MUSIC SHEET MAKER AND GENERATOR (MOBILE APPLICATIONS)

BY

LEONG YUAN LING

A REPORT

SUBMITTED TO

Universiti Tunku Abdul Rahman

in partial fulfillment of the requirements

for the degree of

BACHELOR OF COMPUTER SCIENCE (HONS)

Faculty of Information and Communication Technology

(Kampar Campus)

JAN 2020

UNIVERSITI TUNKU ABDUL RAHMAN

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Supervisor's name

Date: 20/4/2020

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DECLARATION OF ORIGINALITY

I declare that this report entitled "**Music Sheet Maker and Generator (Mobile Applications)**" is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

Signature : 

Name : Leong Yuan Ling

Date : 20/4/2020

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ABSTRACT

A mobile application is developed in this project, which is Music Sheet Maker and Generator. It is named as CnG music where C stands for composing and G stands for generating. The problem statements of this project are difficulty in getting a music sheet and composing music. Hence, this mobile application is able to generate music sheet for music players, especially for those newbies. In this project, it allows conversion from music to music sheet. This means that a music producer is able to generate music sheet from music. They can also compose their own music in term of the rhythm of the music, the pitch, music pattern and tempo of the music. In this project, waterfall development methodology is used in developing this application. This is because there are some additional functions could be added when it is applicable. The scope of the project is to generate the music sheet from the music and music composer. All the functions will mainly focus on one instrument which is piano. The music sheet is piano sheet and the music composition will also compose by using the keyboard piano provided. By using this mobile application, music players can learn a new song easily and help them in composing a song as well.

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LIST OF SYMBOLS

€	Euro Sign
$	Dollar Sign
♭	Flat
#	Sharp

LIST OF ABBREVIATIONS

BDNF	Brain-derived Neuropsychiatric
IOS	iPhone Operating System
MACOS	Mac Operating System
MIDI	Musical Instument Digital Interface
XML	Extensible Markup Language
MP3	Mpeg Audio Layer 3
PDF	Hardware Description Language
JRE	Java Runtime Environment
JDK	Java Development Kit
IDE	Integrated Development Environment

CHAPTER 1: INTRODUCTION

1.1 Overview

Is that learning to play a music instrument a dream that somebody knows will never happen? Well, everyone must answer yes. Actually playing an instrument is not difficult, just have to pay more patience when learning it. Everything must have their own difficulties, if a person insisted enough, then he/ she sure can play it well. There is a lot of benefits that come along with playing music instrument. According to Shankar Mahadevan Academy (2013), it can make a person become smarter. There had been many research works done by scientists to determine whether music really can make our brain become smarter. This is because according to Learning to Play (2016) while someone is playing a music instrument, Brain-derived neuropsychiatric factor (BDNF) and synapse will be released. All these elements can help to strengthen out mental capacities. Thus, playing an instrument will produce brain-building compounds and neural growth factors that making the brain smarter, stronger and better in doing activities throughout their day. On the other hand, playing an instrument can help someone to reduce their stress. Music keeps a person calm. It can effect someone emotions and lower the heart rate and blood pressure. According to Collingwood (2018) listening to music can have a tremendously relaxing effect on our minds and bodies, especially slow, quiet classical music. This type of music imposes positive effect on our biological functions, calming the pulse and heart rate, lowering blood pressure and the levels of stress hormones.

Although there are a lot of benefits of learning and playing a music instrument, there is still some upsets will occur during their learning and playing process. The most common issue that had found out is no music sheets provided. Not all the music players or musicians can have the “play by ears” technique. According to Sutton (2012), “Play by ears” is play what a music player hear which describing someone that can play music without sheet music or either remembered the music and impermanent it. From there, a music player can listen to music or song and just remember the melodies, then he/she can play the music out on the instruments. It considers as a technique in which a music player needs to have a long time practicing and experiences in playing a music instrument. A music player which has certain talented in music only can “play by ears” easily such as Jay Chou, Lang Lang and

others. They can play by ears and they can also find the exactly accurate pitch and tones for the music, this is somehow a normal music player difficult and even cannot do. For those players which cannot “play by ears”, they must find out the music sheet and practice it only they able to play the full version of the music. Hence, according to Gennet (2011), a music sheet is really important to a music player or musician in order to play an accurate pitch and tones music or song.

Besides that, composing music is the dream for all music players. Most of the music players will become a composer in one day. According to Macdonalda (2016), not everyone has the ability to be a composer, creative is very important for a composer. Besides creativity, tools and knowledge in composing music is also very important. A song composed by using a different type of music instruments such as piano, guitar, violin, cello, drum and others. If a music player wants to compose music, they need to learn various types of music instrument. It is impossible for a music player because the fees and times to learn a music instrument are high. Those from normal family are not affordable to pay for the fees. Composing music applications and systems were built to let them try to compose music. Unfortunately, most of the applications and systems need to pay at a higher cost. So, it is another trouble for them. A composing music keyboard also appears in the market to help the users to compose music but they are expensive.

Furthermore, most of the software for composing a music sheet and generating music sheet are developed in software system platform. It is not convenience for a music player to use. A software system can only be used in laptop and desktop, it is hard for a user to bring a laptop and desktop everywhere. Hence, a mobile application is proposed in this project.

1.2 Problem Statement

The first problem statement is difficulty in getting a music sheet. This problem was found from a piano forum, according to the author, nmitchell0706(2010), in the forum, he had asked for a few music sheets. This issue always meets by the newbie in playing a music instrument, those lacks of practicing players and some less talented players. They will feel hard to play a music instrument without the music sheet. Even if they had the music sheet, they still need to practice for a long time only they can play a full song smoothly and nicely. It is very hard to find a music sheet from the internet especially those new pop songs. Many of the music players like to play pop songs rather than play a classical song. Sometimes classical songs are very bored and hard to play, so the newbies always like to play a pop song more than classical music. They can listen to the new pop songs from drama and movie, and want to play it with music instrument. Because it is new song, so the music sheets cannot be found from the internet or even found it but have to pay it for full versions. Normally, it is not cheap to buy a music sheet, it always is at a higher cost. This will make a player spend more money on playing a music instrument. It is hardly to support by those who come from a normal family and they are just a college or universities student. This problem had been solved by some others existing software system and application, but they are a hefty charge. If users want to get a full version music sheet, they had to pay for it.

The second problem statement is difficulty in composing own music. A music player must have a dream of composing his own music, but it has to buy different types of music instrument in order to compose music. This is because to compose music, it needs to be combined with different types of the instrument such as drum sets, guitar, violin, piano, keyboard and others. A song cannot be made up using only one music instrument because the music will become vapidity and bored, it must be made up of different instrument to make it more diversification, dolce and interesting. It is difficult to buy different types of the instrument because the price of an instrument is higher and a player will not manage to learn many instruments at the same time. The only ways they can do to compose music is finding their friends or someone that know to play music instruments other than what they can play and join together to compose music, but it is hard for them to find it. Another way that they can do is using an application to compose music. Unfortunately, most of the music

composition application is payable and the full version is not provided for them if it is a free version. So, they had no chance to compose music by themselves.

As the problem of hardly to get a music sheet, so this project is to be proposed for converting music into music sheet. On the other hand, it also consists of music composer functions. The mobile application is proposed in the Android platform. This is because the numbers of the user using Android is more than IOS users.

By using this mobile application, music players can find out that learning or playing a music instrument is very easy and fun. This mobile application is able to increase their interest in playing and learning a music instrument and the issues faced by them can be solved easily.

1.3 Project Objectives

The main objective of this project will let the music players especially the newbie to generate a music sheet from music. This is able to solve the first problem statement which is **difficulty in finding a music sheet**. As acknowledgement, it is hard to get a music sheet from the internet or market especially for the new pop songs or drama songs, so they able to get the music sheet by using the music file. With the fast growing in the music industry, it is getting easier in composing new music. In the old generations, a composer needs to use up different types of instrument to compose music, but for this generation, due to the growth of technologies, they can just compose music with the mobile applications. To overcome the second problem statement which is **difficulty in composing their own music**, an easier ways to compose of music in terms of the rhythm of the music, the pitch, music pattern and tempo of the music. It can be shorter the time consume in composing a new music. So, the whole project will mainly focus on one instrument which is piano.

1.4 Project Scopes

This project is developed an application that able to generate music sheet from music and compose a new song. This project will generate melody for new proposed music piece and convert music to the music sheet. The generator will first receive the input file from the user, and the user will need to convert the music file by using the music converter. Then, it will generate the first stage of music sheet which with the single notes and then improve the degree of usability step by step. They are allowed to save the generated music sheet and download it.

To compose music, there must be consisted of multiple layers of music melody string, which combining all together plays simultaneously. There must be certain rules in between the music notes such as the pattern of the music, how the melody should go for making music become more nicer. Users are allowed to modify and editing on the music in term of composing them in a minor or major scale, higher or lower pitch and others. Users are allowed for an instant preview for the music sheet after they finishing composing the music. They can also instantly playback the music or choose to save it down and playback it in future.

Lastly, the project will mainly focus on one instrument which is piano. The composition function is composed by using the keyboard provided in the application and also the piano sheet is generated from the music.

1.5 Impact, significance and contribution

Generally, this project is going to bring several benefits to a music player, music studio and composer. Music studio does not have to find hardly for the music sheet or spend a higher price to get the music sheet. Normally, students in a music studio will always ask their teachers for some new pop songs music sheet, their teachers will hard to find it, so with this mobile application, they can generate a music sheet easily. As we know, it is same for those who are a music player, a music sheet is very important. Without a music sheet, they cannot play music well.

On the other hand, a music player can compose their music by using this mobile application. They can stay away from the traditional ways in composing music which makes up a music band with different music instrument players or learns different types of music instrument just to compose music. Make up a music band needs to spend a lot of money and time, it will drag the time to compose music. By using this mobile application, a composer can compose music in a short time and easy. The composer can also stay away on writing the music sheet by themselves. With this mobile application, after composed, the music sheet and music demo is generated automatically. So, they do not need to record the music demo by themselves. It can reduce human resources such as does not need to spend money on finding people to record and reduce the number of papers used up. This is because, in the traditional way, composers need to play the new melody first then only note it down. They will keep making changes and modify on their compose music, then they will keep using the new paper to write down their sheet, so many papers are used up when music was done composed. All of these processes are also apparently time consuming.

From the acknowledged, sound processing technique is used in the generating music sheet from the music part and support music composition function. Music players just need to input the audio file then the music sheet is generated and composers just need to key in the parameters, and then this mobile application will do its job to produce some fresh and unique music melodies.

1.6 Report organization

The details of this project are shown in the following chapters. In Chapter Two, some related software systems and applications are reviewed. Their functionalities were discussed and the limitations were figured out. After discussing, some ways are figured out to solve their limitations. After that, Chapter Three will describe in detail the methodology used in proposed the application. Waterfall methodology is chosen to use to propose this mobile application. The details for all the steps is elaborated in this chapter. The use case diagram and activity diagrams are shown in this chapter. Next, in Chapter Four, it will describe architecture design, composition algorithm and testing. Furthermore, a short conclusion and future work is figured out for the whole project in Chapter Five.

CHAPTER2: LITERATURE REVIEW

2.1 Overview

Before proposing this application, a few software systems and applications were reviewing for a research. There are totally four software systems and applications are reviewed. There are ScoreCloud, AnthemScore, MuseScore and MelodyScanner. Some of them were developed in both software system and application and some of them were only developed in software system. All of them required fee paying to use for the full functionalities. Their limitations were reviewed and solving ways were figured out. The user requirements and functionalities were decided after reviewing the existing software systems and applications.

2.2 ScoreCloud

Doremir developed the ScoreCloud by utilizing Lisp and Common Lisp programming language to review the existing version of the software system and mobile application. For the software system, it is compatible with macOS and Microsoft Windows, whereas, for the mobile application, it only supports the IOS platform which included the iPhone and Apple iPad family. Besides, it performs the functions of creating, storing and sharing music notation. Another main function of the ScoreCloud is automatic creation of music notation directly from music performance or recording. It comprised of two varieties, which are ScoreCloud Studio and ScoreCloud Express. ScoreCloud Studio provides full editing function for the Microsoft Windows and macOS. On the other hand, ScoreCloud Express consists of simple editing function for the IOS mobile platform. Recently in the year 2018, ScoreCloud 4 has been released.

The ScoreCloud webpage consists of the download page for ScoreCloud and the support version of ScoreCloud, providing ease for Microsoft Windows and macOS users to download, however, the IOS users need to download it from the IOS App Store. The plus side for Microsoft Windows and macOS users is they are allowed to perform audio and MIDI transcription, a powerful editing, multiple output formats such as XML and MP3 and sync across devices. On the contrary, for IOS users, they are only allowed to make basic editings. The biggest advantage is the users can bring and use the ScoreCloud application at anywhere and anytime. After downloading ScoreCloud, a sign in or register is needed for users to proceed. Figure 2.2.2 has shown that the user can choose to sign in with Facebook or register a new account.

Figure 2.2.1 shown the price list of ScoreCloud. ScoreCloud is not a free software system, and it is categorized into 3 different versions, which are ScoreCloud FREE, ScoreCloud PLUS and ScoreCloud PRO. The price for ScoreCloud PLUS is $4.99 per month and $49 per year while the price for ScoreCloud PRO is $19.99 per month and $139 per year. For the free version, the users can create sheet music without being charged, however, there are only 10 songs available for the users to synchronize and collect. The keys played on the virtual piano will be generated as sheet music and users can print out the sheet music with ScoreCloud watermark on it. It also supports sync across different types of devices and intuitive editing. The PLUS version offers

the print watermark to be removed, enables an unlimited number of songs for synchronizing and collect, and higher import and export of MIDI formats. Conversely, the PRO version allows users to local save the sheet music and songs, batch MIDI analysis and all import and export of XML formats are available.

The strength of ScoreCloud is multiple instruments can be incorporated in generating the sheet music. Figure 2.2.3 has shown a list of musical instruments that can be chosen from, including violin, cello, acoustic piano, electric piano, guitar, electric guitar and other music instruments provided, in which each of them will produce different sounds. Interestingly, the sounds of different musical instruments and sheet music can be generated simultaneously by playing on the virtual piano. Full sheet music will be generated which is shown in Figure 2.2.5 after users had done composing the music. The users are then allowed to edit and export the music as MIDI file and play with Windows Media Player, followed by the transposition of the sheet music.

The weakness of ScoreClould is it only allows access to the IOS platform but not to Android platform, thus, hindering the Android users from using the ScoreCloud on a mobile device. The functions limited to the FREE version user includes conversion and storage of 10 songs in the cloud and the composition functionality. For users of the FREE version who wish to have more functions, they are required to pay a sumptuous amount of fee.

ScoreCloud
FREE

–

Create sheet music for free

Sheet music from playing.
Sync across all devices.
Intuitive editing.

ScoreCloud
PLUS

$4.99 / month

Serious about your music

No print watermark.
Unlimited songs.
More import & export.

ScoreCloud
PRO

$19.99 / month

For the professionals

Local saving.
Batch MIDI analysis.
All import & export formats.

	FREE	PLUS	PRO
Sign up for Monthly (USD)	$0	$4.99 / month	$19.99 / month
Sign up for Yearly (USD)	$0	$49 / year	$139 / year
Notation from Voice Recording (monophonic)	YES	YES	YES
Notation from MIDI Performance *	YES	YES	YES
Manual Notation Input *	YES	YES	YES
Intuitive Editing	YES	YES	YES
Automatically add Chords *	YES	YES	YES
Import MusicXML	YES	YES	YES
Sync Across Devices	YES	YES	YES
Save Songs in Cloud	10	unlimited	unlimited
Print Notation	watermarked	YES	YES
Print to PDF *	watermarked	YES	YES
Notation from Instrument Recording (polyphonic) *	NO	YES	YES
Save Songs to Local File System *	NO	YES	YES
Import MIDI *	NO	YES	YES
Export MIDI *	NO	YES	YES
Notation from Audio Files *	NO	NO	YES
Export MusicXML *	NO	NO	YES
Batch MIDI Analysis *	NO	NO	YES

Figure 2.2.1 Price list comparison of Score Cloud

Figure 2.2.2 Sign in with Facebook or register for free

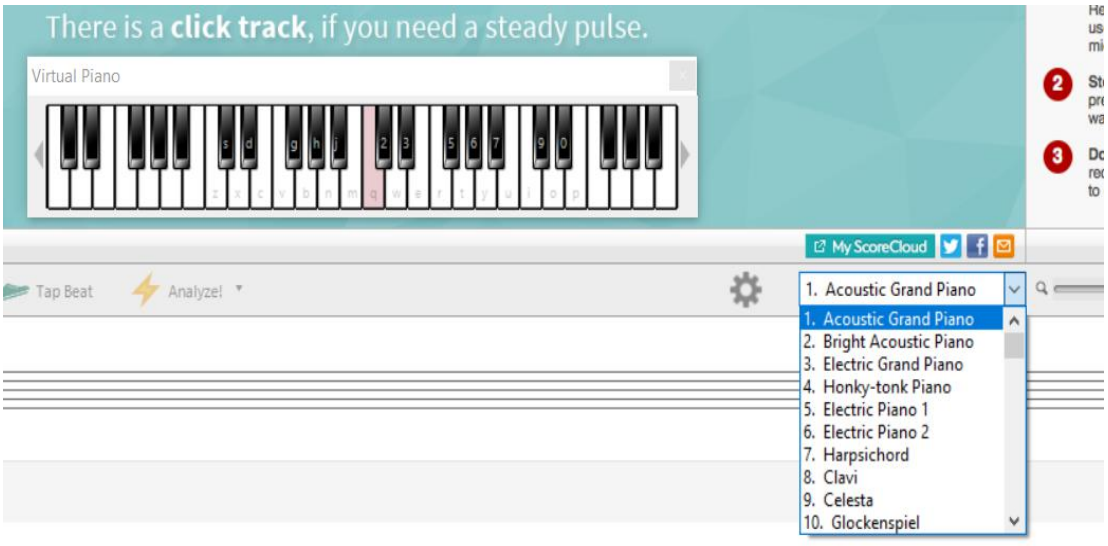


Figure 2.2.3 List of music instrument sound

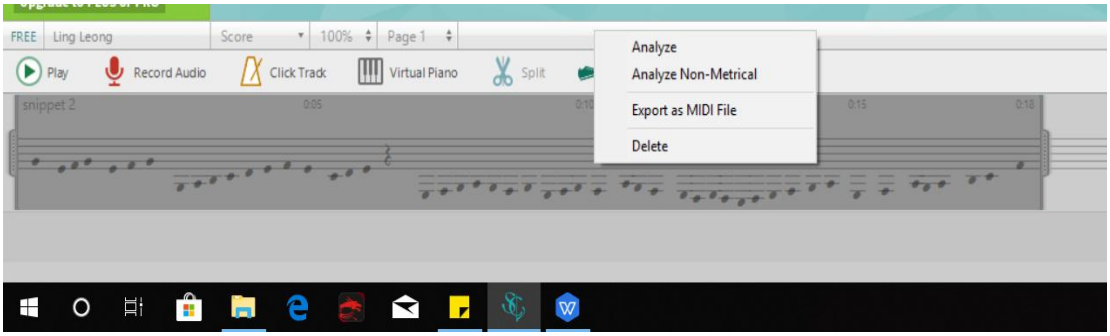


Figure 2.2.4 Export as MIDI file and play with Windows Media Player

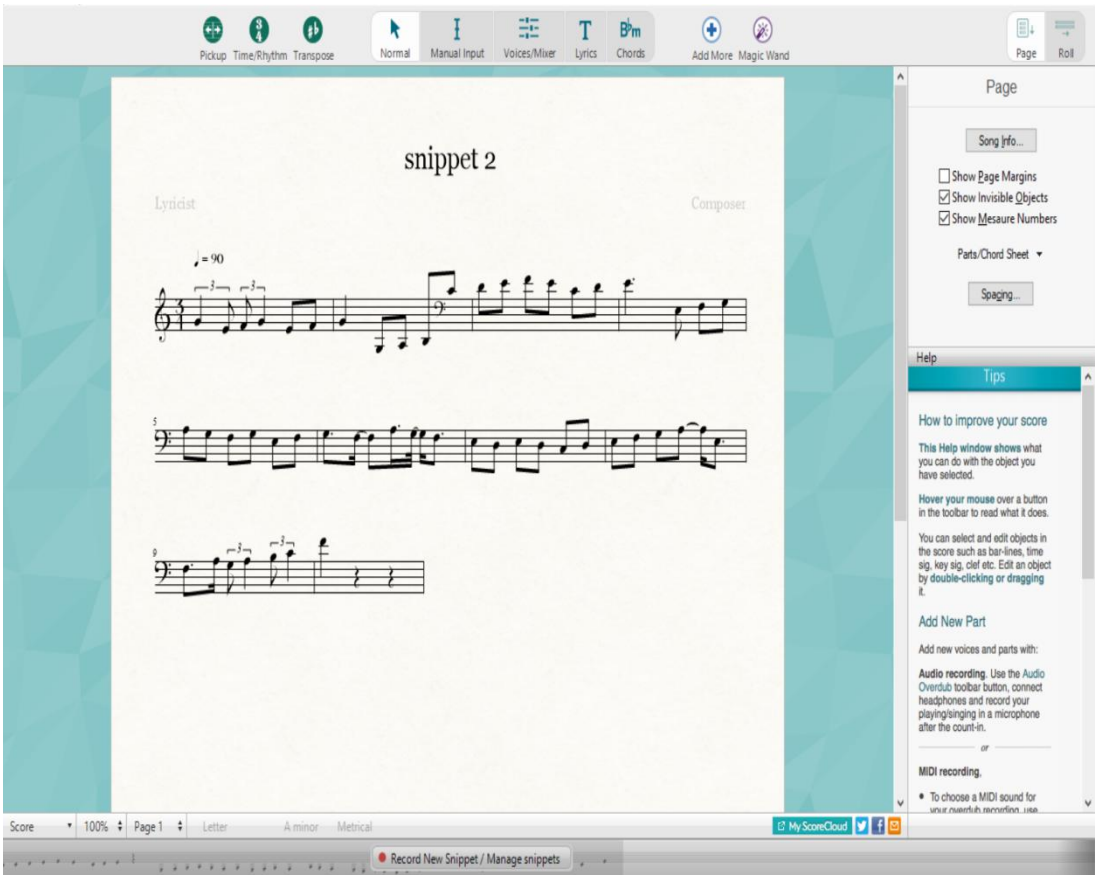


Figure 2.2.5 Composing result

2.3 AnthemScore

The current study reviewed the second system which is the AnthemScore developed by Lunaverus in the year 2016. The main functionality of the AnthemScore is to transcribe the music into sheet music. It advanced neural network functions to ensure the accuracy level. It brings convenience to a music player and composer in generating sheet music. Users can input a recording or any other audio file into the system, then a transcript of the music sheet will be generated immediately. It is fast and saves time.

AnthemScore webpage is open for a user to download the 30 days free trial version. After 30 days, users are not allowed to use unless purchased. From Figure 2.3.1, it has shown that the free trial version offers a full set of features. The trial version is compatible for the AnthemScore Professional edition, but users can freely change it into Lite edition for a comparison between the Lite and Professional edition. There are 3 different download platforms for the AnthemScore which includes the Microsoft Windows, macOS, and Linux. The Microsoft Windows is available in Windows 10, Windows 7 and others, while the macOS is available in OS X 10.9+ Intel, while the Linux encompasses the Linux x64 installer.

From Figure 2.3.2, the editions of AnthemScore are shown and comparisons were made. The three editions provided are the AnthemScore 4 Lite, AnthemScore 4 Professional and AnthemScore 4 Studio. For the AnthemScore 4 Lite edition, it is an entry-level AnthemScore with only basic functions such as automatic song transcriptions, view, save and print music sheet. The function of notes editing, spectrogram display and audio playback are inaccessible in this edition. The price for the Lite edition is $32 per year. On the other hand, for the AnthemScore 4 Professional edition, the full set of editing functions were added in, including playback of audio and notes, editing of notes, beats, time/key signature and tempo are attainable in this version. The price for the AnthemScore 4 Professional is $38 per year. Lastly, the AnthemScore 4 Studio is priced at $680 per year. Other than the full set of features provided, it also comes with the benefit for customer support and lifetime hassle free software updates. The support requested made by AnthemScore 4 Studio user will be prioritized and valued.

Figure 2.3.3 shows the main page of AnthemScore 4 Trial edition. There are several function buttons on the left side of the system. Since there is no log in and sign in function for the AnthemScore, hence, the users can directly import the MP3 file into the system as shown in Figure 2.3.4. After converting the music file, the music sheet will be shown as an example in Figure 2.3.5. Playback of the music or notes is allowed. Then, the users can edit the notes, beats, time/key signature and tempo of the sheet music as shown in Figure 2.3.6. After editing the music sheet, the users can proceed to print out and save the music sheet.

The strength of AnthemScore is it offers an automatic transcript of sheet music from the music file. Next, the editing of the notes and measures are available. The performance of AnthemScore is the top and swift. The transcription of a music sheet from the music only consumes a few seconds. It also allows accessibility and conversion to different audio file format in multiple platforms such as Linux, Microsoft Windows and macOS.

The weakness of AnthemScore is it is not available for mobile application. It is inconvenient for users to use it anywhere and anytime. Other than that, it has only 30 days trial, and activation will be granted upon purchase. Moreover, the only function is the conversion of the music file into the music sheet.

