D6$ ) in BoBing.

**Output:** The output consists of  $P1, P2, P3, P4, P5, P6$  representing (1st Prize, 2nd Prize, 3rd Prize, 4th Prize, 5th Prize, 6th Prize). Only one LED should be lit up when a valid prize is won. If any of the dice is invalid, all the lights will light up.

**Limitations:** You can use logic gates, multiplexers and decoders.

### II. Truth Table ( Dice Table ) & Winning Requirements

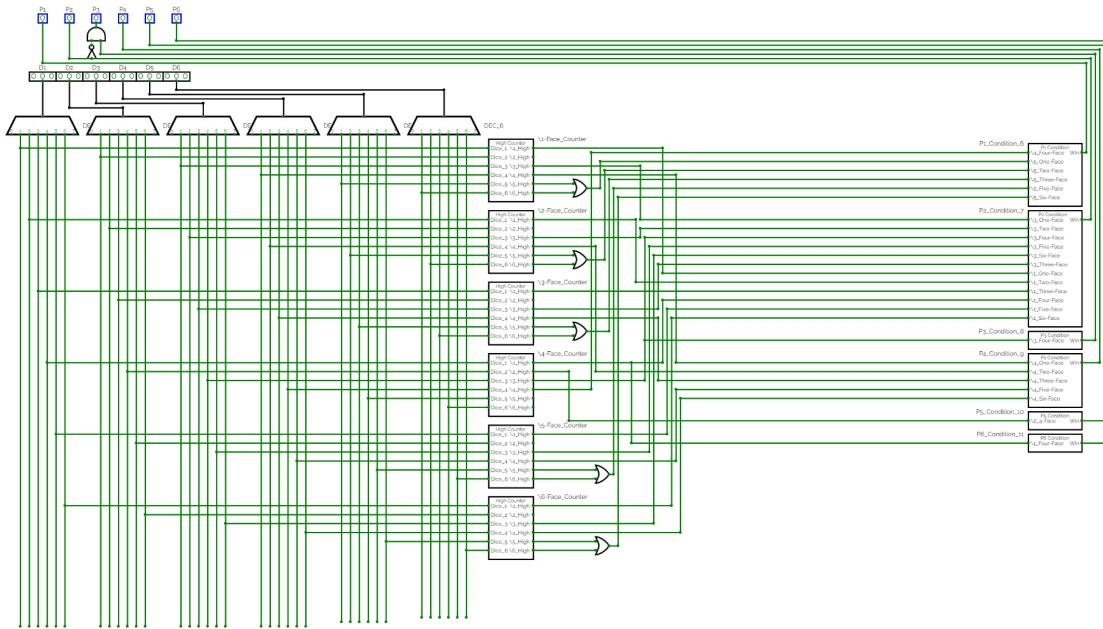
Taken from the [specifications](#), there are 2 columns in the table; with the first being '**3-bit input D**' represents the 3-bit binary input to the circuit labeled as "D", while the second column '**Dice Value**' displays the decimal value equivalent to the 3-bit binary input. Each row shows a different combination of 0s and 1s for the 3-bits.

3-bit input D	Dice Value
000	Invalid
001	1
010	2
011	3
100	4
101	5
110	6
111	Invalid

From the dice inputs up above, the win requirements for each prize will be shown below:

<b>Win requirements</b>		<i>Note:</i> The subscript denotes number of times dice value is rolled  X and Y means any 2 different dice values
<b>Prize</b>	<b>Requirements</b>	<b>Requirements ( Mathematical Notation )</b>
<b>1st prize</b>	Any 4 4-faced dice, or 5 of any number	$1_5 + 2_5 + 3_5 + 4_4 + 5_5 + 6_5$
<b>2nd prize</b>	All numbers 1-6, or 3 of one number and 3 of another number	$1_1, 2_1, 3_1, 4_1, 5_1, 6_1 + X_3 Y_3$
<b>3rd prize</b>	3 4-face dice + 3 of any number	$4_3$
<b>4th prize</b>	4 of the same number except four	$1_4 + 2_4 + 3_4 + 5_4 + 6_4$
<b>5th prize</b>	2 4-face dice + 4 of any number	$4_2$
<b>6th prize</b>	1 4-face die + 5 of any number	$4_1$

