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CONTENT ADAPTION AND DESIGN IN MOBILE LEARNING OF WIND INSTRUMENT

A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science

by

NEHA PRIYADARSHANI

B.Tech., West Bengal University of Technology, India 2013

2021

Wright State University

WRIGHT STATE UNIVERSITY

GRADUATE SCHOOL

December 10, 2021

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION
BY Neha Priyadarshani ENTITLED Content Adaptation And Design in Mobile Learning of
Wind Instrument BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF Master of Science.

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Thomas Wischgoll, Ph.D.

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Dean of the Graduate School

ABSTRACT

Priyadarshani, Neha. M.S., Department of Computer Science and Engineering, Wright State University, 2021. Content Adaption and Design In Mobile Learning Of Wind Instruments

People in today's world seek things that are simple to use. Learning is one of the most crucial aspects of the ongoing digital transformation. Everything is now accessible with a single click on mobile devices, making access to instructional materials faster, easier, and more comfortable. It takes time and effort to build abilities and become an expert in the fields of learning, training, and teaching; and music learning demands a great deal of both practice and mentoring. Initially, music teachers and band directors must maintain a steady attention and devote a significant amount of time to manually teaching materials. This has prompted the question of how to make accessing the expert's information easier and less time consuming. Dr. Shelley Jagow' s book "Tuning for Wind Instruments: A Roadmap to Successful Intonation" has evolved into a series of iOS/Android Apps "Fingering and Tuning Charts" to make the learning process easy and convenient.

The purpose of this thesis project is to integrate and test various new user interface components into iOS Apps for a better user experience by adapting textbook content to various mobile devices for a more interactive, colorful, and detailed representation of how to play the note correctly.

Swift 5.0 was utilized to construct these additional additions, which were finalized in XCode. The code for all iOS apps has been upgraded from Swift 4.0 to Swift

5.0, allowing for future enhancements and upgrades. If someone wants to refer to the

code in the future, extra effort has been made to make it easy to grasp. TestFlight, an iOS

App testing tool built and administered through Apple App Store Connect, was used to

deploy the improved version for testing and feedback collection. The App Store has since

been updated with the finalized version of the app, which is now available for download

and use.

Contents

List of Figures

ACKNOWLEDGMENT

First and foremost, I want to express my gratitude to Dr. Pei for giving me the opportunity to work under his supervision and for providing me with all of his support as well as a fantastic opportunity to work on the user interactivity portion of the iOS mobile app "All Instrument and Fingering and Tuning Chart." He is such a nice and giving person, and he has given me the freedom to express my thoughts and opinions on a variety of topics. He has a lot of patience and thinks things through.

Next, I'd like to express my gratitude to Dr. Jagow for her patience and faith in me. She was always willing to help me with any concerns or issues I had. She was always upbeat, and her words of encouragement gave me more energy and joy as I worked on this project.

I'd like to express my gratitude to Mitesh Vosayo and Swathi Pamidi for their assistance in getting this project off the ground and guiding me through the code and application flow.

I'd want to express my gratitude to my husband Kumar Abhinav, who encouraged and supported me throughout the process. It would have been difficult for me to get to where I am now without his help. I owe him a debt of gratitude.

1. INTRODUCTION

Music has a calming effect on our spirits. Music is one of the most beautiful arts on the planet and learning to play it well is one of the loveliest things you can do. There are a variety of instruments to choose from, each with its own learning process. Music mastery demands a great deal of practice, training, patience, and effort. People used to learn the notes and play them for each specific instrument using the conventional book technique before the world went digital, and the expert had to manually assess whether the student was playing the note correctly or not. A student requires a teacher to constantly help them in their progress, which is not always possible and can even slow down the learning process. Furthermore, in the present pandemic scenario, where most learning has moved online and distant, obtaining regular guidance and supervision to assist students in constantly guiding their progress is quite challenging. So, on your fingers, there's the iOS app, which might play a big role in making continuous learning easy and fun.

To make app-supported learning easier, it's critical to create interactive apps that can clearly explain which note to play and how to play it to achieve perfect pitch using colorful pictorial representations.

1.1 Designing of Fingering and Tuning Chart Application

The first question that arose during implementation was how to design the application's flow so that students and band directors could operate it easily. Because this application contains a total of ten wind instruments, it was necessary to determine how to select each instrument and start with the learning process. The solution was to display images of all ten instruments and allow the user to select one to play.

The second question asked for all possible notes or pitches to be played, as well as a description of how they should be played. This has led to the conclusion that graphical and colorful images are an easy way to represent all of these. The easiest way to demonstrate is through well-explained and detailed images, and Dr. Shelley Jagow' s book "Tuning for Wind Instruments: A Roadmap to Successful Intonation"[1] takes the same approach. Images portrayal has been fine-tuned to move further with the pictorial representation of the way to play the note and which note to play, keeping in mind the same thoughts presented in the book.

When the app is loaded, a beautiful welcome screen comes up that represents the book's cover page[1] for a fraction of seconds. This feature was added to make the app feel like a miniature book. This is a lovely and colorful image that has been intended to fit inside every iOS device, whether it's an iPhone with or without a notch, or an iPad with a variety of screen sizes and resolutions. The goal was to design the welcome page in such a way that it will appear appropriately on devices with notches, filling the entire available space adjacent to the notch and making the most of the screen size.
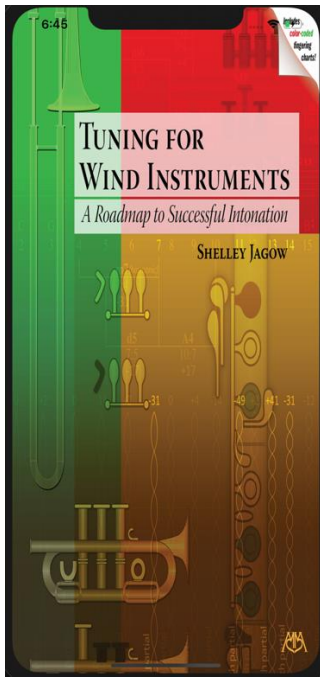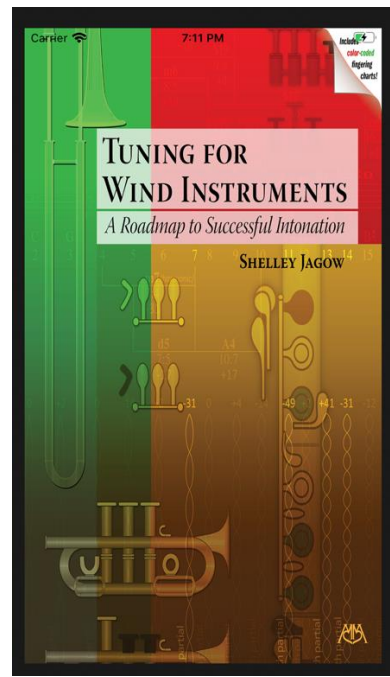
Figure 1.1. Image from iPhone 11 Pro Max

