CE-355
Final Project: FPGA-based Tank Duel Game

Objective:
In this project, you will design a game called "tank duel" that could be displayed on the VGA monitor and controlled by two players by one PS/2 keyboard.

Requirements:

1. Draw two tanks facing each other on VGA screen with different colors (e.g. red and blue). One tank should appear on the top of the screen and the other should appear on the bottom. The tanks can be drawn as simple rectangles or any other complicated shapes that you choose. Draw whatever background you like for the battle field.
2. Both tanks should be continuously moving back and forth on a horizontal line on the screen. That means when they reach one end of the screen they should automatically move in the opposite directions without any external input,
3. Both tanks should have 3 different moving speeds that are adjusted by keyboard inputs by the player.
4. Both tanks shoot one bullet at a time; if it hits the opponent's tank, it scores one point. A tank can shoot the second bullet only when the previous bullet goes out of the screen or hits the opponent.
5. The score of both players should be displayed on the LEDs. Whoever first scores 3 points wins.
6. When one player reaches three points:
    a. Only the winner's tank should be displayed on the screen.
    b. A message declaring the winner should print out on the LCD screen.
7. There should be a global reset signal to reset the game;

Project Description:

In this project, we do not provide a specific interface for your entity. Instead, you are expected to determine the inputs and outputs according to the specifications described above. Having said that, we have provided three miniprojects that are readily coded projects to operate the VGA, a ROM memory, LCD display, and the keyboard. These will provide you significant background information and code to be reused in your own design.

Furthermore, several aspects of the design, such as choice of graphics, approaches to deal with movement and collision, will need to be decided by each individual designer—meaning you! But, here are some hints that you are strongly advised to follow:

1. ***Read and try the provided miniprojects for VGA monitor, LCD screen, and keyboard***; make sure that you understand how these devices work on the FPGA board. In your project, you could reuse most parts of the provided examples to support your design.
    a. For the VGA component, note how the Block RAM is used as a ROM memory to perform as a color-palette. If a Block RAM is not used, the graphics will appear fuzzy and erratic at the edges of shapes. A Block RAM should be used as a ROM to look up colors in your design as well. Study the VGA mini project carefully to replicate similar functionality.

2. ***First, try displaying a fixed simple colored rectangle on a black background screen. If you cannot do this simple design, you will likely not be able to perform anything more sophisticated.***
3. After you get familiar with the VGA, LCD, and keyboard, you should start thinking about the algorithm to draw moving objects on the screen as well as the algorithm for detecting a collision between a bullet and a tank.
4. You should simulate any other additional design files that you create before testing it on the board. Make sure your algorithms for moving tanks, shooting bullets, etc. work correctly. You do not need to worry about simulating the VGA, LCD, and keyboard interfaces.
    a. The output from your entity would be the pixel data fed to the VGA interface. You should understand that these pixel data will be placed on the screen by a row-by-row scan mode, in which each row is scanned from the left side to right side. So try to output your data into a text file in ModelSim. In this way, you can debug your VGA design without actually using the VGA monitor.

General Notes:

MAKE SURE TO HAVE THE VGA AND KEYBOARD PLUGGED INTO THE ALTERA DE2 BOARD BEFORE YOU POWER IT UP. NOT DOING SO MAY RESULT IN DAMAGE TO THE BOARD OR KEYBOARD.