EEL4511 Real-time DSP Applications
Lab 9 Final Project

Title: Real-Time Pitch Shifter

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Abstract:

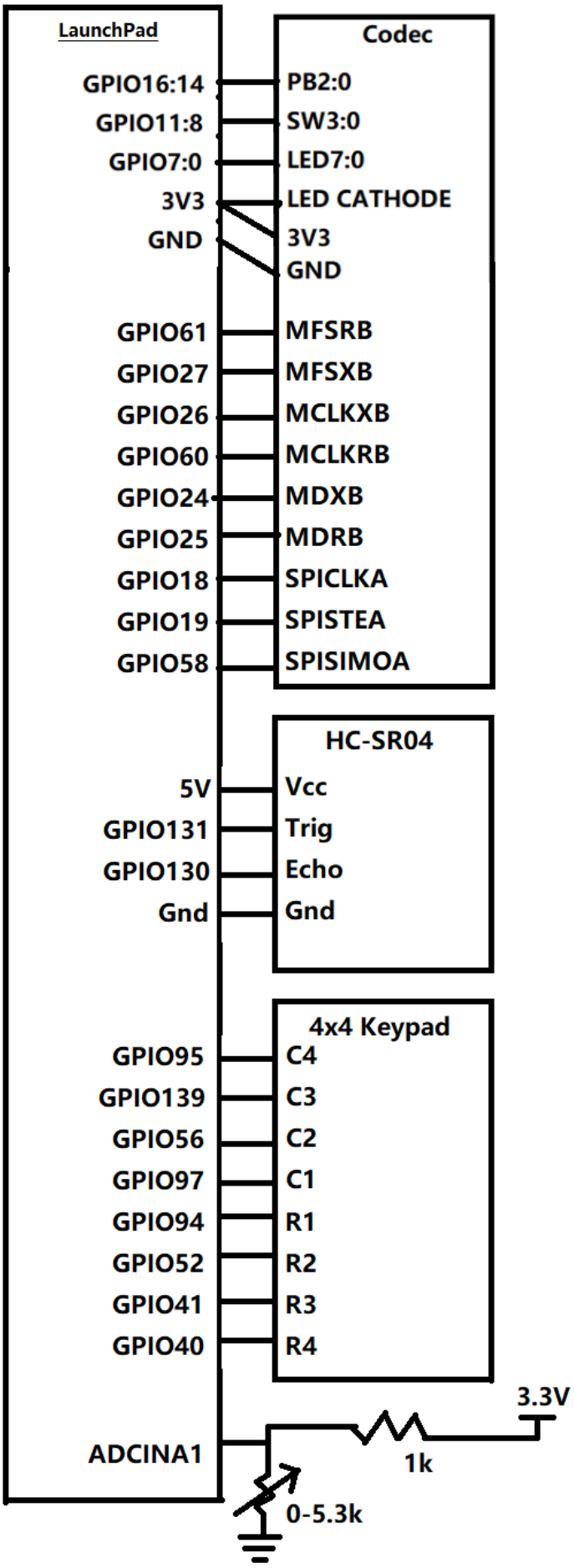
The main goal of this project is to create a real-time pitch shifter that uses a phase vocoder to do time stretching and uses interpolation to shift pitch.

Features:

1. Fs=48kHz
2. 512-point FFT, with 50% overlap
3. Real-time phase vocoder
    a. Interpolation in the frequency domain
    b. Switch between rectangular and polar coordinate
    c. Handles up to 2x time stretching in real-time
4. Pitch shifting control:
    a. HC-SR04 distance sensor mode
        i. 0m < distance < 1m : linear pitch-shifting increment from 0.5x to 2x continuously
        ii. Distance > 1m: pitch shifting = 1x
    b. 4x4 Keypad mode
        i. Continuous mode: when no key is pressed, play original sound (1x)
        ii. Non-continuous mode: when no key is pressed, mute output
        iii. In both modes: pitch shifting = 0.5+0.1*keyNum
            1. Range from 0.5x to 2x
            2. Increment is discrete
5. Volume control:
    a. Uses an ADC to sample the voltage on a potentiometer
    b. Volume increases quadratically with the voltage
6. A bug I was not able to fix:
    a. The average output rate of my algorithm is slightly different from the sampling frequency due to rounding error. Therefore, occasionally, the output DMA will collide with my writing to the output buffer, which results in a short-disordered sound.

b. **Remedy: I used a huge output buffer (16384 floating points) to make this happen less frequently, but I was not able to completely eliminate it.**

Grade:


LaunchPad
Codec
GPIO16:14
PB2:0
GPIO11:8
SW3:0
GPIO7:0
LED7:0
3V3
LED CATHODE
GND
3V3
GND
GPIO61
MFSRB
GPIO27
MFSXB
GPIO26
MCLKXB
GPIO60
MCLKRB
GPIO24
MDXB
GPIO25
MDRB
GPIO18
SPICLKA
GPIO19
SPISTEA
GPIO58
SPISIMOA
HC-SR04
5V
Vcc
GPIO131
Trig
GPIO130
Echo
Gnd
Gnd
4x4 Keypad
GPIO95
C4
GPIO139
C3
GPIO56
C2
GPIO97
C1
GPIO94
R1
GPIO52
R2
GPIO41
R3
GPIO40
R4
3.3V
ADCINA1
1k
0-5.3k