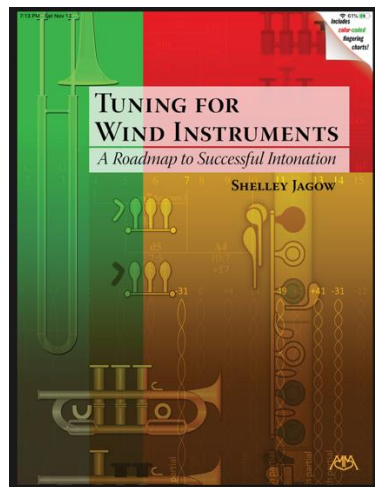Figure 1.2. Image from iPhone 8

Figure 1.3. Image from iPad gen 7

1.2 **Fingering and Tuning chart iOS Application images designing**

Once the instrument for the note to be played has been selected in the app, the strategy is to show the image of the note to be played at the bottom of the screen, followed by a comprehensive visual of how to play the note of that instrument in the center. The second issue that arose after determining the ideal resolution and size was that both images were overlapped and did not align properly. Even if all the images for the note were made at the same size and resolution, there was still an issue with overlapping or displacement. As a result, more in-depth research was conducted to better understand the application's design.

One of the most difficult issues encountered while incorporating images in the app was ensuring that the size and quality of the images were visible on all iOS devices, whether it was an iPhone of various models and screen sizes or an iPad. It must be appropriately aligned with all the different screen sizes and resolutions. Images with a higher resolution and size were created to provide a higher level of visibility. The next issue that occurs is that the addition of high-quality images increases the size of the mobile application, which in some situations can cause the application to use a lot of memory and, in some cases, cause the app to crash, rendering it unusable. Many people use iPhones or iPads with limited memory, and in this situation, this software can use a significant amount of RAM and storage space, making it difficult to run, and students and band directors may find it hard to use. When using the tuner, there may be some lag (future work). For example, if a student plays the erroneous note, it takes time for the red color in the tuner to appear, which causes confusion. More study was required to cope with all these conditions to discover the best image size and resolution for better visibility and seamless running of the

iOS App. Many images of all sizes and resolutions were made and tested on all mobile devices to examine how they render, as well as the app's size and performance. All the images were generated with Adobe Illustrator, although multiple online sources [7][8][9] were used to determine the appropriate size and resolution.

1.3 **Learning Swift Programming language**

Because the code for this iOS application was built in the Swift programming language, knowledge of programming was required to understand the code and flow. Swift is a programming language that is like other programming languages, but there are a few elements that are unique to this programming language that were critical to grasp before making any decisions, so the next step was to bridge the gap between other programming languages and Swift. To gain a better knowledge of the Swift Language, various tutorials were referred to online [3][4][5][10].

Swift 5.0 was utilized to construct these additional additions, which were finalized in XCode. The code for all iOS apps has been upgraded from Swift 4.0 to Swift 5.0, allowing for future enhancements and upgrades. If someone wants to refer to the code in the future, extra effort has been made to make it easy to understand.

1.4 **Contribution of this Thesis**

Many new features have been introduced to the iOS mobile app to make it more user-friendly. Before releasing the final version of this app on the App Store, the focus was mostly on user interaction.

Some of the content which has been adapted to make this interactable are:

1. Adding a beautiful app icon to refer to the app after it has been downloaded to an iPhone or iPad.

2. When the app loads, the welcome image is properly aligned on all sorts of iOS devices, with or without notch, to give the app the appearance and feel of the book.

3. Screen size allocation for displaying a list of all available instruments, with an interactive backdrop color to make it appear nice.

4. Redesigning the credit page to include the most up-to-date information about Dr. Shelley Jagow' s courses and books, as well as an external link to information about the various online courses given by Band Director Dr. Shelley Jagow, their prices, and purchase choices.

5. Adding an interactive feature that highlights the pitch to play and its related detailed image popup by adding a black border to the selected pitch image.

6. Keeping the application's size in mind, the image was optimized with the right resolution and dimensions to fit into screens of all sizes and avoid pixelation on all iOS devices, whether it's an iPhone or iPad.

7. Adding border to detailed images to look more attractive on screen.

8. Dynamic screen allocation mechanism has been introduced to fit the images in all screen size without stretching.

9. Making sure that no data has been collected from user to maintain users' security.

10. Future app release including Tuner.

These new features have been finalized and have been deployed for testing and feedback collection via TestFlight, an iOS app testing tool developed and maintained by Apple through App Store Connect [15]. The App Store has since been updated with the finalized version of the app, which is now available for download and use.

2. LITERATURE SURVEY

The App Store and Google Play Store both have a wide selection of iOS and Android apps. What difference will this software make compared to others that are presently available for download and usage, was the main issue that was raised. Many different iOS Apps were downloaded and referred to solve this question. The "Fingering and Tuning Charts" app was the clear winner among them all. Comparisons based on size, instruments supported, and features were done with the following apps, which made this app successful over the others:

Fingering and Tuning Charts is a music app with a lot of features. It's only 26MB and has a lot of them compared to 90% of the music apps on the App Store. There are various different music learning apps in the App Store, and when the sizes were compared, some of them were big, up to 196MB in size.

