

Milestone 2 Progress Evaluation (10/28)

1. The Music Assistant

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2. Faculty Sponsor: Dr. Thomas Eskridge, teskridge@fit.edu

3. Client: Professor Elizabeth Dopira, Director of Choral and String Studies at FIT

4. Progress of current Milestone (progress matrix)

Task	Completion %	Daniel Griessler	Daniel Levy	Javier Muñoz	Todo
JavaScript Pitch Detection Library Research	100%	0%	100%	0%	None.
ML5 Pitch Detection Integration	100%	60%	40%	0%	None.
Connect AlphaTab and ML5 Pitch Detection	100%	90%	10%	0%	Fix bugs that came up with bar cursor and adding in options for rendering. Be able to select what part with which to sing along.
UI Design (Home page, practice selection page, and practice page)	100%	0%	100%	0%	None.
Code Practice Page (not including (6) below)	100%	0%	100%	0%	None.
Integrate AlphaTab and ML5 Pitch Detection into Test Website	100%	95%	5%	0%	None.
Integrate AlphaTab and ML5 Pitch Detection into Main Website	20%	3%	17%	0%	Work out kinks in getting code properly integrated with React.
Replace demo Sheet Music with selection(s) from Client	10%	100%	0%	0%	Given one piece of sheet music, we have added one page to AlphaTab
Aubio Research: Beats, Tempo, and Notes	100%	0%	0%	100%	Possibly integrate Aubio as a server-side application for the post-analysis

5. Discussion (at least a few sentences, ie a paragraph) of each accomplished task (and obstacles) for the current Milestone:

- JavaScript Pitch Detection Library Research
 - Researched possible integration of Aubio client-side. The determination was that this would be quite difficult because Aubio is written in C++. A decision was made to look for a new pitch detection library written in JavaScript (to run client-side). ML5 pitch detection was selected based on accuracy and ease-of-use. ML5 pitch detection is a pre-trained Tensorflow model.
- ML5 Pitch Detection Integration
 - Used P5, a JavaScript library that can sketch drawings as well as read microphone input. Using a developed model from ML5, we can use the microphone stream from P5 to receive what pitches the user is producing and then render it on the web page. This can be embedded easily since both libraries are written in JavaScript.
- Connect AlphaTab and ML5 Pitch Detection
 - We had a few bugs with the AlphaTab's bar cursor behaving erratically when parts were selectively presented which we need to discuss with AlphaTab's main developer. We also will be including customization options using AlphaTab's API to select which tracks to display, mute specific tracks, make a specific track, and include other customization options for rendering.
 - Finally, we will also be adapting the script so that you can select which part to sing along with since it currently defaults to the top track that is drawn.
- UI Design (Home page, practice selection page, and practice page)
 - Sketch was used to create the UI design for the following pages
 - Home Page: Holds the last piece of music that the user played
 - Practice Selection Page: A list of the most recent pieces of music played
 - Practice Page: Real-time practice
 - Dan Levy has experience with both Sketch and UI design. While this task took some time, there were no major issues.

