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ECE 153A
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Lab 2B - The Rotary Encoder

Purpose and expected goals of the lab

The main purpose of this lab was connecting and programming an LCD screen. At completion, the screen shall display a graphical representation of a volume bar that can be adjusted using an encoder. The volume bar disappears after 2 seconds of inactivity whereas pressing down on the encoder sets the volume to 0. Lastly, designated buttons on the FPGA are configured to display different texts on the LCD screen when pressed.

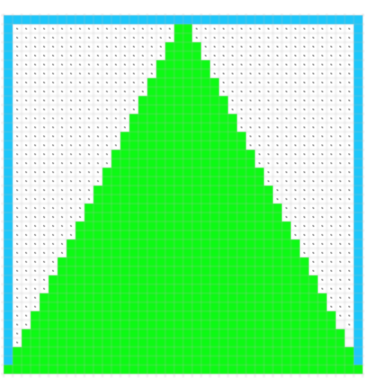
Methodology

Lab 2A served as a foundational layer for the system and several new modules were added to achieve new functionality. To be more specific: an SPI module, a GPIO module, and an SPI clock module were the new additions to the system. The SPI module connects the LCD screen and the frequency of the clocks tells the screen how fast to update. In this system there are two states - the "Draw State" and the "Idle State"(State B). The Idle State draws the text and/or waits for encoder button to be pressed. Once this state gets an input from the peripherals, it transitions to the Draw State, where it updates the volume bar.

The Peripheral inputs come from the encoder or the programmed buttons on the FPGA. A 100MHz AXI timer is used to detect user inactivity. The timer is reset every time an interrupt from the encoder or button occurs, or if the timer exceeds 2 seconds. .

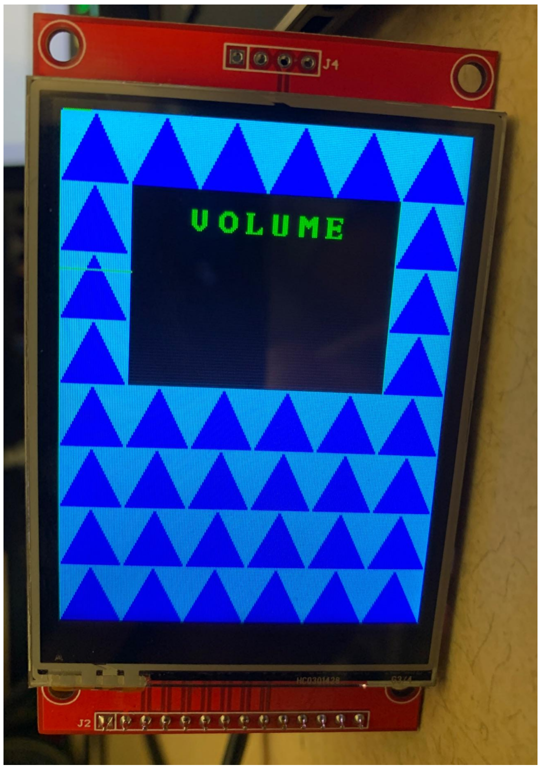
Results

Report on how you created your function for drawing the background and include a picture of your background pattern with your LCD photos.



The triangular pattern background instructions were split into a pixel square of 40x40, then repeated for the entire display. We used a template such as this picture. We noticed that each step is an increment of 2 pixels. Therefore, to measure the width of the green pixels, we can run 2*ceil(y/2), where y represents the rows, counting downward. Once we figured out the width of the green pixels, we then draw 3 horizontal lines using drawHLine, first the aqua line before the green pixels, then the green pixels, and last the aqua line after the green pixels. We drew 3 horizontal lines per row. To get the black box, we neglected the instructions for boxes within the area of (Columns 2-5 and Rows 2-4). Lastly, add the text "VOLUME" with the lcdPrint function. The function is labeled AQUABLUE() for reference.

Report where you acquired your LCD from, and include a photo of the front and back of the LCD with your report. (Let us know if you got it on time and if you had any problems getting it setup.)



Explain how you integrated the LCD and the Rotary Encoder using QP-nano.

The FSM is used from Lab 2A. When the encoder is turned in a certain direction, a signal is sent to the QSM. The QP nano FSM handles what is drawn on the LCD screen (drawing the background or volume bar for example).

Explain how you detect inactivity and how you quickly remove the overlay graphic or text.

The AXI timer measures a time frame after an interrupt is called and evaluates whether the time frame exceeds 2 seconds. Once an interrupt is triggered, the timer stores that time in variables called VolumeTimeOut and TextTimeOut. The timeout variables are then incremented until the value is greater than or equal to 2 seconds and the volume bar disappears.

Draw a statechart that models the behavior of your system.