

Audio Analyzer

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Agenda

Team Number: 3

Project Title: Audio Analyzer

- Design Overview
- Technologies Used
- Final Schematic
- Technical Hurdles
- Signal Analyzation in MATLAB
- Arduino Sampling Method
- LED Display Implementation
- Future Challenges

Team Members

Andrew Pehrson:

Henry Gillespie:

Jordan Hendricks:

Project Task

Arduino / FFT / LED Implementation

Arduino / MATLAB / FFT / Hardware

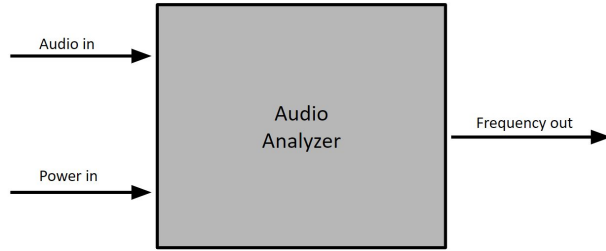
Hardware / Schematic / Presentation

Project Requirements

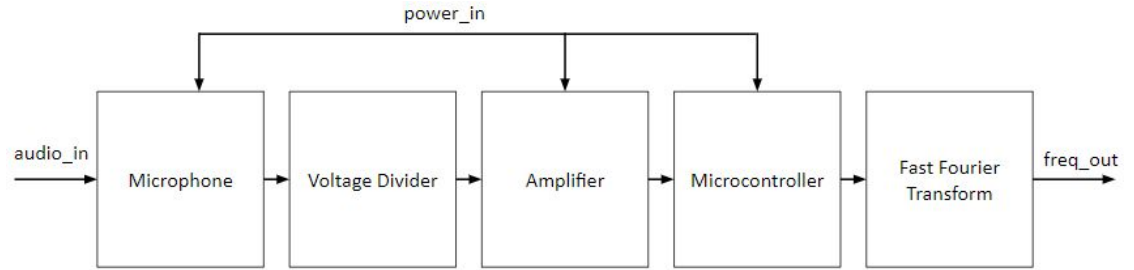
- Detect 8 notes in the range C(261 Hz) to high C(523 Hz) at $\pm 5\%$ accuracy
- Audio must be analyzed from at least 10 ft away
- More than 20 samples must be acquired for the detected period
- At least 3 periods of data must be recorded and graphed
- The signal to noise ratio must be at least 20

