FPGA HERO!

(Guitar Hero)

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Introduction:

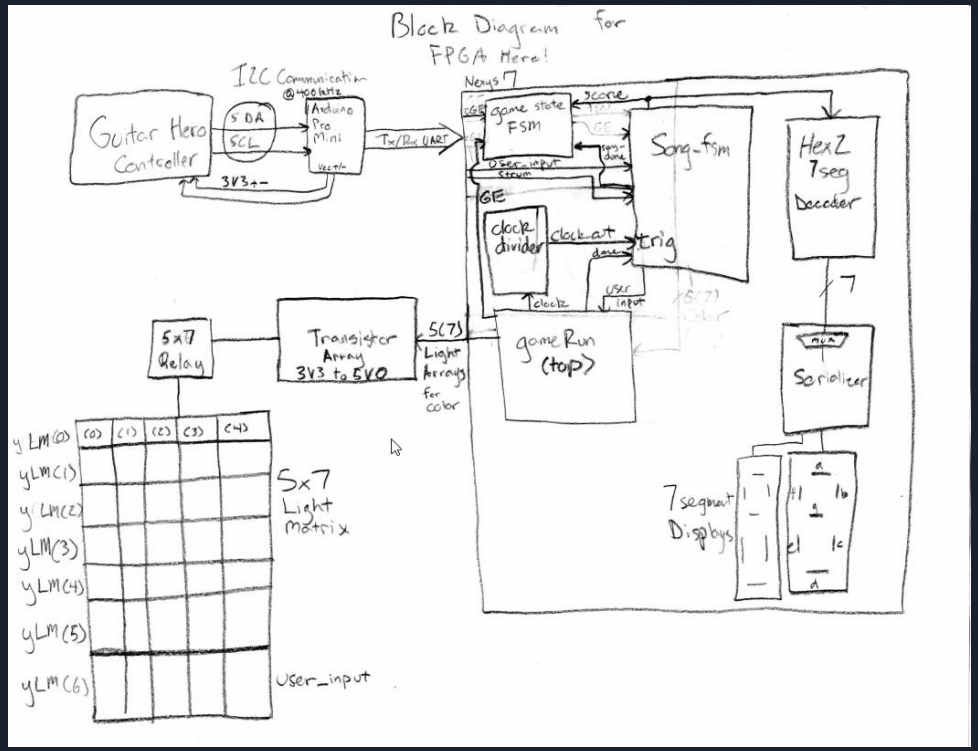
Our goal with this project was to create a game based on the Guitar Hero game series. A player will be given a color pattern that he/she must play along with the given pattern by pressing the corresponding color and simultaneously strumming with the controller. A point is awarded if the correct color is pressed and strummed at the appropriate time.

Methodology:

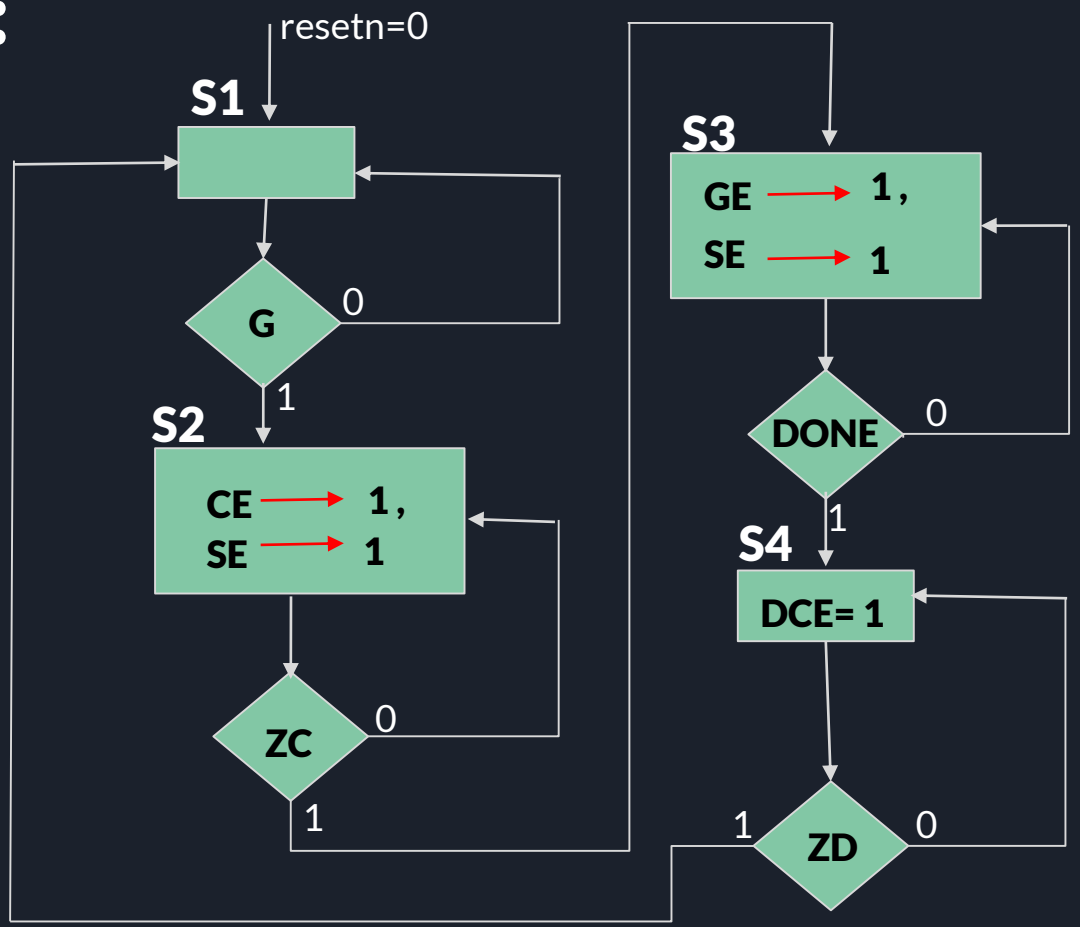
This project is heavily focused on external hardware which all communicate with each other. Using the Arduino Pro Mini 3V3, we communicated with a Wii Guitar Hero controller using I2C at a frequency of 400kHz.

We utilized UART to form a communication between the Arduino and the Nexys-A7 FPGA. The FPGA is powered externally by the 5V connector. Using a light matrix, we send a series of signals that turn on the lights in a corresponding sequence. As time passes, the signals will all flow down the rows of the matrix. As a signal reaches the second to bottom row, the user will need to press the correctly colored button that matches the light row. The bottom row of the light matrix is used to display the user's input. For example, if the user presses the red button, the bottom row will have the red light turned on. Two 7-segment displays are utilized to keep score, and they are serialized in order to display both 'simultaneously'.

Block Diagram



FSM:



FSM:

There are 4 states: s1, s2, s3, s4. State 1 is an rest state. State 2 is an initialization state. State 3 is the game state, and state 4 is the score display state. State 1 goes to initialization if the user presses down on the green button, and state 2 goes into the game state if the countdown is finished. State 3 will go into state 4 when the game is over and the light pattern has finished flowing through the light matrix. The final score will be displayed, and after an internal countdown is completed, the machine will go into state 1. At any point, a reset will return the machine to state 1.

In state 2, a counter enable and a serial enable are activated. These outputs will initialize the countdown sequence. In state 3, a game enable and the serial enable are activated. The game enable facilitates the start of the ‘game’ part of the project, and in the fourth state, a delay counter enable is activated to internally countdown before the machine returns to State 1. This is to allow the user to look at his/her final score after the game.

Project Setup