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User manual for fpga-based mental binary game

# Introduction

This user manual is designed to explain and walk through the rules of the mental-binary game. Depicted below is the playing surface, with player controls and displays marked.

Diagram

Description automatically generated

Each player’s switches are arranged from most significant bit to least significant bit, left to right. For example, if player 2 flips their farthest left switch, this would correspond to a binary number of 1000, or decimal 8. The same is true for Player 1 and their leftmost switch.

The objective of the game is to mentally calculate the number needed to add to your opponent’s number to equal decimal 15. For example, if Player 1 starts and inputs 1010, decimal 10, then Player 2 must mentally convert decimal 5 to binary and input their answer correctly to win. In this case, it would be binary 0101. Which player sets the number to be matched alternates between rounds, and score is kept manually without the assistance of the FPGA. If the sum adds up correctly, the left most LED will light up to indicate that the round was won, otherwise the right most LED will be lit.

# Example Gameplay: Failed Attempt

Player 1 starts, with Player 2 attempting to match.

P1: Flips switches 3, 1 and 0. Binary number 1011. Decimal display 11

P2: Flips switch 7. Binary number 0010. Decimal display 2

Sum calculated to be binary 1101.

Sum displayed as hex D, incorrect sum. Right most LED remains lit.

# Example Gameplay: Successful Attempt

Player 1 stars, with Player 2 attempting to match.

P1: Flips switches 2 and 0. Binary number 0101. Decimal display 5.

P2: Flips switch 9 and 7. Binary number 1010. Decimal number 12.

Sum calculated to be binary 1111.

Sum displayed as hex F, correct sum. Left most LED is now lit.