Design Overview

Black Box Diagram



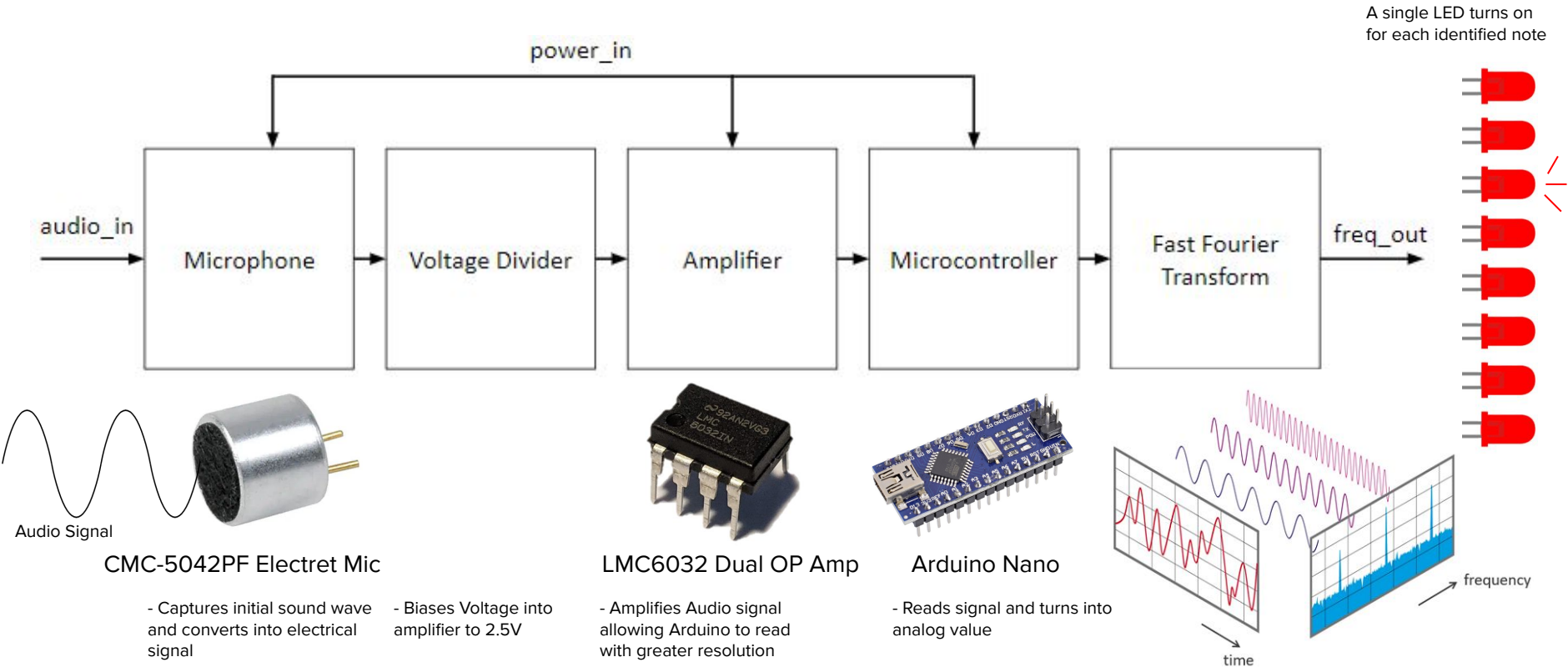
Block Diagram



Frequencies to Analyze at $\pm 5\%$ Accuracy

	Middle C	D	E	F	G	A	B	C
High	274.7	308.4	339.5	366.7	411.6	462.0	508.1	549.5
Middle	261.6	293.7	329.7	349.2	392.0	440.0	493.0	523.3
Low	248.5	279.0	313.2	339.5	372.4	418.0	468.4	508.1