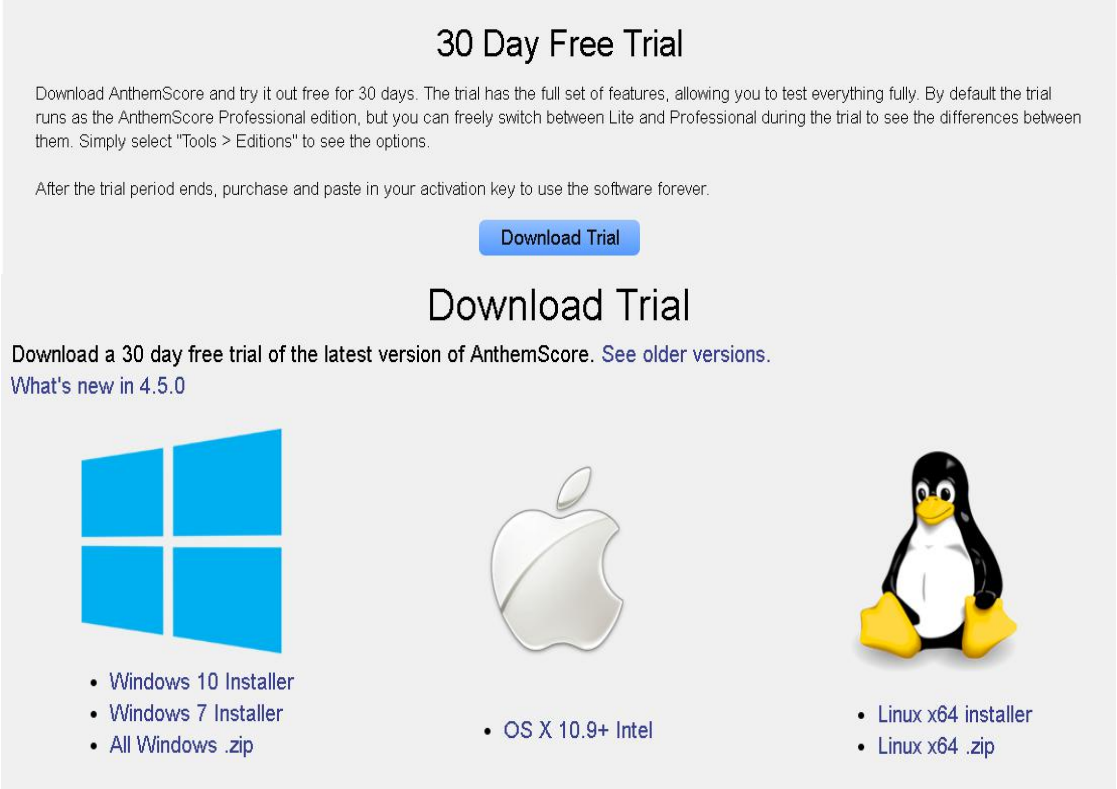


Figure 2.3.1 AnthemScore download for 30 days free trial and download platfor

AnthemScore 4 Lite

Entry-level AnthemScore with just the basics. Automatically transcribe songs and view, save, and print sheet music. No note editing, spectrogram display, or audio playback. One year of free software updates.

Learn more
$32
Buy Now

AnthemScore 4 Professional

The full set of editing features. Edit notes and measures. View the spectrogram, keyboard, and timeline. Playback audio and notes. One year of free software updates.

Learn more
$38
Buy Now

AnthemScore 4 Studio

In addition to the full set of features, AnthemScore Studio comes with priority customer support and lifetime free updates. Support requests immediately go to the top of the queue. No-hassle free software updates for life.

Learn more
$680
Buy Now

AnthemScore Editions Comparison

	Lite	Professional	Studio
Automatic transcription. Automatically detect notes in audio with machine learning.	x	x	x
Sheet music. View, print, and save sheet music. Transpose and select instrument.	x	x	x
Conversion formats. Save as PDF, musicXML, MIDI, or ASDT.	x	x	x
1 year of software updates. Get any software update released within 1 year of purchase for free.	x	x	x
View spectrogram. View a dynamic Q spectrogram to help visualize notes.		x	x
Playback. Slow down tempo without changing pitch. Play audio, notes, or both together.		x	x
Adjust the note threshold. Add or remove many notes quickly by dragging a slider to set the cutoff threshold on machine learning note scores. Edit the whole song or selected sections.		x	x
Edit single notes. Add/remove single notes with one click. Drag any note edge to lengthen or shorten note duration. Add/remove triplets.		x	x
Edit measures. Change beat locations, time/key signatures, and tempo. Add/remove and double/halve measures.		x	x
Lifetime software updates. No-hassle, free software updates for life.			x
Priority customer support. Support requests immediately go to the top of the queue.			x

Figure 2.3.2 AnthemScore versions and comparison

Figure 2.3.3 AnthemScore downloaded (Main Page) and function buttons (left side)

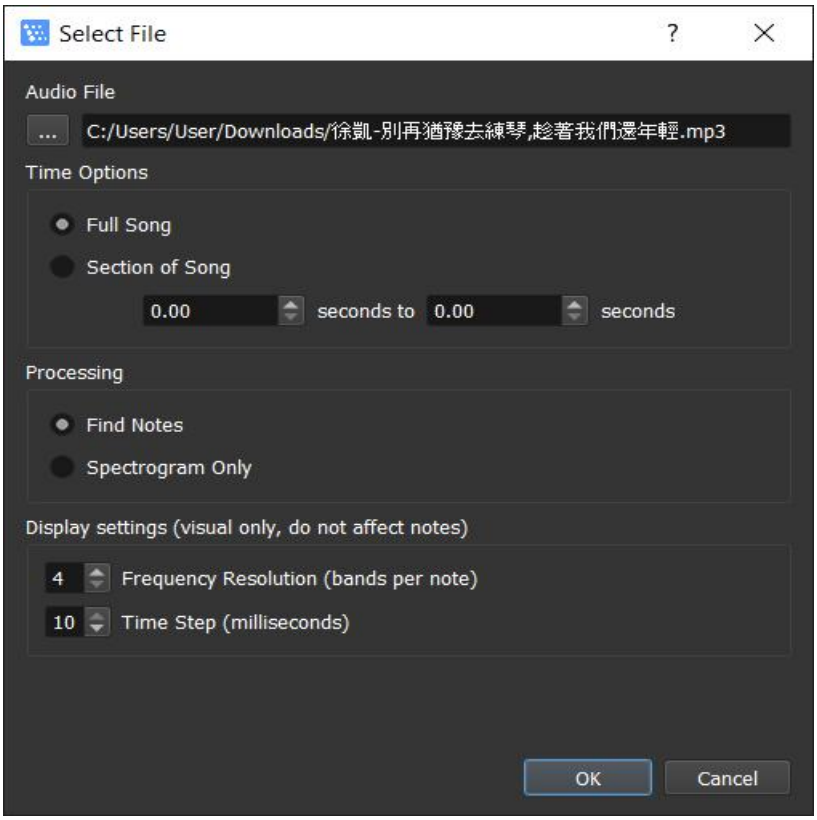


Figure 2.3.4 Input file

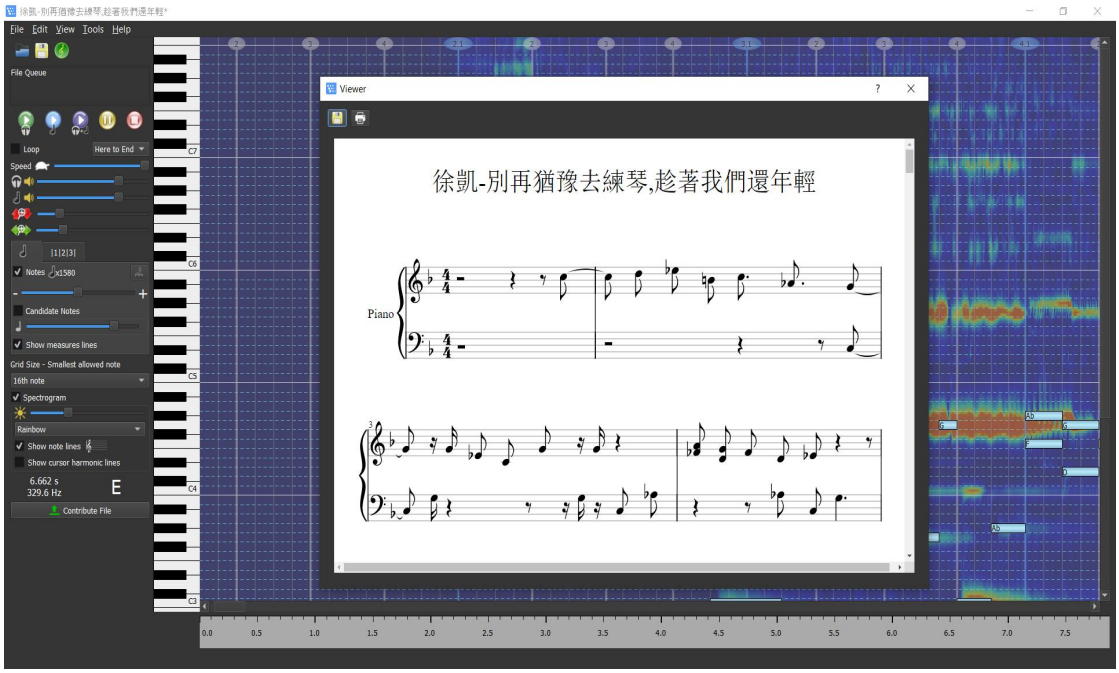


Figure 2.3.5 Sheet music generated from the MP3 file.

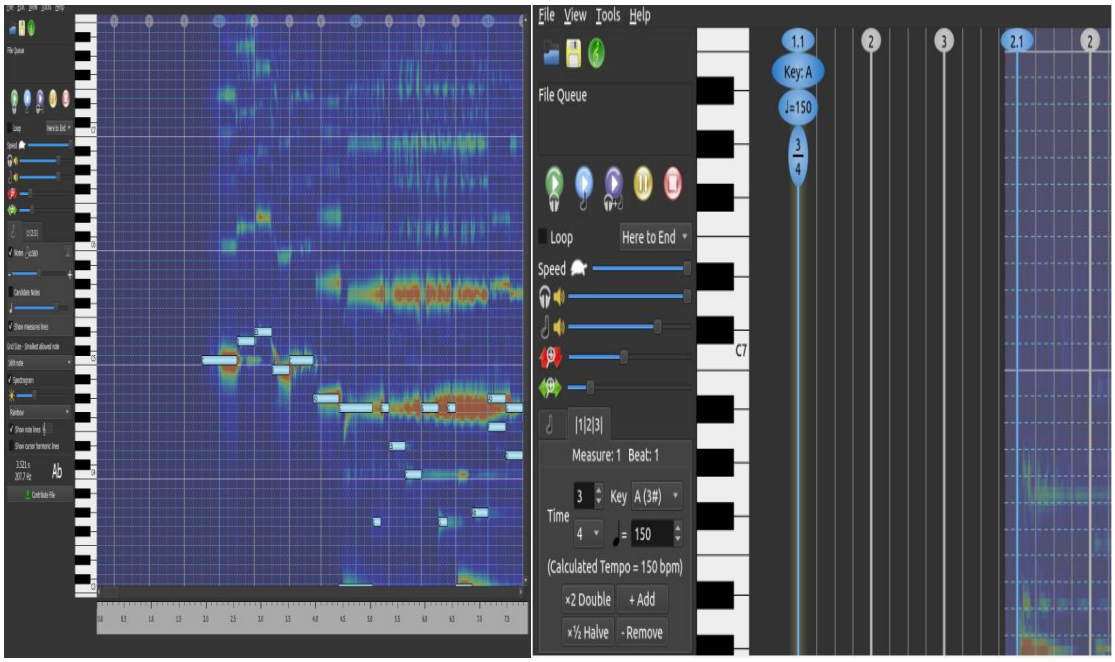


Figure 2.3.6 Editing of notes, beats, time/key signature, tempo

2.4 MuseScore

The third software system current study had reviewed is the MuseScore developed by Werner Schweer, Nicolas Froment and Thomas Bonte in the year 2002 using C++ and Qt programming language. The MuseScore mainly functions to let a composer generate the music sheet. It supports the MIDI input and output, percussion notation, part extraction, automatic transposition, adding lyrics and others. Users can save progress via the online cloud. It also enables users to publish their music sheet on their community and blog for the public to refer.

Figure 2.4.1 has shown the download platform for the MuseScore. The installation of the MuseScore is only available for software system but not application, specifically for Windows 7 version and above; macOS 10.10 or above; and all versions of Linux.

Login to the system is required if the users want to use their cloud service. Users can choose to login with Facebook or Google account. After logging in to the system, the users will be prompted for the 30 days trial. From Figure 2.4.2, it has shown that the system requested users to start the free trial of the MuseScore Pro for 30 days. MuseScore Pro will allow the access of unlimited uploads of the music sheet composed by the users. Next, MuseScore Pro will adjust the score playing by parts in term of upgrading their playing skill. Then, users are allowed to publish their composed music sheet, thus boosting their fan numbers and the ads will be terminated.

There are more than one hundred types of music instruments to compose music available in the MuseScore. When writing the sheet music, users can choose all the music symbols from the left hand side of the system. From Figure 2.4.3, there are the symbols shown in the picture such as clefs, key signatures, time signatures, accidentals, lines, text, tempo and others. After writing the sheet music, the sheet music will be generated and users are allowed to print it out. The users can also explore for the other sheet music from the MuseScore. Editing is allowed for users to modify their sheet music.

The strength of the MuseScore is it enabled the input and output of the file in different types of format. Besides, the features for composing sheet music are

sufficient. Moreover, it allowed users to search for various sheet music in their online cloud. Lastly, they allowed users to publish their sheet music in the community to serve as a guideline for others.

The weakness of MuseScore is it is incompatible in a mobile application platform. A mobile application is more user-oriented because users will always bring their mobile phone with them. Next, the users can only obtain a full functionality upon purchasing the MuseScore Pro. In other words, users who did not purchase are not allowed to do conversion between music and music sheet.

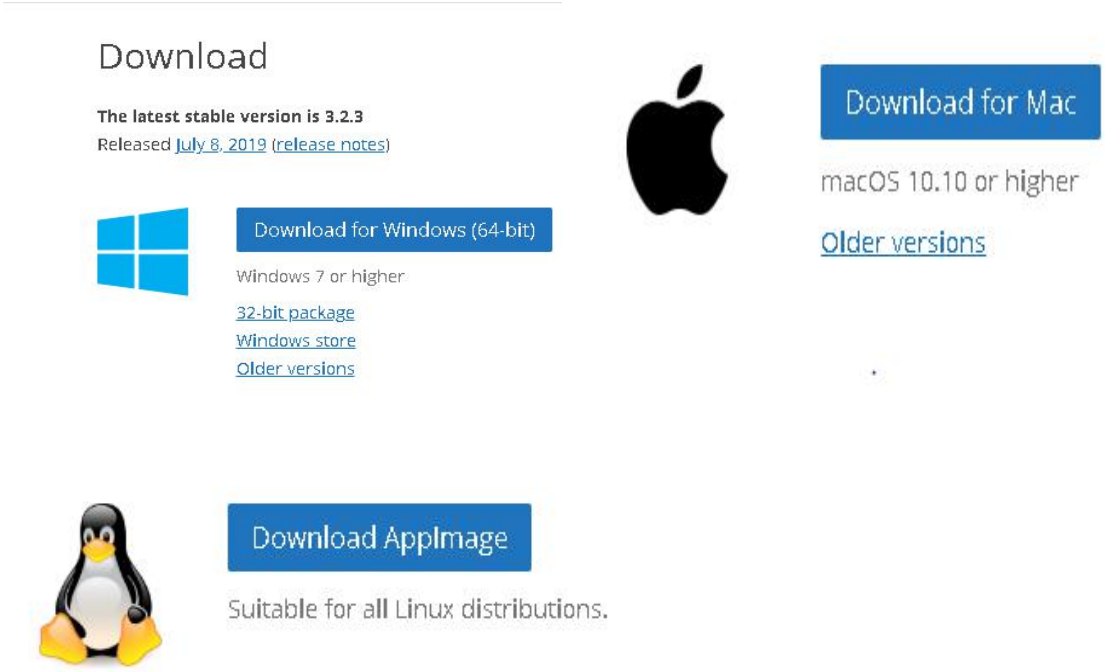


Figure 2.4.1 MuseScore download platform

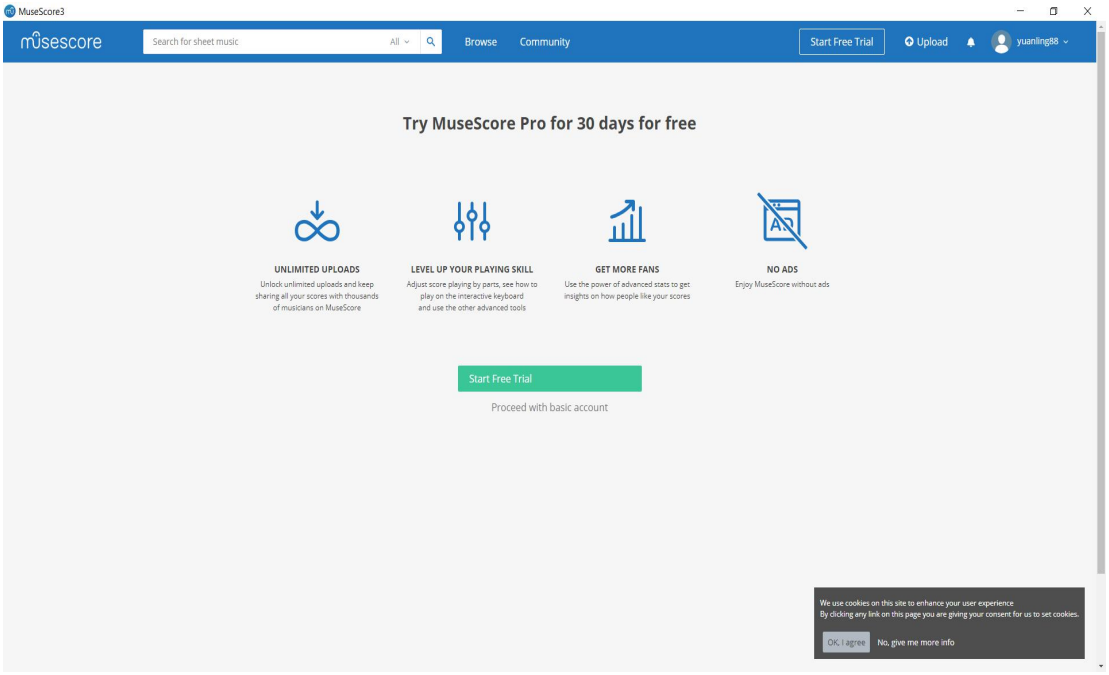


Figure 2.4.2 Free Trial

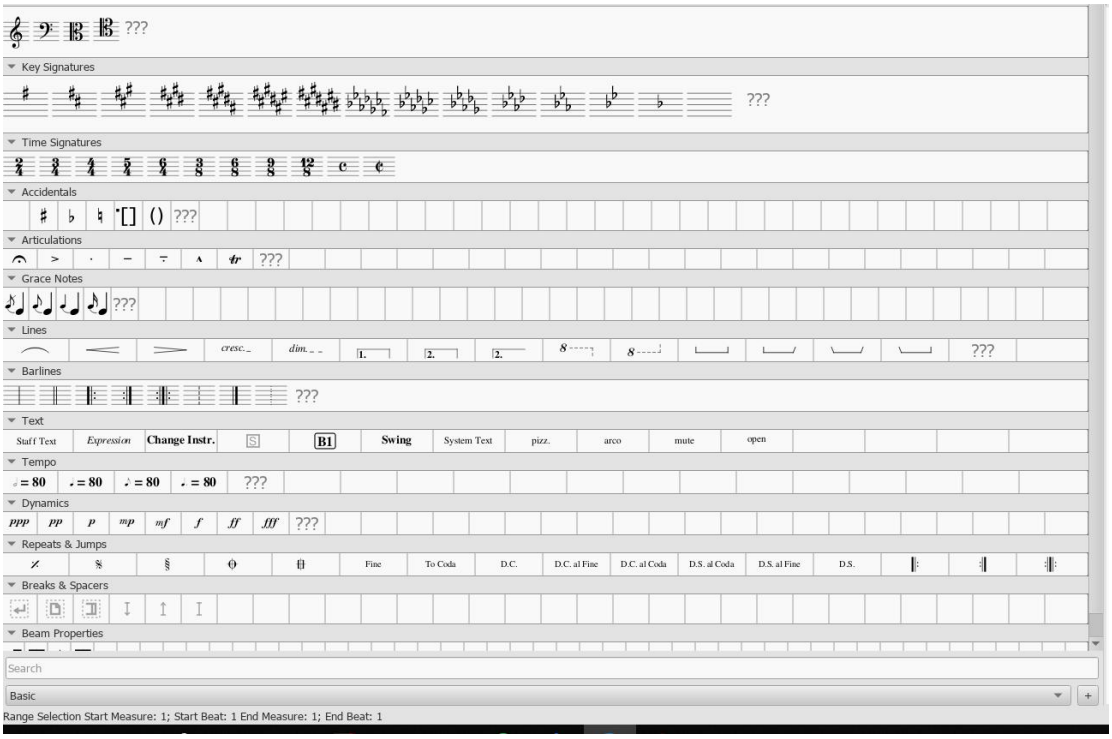


Figure 2.4.3 List of music symbols

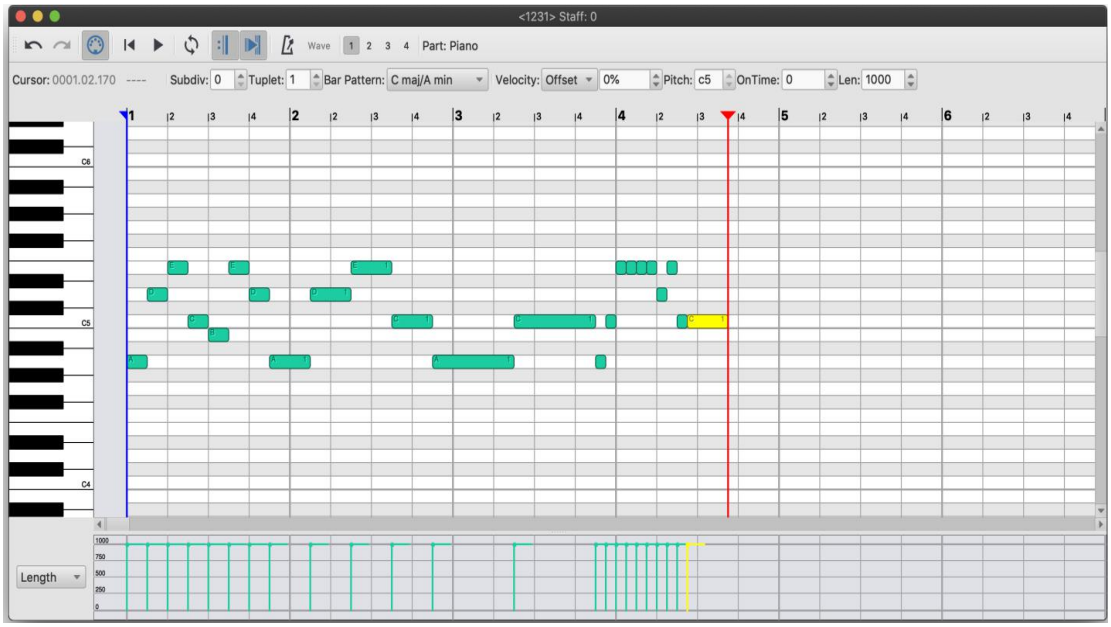


Figure 2.4.4 Editing

2.5 MelodyScanner

The forth system software that has been reviewed is the MelodyScanner developed by Sebastian Murgul, Alex Luengen and Tamar Mirbach. They established the MelodyScanner from Kalsruhe, Germany with a strong technological background in the year 2017. Their vision is to create a new generation of musicians. MelodyScanner had been developed into two types which are online system and Android mobile application. The main functionality of this system application is to transcribe piano music recordings to scores and edit them online.

Figure 2.5.1 and Figure 2.5.2 had shown that the list of instruments which consist of MelodyScanner for both online system and mobile application. The supported instruments are piano, flute, violin, acoustic guitar and others. By this stage, only solo instruments are supported with no bands or orchestras. From Figure 2.5.3, the price list of MelodyScanner is shown. For the free of charge version, the users are only allowed to make a Youtube import but not MP3 file import, whereas transcription of the sheet music is only allowed to the piano, the others musical instruments are not available for them. It also allows PDF export for sheet music. Unfortunately, the maximum bars can be generated on the sheet is a maximum of 40 bars. The yearly fee

for subscription is €35.88 per year. The functions for free trial users is the Youtube import, transcribe sheet music and upload the MP3 audio files. A full music sheet can be viewed and export as PDF format. They can also export the MIDI or MusicXML audio file. For the monthly subscription, users have to pay €4.99 per month and the functionalities they obtain is the same as the yearly users. So, subscription for a yearly user is worth more than a monthly user.

From Figure 2.5.4, prior to using the MelodyScanner requires a sign up. This is because they want to ensure that users can only access their own created sheet music. The sign up page for both online system and mobile application is the same. Users can choose to sign up with a Facebook account or Google account. After sign up, a simple main page will be shown. From Figure 2.5.5, it has shown a + button at the right button, click it to upload the audio files. The sheet music is then quickly generated. Luckily, users can playback the sheet music and listen in a clear manner. The download of the sheet is available in PDF, MIDI or MusicXML format. For the free users, only limited 10 songs for them to transcribe, after 10 songs, they have to subscribe for future use as shown in Figure 2.5.6.

