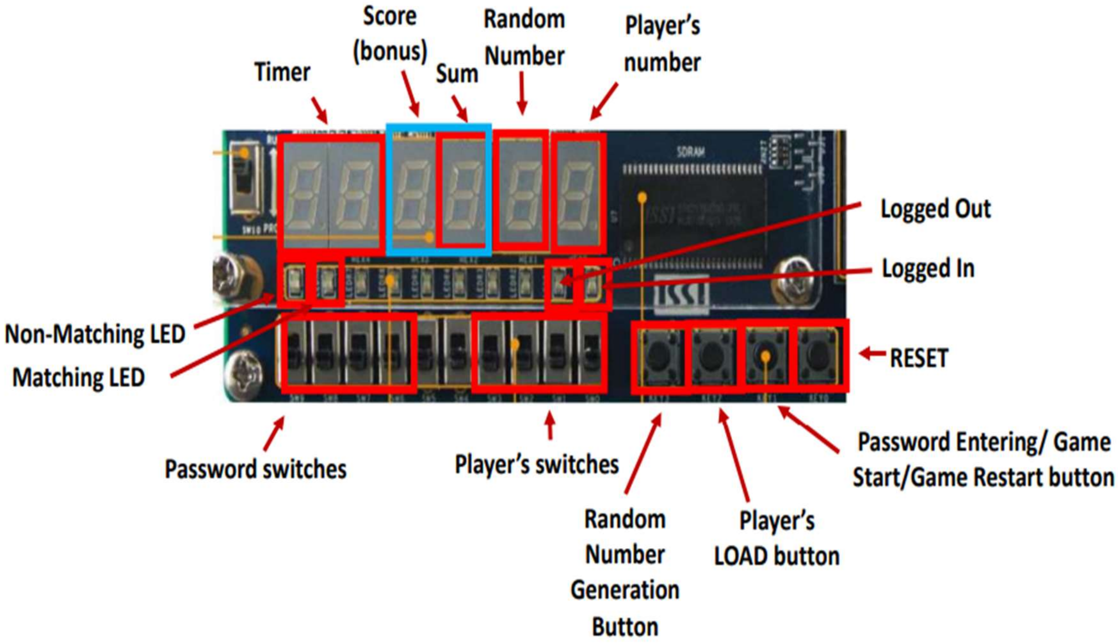
User Manual for FPGA Mental Binary Math Game

The mental binary math game is a game that requires 1 player. A player will use a button to generate a random number. The player must enter a value using the player switches so that both numbers add up to 15, or hexadecimal value F. The 4 switches represent a binary number. Each switch represents a binary digit. A binary digit (bit) can take on the value of either a 1 or a 0. When a switch is down, the bit is set to 0; when the switch is up, the bit is set to 1. When a bit is set to one, it represents a number that is equal to a power of 2. The right most switch represents the least significant bit, or bit 0. This means that the number represented by this bit when set to 1, will be $\mathbf{2^0}$. The next switch will represent $\mathbf{2^1}$, the next will be $\mathbf{2^2}$, and the last will be $\mathbf{2^3}$. When the player successfully sums both values to a 15, the 2nd LED on the left-hand side with light up in red, indicating that the player has successfully entered the correct input. When the sum is not equal to 15, the left most LED will light up in red. The objective of the game is to get as many successful inputs as possible in 99 seconds. Additionally, the game has now gained an authentication feature to allow players to have a go at the game. Previously, players were able to just turn on the board and were allowed to play. Now, players must enter a password using the third button and the 4 left-most switches to gain access to the game. Once authenticated, the 7 segment displays will display the timer of 99 seconds, a random number, the sum, and the player's value which should be 0 as no input has been entered with the load button.



Instructions:

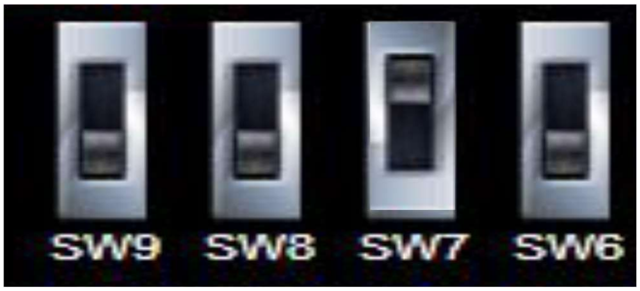


Figure 1. *User flips on bit 1 to represent the hexadecimal value 2*

Step 1: User must enter the password to gain access to the game. The user must start by entering one digit at a time. The user does this by flipping the switches representing the number they need to enter

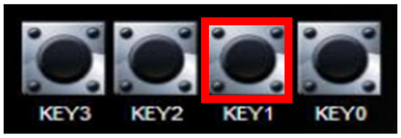


Figure 2. *User presses the enter button*

Step 2: To enter the digit, the user must press the enter button. The first digit is now read.

