

Ping Pong Game with Touch-screen

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Abstract:

This project is conducted using the Altera DE2 development board. We are aiming for implementing a touch-screen-based ping pong game. It will be a computer vs. player game with a specified rule. Player serves and receives the ball by touching the screen connected to DE2 board. The ball can accelerate and decelerate by control the moving speed of the bat.

Introduction:

The Ping Pong game is an extension of the real Ping Pong game. We set a few new rules for the game for example, the ball can bounce on the two horizontal sides of the screen and once the ball hits the perpendicular side of the screen, the game is over. In terms of movement of the bat, it can move in 2D screen by following the moving trajectory of the hand on the touch screen. The horizontal rebound velocity of the ball depends on the velocity of the moving bat when batting occurs.

To implement the Ping pong game, the project will involve both hardware set up and software programming. Especially, due to the complexity of the touch screen, the hardware set up will take the most of the work.

For the software part, the difficulty lies in how we realize the algorithm of the Ping pong Game.

For the hardware part, the major workload is to set up the touch screen and interface. Moreover, the display of the game graphics can also take some efforts.

Project Details:

1. General Idea

The general idea of the project is that the Altera Cyclone II FPGA board is used to display the game graphics and the nios2 processor will transfer the received touch coordinates and velocity to the movement of the bat. Moreover, the nios2 will introduce the play rules of the game.

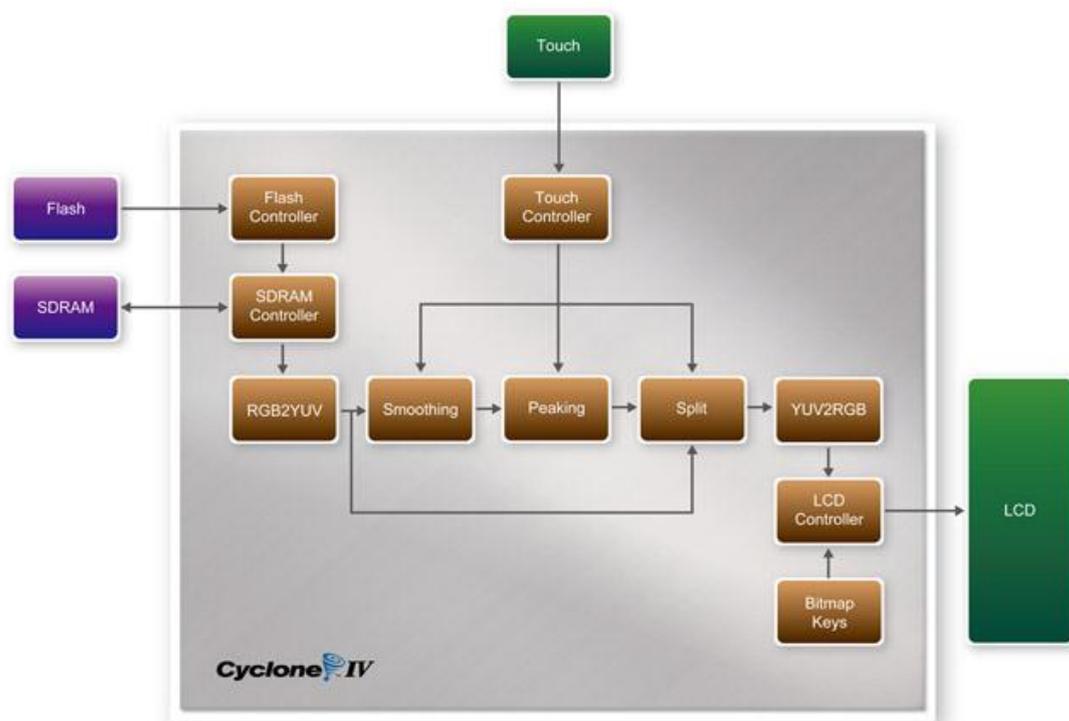
2. Implementation

Incorporate VGA display with the TRDB_LTM Kit to develop the application using a digital touch panel on an Altera DE2 board.

- VHDL (compiled with Quartus 7.2 and Nios II) will be used for the inter-connections of hardware.
- C will be also employed to handle the hardware implementation.
- The Terasic LCD Touch Panel Module (LTM) board is a displayer and a controller.
- A 40-pin IDE cable will be used for connecting between the LTM and the DE2 board.