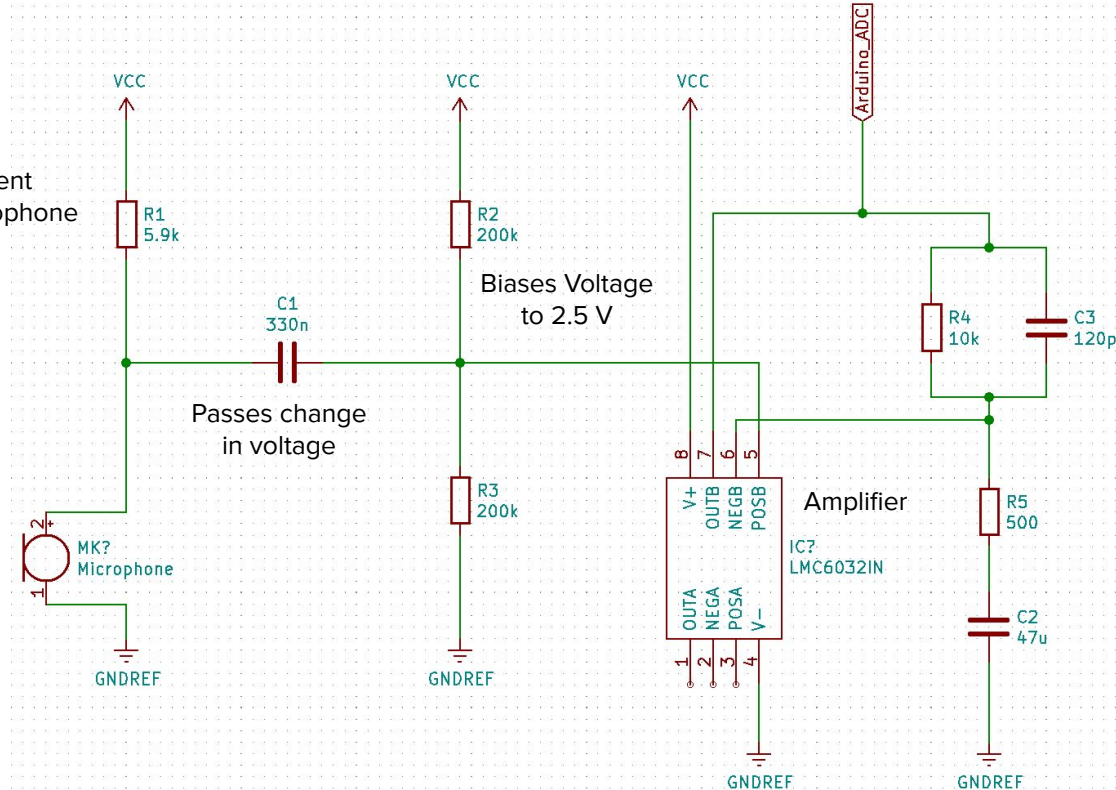
Integrated Technologies Used



Final Schematic

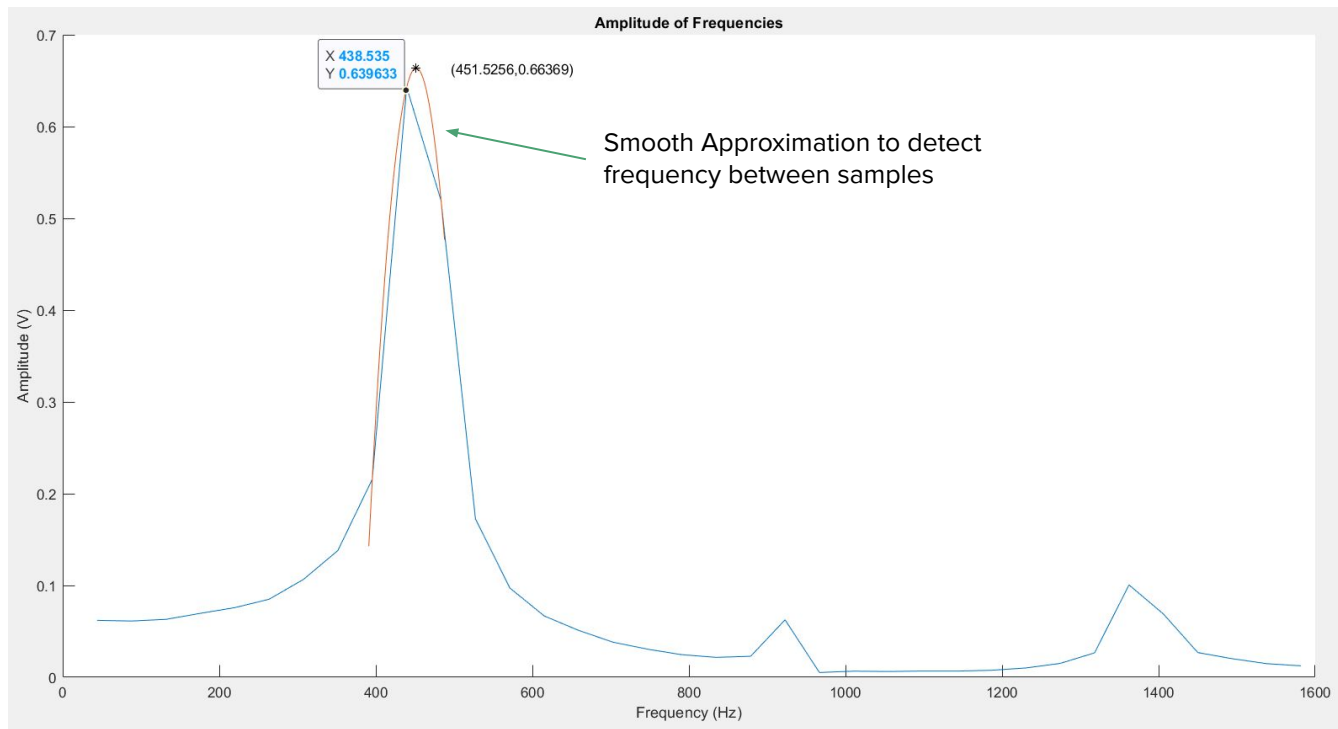
Voltage converted to ADC value

Sets bias current
specified by microphone



Sets the voltage
gain to the Arduino

Technical Hurdles



Fourier Transform of the input signal

Note Tested: A

Frequency: 460 Hz

Speaker Distance: 0in