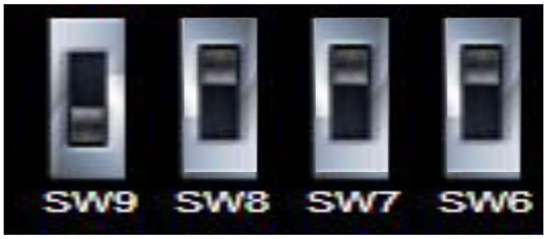


Figure 3. *User flips on bits 0,1, and 2 to represent hexadecimal value 7*

Step 3: User flips switches again for the 2nd digit.

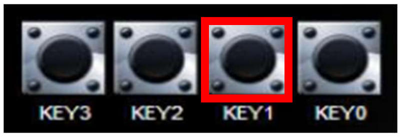


Figure 4. *User presses the enter button*

Step 4: The user presses enter button. The second digit is now read.

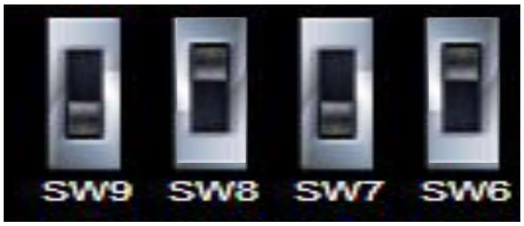


Figure 5. *User flips on bits 0 and 2 to represent hexadecimal value 5*

Step 5: User flips switches again for the 3rd digit.

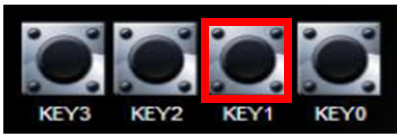


Figure 6. *User presses the enter button*

Step 6: The user presses enter button. The third digit is now read.

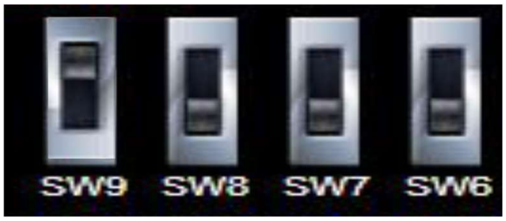


Figure 7. *User flips on bits 3 to represent hexadecimal value 8*

Step 7: User flips switches again for the 4th digit.

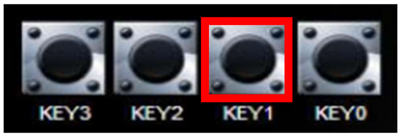


Figure 8. *User presses the enter button*

Step 8: The user presses enter button. The fourth digit is now read.

Players will now have access to the game and can input their desired numbers. The right-most LED will now turn on indicating that the players are logged in and have access to play the game as show below.

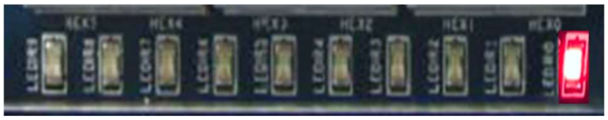


Figure 9. *LED on the right turns on to indicate users are logged in*

If the 2nd LED from the right is on even after entering the password, the user entered the password incorrectly and the LED indicates that the user is currently still logged out as shown below.

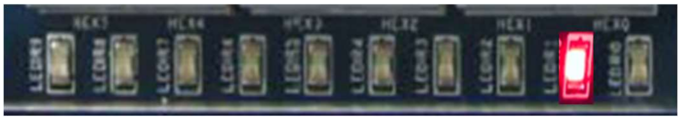


Figure 10. *2nd LED turned on indicating that users are logged out*

To initiate the game, the player must press the button they used for the password 2 more times. One to set the clock and another to begin the game. Below is an example of a player setting the timer and playing the game.

Step 9: The user presses enter button again to set the timer.

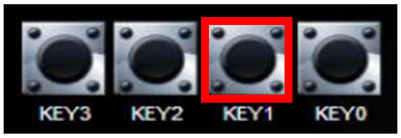


Figure 11. *User presses the Game Start button*

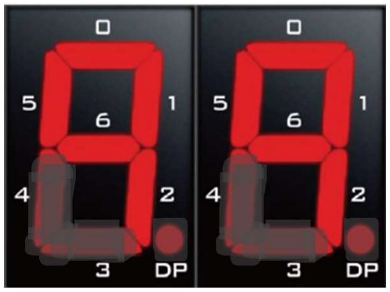


Figure 12. *Timer is set to 99 seconds*

Step 10: The user presses the button once again to begin the game.

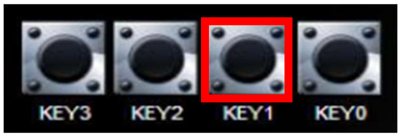


Figure 13. *User presses the Game Start button*

The timer begins to count down and the user can now use the 1st button to generate a random number.