3. Hardware Organization and Peripheral Set Up

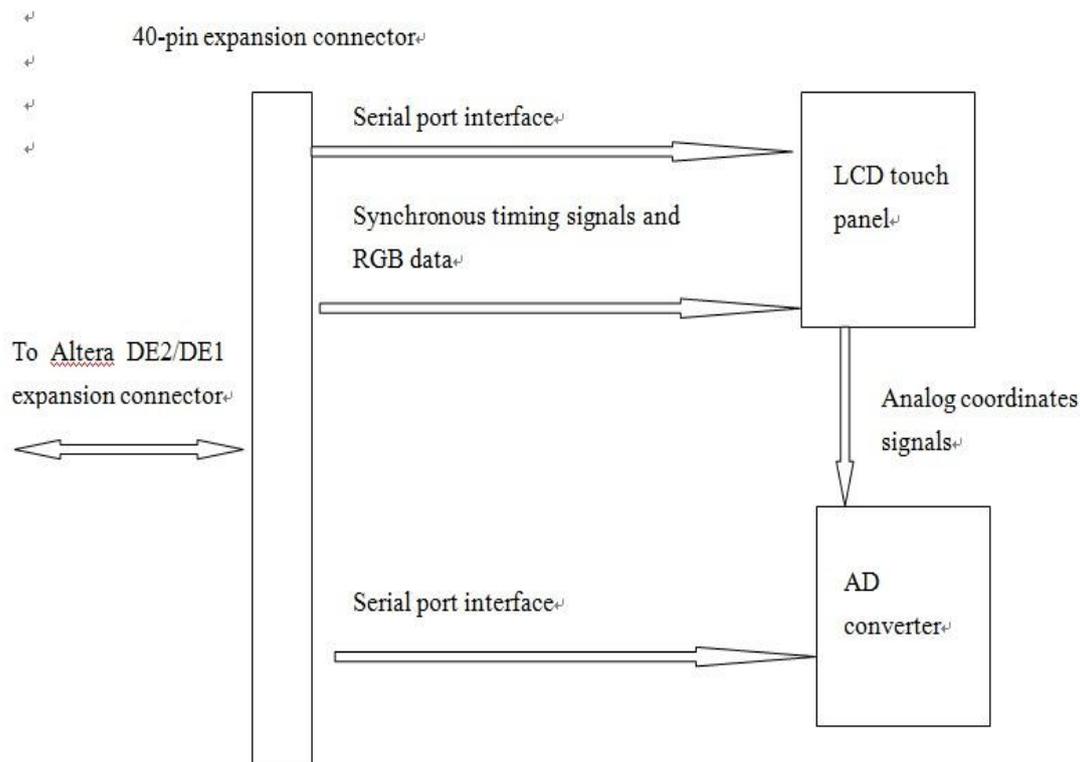
Figures in this section are the block diagrams of the basic hardware architecture and thus makes the FPGA board programmable.



Touch Screen Processor Block Diagram

The LTM consists of three major components: LCD touch panel module, AD converter, and 40-pin expansion header. All of the interfaces on the LTM are connected to Altera DE2 board via the 40-pin expansion connector. The LCD and touch panel module will take the control signals provided directly from FPGA as input and display images on the LCD panel. Finally, the AD converter will convert the

coordinates of the touch point to its corresponding digital data and output to the FPGA via the expansion header.



System Structure

4. Software Infrastructure and Implementation

With the properly set up hardware, the software can access to each module through the connector. The C code will try to read the coordinate input from the LCD panel. Then the program will react to the input and then transfer the discrete coordinate input data to the velocity and movement direction of the bat. Meanwhile, the program will check to see if the bat hit the ball or not and then calculate the rebound speed and direction of the ball.

Moreover, another part of the software design is to control the movement of the ball. At the beginning of the game, the ball will move from the middle of the table and run at a constant speed and direction. If the ball hit the parallel sides of the game table, the ball will rebound at the same speed but with the symmetry direction. For another situation, if the ball hit the perpendicular side of the table, the game would be over since the player missed the game.

Apart from these, the hitting and the ball movement followed is a complex design. In order to make the batting closer to the real one, the rebounding speed of the ball will be decided by both the velocity of the bat and the ball itself at the batting moment. But the rebounding direction is just depend on the incident angle of the ball.