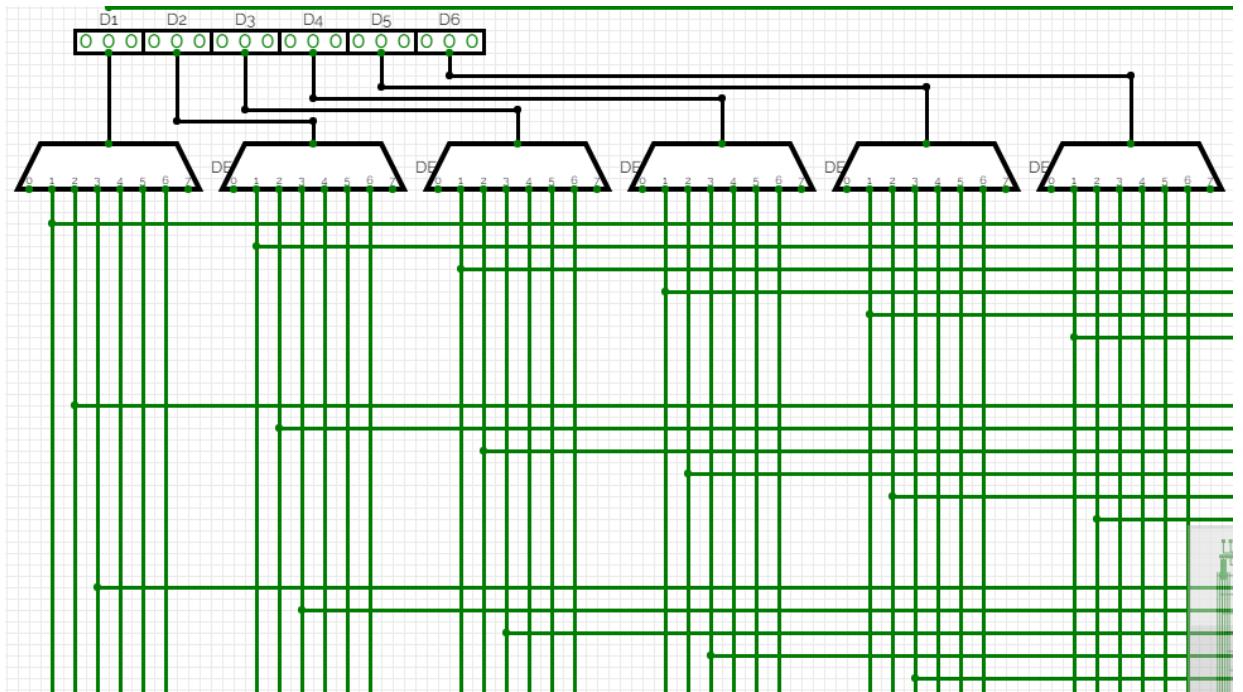
### III. Circuit Verse



**Figure 1. Full Image of Circuitverse Diagram**

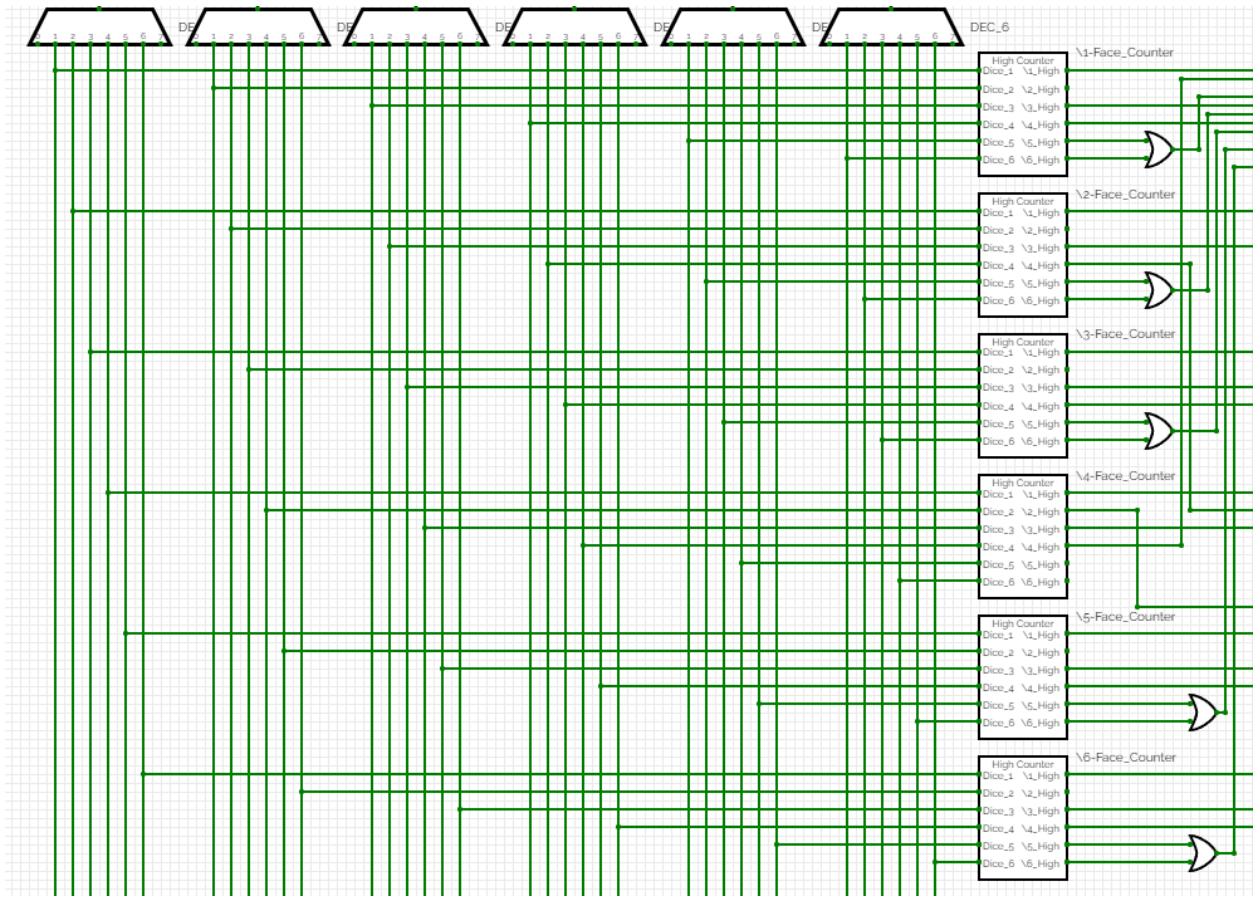
Element Usage Report from our diagram:

Input	- 38 times
OrGate	- 8 times
Output	- 18 times
Adder	- 4 times
Splitter	- 1 times
Decoder	- 7 times
ConstantVal	- 1 times
AndGate	- 3 times
NorGate	- 1 times
NotGate	- 2 times
XnorGate	- 1 times
SubCircuit	- 12 times



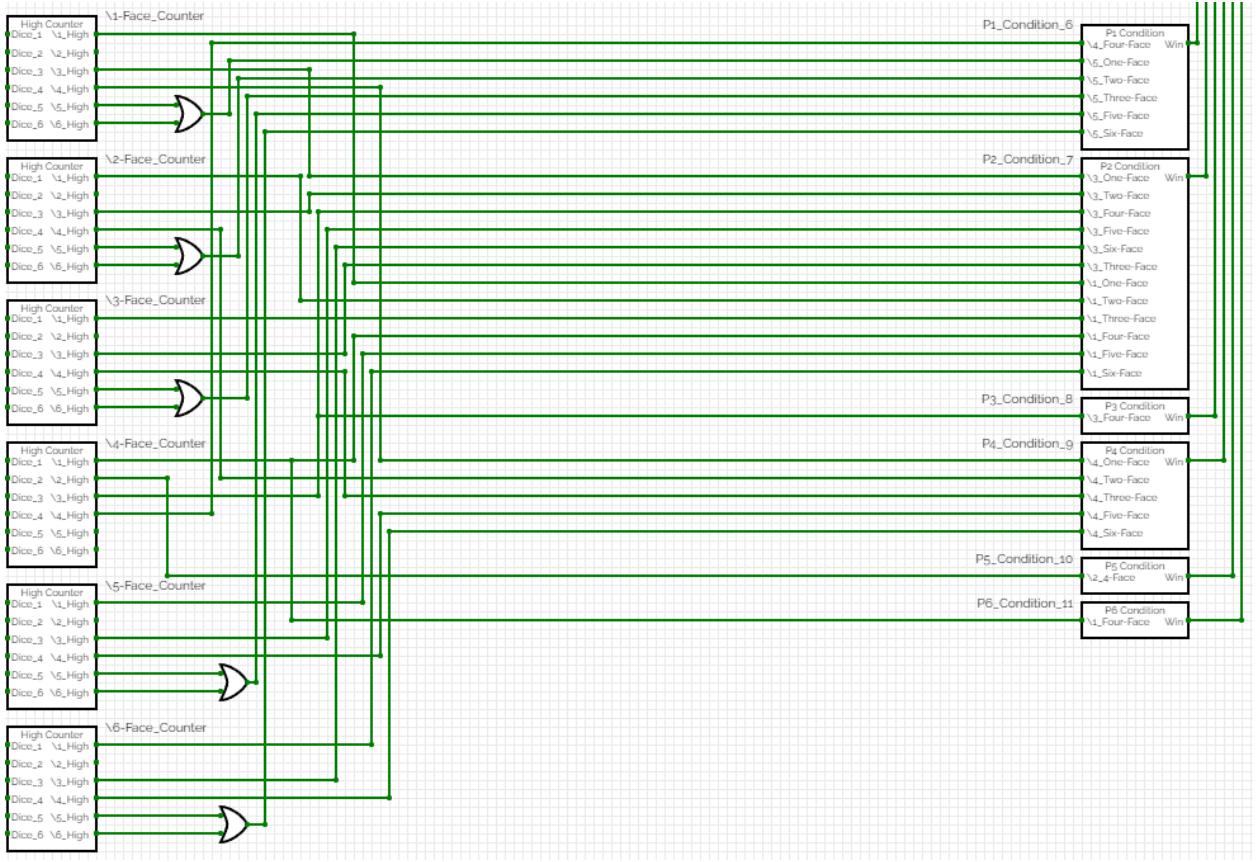
**Figure 1.1. Dices connected to respective Decoders**

