**USER MANUAL:**

The proposed FPGA game is a multi-user authentication game inspired by the series "The Last of Us". The player is required to solve a given question within a set time limit, failing which, a fungi will spread, indicated by the LED lights.

The game has three levels, and in each level, the player is required to shift each generated random number with the key and add the resultant numbers after the shift which would result in a two-digit number. The player needs to input the correct value within the given time limit, failing which, an LED will turn on i.e., the fungi spreads. The objective of the game is to break the spread of the fungi, i.e., turn off all the LEDs before the time limit expires.

The game also features score tracking, where the player's score is equivalent to their health. Starting at 51 %, the player's health increases by 10 % from level one to level two and by 20 % from level two to level three and increasing by 1% for every correct answer, decreases for every incorrect answer ultimately reaching a maximum of 99 % when the player passes level three. After completing the game, the player can view their personal and global best scores.

A close-up of a circuit board

Description automatically generated with medium confidence

**Game Instructions:**

1. The game starts with player authentication (we allowed four players and a guest to enter their unique ID and password for this game). The FPGA board's left four switches can be used to input the player's ID and password, and the password enter button can be pushed to submit each value.

**Players IDs and Passwords:**

Player 1: ID - 6528, Password – 120300

Player 2: ID - 0281, Password – 251296

Player 3: ID - 7713, Password - 271198

Player 4: ID – 6085, Password - 090298

Guest: ID – 8888, Password - 006370

When the player enters the correct ID, left most LED turns on.

The system checks the ID and password against the stored information to ensure that only valid users can access the game.

After the player has been authenticated, player will enter into the game in Level 1 by pressing the game start button.

1. Then 3 random numbers are displayed on the 3 rightmost 7segment displays and a key for the player to shift the numbers on the third left most 7segment display. The player must solve the given question within the set time limit by shifting the generated numbers with the key and adding the resultant numbers to form a two-digit number and enter it into the board by using the leftmost 4 switches for tens digit and rightmost 4 switches for one's digit input and then pressing the leftmost button (Player\_load button).

**Example:** In the game, let three random values generated be 9, 4, and 11, along with a key value, 6. The player needs to shift each random value by the key value and then add the resultant numbers. Shifting 9 by 6 results in 15, shifting 4 by 6 results in 10, and shifting 11 by 6 results in 1(after F values start from 0 again). Adding these shifted values gives a total of 26.

1. If the player inputs the correct value (26 in above example) within the given time limit, an LED turns off, indicating success. If the player fails to input the correct value within the given time limit, an LED turns on, indicating failure, and the fungi spreads.
2. In Leve 1, timer for each math puzzle to solve is 40 seconds. In this level, 4 LEDs are on and the remaining 6 LEDs are off. Turning off all the LEDs will take the player to level 2. In level 2, 6 LEDs are on and 4 LEDs are off and the timer to solve each math puzzle is 30 seconds. In level 2 if player turns off all the LEDs, he/she will enter into level 3 in which time to solve each math puzzle is 15 seconds and 8 LEDs are on and two LEDs are off at the start.
3. At any point while the timer is running, if the player wants to toggle between his/her input value and the random numbers set (3 random numbers and key), they can use the multipurpose button (2nd rightmost button on the board).
4. In this game, the score is indicated by the player's health. Initially, the players are at 51% of health due to fungi outbreak in the world, solving one math puzzle correctly increases health by 1% and whereas missed to solve the puzzle correctly decreases the health by 1%. Clearing level 1, gives a bonus health of 10% to the players making the player health- 67% while entering into level 2. Clearing level 2 gives a bonus health of 20% making the player health 91% entering level 3. Finally, clearing level 3 makes the players health 99% essentially eliminating the fungi from the world. This indicates the player has won the game whereas turning all the LEDs off makes the player lose the game.
5. When the player completes the game or fails, their score is displayed on the middle two 7 segment displays.
6. At any point of the gameplay and the timer is not running, if the player wants to check his/her health, they can press the multipurpose button to view their health on the 7 seven segment displays. The global winner health is displayed on the 2 leftmost 7 segment displays, the global winner id is displayed on the middle two 7 segment displays and the personal best health.
7. At any point of the gameplay and the timer is not running, if the player wants to log out of the game, they can press the Player\_load button.