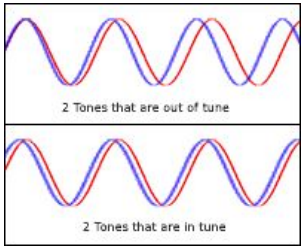
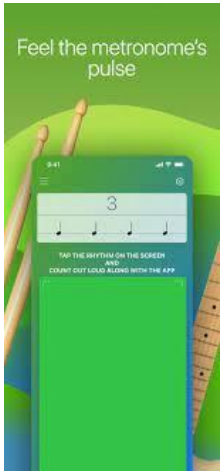
Use Case

Harmony Instruction Tool



ECE Areas: Signals, Software

Existing Tools



Use Case Requirements: Signal Processing

Pitch Accuracy	± 3 cents
Rhythm Accuracy	± 10 milliseconds
Optimal Noise Bound	< 30 decibels

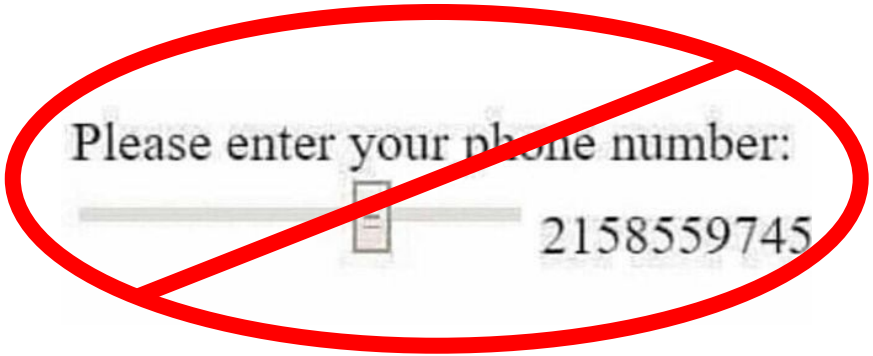
Tuning Parameters: 12-Tone Equal Temperament, A = 440 Hz

Use Case Requirements: User Interface

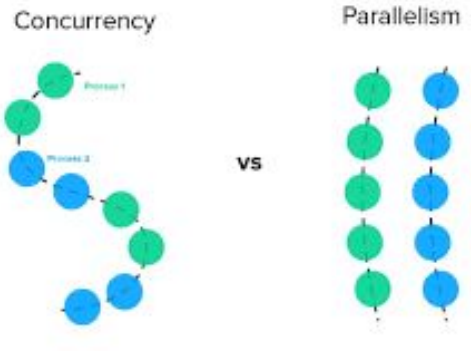
Visual Accuracy	± 10 milliseconds

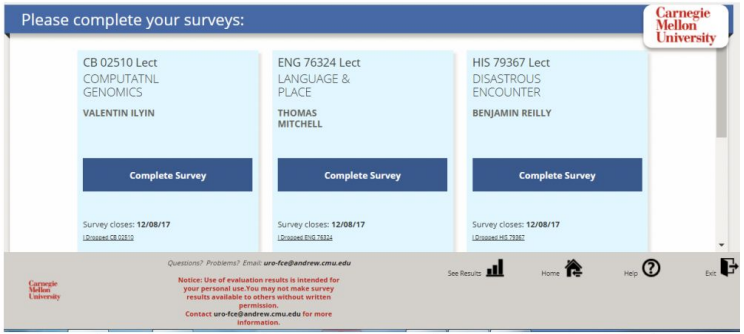
- Visual feedback is easy to understand
- User has control over testing parameters
- Metronome is accurate within 10 ms of user set bpm
- Changes to viewing area correspond with user based parameters

