Department of Computer Science & Engineering
The University of Texas at Arlington

Project Charter
CSE 4316: Senior Design I
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Melody Masters
SoundSync

Angel Aguirre
Benjamin Farmer
Patrick Ferguson
Edgar Hernandez
Adrian Ramos

Revision History

Revision	Date	Author(s)	Description
0.1	06.21.2023	AR	document creation
0.2	06.22.2023	AA, AR, PF, BF, EH	Document revision with team information
0.3	06.27.2023	AA, AR, PF, BF, EH	Complete draft V1

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1 Problem Statement

Whether in the privacy of their own room or in a concert hall with an orchestra, musicians read music in order to keep track of where they are when playing. However, a common annoyance of this art is the need to turn a page! When a musician is playing a longer piece and needs to turn the page, it can be a distraction. If there were a way to leverage technology to remove this burden entirely, it could prove to be a useful tool for any musician who wants to concentrate on their playing, and not their page-turning.

2 Methodology

The Melody Masters intend to solve this problem by developing a portable device paired with a mobile application that can replace physical sheet music entirely. This application/device will be capable of scanning physical sheet music and storing it in an account for the user, listening to the user's live playing, following along with the user on the sheet music, and automatically turning the page when appropriate.

3 Value Proposition

One of the benefits of a musical product is that there are millions - possibly billions - of people who have played an instrument at least once in their life. The demand for a product that can make learning easier, make high-stakes concerts less risky, and even make organizing your music sheets a breeze will undoubtedly be apparent.

4 Development Milestones

- Project Charter first draft - June 2023
- System Requirements Specification - July 2023
- Architectural Design Specification - July 2023
- Demonstration of <feature or implementation milestone> - August 2023
- Detailed Design Specification - September
- Demonstration of <feature or implementation milestone> - September
- Demonstration of <feature or implementation milestone> - October
- Demonstration of <feature or implementation milestone> - November
- Demonstration of <feature or implementation milestone> - December
- Demonstration of <feature or implementation milestone> - December
- Final Project Demonstration - December

5 Background

Performing music is a craft that takes many hours to complete effectively. One challenge of playing a new song is reading and playing the sheet music repeatedly to understand what spots in the songs are more challenging to play than others. Also, memorizing the start and end of pages allows a smoother transition to turning the page while still playing. This makes the time to learn new music longer than if one could just focus on the notes that need to be played.

SoundSync will be an app that will follow along with the music the user is playing and progress through the sheet music in the app to allow the user to keep playing the song they are on. This will allow users to play a song at their own pace, learning how to play and focusing solely on reading and playing music. Most apps now can write sheet music based on what is being played or play sheet music for the user to hear. These are good for improving a different task at hand. Our objective is unique in allowing users to play the music they want and not worry about having a booklet of music sheets with them or the annoyance of turning the sheet music to keep playing during their performance. Our sponsor explained his passion for music and learning new songs. This app would allow our sponsor and many other music lovers to enjoy learning new music without the hassle of carrying sheet music or turning pages while playing.

6 Related Work

SoundSync will combine the features that others apps currently out in market are offering and build upon them to create an app that will do tracking of the notes played on the music sheet depending on speed and accuracy. It will also let new music be added that the user would like to play along with a pedal that will manually allow the user to flip pages if they choose to do so. The app store of both android and iOS operating systems has a dozen app based commercial products while amazon based music turners are mostly hardware products used to guide the user along with the music. Android and iOS apps currently available do not do both music tracking and manual page turning. This separation of features is a limitation for the user since the features are separated and there is a chance that the pedal will require its own app to use its full features. The PageFlip Firefly is a bluetooth/usb device that will connect to the device the user is using and is compatible with all current modern OS (MAC, Windows, iOS, Android, Linux) but this type of connectivity is expensive for the average consumer [5].

Another limitation for users is having too many apps for one subject. The frustration of multitasking between apps with no cross data transfer or seamless transition can be too much of a hassle for some users. The MusicReader, PlayScore 2 Sheet Music Scanner, RemoFinger S, SM Music Reader and Sheet Music reader are five separate apps that perform the same functions as SoundSync. These apps display music sheets, read music notes and articulation, and music page turner with compatibility of using an optional pedal. This can become an inconvenience to many users having to switch to different apps and lose their concentration in the music [1], [2], [3], [4].

7 System Overview

Our team's solution to the problem will be to create a mobile application that handles the page turning automatically. Additionally, since the application will have to recognize the music the user is playing, we will implement an extra feature to return the user's accuracy for a given song. This will streamline the user's experience and provide feedback to help them improve their playing. The general process is illustrated in the following diagram.