The strength of MelodyScanner is it is easy and simple to use. It allows transcribing music to sheet music in a short time. Moreover, there are several types of instruments that can be chosen by users and sheet music will be generated. Next, users can edit the sheet music that they had generated. Lastly, they had developed it into a mobile application which brings more convenience to the users.

The weakness of MelodyScanner is the free users can only transcribe 10 songs which contributed to the need to purchase for future use. After that, the sheet that generated for the 10 songs is not complete. They only allow users to view for a maximum of 40 bars of sheet music. It only allows transcribing sheet music but no composition available.

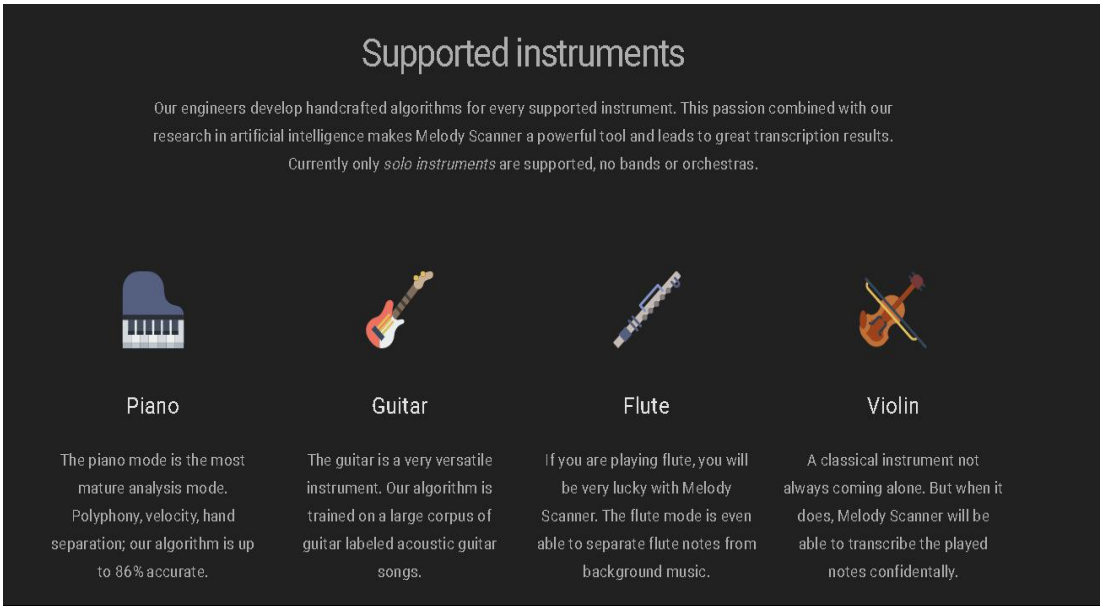


Figure 2.5.1 List of music instrument in MelodyScanner Online system

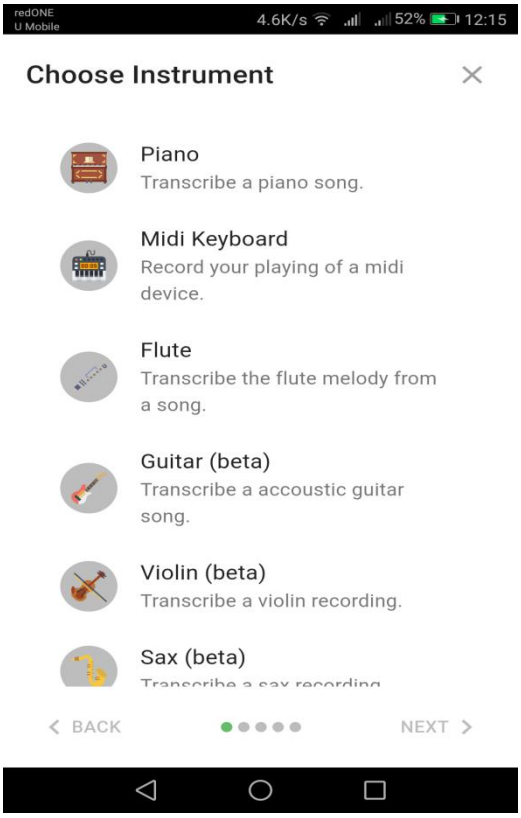


Figure 2.5.2 List of music instrument in MelodyScanner Mobile Application

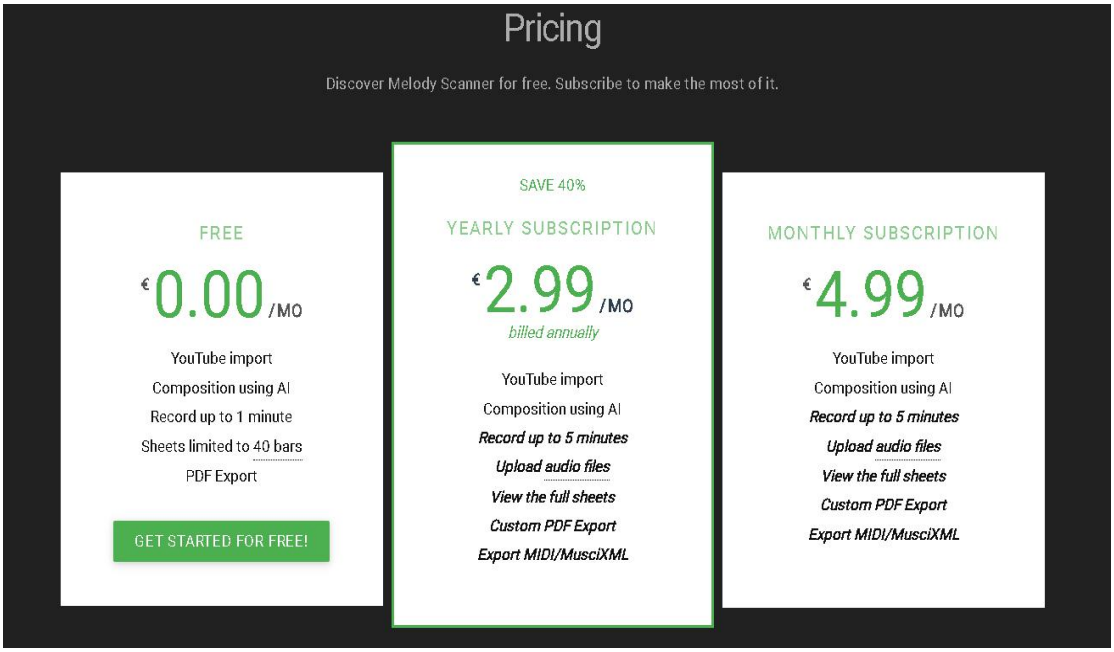


Figure 2.5.3 Price List of MelodyScanner Mobile Application and Online System

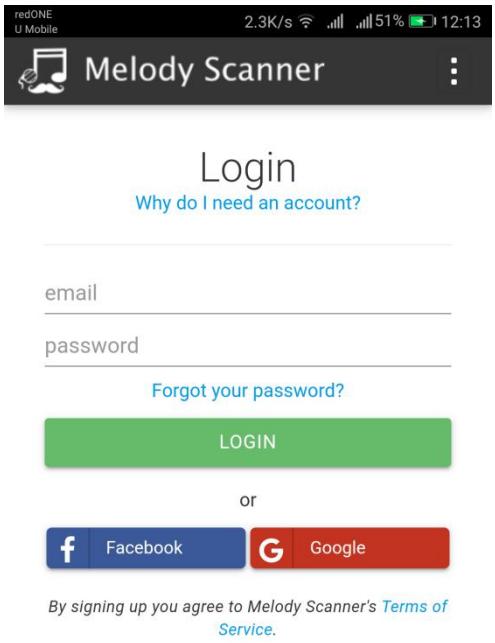


Figure 2.5.4 Sign up page for MelodyScanner online system and mobile application

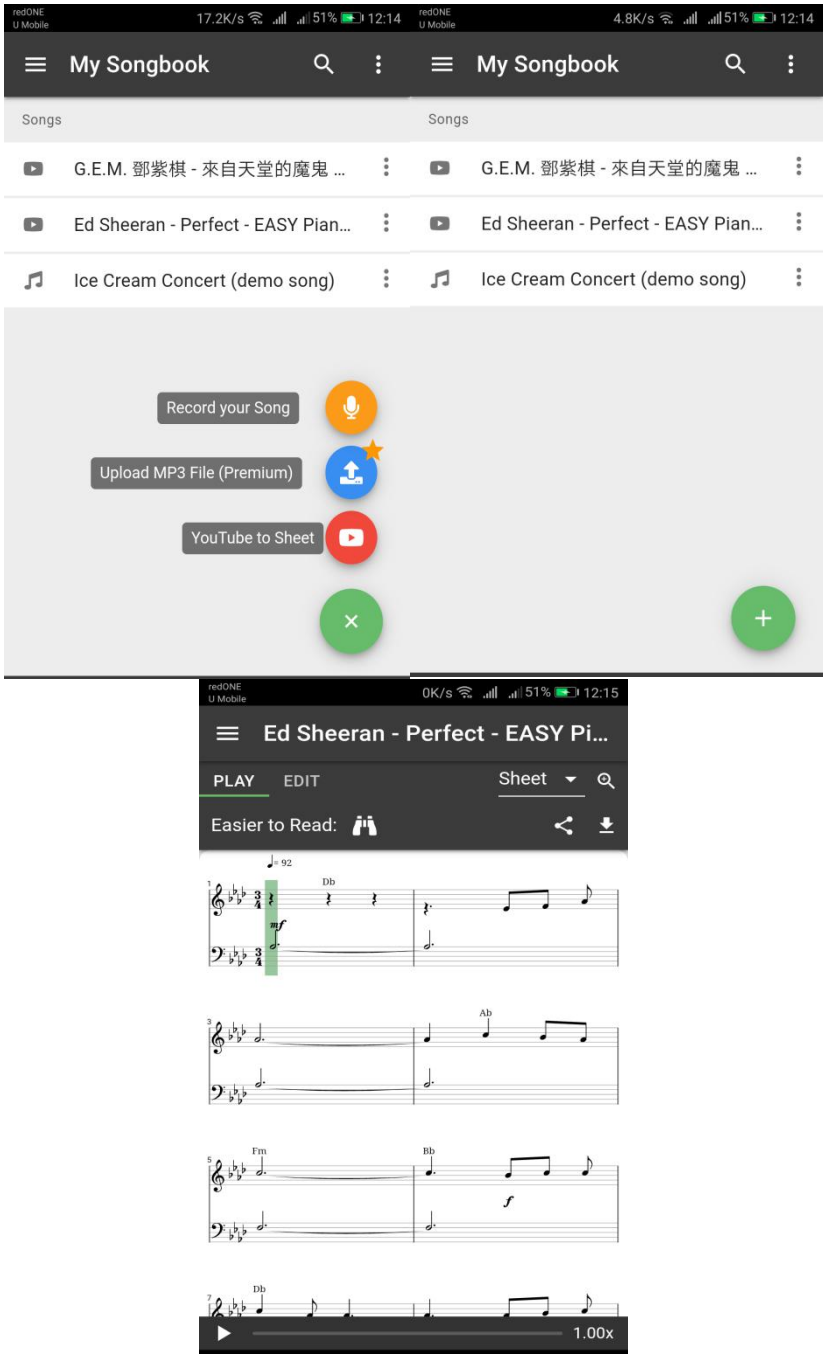


Figure 2.5.5 Upload MP3 file or find media file from youtube and sheet music list

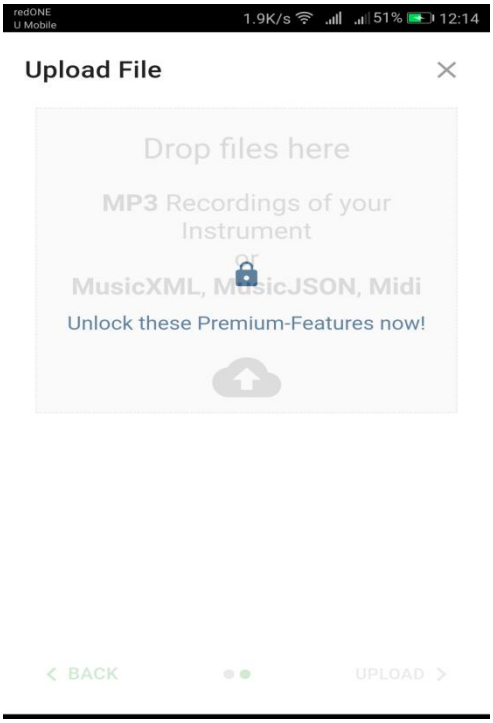


Figure 2.5.6 Upgrade to Premium

2.6 Summary

After reviewing the existing software systems and applications, some functionalities and user requirements were figured out for the proposed application. In order to solve the limitations of them, a mobile application will be developed. The mobile application will be developed in the Android platform. This is because a mobile application will bring convenience to a user. There is additional functionality in the proposed application which are conversion between the music file and the music sheet and composing of music. The application will provide a full view of sheet music and an unlimited number of songs for transcription. The application will be free of charge.

Functionalities / Application Names	Generate music	Edit music sheet	Save and download music sheet	Playback music	Convert music to music sheet	Platform
ScoreCloud	√	√	√	√		System
AnthemScore		√	√	√		System
MelodyScanner		√	√	√	√	Web, App
MuseScore	√	√	√	√		System
Proposed System	√	√	√	√	√	App

Table 2.6.1 Comparison between existing systems and applications

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Overview of methodology

This chapter discusses the methodology used in proposing this mobile application. Choosing a suitable and good methodology is important in developing a new mobile application. According to Gelinas, et. al. (2016), a methodology is a formalized approach to implementing the SDLC. The methodology can also define as a set of general principles that guide a manager to choose a particular method suited to a project. There are several types of methodology such as Software Development Methodology, Agile Software Development, Extreme Programming, Rapid Application Development and others.

The software development methodology will be used in proposing this mobile application is a Software development method. System Development Methodology is a tradition obeyed in an organization to perform all the steps to analyze, design, implement, and maintain information systems. Thus, system development methodology is suitable for developing this mobile application. There are several types of system development methodology such as waterfall, prototype, incremental development and others.

In the development of this mobile application, users have to involve in the mobile application development stages. There are several users were found and they will involve in the development stages. They had given some suggestions and the requirements that they needed in this application. In meanwhile that the first simple design will be constructed. The developer will have a discussion with the users on the way to modify or improve the mobile application. After the discussion, the second simple design will be constructed which modified from the first simple design. The steps will be repeatedly until the mobile application had fulfilled on the needed of users and users satisfied with the application. Hence, a finalize application will be developed.

3.2 Chosen Methodology

Waterfall methodology was chosen and implemented as a software development methodology in proposing this mobile application. A logical progression of steps be taken throughout the software development life cycle (SDLC) was highlighted by the waterfall model which is much more like the cascading steps down an incremental waterfall. (Andrew Powell-Morse, 2016).

First of all, the goal of the project and its main functionalities and components were decided and identified. The basic requirements for this application were figured out which are composing music, generating music from a music sheet and generating music sheet from music from the different file type. After that, a preliminary design is created for the project. The design will be continued until the design of the whole application is created. After finishing the design, it will proceed to the implementation stage which is implemented the design with code. In this stage, Android Studio, Kotlin programming language and Java programming language will be used. Next, it will proceed to the verification stage which is testing of the application. Unit testing is carried out to ensure that the application is fulfilling the goals for the application. In this stage, the errors done from the previous stages are shown and it needs to be solved. Lastly, the documentation are prepared. This is to ensure that the application can work as intended and the user can understand what the application working on.

According to Sudarsan Reddy (n.d), the benefit of waterfall methodology is the mobile application can be easier to measure. All the conveyances can be measured easily if there are no unequivocal requirements. There is no overlapping in the waterfall model because all the tasks are in sequential. Other than that, the waterfall model can provide extensive documentation because all the tasks, steps and requirements are extensively documented. By using the waterfall model methodology, it is easier to follow when doing the application as the requirements to be well defined.

But there are still have some limitation of waterfall methodology which are the project manager has the responsibility for almost the whole developing program. There is no user involved in developing the application so it is hard to know whether the application can fulfill user requirements.

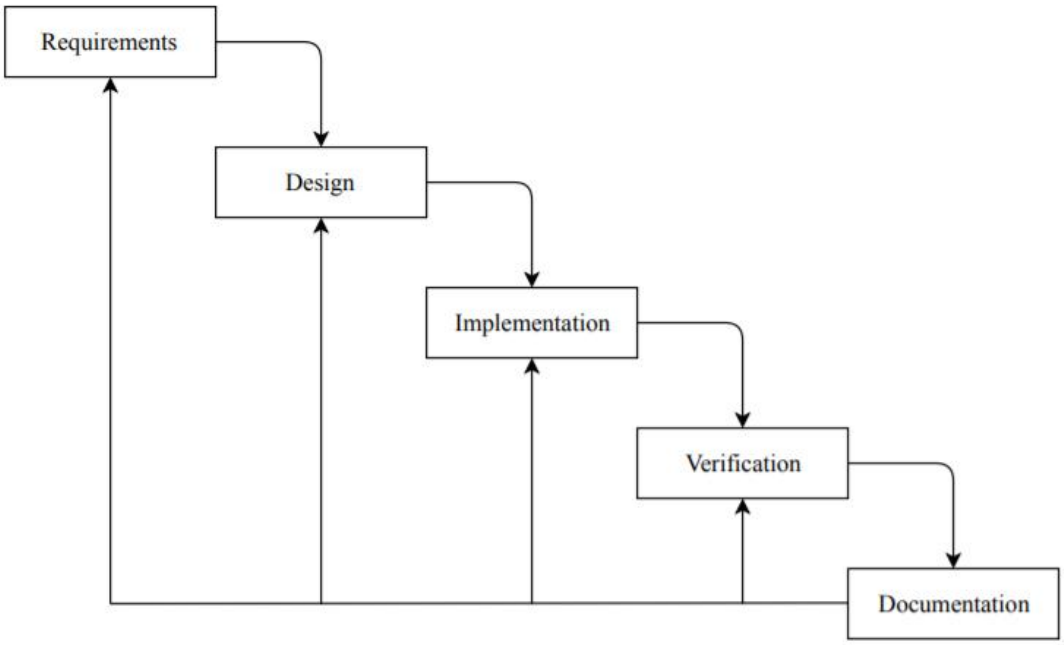


Figure 3.2.1 Waterfall model

- Requirements

  The first phase in the waterfall model methodology is requirements. This project is developed as an Android based mobile application. Once the title was confirmed, researches and studies on the existing software systems and mobile applications were started. From the existing music generator systems and applications, some limitations of the systems and applications were found. So, the purpose of developing this project is to solve the limitation of the existing system. Other than that, some new features will also be added to the mobile application in this project. The problem statement of the project was found and listed in the requirement phase. Based on the problem statement, the objectives of this project were created. As a suggestion from the project supervisor, the application will combine a few functionalities from the existing systems which the existing systems had no function it yet. The project scopes are created also in the requirement phase.

  Deliverables: Problem statement, objective and project scopes

- Design

In the design phase, it begins the software development. A decision on the user and software interface is created. A simple design of the application is created. The layout of the application is included in the simple design of the application. For example, the background picture of the application, the position of the function buttons and the position of the icon. The text font, text colour and layout design is created. Hence, the application is designed and produced.

Deliverable: user interface design, application specification

- Implementation

As the application was designed, now proceeding to the implementation stage. In the implementation, source code is written. The source code is written in Java and Kotlin programming language. All the application is developing by Android Studio.

Deliverables: initial version of application

- Verification

In this stage, unit testing is created for the application. This is to ensure that there is no error for the application. Other than that, the errors are solved in this stage as there are errors found while testing this application.

Deliverables: Requirement analysis, methodology, user interface design, test application specification, design of application

- Documentation

Documentation is prepared for the whole application. This is to ensure that the users can understand and know how to use the application.

Deliverables: Proposed application

3.3 System Design

3.3.1 UML - Use Case Diagram

A use case diagram as shown in Figure 3.3.1.1 was designed in the design phase. There are a total of four main functions in this application which are music composer, generate music sheet from music, music theory and searching music sheet. The sub functions of music composer are generating music, then edit the music sheet and playback music. Then, the sub functions of generating music sheet from music are generating music sheet, then edit the music sheet and save and download music sheet. Next, the sub functions of music theory are able to let user learning music theory in terms of the scales, rhythm, notes and others. Lastly, the sub function of searching music sheet are searching the piano sheet in two version both English songs and Chinese songs.

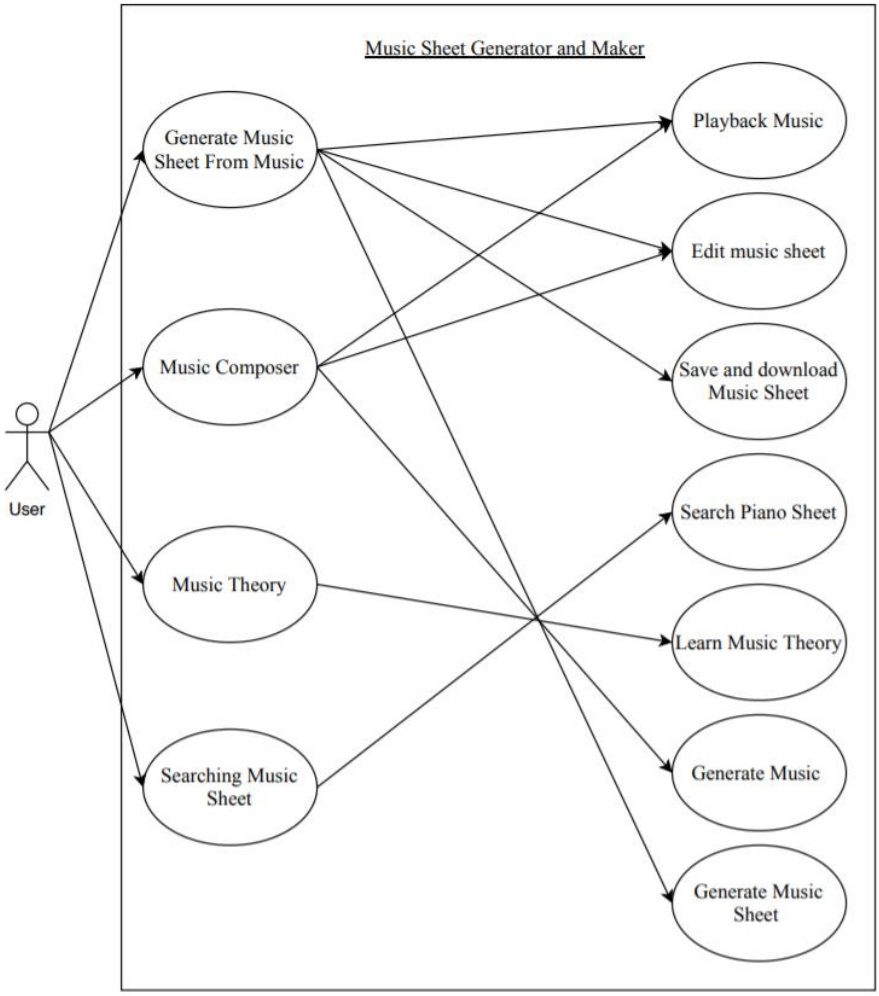


Figure 3.3.1.1 Use Case Diagram

3.3.2 UML - Activity Diagram

The activity diagram is separated following by the different functions. Firstly, it is generate a music sheet from music. Next, it is music composer. Then, it ill be music theory. Lastly, it is searching music sheet.

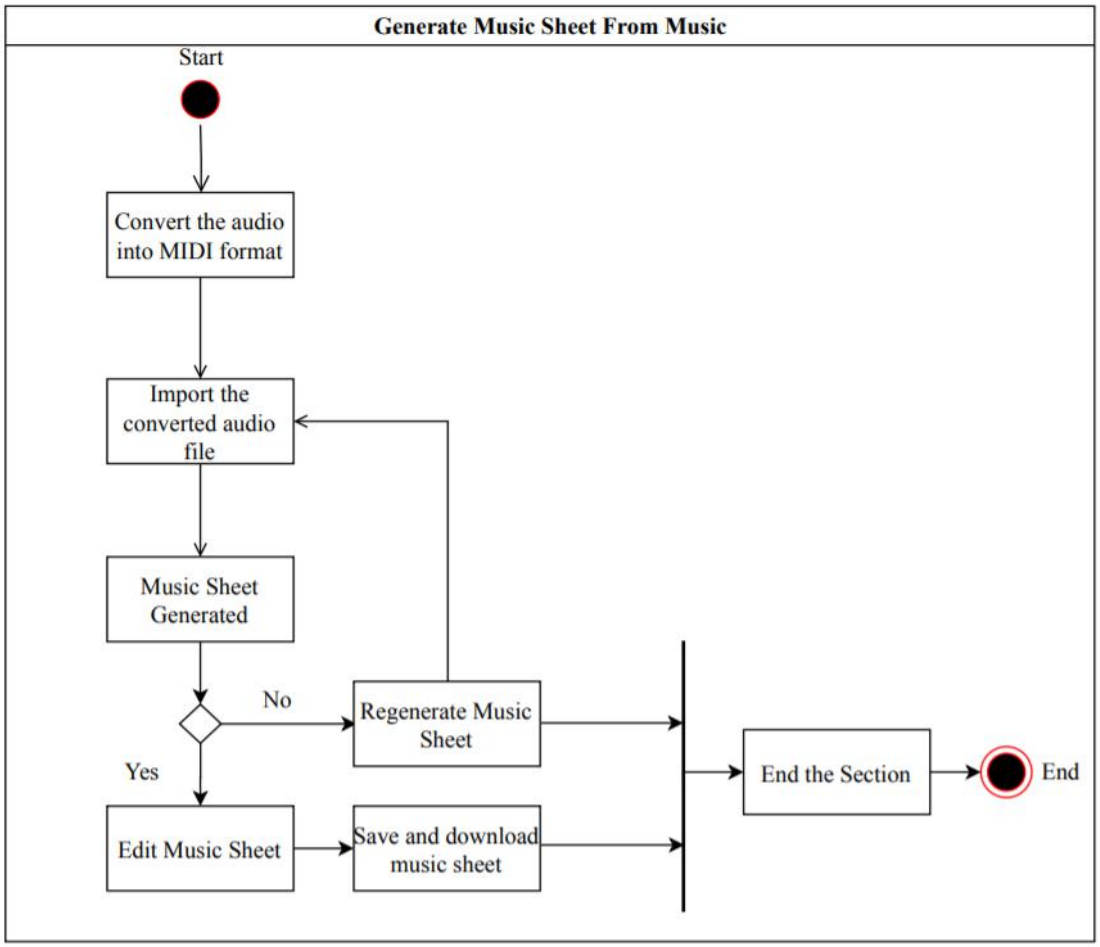


Figure 3.3.2.1 Activity diagram for Generate Music Sheet From Music

Firstly, user needs to convert the audio into MIDI format by themselves. After converting the file, import the file into the application. After that, a music sheet is generated. If they choose to save the music sheet, then it will proceed to edit the music sheet, then the music sheet able to save and download. If they do not want to save it, they can regenerate the music sheet again. Otherwise, the section is ended.