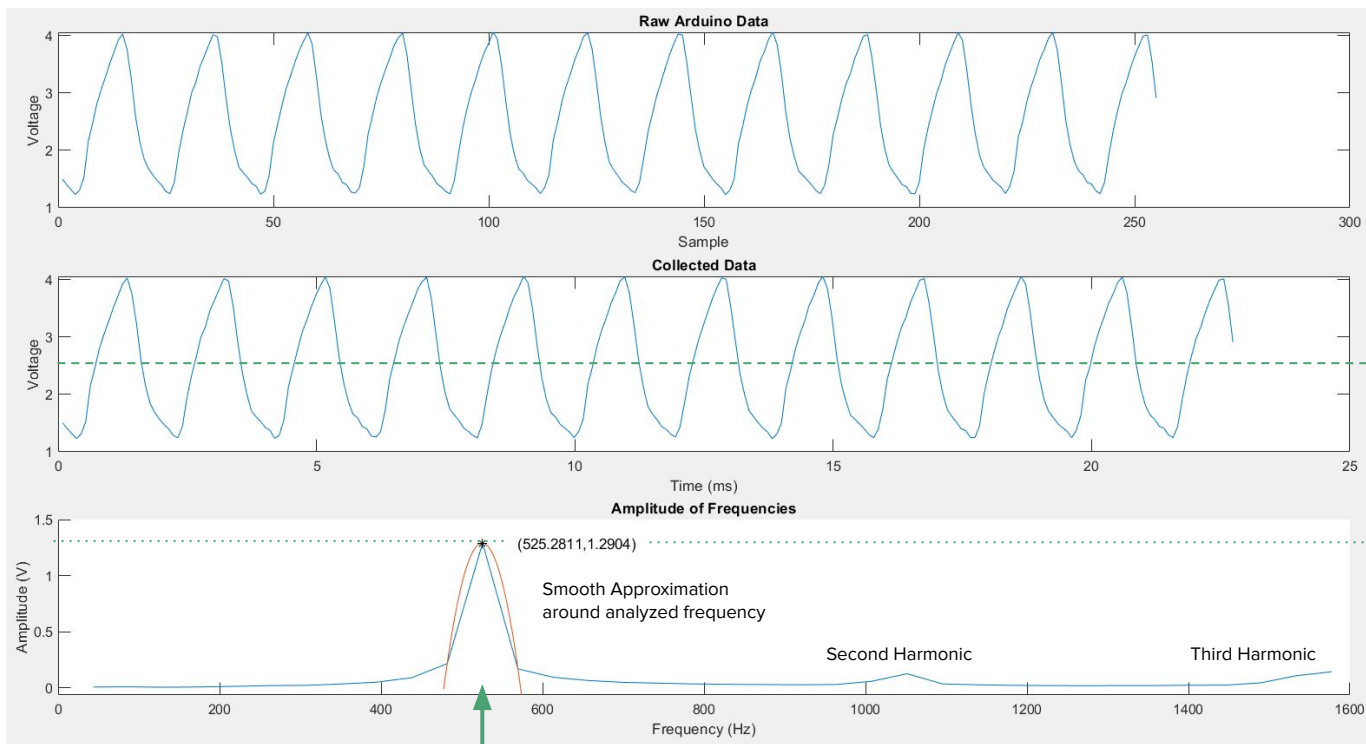
Frequency Resolution too low

Analyzed Frequency without Approximation: **438.5 Hz**

Analyzed Frequency with Approximation: **451.5 Hz**

Frequency Difference: **13 Hz**

Matlab Graphs



Note Tested: High C

Frequency: 520 Hz

Speaker Distance: 0in

Clean Signal

Biased at 2.5V

Amplitude > 1V