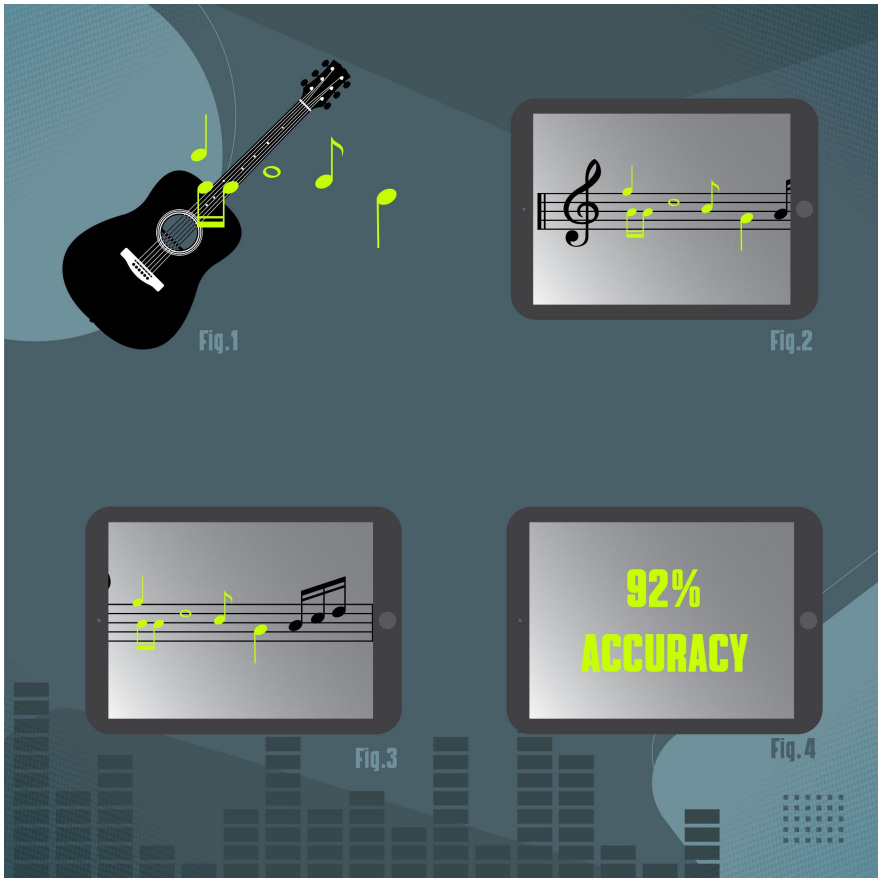


Fig.1) The user plays a song on their instrument. They will have their mobile device nearby with ScoreSync open.

Fig.2) ScoreSync will receive the music as an input, and match it to a stored set of sheet music. The application will keep track of which notes have been played, illustrated by the green music notes.

Fig.3) Once the user approaches the end of each section of sheet music, ScoreSync will display the next unplayed notes, illustrated by the black music notes.

Fig.4) If requested by the user, ScoreSync will also keep track of how well the input music matched with the expected stored music. Based on this, as well as the timing, it will provide the user an accuracy score to keep track of improvement.

8 Roles & Responsibilities

On behalf of the CSE department, Dr.Gieser will be our sponsor. All five team members are in contact with him, and the entire team will be present during sponsor feedback meetings. While working on the project, the following tasks will be the responsibility of the whole team:

- Documentation - This includes the project charter, sprint plans and reviews, and keeping up with engineering notebooks. The former three will be done during team meetings, and the notebooks will be filled out individually.
- General Research - This includes familiarizing ourselves with relevant topics such as music theory and app development tools.
- Presentations - Team members will rotate speaking roles for sprint presentations.

Separately from the team tasks, individual team members will be responsible for the following:

- Angel Aguirre - focus on hardware research and implementation, software contributions
- Benjamin Farmer - focus on software research and development, product testing
- Patrick Ferguson - focus on software research and development, development tools research
- Edgar Hernandez - focus on hardware research and implementation, software contributions, team graphics
- Adrian Ramos - Scrum Master, software research and development

It is also worth noting that these roles are somewhat fluid as we will be collaborating on most components of the project.

9 Cost Proposal

The budget for this project is $800. The majority of this will go towards the hardware components required for testing and use of the application. The main components will be the instrument and microphone, a USB audio interface for communicating with the mobile device, a backup page-turning pedal as an optional page turning method, all the corresponding cables, and an additional tablet for testing.