All six dice are connected to their respective decoder chips, these chips convert the binary code from the dice roll ( 0s and 1s ) into a decimal output representing the number rolled on that particular chip.



**Figure 1.2. 6 Decoders connected to 6 Counters**

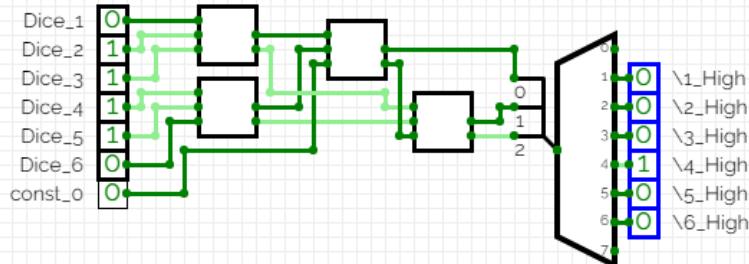
1 to 8 decoders were used to extract the corresponding decimal value from the 3 bit input. Output values 1-6 from each are then fed to the sub circuit High Counter. It counts how many of the inputs are high (1) and gives a high signal on its output equivalent to the count of high signals in the input.



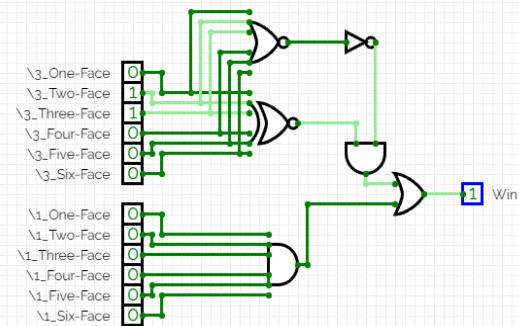
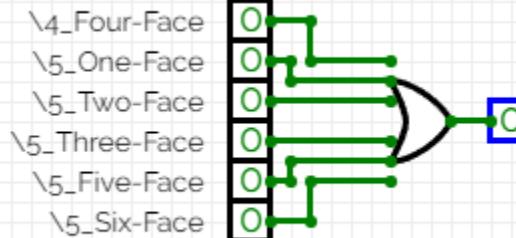
**Figure 2. Counters connected to check Prize Conditions**

High counter outputs are then fed to sub circuits containing different prize conditions. Or gates are used on some conditions where counts greater or equal than the specified ones can be considered. Once processed inside each prize condition sub circuit, respective prize output will light up showing the user which prize they got.