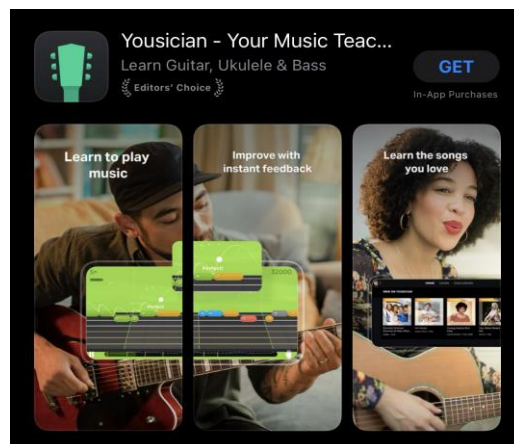## 2.1 Yousician- Your music teacher

Figure 2.1 Yousician

This program is 196 MB in size and is only for teaching Guitar, Ukulele, and Bass music instruments [11]. When compared to "Fingering and Tuning Charts," which includes

Flute, Oboe, Clarinet, Saxophone, Bassoon, Horn, Trumpet, Trombone, Euphonium, and **Tuba**, "Fingering and Tuning Charts" has 10 instruments accessible. As a result, "Fingering and Tuning Charts" emerged as the victor, as it will take up less memory on the smartphone than "Yousician" and provide access to ten instruments.
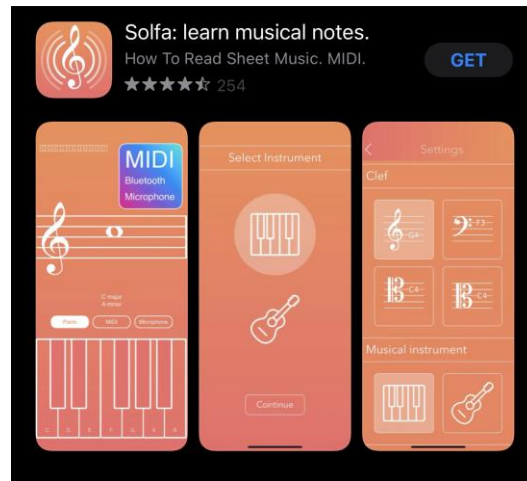
2.2 **Solfa: learn music notes.**

Figure 2.2 Solfa

This application is 66.7 MB in size and can only be used to teach note names for the **Bass**, **Guitar**, **Violin**, **Cello**, and **Piano** [12]. When compared to "Fingering and Tuning Charts," which contains a total of 10 instruments, "Fingering and Tuning Charts" has an option to highlight the note name, which is useful for learning the note name at the same time.
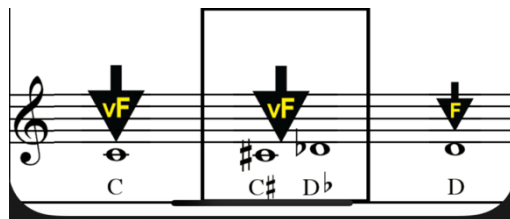

Figure 2.3 Note displayed along with name for easy learning in Fingering and Tuning Chart
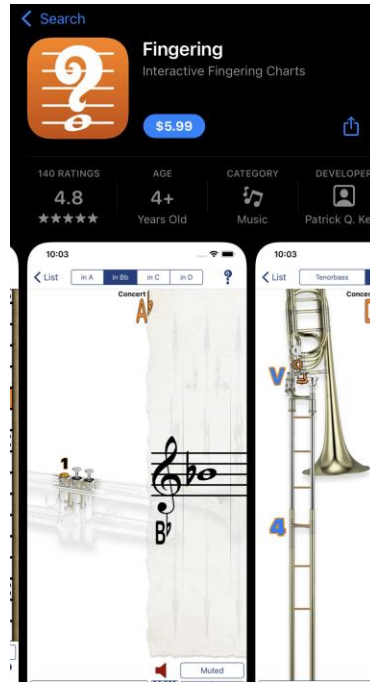
2.3 **Fingering**

Figure 2.4 Fingering

This is one of the most popular apps, and it's primarily for Bass and woodwind instruments [13]. This software is 145.2MB in size, which is not surprising. This program offers various interactive features; however, it falls short in that there is no way to determine whether it aids the learner in accurately learning the note.

In comparison to the apps mentioned above and others, our app "Fingering and Tuning Charts" provided a significant difference to the user in terms of size, number of instruments, and interactive features.

Apart from all these advantages, when the Fingering and Tuning charts were released in the App Store and publicized on social media, a flood of positive feedback and comments poured in, which was amazing. The App's interactive features and look were

complimented by several band directors and students. Many of the app's important features were highlighted when it was published to the App Store, giving new users a better understanding of the app's characteristics before downloading it.

The following are some of the features that have been added to the App description:
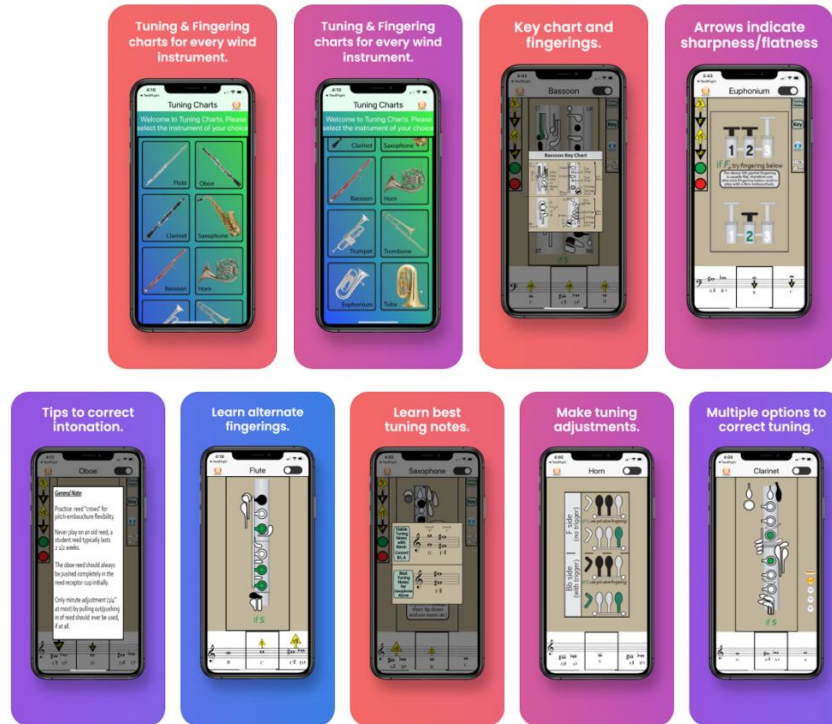

Figure. 2.5 Interactive features added into App Store

The overview photos provide a good representation of all the features that have been crammed into the app, as well as a general notion of the content before users download it.

