Flappy Bird User Manual

The DE1_SoC Flappy Bird Project, at its most basic level, is two arrays of shift registers connected to an LED array. One array represents the bird, while the other represents the pipes. The goal of the game is to press and release KEY[3] on the DE1_SoC board to move the bird up and down, avoiding the approaching pipes. Each time the bird passes through a set of pipes, the user's score increasing by 1, and the goal is to obtain the highest score possible. Upon the bird's collision with the pipes, the game is over, and the final score is displayed. The game can be replayed by switching on SW[0] on the DE1_SoC board.

The remainder of the document highlights each sub-module for the Flappy bird project, and describes its purpose as well as its function.

CC (bird)

- The CC module is a 16-bit shift register contains a single 1 in the center of the array at reset. At the positive edge of the *birdCount* signal, the 16-bit array shifts to the right if there is no user input and shifts to the left if there is user input. The array is connected to the 13th row of the red LEDs in the array, particularly to the red pixels.

PipeShift

- Pipeshift is a module containing a 16x16-bit shift register. At the positive edge of the *pipeCounter* signal, the 16x16-bit array shifts to the left, and the rightmost column is replaced by the 16-bit signal generated in the *generatePipe* module. The array is connected to the green pixels in the entire LED array.

birdCounter

- birdCount is a counter that takes the clock *(SYSTEM_CLOCK)* as its input and output a true on every 2^8th clock cycle. The purpose of this clock is to slow the shift register down so every shift is represented by the LED, since the refresh rate for the LED array is slower.

pipeCounter

- pipeCounter is a counter that takes the clock *(SYSTEM_CLOCK)* as its input and output a true on every 2^10th clock cycle. The purpose of this clock is to slow the shift register down so every shift is represented by the LED, since the refresh rate for the LED array is slower.

generatePipe

- generatePipe is a module that outputs a 16-bit array. The array cycles through three sets of all zeros followed by a randomly chosen array pattern which represents a set of pipes. All possible shapes of pipes are represented by states in this module and are chosen pseudo-randomly by a 3-bit LFSR. The 16-bit array is connected to the first column of the green pixels in the LED array.

hit

- hit is a 1-bit logic variable defined in the top module. It represents the collision of the bird hitting either the pipe, the top of the screen, or the bottom of the screen with a 1. The hit detection against the pipe is accomplished by looping through each pixel on the 13th row of the LED array and using and if statement to see if both the red and green pixel are on simultaneously. If they are, that means the bird has hit the pipe, and hit is assigned a value of 1 until reset. The hit detection against the top and bottom of the screen is accomplished by using two AND gates and one OR gate: (bottom red light is turned on AND there is no user input) OR (top red light is turned on AND there is user input). If this statement is true, that means the bird has hit the edge, and hit is assigned a value of 1 until reset. This hit variable is used as a secondary reset for *hexCount* (freezes score count until hard reset), and a primary reset for *cc* and *pipeShift*.

hexCount

- hexCount is a 10-state counter, which has an increment-in (as an input) and an increment-out (as an output). Increment-out is true when the state of the machine is moving from the 10th state into the first state again. This module is instantiated 3 times, as to represent three digits in the score board. The increment-in for first instantiation of the module occurs when a pipe is recognized as passing the bird; increment-in is true when a pipe reaches the 14th row of the LED array. In the two subsequent instantiations, increment-in is true for every 10th cycle of the preceding instantiation. Each hexCount is connected to a HEX display on the board, which results in a 3-digit counter for the score.