Final Project

Project description

In this project, you will use the Vivado CAD tool and the Basys3 board to design and test a snake game over the VGA interface. The requirements for this project consist of completing the design and submitting the source files (.v files, NOT .xpr files) and the .bit file for a working game (along with the same from some checkpoints in the design).

The screen should be blank at the beginning of the game. Moving SW0 from low to high initiates a new game. A "snake" should begin moving from the left edge of the screen. At this point in the game, the snake should be relatively short (40x10 pixels).

The pushbuttons will control the movement of the snake from this point forward. The scrolling graphic should respond to the arrow key presses beginning with the head of the snake in the following way:

Original orientation	**Change**	
Horizontal	BTNU	Flip to vertical movement and scroll up
	BTND	Flip to vertical movement and scroll down
	BTNL	No change
	BTNR	No change
Vertical	BTNU	No change
	BTND	No change
	BTNL	Flip to horizontal movement and scroll left
	BTNR	Flip to horizontal movement and scroll right

Note that the pushbuttons BTNU, BTND, BTNL, and BTNR correspond to the original concepts of the UP, DOWN, LEFT, and RIGHT keys, respectively. Note that the buttons should not be glitchy. Therefore, you may need to introduce a debouncing algorithm into your design to help with this.

Movement of the snake should mirror traditional snake games where the links of the body follow the "link" in front of them. At the beginning, since the snake is 40x10 pixels, the snake is 4 "links" long. If you are confused about what I mean here, please ask me for clarification.

As stated earlier, SW0 should serve as the New Game/Reset switch. When the switch is up, or "on", a new game should commence. When the switch is down, or "off", the game should reset to a blank (or graphic, etc.) screen.

SW1 should serve as the "pause" button. When up/on, the game should pause. When down/off, the game should continue.

Apples should appear periodically in different locations on the screen. When the head of the snake rolls over an apple, the apple is consumed, and the length of the snake should increase by 10 pixels. An apple

should be on the screen at the start of a game and a fresh one should appear in a new location when one is consumed.

When the snake touches any edge of the screen or itself, the snake should freeze and no longer respond to pushbutton presses.

Notable game parameters are given below:

Parameter	Value
Background color of the screen	Black
Color of the snake	Green
Color of apples	Red
Length and width of the snake (at the beginning)	40 (length) x 10 (width) pixels
Speed of the snake	50 pixels per second (smooth motion, not choppy)

You are encouraged to make additions to this description to make your game "yours". Examples could include a start screen, a score/high-score monitor, credits at the end, a "hard" mode where the snake moves faster (could be controlled by an additional input), interfacing with a USB keyboard, etc.

Grading

This project will be graded in a "stair-step" format, meaning your grade will not come from just the final output but also some internal "milestones."

The first 150 points will be given based on a *part1* deliverable. This deliverable should meet these requirements:

- The screen should be black.
- An apple should appear somewhere on the screen when the game is started.
- The snake should be moving but does not have to respond to any controls or change direction.
- When the head hits a wall, the game freezes until reset.

The next 200 points will be given based on a *part2* deliverable. This deliverable should meet these requirements:

- Buttons change the direction of the snake. Movement of the trailing body is operational.
- When an apple is eaten (the head moves over it), the snake grows one link on the body.
- After an apple is consumed, another replaces it in a semi-random location.

The final 50 points will be given based on the same *part2* deliverable. This deliverable is based on your creative spin on the project. Add features, cosmetics, whatever you like, so long as the original functionality of the game remains the same. Note that the primary measure of earning this final 50 points is effort. Changing the color of the background is an example of a "low-effort" modification that would earn very few points.

Submitting your project

There will be two assignments posted on Blackboard – one for each part of the project described above. **There will be only one attempt available for Part 1!** Once I see your Part 1 as submitted in Blackboard,

assume that I will grade it at any time. This is so you can get feedback before finishing the remainder of the project.

The second part will be an assignment with unlimited attempts. I will grade the last one I see in Blackboard after the final exam period for the class is over.