

Project:

LEARN CHINESE FPGA GAME

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Description of the System

The DE2-115 FPGA board is a development kit used to create and execute digital designs with programmable logic, from a simple circuit to complex projects. The DE2 board comes with the Cyclone IV E device, known to be a low cost and low power device.

The hardware that comes with the DE2-115 board includes:

- Altera Cyclone IV 4CE115 FPGA device
- USB Blaser for JTAG and Active Serial programming
- 2 MB SRAM
- 8 MB Flash memory
- 18 Slide switches

Figure 1 displays the image of the DE-115 board and lists all its components.

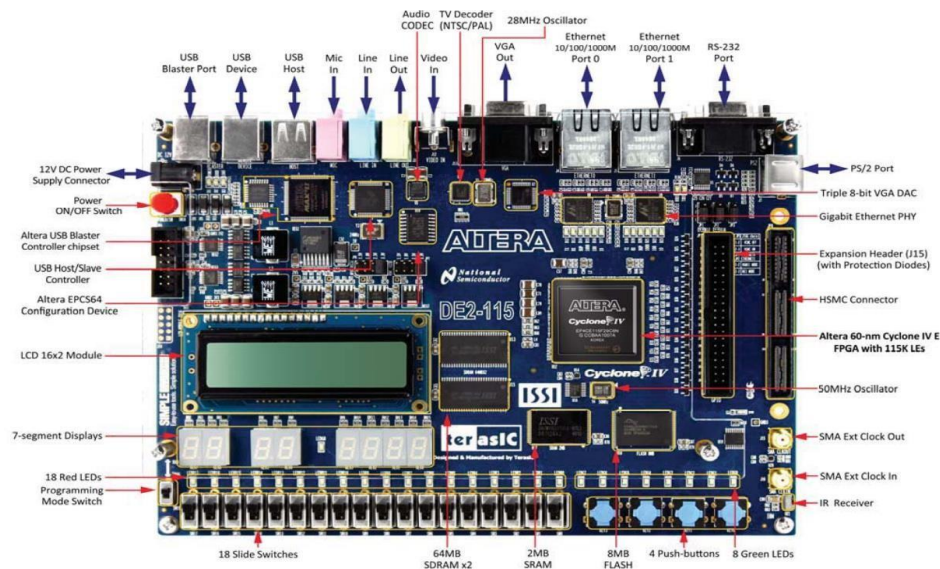


Figure 1. DE-115 board

Board Picture

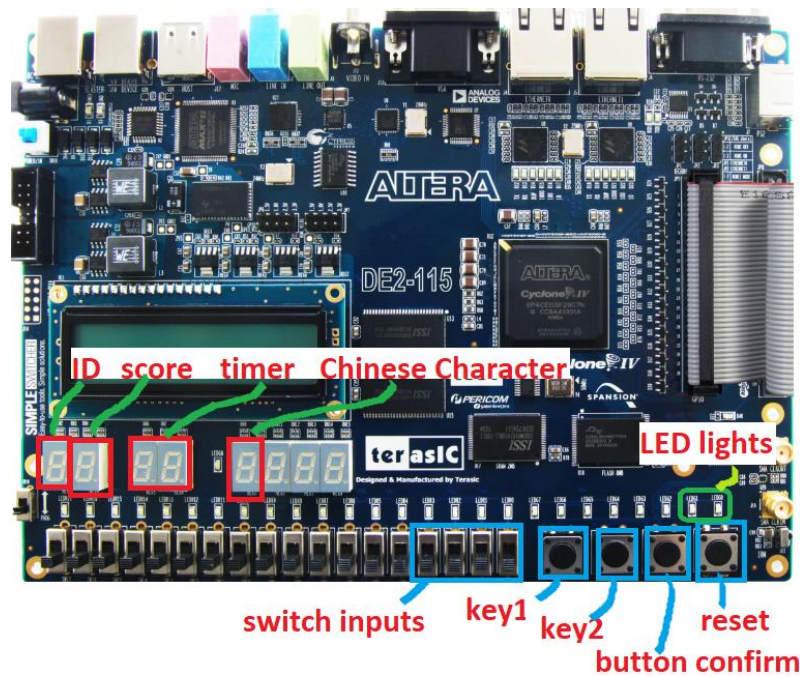


Figure 3. The peripherals used to play the game.

The DE2-115 device used for this project is only for educational purposes. The Learn Chinese FPGA Game is the game we proposed to Dr. Chen for our team's final project. This project utilizes the key concepts learned through the ECE 5440 Advanced Digital Design course. The requirements for this game included the following:

- Multiplayer aspect
- ID authentication
- Timer control
- Seven segment displays
- Random number generator
- Rom control
- Ram control
- Button control
- Switch control

Figure 3 shows on the bottom right the toggle switches SW3, SW2, SW1, and SW0 for ID and password input. Player 2 uses toggle switches SW13, SW12, SW11, and SW10. On the bottom right, the game uses four buttons for key 1, key 2, key confirm, and reset. The Key 1 button uses KEY3, Key 2 uses KEY2,

confirm button uses KEY1, and reset button uses KEY0. Last, the games use the green for LEDG1 and LEDG0.