Technical Challenges

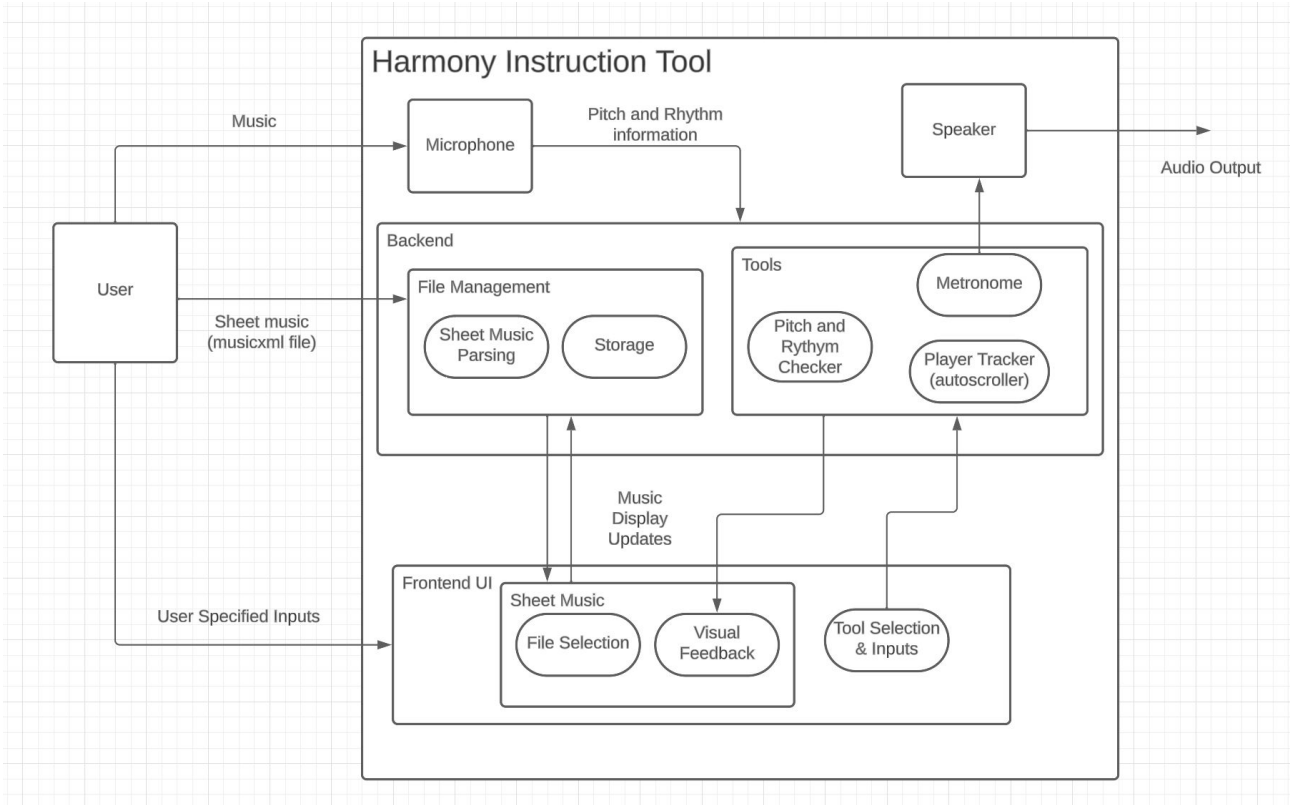


Risk Mitigation



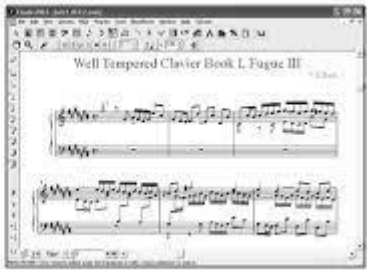


Solution Approach



Current Implementation Ideas

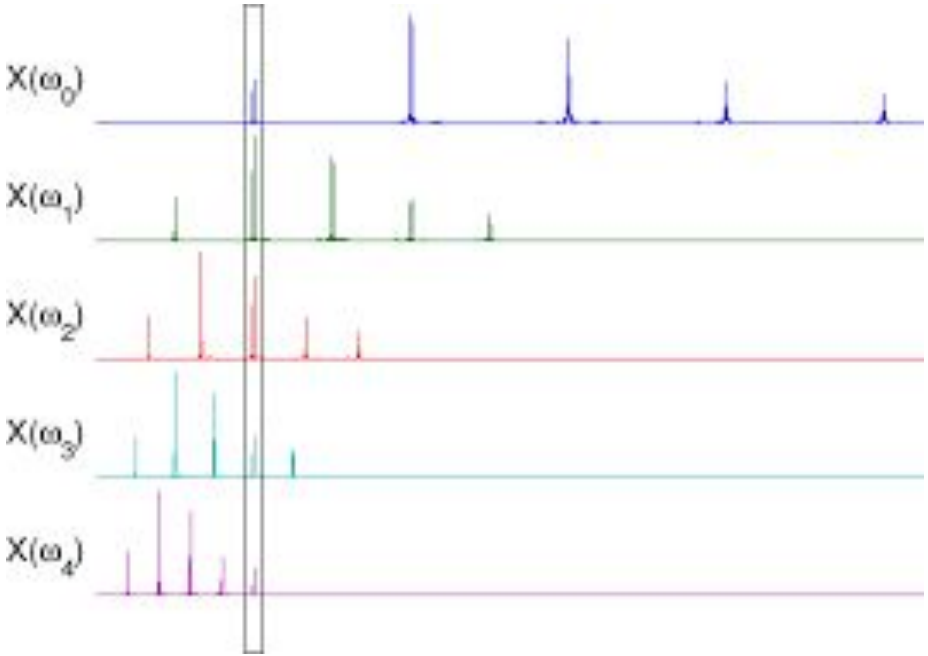
React Native



ARDUINO

iOS

Algorithms



+

$$\hat{\rho}_k = \frac{\sum_{t=k+1}^{T} (r_t - \bar{r})(r_{t-k} - \bar{r})}{\sum_{t=1}^{T} (r_t - \bar{r})^2}$$

Testing, Verification, and Metrics

Test Data: Audio recordings, live performance, static testing, and user survey's and feedback

Multiple Instruments: voice, piano, trombone, and violin

Varying Environments, Pieces, Tempos, and Dynamics

Tasks and Division of Labor

Max:

- Signal Processing
  - Pitch detection algorithm
  - Rhythm detection algorithm
  - Music tracking algorithm
  - Internal representation of music
  - Audio input handling

Jerry:

- User interface
  - Music xml file parsing
  - Visual representation of music
  - Visual feedback
  - File management
  - Implement user input parameters

Schedule

TASK TITLE	TASK OWNER	START DATE	DUE DATE	PCT OF TASK COMPLETE
Project Planning				
Proposal Presentation Slides	Max J/Jerry F	9/11/23	9/17/23	100%
Design Presenation Slides	Max J/Jerry F	9/20/23	10/1/23	25%
Design Review Report	Max J/Jerry F	10/2/23	10/13/23	50%
Final Presentation Slides	Max J/Jerry F	11/26/23	12/3/23	
Project Implementation				
Pitch detection research	Max J	9/18/23	9/21/23	0%
Note detection research	Max J	9/22	9/25/23	0%
"Shazam" algorithm research	Max J	9/26/23	9/29/23	0%
Audio Input Handling	Max J	10/1/23	10/7/23	0%
Research on module options	Max J	10/8/23	10/14/23	0%
Audio input system setup	Max J	10/15/23	10/16/23	0%