3. APPLICATION FUNCTIONALITY AND USER INTERACTIVITY

3.1 Instrument selection from first screen

Flute, Oboe, Clarinet, Saxophone, Bassoon, Horn, Trumpet, Trombone, Euphonium, and **Tuba** are among the ten instruments offered by "Fingering and Tuning Charts." After the program has been loaded, the user is presented with a gorgeous front screen where they may select their preferred instruments using a slider from top to bottom.

All the instrument's images have been created to be semi-transparent but not translucent, allowing part of the background color to show through.
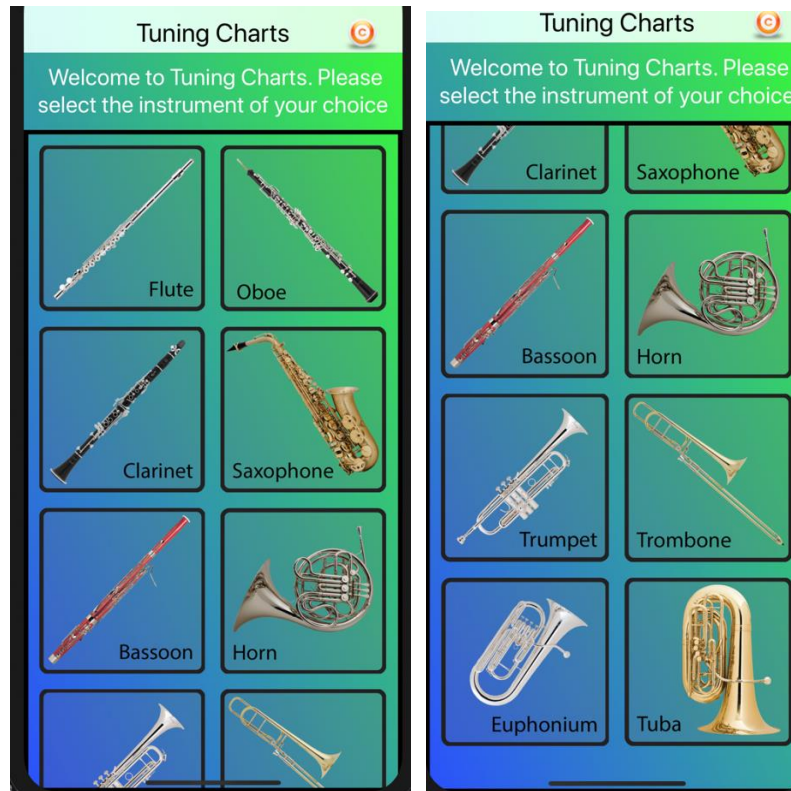

Figure 3.1 Instrument selection screen, iPhone

When a user taps on one of the instruments, they are sent to the next screen, which contains the instrument's capabilities. The arrangement of the instrument image and its functionality has been designed to be compatible with large-screen devices like the iPad.
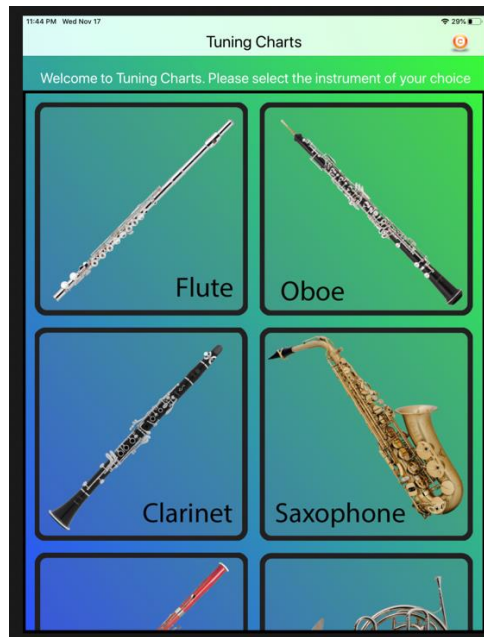

Figure 3.2 Instrument selection screen, iPad

The first screen look is also quite attractive with a large screen size device, as seen in Fig 3.2. To browse all the instruments, the same scroll mechanism is used.

3.2 **Credit button to provide additional information.**

A credit button in the top right corner of the screen is one of the crucial components included in the landing page. When you click it, you'll be taken to a credit and copyright information page with all the relevant details about the author of the book [1] "Shelley Jagow" and her works. This website also includes a list of all the developers from Wright State University's Smart Lab who worked on various stages of the app development

process. There is also a link on this page that, when clicked, brings you to the URL "www.giamusic.com." This interactive tool was created to assist music directors and students in finding all the courses linked to each unique instrument taught by music director Dr. Shelley Jagow, as well as their details and purchasing prices. This has been implemented so that the app user can have all they need in one location and refer to it whenever they want.
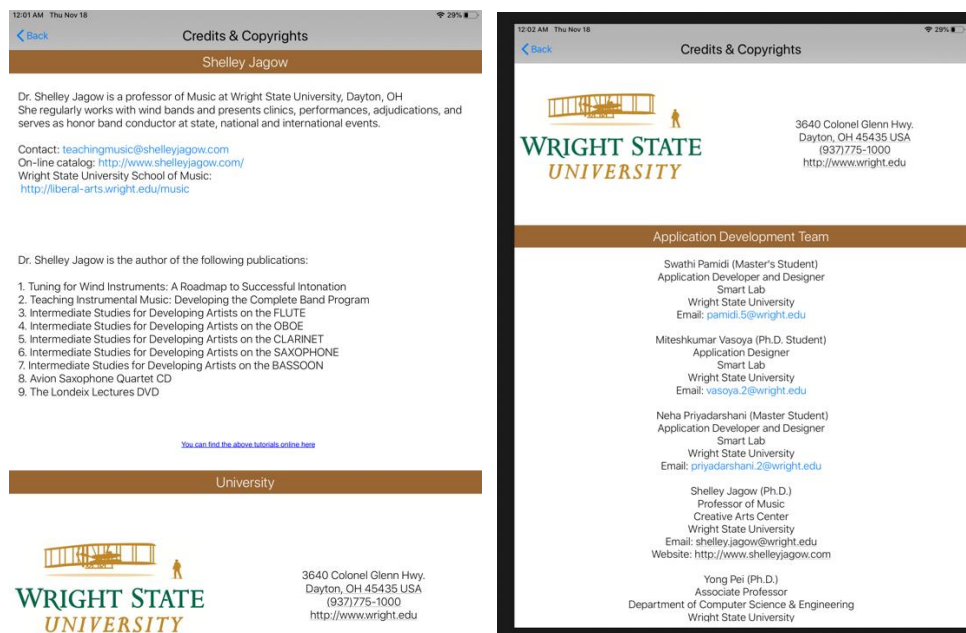