### Different circuits other than “Main”

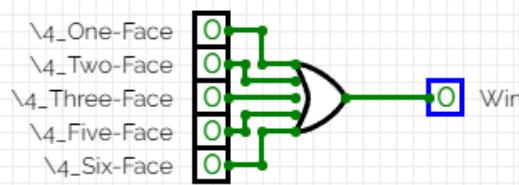


**Figure 2.1 High Counter**



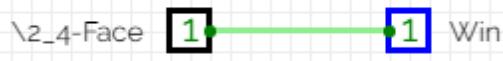
**Figure 2.2 Prize 1 Condition**

**Figure 2.3 Prize 2 Condition**



**Figure 2.4 Prize 3 Condition**

**Figure 2.5 Prize 4 Condition**



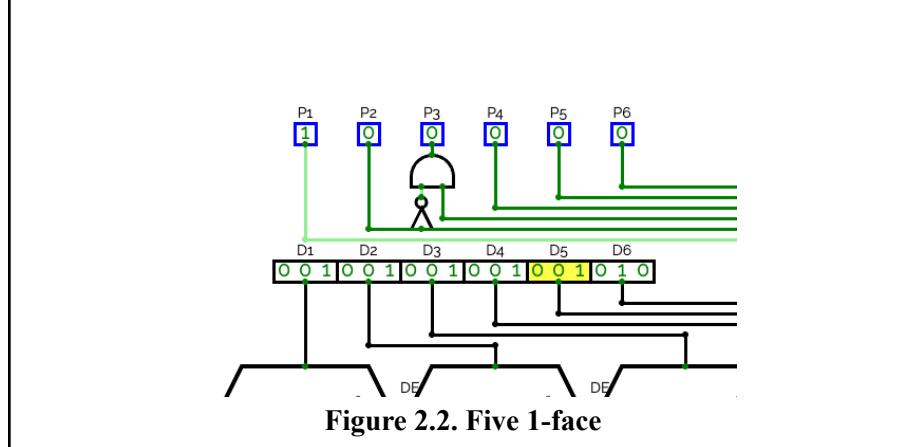
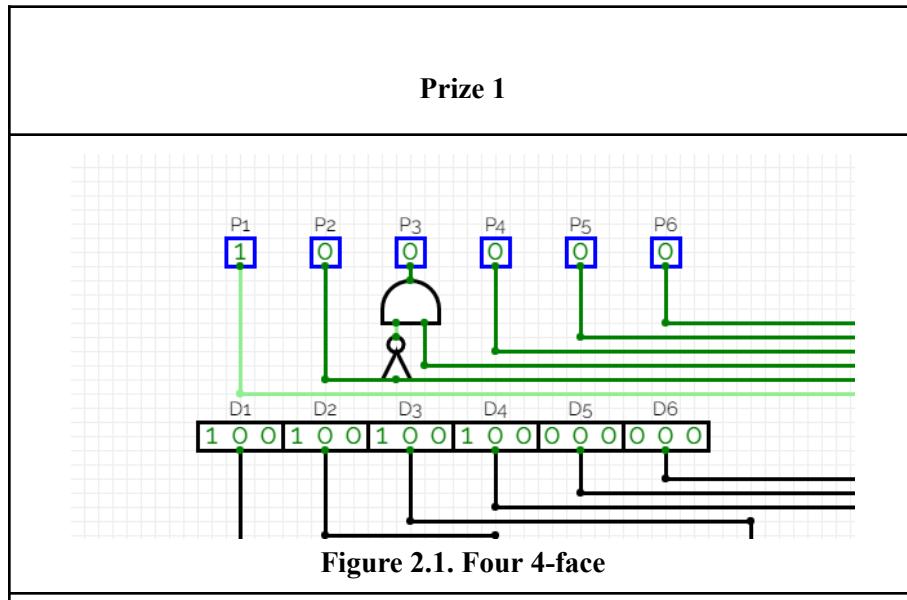
**Figure 2.6 Prize 5 Condition**

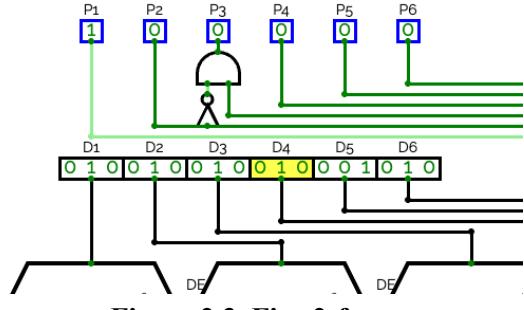
**Figure 2.7 Prize 6 Condition**

## IV. Prize Outputs

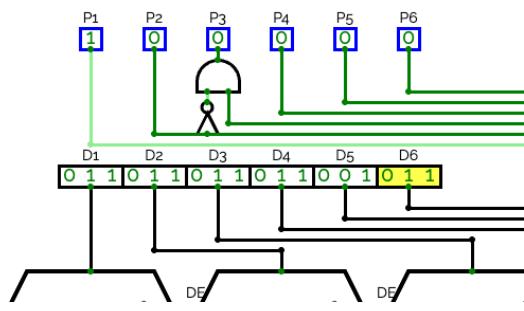
All 16 prizes were organized taken by our Circuit Verse diagram in descending order from P1 - P6.