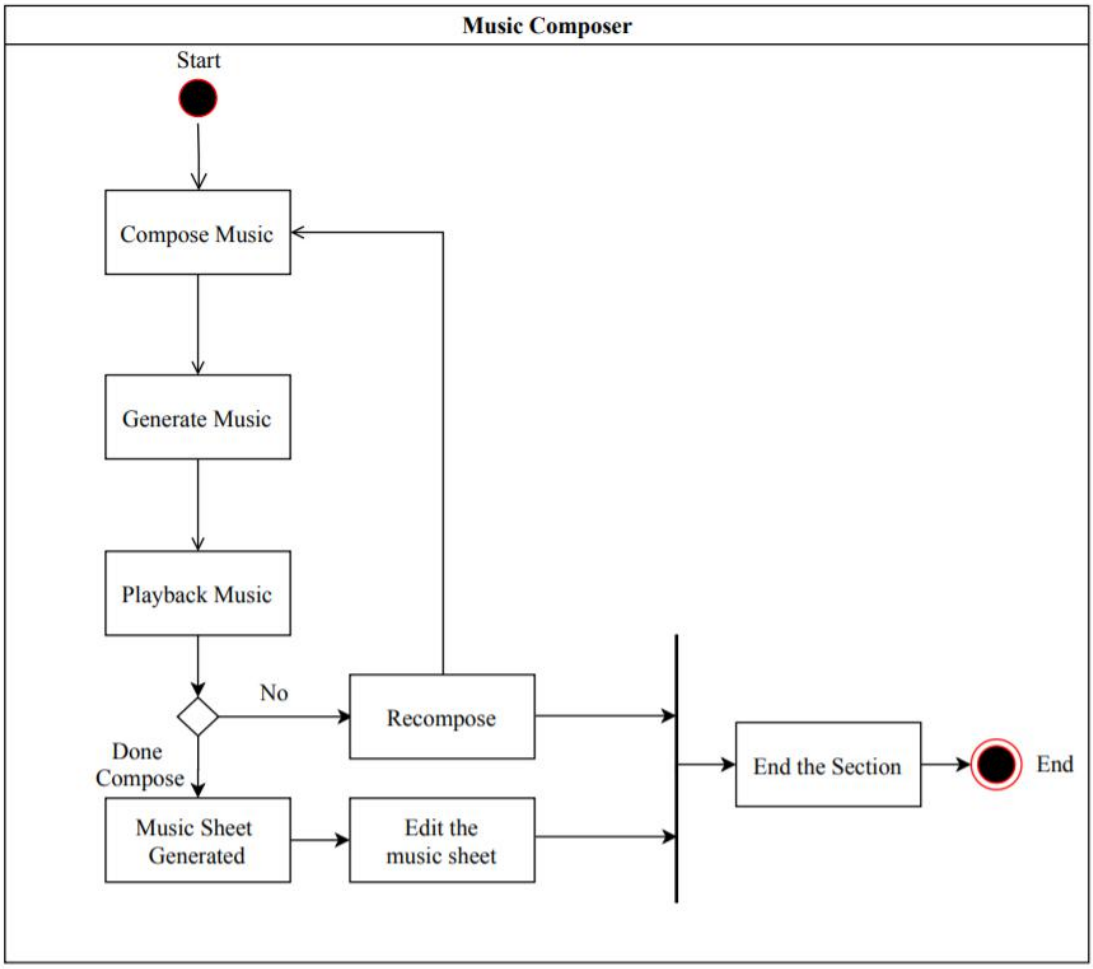


Figure 3.3.2.2 Activity diagram for Music Composer

Firstly, user needs to compose music by themselves. After composing, a music is generated. They able to playback the music for a listen. If they choose to save the music, then it will proceed to generate the music sheet. It not, they can choose to recompose the song. They also able to edit the music sheet and save it. Otherwise, the section is ended.

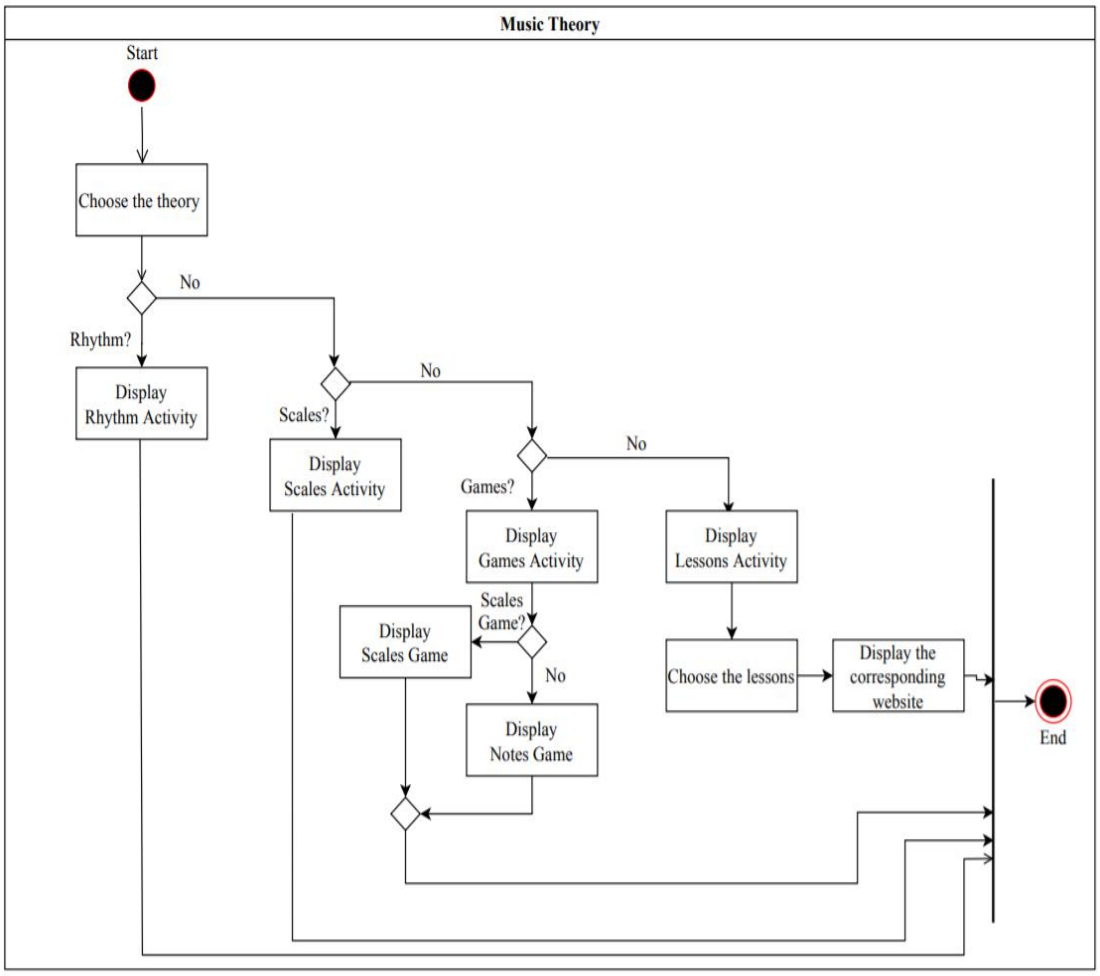


Figure 3.3.2.3 Activity diagram for Music Theory

Firstly, user needs to choose the theory activity that provided. If they choosing rhythm activity, so the page of rhythm activity is displayed. Other than that, if they choose to learn scales activity, so the page of scales activity is displayed. Beside that, they can choose to play the mini games provided by choosing the game activity. There are scales game and notes game provided in the games activity. Lastly, they can choose to learn the lessons from the website provided.

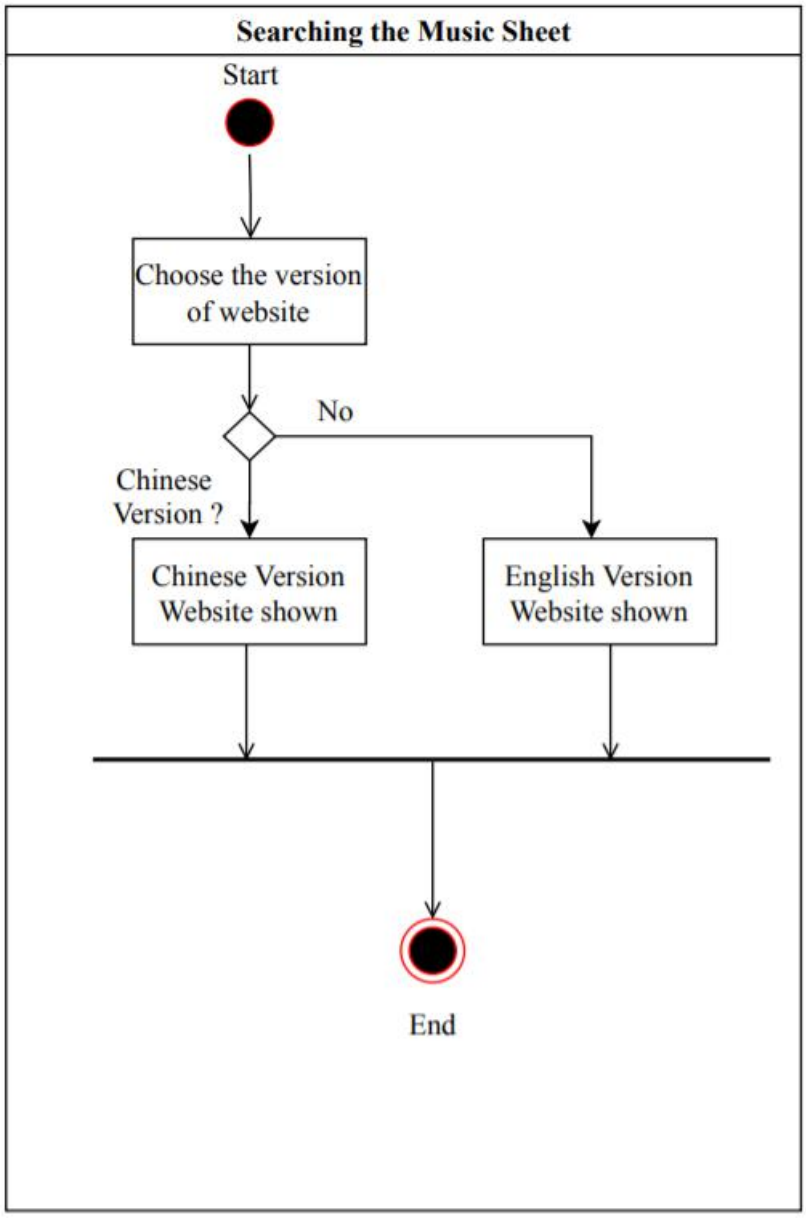


Figure 3.3.2.4 Activity diagram for Searching Music Sheet

Firstly, user needs to choose whether they want to access English Version website or a Chinese Version Website. If they are choosing Chinese Version website, then the website is shown. Otherwise, the English Version website is shown. The differences between Chinese Version and English Version are Chinese Version website able to get the songs in different language such as Chinese, English, Japanese, Korean and others while the English version only can get English Songs.

3.4 Technologies Involved

3.4.1 Hardware Requirement

The hardware required to run the Music Sheet Maker and Generator Application are as follow:

Description	**Minimum Requirement**
Android Version	Android 7.0 or above
Memory	2GB or above
Storage	5GB of storage
Resolution	800 x 1280 or above
Audio Playback	Media Player

Table 3.4.1.1 Hardware requirements for user

From Table 3.4.1.1, it had shown that the hardware requirement to run the mobile application. The user device must include Android 7.0 or above, 2GB or above ram in order to support the system to run in their mobile phone. An IOS system is not available to use this application because it is only open for Android users. The storage needed is 5GB, the resolution is 800 x 1280 or above. The audio can playback by using the media player.

The hardware required to test the Music Sheet Maker and Generator Application on a mobile application are as follow:

Description	**Minimum Requirement**
Android Version	Android 7.0 or above
Memory	3GB or above
Storage	10GB of hard disk space
Resolution	800 x 1280 or above
Audio Playback	Media Player

Table 3.4.1.2 Hardware requirements for device

From Table 3.4.1.2, it had shown that the hardware requirement to test and implement the mobile application. The develop device must include Android 7.0 or above, 3GB or above ram in order to support the system to run in their mobile phone. The storage needed is 10GB, the resolution is 800 x 1280 or above. The audio can playback by using the media player.

The hardware required to develop the Music Sheet Maker and Generator Application are as follow:

Description	**Minimum Requirement**
Processor	2.0GHz or above processor
Memory	2GB or above
Hard Disk	10GB of hard disk space
Video Card	DirectX9 or above
Resolution	1024 x 768 or above

Table 3.4.1.3 Hardware requirements for device

From Table 3.4.1.3, it had shown that the hardware requirement to develop the mobile application. This application is developed in the laptop device and then input for testing on the mobile phone. The develop device must include of 2.0GHz or above processor, 4GB or above, 10GB of hard disk space, DirectX9 or above video card and a resolution which above 1024 x 768 in order to support the system to run in their mobile phone.

3.4.2 Software requirement

The software required to develop the Music Sheet Maker and Generator Application are as follow:

Description	**Minimum Requirement**
Operating System	Windows 7 or above
Third Party Environment Set Up	Latest version of Java Runtime Environment (JRE)
Development Kit	Latest version of Java Development Kit (JDK), Android Studio
Interface Design	Net-beans IDE 7 or higher version

Table 3.4.2.1 Software requirements for developer

From Table 3.4.2.1, it had shown that the software requirement to develop the mobile application. This application is developed in the laptop device with Windows 7 or above Operating System. The third party environment set up is the latest version of Java Runtime Environment (JRE). The development kit is the latest version of Java Development Kit (JDK) and the interface design is Net-beans IDE 7 or higher version.

3.5 Timeline

3.5.1 Gantt Chart for FYP1

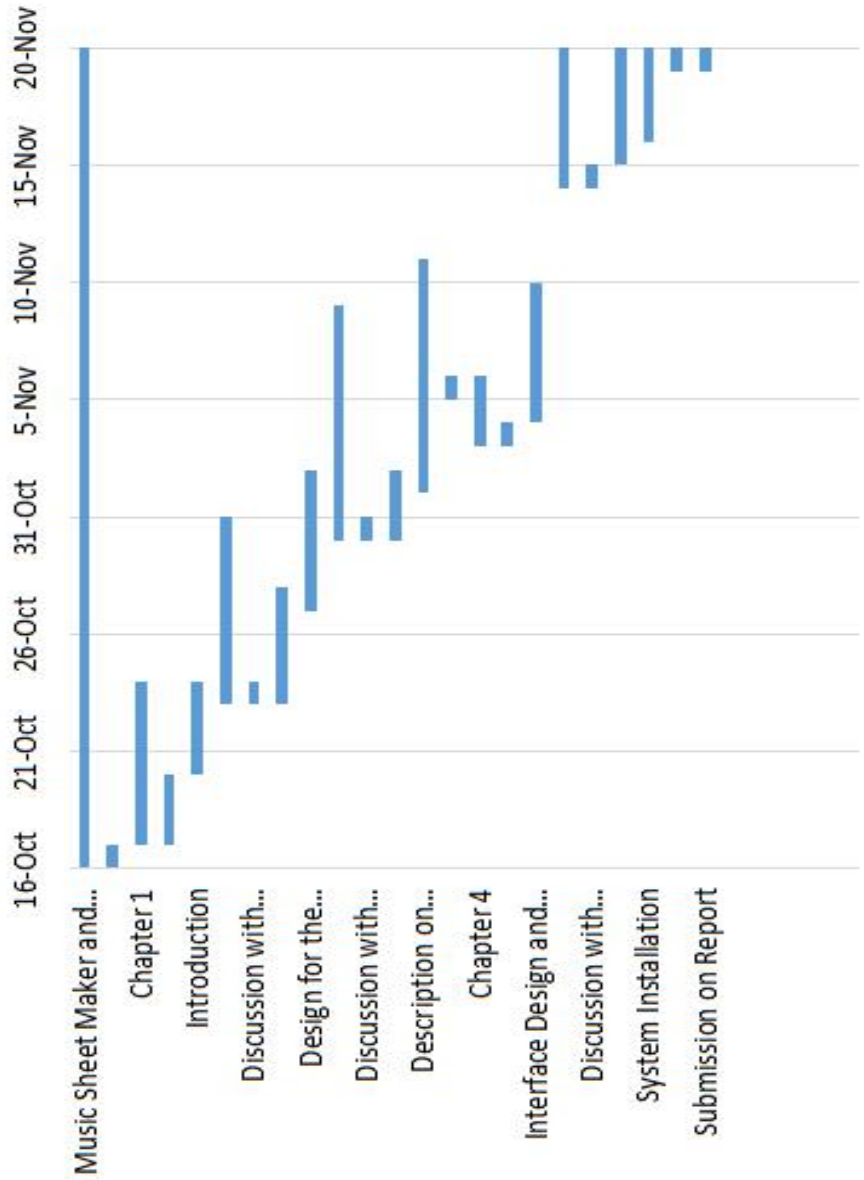
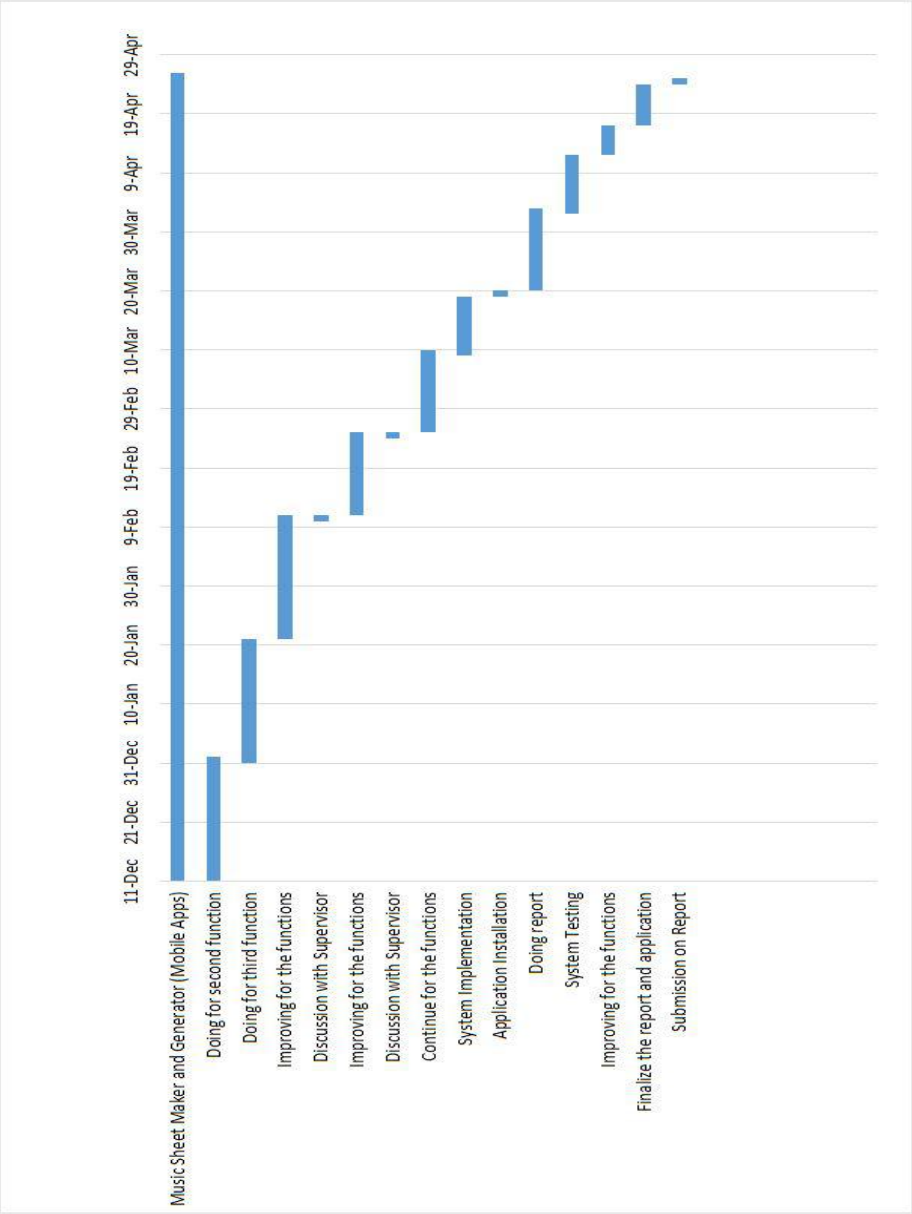


Figure 3.5.1 Gantt Chart for FYP1

3.5.2 Gantt Chart for FYP2



3.5.2 Gantt Chart for FYP2

3.6 Summary

In this project, the program is written in Java Programming Language by using Android Studio. Furthermore, this project is divided into 5 phases which are requirements, design, implementation, verification and maintenance. In the first phase which is requirements phase. The requirements of this application were figured out by reviewing the existing software systems and applications. The objectives, problem statements and project scopes also figured out in this phase. Next, in the design phase, the simple user interface was designed by using Paint. The layout of the application was figured out and design. After that, in the implementation phase, the design of the application was proceeding by written source code. The whole application is developed in Android Studio. Then, verification of the system is carried out which is testing of the application whether it is a function or not. Lastly, documentation was prepared. This is to allow the user to read it and understand how to application works. By following the schedule of 5 phases, the project is able to be conducted and completed on time.

The methodology used in developing this application and the software and hardware requirements also describing in this chapter. A use case which describe of the whole system was provided in this chapter. There are also explanation for the use case diagram. Other than that, activity diagrams for each single main functions also provided in details. All the diagrams are describing how to project is developed and the necessary information are provided for the reader. The gantt chart for both FYP1 and FYP2 also shown in this chapter.

CHAPTER 4: SYSTEM DEVELOPMENT

4.1 Application Design

Interface design is very important for a developer to start developing an application. Interface design has to be done before developing an application. Good application design can attract users to use it and become user friendly.

The application interface design is a very simple design. This is to ensure that the application is user friendly enough, so the users do not need to spend too much time learning how to use the application.

After reviewing for some related software systems and applications, some idea was coming out on how to design the application. A splash screen as shown in Figure 4.1.1, is shown for 2 seconds when the application is opened. After that, it will go into the application home page which also the application interface the main page which as shown in Figure 4.1.2. The interface main page was build up with a simple design which is a black colour background with a few welcoming sentences and there are totally four buttons are shown. Each of the buttons will link to different functions.

Figure 4.1.1 Splash Screen

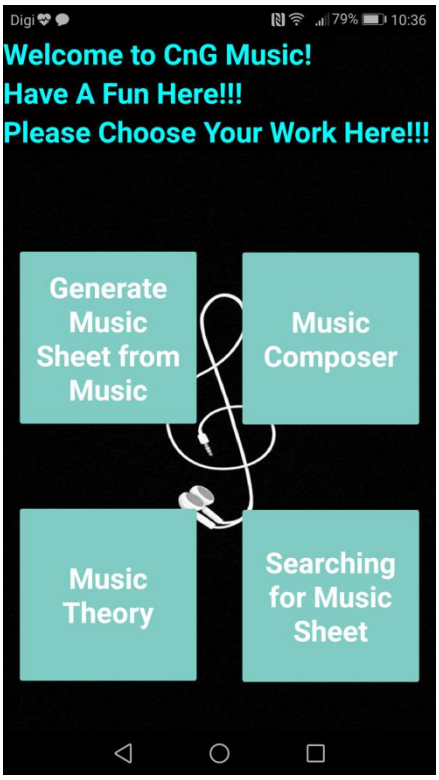


Figure 4.1.2 Main Page

Since there are four different main functions are proposed in this application, they are separated into Generate Music Sheet from Music, Music Composer, Music Theory and Searching Music Sheet. The first function is Generate Music Sheet from Music. It is mainly convert the music into the music sheet. From the Figure 4.1.3, it had shown the main menu in the Generate Music Sheet function. It consists of two buttons which are convert music file and import song file.