Figure 3.3 Credit and Copyright page

3.3**. Detailed and pitch image alignment and accessibility**

It was simple to fix the images in their allocated size and display them appropriately without any form of overlap between the two images once the flow of the application was identified and how the screen size was partitioned between the detailed image and the note image. Additionally, new buttons have been added to each side of the screen, which have taken up a fixed percentage of the screen's area. Changing the screen size division presented another issue, as the detailed image became overlapping with side alternatives while being

properly aligned from top to bottom. The approach used to resolve this issue was to change the screen size for all allotted areas from dynamic to fixed, ensuring that all images, regardless of their size or resolution, will never overlap under any circumstances. This was one of the major features which made it more user interactable and clean on screen.
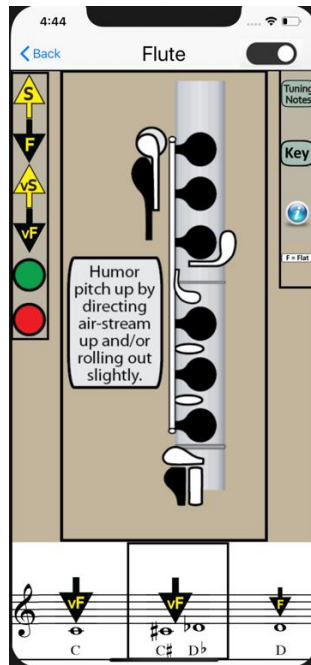

Figure 3.4 Screen size allotment and view

According to Fig. 3.4, the detailed picture is in the center of the screen size, while the pitch image is at the bottom. There are several pitch options as well as a comprehensive graphic. A slider has been introduced to allow access to all of them. To see the next and previous image, the user of this software can slide the detailed image left to right or vice versa. The same may be said for the pitch image. When you slide the detailed image or the pitch image, the appropriate other image is automatically aligned to avoid any mistake. This is quite helpful for someone who is brand new to music. Each detailed image is created in such a way that it adapts to the screen size of the content. If the image has more to say, it will use the entire size allotted, and if the content isn't huge enough to fill the entire

screen, it will adjust itself accordingly. This prevents pixelation by removing the need for an unneeded expansion of the detailed image.
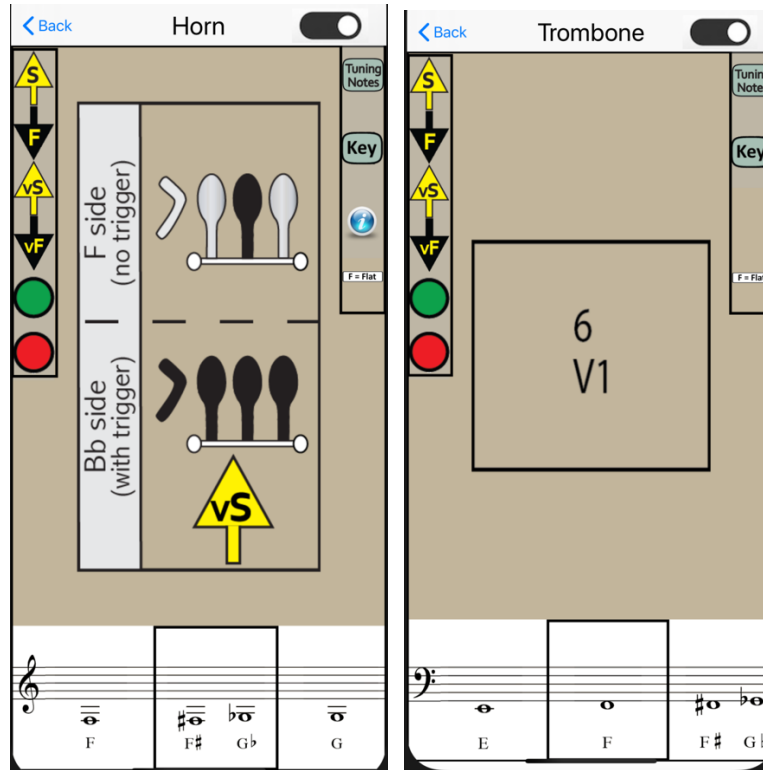

Figure. 3.5 Detailed image screen size based on content

Fig 3.5 shows how the detailed picture perfectly accomplishes its role by aligning itself based on the detailed image's information. There have been instances where the image size was stretched to fill the entire allocated space, and it appeared over stretched and pixelated.

A black border on the selected pitch picture immediately comes to center to portray the current pitch and its matching detailed image in the center of the screen, which is one of the user interactive elements provided here in the pitch image part. This eliminates user uncertainty about the relationship between detailed and pitch images.

3.4 **Left navigator, user interactable and detailed information access and visibility**

A guide has been added in this program as one of the useful user interface features to assist the application user in identifying the type of note. Sharp, Flat, Very Sharp, and Very Flat are the different types of notes. A novice music learner may need some time to grasp the concept of a music note because it is a symbolic representation. To make this process easier, a lovely arrangement has been built on the left side of the instrument details page, which is always useful. This aids in determining and identifying the type of music note on the fly, as well as how to approach playing it.
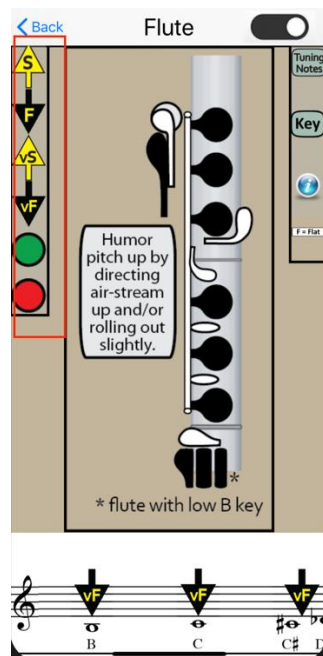

Figure 3.6 Side Helper toolbar

It has an image cum button, which is a symbolic representation of the music note located at the bottom of the screen, as seen in Fig 3.6 on the left side with the red rectangular box. These buttons correspond to the image of the note at the bottom of the screen. This is

a fixed area of the screen that does not vary for any instrument because all instruments have the same note representation.