- Code Practice Page (not including AlphaTab and ML5 integration)
 - Created a development environment with React (UI library) and Firebase (website hosting). Confirmed that the development environment could be replicated on all team members' computers. There was one small expected hiccup, but the problem was quickly resolved.
 - Coded the practice page using React. Over the last few weeks, Dan Levy has been learning React (and continues to learn). Getting the website up and running took more time than anticipated, but is expected to speed up development in the future.
- Integrate AlphaTab and ML5 Pitch Detection into Test Website
 - We were able to combine ML5, P5, and AlphaTab together for a cohesive experience. When you start the playback using AlphaTab, the note that the microphone is picking up is rendered onto the web page on the score at the correct position.
 - An alternative tool NoteFlight was explored as a replacement for AlphaTab. Although it has superior representation and playback in some respects, it also requires a paid service and is more difficult to integrate into our overall design. We will use NoteFlight in place of AlphaTab if we can't bring AlphaTab up to the same quality. Currently, we decided to stick with AlphaTab for representation and playback.
- Integrate AlphaTab and ML5 Pitch Detection into Main Website
 - The team had planned to have AlphaTab and ML5 pitch detection integrated into the main website for this milestone, but some problems with the way AlphaTab is written and its compatibility with React has caused development problems. Dan Levy believes that he has found a solution, but the solution has not yet been completed. Note, however, that the team does have a working integration on a test website (not using React).
- Replace demo Sheet Music with selection(s) from Client
 - We received a sample piece of sheet music from our client, Professor Dopira, and were able to import and render the first page. We were concerned about importing more than the first page since we are hosting publicly, and we don't want to encounter copyright issues. The process of importation was manual. One of the additional features we hope to achieve by the end of the project is to have an automatic importer.
- Aubio Research
 - While we switched over to ML5 and P5 for the real-time analysis on the client side, we were able to obtain the timestamps of beats in recordings along with the overall tempo. While this can be done in real-time, we're relying on ml5 so that all real-time functions can take place client side. The ability of aubio to extract beats, tempo, and midi-like notes could possibly be used on a server-side post-analysis.

6. Discussion (at least a few sentences, ie a paragraph) of contribution of each team member to the current Milestone:

- Daniel Griessler: I went through about 30 hours of video on Udemy covering the basics of Node.js which we might use for our back-end server. After Dan Levy found ML5 and P5, I integrated ML5, P5, and AlphaTab together into the current website that we have working. I assisted Dan Levy beginning to integrate the logic I had developed into the main website. I fixed bugs as they came up in AlphaTab and kept in touch with the main developer to fix issues as they came up.
- Dan Levy: I went through 7 hour React course on Treehouse and began a 47 hour React course on Udemy. My first task for the milestone was to create a UI design for the home page, practice selection page, and practice page. This was completed without any problems. My next task was to research a new pitch detection library to replace Aubio. I had initially done some research on how to integrate Aubio client-side, but this proved to be difficult because Aubio is written in C++. I ended up selecting the ML5 pitch detection library which is written in JavaScript. Daniel Griessler handled the integration of AlphaTab and ML5 in a test website. My final task was to code the practice page using React. Everything except for the integration of AlphaTab and ML5 has been completed. This integration has been difficult due to the way React integrates JavaScript files. I believe that I have found a solution, but most likely won't have the fix ready for this milestone presentation.
- Javier Muñoz: I went through most the 11 week Andrew Ng Machine Learning Course on Coursera in order to prepare for the exercise generation, but we ultimately decided to rely on more rule-based techniques for the initial exercises, and only later rely on machine learning when we've gathered data about how much the exercises actually improve student performance. I also created a program that combines several of Aubio's functions in order to detect the beats and tempo of audio streams. It should be possible to in turn adapt this to analyze recordings.

7. Plan for the next Milestone (task matrix)

Task	Daniel Griessler	Dan Levy	Javier Muñoz
Finish Integration of AlphaTab and ML5 Pitch Detection into Main Website	2%	98%	0%
Code Home Page Template (no real data)	0%	100%	0%
Code Practice Selection Page	0%	100%	0%
Design Real-Time Feedback UI	33%	33%	33%
Improve P5 Note Drawing	95%	5%	0%
Improve AlphaTab rendering and add options	100%	0%	0%
Exercise Generation - Basics	0%	0%	100%
Post Analysis Program- Basics	0%	0%	100%

8. Discussion (at least a few sentences, ie a paragraph) of each planned task for the next Milestone or "Lessons Learned" if this is for Milestone 6

- Finish Integration of AlphaTab and ML5 Pitch Detection into Main Website
 - As was mentioned previously, the integration needs to be completed. The team believes that a fix has been found, but the

integration still needs to be completed. The final integration will include AlphaTab, ML5, and dot showing the current pitch on the sheet of music.