When the convert music file button is pressed, a conversion tool website is shown as in Figure 4.1.4. User able to convert their song file from MP3 into MIDI types and they can download the song file after they converted it.

While pressing the second button which is import song file, it will come out with the recent activity and browse activity as shown in Figure 4.1.5 and Figure 4.1.6. The recent activity will show the convert history and the browse activity will browse the song file in the phone. After choosing the song file, the music sheet is converted as shown in Figure 4.1.7. From the Figure 4.1.8, after converting the music sheet, it can be modified, playback and download as image.

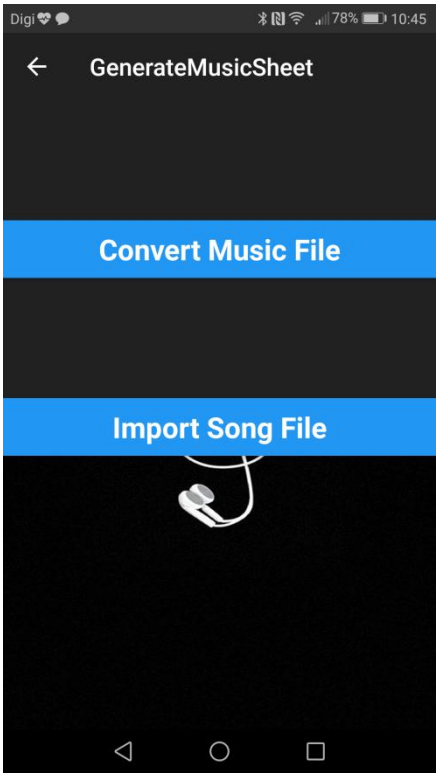


Figure 4.1.3 Main Menu for Generate Music Sheet

Figure 4.1.4 Website for converting Music file

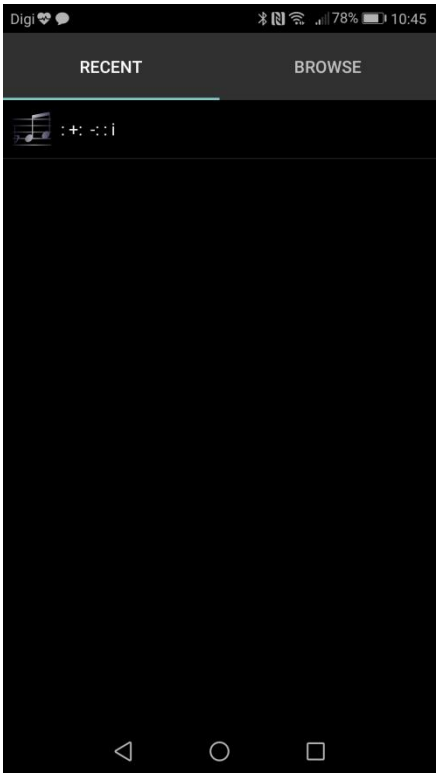


Figure 4.1.5 Recent Activity

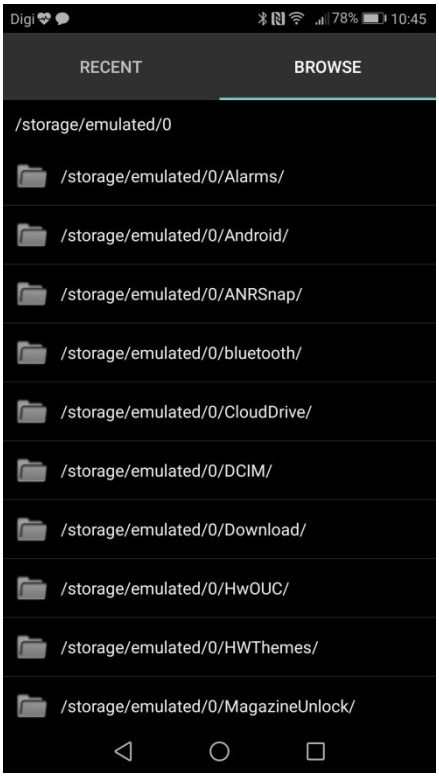


Figure 4.1.6 Browse Activity

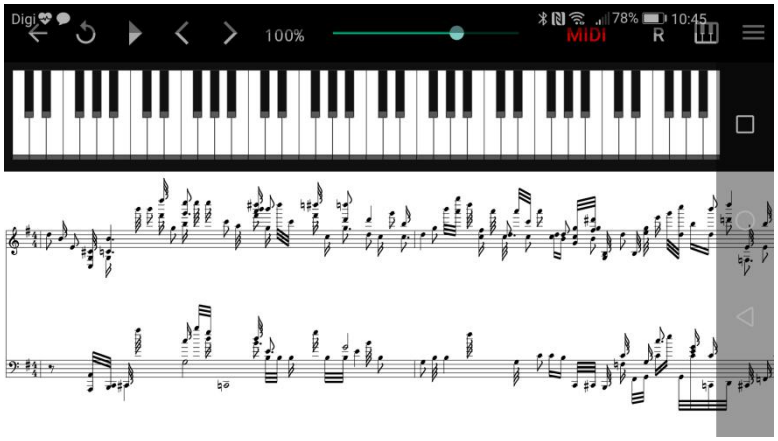


Figure 4.1.7 After Converting

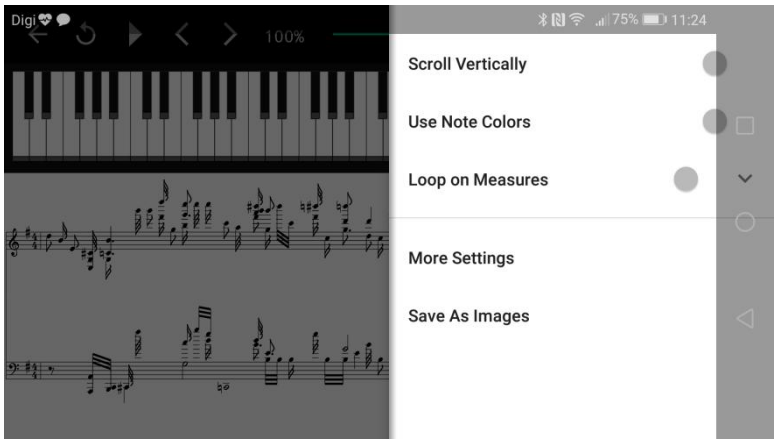


Figure 4.1.8 Setting for Generate Music Sheet

The second main function is music composer. It is mainly to let the users to compose their music by using music composer function. As shown in Figure 4.1.9, it is the main menu for music composer function. It consists of three buttons which are keyboard, saved compositions and settings. If user pressed the keyboard button, a piano keyboard is shown as Figure 4.1.10. After pressing the record button beside the keyboard, the recording is started. When the stop button is pressed, the composition activity is stop and a piano sheet is shown as Figure 4.1.11. User can playback the rhythm and when the done button is pressed, the compositions are save into the saved compositions.

If the user pressed the saved compositions button, it will show the compositions list which done by the user as shown in Figure 4.1.12. From the figure 4.1.13, it shows that the edit page for the music composer which user able to edit their composed music by changing their key and scale. Changing of the key and scale had been shown in Figure 4.1.14 and Figure 4.1.15. After editing the piano sheet, the edited sheet will be shown directly as in Figure 4.1.16.

If the user pressed the settings button, they can change the playback speed as shown in Figure 4.1.17.

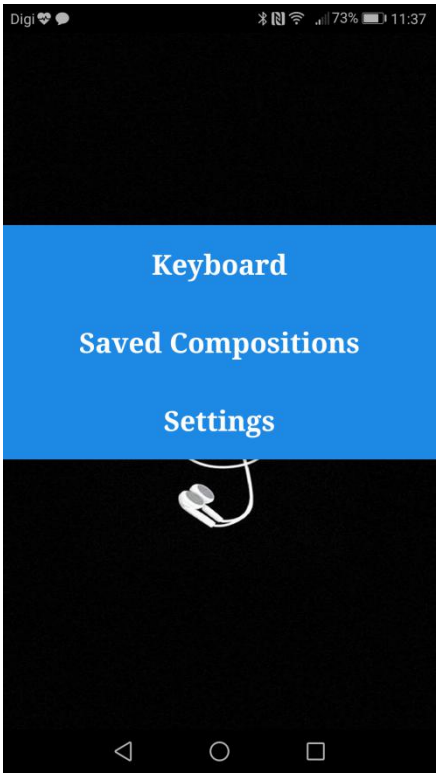


Figure 4.1.9 Main Menu for Music Composer

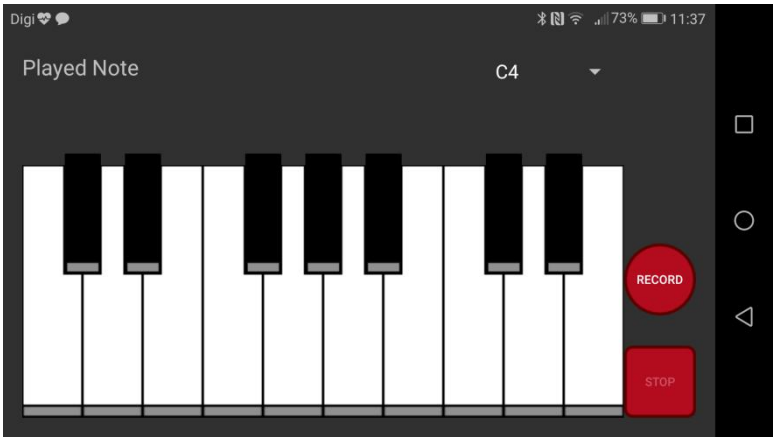


Figure 4.1.10 Piano Keyboard

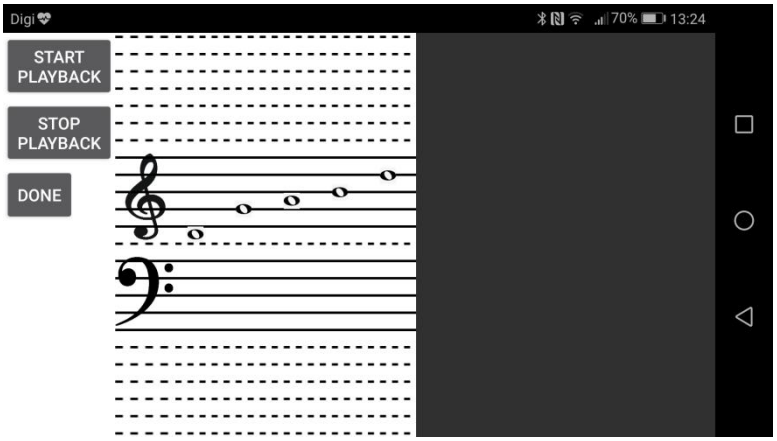


Figure 4.1.11 Piano Sheet Shown after composition

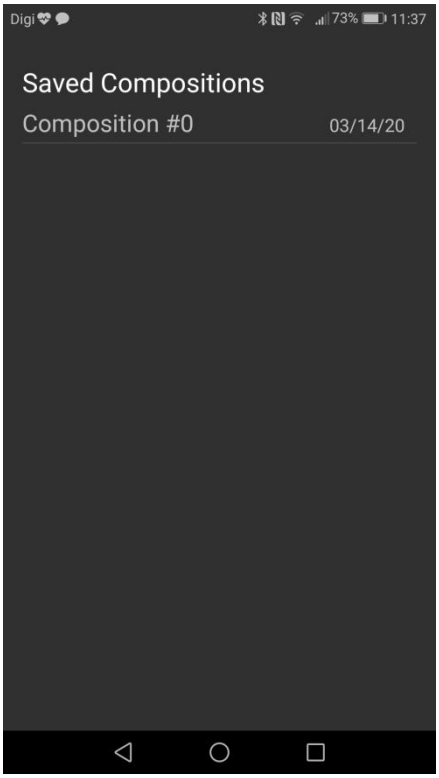


Figure 4.1.12 Saved Composition

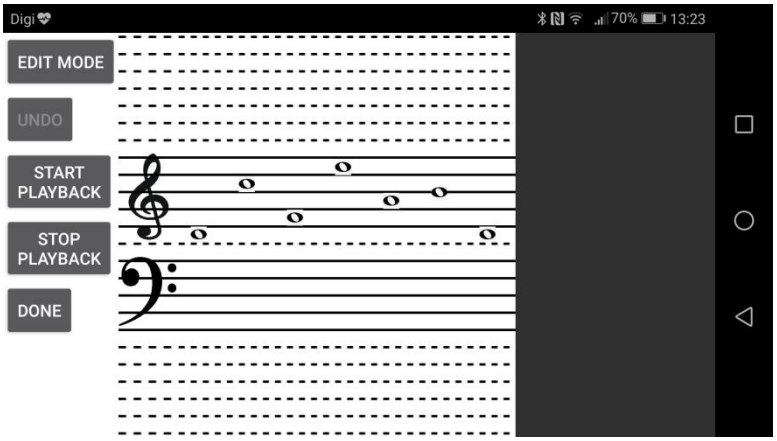


Figure 4.1.13 Edit Piano Sheet

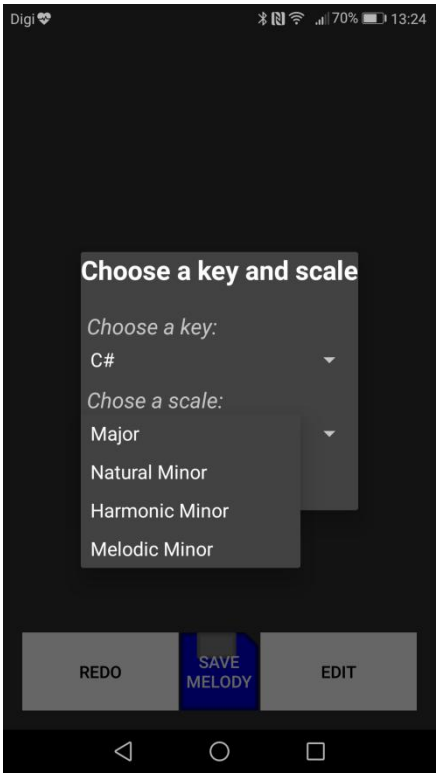


Figure 4.1.14 Choose a key for editing

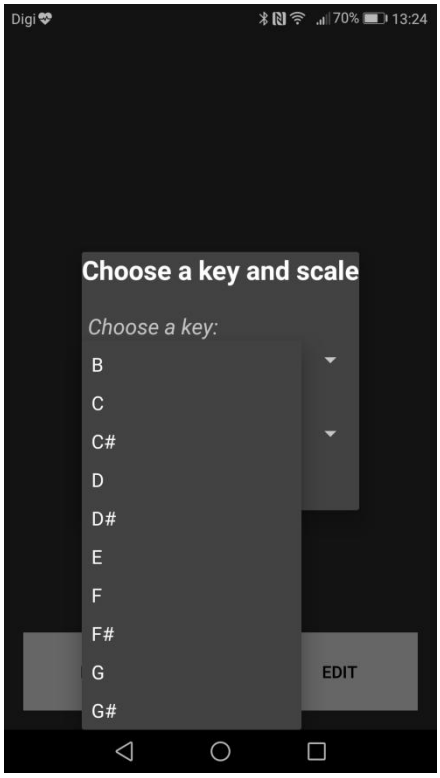


Figure 4.1.15 Choose a scale for editing

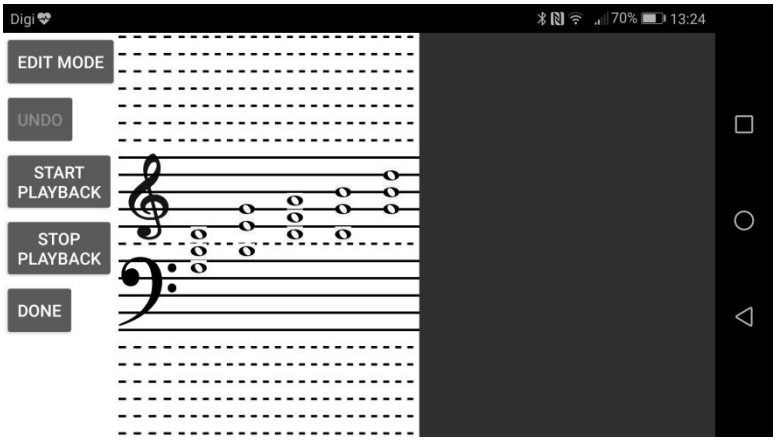


Figure 4.1.16 Piano Sheet after editing

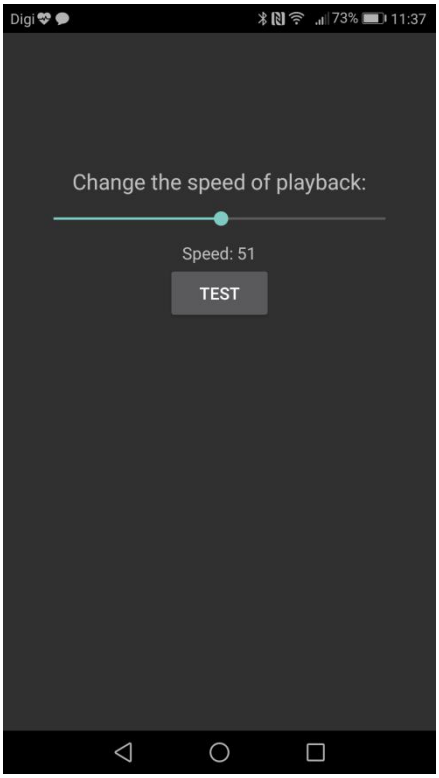


Figure 4.1.17 Setting for Music Composition

The third main function is music theory. It is mainly to let the users to learn the music theory. As shown in Figure 4.1.18, it is the main menu for music theory function. It is a show list with four buttons which are rhythm, scales, games and lessons. If user pressed the rhythm button, a page that let user to learn music rhythm is shown as Figure 4.1.19.

If the user pressed the scales button, it will show the staves with both right and left hands. It will show the notes on the staves accordingly to the scales that chosen by the user as shown in Figure 4.1.20.

If the user pressed the games button, the main menu for the games activity is shown as Figure 4.1.21. It had two types of game provided in the game activity which are scales activity and notes activity. It also consists of a button called Reset the high score which able to let the user to delete their previous score. As they had learned about the scales and notes from the scales activity, so the user able to answer the questions in the games activity. From the figure 4.1.22, it shows that the scale games activity. User may choose the correct answer from the scale list and press the submit button, if it is correct answer, there is one mark added to the record. From the Figure 4.1.23, it shows that the notes game activity. The notes will come out randomly on the staves after the user pressing the start button. After the note is shown, user may answer it by key in the correct notes name into the blank box and press the submit button. If the answer is correct, one mark is added into the record.

If the user pressed the lessons button, there is a list of lesson shown as in Figure 4.1.24. User can choose from the list on which course they want to learn and it will proceed to a website that teach the user for the theory as shown in Figure 4.1.25.

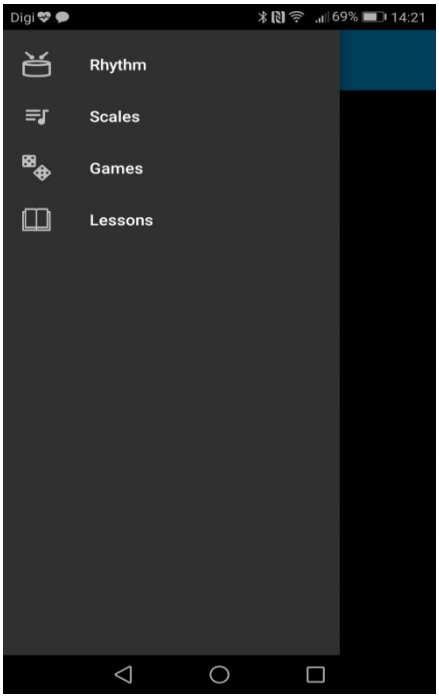


Figure 4.1.18 Music Theory Activity

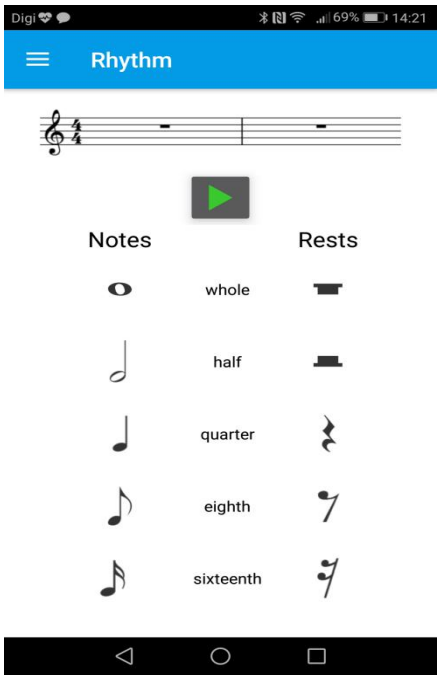


Figure 4.1.19 Rhythm Activity

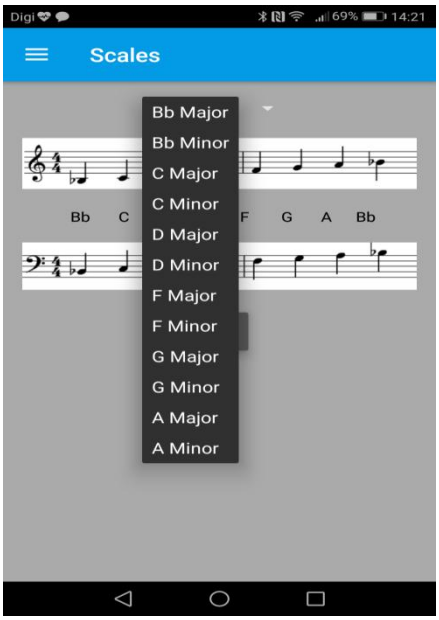


Figure 4.1.20 Scales Activity

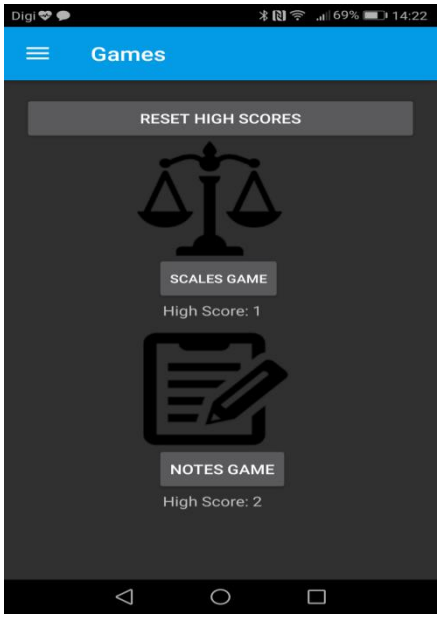


Figure 4.1.21 Main Menu Games Activity

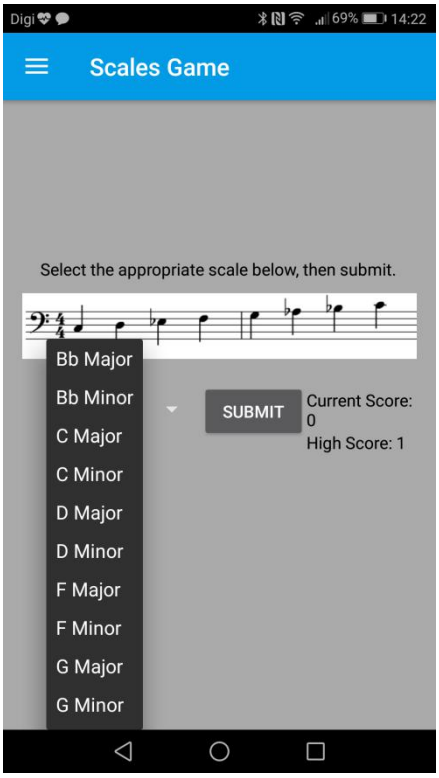


Figure 4.1.22 Scales Game

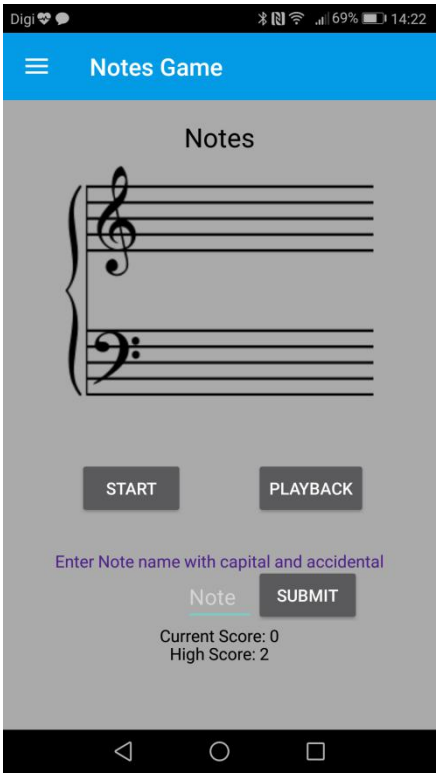


Figure 4.1.23 Notes Game

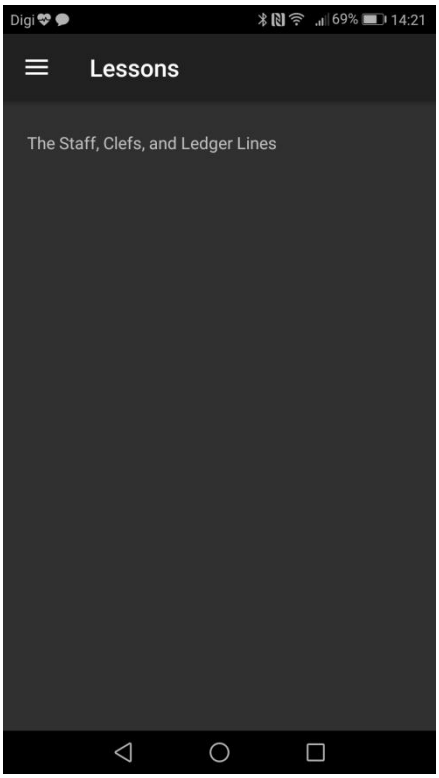


Figure 4.1.24 Lessons Activity

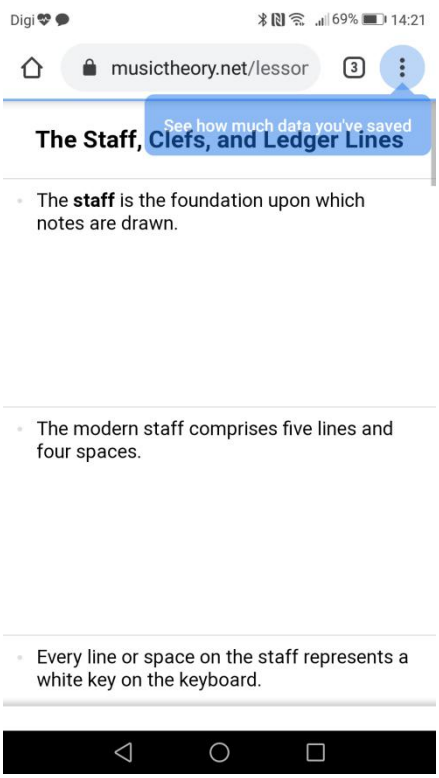


Figure 4.1.25 Lessons website

The last main function is searching the music sheet. It is mainly to let the users to search for the piano sheets. As shown in Figure 4.1.26, it is the main menu for searching music sheet function. It consists of two buttons which are English version and Chinese version. If user pressed the English version button, a website is shown as in Figure 4.1.27 and if user pressed the Chinese version button, a website is shown as in Figure 4.1.28.