Step 11: The user presses the 1st button to generate a random number

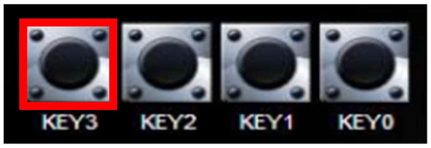


Figure 14. *User presses the Random Number Generator button*

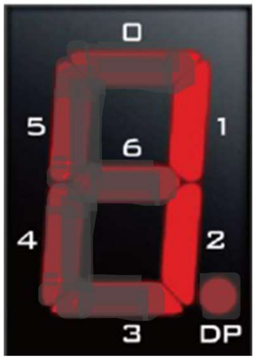


Figure 15. *The random number generated is a value of 1*

Using random number generated, the player must enter the value that will add both numbers to a hexadecimal value F, or 15.

Step 12: The player flips the corresponding to represent the value they want to input

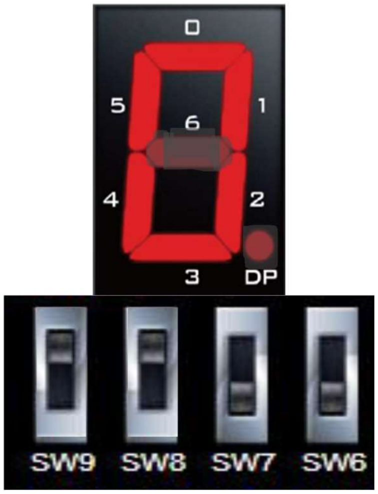


Figure 16. *User flips switches 2 and 3 which represent a hexadecimal value E, or 14*

Step 13: The player loads the value into 7-segment display when pressing their load button.

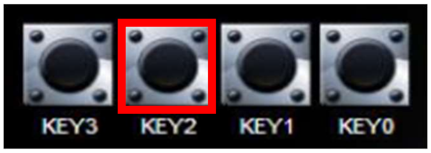


Figure 17. *User presses the Player Load Button*

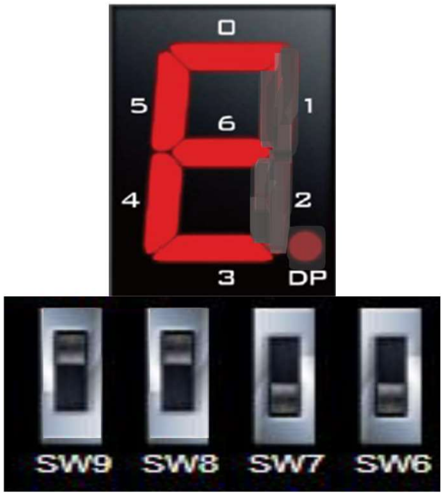


Figure 18. *7-segment display illustrates the loaded value*

Step 14: The display now illuminates the value loaded onto the board

If the player successfully enters a number that sums up both values to 15, the 2nd LED from the left hand side lights up. If a player fails to enter a number that sums up both values to 15, the 1st LED from the left hand side will light up as shown below.

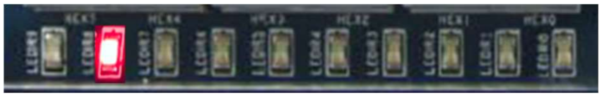


Figure 19. *Player successfully enters value that adds to 15*

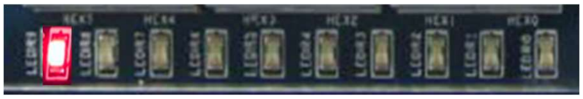


Figure 20. *Player fails to enter value that adds to 15*

The player can then press the random number generator button to generate a new number and enter a new number that will sum both values to 15. The game will continue like this until the time is up. When time is up, the buttons will not generate new numbers or load the player value onto the board. The player must press the game start button again to reset the timer and start the game again. The player may also log off the device using the load button, the second button from the left.

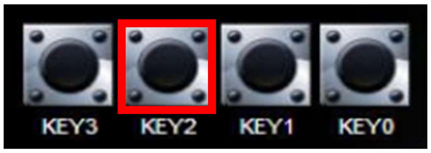


Figure 21. *User presses the Player Load Button to Log off*

The numbers that were previously on the board during gameplay will remain on the board, but the player will not be able to reset the game timer, load a number onto the board, or generate a new random number.

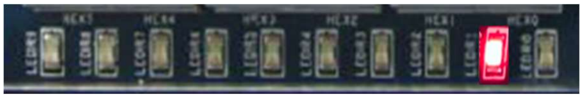


Figure 22. *2nd LED on the right hand side indicates player is logged out*