EECS 3201 Final Project Report

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Overview of the Project

We have designed and implemented a reaction-based game on the DE10 Lite Board by making use of the hardware and software components. The game makes use of the six HEX displays, six switches (SW0 to SW5) and the LEDs on the board to create an interactive user experience. Players need to match the lighted HEX display with the corresponding switches on the BOARD within 2 seconds which gets them a point and if they fail to do so, they lose a life. At the start of the game each user gets 5 lives which are represented using the first five LEDs (LED0 to LED5) on the board. The game has a timer of 30 seconds which is implemented and displayed using LEDs (LED9 to LED6) in which LED6 keeps on blinking to represent each second. The game has a logic which makes it end either when the timer runs out or the 5 lives of the user are over. Resetting the game was also implemented using KEY0.

Game Dynamics:

1. HEX Display: One of the six displays light up randomly and players must identify which HEX lit up and respond by flicking the corresponding switch within a 2 second window.
2. Scoring System: The points in the game are awarded for correct inputs matching the illuminated HEX with the correct switch in the required time. If the user fails to provide an input or provides a wrong input score remains the same.
3. Lives Indicator: The game has another element which is the concept of lives. If a player provides an incorrect input or no input at all, he/she loses a life and the game ends when all 5 lives are finished. Players need to maintain accuracy to not lose lives.
4. Timer: The game operates within a 30 second time limit which is part of the gameplay. Players must manage their time to maximize their score in the allocated time frame.
5. Game Over Condition: The game ends when either the 30 second timer expires or the player exhausts all their lives.
6. Final Score Display: After the game is concluded, we make use of the HEX displays to show the final score a player has achieved in the game which is in the form of PtS. <score>
7. Reset Key: The game can be reseted using the button in between of a running game or when a game ends, another one can be started using the same button.

Description of Design:

At the beginning of the code, we make use of two clock dividers (ClockDividerLong and ClockDividerFast) which are instantiated to generate different clock frequencies for long (2-second) and fast (10 ms) intervals. We also used the shot clock from Lab 4, as a timer for our game, and some changes were made to the code.

We used Lab 5 code to generate a random number of 6 bits using LFSR. Since LFSR repeats a pattern after a set period, we used 2 different bits of the 6 bits, and performed XOR on them, which makes it even more random. This was done thrice, after which all the three bits obtained were combined to make a 3 bit number (rand). A random number is generated every 10 ms, but in the code it is updated after 2 seconds, making the number more random.

Then we make use of the random number (rand) to determine which HEX display (hexOn) lights up. The HEX display changes every 2 seconds which is done using the ClockDividers we have.
To manage the gamestate, we have a reset button which resets the game by initializing the score to 0 and lives to 5 and the variable ‘gameEnd’ becomes 0.

Then, we have conditions for the timer expiration or lives and the game continuously checks these conditions. If the game is not reset, it continues if the timer is greater than 0 and the player has more than 0 lives. When these conditions are met, we have a condition to check the input of the user on the switches (SW) and compare it on activated HEX (hexOn). If the input is correct, the score is updated otherwise the player loses a life.

We have written a code and a condition which lights up the LEDs (LEDR) on the board based on the number of lives(life) remaining.

In the golden top file, we have initialized the main module which takes the following inputs: KEY[0], MAX10_CLK1_50, SW[5:0], and outputs: hex[5:0], LEDR[4:0], LEDR[9:6], score, and gameEnd.

We have initialized the value of HEX to all bits being ON 8'b11111111 then on the basis of the ‘gameEnd’ the specific HEX corresponding to the current game turns on.

Finally, we split the score into ones and tens and then used a switch case to convert the digits to their 7-segment display representation. Additional HEX displays (hex5, hex4, hex3) are configured to show the letters "P", "t", and "S." followed by the score when the game has ended.

Resources used:

1) LFSR logic reference: https://vlsiverify.com/verilog/verilog-codes/lfsr
2) DE-10 LITE user manual
3) Lab 2 (using HEX’s)
4) Lab 4(shot clock/ timer)
5) Lab 5 (part b) from the course

Video link: https://youtu.be/kQf6JQvq5Sg