5. Timing

5.1 The Serial Port Interface of the LCD Driver IC

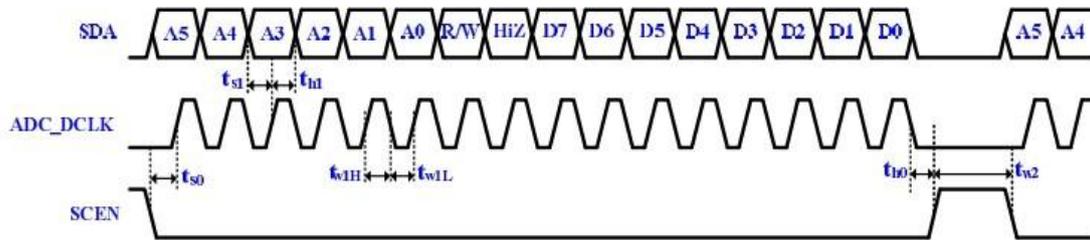


Figure1 The frame format and timing diagram of the serial port interface

5.2 Input timing of the LCD panel display function

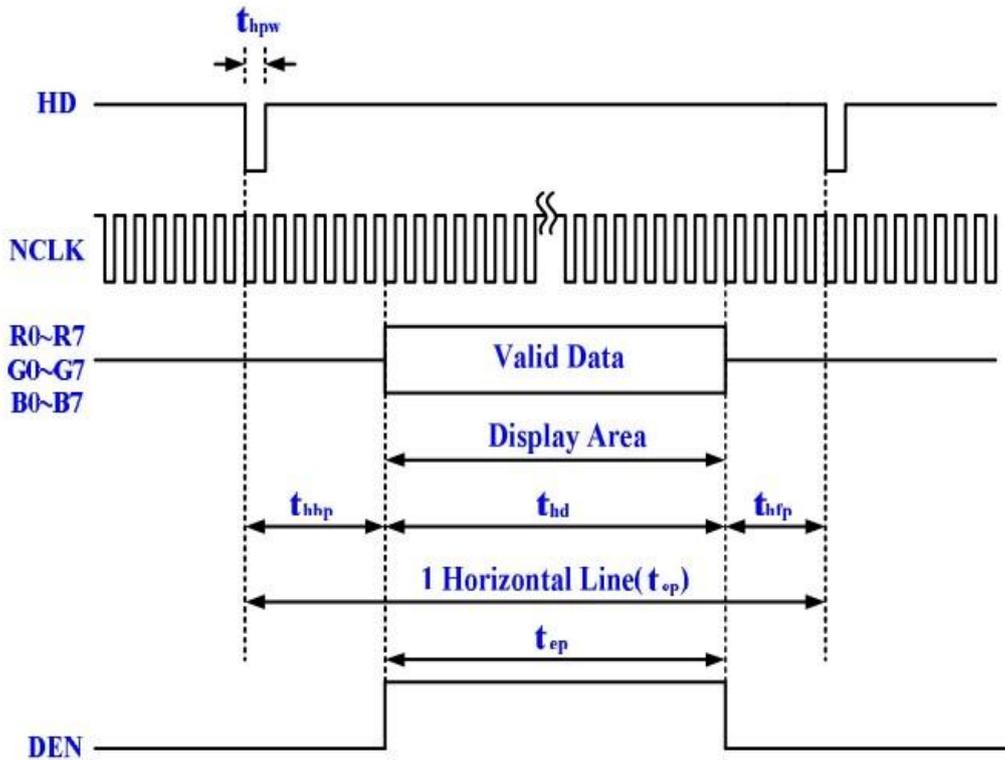


Figure2 LCD horizontal timing specification

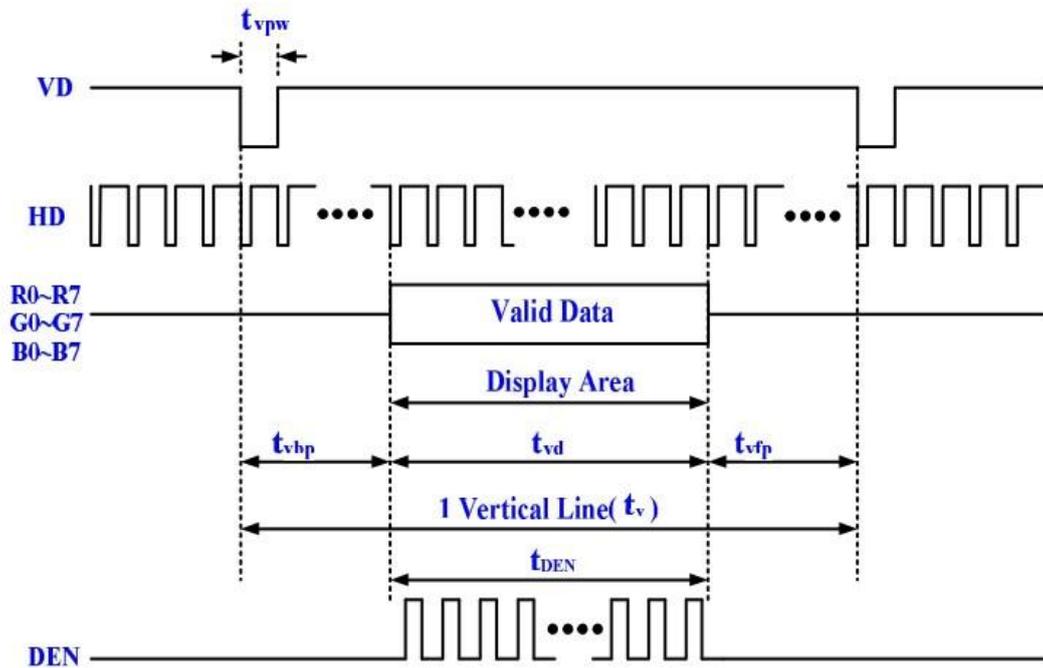


Figure 3LCD vertical timing specification

5.3 The serial interface of the AD converter

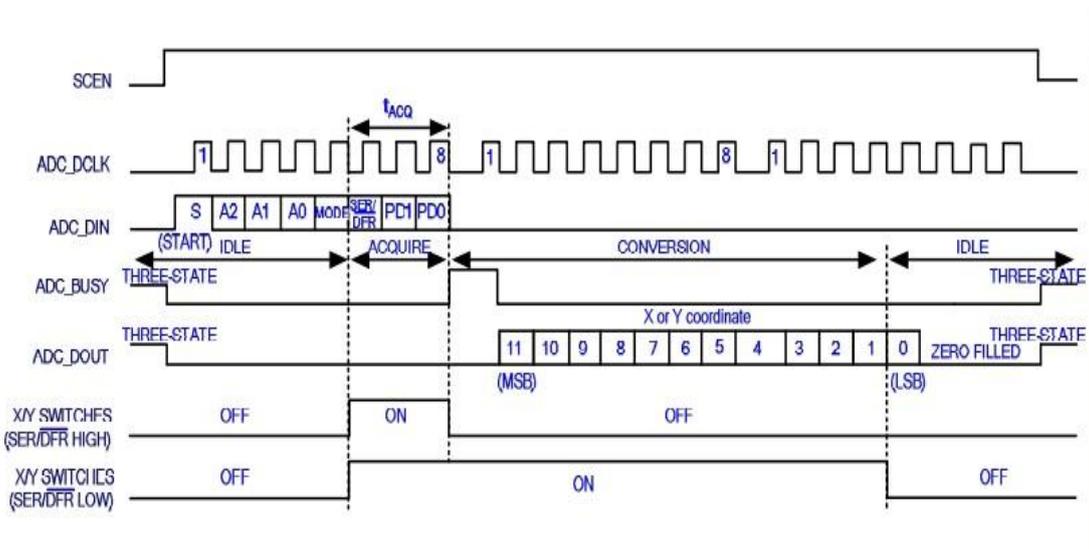


Figure 4Conversion timing of the serial port interface

6. Control Signal

0	1	2	3	4	5	6	7
0	Vertical position						
1	Horizontal position						
2	Hand						

0	1	2	3	4	5	6	7
0	Vertical position						
1	Horizontal position						
2	Racket						

0	1	2	3	4	5	6	7
0	Vertical position						
1	Horizontal position						
2	Ball						

7. Milestones

Milestone 1

- Define game logic function.
- Implement RTL design.
- Implement partial graphic scenes.
- Determine the sequencing and the timing of the image signals displayed on the Terasic LCD Touch Panel Module (LTM) board.

Milestone 2

- Implement the game code in C.
- Add advanced playing levels (faster speed).
- Completely build graphic scenes.

Milestone 3

- Implement protocol between touch screen and DE2 coding in VHDL.
- Detect and fix bugs.
- Display the game to make sure that everything works well together.