SECRET NUMBER

Lindsey Erps
EENG 2410

Introduction

- In this two player game, each player holds up either 0,1,2, or 3 fingers behind his back. If the sum of the number of fingers both players are holding up is even, player 1 wins. If the sum is odd, player 2 wins.
- In addition, the sum of the fingers must be at least 1 and no greater than 4.
- To design this circuit, a truth table was created, and then Karnaugh maps were used to create logical expressions which describe the game.

Input Variables

- P1-1
  - Also dubbed A for clarity in the Karnaugh maps
  - MSB of 2 bit input for player 1
- P1-2
  - Also dubbed B for clarity in the Karnaugh maps
  - LSB of 2 bit input for player 1
- P2-1
  - Also dubbed C for clarity in the Karnaugh maps
  - MSB of 2 bit input for player 2
- P2-2
  - Also dubbed D for clarity in the Karnaugh maps
  - LSB of 2 bit input for player 2

Output Variables

- P1w (Noah)
  - 1 if player one wins (even sum)
  - 0 if player one loses (odd sum)
- P2w (Dina)
  - 1 if player two wins (odd sum)
  - 0 if player two loses (even sum)
- O
  - Out of Bounds
  - 0 if sum is greater than 0 and less than 5
  - 1 if sum is 0 or greater than 4

Truth Table

	P1-1 A	P1-2 B	P2-1 C	P2-2 D	P1w	P2w	O
0	0	0	0	0	0	0	1
1	0	0	0	1	0	1	0
2	0	0	1	0	1	0	0
3	0	0	1	1	0	1	0
4	0	1	0	0	0	1	0
5	0	1	0	1	1	0	0
6	0	1	1	0	0	1	0
7	0	1	1	1	1	0	0
8	1	0	0	0	1	0	0
9	1	0	0	1	0	1	0
10	1	0	1	0	1	0	0
11	1	0	1	1	0	0	1
12	1	1	0	0	0	1	0
13	1	1	0	1	1	0	0
14	1	1	1	0	0	0	1
15	1	1	1	1	0	0	1

Karnaugh Map
P1w(Noah) = ∑m(2,5,7,8,10,13)

AB

CD	00	01	11	10
00	0	0	0	1
01	0	1	1	0
11	0	1	0	0
10	1	0	0	1

N = AB'D' + BC'D + A'BD + B'CD'

Karnaugh Map
P2w(Dina) = $\sum m(1,3,4,6,9,12)$

AB

CD	00	01	11	10
00	0	1	1	0
01	1	0	0	1
11	1	0	0	0
10	0	1	0	0

D = BC’D’ + B’C’D + A’B’D + A’BD’

Karnaugh Map
O = ∑m(0,11,14,15)

AB

CD	00	01	11	10
00	1	0	0	0
01	0	0	0	0
11	0	0	1	1
10	0	0	1	0

O = A’B’C’D’ + ACD + ABC

Implementation & Cost Analysis

- To build the final circuit in LogicWorks, I used 1 hex inverter chip and the other 6 chips were all NAND gates with either 3 or 4 inputs.
- Gate Cost: 18 gates
- Input Cost: 49 inputs
- Fractional Chip Cost: 6
- <u>Whole Chip Cost: 7 chips</u>