- Prize 1: 5 approaches
- Prize 2: 2 approaches
- Prize 3: 1 approach
- Prize 4: 5 approaches
- Prize 5: 1 approach
- Prize 6: 1 approach

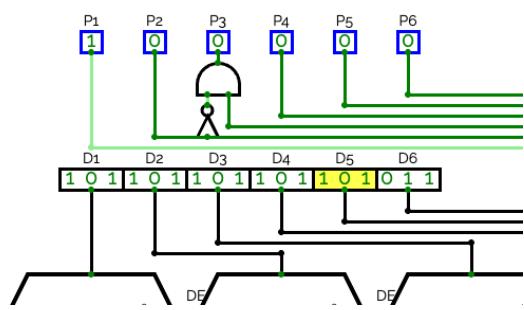




**Figure 2.3. Five 2-face**



**Figure 2.4. Five 3-face**



**Figure 2.5. Five 5-face**

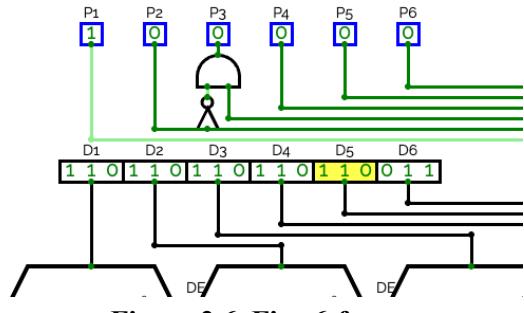


Figure 2.6. Five 6-face

### Prize 2

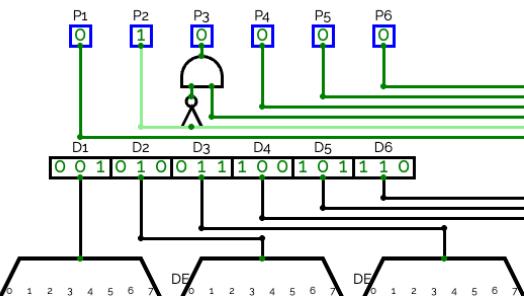


Figure 2.7. All numbers (1,2,3,4,5,6)

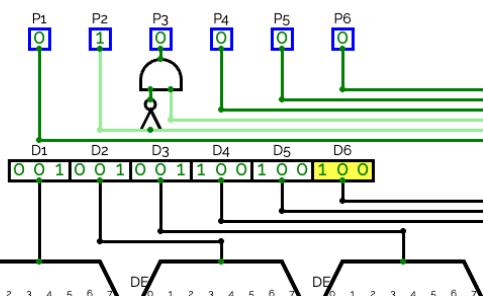
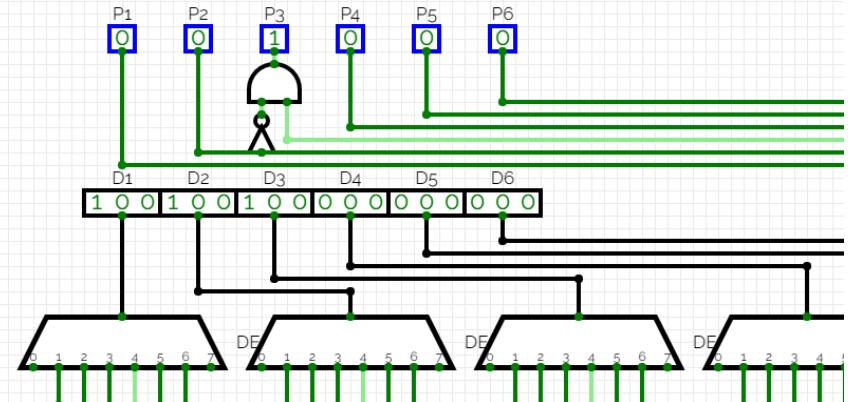


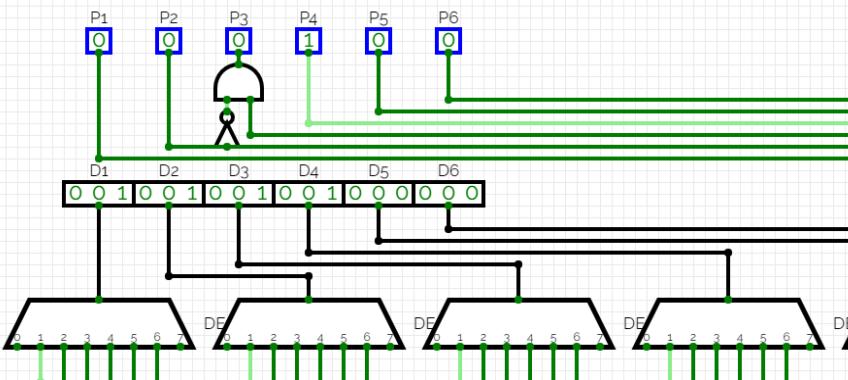
Figure 2.8. Three of a number, and three of another number