How to Play

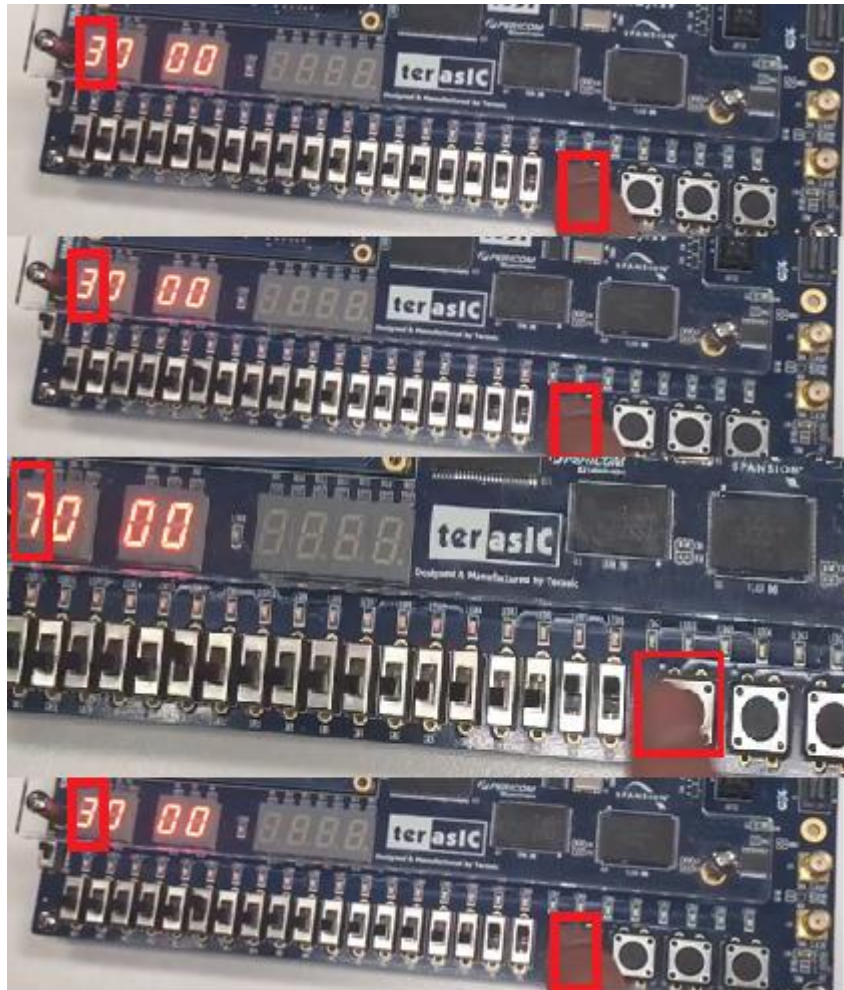


Figure 4. Sequence to ID password.

The Learn Chinese FPGA Game uses the Game Access Control to allow players to go through an ID and default password authentication before playing the game. The ID number for the game is 3373 and the default password for this game is 1111. First the game requires an ID check, so the player must input his or her ID via switch and button input. Once the ID has been inputted, a green LED will light up to let the player know that the ID was correct. Afterwards the game will require a unique

password. The player gets access the game after doing the action sequence of pressing Key3 four times for the unique password 1-1-1-1. Doing the following action shows enables the green led to emit allowing the player to start the game.



Figure 5. Inserting unique password.



Figure 6. Timer and Chinese character displayed on FPGA.

After confirming the password by pressing the confirm button, the timer will countdown on the segment display and a random Chinese character will be displayed as well. The player will then start to match the correct Chinese characters shown below to get a high score.



Figure 7. Chinese character 1.



Figure 8. Chinese character 2.



Figure 9. Chinese character 3.



Figure 10. Chinese character 7.

Figures 7 through 10 shows the Chinese characters for 1, 2, 3, and 7. The combinations for each character is hard to remember, so here are the correct key inputs for these four numbers:

- 1: key 1, key 1
- 2: key 2, key 2
- 3: key 1, key 2, key 1
- 7: key2, key1, key2

The correct way to play:

The correct way to play the game is straight forward. First the player must enter the ID 3373 and press Key 3 to confirm. After entering the correct ID, a green LED will emit. Next the player should enter the unique password 1111 and press Key 3 to confirm. Then another green LED will emit as well notifying the player to start playing the game. Afterwards, the player must press Key 3 to start playing the game. The game starts when the 30 second timer begins to countdown. During the timer countdown, the game will display a few Chinese numbers. Enter the correct key sequences when the Chinese number is randomly generated. Remember the key sequences of each Chinese number and keep matching to get a high score!

The wrong way to play:

Playing the game incorrectly is not suggested, however the player must know the wrong way to play the game. First the player must enter his or her own personal ID and press Key 3 to confirm. Do not worry about the green LED as it's not that important. Next the player should enter the unique password of their choosing and press Key 3 to confirm. This should not allow the player to start the game. If the player somehow manages to bypass the game control, then he or she can press Key 3 to start the game. When the game starts, 30 second timer begins to countdown. During the timer countdown, the game will display a few Chinese numbers. Enter the key sequences when the Chinese number is randomly generated. The player can press Key1 and Key2 of his or her choosing. The player can ignore the Key sequence of the randomly generated Chinese number. The player must make sure to enter as many wrong button sequences as possible to never get a high score!