Pitch detection algorithm	Max J	10/17/23	10/24/23	0%
Note detection algorithm	Max J	10/25/23	10/29/23	0%
Internal Music Representation	Max J	10/30/23	10/31/23	0%
Rythym checking algorithm	Max J	11/1/23	11/5/23	0%
"Shazam" algorithm creation	Max J	11/6/23	11/12/23	0%
Visual Feedback Communication	Max J	11/13/23	11/15/23	0%
Pitch/Rythym Testing	Max J	11/16/23	11/20/23	0%
Shazam testing	Max J	11/21/23	11/26/23	0%
Extra testing/ extra time if done with final slides	Max J	11/27/23	12/1/23	0%
				0%
App tech stack research	Jerry F	9/18/23	9/22/23	0%
Musicxml familiarizing	Jerry F	9/25/23	9/26/23	0%
Frontend design research	Jerry F	9/27/23	9/29/23	0%
File management options research	Jerry F	10/2/23	10/3/23	0%
Research Slack time	Jerry F	10/3/23	10/6/23	0%
App development environment setup	Jerry F	10/9/23	10/13/23	0%
File management	Jerry F	10/16/23	10/20/23	0%
Musicxml file parsing	Jerry F	10/23/23	10/27/23	0%
Visual representation of music	Jerry F	10/30/23	11/1/23	0%
Implement user parameters	Jerry F	11/1/23	11/3/23	0%
Visual feedback	Jerry F	11/6/23	11/10/23	0%
Testing and Verification				
Tuner Testing and Debugging	Max J/Jerry F	11/13/23	11/15/23	0%
Rhythm Checker Testing and Debugging	Max J/Jerry F	11/15/23	11/17/23	0%
Beta Testing (getting people to try it out)	Max J/Jerry F	11/20/23	12/1/23	0%
Slack Time	Max J/Jerry F	12/1/23	12/8/23	0%

9/18 - 9/22					9/25 - 9/29					10/2 - 10/6					10/9 - 10/13					10/16 - 10/20					10/23 - 10/27					10/30 - 11/3					11/6 - 11/10					11/13 - 11/17					11/20 - 11/24					11/27 - 12/1					12/4 - 12/8				
M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F