**Prize 3**

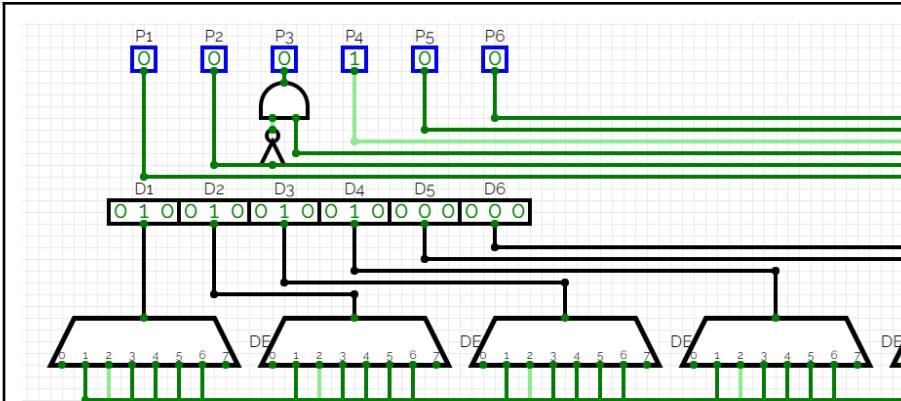


**Figure 2.9. Three 4-face, and three of another number**

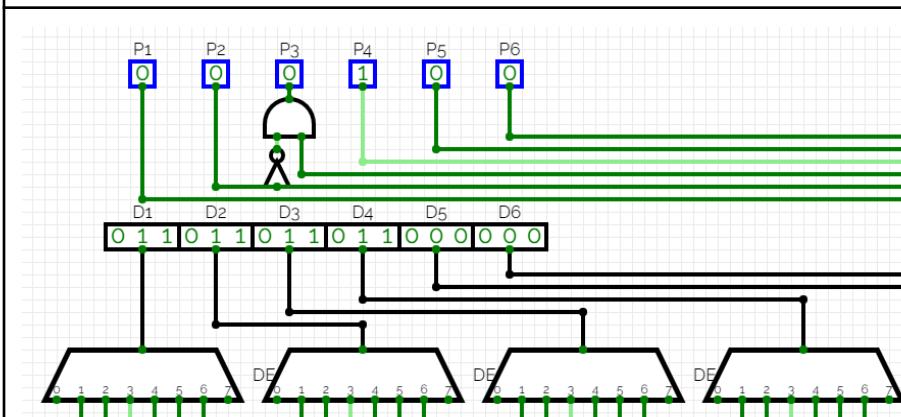
**Prize 4**



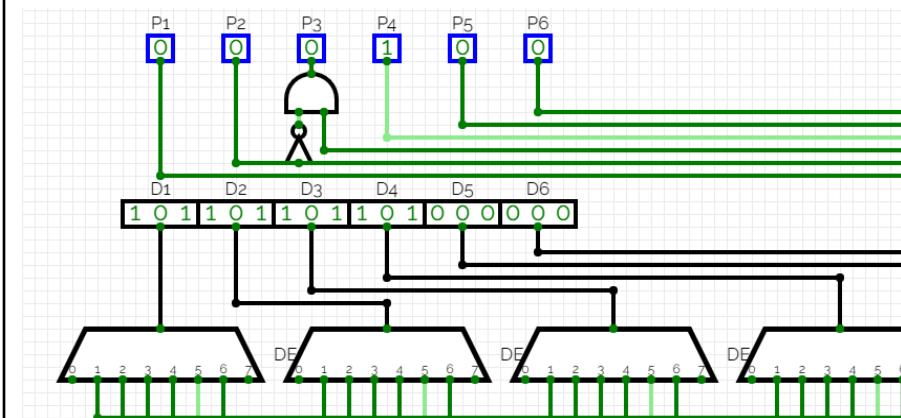
**Figure 2.10. Four 1-face**



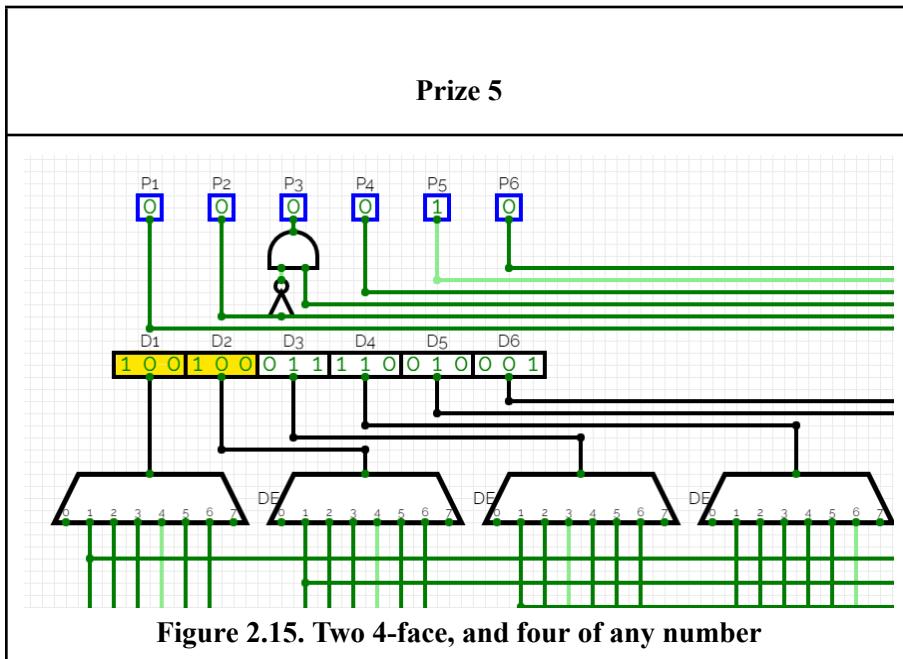