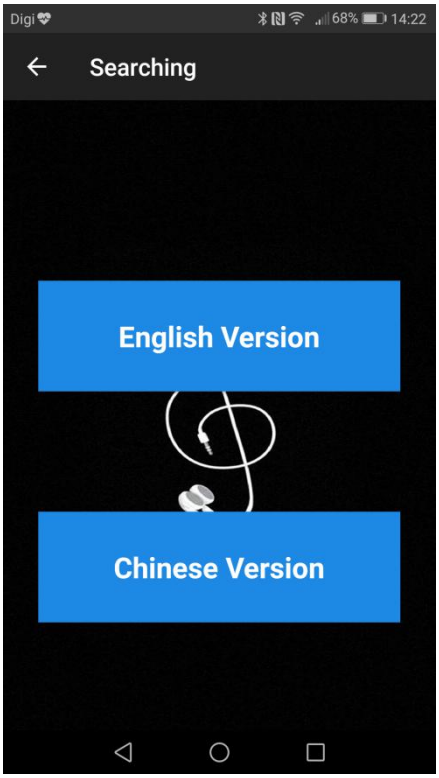


Figure 4.1.26 Searching Activity

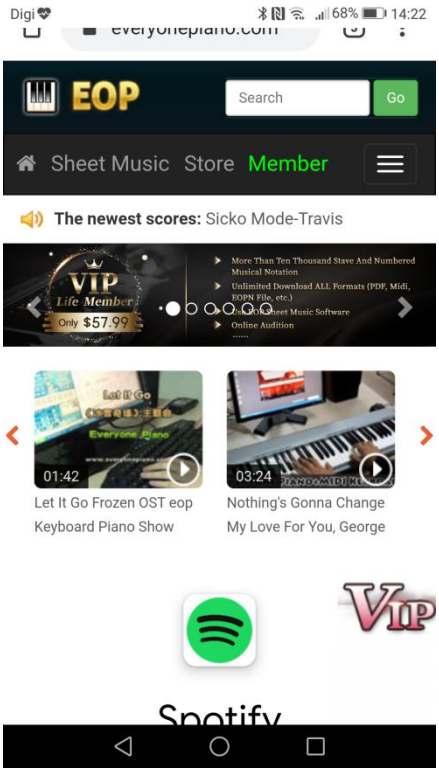


Figure 4.1.27 Website for English Version

Figure 4.1.28 Website for Chinese Version

4.2 Algorithmic composition

According to Christensson, P. (2013), algorithm is a series of manual which is designed to perform a specific task. It can be a simple task and also a complex operation. In the computer science field, algorithm is used to solve a series of problem or to perform the computation such as calculations, automated reasoning, and others.

The algorithm that had been applied in developing this application is algorithmic composition. There are several types of models for the algorithmic composition such as mathematical models, grammars, hybrid systems, optimization approaches and others. The models for the algorithmic composition that had been used in this application is optimization approaches. This is because music can be seen as a combination optimization problem, when it is generating well defined the styles. The aim is to figure out the right combination of notes which typically contains rules of a particular style. It also can be learned by using the machine learning methods which is Markov Model.

According to Alexander Dejeu (2017), Markov model is a stochastic model which used to model the randomly changing systems where it assume that the future states depend only on the current state not depend on the events that occurred before it. Markov model is applied in the music composition function in order to display the music sheet after composing is done by the user.

The Figure 4.2.1 had used as an example picture for the Markov model. For the composition function, user had to compose the music by pressing the keyboard provided in the application. Each of the keyboard key will linked to their own sounds. And the sounds are in difference frequency. After the user compose the music, the application will get the melody that play by the user. The notes frequency are detected and then find out by the application. The right combination of notes are found out and paste it out. As the process of pasting out the notes, it is applying the Markov model. As from the example below, it will arrange by following the sequence from the starting point to the end point. So, the notes are pasted out from the first note which play by the user to the end of composition.

Example of Markov Model in composition music:

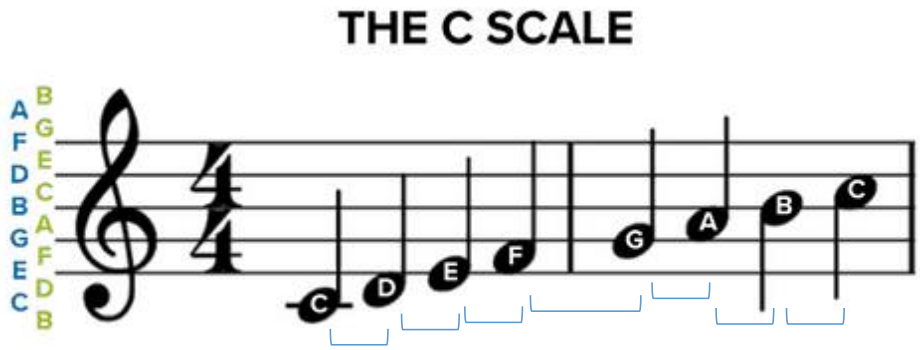


Figure 4.2.1 C Scale

Sequence of the scale:

(*START*, C)

(C , D)

(D , E)

(E , F)

(F , G)

(G , A)

(A , B)

(B , C-HIGH)

(C-HIGH , *END*)

Secondly, there is also an algorithm had been applied in the editing composition function which is calculate the position of notes for the major and minor chords display. Major chords usually will provided a happy mood while the minor chords will provide a sadly mood music. Major and minor chords consist of three notes which are a root, a third and a fifth (1 – 3 – 5). The root is the note upon which the chord is based. For example of the C major chord, the root of C major is C, while the major third is the third note in a major scale. Using the same note C, as an

example, the major third is E. E is four half steps above the root note. And the perfect fifth is the fifth note in the major. It is also called as the seven half steps above the root note. By using note C again, the perfect fifth is G. G is three half steps above the major third. From the theory, it is clear that, the major can be formed by using half steps. The formula using is R + 4HS + 3 HS which is root plus 4 half steps + 3 half steps. More examples for others major chords had shown in Appendix A.

The next example shown is for C minor chord, the root of C minor is C. Using the same note C, as an example, the minor third is E ♭ . E ♭ is third half steps above the root note. And the fifth is the fifth note in the minor scale which also called as the seven half steps above the root note. By using note C again, the perfect fifth is G. G is three half steps above the major third. From the theory, it is clear that, the major can be formed by using half steps. The formula using is R + 3HS + 4 HS which is root plus 3 half steps + 4 half steps. More examples for others major chords had shown in Appendix A.

According to Brandy Kraemer (2018), half step is known as the smallest interval in Western musical scales. For example, C sharp (C#) is one of half-step higher than C while B is half-step lower than C.

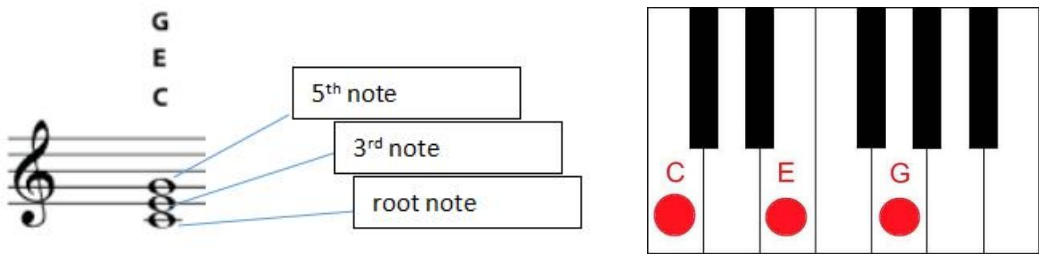


Figure 4.2.2 C major chord

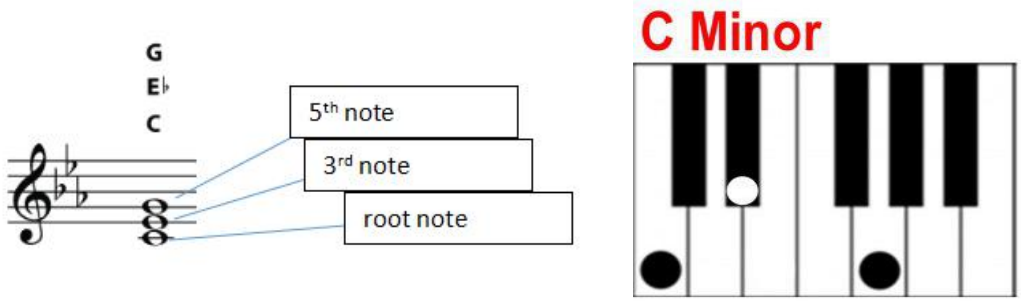


Figure 4.2.3 C minor chord

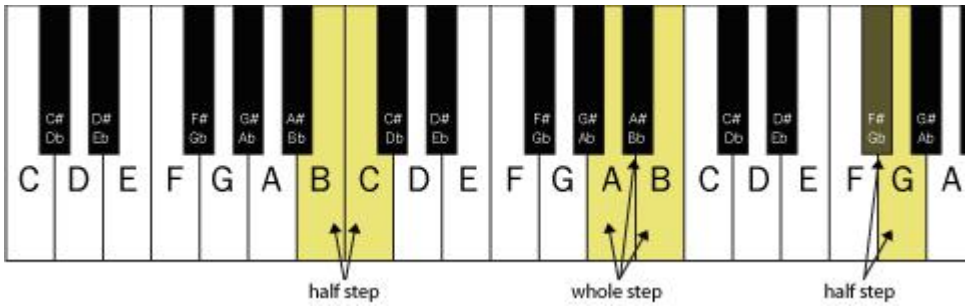


Figure 4.2.4 Half-steps notes

4.3 System Testing

Testing for the application is done, once the application has been successfully developed. This is to ensure that the application working as intentional. This is also to ensure that the application satisfies with its requirements and fit for its objectives as earlier stated. Besides that, testing will help in detecting the errors and bugs that may be hidden from the user. There are many types of testing such as unit testing, functional testing, integration testing and others. The testing must be completed before it is being deploy for user to use.

The testing that is used in testing this application is unit testing. Unit testing is a type of testing that testing an individual components of the software application. According to Margaret Rouse (nd), unit testing is done during the development process by the software developers and QA staff. The main point in unit testing is to find out the defects in the components and verifying the functional and non-functional in accordance to design. If there are errors or bugs were found from the application, developer have to be fixed them immediately to ensure that the number of fault in the application can be decreased. The types of defect which can figure out by implement unit testing are the incorrect functionality, logic and flows. In order to perform the testing, a test plan is provided.

Unit Testing 1: Main Menu

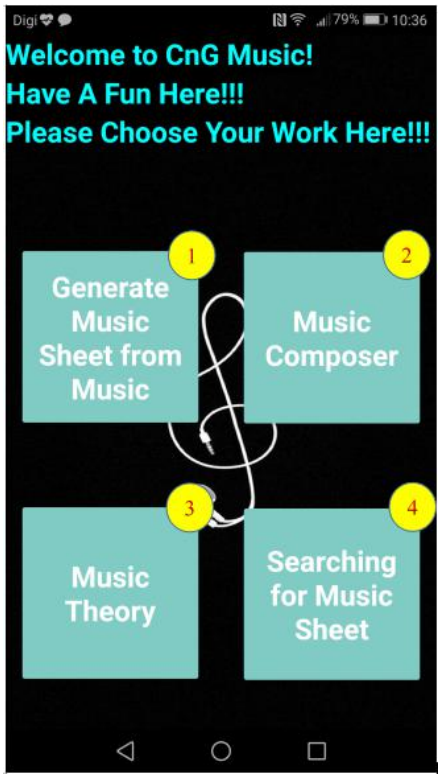


Figure 4.3.1 Main Menu

Activity: Main Menu				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Generate Music Sheet from Music Button	Pressed	Move to Generate Music Sheet Menu	Yes
2	Music Composer Button	Pressed	Move to Music Composer Menu	Yes
3	Music Theory Button	Pressed	Move to Music Theory Menu	Yes
4	Searching for Music Sheet Button	Pressed	Move to Searching for Music Sheet Menu	Yes

Table 4.3.1: Main Menu Testing

Unit Testing 2: Generate Music Sheet from Music

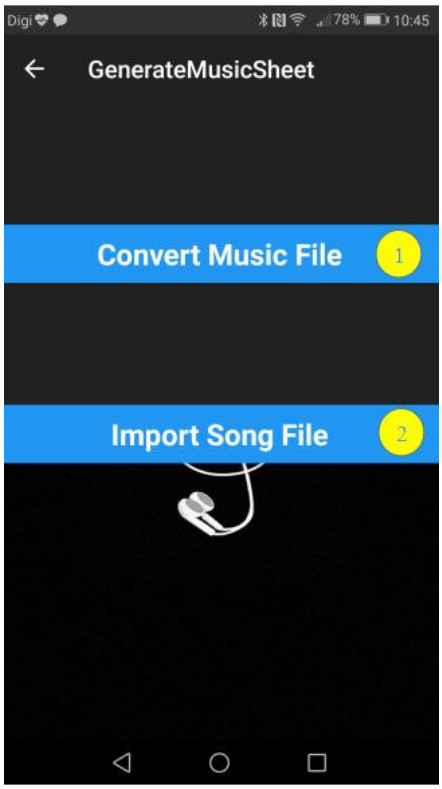


Figure 4.3.2 Generate Music Sheet from Music

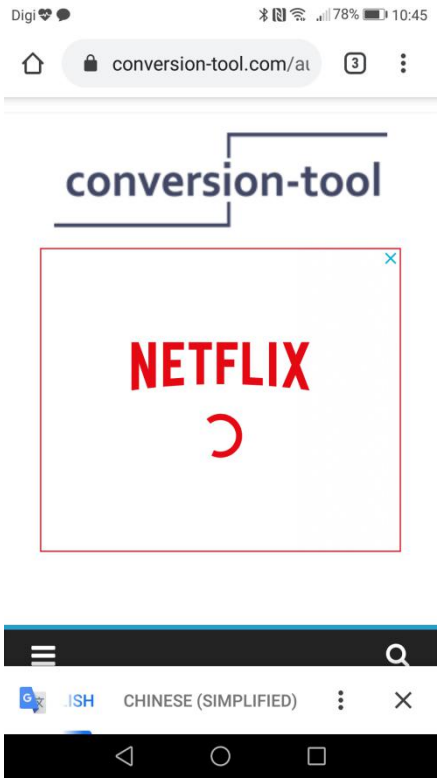


Figure 4.3.3 Convert Music File

Activity: Generate Music Sheet from Music				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Convert Music File Button	Pressed	A conversion website is shown	Yes
2	Import Song File Button	Pressed	Move to Import Song File Menu	Yes

Table 4.3.2: Generate Music Sheet from Music Testing

Unit Testing 3: Import Song File

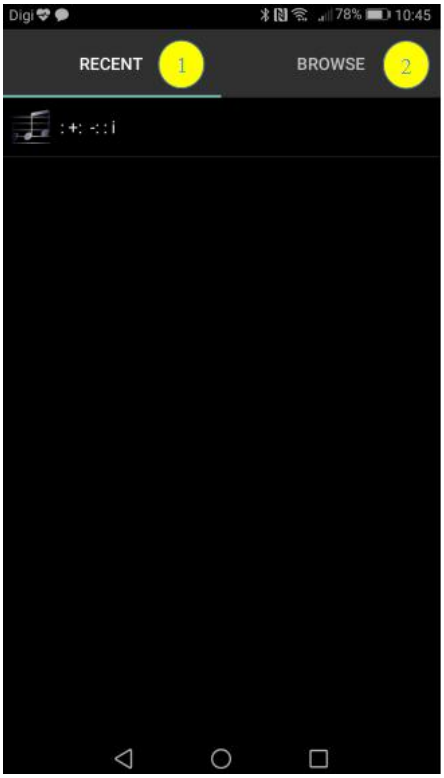


Figure 4.3.4 Import Song File

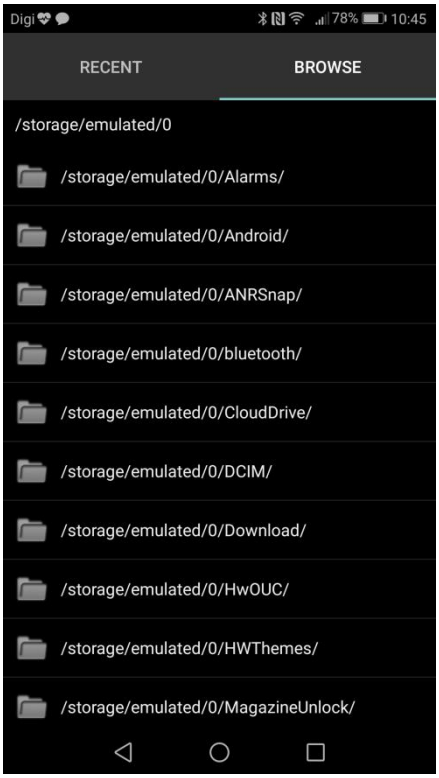


Figure 4.3.5 Browse Activity

Activity: Import Song File				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Recent Button	Pressed	Show recent list	Yes
2	Browse Button	Pressed	Show the files list	Yes

Table 4.3.3: Import Song File Testing

Unit Testing 4: Music Sheet Generated

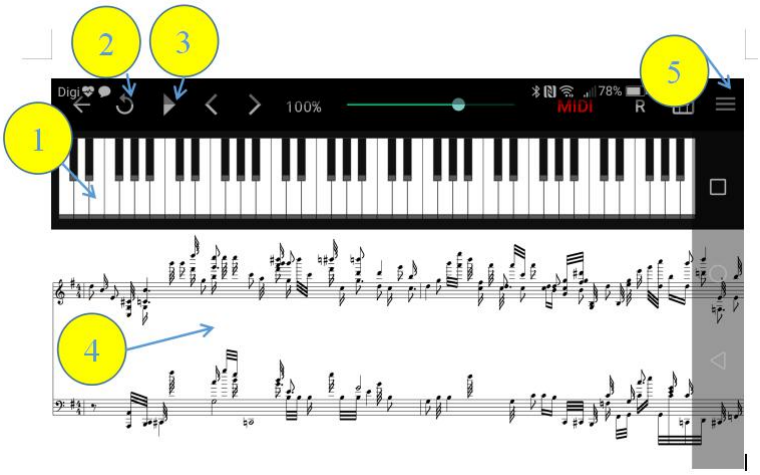


Figure 4.3.6 Music Sheet Generated

Activity: Music Sheet Generated				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Keyboard Shown	Display	Display note positions	Yes
2	Repeat Button	Pressed	Repeat the song	Yes
3	Playback Button	Pressed	Playback the song	Yes
4	Music Sheet Shown	Display	Display music sheet	Yes
5	Settings Button	Pressed	Move to Setting lists	Yes

Table 4.3.4: Music Sheet Generated Testing

Unit Testing 5: Settings List

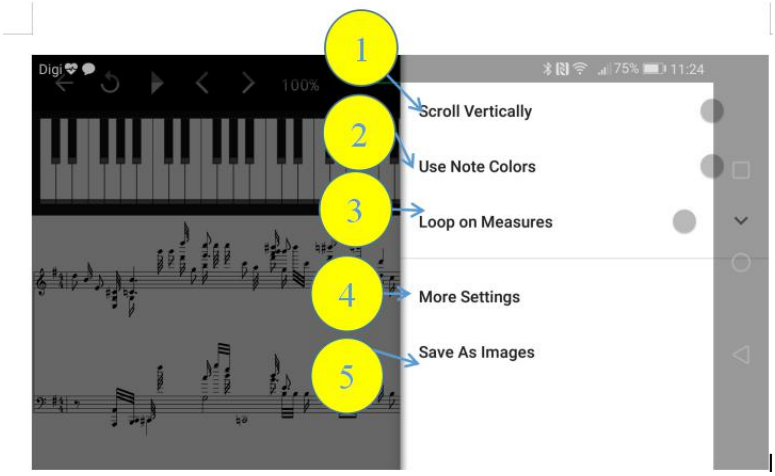


Figure 4.3.7 Settings List

Activity: Settings List				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Scroll Vertically Button	Pressed	Change the sheet to vertically view	Yes
2	Use Note Colors Button	Pressed	Display notes with different colour	Yes
3	Loop on Measures Button	Pressed	Change the Playback speed	Yes
4	More Settings Button	Pressed	More settings are chosen	Yes
5	Save As Image Button	Pressed	Save music sheet into image	Yes

Table 4.3.5: Settings List Testing

Unit Testing 6: Music Composer Main Menu

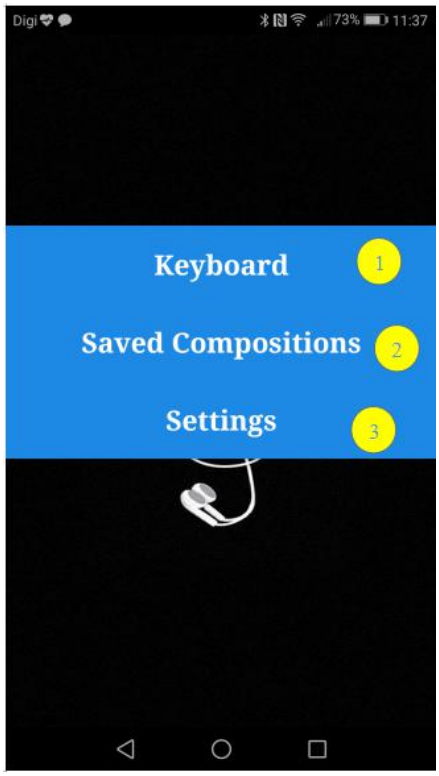


Figure 4.3.8 Music Composer Main Menu

Activity: Music Composer Main Menu				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Keyboard Button	Pressed	Move to Music Composer activity	Yes
2	Saved Compositions Button	Pressed	Show Saved Compositions list	Yes
3	Settings Button	Pressed	Change the Playback speed	Yes

Table 4.3.6: Music Composer Main Menu Testing

Unit Testing 7: Music Composer Activity

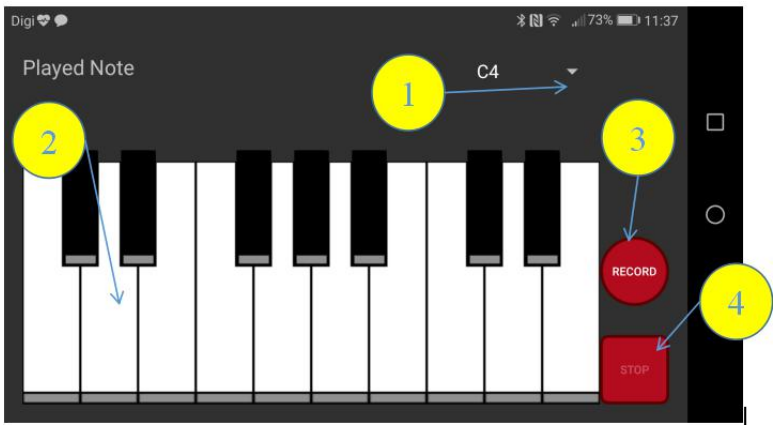


Figure 4.3.9 Music Composer Activity

Activity: Music Composer Activity				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Choose Piano Octave Button	Pressed	Display different octave sounds	Yes
2	Keyboard Button	Pressed	Produce keyboard sounds	Yes
3	Record Button	Pressed	Record down the notes that had played	Yes
4	Stop Button	Pressed	Stop music composer activity and move to saved composer	Yes