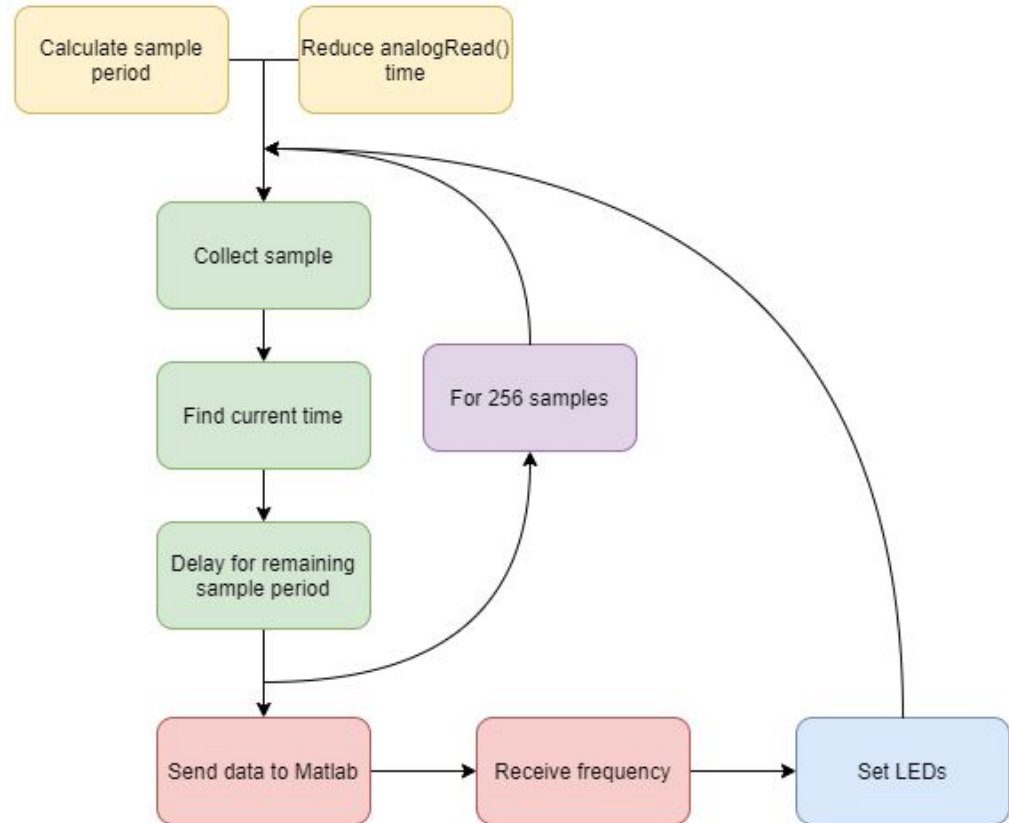
Fourier Transform of the input signal

Analyzed Frequency: 525.3 Hz

Signal to Noise Ratio: 30.8 dB

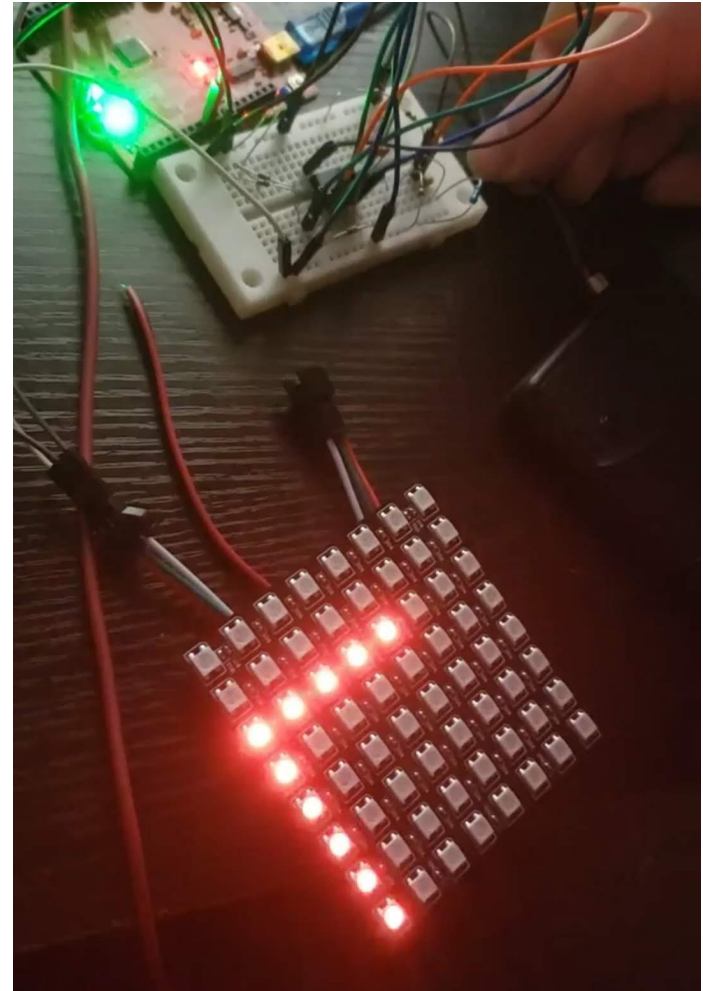
Arduino Sampling Method

- Sample at >10.5 kHz (once every $95\text{ }\mu\text{s}$)
- Need at least 120 samples to graph 3 periods at 261 Hz
- More samples increase FFT resolution

