Final Project

Project description

This project will use the Vivado CAD tool and the Basys3 board to design and test a snake game over the VGA interface. The project requirements 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 some checkpoints in the design).

The screen should be blank at the beginning of the game. The act of switching 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.

The snake's movement should mirror traditional snake games where the links of the body follow the "link" in front of them. In 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) 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 snake's head rolls over an apple, the snake consumes the apple, and the snake's length 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 consumed.

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

The table below lists some notable game parameters.

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), or interfacing with a USB keyboard.

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."

You can achieve the first 100 points based on a *part1* deliverable. This deliverable should meet these requirements:

- The screen should be black.
- An apple should appear somewhere on the screen at the beginning of the game.
- 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.

You can achieve the next 150 points based on a *part2* deliverable. This deliverable should meet these requirements:

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

You can achieve an additional 50 points based on the same *part2* deliverable. This portion of the rubric measures 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 background color is an example of a "low-effort" modification that would make 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 we see your Part 1 as submitted in Blackboard,

assume that it will be graded 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. The latest one in Blackboard after the deadline is passed will be graded.