Table 4.3.7: Music Composer Activity Testing

Unit Testing 8: Saved Composer Activity

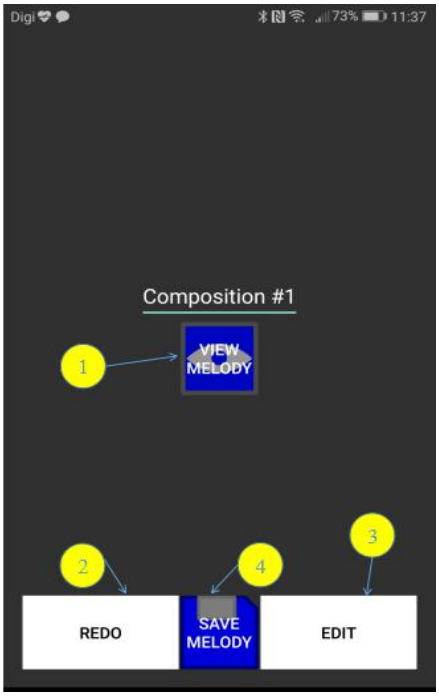


Figure 4.3.10 Saved Composer Activity

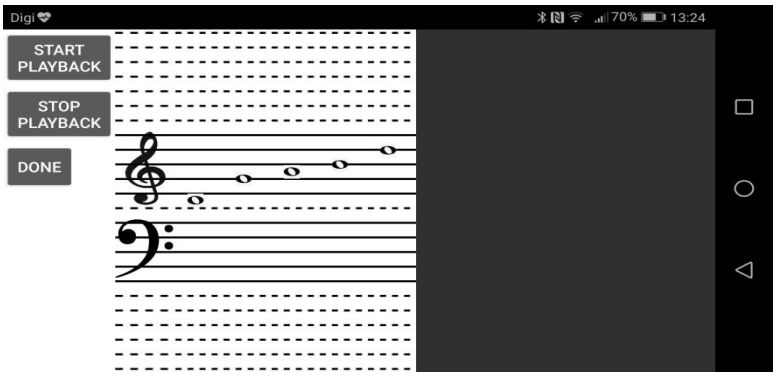


Figure 4.3.11 Music Sheet Showing

Activity: Saved Composer Activity				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	View Melody Button	Pressed	Move to music sheet showing	Yes
2	Redo Button	Pressed	Move back to music composer activity	Yes
3	Saved Melody Button	Pressed	Move to Saved Compositions List	Yes
4	Edit Button	Pressed	Move to Edit music sheet Main Menu	Yes

Table 4.3.8: Saved Composer Activity Testing

Unit Testing 9: Edit Music Sheet Main Menu

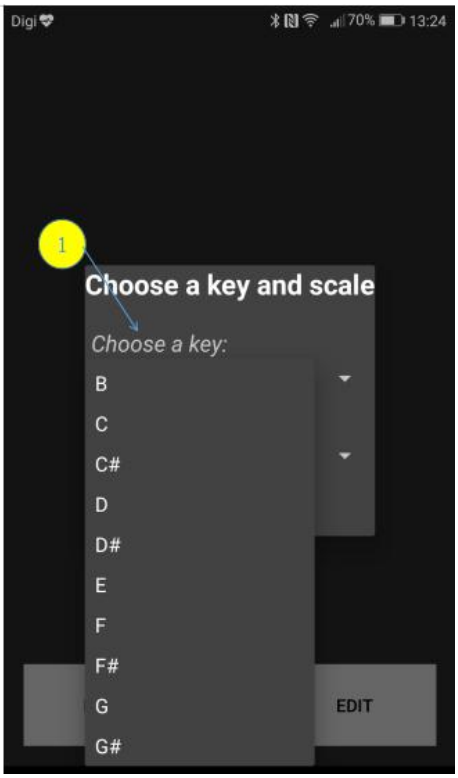


Figure 4.3.12 Choose a key

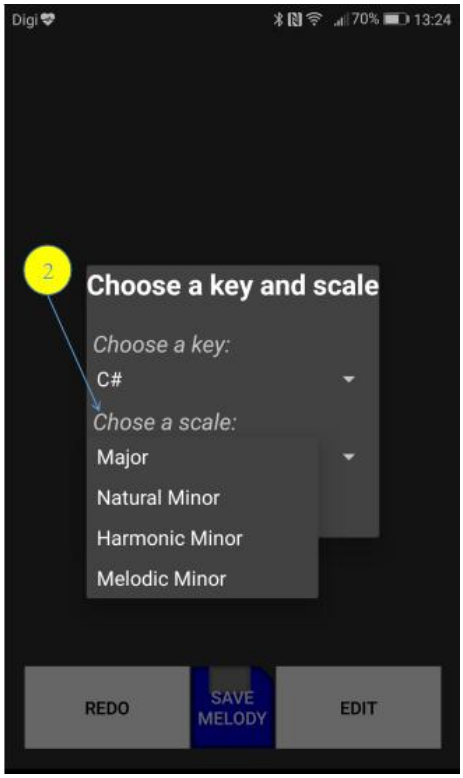


Figure 4.3.13 Choose a scale

Activity: Edit Music Sheet Main Menu				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Choose a key Button	Pressed	Show the key list	Yes
2	Choose a scale Button	Pressed	Show the scale list	Yes

Table 4.3.9: Edit Music Sheet Main Menu Testing

Unit Testing 10: Edit Music Sheet Activity

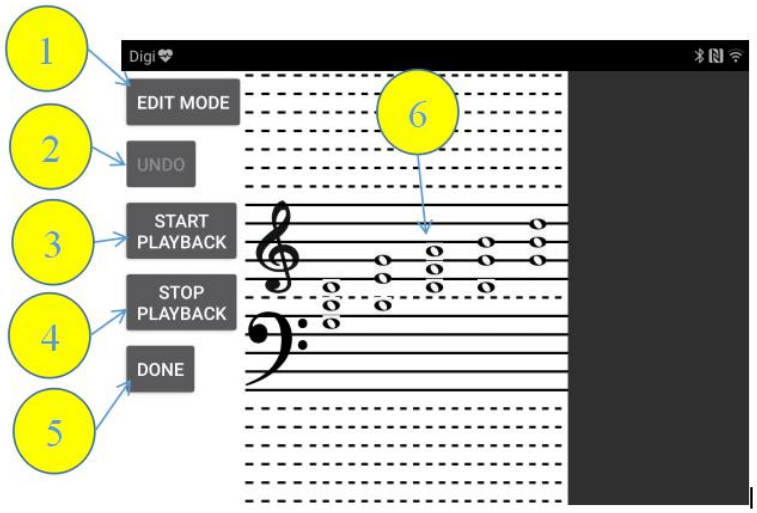


Figure 4.3.14 Edit Music Sheet Activity

Activity: Edit Music Sheet Activity				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Edit Mode Button	Pressed	Able to edit	Yes
2	Undo Button	Pressed	Undo to the previous edited sheet	Yes
3	Start Playback Button	Pressed	Start playback of music	Yes
4	Stop Playback Button	Pressed	Stop playback of music	Yes
5	Done	Pressed	Done editing and saved music sheet	Yes
6	Music sheet after edited	Displayed	Display the music sheet that is editing	Yes

Table 4.3.10: Edit Music Sheet Activity Testing

Unit Testing 11: Saved Compositions Activity

Figure 4.3.15 Saved Compositions Activity

Activity: Saved Compositions Activity				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Saved Compositions list	Pressed	Move to edit music sheet activity	Yes

Table 4.3.11: Saved Compositions Activity Testing

Unit Testing 12: Settings Activity

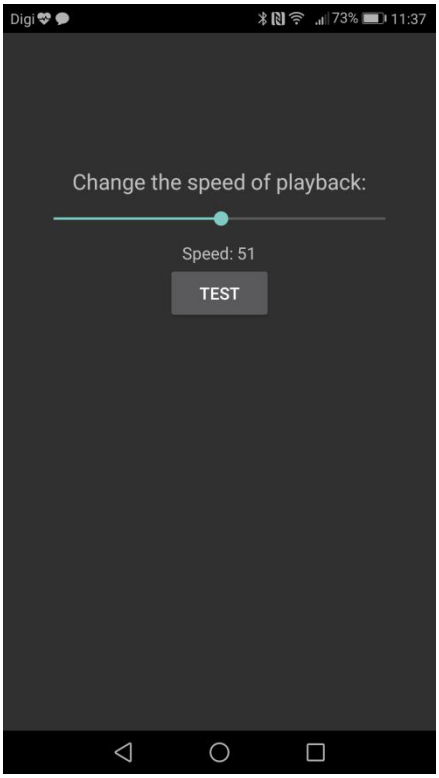


Figure 4.3.16 Settings Activity

Activity: Settings Activity				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Settings bar list	Pressed	Change the playback speed	Yes

Table 4.3.12: Settings Activity Testing

Unit Testing 13: Music Theory Activity

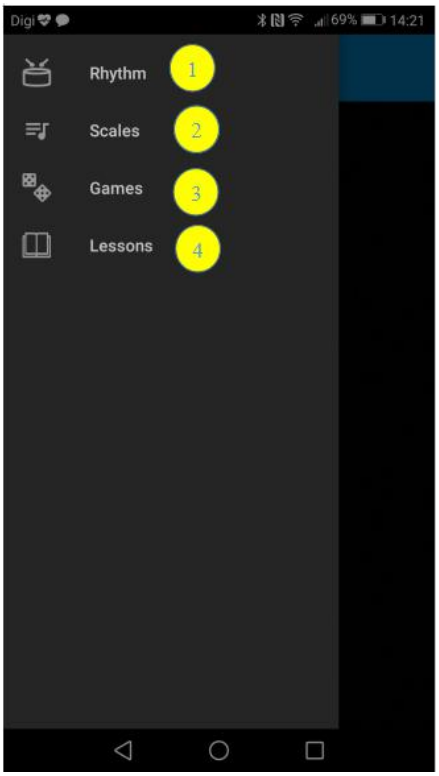


Figure 4.3.17 Music Theory Activity

Activity: Music Theory Activity				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Rhythm Button	Pressed	Move to Rhythm activity	Yes
2	Scales Button	Pressed	Move to Scales activity	Yes
3	Games Button	Pressed	Move to Games activity	Yes
4	Lessons Button	Pressed	Move to Lessons activity	Yes

Table 4.3.13: Music Theory Activity Testing

Unit Testing 14: Rhythm Activity

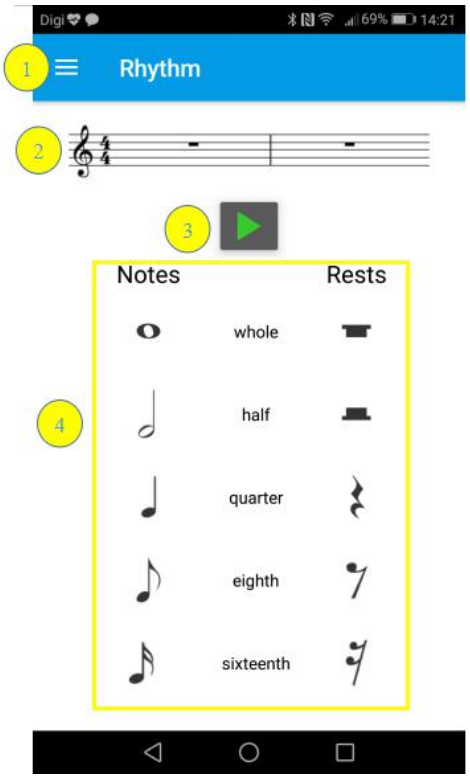


Figure 4.3.18 Rhythm Activity

Activity: Rhythm Activity				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Music Theory List Button	Pressed	Move to Music Theory Activity	Yes
2	Staves	Displayed	Display the notes and rests	Yes
3	Playback Button	Pressed	Playback the rhythm of notes and rests	Yes
4	Notes and Rests list	Pressed	Move to Shaves and playback allowed	Yes

Table 4.3.14: Rhythm Activity Testing

Unit Testing 15: Scales Activity

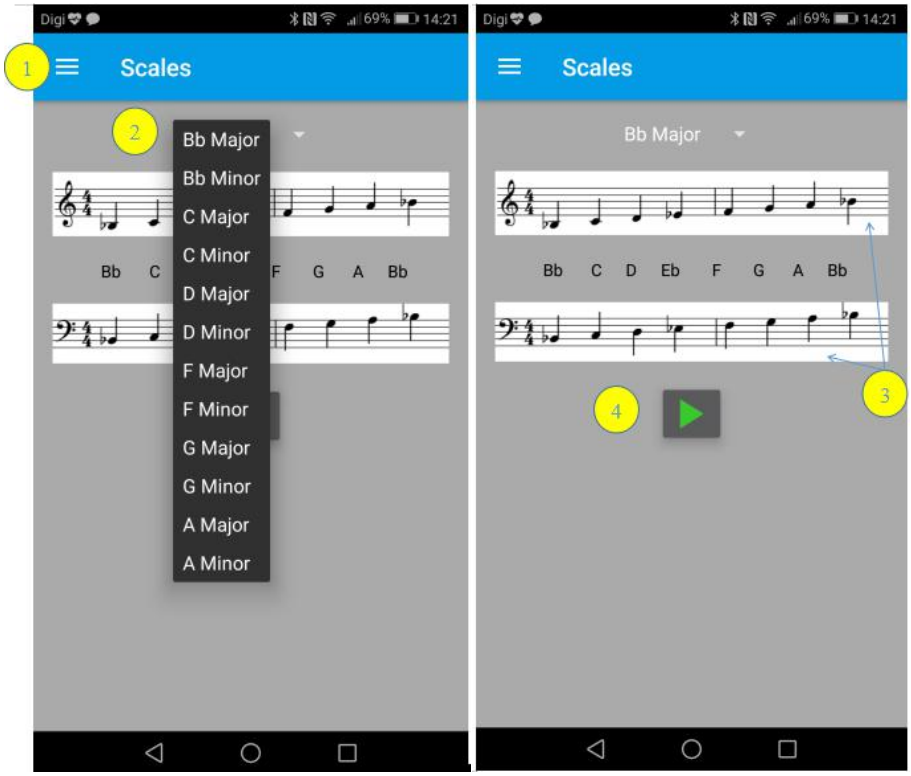


Figure 4.3.19 Scales Activity

Activity: Scales Activity				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Music Theory List Button	Pressed	Move to Music Theory Activity	Yes
2	Scales List	Pressed	Move to the Scales	Yes
3	Staves	Displayed	Display the scales	Yes
4	Playback Button	Pressed	Playback the scales	Yes

Table 4.3.15: Scales Activity Testing

Unit Testing 16: Lessons Activity

Figure 4.3.20 Lessons Activity

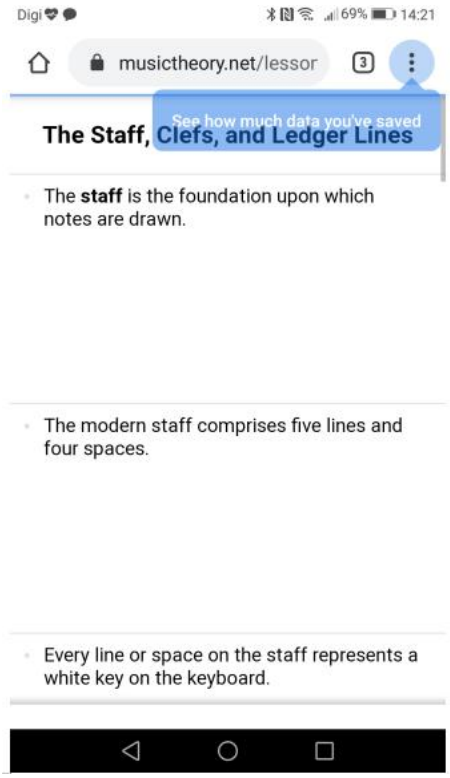


Figure 4.3.21 Lesson Web pages

Activity: Lessons Activity				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Music Theory List Button	Pressed	Move to Music Theory Activity	Yes
2	Lessons List	Pressed	Move to the Lesson Web pages	Yes

Table 4.3.16: Lessons Activity Testing

Unit Testing 17: Games Activity

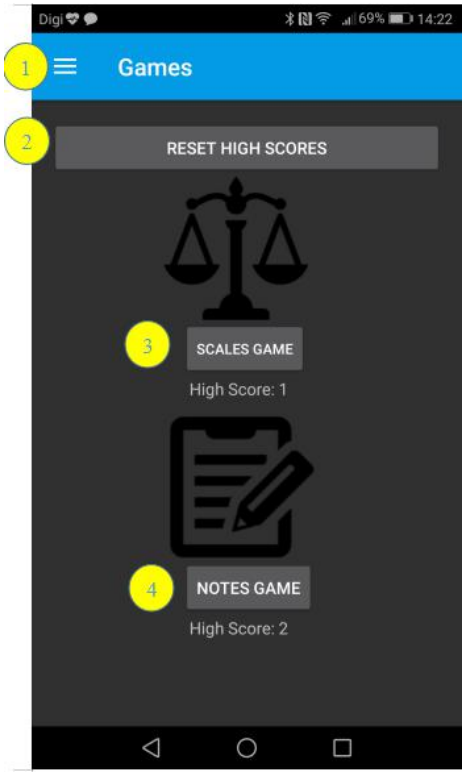


Figure 4.3.22 Games Activity

Activity: Games Activity				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Music Theory List Button	Pressed	Move to Music Theory Activity	Yes
2	Reset High Scores Button	Pressed	Reset the high score	Yes
3	Scales Game Button	Pressed	Move to Scales Game Activity	Yes
4	Notes Game Button	Pressed	Move to Notes Game Activity	Yes

Table 4.3.17: Games Activity Testing

Unit Testing 18: Scales Game Activity

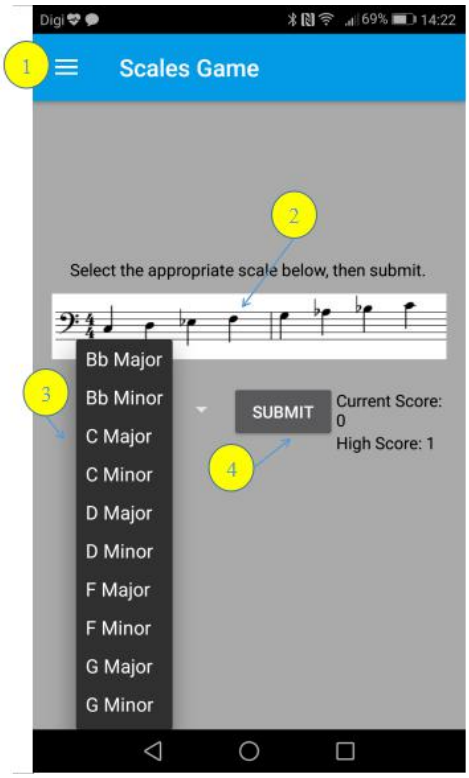


Figure 4.3.23 Scales Game Activity

Activity: Scales Game Activity				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Music Theory List Button	Pressed	Move to Music Theory Activity	Yes
2	Staves	Displayed	Displayed the scales	Yes
3	Scales List	Pressed	Select the scales	Yes
4	Submit Button	Pressed	Submit the scales chosen	Yes

Table 4.3.18: Scales Game Activity Testing

Unit Testing 19: Notes Game Activity

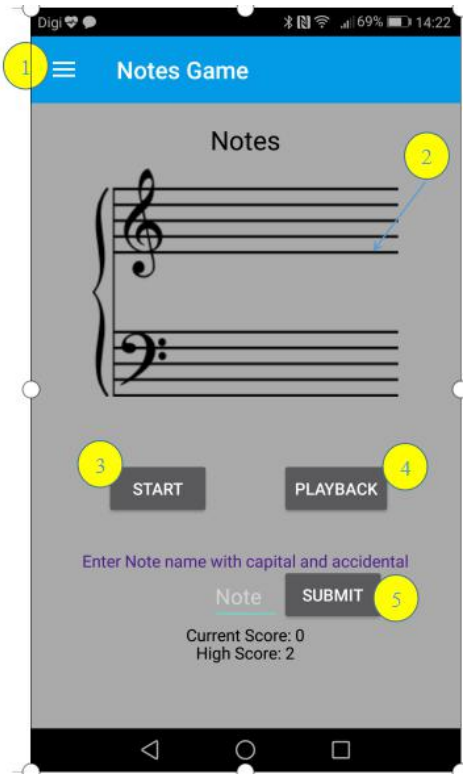


Figure 4.3.24 Notes Game Activity

Activity: Notes Game Activity				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	Music Theory List Button	Pressed	Move to Music Theory Activity	Yes
2	Staves	Displayed	Displayed the notes	Yes
3	Start Button	Pressed	Start the notes game	Yes
4	Playback Button	Pressed	Playback the notes given	Yes
5	Submit Button	Pressed	Submit the notes answer	Yes

Table 4.3.19: Notes Game Activity Testing

Unit Testing 20: Searching Main Menu

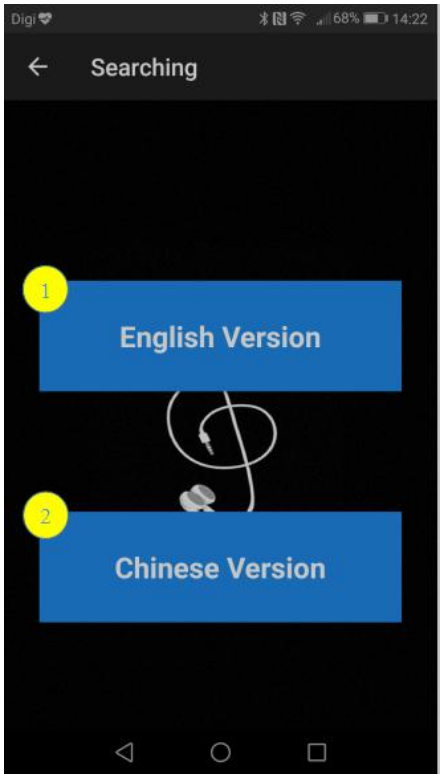


Figure 4.3.25 Searching Main Menu

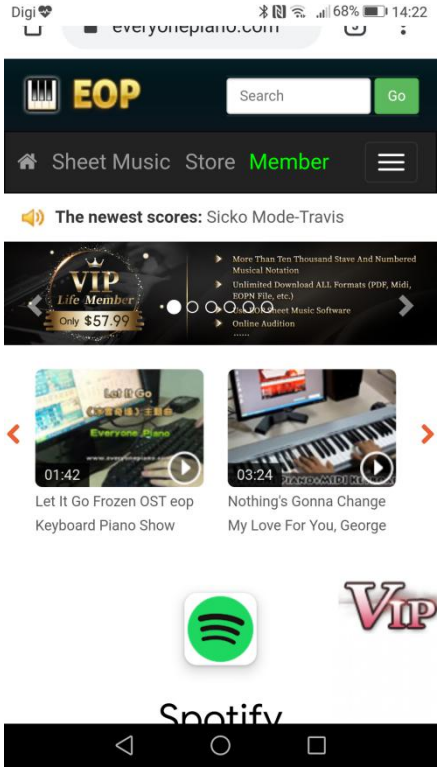


Figure 4.3.26 English Version

Figure 4.3.27 Chinese Version

Activity: Searching Main Menu				
Id	**Test Case**	**Attribute and value**	**Expected result**	**Result**
1	English Version Button	Pressed	Move to English Version webpage	Yes
2	Chinese Version Button	Pressed	Move to Chinese Version webpage	Yes

Table 4.3.20: Searching Main Menu Testing

4.4 Summary

In this chapter, the whole architecture design of the application is shown and described. Other than that, composition algorithm which applied in proposed the application also describing in details. Lastly, unit testing also carried out in ensure that the application works well.

CHAPTER 5: CONCLUSION

5.1 Conclusion

The project goal is to develop music sheet maker and generator application which called as CnG music that allows the user to convert their piano sheet from the song that they want at anywhere and anytime according to the application. Beside that, they can also compose the song by using this application. Next, they can also learn the the music theory in terms of the rhythm, scales notes and others by using this application. Lastly, they able to search for a music sheet from the internet. It was separated into two versions which are English version and Chinese version. Thus, CnG music is suitable for the music player especially the beginner. It is very simple and easy to use. Even a kindergarten student also can use it easily.

5.2 Future Work

After developing the application, there are still some future work can be carried out in the future. First of all, for the music composition function, it can be adding more scale and chord types to the composition algorithm, implementing the rhythm and able to download the music sheet as PDF or picture format. Other than that, for the generating music sheet, there can be generated music sheet of multiple instruments which not only piano. More lessons are provided in the music theory.

