

Microprocessor-Based Systems (E155)

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Lab 5: Digital Audio

Requirement

Build a system to play music on a speaker. Use your Pi, a LM386 audio amplifier, and an 8-ohm speaker. The Pi should read a list of notes specifying the pitch (in Hz) and duration (in ms) of each note. It should generate a corresponding sequence of square waves. A period of 0 indicates a rest (silence for the given duration). A duration of 0 indicates the end of the song. Test your system on the score of Fur Elise, which is provided.

Discussion

You can find lab5_starter.c on the class web page with the Fur Elise score and pioInit() function.

The GPIO pins don't generate enough output current to play satisfactory music directly on the speaker, so use an LM386 audio amplifier between the Pi and the speaker. Do not connect the Pi directly to the speaker, as the current draw could damage the BCM2836. The datasheet shows AC coupling from the amplifier to the speaker, but you can leave out the capacitors and resistors and produce an acceptable square wave. Volume control is optional. There are only a limited number of speakers available in the lab so ***please leave the speakers in the supply cabinet when you leave lab.*** Do not leave them attached to your breadboard when you are done working.

Extra Credit

Up to one point of extra credit can be earned if you compose and play a different tune. The following information may help as you compose your music.

The duration depends on an arbitrary choice of tempo (speed at which the piece is played). If a whole note is chosen to be $\frac{1}{2}$ second long, other notes follow accordingly:

Duration	Seconds
Sixteenth	0.03125
Eighth	0.0625
Quarter	0.125
Half	0.25
Whole	0.5

LABORATORY #5: DIGITAL AUDIO

Recall that the A above middle C (called A4) is 440 Hz and that an octave spans a factor of 2 in frequency. There are twelve notes in an octave spaced evenly on a geometric scale, so each is separated in frequency by a factor of $2^{(1/12)}$.

Note	Frequency (Hz)
A3	220
A sharp / B flat	233.1
B3	246.9
C3 (middle C)	261.6
C sharp / D flat	277.2
D3	293.7
D sharp / E flat	311.1
E3	329.6
F3	349.2
F sharp / G flat	370.0
G3	392.0
G sharp / A flat	415.3
A4	440
A sharp / B flat	466.2
B4	493.9
C4	523.3
C sharp / D flat	554.4
D4	587.3
D sharp / E flat	622.2
E4	659.2
F4	698.4
F sharp / G flat	740.9
G4	784.0
G sharp / A flat	830.6
A5	880