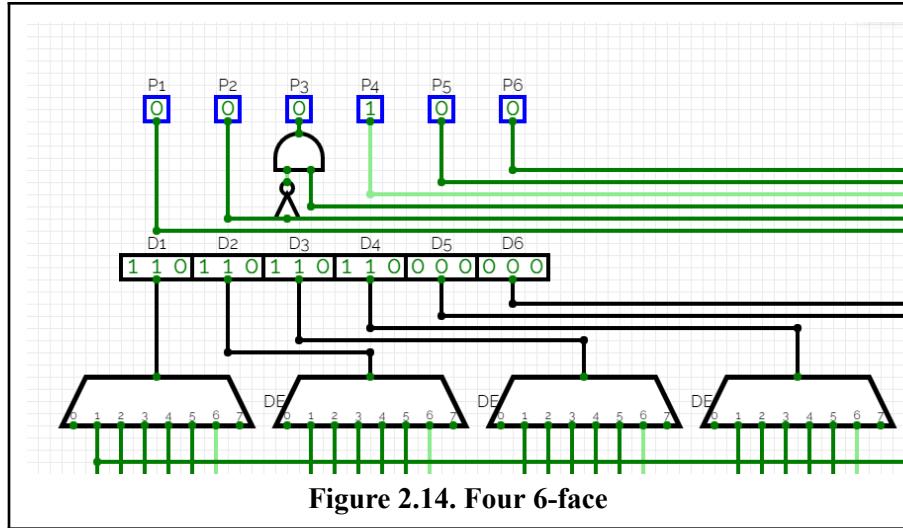
**Figure 2.11. Four 2-face**



**Figure 2.12. Four 3-face**



**Figure 2.3. Four 5-face**



## Prize 6

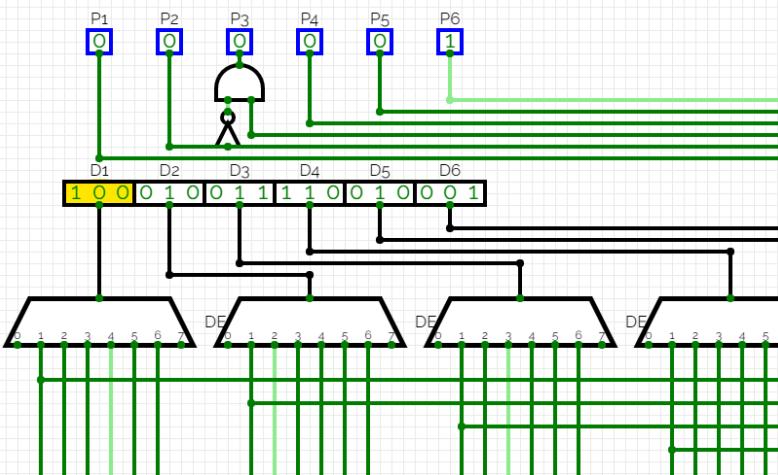


Figure 2.16. One 4-face, and five of any number