- Code Home Page Template (no real data)
 - Based on the UI design, the home page needs to be coded using React. At this point in time, it will not have any real functionality, but may include a few placeholders to show future intensions. The home page will eventually display the last piece of music the user played, as well as singing statistics.
- Code Practice Selection Page
 - Based on the UI design, the practice selection page needs to be coded using React. The team needs to create some more pieces of sheet music using the AlphaTex format. Once this is complete, the practice selection page can show some of these pieces of music.
- Design Real-Time Feedback UI
 - Create a UI design for the real-time feedback that will be presented on the practice page. Some of these design options have already been discussed with the client.
- Improve P5 Note Drawing
 - Add options for selecting which part to sing-along with
 - Adjust for changes in sheet music scaling
 - Add smearing and save performance data for analysis
- Improve AlphaTab rendering and add options
 - Add options to AlphaTab rendering including selecting tracks, muting tracks, soloing tracks, and changing track volume
 - Fix playback issues with bar cursor issues
- Exercise Generation-Basics
 - Generate Basic Exercises for students to practice. These exercises should be short and have a measurable way to determine success.
 - Rhythm exercise and pitch exercise
 - Outline the method to generate exercises dynamically based off student performance and implement this method
- Post Analysis -Basics
 - Given an audio recording of student performance, extract the information about pitch, beats, tempo, and notes
 - Given the information about the student's performance and the piece they were working on, provide feedback off of that.

9. Date(s) of meeting(s) with Client during the current milestone:

10/3/2019 - Showed client demos of AlphaTab and Aubio and completed Requirements Document, Design Document, and Test Plan

10/24/2019 - Show the current integration website, choose a design for the real-time pitch detection, show the current main website design, discuss dynamic exercises

10. Client feedback on the current milestone

- Client liked the demos of AlphaTab and Aubio and the documents as they are written so far.
- Client recommended the "smear" note appear where you have a continuous line for pitch across the shet music.
- Client added requirement that the sheet music is digitally represented faithfully including metadata.
- Discussed exercise generation with Client for next milestone. Client rejected idea for generating exercises with only pitch since that deviates too far from the actual sheet music. Client approved generating rhythm exercises without pitches, however, and agreed with an iterative approach to exercise generation (master the first note, then the seconds note, etc.).
- Discussed how to represent feedback real-time. Client recommended showing pitch using a continuous line and dynamics using the thickness of the line. Client favored overall measure highlighting with typical red for bad, yellow for moderate, and green for good over cluttering the sheet music with too many symbols and information. Client agreed with stopping playback if the student is struggling for a given amount of time.

11. Date(s) of meeting(s) with Faculty Sponsor during the current milestone:

10/17/2019 - Showed AlphaTab, ML5, and P5 integration. Discussed trade-offs between AlphaTab and NoteFlight

10/25/2019 - Showed final progress and demos for Milestone 2. Discussed Milestone 3 goals.

12. Faculty Sponsor feedback on each task for the current Milestone

1. JavaScript Pitch Detection Library Research
 - a. Seems fine
2. ML5 Pitch Detection Integration
 - a. Add simple fix for background noise or research how to filter it.
3. Connect AlphaTab and ML5 Pitch Detection
 - a. Looks great.
4. UI Design (Home page, practice selection page, and practice page)
 - a. Making side menus contextual
 - b. Removing everything but the sheet music from the center
 - c. Adding authorized use only
5. Code Practice Page
 - a. Same as the UI Design
6. Integrate AlphaTab and ML5 Pitch Detection into Test Website
 - a. Looked good
7. Integrate AlphaTab and ML5 Pitch Detection into Main Website
 - a. No feedback
8. Replace demo Sheet Music with selection(s) from Client

- a. Any music works.
- 9. Aubio Research: Beats, Tempo, and Notes
 - a. Looks promising.
 - b. Add more formatting for output.

Faculty Sponsor Signature: _____ Date: _____