MusGator Proposal

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Abstract

This proposal outlines the steps for the development of an application that teaches music theory as well as the practical applications of that knowledge. This app will contain a variety of tools, including lessons and quizzes, for people with different levels of musical background, designed to engage the users and make learning music more accessible. The application will cover topics such as: pitch recognition, sight reading, and rhythm; and will include real-time feedback on users' performances so that they may track their progress. The end goal of this project is to create an accessible and enjoyable platform that allows users to better understand, and therefore appreciate, music. This application will make use of Python for sound processing, as well as a UI library for display purposes.

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Introduction & Motivation

In a world filled with music, why is it that to learn how to play an instrument, you have to seek external help? In this day and age, the form of learning how to play music has not substantially progressed past the in-person format. In a tech-driven world, we *Keyboard Warriors* find it imperative to provide an alternative to learning how to play an instrument in an accessible manner.

We are four college software engineers who have an interest in music and believe there must be other resources for novice musicians to learn musical instruments that are not reliant on in-person teaching methods. Our proposed solution is to create a web application that allows novice musicians to learn the fundamentals of music. *MusGator* will give users the ability to choose from beginner and intermediate levels where they will be able to build/enhance their skill set through interactive chord learning, pitch recognition training, and note training tests.

MusGator will help bridge the gap between in-person and fully online teaching methods. With its machine learning approach, *MusGator* is an alternative resource to learning an instrument for those who are unable to obtain in-person teaching methods. In turn, this vastly contributes to software engineering applications as it provides a more accessible means of learning music to those who are unable to obtain other teaching methods.

Objectives

The objectives for this application are to have a suite of learning and testing tools designed to help the user become more knowledgeable about music theory and more adept at applying that knowledge. The first important features are lessons about topics including sight reading, which can be split into musical notation, key signatures, rhythm, and time signatures, as

well as the application of that knowledge on an instrument of choice, most likely a piano. This would include examples of how to understand musical notation, then translate that knowledge onto an instrument. The next important features are quizzes, both practical and theoretical. The theoretical portion of the quizzes would include different styles of questions, from multiple choice to fill-in-the-blank, which tests the user on how well they understand and remember the material they just learned. The practical quizzes would test the user on how well they are able to replicate their knowledge when playing an instrument. This would require the use of sound processing to determine whether the notes or chords played are correct. The final feature would be a way for users to track their progress, which requires subdividing the lesson into sections, making learning more accessible and allowing users to recognize what they need to focus on more.

Literature Survey

To establish a method and motive for creating this project, several articles and journals were examined. “Musical Notes Identification using Digital Signal Processing” [2] by Patel and Gopi discusses a project that can identify both the pitch and duration of notes in a song. This establishes that it is possible to identify both pitch and rhythm from an audio input stream. This is vital to one of the core functionalities of this project– live performance training. Furthermore, the project in the article is shown to be quite sophisticated as it can detect both musical features within songs that have both vocal and instrumental elements. As a result, this extends the potential of this project to handle audio input.

Other examined articles discuss the importance of musical training. Schlaug et al discuss the impact that training can have on children’s brains: “Research has also demonstrated that

music training in children results in long-term enhancement of visual-spatial, verbal, and mathematical performance." [3] This cognitive improvement is not limited to adults– Chan et al show how musical training improves other aspects of cognition: "Magnetic resonance imaging has shown that the left planum temporale region of the brain is larger in musicians than in non-musicians." [1] Clearly, increasing the ease of access to musical training is a net positive for those who undertake it. As a result, creating this project will serve to benefit anyone who uses it.

This literature survey aimed to show that musical training is both feasible and beneficial from a software development standpoint. As a result, developing this project should create a valuable product that can benefit society as a whole.

Proposed Work

The goal of this section is to define the scope of this project as well as the technologies we plan to use. For this project, we plan to use a python library for sound processing in order to determine the note or chord being played, as well as a user interface library in order to effectively display the lessons and assessments to the end user in an intuitive and accessible way. These two components will work in conjunction to allow us to achieve our goal of providing a comprehensive platform for allowing people from multiple musical backgrounds to become more comfortable and engage more deeply with music.

Project Plan

The timeline of this project is the duration of the Spring 2023 academic semester. We will provide three presentations to showcase our progress and completion of the application. These presentations are scheduled for February 19th, March 26th, and a final presentation on April

16th. We will also compose a posterboard and demo of our application at a senior tech showcase at the end of the semester in April. Regarding the specifics of our project milestones, we will implement sprint planning along with the agile methodology. Our first sprint will conclude the week leading up to our February 19th presentation. It should include all planning for the project, workflow diagrams and wireframes, initial coding environment setup, and the basics of a web application. The second sprint will conclude the week leading up to our March 26th presentation and will be more focused on the application functionality and UI. We have a handful of services such as quizzes, audio input, user interactions, and feedback that we want to implement during this sprint. The third and final sprint will conclude the week leading up to our April 16th presentation. It will focus on testing and implementation, overall improvements and organization, and final project documentation. To help us, we will utilize GitHub's built-in project board functionality to assign tasks and keep track of our backlog throughout the semester.

Conclusion

The application we propose will assist users in gaining and practicing their knowledge of the music world. It will be accessible to those wishing to learn music without the need of a face-to-face learning environment. The application itself will test the user's pitch recognition, sight reading, and rhythm while providing real-time feedback based on their performance.
We will use what we have learned throughout our academic careers to create a product that will benefit the community and be accessible to others. It will be a collaborative process that combines previous research, our own technology implementations, and rigorous testing.

References

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[3] Schlaug, G., Norton, A., Overy, K., & Winner, E. (2006). Effects of Music Training on the Child's Brain and Cognitive Development. *Annals of the New York Academy of Sciences*, *1060*(1), 219-230. https://doi.org/10.1196/annals.1360.015