**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**
   1. **Interpolation in the frequency domain**
   2. **Switch between rectangular and polar coordinate**
   3. **Handles up to 2x time stretching in real-time**
4. **Pitch shifting control:**
   1. **HC-SR04 distance sensor mode**
      1. **0m < distance < 1m : linear pitch-shifting increment from 0.5x to 2x continuously**
      2. **Distance > 1m: pitch shifting = 1x**
   2. **4x4 Keypad mode**
      1. **Continuous mode: when no key is pressed, play original sound (1x)**
      2. **Non-continuous mode: when no key is pressed, mute output**
      3. **In both modes: pitch shifting = 0.5+0.1\*keyNum**
         1. **Range from 0.5x to 2x**
         2. **Increment is discrete**
5. **Volume control:**
   1. **Uses an ADC to sample the voltage on a potentiometer**
   2. **Volume increases quadratically with the voltage**
6. **A bug I was not able to fix:**
   1. **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.**
   2. **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:**

**A screenshot of a cell phone

Description automatically generated**