As previously stated, these images function as a button, and when pressed, details about the image come up in front of the screen, dimming the remainder of the screen to highlight the information, as shown in Fig. 3.7.

The pop-up image is placed in the center of the screen, and it is dynamically allocated to deal with different pop-up image sizes and resolutions if the app requires further development in the future.
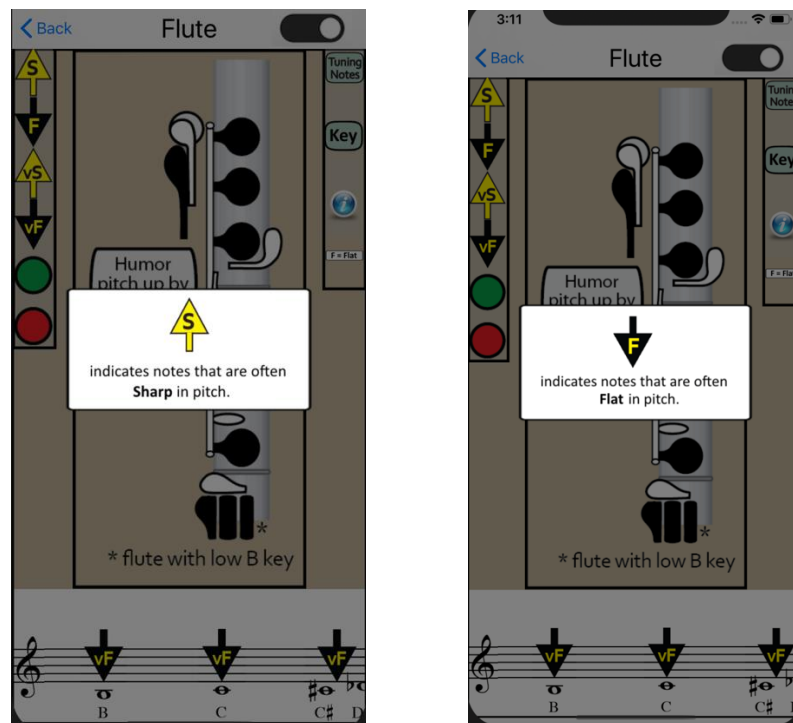

Figure 3.7 Note image pop up

3.5 **Right navigator, user interactable and detailed information access and visibility**

Another feature in the same family is a function that displays detailed information about the Tuning Chart, Key, and general information on the right side of the screen. This is a unique feature of this application that serves as a guide upfront to assist the music teacher and student in coordinating and explaining the advanced intricacies.

3.5.1 **Tuning Notes button**
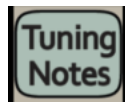
When you press the tuning note, a pop-up appears on the screen that explains both generic and instrument-specific tuning. Tuning note details is a tool that helps students learn the intricacies of a note in greater depth.
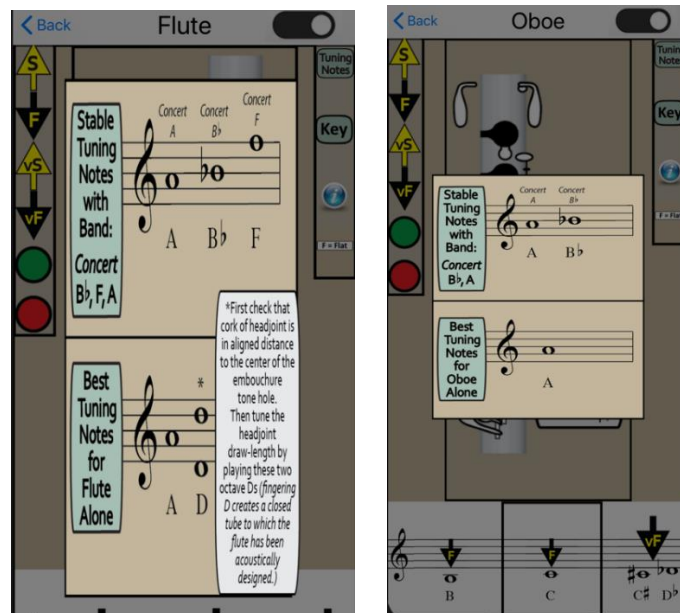

Figure 3.8 Tuning Note pop-up

To create this functionality, a dynamic screen size allocation approach was used, which dynamically adjusts the screen size to the size of the information graphic that appears.

3.5.2 **Key button**

When the Key button is hit, a graphic appears on the front of the screen that illustrates the instrument's Key chart. This is, once again, unique to the instrument that has been chosen. This has been added to demonstrate how to grip or hold an instrument by situating the fingerings for sound to be played. This is an interactive element that has been incorporated into the app, making it stand out from other apps, and it is always present upfront to teach the user on how to handle the instrument with several fingers.
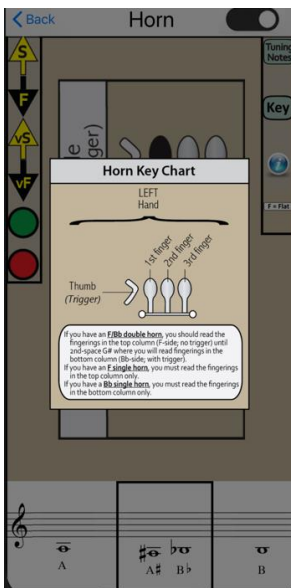

Figure 3.9 Key pop-up

3.5.3 **info button**

There is a new info button that provides further information about how to tune the slide as well as some basic information. This applies to all notes and is unique to each instrument.