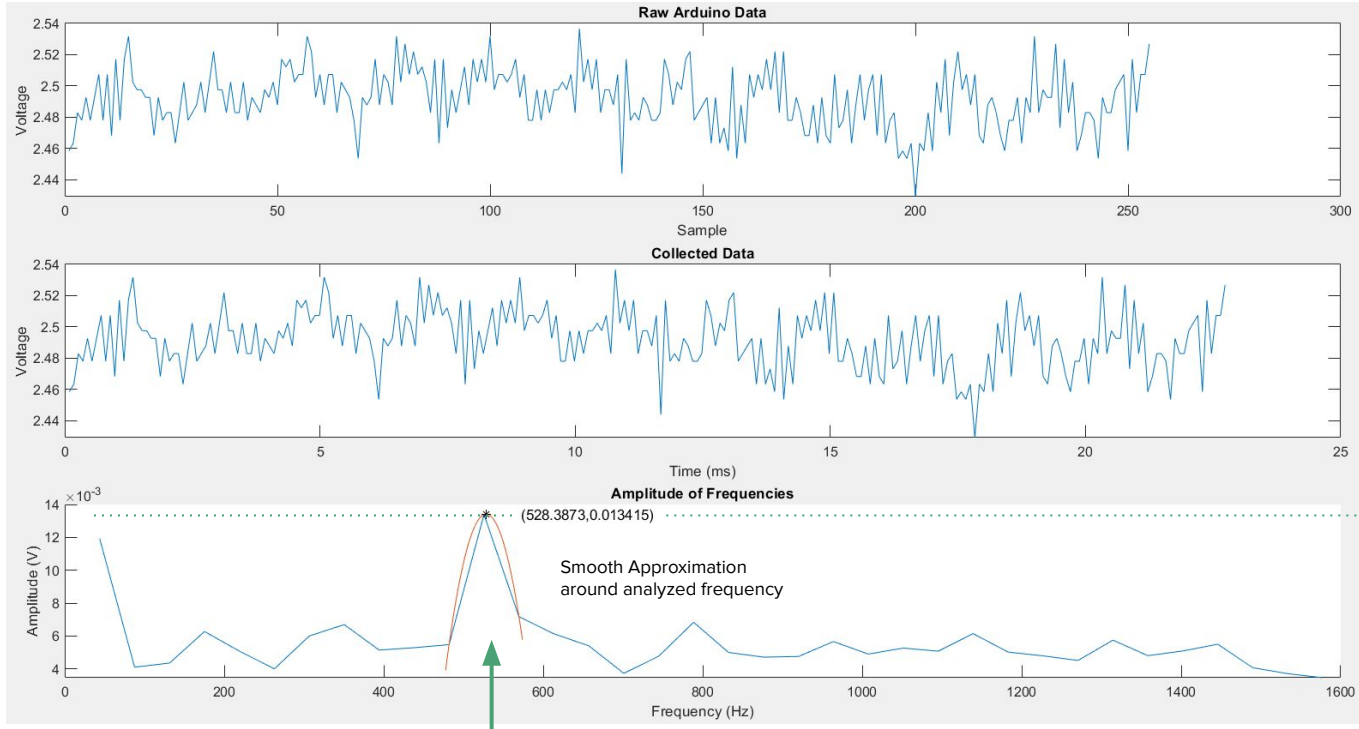


LED Display

- Display[] stores mean Amplitude for note
 - Display[] sent to Arduino
 - Amplitude for later 8x8 LED matrix
- Current challenge:
Data getting messed up in serial connection



Future Challenges



Note Tested: High C

Frequency: 515 Hz

Speaker Distance: 5ft

Noisy Signal

Amplitude $\ll 1V$

Fourier Transform of the input signal

Frequency Analyzed: 528 Hz

Signal to Noise Ratio: -4.5 dB

Next steps

- Multi-stage audio amplifier
- Better refine bandpass filter
- Adaptive gain
- Make pcb
- Design enclosure