9.1 Preliminary Budget

Line Item	Cost
Instrument	$200.00
USB audio interface	$150.00
Backup pedal	$100.00
Microphone	$50.00
Tablet	$300.00

Table 1: Overview of preliminary budget for SoundSync

9.2 Current & Pending Support

Our $800 budget will be provided by the UTA CSE department.

10 Facilities & Equipment

For facilities we will use the music rooms located on the first floor of the UTA library. Music can be played there and with UTA-provided tablets, we can test to see if our app is working. If the music rooms don't have enough sound proofing then we will buy and bring some foam sound proof pads. We will also need some hardware components for our app. This will include a pedal so we can have the user manually turn the page if they wish. We can use our assigned budget and purchase a music pedal off Amazon or other websites like Sweetwater, Tonebox, etc. Depending upon what instrument we pick we will need to order the appropriate equipment to go along with it. If say we do a flute then we only need the flute but, if we go with a guitar then we will need to buy an ADC analog converter. This will allow us to send sound directly to our tablet device to be processed by our app, skipping the process of it being picked up by the mic. We also will need to buy any other accompanying equipment required for an electric guitar. This can all be bought from the same websites as previously mentioned with the pedal.

11 Assumptions

The following list contains critical assumptions related to the implementation and testing of the project.

- There will be an adequate music library to help us interpret musical notes on the software side.
- The UTA provided tablets will be compatible with our music turning page app.
- An open senior design lab will be available during senior design 2 for us to test our app.
- React native will be a good web design environment and the depreciated functions wont be too intrusive.
- Any music library we use will be compatible with JavaScript.
- Our group will have a good understanding of music theory allowing us to properly model it in the software environment by the time senior design 2 starts.
- A group member will be able to play an instrument or have someone outside the group play an instrument.
- We will be able to use the sound provided by the ADC analog converter.

12 Constraints

The following list contains key constraints related to the implementation and testing of the project.

- Final prototype demonstration must be completed by December 2nd, 2023
- Project members must have an individual play on a real instrument to measure speed an accuracy metrics
- Resources needed for build may be out of stock due to chip shortage or other constraints caused by pandemic
- Total development costs must not exceed $800
- Learning of music theory and musical instruments on a foundational level to begin implementaion of app based features

13 Risks

The following high-level risk census contains identified project risks with the highest exposure. Mitigation strategies will be discussed in future planning sessions.

Risk description	Probability	Loss (days)	Exposure (days)
Delay of Music theory concept grasp	0.20	5	1
Delays in shipping from online vendors	0.30	5	1.5
Finding an instrument player for testing	.25	5	1.25
ADC or pedal not available for testing	.50	14	7
App failure/Major Bugs	.75	10	7.5
Tablet port errors and issues	.20	7	1.4

Table 2: Overview of highest exposure project risks

14 Documentation & Reporting

14.1 Major Documentation Deliverables

14.1.1 Project Charter

The initial project charter will be completed by the end of sprint 1. The charter will be reviewed at the end of every sprint.

14.1.2 System Requirements Specification

Starting in sprint 2, we will have a formal meeting to discuss the specific system requirements. This document will be updated as sprints go forth.

14.1.3 Architectural Design Specification

Starting in sprint 3, we will create an initial architectural design specification document. We will review this as sprints go forth.

14.1.4 Detailed Design Specification

Starting in sprint 4, We will create a Detailed Design Specification. This document may be updated in senior design 2 if we find some parts are not up to par.

14.2 Recurring Sprint Items

14.2.1 Product Backlog

Items will be added from the SRS based on how essential they are for our app to function and perform it primary purpose. Items will be prioritized based on a numbering system of importance. The most important features being completed first. The decision to prioritize tasks will be a group decision. We are using Trello to keep track of tasks and who doing what.

14.2.2 Sprint Planning

Each sprint will be planned based on what we need to get done and what we will need for the next sprint to continue without being held back. There will be 8 sprints in total.

14.2.3 Sprint Goal

The group will decide the sprint goal. We will begin involving the customer around senior design 2 when we have actual software for them to use.