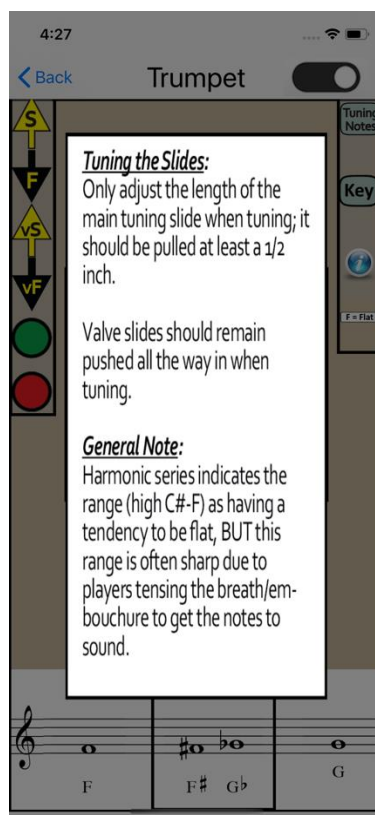
Figure. 3.10 Note pop-up

A slider button in the top right corner of the screen is another interactive feature that has been put here. When the slider is pressed, the above-mentioned side helper choices are hidden. This was implemented to allow students to learn topics on their own without relying on the supplementary information offered by these helper alternatives.
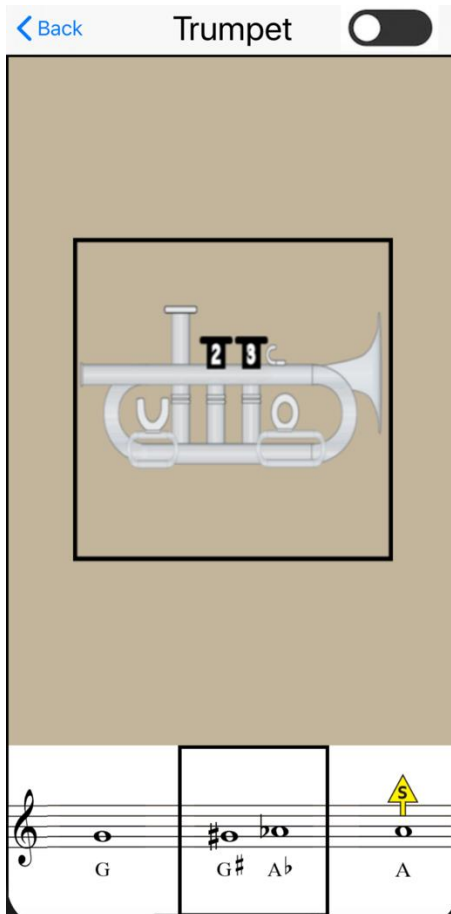
Figure 3.11 Slider button

4. DATA ANALYSIS

4.1 **Data collection**

Multiple programs collect personal data from users such as location, name, phone number, email address, and so on, however the "Fingering and Tuning Charts" mobile app does not. Neither the Android nor the iOS versions of the app collect data. This was created solely to assist music directors and students with learning and teaching purposes.

4.2 **Feedback and positive reviews**

This application was created in collaboration with Dr. Jagow, and as a result, she and other band directors provided continuous feedback and positive feedback. Several rounds of testing with several band directors were conducted using TestFlight, and constant upgrades and enhancements were made in response to the feedback and ideas received. Dr. Jagow has been extremely patient and supportive throughout the entire development and upgrading process. Dr. Jagow praised the way all the features and functions were blended and made accessible in the final version of the application. This gives me immense pleasure.

When the software was uploaded to the App Store and made available for download, it was promoted on social media, and it received a lot of positive feedback from people all around the world. Many band directors were grateful for the information and voiced their thoughts on how they could apply it to their own teaching methods. There was also a suggestion that the app be released in French in order to reach a larger number of people in the music industry. This made me so happy and proud to hear.

Figure 4.1 Positive Reviews

4.3 **Unavailability and downtime**

So far, there hasn't been any unavailability or outage with this iOS app. The app is fully functional on App Store Connect [15] and is available for download at any time. There hasn't been a single instance where the app has crashed. The app can be found in the App Store by searching for "Fingering and Tuning Charts" or the developer's name "Shelley Jagow." The total availability record for the months of October 2021, and November 2021 is shown in Figures 4.2.
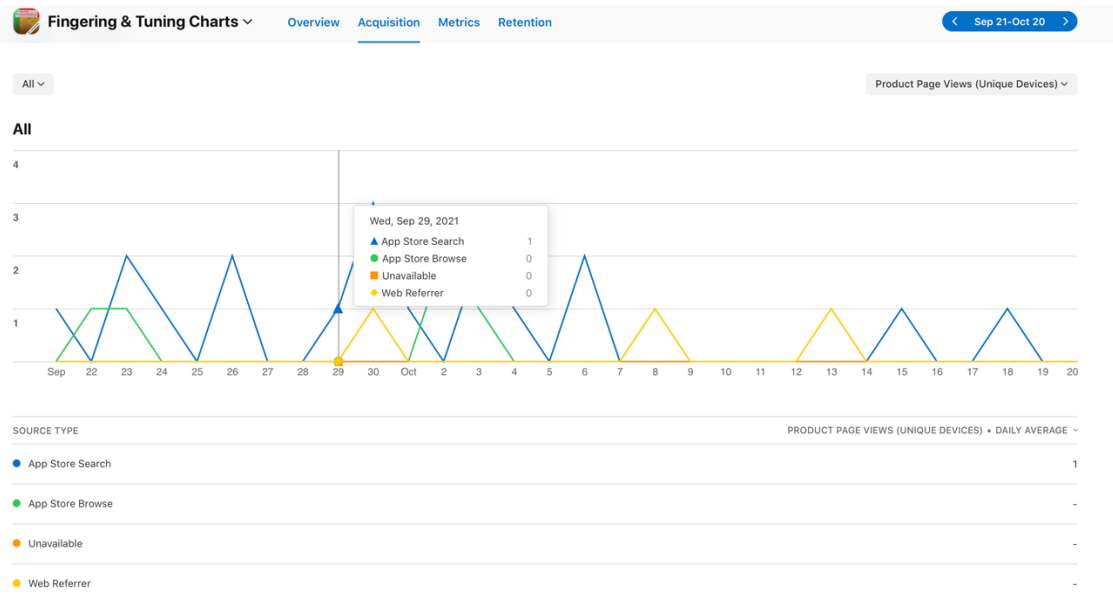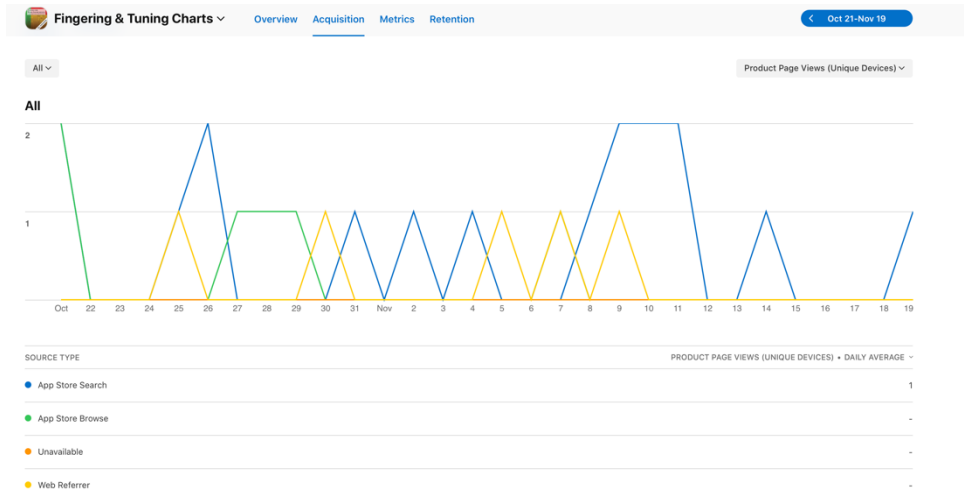
Figure 4.2 App Store availability graph