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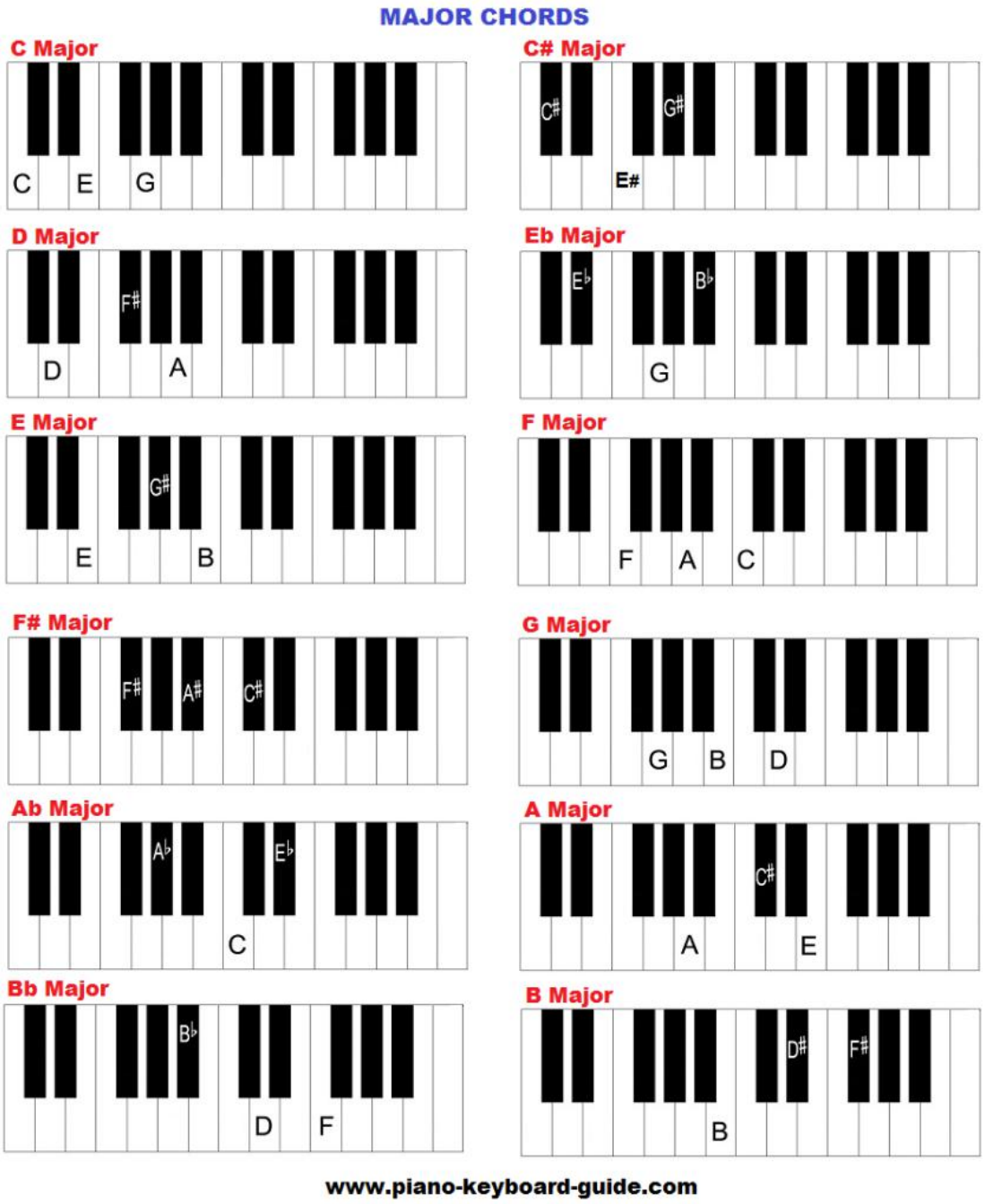
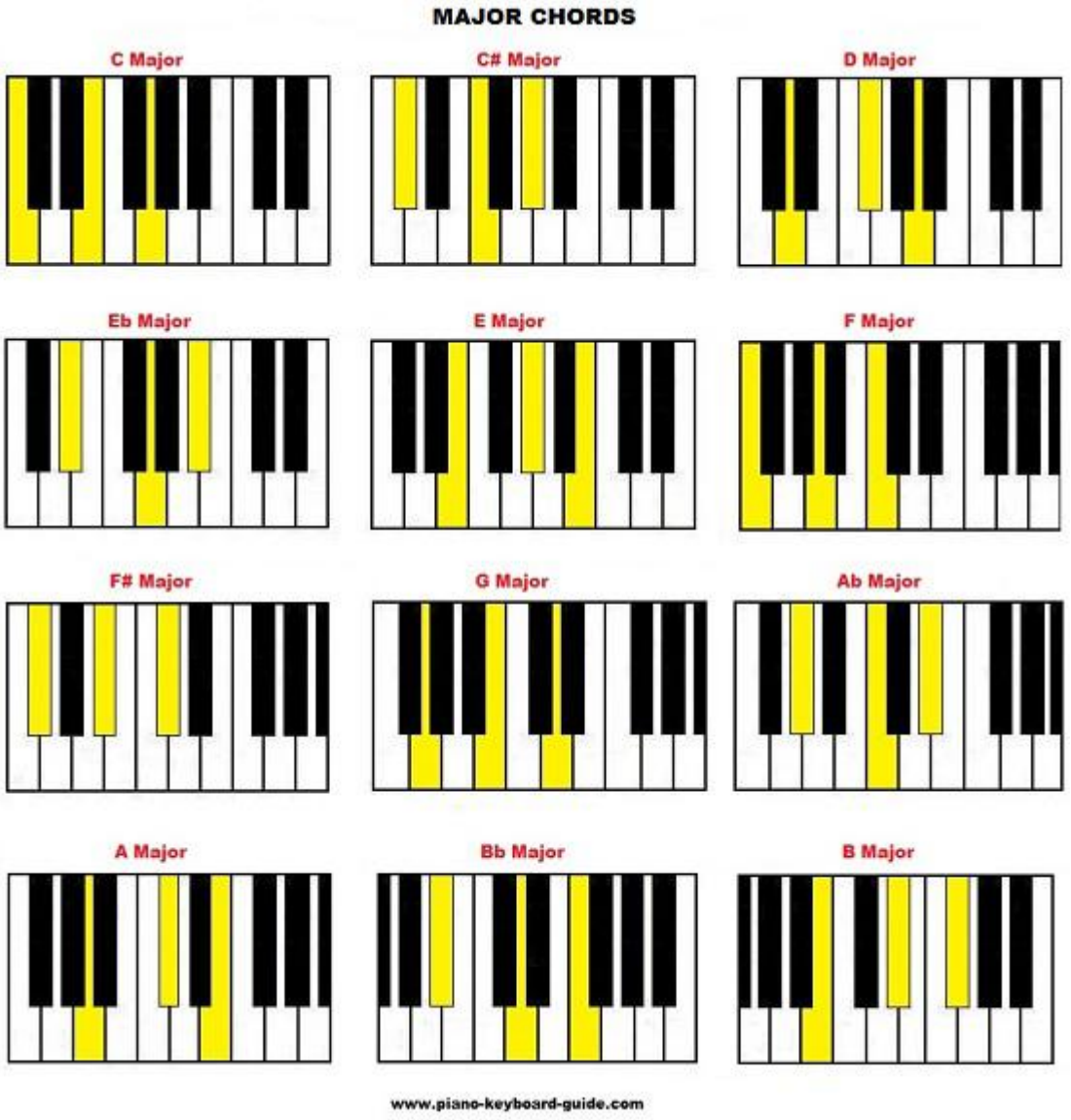
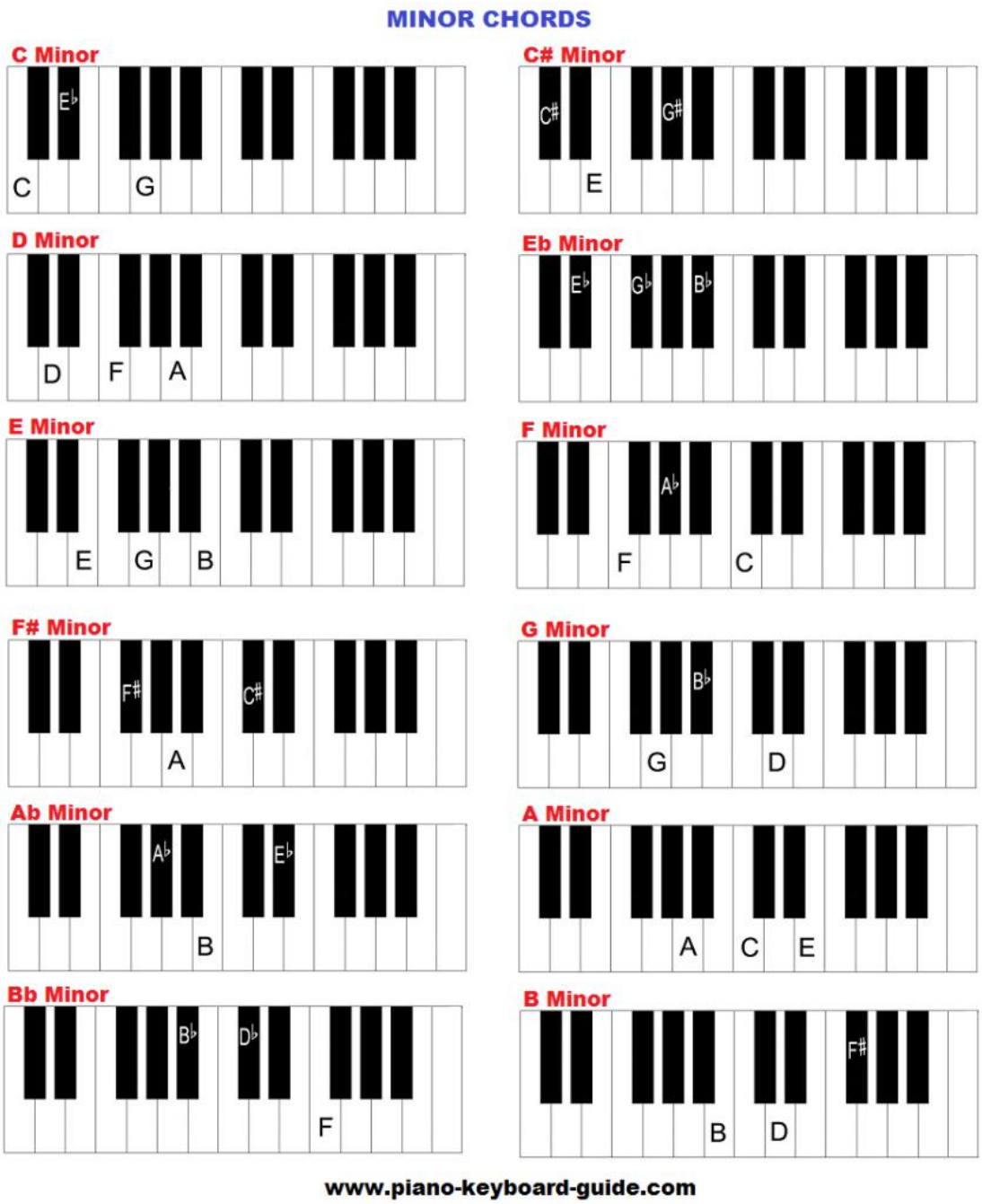
APPENDIX A



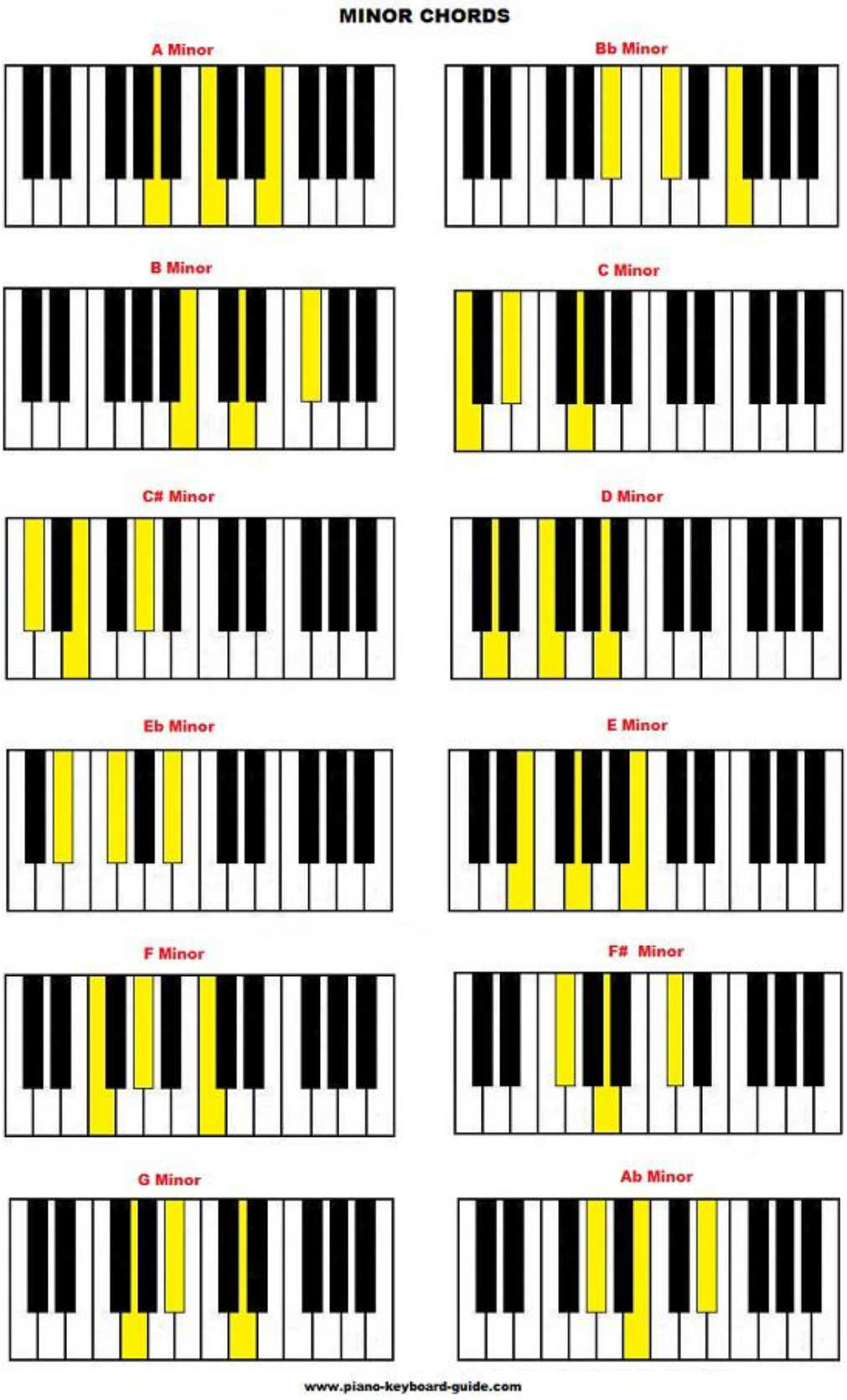
All the major chords.



All the major chords in keyboard.



All the minor chords



All the minor chords in keyboard.

Appendix B: Weekly Report

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 3, Year 3	**Study week no.: Week 1**
Student Name & ID: LEONG YUAN LING 1600803	
Supervisor: TS. Dr. LIM SENG POH	
Project Title: Music Sheet Maker and Generator	

1. WORK DONE [Please write the details of the work done in the last fortnight.] Meet supervisor and discussed on the project. Doing research for the second function.
2. WORK TO BE DONE **Start to the second function.**
3. PROBLEMS ENCOUNTERED **Requirements collected.** **Techniques to use in propose this application**
4. SELF EVALUATION OF THE PROGRESS **FYP 2 has been completed 15%**

Supervisor's signature

Student's signature

Appendix B

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 3, Year 3	**Study week no.: Week 2**
Student Name & ID: LEONG YUAN LING 1600803	
Supervisor: TS. Dr. LIM SENG POH	
Project Title: Music Sheet Maker and Generator	

1. WORK DONE [Please write the details of the work done in the last fortnight.] Discuss with supervisor on the functions.
2. WORK TO BE DONE **Complete the second function.**
3. PROBLEMS ENCOUNTERED **Techniques to use in propose this application.** **The design of the application (colour use, background image)**
4. SELF EVALUATION OF THE PROGRESS **FYP 2 has been completed 23%**

Supervisor's signature

Student's signature

Appendix B

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 3, Year 3	**Study week no.: Week 5**
Student Name & ID: LEONG YUAN LING 1600803	
Supervisor: TS. Dr. LIM SENG POH	
Project Title: Music Sheet Maker and Generator	

1. WORK DONE [Please write the details of the work done in the last fortnight.] Discuss with supervisor for the functionality.
2. WORK TO BE DONE **Start to do third function.**
3. PROBLEMS ENCOUNTERED **Techniques used to convert the music sheet from the music**
4. SELF EVALUATION OF THE PROGRESS **FYP 2 has been completed 30%**

Supervisor's signature

Student's signature

Appendix B

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 3, Year 3	**Study week no.: Week 7**
Student Name & ID: LEONG YUAN LING 1600803	
Supervisor: TS. Dr. LIM SENG POH	
Project Title: Music Sheet Maker and Generator	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

Showing supervisor for the generate music sheet from music function.

2. WORK TO BE DONE

Continue to work on the save image from the converting music sheet.

3. PROBLEMS ENCOUNTERED

Music sheet showing.

4. SELF EVALUATION OF THE PROGRESS

FYP 2 has been completed 45%

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 3, Year 3	**Study week no.: Week 9**
Student Name & ID: LEONG YUAN LING 1600803	
Supervisor: TS. Dr. LIM SENG POH	
Project Title: Music Sheet Maker and Generator	

1. WORK DONE [Please write the details of the work done in the last fortnight.] Discussing the forth function with lecturer.
2. WORK TO BE DONE **Continue work on the third and forth function.**
3. PROBLEMS ENCOUNTERED **The lessons that need to provide.**
4. SELF EVALUATION OF THE PROGRESS **FYP 2 has been completed 60%.**

Supervisor's signature

Student's signature

Appendix B

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 3, Year 3	**Study week no.: Week 12**
Student Name & ID: LEONG YUAN LING 1600803	
Supervisor: TS. Dr. LIM SENG POH	
Project Title: Music Sheet Maker and Generator	

1. WORK DONE [Please write the details of the work done in the last fortnight.] Done the whole application. Discussing on the report format
2. WORK TO BE DONE **Complete the report for FYP2.**
3. PROBLEMS ENCOUNTERED **Reporting**
4. SELF EVALUATION OF THE PROGRESS **FYP 2 has been completed 100%**

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 3, Year 3	**Study week no.: Week 13**
Student Name & ID: LEONG YUAN LING 1600803	
Supervisor: TS. Dr. LIM SENG POH	
Project Title: Music Sheet Maker and Generator	

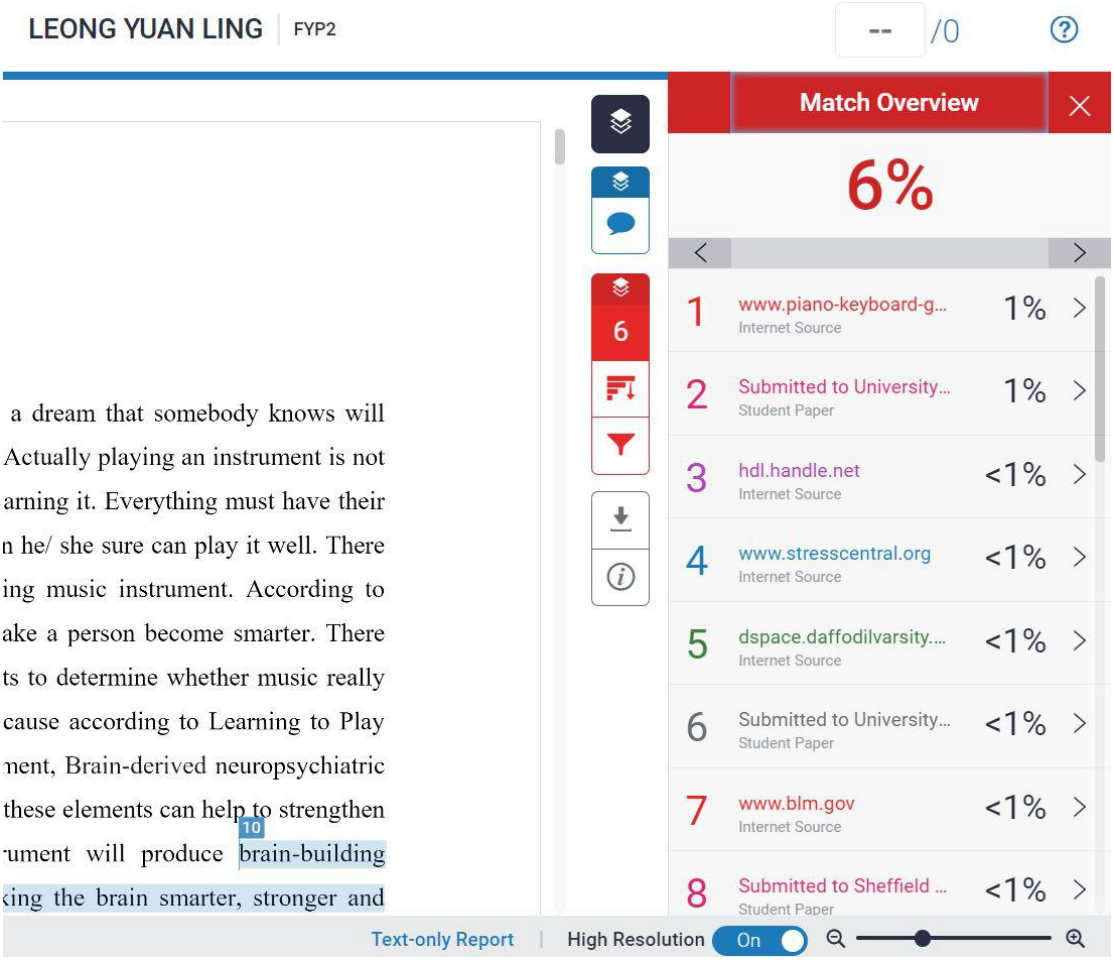
1. WORK DONE [Please write the details of the work done in the last fortnight.] Let supervisor check for the report.
2. WORK TO BE DONE **Complete the report for FYP2.**
3. PROBLEMS ENCOUNTERED **Checking and changing the report**
4. SELF EVALUATION OF THE PROGRESS **FYP 2 has been completed 100%**

Supervisor's signature

Student's signature

POSTER

Music Sheet Maker and Generator: CnG Music
By:Leong Yuan Ling
ABSTRACT
A mobile application is developed in this project, which is Music Sheet Maker and Generator. It is named as CnG music where C stands for composing and G stands for generating. The problem statements of this project are difficulty in getting a music sheet and composing music. Hence, this mobile application is able to generate music sheet for music players, especially for those newbies. In this project, it allows conversion from music to music sheet. This means that a music producer is able to generate music sheet from music. They can also compose their own music in term of the rhythm of the music, the pitch, music pattern and tempo of the music. In this project, waterfall development methodology is used in developing this application. This is because there are some additional functions could be added when it is applicable. The scope of the project is to generate the music sheet from the music and music composer. All the functions will mainly focus on one instrument which is piano. The music sheet is piano sheet and the music composition will also compose by using the keyboard piano provided. By using this mobile application, music players can learn a new song easily and help them in composing a song as well.
Requirements
Design
Implementation
Verification
Documentation
CnG Music
Welcome to CnG Music!
Have A Fun Here!!!
Please Choose Your Work Here!!!
Generate Music Sheet from Music
Music Composer
Music Theory
Searching for Music Sheet
PROBLEM STATEMENT
Difficulty in getting a music sheet
Difficulty in composing their own music
PROJECT OBJECTIVES
Generate a music sheet from music
An easier ways to compose of music was created
PROJECT SCOPES
An application that able to generate music sheet from music and compose a new song.
This project will generate melody for new proposed music piece and convert music to the music sheet.
For composing music, users are allowed to modify and editing on the music.
Users will be allowed for an instant preview for the music sheet.
CONCLUSION
The project goal is to develop music sheet maker and generator application which called as CnG music that allows the user to convert their piano sheet from the song that they want at anywhere and anytime according to the application. Beside that, they can also compose the song by using this application. Next, they can also learn the the music theory in terms of the rhythm, scales notes and others by using this application. Lastly, they able to search for a music sheet from the internet. It was separated into two versions which are English version and Chinese version. Thus, CnG music is suitable for the music player especially the beginner. It is very simple and easy to use. Even a kindergarten student also can use it easily.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Form Title : Supervisor's Comments on Originality Report Generated by Turnitin for Submission of Final Year Project Report (for Undergraduate Programmes)			
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FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY

Full Name(s) of Candidate(s)	LEONG YUAN LING
ID Number(s)	16ACB00803
Programme / Course	BACHELOR OF COMPUTER SCIENCE
Title of Final Year Project	MUSIC SHEET MAKER AND GENERATOR (MOBILE APPLICATIONS)

Similarity	**Supervisor's Comments (Compulsory if parameters of originality exceeds the limits approved by UTAR)**
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Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

Signature of Supervisor

Name: TS. DR. LIM SENG POH

Date: 20/4/2020

Signature of Co-Supervisor

Name: _____

Date: 20/4/2020

BCS (Hons) Computer Science
Faculty of Information and Communication Technology (Kampar Campus), UTAR

UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY (KAMPAR CAMPUS)

CHECKLIST FOR FYP2 THESIS SUBMISSION

Student Id	16ACB00803
Student Name	LEONG YUAN LING
Supervisor Name	TS. DR. LIM SENG POH

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/	Signed Report Status Declaration Form
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/	Signed form of the Declaration of Originality
/	Acknowledgement
/	Abstract
/	Table of Contents
/	List of Figures (if applicable)
/	List of Tables (if applicable)
/	List of Symbols (if applicable)
/	List of Abbreviations (if applicable)
/	Chapters / Content
/	Bibliography (or References)
/	All references in bibliography are cited in the thesis, especially in the chapter of literature review
/	Appendices (if applicable)
/	Poster
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