14.2.4 Sprint Backlog

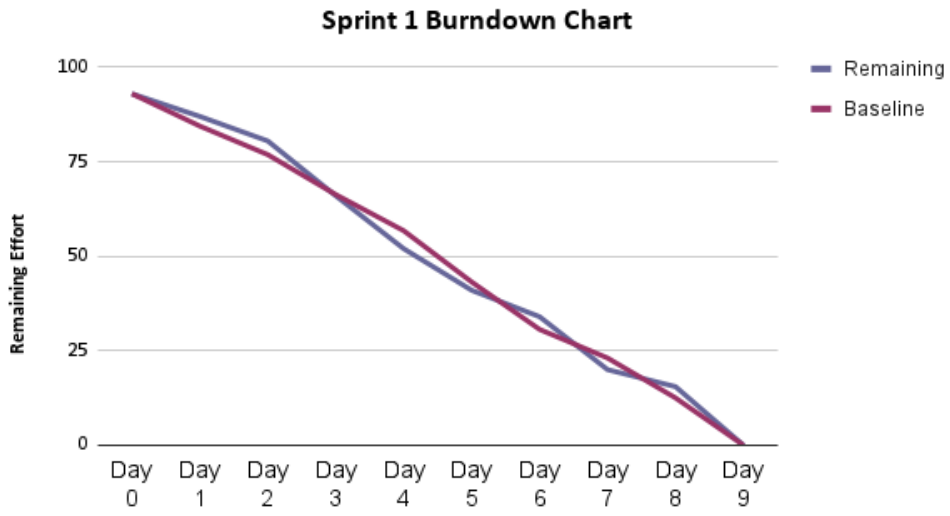
We decide as a group which items will go on the sprint backlog. The backlog will be maintained by checking it every Friday and marking what items have been completed.

14.2.5 Task Breakdown

Tasks will be claimed voluntarily first and if tasks need to be assigned the sprint master will assign tasks. Time spend on tasks will be documented through engineering notebook.

14.2.6 Sprint Burn Down Charts

The sprint burn down chart will be a group effort created by all members. All members should keep a running total of the hours put into the project creation. The burn down chart will be in a line graph format that will use the projected hours from the sprint outline to actual committed hours during the sprint.



	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed
	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9
Remaining Effort	93	87	80.5	66	52	41	34	20	15.5	0
Baseline Effort	93	84.44	76.88	66.32	56.76	43.2	30.64	23.08	12.52	0

Figure 1: Sprint 1 Burn Down Chart

14.2.7 Sprint Retrospective

The team will meet on Friday's after the sprint to discuss what needs to be worked on during the next sprint, issues we ran into, what tasks didn't get completed, and how we will complete them during the next sprint.

14.2.8 Individual Status Reports

Individual status reports will be delivered bi-weekly and should include the progress made toward the research and development of the app and pedal. Key items will include the hours committed toward research and development.

14.2.9 Engineering Notebooks

Engineering notebooks will be updated as needed per member and will be checked on a bi-weekly basis. There is no minimum amount of pages set per sprint as long as entries to the notebook are to improve knowledge for project completion. No signatures are required for pages.

14.3 Closeout Materials

14.3.1 System Prototype

The final prototype will include a device that inputs an analog signal and outputs a digital signal to a tablet device, which can then use this signal to follow along with a previously scanned piece of sheet music, flipping the pages when the user approaches the end of the current one. The final system prototype will be demonstrated at the end of Senior Design II, in December.

14.3.2 Web Page

The project web page will include all the information about what the app does. This will include it accuracy score, manual page turning, music page scanning, and music page turning. This web page will only be available to the senior instructor and the group until the app is ready to launch. The website will most likely be updated near closeout.

14.3.3 Demo Video

The demo video will show the actual music page being turned along with it accuracy score as music is being played. It will also show the pedal in action for the hardware side of the project. We may include B-reel footage if the demo video is too long. The video will probably be 10 minutes long at the most and will include the music page turning, accuracy score, and the pedal.

14.3.4 Source Code

Our source code will be maintained with GitHub. The source code may be provided to the customer if we deem it necessary for them to have it. If not then we will simply launch the app for them to be able to download from the app store. We are still deciding if the app will be open source, we will know more as we get near the end. Licenses for any library we use will be provided.

14.3.5 Source Code Documentation

14.3.6 Hardware Schematics

The pedal or the adc will be wired together. Wiring diagram will be created to show the layout of the hardware component

14.3.7 Installation Scripts

The customer will use the app store to download and install the app. No installation scripts will be needed.

14.3.8 User Manual

The customer will need a digital user manual with set up steps. No video is needed. The manual will consist of app instructions for usage and features/capabilities.

REFERENCES

[1] Remofinger s page turner for digital sheet music, 2016.

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[3] The only music solution you'll need, 2020.

[4] Janet Ingber. A review of two sheet music apps: Sm music reader and sheet music scanner, 2022.

[5] Justin Lin. Pageflip firefly bluetooth/usb page turner review, 2017.