EE113D - DIGITAL SIGNAL PROCESSING DESIGN

LAB 2: VOICE TRANSFORMATION

DURATION: 2 SESSIONS

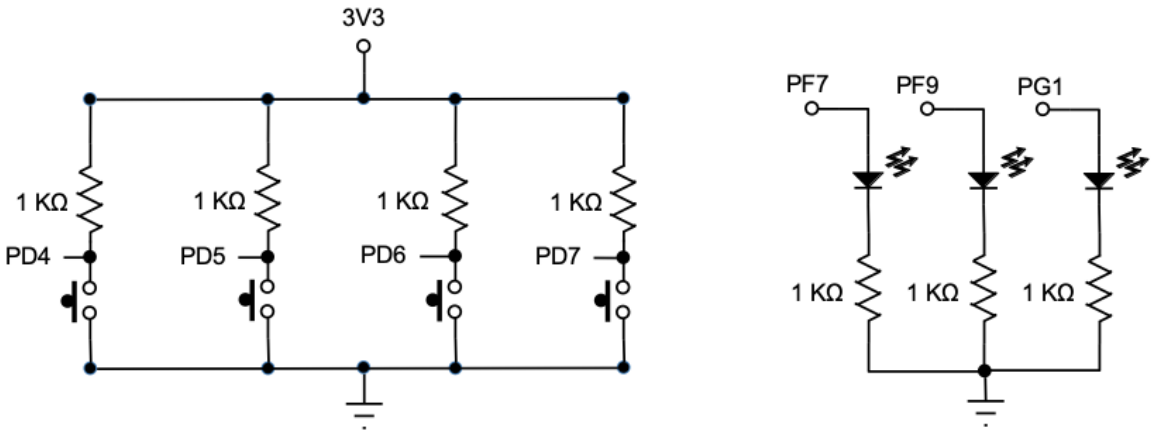
In this part of the lab, you will be asked to implement a DSP based player & recorder. You will need to construct your own breadboard setup for push buttons and LEDs. Make sure that you are familiar with how to read the change of the switches and how to control the LEDs.

NOTE: It is a good idea to download and start with the Base Voice Demo from CCLE, under Week 2. But be careful: you will need to check the project setup to be sure that all the settings are appropriate for the experiment.

ALSO, it is a very good idea to to use the plotting facility that you used in Lab 1. Try voicing "a-a-a-h" for 1-2 seconds before clicking on the green arrowhead, and maintain the voicing for 1-2 seconds after clicking. Plot out only the first 500 samples or so. If things are working correctly, you will see a definite pattern that we can instantly recognize as being correct. Another test is to begin counting, and click on the arrowhead at three, and keep counting to 6.

THIRDLY: To check your reverb code, test it with a single staccato sound, such as a quick click with your tongue.

On the breadboard, you will need four push buttons and three LEDs. Please refer to lecture for more details. As you build and modify your circuit, please make sure your H7 board is not powered on. And employ other electrical engineer's common sense as well to protect your H7 board. This is the schematic you will implement:



You may choose the mapping between pushbutton number and pin number.

You should follow the specifications as stated below:

A. Sampling rate: 8 Ksps

B. No button is pressed: the program waits for one to be pressed.

C. When you press the first button:

    a. The LEDs flash in succession, one by one. Each LED turns on for 1 second, with no time gap between one LED turning off and the next LED turning on.

    b. When the last LED turns on, begin recording for one second. The last LED becomes the signal to speak into the microphone. This is the ONLY time that the buffer is updated with new samples from the microphone.

    c. Store a 1-second recording of you speaking your name. USE A MICROPHONE. DO NOT RECORD MUSIC; RECORD YOUR FULL NAME.

    d. Delay for ½ second.

    e. Play the recording back at normal speed.

D. Depending on the button action, make the following transformations to the recorded speech and play it out of the speaker.

    a. Second button is pressed: create a *reverb*. Send out through the speaker (at normal speed) the recorded speech added to a delayed version of it at 2/3 the amplitude. The delay should be 70 msec. The effect is similar to standing in the middle of a large room with one smooth concrete wall about 40 feet away, and speaking your name. You can check this effect by recording one short, sharp staccato click sound.

    b. Third button is pressed: Keeping the sample rate the same, speed up the recorded speech by a factor of ⅓ and send it out through the speaker. It means the voice is now $^4/_3$ regular speed, it will finish in ¾ of the regular speed time. This operation requires you to do some interpolation to make it sound natural. See the lecture for more details.

    c. Fourth button is pressed: keeping the sample rate the same, slow down the recorded speech by a factor of 2 and send it out through the speaker.

E. Every time you press the first button, the old recorded sound is erased, allowing you to record a new sound after last LED turns on.

F. When demonstrating your project:

    a. You are only allowed to load the program ONCE.

b. We will test the functions you implemented by pressing the buttons in RANDOM order.

Report requirements:

- The report should include the objectives of the experiment, illustrations of your results, and discussion of the results and explanation of things that did not go as planned.
- Project will be demonstrated, before the due date, to the instructor or to the TA, who will mark you as success.
- Include the C code that you wrote in between the USER CODE BEGIN and END sections in the report.