4.4 Revenue Generation

Because of its interactive and distinctive features, this software generates a significant amount of cash each month, with an average of 5 downloads per month from all over the world. This app will set you back $14.99. Returning users do not have to pay for downloads

again, according to the App Store's guidelines. The total download for the last two months

is shown in Fig. 4.3

Figure 4.3 Download graph

5. CONCLUSION

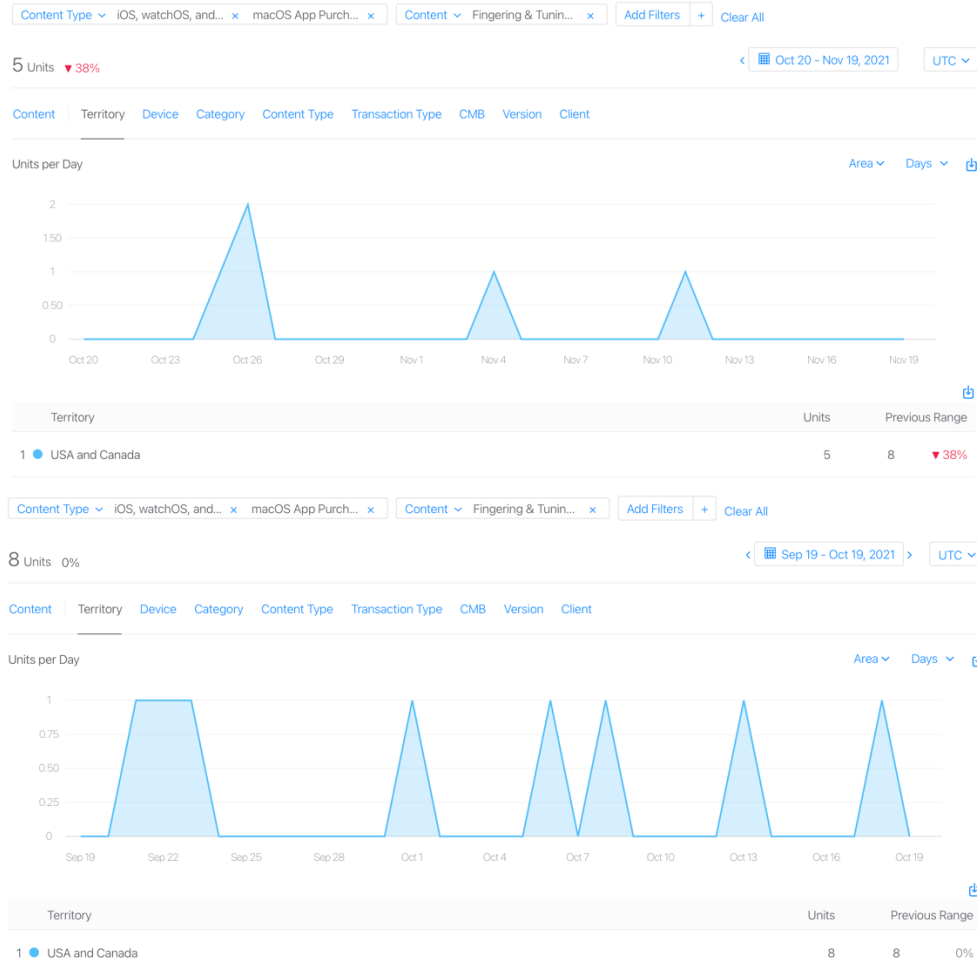The goal of this thesis is to investigate human interaction with mobile apps in the field of music education and learning to improve mobile learning. The main contribution of this thesis research is to investigate and implement various user interface features provided by iOS Apps for improved user experience by adapting content from traditional textbooks to various mobile devices for a more interactive, colorful, and detailed representation of instrument playing knowledges.

5.1 Conclusion

Because of a variety of factors, the world is becoming increasingly digital, and this smartphone app is playing an important role in this transformation. Learning music is not an easy feat; it necessitates constant practice, persistence, and effort. However, getting in-person help is tough all of the time. This learning app has reduced the amount of work and time required to access music learning materials in person, making it more comfortable for users. Our iOS application showcases all of the capabilities that are required to teach and study music for 10 different instruments with the touch of a finger. User engagement has been highlighted as part of the thesis effort to make this mobile app more pleasant to use by introducing colorful visual presentation. For easier navigation and to avoid confusion between them, different user interaction elements such as pitch image and detailed image pairing have been included. It provides an interactive way to select the instrument to study and displays information such as a detailed image, pitch image, Tuning Notes, Key, and other details. This program can also be used as a flashcard to refresh your memories quickly. As a result, this software can be thought of as an interactive version of Dr. Shelley

Jagow' s book "Tuning for Wind Instruments: A Roadmap to Successful Intonation." It also includes links to additional online learning resources provided by Dr. Shelley Jagow for easy access.

5.2 **Future Work**

There is a need to provide learners with timely and meaningful feedback on their practices, such as through the usage of "Tuner" in the app, which uses the mobile's microphone to hear the pitch being played and then assesses and provides feedback on the performance. As a result, such tuner features may be included, which will provide additional convenience in the future:

There is a tentative future version in the process that will contain complete Tuner capability, which will provide a lot more convenience in the future:

- Adding a new visual cue function to the in-app tuner that easily displays the green, orange, or red color showing the difference between the played note and the real note to be played. This will help the student understand how close they are playing the pitch; if it is green, the pitch is being played correctly; if it is orange, there is a tiny deviation; and if it is red, the learner needs to work on it.

- Providing an event-driven content display feature, such as hiding/displaying the tuner depending on whether an active play event is in progress, which makes better and clearer use of the available screen and reduces user distraction/overload.

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